PUBLIC INVESTMENT CORPORATION®
Est. 1911

BID NO: PICPROP012/8 /2019 BULK EARTHWORKS, LATERAL SUPPORT AND SERVICE RELOCATION FOR DEVELOPMENT OF SUNNYSIDE OFFICE DEVELOPMENT, CNR STEVE BIKO AND TREVENNA STREET SUNNYSIDE PRETORIA

The Public Investment Corporation (PIC) acting on behalf of the Unemployment Insurance Fund hereby extends an invitation to construction companies with a CIDB Level Grading CE/SC 8, proven experience in bulk earthworks and lateral support for high rise commercial offices Bidders are to meet the following minimum requirements to qualify for supplier database approval:

- Bidder must have 51% Black Owned Bidder must have minimum B-BBEE Level 1 up to 4
- Bidders must submit a Generic Construction SANAS Certificate and failure to submit will lead to automatic disqualification.
- SARS Pin upon appointment must be submitted.
- Consolidated generic Construction SANAS B-BBEE Certificate.

The PIC is open to consider bidders that form or already have an existing Joint Venture/Consortium agreement in place to achieve a Broad-Based Black Economic Empowerment Status Level. For Joint Venture/Consortium the following additional information will be required:

- Ownership and Executive Management information
- A formal signed JV Agreement, indicating the leading company as well as the other company's role and responsibilities.
- Skills transfer plan between the parties must be submitted

CLOSING DATE FOR SUBMISSIONS OF TENDERS: 11 September 2019 at 11h00.

LATE SUBMISSIONS OR SUBMISSIONS HANDED IN AT ANY OTHER OFFICE THAN IS LISTED BELOW, WILL NOT BE ACCEPTED.

The completed tender document must be submitted in a sealed envelope in the Tender Box at the following address: Public Investment Corporation, No 1 Central Square , Menlyn Maine, Corner Aramist Avenue & Corobay Avenue, Waterkloof Glen Extension 2, 0181

Tender documentation will be available for downloading from **12 August 2019** on the following website address: **www.pic.gov.za**

COMPULSORY TENDER BRIEFING SESSION
A compulsory tender briefing session will be held on Monday, **19 August 2019** at **11h00** on site corner of Steve Biko and Trevenna streets in Sunnyside, Pretoria
Note:

- An attendance register will be signed during the compulsory tender briefing session;
- Respondents need to ensure that they are in possession of a full set of bid documents when attending the briefing session; and
- Respondents are requested to ensure that the person who would be authorised to complete the bid documents attend the briefing session.

ENQUIRIES TO BE SUBMITTED TO THE TENDER MANAGER: enquiries4@pic.gov.za

AD1932020

PUBLIC INVESTMENT CORPORATION

SUNNYSIDE OFFICE DEVELOPMENT

AT

SUNNYSIDE, PRETORIA

BULK EARTHWORKS, LATERAL SUPPORT AND SERVICES RELOCATION PRINCIPAL CONTRACT

TENDER DOCUMENT

PICPROP012/8/2019

August 2019

NAME OF TENDERER: _____

ADDRESS OF TENDERER: _____

TEL: _____

PROJECT PARTICULARS

1.1	Project Name and Location	Sunnyside Office Development Sunnyside, Pretoria
1.2	Employer (Client)	Public Investment Corporation
1.3	Form of Contract	JBCC Principal Building Agreement, July 2007, Edition 5.0 Reprint 1
1.4	Anticipated Start on Site Date	October 2019
1.5	Anticipated Completion Date	March 2020
1.6	Period for Tender to remain open for acceptance	90 days from tender return date
1.7	Penalty Amount	R60 000 per Calendar day
1.8	Contractors all risk	Contract sum plus 20%
1.9	Public Liability Insurance	R 15 Million
1.10	Lateral Support Insurance	R 15 Million
1.11	Surrounding Property Limit	R 30 Million

PART I - EMPLOYER TO TENDERER

SECTION 1: INSTRUCTIONS TO TENDERERS

SECTION 2: ADDITIONAL INFORMATION TO TENDERERS

2.6 Green Building Specifications
2.7 Geotechnical Report
2.8 Hydrogeological Study
2.9 City of Tshwane Metropolitan Municipality Standard Specifications for Municipal Civil Engineering Works.

PART II - TENDERER TO EMPLOYER

SECTION 3: FORM OF OFFER AND ACCEPTANCE

3.1 Form of Offer and Acceptance

SECTION 4: BILLS OF QUANTITIES

4.1 Bills of Quantities

SECTION 5: DAYWORK RATES

5.1 Daywork Rates
5.2 Daywork Rates Schedules

SECTION 6: RETURNABLE DOCUMENTS REQUIRED FOR TENDER EVALUATION PURPOSES

6.1 Site Visit Certificate
6.2 Program of works
6.3 Method Statement
6.4 Proof of Plant and Equipment
6.5 Schedule of Deviations
6.6 List of Subcontractors
6.7 Proposed Organization
6.8 Schedule of Experience
6.9 Authority for Signatory
6.10 Financial Information
6.11 Material on Site
6.12 Declaration of Criminal Record
6.13 Supply of Additional Information
6.14 Declaration of Good Standing Regarding Tax
6.15 Declaration of Interest
6.16 Company Details
6.17 CIDB Grade Certificate
6.18 B-BBEE Certificate
6.19 Certificate of Tendering Entity Details
6.20 Construction Guarantee
6.21 Waiver of Lien

SECTION 1

INSTRUCTIONS TO TENDERERS

INSTRUCTIONS TO TENDERERS

1.1 SUBMITTING OF TENDERS

The Tender shall be submitted on the enclosed "Form of Offer and Acceptance" fully completed in black ink or typed, priced and totalled.

No unauthorised alteration shall be made to the Tender Form or any other of the Contract Documents. If any such alteration is made or if the Appendices are not properly completed, or if these instructions are not fully complied with, the Tender will be disqualified.

All spaces in the Tender Form must be completed, and the person or persons executing the Tender on behalf of the Tenderer must initial handwritten or typewritten alterations to the parts so completed. This initialling must be immediately beside the alterations.

Submission of 1 original and one copy of the bid document. Please also include a flash drive memory stick (not a CD) with the proposal.

All documents should be indexed, clearly marked with bid number, indicate original or copy, envelope addressed and marked as follows:

SUNNYSIDE OFFICE DEVELOPMENT BULK EARTHWORKS, LATERAL SUPPORT AND SERVICES RELOCATION: PRINCIPAL CONTRACT

Tenderers Name …….

Tender documents must be delivered at the offices (Tender Box) of:

Public Investment Corporation (SOC)
Groud Floor, No1 Central Square
Central Square Menlyn Maine,
Corner Corobay Avenue and Aramist,
Waterkloof Glen Extension 2
Pretoria,
0181

Closing date **11 September 2019,** Time: **11:00am**

NOTE:

General:

Late tenders will not be accepted.
Tenders addressed and sent contrary to the above will not be considered.
No email telex, fax or oral tenders will be accepted.
Please request to sign the register when delivering the submission.
Tenders received in an envelope that is not sealed will be disqualified.

B-BBEE Verification:

The amended codes of good practice October 2014

Pricing Of Quotation and Currency of Payment

Prices offered shall be exclusive and inclusive of all costs related to the provision of the services.

Proposals must be expressed in South African Rand (ZAR).

The pricing to be shown with and without Value Added Tax.

Prices to be valid for a minimum of 90 days from date of submission.

All payments to Service Providers shall be made in South African Rands for services rendered in the Republic of South Africa.

The onus will be on the tenderer to ensure that his tender is correctly marked, addressed and delivered by hand or by post, so as to reach the above address in due time.

Compulsory Tender Briefing Session

A compulsory tender briefing session will be held on **Monday, 19th August 2019 at 11h00am** on site corner of Steve Biko and Trevenna streets in Sunnyside, Pretoria**. (Late arrival after 11:01am OR failure to attend will result in automatic disqualification).**

1.2 OPENING OF TENDERS

The tenders will **not** be opened in public and the tendered amounts and names of the Tenderers will **not** be disclosed.

1.3 ALTERATIONS BY TENDERER

Should the Tenderer desire to make any departures from or modifications to the Tender Documentation, or to qualify his Tender in any way, he shall set out his proposals clearly on the form "Alterations by Tenderer" attached to the form of Tender or alternatively state them in a covering letter attached to his Tender and referred to on the form "Alterations by Tenderer".

1.4 SIGNING OF TENDER

A person duly authorised thereto shall sign the Tender. In the case of a company submitting a Tender, a certified copy of the Certificate of Incorporation of such a company shall be included with the Tender, together with a resolution by its board of directors authorising a director or other official of the company to sign the documents on behalf of the company. In the case of a closed corporation submitting a Tender, a certified copy of the Founding Statement of such corporation shall be included with the Tender, together with a resolution by its members authorising a member or other official of the corporation to sign the documents on their behalf. In the case of a partnership or a natural person submitting a Tender, this must be clearly stated.

1.5 QUERIES AND DISCREPANCIES

Before submitting a Tender the Tenderer shall have satisfied himself that the Tender Documents are complete as no liability in respect of errors or omissions in Tenders will be accepted. Should any pages or drawings be found to be missing or any doubt or obscurity as to the meaning of any particulars or descriptions or any queries arising from discrepancies in or omissions from the Tender Document or Drawings, the Tenderer shall direct the queries to:

Queries: **Email: enquiries4@pic.gov.za**

The Tenderer shall be held solely responsible for and shall, at his own expense, rectify any errors arising out of incorrect interpretation of the tender documentation. Last day for questions or queries **26th August 2019.** Last day for answers to all questions and queries **02nd September 2019.**

1.6 WITHDRAWAL OF TENDER PRIOR TO CLOSING DATE

A Tenderer shall be entitled to withdraw his Tender after it has been delivered, provided that the request for such withdrawal is received at the address given for the submission of Tenders either in writing before the time set on the closing date for Tenders. No withdrawal will be allowed after closing date.

1.7 INFORMATION TO TENDERERS

All information is furnished in good faith for the guidance of the Tenderer, but in no way shall information relieve him of the responsibility of ascertain to his own satisfaction, the scope and conditions of this Contract. He shall make investigations necessary to inform himself thoroughly as to the character and magnitude of the work, the facilities for delivery, placing and operating the necessary plant and for delivery and handling the material at the Site. No plea of ignorance of conditions that exist or may hereafter exist, or of conditions of difficulties which may be encountered, will be accepted as a reason for failure to complete the Contract or as a basis for claims for additional compensation or extension of time.

1.8 ACCEPTANCE OF TENDER

The lowest of any or portion of any tender will not necessarily be accepted and the Employer does not bind himself to give any reason for the acceptance or rejection of any or all tenders.

1.9 PERIOD FOR WHICH THE TENDER HOLDS GOOD

Tenders must remain open for acceptance for a period of Ninety (90) days from the date on which they are to be lodged, and may be accepted at any time during the said period of Ninety (90) days. The submission of the Tender shall be deemed to constitute an agreement between the Tenderer and the Employer, Subjected to that the tenderer has signed the declaration.

1.10 INTERVIEW WITH AND ADDITIONAL INFORMATION REQUIRED FROM TENDERER

During the period when Tenders are open, and as soon as practicable after the closing date of the Tender, the Employer may require the Tenderer to attend a meeting in order to clarify matters relating to the Tender.

The Employer may ask any Tenderer to clarify any aspect of his Tender, but the Tenderer will not be permitted to alter the sum stated in the Tender after Tenders have been opened.

The Employer may ask any Tenderer to provide evidence that his financial, labour and other resources are adequate for the requirements of the Contract.

All written information submitted by the Tenderer together with and in support of his Tender shall be considered to form the basis on which the Tender has been prepared and submitted.

1.11 COSTS INCURRED BY THE TENDERER

The Employer will neither be responsible for nor pay for expenses incurred or losses suffered by any Tenderer in preparing the Tender, in visiting the Site in connection therewith, or for any reason whatsoever.

1.12 SUFFICIENCY OF THE TENDER

The Tenderer shall satisfy himself as to the correctness and sufficiency of his Tender to meet the Tenderers obligations for the proper execution / completion / maintenance / defects correction of the Works and all requirements with regard thereto except as may be specifically excluded in terms of the Tender documents.

1.13 VALUE ADDED TAX

The tendered prices shall exclude VAT, which must be shown separately in the space provided in the Bill of Quantities Summary.

1.14 DUTIES, CHARGES, LICENCES, ETC.

The Contract Price shall include all taxes, duties, charges, licences and other costs that may apply to the Contract.

1.15 PROPOSED ORGANIZATION

The Tenderer shall provide with his Tender an Organization Chart outlining his proposed staffing of the Contract together with detailed curriculum vitae of staff from foreman level up.

1.16 EXPERIENCE

Tenderers are required to give satisfactory evidence that they have had actual experience in the class of work for which they have tendered and must complete the “Schedule of Experience” form.

1.17 NEW RATES

New rates filed in terms of the Contract shall be based upon labour, plant, material and profit costs in use at the time of tendering.

1.18 CONTRACT PRICE ADJUSTMENT PROVISIONS

The contract rates are fixed and firm and therefore not subject to Contract Price Adjustment Provisions (CPAP) or to fluctuations in the currency rate of exchange.

1.19 THE SITE

The Site is situated at the comer of Steve Biko road and Trevenna Street in Sunnyside, Pretoria Gauteng Province.

The Tenderer shall view the Site and make himself thoroughly acquainted with the conditions under which the Works are to be done, the means of access to the Works, the condition of the roads, the nature of the Site and generally with all matters which may influence the Contract and any restriction or condition which may be imposed by the Local Authority. No claim of any kind whatsoever will be entertained in connection with the position, conditions or circumstances of the Works or location of buildings and access thereto.

The appointed Contractor should also acquaint themselves with the existing wetlands and protective measures should be in place at all times. Any damage to the wetlands will result in a fine to the Contractor at fault. An environmental report will be issued to the appointed Contractor.

1.20 MATERIALS OFF SITE

An advanced payment guarantee will be required for any Material off Site and will be recouped in a process that will take cognisance of the contract.

1.21 ORDERING OF MATERIALS

No material shall be procured prior to the Employer approval.

1.22 RATES / PRICES

The rates and prices inserted in these Bills of Quantities shall be deemed to include but shall not be limited to the following: -

- materials, workmanship and utilisation of plant and equipment
- transport, unloading, storing and hoisting to all levels of all materials
- temporary works
- cutting and waste
- overhead charges and profit

- stoppage for inspection purposes by the Employer or his Agents
- overtime working necessary to complete the Works within the time for completion
- as built drawings where applicable.

1.23 BILLS OF QUANTITIES

The Bills of Quantities shall have all items properly priced and extended. If any items in the Bills are not priced, it shall be deemed that either no costs are involved or the costs are covered elsewhere. Tenderer to provide breakdown of all P&G's Cleary indicating Fixed, Time and Value related P&G's.

The total tender price in the Form of Offer and Acceptance shall constitute the contract price of the successful tenderer. Tenderers are advised to check their item extensions and total additions, as no claims for arithmetical errors shall be considered.

No alterations, erasures or additions shall be made in the text of the bills of quantities. Should any alterations, erasure or addition be made, it will not be recognised but the original wording of these Bills of Quantities shall be adhered to.

The priced Bills of Quantities of the successful tenderer will be checked and the Quantity Surveyor reserves the right to call for reasonable adjustments to any individual price and to rectify any discrepancy whilst the total price, as submitted, remains unaltered.

1.24 PRACTICAL COMPLETION DEFINITION

Definition
Practical Completion is defined as follows: The facility can effectively be used for the purposes intended : All items on the practical completion list must be completed and attended to in its entirety. All work contemplated under the contract/specific section should be complete. The works must be completed to a point that it is fit for the purpose for which it was intended i.e. The works must be handed over in its complete and safe state in order that the subsequent Main Building Contractor is able to work without disruption while any remedial work is being completed. The site/specific section should be secure and safe. All consultants must have inspected their respective sections of work and certified the same as being practically complete. Commissioning & O&M Manuals to be completed and handed over, where applicable. All documentation and certification required for the hand-over to the subsequent Main Building Contractor must be available for the works.

1.25 NOTES TO TENDERERS

The successful tenderer will be appointed in terms of JBCC Principal Building Agreement, July 2007, Edition 5.0 Reprint 1.

The Contract Document shall comprise of the following:

1. JBCC Principal Building Agreement, July 2007, Edition 5.0 Reprint 1
2. City Of Tshwane Standard Specifications for Municipal Civil Engineering Works, Third Edition 2005.
3. Additional project specific specifications and scope of work as detailed by the Engineer.
4. These Bills of Quantities including all annexures and supplementary documentation referred to therein.
5. Documents to be provided by the Contractor in terms of the requirements of this tender.
6. Drawings

Note that the Bills of Quantities are measured in terms of City of Tshwane Standard Specifications for Municipal Civil Engineering Works (third Edition, 2005) and supplementary preambles as indicated. Payment and payment conditions are in accordance with the JBCC Principal Building Agreement July 2007, Edition 5.0 Reprint 1, as detailed in the Preliminaries section of the Bill of Quantities.

A tender may not be regarded as bona fide and complete unless it comprises the return of One original and One Copy complete and one soft copy on USB in all respects, of the following:

1. Form of Offer and Acceptance
2. Returnable Documents as included herein, complete in their entirety by writing in black ink
3. A resolution of the Board of Directors authorizing the signatory of the tender to sign and enter into an agreement on behalf of the tender
4. Latest B-BBEE rating certificate from a reputable rating company
5. Full quality management plan and procedures
6. Full organogram with each CV for each member of the site team/management
7. Joint Venture Agreement (if applicable): The contractor to provide a Joint Venture Agreement including proposed personnel CV's and Org Chat.
8. Priced BOQ
9. Tenderers to submit a detail planning methodology to show their understanding of the scope and execution of this project
10. Current project commitments & value per project and their proposed date of completion
11. A minimum of five (5) references with the following:
    a. Contact person – contact telephone numbers and email addresses
    b. Company name
    c. Project value and date complete
12. Health and Safety Plan

1.26 METHODOLOGY

The tenderer to provide a detailed methodology indicating their technical understating of the inter dependency between bulk earthwork and lateral support. The methodology will be subject to final coordination once the contractor is appointed.

1.27 DOCUMENT CONTROL

The Contractor will be required to have knowledge of working with Autodesk BIM 360 Document Management Software.

1.28 CONTRACT PARTICIPATION GOAL

The tenderer shall reserve a minimum of 30% of the tender sum exclusive of value added tax for the work to be executed by Local Enterprises, Labour and local Unemployment Insurance Fund (UIF) clients in the performance of the contract. The Unemployment Insurance Fund (UIF) client's data base will be provided by the employer.

The contractor shall make use of local labour. It is a requirement by the employer that all unskilled labour be recruited from the local areas of the vicinity of the works. The contractor will demonstrate his effort to fulfil compliance with this requirement.

Please note local enterprises should have a Broad-Based Black Economic Empowerment (B-BBEE) Level 1-4. Preferably, the local enterprise should be a minimum of 51% Black Owned and Controlled.

The tendered will be required to provide monthly reports for spent against the 30% Local participation.

Participation Goal Plan

The tenderer must submit details of his plan to achieve the tendered contract participation goal together with the tender submission.

In the event that the tenderer fails to meet the tendered contract participation goal, penalties provided below shall apply:

The tenderer shall be liable to the employer for the payment of a penalty amount equal to 15% of the financial value of the amount by which they have not achieved the tendered contract participation goal value.
The penalties applicable for failure to adhere to the transformation programme contained in this clause shall be calculated as follows:

P = (0,15 x (**D** – **Do**) x **CA)/**100;

D is the tendered contract participation goal percentage;

Do is the contract participation goal which the Employer's representative, certifies based on the credits passed, as being achieved upon completion of the contract;

CA is the contract amount;

P is the monetary value of penalty payable

1.29 EVALUATION CRITERIA

a. Phase I: Compliance with the minimum and administrative requirements
b. Phase II: Functionality (Only companies who achieved the minimum qualifying 70% score will be evaluated in terms of the third phase).
c. Phase III: Evaluation in terms of Price and Preferential Procurement

80 (Price) / 20 (B-BBEE status level of contribution) preference point system will be utilised.

Minimum and Administrative Requirements

Submissions are to comprise a comprehensive report that must provide the PIC with sufficient information to make a sound and fair evaluation of the tender, as well as the experience and capability of the firm to undertake this type of project successfully. The tender should include a complete price Bill of Quantities with a signed form of tender and all returnable as per the tender requirements.

Failure to meet the following minimum criteria will result in automatic disqualification.

- Bidder must have 51% Black Owned and Controlled.
- Bidder must have B-BBEE Level 1-4.
- Grade 8 CE/SE CIDB Grading.
- A valid Generic construction B-BBEE certificate from a SANAS accredited verification agency.
- Signed declaration of interest.
- Completed and signed Company Information document and submission of all the required documentation as stipulated in the company profile document.
- No unauthorised alteration shall be made to the Tender Form or any other of the Contract Documents.
- Attendance to the compulsory tender briefing session
- Letter of Intent specific for the project from a Financial Institution to provide a Construction Guarantee.

The following documents must be included in the proposal:

- Three year audited financial statements.
- A joint venture formal signed agreement indicating the leading company as well as the other company roles and responsibilities.
- Bidders are encouraged to register on the National Treasury's Central Supplier Database.
- Organogram and CV's of all personnel who will be working on the project.
- Bidder to provide a SARS PIN in order for PIC to verify Tax Compliance
- CSD Report from the National Treasury supplier database.
- Name Three (3) contact numbers and Three (3) reference letters from clients for similar projects undertaken in the past 36 months.

Joint Ventures/ Consortiums

The following information and documentation must be submitted:

- Joint Ventures will score as the Joint Venture throughout the tender as bids cannot be split between the Joint Venture and individual bids.
- A consolidated Generic construction B-BBEE certificate in case of joint venture.
- All information stipulated under minimum and administrative requirements in the bid must be submitted by all parties involved in the Joint Ventures/Consortiums, including ownership and executive management information.
- A percentage breakdown of the work allocation between the parties must be clearly indicated.
- A formal signed agreement indicating the leading company as well as the other company roles and responsibilities must be submitted.
- A skills transfer plan between the parties must be submitted.

(The PIC Acting on behalf of the Unemployment Insurance Fund (UIF) reserves the right to disqualify any submissions should they be incomplete or inadequate.)

System to be followed for the evaluation of this Tender.

Selection Criteria

Selection of the proposals shall be based on the following pass/fail criteria for compliance and standing of the company. Proposals which do not comply with the requirements or fail to meet the administrative requirements will be disqualify:

a) First Phase: Compliance with Administrative Requirements;
b) Second Phase: Technical Competency Evaluation.
c) Third Phase: Price and Preferential Procurement

Bidders must achieve a minimum of 70% for the technical evaluation in order to be considered for the next phase.

FUNCTIONALITY

Criteria	Requirements from service providers	Weighting
1. Company Experience	1.1 Track record, comprising experience of successfully completing at least 3 projects exceeding R70m in value with 3 relevant contactable references for each.	15
	1.2 Current similar contracts in place including details of contract value and references.	10
2.Technical & Project Management Team	2.1 The organogram of the proposed project team and the CV's of the key personnel involved namely; Contracts Manager; Site Agent; QS, Safety Officer; Foremen.	10
3.Methodology	3.1 Methodology relevant to the development detailing how the contractor plans to manage works onsite which includes the process of completing all works i.e. bulk earthworks, lateral support and service relocation, etc.	15
	3.2 How the contractor will deal with live services, surrounding properties and risk mitigation of damage to these services and surrounding properties.	15
	3.3 How the contractor will deal with blasting of the rock.	15
4. Programme of works	4.1 The Contractor must demonstrate superior knowledge of sequencing of activities, linkages etc.	10
5.Local Participation	5.1 The Contractor must demonstrate how they plan to implement the 30% local procurement spend requirement. This can be done through the usage of local subcontractors; suppliers; labourers; equipment, etc.	10
Total		**100**
Minimum Threshold		70

Price and B-BBEE Level

80/20 Preference Procurement points system (80: Price and 20: B-BBEE status level of contribution) where the services required total more than R1million.

80/Price

Prices must be quoted in South African Rand excluding of VAT and must be submitted separately (Please see minimum requirements).

A detailed price breakdown for per annum must be attached in a separate price schedule (see annexures).

A maximum of 80 points is allocated for price on the following basis:

Where

- P = Points scored for price of bid under consideration
- Pt = Rand value of bid under consideration
- Pmin = Rand value of lowest acceptable bid

20/Broad Based Black Economic Empowerment Status Level Certificates

Bidders with annual total revenue of R10 million or less qualify as Exempted Micro Enterprises (EMEs) in terms of the Broad Based Black Economic Empowerment Act, and must submit a certificate issued by a registered auditor, accounting officer (as contemplated in section (60 (4) of the Close Corporation Act, 1984 or an accredited verification agency.

Bidders other than the Exempted Micro-Enterprises (EMEs) must submit their original and valid B-BBEE status level verification certificate or a certified copy thereof issued by a SANAS accredited agency, substantiating their B-BBEE rating.

Points will also be awarded based to a bidder for attaining their B-BBEE status level of contributor in accordance with the table below:

B-BBEE Status Level of contributor	**Number of 80/20**
1	10
2	9
3	8
4	7
Non - compliant	0

Points to be allocated for Black Ownership

The following point system will be utilised to allocate an additional 10 or 5 points, in accordance with 80/20 preference point system, respectively for 51% or more Black Ownership:

Percentage	Black Ownership
Preference point system	80/20
Percentage %	5 Points Allocated
0-50	0
51-59	1
60-69	2
70-79	3
80-89	4
90-100	5

Points to be allocated for Black Executive Management and Women & Disabled Ownership

The following point system will be utilised to allocate the additional 5 points in accordance with the 80/20 preference point system, respectively for Black Executive Management and Women & Disabled Ownership:

Percentage	Women & Disabled Ownership
Percentage %	**2.5 Points**
10-25	0.5
26-45	1
46-65	1.5
66-85	2
86-100	2.5

Percentage	Black Executive Management
Percentage %	**2.5 Points**
10-25	0.5
26-45	1
46-65	1.5
66-85	2
86-100	2.5

Ownership:

Indicate percentage of Black Ownership_____%

List of Shareholders

Name	ID No	SA Citizen	Race	Gender	Share Holding %

List of Executive Management _____%

Indicate percentage Black Executive Management_____%

Name	ID No	SA Citizen	Race	Gender	Share Holding %

Points scored in terms of the 80/20 preference system will be added to the points scored for % black ownership and % of black Executive Management.

Points scored will be rounded off to the nearest 2 decimal places.

a. The bidder who scored the highest point will be awarded the bid.
b. In the event where two or more bidders scored equal points, the successful bidder must be the one scoring the highest preference points for B-BBEE.
c. If two or more bidders have scored equal points including equal preference points for B-BBEE, the successful bidder must be the one scoring the highest for functionality.
d. Should two or more bidders be equal in all respects, the award shall be decided by the drawing of lots

1.30 CONDITIONS

a) Appointment

PIC reserves the right to appoint more than one service provider.

b) PIC Client's Auditors

The auditors have the right to audit the valuations performed by the service provider.

c) Non Commitment

Public Investment Corporation (PIC) reserves the right to withdraw or amend these terms of reference by notice in writing to all parties who have received the terms of reference prior to the closing date.

The cost of preparing of bids will not be reimbursed.

d) Reasons for Rejection

i. PIC reserves the right to reject bids that are not according to specification/Terms of Reference. Bidders must clearly indicate compliance or non-compliance with specification/Terms of Reference.

ii. Bidders shall not contact PIC on any matter pertaining to their bid from the time the bids are closed to the time the bid has been adjudicated. Any effort by a bidder to influence the bid evaluation, bid comparisons or bid award decisions in any matter, may result in rejection of the bid concerned.

iii. PIC shall reject a submission if the bidder has committed a proven corrupt or fraudulent act in competing for a particular contract.

iv. PIC may disregard any submission if that bidder, or any of its directors:

- Have abused the Supply Chain Management (SCM) system of any Government Department/ institution.
- Have committed proven fraud or any other improper conduct in relation to such system.
- Have failed to perform on any previous contract and the proof thereof exists.
- Is restricted from doing business with the public sector if such a supplier obtained preferences fraudulently or if such supplier failed to perform on a contract based on the specific goals.

e) Cancellation of Bid

PIC may prior to the award of a bid, cancel a bid if:

i. Due to changed circumstances, there is no longer a need for the goods or services requested;

ii. Funds are no longer available to cover the total envisaged expenditure

iii. No acceptable bids are received.

f) Receipt of Bids

Each bid shall be in writing using non -erasable ink and shall be submitted on the official document of Bid issued with the bid documents. The bid shall be submitted in a separate sealed envelope with the name and address of the bidder, the bid number and title, the bid box number (where applicable), and the closing date indicated on the envelope. The envelope shall not contain documents relating to any bid other than that shown on the envelope.

The onus shall be on the bidder to place the sealed envelope in the official marked locked bid box provided for this purpose, at the designated venue, not later than the closing date and time specified in the bid notice.

Where bids are submitted via courier services is the responsibility of the tenderer to ensure the courier service signs the submission register on the name of tenderer.

Documents submitted on time by bidders shall not be returned and shall remain the property of the Public Investment Corporation (PIC).

g) Late Bids

Bids received late shall not be considered. A bid will be considered late if arrived only one minute after 11:00 or any time thereafter. The tender box shall be locked at exactly 11:01.
Bids received late shall be returned unopened. Bidders are therefore strongly advised to ensure that bids be despatched allowing enough time for any unforeseen events that may delay the delivery of the bid.

h) Presentations

PIC may require presentations from short-listed bidders as part of the bid process.

i) Service Level Agreement

The service level agreement will set out the administration processes, service levels and timelines.

SECTION 2

ADDITIONAL INFORMATION TO TENDERERS

SUMMARY OF SCOPE OF WORKS

Scope of Work

This document is to be read in conjunction with the document titled 'City Of Tshwane Standard Specifications for Municipal Civil Engineering Works, Third Edition 2005'. The tenderer is referred to this document as well as the specifications detailed hereunder when pricing the Bills of Quantities.

The scope of work of this tender is as follows:

1. Bulk earthworks

   Bulk excavation for the construction of a 5-level super basement. Mass earthworks to include excavation of soft, intermediate and hard material (including blasting or other suitably approved techniques).

2. Lateral support

   The geometry of the bulk excavations require vertical sides around the perimeter of the site for the full basement depth. The cores drilled indicated three prominent layers at varying depths: Soft material encountered to a depth of approximately 5m deep. Intermediate material to a depth of approximately 10m and hard rock material to the bottom of the basement approximately 15m deep.

   The lateral support design requires temporary soil and rock Y25 anchors to be used at approximately 1.5m spacing vertically and horizontally. A 200mm thick reinforced gunite wall with mesh ref 395 on each face is be constructed incrementally deeper as the excavation progresses (as shown on *drawings 1600073-LS-T-01 to 03 Rev 0*). Provide a high flow wick drains in the form of Zipcore with 80% Shade cloth at the back of the gunite wall. Once the building frame is constructed in the basement, the reinforced concrete floors will butt against the gunite walls and accommodate the lateral forces. The temporary anchors can then be de-stressed.

3. Cross cutting for wayleave approval

   Exposure of existing underground municipal services and the survey thereof in accordance with the requirements for City of Tshwane (CoT) wayleave approval process. The survey information is to be provided to the engineer for finalization of the construction drawings of the municipal services requiring upgrade or relocation. The construction drawings are to be submitted to CoT by the engineer for final approval of the drawings and wayleave applications. Contractors must therefore programme their works accordingly to factor in this approval process. Cross cut positions to be determined by the engineer and contractor following appointment of the contractor. Indicative positions provided as per *Drawing 1600073-08-81-C010.*

4. Sewer Relocation

   There is an existing and operational municipal sewer pipeline (250mm diameter) that runs through an existing servitude through the proposed development site. This sewer line is to be replaced by a new pipeline (220m length, 250mm diameter and 70m length, 315mm diameter) along a new route around the development site *(*as shown on *Drawing 1600073-08-81-C202 rev A*).

5. Municipal Water Upgrade

As part of the rezoning agreement for the new development, the existing municipal water pipeline (672m length, 160mm diameter) along Jeppe Street is to be upgraded (to a 250mm diameter) along the same route in Jeppe Street (as shown on *Drawing 1600073-08-81-C101 rev A*).

6. Stormwater diversion

   Stormwater runoff generated from the National Department of Tourism building on the neighbouring property drains onto the new development site. Stormwater is to therefore be diverted away from the site onto Trevenna Street into a new municipal pipeline (115m length, 450mm diameter) that joins into the existing municipal system on Jeppe Street (as shown on *Drawing 1600073-08-81-C301 rev A*).

Standards and Specifications

All dimensions and quantities shall be expressed in the SI system of units. Standards shall be those of City of Tshwane.

The conditions of contract and the conditions of payment shall be in accordance with the JBCC Principal Building Agreement July 2007 Edition 5.0 Reprint 1, and JBCC Preliminaries May 2005 as detailed and expanded upon in the Preliminaries and General section of the Bills of Quantities.

For the Bills of Quantities, the method of measurement shall be the CoT Standard Specifications for Municipal Civil Engineering Works Third Edition 2005.

Reference in the specifications of the 'Schedule of Quantities' shall mean 'Bills of Quantities' as defined in the JBCC Principal Building Agreement. Reference in the specification to the 'Engineer' shall mean the 'Principal Agent' and/or his delegated authority to the Engineer as detailed in the JBCC Principal Building Agreement.

Particular specifications in addition to those provide in the CoT specifications are provided below:

Series 0: General

Section 001, Clause 27: Dealing with Water

Add: 'Refer to the attached geohydrological report for the expected ground water infiltration rate. This information is based on hydrogeological studies that were carried out on the site and is provided as a guide. It is expressly understood that, while rate of ground water infiltration is given in good faith, the correctness of the information furnished is not guaranteed. Any variation to the actual infiltration rate shall not justify any variation of the cost of carrying out works associated with dewatering of ground water.'

PIC001.02.01 Extra over item 001.02, the tendered lump sum shall include full compensation for the cross-cuts in the road reserve for wayleave application purposes. The rate shall include hiring or supply of specialized detecting equipment, the use of such equipment, site photographs prior to and after cross-cuts are undertaken, survey of affected exposed services, drawing up plans of located services as specified, cross-cut traffic management plan and engagement with affected parties and service providers. Cross cuts

are to be undertaken along the proposed routes for new services before and after road crossings, and at a minimum of 30m intervals in between.

PIC001.03.01 The tendered rate shall include full compensation for all hand excavation within the lengths and widths authorized by the Engineer and the depth required to expose the service (excavation in excess of the authorized dimensions shall not be measured for payment), for backfilling and compacting to a minimum of 90% of modified AASHTO density, for disposal of any excavated material not required for backfilling, for keeping excavations safe, for dealing with any surface or subsurface water, for taking special care to ensure that services are not damaged in any way, and for any other operation necessary to complete the work. The tendered rate shall also include the transporting of surplus excavated material within the defined free-haul boundaries as well as for supplying adequate supervision during both excavation and backfilling operations. No distinction will be made between hard and soft material neither will distinction be made between the various types of services to be exposed or the depths to which excavations are taken.

PIC001.06 Environmental Management

PIC001.06.01 Compliance with Environmental Management Plan – tendered rate shall include compilation of EMP, its implementation, method statement, documentation and recording compliance monitoring programmes, acquisition of permits or approvals and licensing, hazardous material handling and storage, corrective actions and mitigation.

PIC001.06.02 Environmental Control Officer

PIC 001.06.02.01 An independent Environmental Control Officer (ECO) shall be appointed to audit the site works and ensure compliance with the Environmental Management Plan. The lump sum tendered shall include full compensation for the appointment of the ECO for the duration of the construction works.

Payment shall be made in equal monthly instalments, spread over the tendered completion period, upon proof of payment to the ECO.

In the event of the construction period exceeding the tendered completion period and no extension of time been granted, the Contractor shall still pay the ECO the specified remuneration but shall not be reimbursed.

PIC002.04 Additional Survey Requirements

PIC 002.04.01 The tendered lump sum shall include full compensation for the survey and confirmation of the contractor's setting out of the bulk earthworks excavation in accordance with the engineer's drawing. The setting out shall be carried out according to the existing boundary lines, roads and survey station pegs. All dimensions, levels and data necessary for the complete setting out of the Works will be provided on the Drawings. The Contractor shall not scale dimensions from the drawings but shall request from the engineer any information which is not clearly stated on the drawings. The setting out must be approved by the engineer.

PIC 002.04.02 The tendered lump sum shall include full compensation for the survey and verification by an independent contractor of the setting out of the bulk earthworks excavation as completed by the contractor. This independent survey will be approved by the engineer.

Series 1: Ancillary Work

PIC101.05.04 The unit of measurement shall be the actual square metres of existing interlocking or non-interlocking paving blocks broken out, removed and disposed of. Dimensions in determining the areas are to be confirmed on site by the Engineer or his representative before the work commences.

The tendered rate shall include full compensation for demolishing, removing, uplifting, transporting, the disposal of material to a dump site and the backfilling and finishing off of the excavation to the satisfaction of the Engineer.

PIC101.07 The unit of measurement shall be the actual cubic metres of existing rubble not measured elsewhere, removed and disposed of. Dimensions in determining volumes are to be confirmed on site by the Engineer or his representative before the work commences.

The tendered rate shall include the breaking down, removal, transporting and disposing of rubble or any other material not measurable elsewhere at the Engineer's instruction.

Series 2: Earthworks

PIC 203.03 The tendered rate for all excavations (for trenches and mass earthworks) shall include free haul and disposal of spoil material to a location identified by the contractor, together with the removal of oversize material with specialized equipment. The contractor will not be compensated separately for any overhaul or disposal of spoil material, or removal of oversize material.

PIC 203.03A Additional general specifications for mass earthworks as follows:

- Bulk earthworks quantities are based on the final levels required. Rates are deemed to include for sequencing of work if required, temporary ramps and the removal thereof, double handling, etc, deemed necessary during the construction period.
- Rates for bulk excavations are deemed to include for risk of collapse/shoring to sides of excavated faces.
- Rates for bulk excavations are deemed to include for any necessary precautions or varied method of excavation required for excavating along the lateral support structure, existing services, etc.

- Temporary access ramps, forming temporary support banks, etc, as required by the Contractor, and the sequencing, staging and removal thereof have not been separately measured and are deemed to be included in the items described in the Bills of Quantities.
- Engineer to confirm acceptability of all temporary banks.
- Excavated areas to be regularly watered to control dust.

PIC 203.10 The in-situ treatment of the construction bed must include finishing to final tolerance levels as stated by the engineer (i.e. within 50mm of the levels of the final levels as shown on the engineering drawings).

PIC 203.11 Sloping walls shall be trimmed by ripping, blasting and shaping to finish side slopes to tolerance levels to within 25mm tolerance of the finished slopes as shown on the engineering drawings or as otherwise approved by the engineer.

Series 3: Sewers

PIC 302.01 Tendered rate for installation of new sewer pipes shall include all temporary diversions of existing sewer systems and other affected services during construction to ensure minimal disruption of service to the surrounding areas. Affected parties are to be notified by the contractor of any disruption prior to the commencement of construction of that portion of the works.

Series 4: Water Reticulation and Water Mains

PIC 402.01 Tendered rate for installation of new water pipes shall include all temporary diversions of existing water systems and other affected services during construction to ensure minimal disruption of service to the surrounding areas. Affected parties are to be notified by the contractor of any disruption prior to the commencement of construction of that portion of the works.

SERIES 7: STRUCTURES

SECTION 701: FOUNDATIONS FOR STRUCTURES

701.04.03 Dewatering of foundation excavations

Add 'Refer to the attached geohydrological report for the expected ground water infiltration rate. This information is based on hydrogeological studies that were carried out on the site and is provided as a guide. It is expressly understood that, while rate of ground water infiltration is given in good faith, the correctness of the information furnished is not guaranteed. Any variation to the actual infiltration rate shall not justify any variation of the cost of carrying out works associated with dewatering of ground water.'

SECTION PIC708: LATERAL SUPPORT

PIC708.01 Subsurface Information

If it is found during the course of excavating that the soil conditions differ greatly from those shown on the drawings or specialist reports, the contractor shall immediately notify the Engineer.

PIC708.02 Safety Particular Specifications

The contractor shall take the necessary precaution to safeguard the stability and safety of the excavations and adjacent structures.

The personal safety of no person shall be jeopardised neither shall any situation be allowed to arise which may result in damage of whatever nature.

The design for shoring, signing of the drawings and inspection prior to construction of the permanent works of excavations to ensure it is safe shall be undertaken by the contractor's competent person, who shall be a professional engineer with the relevant experience. The contractor shall ensure that all temporary works undertaken shall comply with the relevant sections of the Occupational Health and Safety Act, the Construction Regulations.

PIC708.03 Grout Particular Specifications

The grout to be used for the anchors shall consist of a colloidal mix of Cem I (42.5) or Cem III (42.5) complying with Section 704 of the Standard Specification and water. The water: cement ratio of the grout shall be 0,4 ± 0,05 and the 28 day cube strength shall not be less than 30 MPa. Certain admixtures that require approval by the Engineer may be used in order to improve the plasticity of the grout, reduce bleeding and induce a certain degree of expansion, but they shall not contain any chlorides, nitrates, sulphides or sulphites. The proportion of an admixture shall be as specified by the manufacturer and approved by the Engineer. The Contractor, shall, when required, provide evidence to the Engineer that admixtures are being used strictly in accordance with the manufacturer's recommendations. The costs of admixtures shall be included in the Contractor's rate for dowels.

The mixing equipment shall be of a type capable of producing grout of uniform and colloidal consistency and shall incorporate suitable sieves for retaining lumps or other solid ingredients.

The cement shall be added to the measured quantity of water in the mixer drum and high speed mixing shall be carried out for at least four (4) minutes. Admixtures shall be added 2 to 3 minutes after commencement of mixing. Thereafter and during injection the grout shall be continuously agitated. Dual drum mixers comprising a high speed mixer drum connected to a slow speed agitator drum from which the pump shall be fed, are preferred. Any grout that has been left standing shall be discarded and the container thoroughly washed before further mixing is carried out.

PIC708.04 Lateral Support Anchors Measurement and Payment

Payment Item	Description	Unit
PIC708.04.01	**Moving to and setting up the equipment at each position for drilling the holes**	**number (No)**

The unit of measurement shall be the number of positions to which the drilling equipment has to be moved and set up in position to drill an anchor hole.

The quantity measured shall be the number of set ups at anchor positions as well as at site suitability /trial anchor positions or at positions where the Engineer has ordered re-drilling of the holes.

The tendered rate shall include full compensation for all costs involved in moving and setting up any equipment.

Item	Description	Unit
PIC708.04.02	**Drill holes with a diameter of 115mm to the specified depths and inclinations of 10º below the horizontal**	**metre (m)**

The unit of measurement shall be the metre of hole drilled to the specified depths and inclinations, including the depth of the bulbous base formed, as may be applicable.

The tendered rate for forming augered holes regardless of class of material shall include full compensation for augering, extracting any driven temporary casing and disposing of surplus material from the hole having been formed.

The tendered rate shall include full compensation for supplying, installing, placing, fixing, fitting, dust suppression systems, cloths or nets to equipment and machines to ensure no dust during drilling operations.

Item	Description	Unit
PIC708.04.03	**Water Tests**	**number (No)**

The unit of measurement shall be the number of holes tested.

On completion of drilling in rock, the hole shall be tested for water tightness. If the loss of water over a period of 10 minutes exceeds 3 l/min at a pressure of 100kPa at collar level the hole shall be grouted and re-drilled. The water proofing grout shall be cement grout of similar composition to the anchor grouting.

The tendered rate shall include full compensation for installing and subsequent dismantling and removal of the testing equipment, conducting the test and processing and submitting results.

Water tests shall be executed at the instruction of the Engineer, the amounts of which shall be used as directed and shall be deducted in whole or in part if not required.

Item	Description	Unit
PIC708.04.04	**Grouting and Re-drilling**	**metre (m)**

The unit of measurement shall be the metre of holes grouted and re-drilled.

The tendered rate shall include full compensation for all grouting materials and equipment to achieve a 30MPa grout, the grouting operation, resetting up drilling equipment, the re-drilling operation, flushing and cleaning the hole to provide a water-tight hole.

Grouting and re-drilling of holes shall be executed at the instruction of the Engineer, the amounts of which shall be used as directed and shall be deducted in whole or in part if not required.

Payment Item	Description	Unit
PIC708.04.05	**Anchorages and Couplers**	**number (No)**

The unit of measurement shall be the number of anchors to installed.

The tendered rate shall include full compensation for supplying, storing, handling, fabricating and protecting the complete anchor or coupler assembly, insertion into the augered hole, anchor reinforcement bars, free length sheath, greasing, tensioning of the anchor, anchoring and / or coupling, trimming the anchor ends, face plates, spider bars, using all the equipment, as well as for all work and incidentals required for completing the work as specified. It shall also include full compensation for testing the anchors to the specified test force in accordance with the prescribed methods. The coupler shall include the complete assembly consisting of the anchorage built into the first stage construction and the part coupled to it.

Payment Item	Description	Unit
PIC708.04.06	**Extra Over for Establishment on site for SDA Drilling Equipment**	**lump sum**

The unit of measurement shall be lump sum.

The tendered lump sum shall include full compensation for general levelling of the work site, establishment on site and subsequently removing all structural platforms, rafts and all special plants and equipment required to carry out the shotcrete / gunite operations, the cost of which does not vary with the actual amount of shotcrete done.

The tendered rate must include for moving the required plant and equipment around the site at various stages of construction / excavation.

Establishment on site for SDA Drilling Equipment shall be executed at the instruction of the Engineer, the amounts of which shall be used as directed and shall be deducted in whole or in part if not required.

Payment Item	Description	Unit
PIC708.04.07	**Extra Over for SDA Drill holes with diameter of 115mm to the specified depths and inclinations of 10º below the horizontal**	**metre (m)**

The unit of measurement shall be the metre of the SDA anchors installed.

The tendered rate for installing hollow bar SDA shall include full compensation for augering and disposing of surplus material from the hole having been formed, all grouting materials and equipment to achieve a 30MPa grout, the grouting operation, setting up drilling equipment, supplying, storing, handling, fabricating and protecting the complete SDA anchor and coupler assembly, anchorage reinforcement, tensioning of the tendons, anchoring and / or coupling, trimming the tendon ends, face plates, spider bars, using all the equipment, as well as for all work and incidentals required for completing the work as specified. It shall also include full compensation for testing the tendons to the specified test force in accordance with the prescribed methods.

Installation of SDA anchors shall be executed at the instruction of the Engineer, the amounts of which shall be used as directed and shall be deducted in whole or in part if not required

Payment Item	Description	Unit
PIC708.04.08	**Grouting of Anchors**	**metre (m)**

The unit of measurement shall be the metre of anchors grouted.

The tendered rate shall include full compensation for flushing and cleaning the water-tight hole, all grouting materials and equipment to achieve a 30MPa grout, the grout, the grouting operation, setting up grouting equipment, the grouting operation and testing of the grout.

Tests shall include sampling in-situ cores and grout cubes of the anchor grout, establishment and setting up of coring equipment, cube moulds, curing, curing baths, delivery of cubes and cores to accredited laboratory, testing and reporting of the results, including filling of voids where cores where taken.

PIC708.05 Shotcreting Scope

This specification covers the supply and application of shotcrete to cut and soil nail faces and other areas as directed by the Engineer. It shall include the supply and installation/application of the shotcrete and the mesh.

PIC708.06 Shotcrete and Mesh Particular Specifications

a) Aggregate

The aggregates employed shall be of such quality as to meet the strength requirements specified and shall comply with the requirements of Section 704 of the Standard Specifications.

Fine aggregate shall be stored in such a manner that the moisture content is kept constant at all times. The moisture content should not exceed 5% by weight when a dry mix process for shotcrete application is to be used. The aggregate particles shall be spherical or cubical in shape. Natural river aggregates are ideal.

Where crushed aggregates are used the crushing process shall be aimed at producing aggregate of the specified size from the outset. Aggregates which are screened off during the manufacture of larger sizes generally contain an excess of flaky and elongated particles and are not acceptable for shotcrete unless otherwise approved by the Engineer.

b) Cement

Cement should be either Cem I (42.5) or Cem III (42.5) complying with Section 704 of the Standard Specification.

c) Additives

Proposed additives shall be submitted to the Engineer for approval prior to the commencement of work. The use of additives containing chloride will not be permitted. Additives shall have no deleterious effects on the steel reinforcement or the shotcrete. Once an additive has been approved, its use shall not be discontinued nor the agreed quantities per batch varied, nor another additive substituted without the prior consent of the Engineer. Where different additives are included in the same batch, they shall be chemically compatible. Additives shall be metered into the batch in such a way that uniform dispersal throughout the mix is achieved.

The Engineer may require the Contractor to apply test sections of shotcrete to prove the adequacy of the proposed additives prior be starting on the specified work. Test sections shall be at Contractor's cost.

d) Mesh

All steel employed shall conform to Section 703 of the Standard Specification. The mesh to be used in the shotcrete on plane surfaces shall be welded steel mesh R395.

e) Mix Design

The Contractor shall submit details of the mix proportions he proposes to adopt prior to commencing the work. The Contractor shall demonstrate to the Engineer the suitability of the mix proportions and method of application by shotcreting test sections prior to commencing work. Such test sections shall not be carried out on a cut face requiring being shotcreted. Only when the mix suitability and method of application have been demonstrated to the satisfaction of the Engineer shall the Contractor be permitted to commence production.

f) Mixing and Batching

All constituents shall be thoroughly mixed before they are discharged into the shotcrete pump. All constituents for each batch shall be accurately measured each time a fresh batch is prepared. Weight batching is preferred but volume batching will be permitted if accurately made gauge boxes of an approved design are employed. Where volume batching is permitted, the bulking factor of the sand shall be determined and taken into account. Cement shall be measured by weight. Prepared batches shall be discharged through the nozzle within 30 minutes of mixing.

g) Strength Requirement

The required minimum cube strength of test specimens shall be 12; 20 and 30 MPa at 3; 7 and 28 days respectively. Cubes are to be made by blowing shotcrete into cube and mud using the same technique as for application of shotcrete onto the rock face (i.e. the cube mould shall be placed on its side and shotcrete shot into it horizontally).

The cube mould itself shall be protected by means of a suitable template. A set of three test cubes shall be required to be made for every 100 m² of shotcrete applied or as directed by the Engineer and at the cost of the Contractor.

h) Thickness required and Measurement

The nominal thickness required is 200mm. The thickness shall be determined by means of random test holes drilled by the Contractor at positions indicated by the Engineer. At least one thickness measurement shall be taken every 10 m². The basis of acceptance shall be that in any area of 100 m², the arithmetic mean thickness at all the points checked shall be equal to or greater than the specified thickness. In addition, at no point checked should the thickness be less than 80% of the specified thicknesses. Where the thickness is not acceptable, the Engineer may order an additional layer of shotcrete to be applied. All test holes shall be filled with mortar after the Engineer has approved the thickness of the shotcrete.

i) Sequence of Applying Shotcrete

All soil or rock to be covered with shotcrete shall be cleaned thoroughly with compressed air as ordered by the Engineer, to remove all loose pieces of rock and soil. Where soft material is to be covered, only obviously loose material shall be removed and boulders shall be thoroughly cleaned with compressed air. Shotcrete shall be applied as an initial layer of approximately 30mm thick. The steel mesh shall then be fixed over this initial layer and the shotcrete completed to the final specified thickness on layers shown on the drawing.

j) Method of Fixing Mesh Reinforcement

The reinforcing mesh shall be securely fixed over the initial shotcrete layer by fastening to the dowels and, where necessary, with wire ties embedded in the shotcrete, gun nails, "n" bolts or other approved fixings. The mesh shall be fixed so that it lies snugly against the initial shotcrete layer and will not vibrate during application of the second layer of shotcrete. Where sudden concave or convex surfaces preclude this, the mesh may be cut so that smaller pieces of mesh can be formed into the curved surfaces. All sheets of mesh shall overlap at junctions by at least 300mm. No additional payment shall be made for overlaps.

k) Application of Shotcrete

Equipment used for the application of shotcrete shall be of approved manufacture and in good condition. The operating crew shall be skilled in the use of this equipment. Care shall be taken to ensure that the strands of mesh reinforcement are completely covered with the second layer of shotcrete and that voids are not formed between shotcrete layers.

The operations shall be carried out in such a manner that rebound material falls clear of future working areas, wherever possible. At all times the Engineer may suspend shotcreting operations if in his opinion either the equipment used becomes defective and results in a deterioration in the quality of the resulting shotcrete work, or if adverse weather conditions preclude the application of good shotcrete.

l) Rebound Material

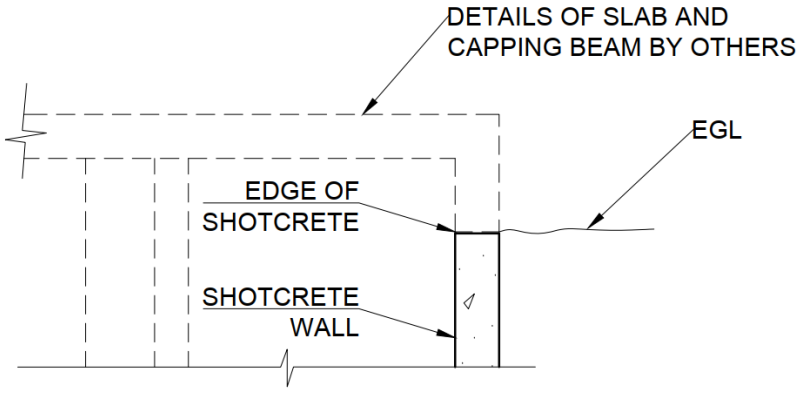
Rebound material shall not be re-used. Rebound material shall be removed from all future working areas and may not be covered up by subsequent applications of shotcrete. Rebound material shall also be cleaned from the surface of any finished work.

m) Weepholes

Weepholes comprising 75mm nominal diameter PVC piping shall be installed at those positions indicated by the Engineer. The pipe shall protrude 20mm beyond the final shotcrete layer and have its inner end wrapped with a single layer of geofabric (Bidim U14 or similar). It is required that weepholes be positioned to intersect seepage anticipated from soft zones and the weepholes shall be positioned prior to shotcreting with the geofabric end hard against the face. The outer ends of the tubes shall be adequately protected against shotcrete.

n) Detail of Edge of Shotcrete

Detail of the finishing off of shotcrete at the brow of cuttings is illustrated below:



Where boulders or outcrop occur on the brow of the cut, no cut off is required and the shotcrete shall be neatly stopped on top of the rock. As an alternative, the contractor may submit details for approval of other proposed methods to terminate the shotcrete at the edge and the top of the cutting so as to prevent surface water from undermining the shotcrete.

o) Curing

The finished shotcrete shall be adequately cured by an approved curing compound applied within half an hour of application of the shotcrete. Where the shotcrete is applied in two layers hanging hessian over the face and keeping the hessian wet for a period of 24 hours shall cure the first layer.

p) Blasting Restriction

In order to reduce damage to the shotcrete no blasting shall be carried out within 50m of a shotcreted section within 72 hours of application of the shotcrete.

Under no circumstances is the peak particle velocity at the wall excavation allowed to exceed 50mm/s and 84mm/s away from the wall excavation.

q) Procedure in Event of Failure of Shotcrete

In the event that test samples do not achieve the specified minimum strength, the Engineer may order the Contractor to carry out additional tests to determine new mix proportions.

If the Engineer considers that the low strengths of the applied shotcrete may reduce the safety of the Works and persons he may order that the following action be taken:

Either

(i) Remove the defective shotcrete in strips or panels in such a way that the safety of the Works and persons is not endangered and replace with shotcrete that is acceptable. This may also require replacement of the mesh; or

(ii) Apply an additional layer of shotcrete not exceeding the specified thickness originally required. In neither case will payment be made for the defective shotcrete already applied, nor for the work involved in removing it from the areas where it has been applied, nor for any mesh that must be replaced, nor for any costs involved in removing the resultant rubble and spoiling it in an approved site.

Any additional laps required for mesh that must be replaced shall be to the Contractor's cost. Payment shall only be made for placed and accepted shotcrete.

PIC708.07 Shortcreting Measurement and Payment

Payment Item	Description	Unit
PIC708.07.01	**Shotcrete of specified thickness applied in one, two or more layers as necessary**	square metre (m^2)

The unit of measurement shall be the square metre of face measured in the plane of the cutting face, which is protected by shotcrete of the specified thickness, installed to the satisfaction of the Engineer. No separate allowance shall be made for an uneven surface when measuring the area over which shotcrete has been applied.

The tendered rate shall include full compensation for all shotcrete materials and equipment to achieve a finished 200mm thick 30MPa reinforced shotcrete face, the shotcrete operation, setting up equipment, including wastage, 50mm of dental work and if necessary, 25mm overspray to achieve a 3m straight edge face finish and testing.

(1) Supplying all materials, including additives (if any), mixing and applying shotcrete including test sections as ordered by the Engineer, either to prove the adequacy of the additives or the shotcrete methods and materials.

(2) Cleaning down the cutting face with air as ordered, and the removal of all resulting soil and rock debris from the site to an approved spoil site, including all loading and transport

(3) Applying the shotcrete in one, two or more layers as specified on the drawings and as directed by the Engineer.

(4) Checking the thickness in the manner specified.

(5) Cleaning off all rebound material and the disposal of same at an approved spoil site.

(6) Making test specimens as specified.

No separate or additional payment shall be made for shotcrete applied to a thickness greater than specified and required, nor shall any additional payment be made for shotcrete whether applied in one or more layers.

Measurement and payment for the mesh shall be based on the square metre of rock slope covered with mesh measured on the plane of the slope. No extra payment shall be made for overlap of the mesh.

Testing shall include sampling in-situ cores of the reinforced shotcrete, test cubes of the fresh shotcrete, establishment and setting up of coring equipment, cube moulds, curing, curing baths, delivery of cubes and cores to accredited laboratory, testing and reporting of the results, including filling of voids where cores where taken.

Payment Item	**Description**	**Unit**
PIC708.07.02	**Subsoil drainage**	
(i)	Zipcore band drain	metre (m)

The unit of measurement shall be the metre of band drain installed to the satisfaction of the Engineer at the spacing indicated on drawings.

The band drain shall be 150mm wide DN3 band drain wrapped in grade A3 and discharge into the weepholes installed through the shotcrete wall as specified on drawings.

The tendered rate shall include full compensation for supplying, delivering, cutting, placing, fixing, fitting, joining the high flow cuspated drainage strip with 80% Shade Cloth including all tying wire and weep holes and pipes, protection during shotcreting, plant, equipment, labour and all other incidentals necessary to complete the specified work.

(ii)	Plastic piping for weepholes 75mm nominal diameter PVC piping	metre (m)

The unit of measurement shall be the metre of PVC piping weepholes installed to the satisfaction of the Engineer.

The tendered rate shall include full compensation for the supply, installation, protection during shotcreting, geofabric wrapping, plant, equipment, labour and all other incidentals necessary to complete the specified work.

Payment Item	Description	Unit
PIC708.07.03	**Monitoring**	**Lump Sum**

The unit of measurement shall be Lump Sum.

The tendered rate shall include full compensation for installing, protecting, fixing fourteen (14) monitoring points / targets and surveying on a regular basis as per the required intervals as shown on the drawings, converting results into graphs and providing reports during the course of the project. In addition, the tendered rate shall include providing and maintaining access to the monitoring points.

Payment Item	Description	Unit
PIC708.07.04	**Finishing off of shotcrete along brow of cut face**	metre (m)

The unit of measurement shall be the linear metre of the top of cut face where the shotcrete is finished off in the manner detailed in Drawings or any other equivalent method, all to the satisfaction of the Engineer.

The tendered rate shall include full compensation for excavation and spoiling of material from cut off surfaces, bending of mesh/netting, application of shotcrete irrespective of the volume involved as well as all equipment, labour, transport and other incidentals necessary to complete the specified work.

PREAMBLES FOR TRADES IN PRICING BILLS OF QUANTITIES

PREAMBLES TO BILL OF QUANTITIES

Contents

A. GENERAL

1. The Bills of Quantities are measured in terms of **City of Tshwane Standard Specifications for Municipal Civil Engineering Works** (third Edition, 2005) and supplementary preambles as indicated.
   Payment and payment conditions are in accordance with the JBCC Principal Building Agreement July 2007, Edition 5.0 Reprint 1, as detailed in the Preliminaries section of the Bill of Quantities.

2. Unless otherwise stated, the description of each item shall be deemed to include manufacturing, conveying and delivering, unloading, storing, unpacking, hoisting, setting, fitting and fixing in position, cutting, waste, patterns, models and templates, plant, Temporary Works, return of packings, establishment charges, profit and other obligations arising out of the conditions of contract.

3. Unless otherwise stated all work shall be measured net as fixed in position. All wants shall be deducted and no allowance shall be made for waste, nor passings and laps except where otherwise stated.

4. Quantities shall be rounded off to the nearest whole unit, unless the value of fractional quantities is of relative significance, in which circumstances one or two decimals may be added. Remeasurement of quantities will be done to the same number of decimals as used in the tender bill.

5. Quantities have been measured **provisionally** in the Bill of Quantities for tender.

6. Quantities will be remeasured primarily from the Engineer's construction drawings, secondary from other technical information approved or issued by the Engineer and site measurements where measurement from drawings is not possible.

7. Variations resulting from an Engineer's instruction shall be measured and valued as follows:

   7.1 items of additional work of similar character and executed under similar conditions shall be priced at the rates in the Bill of Quantities.

   7.2 items of additional work not of a similar character or not executed under similar conditions shall be priced at comparable rates adjusted to suit the changed circumstances.

   7.3 where rates are not applicable and cannot be adjusted in terms of 7.2 above to value a variation for additional work, the items of work shall be priced at new rates which take into account the labour, material and plant necessary for executing the work as well as an allowance for Contractor's overheads and profit which overheads and profit shall relate to those included in the contract sum for items of a similar character.

   7.4 in exceptional cases and following agreement with the Engineer prior to the execution of the works, additional works may be valued on Dayworks, but then only if Dayworks sheets are duly submitted, agreed and signed on a daily basis.

8. Rates shall be tendered for proprietary equipment as stated. No alternatives shall be allowed without prior agreement and the written consent of the Engineer. The phrase “or other approved” shall not relieve the Contractor from the responsibility to obtain such agreement and consent

10. JBCC Principal Building Agreement, May 2018, Edition 6.2, the *Specifications* and the *Drawings* are to be read in conjunction with the Bill of Quantities.

11. The quantities contained in this bill are **not to be used for ordering purposes**. No claims whatsoever arising due to these bill being used for ordering will be entertained.

12. Rates inserted in the Bill of Quantities shall allow for all **abnormal working hours** as may be necessary to execute the works.

13. A Price or rate is to be entered against each item in the Bill of Quantities, whether the quantities are stated or not. An item against which no price is entered will be considered to be covered by the other prices or rates in the Bill of Quantities.

14. The following units of measurement and abbreviations shall be used,

UNIT	ABBREVIATION
Millimetre	Mm
Metre	M
Square Millimetre	mm^2
Square Metre	m^2
Hectare	ha or Ha
Cubic Metre	m^3
Kilogram	kg or Kg
Cubic metre kilometre	m^3.km
Kilometre	km or Km
Tonne	ton or Ton
Sum	sum or Sum
Item	Item
Number	No
Hour	Hr
Week	Wk
Day	D
Minute	Min
Second	Sec
Deci cubic metre	dm^3
Litre	L

B. PRELIMINARY AND GENERAL

1. The Contractor is to allow in this section for all costs that cannot be suitably included in the unit rates for measured works elsewhere in the Bill of Quantities.

2. The Contractor will submit a detailed breakdown of the lump sum prices for items in this bill if so requested by the Engineer.

3. Payment will be made in accordance with the JBCC Principal Building Agreement July 2007 edition 5.0 Reprint 1, as detailed in the Preliminaries and General Section.

4. Descriptions are brief: it is the Contractor’s responsibility to decide on and assure that sufficient infrastructure, management and resources are employed to fulfil all contractual obligations. The

Contractor will supply breakdowns and details for pricing of Preliminary and General items upon request to the satisfaction of the Engineer/ Principal Agent.

5. The value for **Preliminary and General** will fully take into account the nature and location of the works and the particular Site requirements of the Employer as well as the principal client.

C. EARTHWORKS

1. The Works involving site clearance shall be measured in accordance with the City of Tshwane Standard Specifications for Municipal Civil Engineering Works (third Edition, 2005) and supplementary preambles as indicated.

2. The Works involving bulk earthworks shall be measured in accordance with the City of Tshwane Standard Specifications for Municipal Civil Engineering Works (third Edition, 2005) and supplementary preambles as indicated.

3. A survey of the Site will be done by the Contractor's land surveyor before stripping of topsoil may commence and on completion of topsoil stripping. These surveys will form the basis for the final account and will be agreed between the Engineer and the Contractor.

4. Quantities shall be rounded off to the nearest whole unit, unless the value of fractional quantities is of relative significance, in which circumstances one or two decimals may be added. Remeasurement of quantities will be done to the same number of decimals as used in the tender bill.

5. The total volume of cut or borrow to fill in terraces will be computed between the natural ground level (NGL), taking topsoil strip into account, and the terrace design levels.

6. Topsoil strip will be deducted from this cut and fill volumes and paid separately.

7. Only intermediate or hard rock excavation as classified and approved by the *Engineer* shall be certified for payment. Signed and approved surveyed levels of the different material classifications will be submitted prior to certification.

8. The Contractor shall notify and record, for approval, existing services that intersect or adjoin excavations. Only approved records of existing services which intersect or adjoin an excavation shall be assessed for payment.

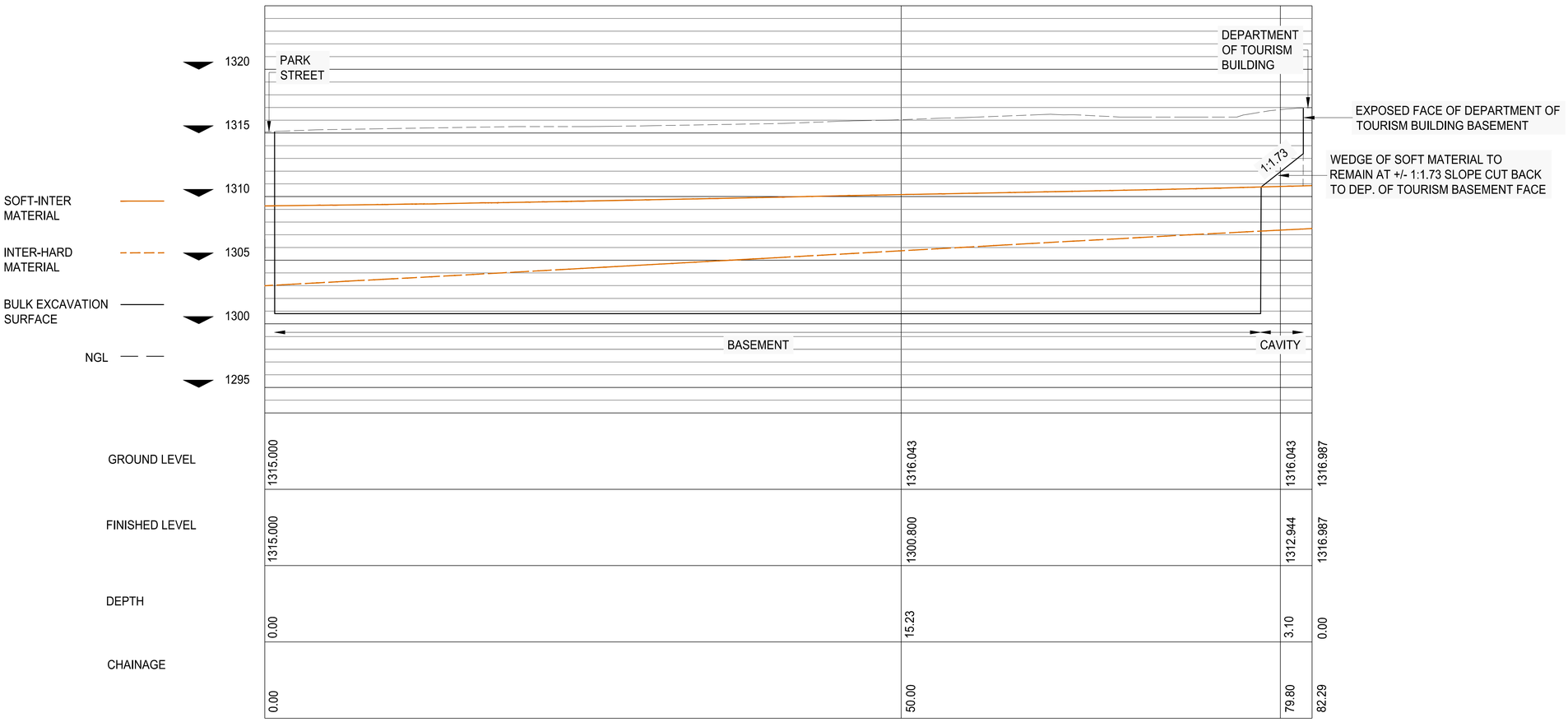
9. No bulking factors shall be applied in any earthworks measure. Excavation and backfill shall be measured compacted and to the design levels and dimensions.

LIST OF DRAWINGS

LIST OF DRAWINGS

No	Description	Drawing No	Rev No
A	**Bulk Earthworks**		
01	Bulk Earthworks - Section Sheet 1 Of 11	1600073-08-81-C-510	A
02	Bulk Earthworks - Section Sheet 2 Of 11	1600073-08-81-C-511	A
03	Bulk Earthworks - Section Sheet 3 Of 11	1600073-08-81-C-512	A
04	Bulk Earthworks - Section Sheet 4 Of 11	1600073-08-81-C-513	A
05	Bulk Earthworks - Section Sheet 5 Of 11	1600073-08-81-C-514	A
06	Bulk Earthworks - Section Sheet 6 Of 11	1600073-08-81-C-515	A
07	Bulk Earthworks - Section Sheet 7 Of 11	1600073-08-81-C-516	A
08	Bulk Earthworks - Section Sheet 8 Of 11	1600073-08-81-C-517	A
09	Bulk Earthworks - Section Sheet 9 Of 11	1600073-08-81-C-518	A
10	Bulk Earthworks - Section Sheet 10 Of 11	1600073-08-81-C-519	A
11	Bulk Earthworks - Section Sheet 11 Of 11	1600073-08-81-C-520	A
12	Earthworks Construction Plan Cavity	1600073-08-81-C-506	A
13	Bulk Earthworks Construction Plan	1600073-08-81-C-502	A
14	Localized Earthworks Construction Plan – Stormwater Tank	1600073-08-81-C-503	A
15	Localized Earthworks Construction Plan - Tower 1 & 2 Lift Shafts	1600073-08-81-C-504	A
16	Localized Earthworks Construction Plan - Tower 3 Lift Shaft	1600073-08-81-C-505	A
17	Earthworks Construction Plan Cavity	1600073-08-81-C-506	A
B	**Bulk Service**		
01	Setting Out Layout	1600073-08-81-C-003	A
02	Bulk Water Pipeline Upgrade Layout	1600073-08-81-C-101	A
03	Proposed Site Sewer Layout	1600073-08-81-C-202	A
04	Proposed Stormwater Layout(Tourism Building)	1600073-08-81-C301	A
05	Stormwater Details	1600073-08-81-C-310	A
	COT Standard Details		
06	Standard Drawing : Lamphole Detail & Sewer Layout for Erven With No Mid-Block Sewers	7515-S209	A
07	Standard Drawing : Sleeves & Culverts For Pipe Crossings At Bridges, Roads & Railway Lines	7515-W214	0
08	standard drawing : typical details	7515-W216	0
09	Standard Drawing : Typical Sewer Connections To Existing Outfall Sewer	7515-S210	A
10	Standard Drawing : Manhole Details For Sewer Pipes Up To 300mm Nominal Diameter	7515-S203	A

11	Standard Drawing : Sewer House Connection Details	7515-S206	A
12	Standard Drawing : Sewer Pipe Trenches And Bedding Details	7515-S205	A
13	Junction Box And Manhole Details: Typical Junction Box Configuration And Cover Slab Detail	STD004 1 OF 7	0
14	Junction Box And Manhole Details: Type A Junction Box	STD004 2 OF 7	0
15	Junction Box And Manhole Details: Type B Junction Box	STD004 3 OF 7	0
16	Junction Box And Manhole Details: Type C Junction Box	STD004 4 OF 7	0
17	Junction Box And Manhole Details: Type D Junction Box	STD004 5 OF 7	0
18	Junction Box And Manhole Details: Manhole	STD004 6 OF 7	0
19	Junction Box And Manhole Details: Manhole	STD004 7 OF 7	0
20	Stormwater Inlet & Outlet Structures Field Inlet And Stormwater Outlet	STD005 1 OF 1	0
21	Kerbing Details Sloping Kerb, Semi-Vertical Kerbs and Edge Beam	STD007 1 OF 2	0
22	Kerbing Details Transition Sections and Vehicle Entrance	STD007 2 OF 2	0
23	Standard Drawing :Thrust Blocks	7515-W210	0
24	Standard Drawing: Valve Chambers	7515-W203	0
25	Standard Drawing : Markers, Typical Bedding and Backfill Details For Water Pipes	7515-W211	0
	Lateral Support drawings		
01	Lateral Support Layout, Sections And Details	1600073 –LS-T-01	A
02	Lateral Support Wall Elevations	1600073 –LS-T-02	A
03	Lateral Support Notes	1600073 –LS-T-03	A



SECTION A
SCALE 1:200

0 8 16 24m
1:200

NOTES:

GENERAL

1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF CITY OF TSHWANE, STANDARD SPECIFICATIONS FOR CIVIL ENGINEERING WORKS.

2. THE CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.

3. A SITE INSPECTION IS TO BE ARRANGED WITH THE RELEVANT SERVICE PROVIDERS, POINTING OUT THE EXTENT OF THE WORKS, TO ENSURE THAT ALL SERVICES ARE ACCOUNTED FOR PRIOR TO THE COMMENCEMENT OF PROPOSED CONSTRUCTION.

   CONTRACTOR TO LIAISE WITH THE CITY OF TSHWANE MUNICIPALITY W.R.T. THE REINSTATEMENT OF ROAD SURFACING AND SIDEWALKS.

4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRAWINGS:
   4.1. 1600073-08-81-C-003-SETTING OUT LAYOUT
   4.2. 1600073-08-81-C-500-EXISTING SERVICES LAYOUT
   4.3. 1600073-08-81-C-501-EARTHWORKS LAYOUT

EARTHWORKS

1. REMOVE ALL VEGETATION & ROOTS.

2. REMOVE TOPSOIL TO AN APPROXIMATE DEPTH OF 150mm.

3. REMOVE UNSUITABLE SUBGRADE MATERIAL AS ORDERED BY THE ENGINEER, ALL IN ACCORDANCE WITH SABS 1200 C.

4. COMPACT IN-SITU MATERIAL TO 93% MOD AASHTO DENSITY.

5. G7 MATERIAL FOR FILL TO BE IMPORTED OR SOURCED FROM ON SITE OPERATIONS AND COMPACTED TO 93% MOD AASHTO DENSITY IN MAX. 150mm LAYERS.

6. DENSITY TESTS TO BE UNDERTAKEN BY THE CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO PLACING OF CONSECUTIVE LAYERS.

7. THE TRANSITIONS BETWEEN SOFT, INTERMEDIATE AND HARD MATERIALS SHOWN ARE ONLY INDICATIVE.

FOR TENDER

WGS 84/ LO 29

No.	DESCRIPTION / REVISIONS	DATE
A	ISSUED FOR TENDER PURPOSES	2019-07-04

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME: R:\.....			
DATE DATUM	2019-06-26	**CLIENT**	
SCALE SKAAL	1:200		
DESIGNED BY ONTWERP DEUR	ZG	**FOR ILISO CONSULTING**	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	ZG	**PROJECT ENGINEER**	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	**CONTENT AND ACCURACY**	**DESIGN COMPLIANCE**	**PROJECT COMPLIANCE**

PROJECT

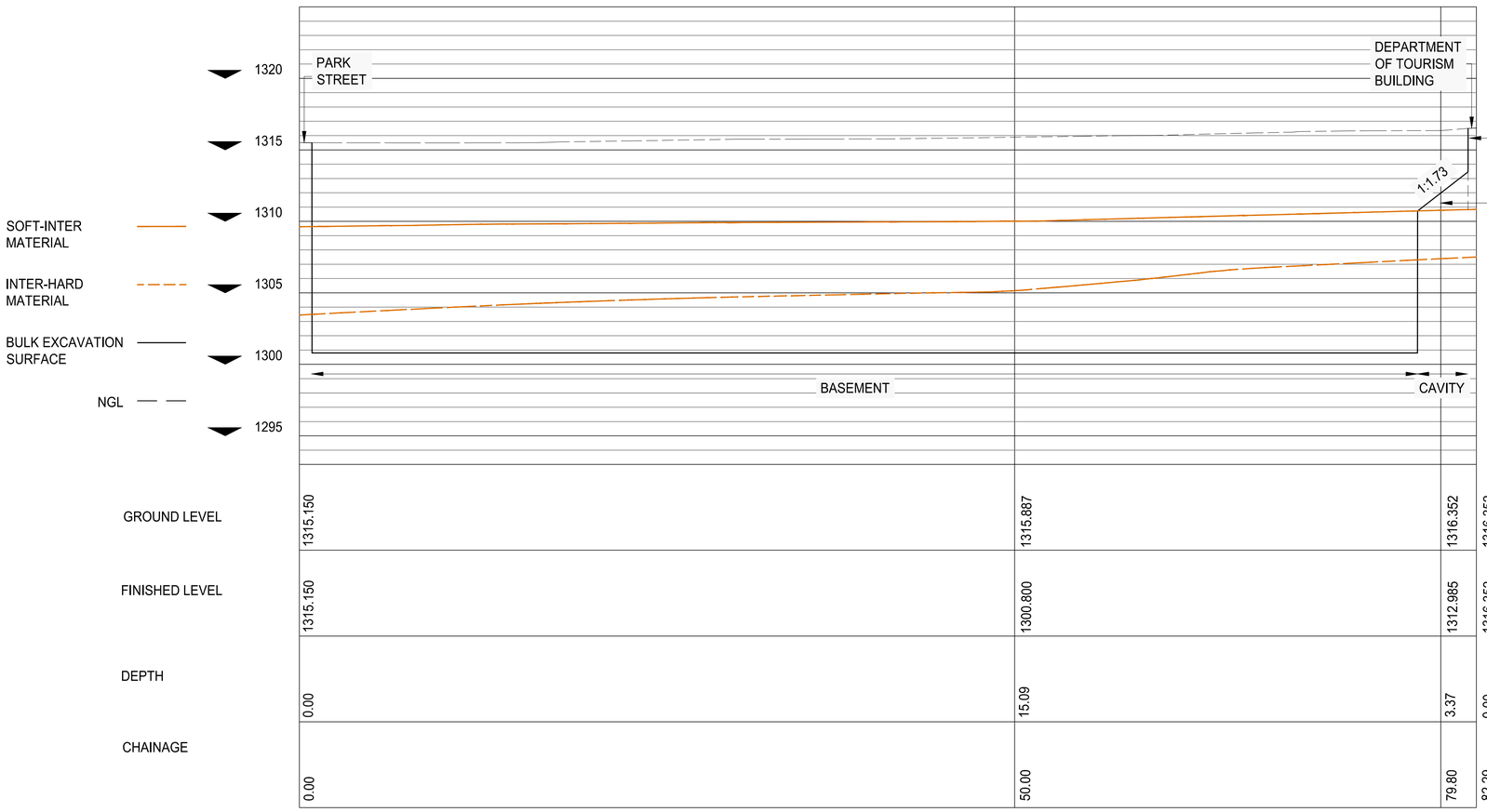
SUNNYSIDE OFFICE DEVELOPMENT

TITLE

BULK EARTHWORKS - SECTION A
SHEET 1 OF 11

PAPER SIZE	PROJECT NO. DRWG. NO.	REV.
A1	1600073-08-81-C-510	A

M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-501-510-522-RA-Earthworks layout and Sections.dwg
Jul 10, 2019 - 10:03am



GROUND LEVEL	1315.150	1315.887	1316.352	1316.352
FINISHED LEVEL	1315.150	1300.800	1312.985	1316.352
DEPTH	0.00	15.09	3.37	0.00
CHAINAGE	0.00	50.00	79.80	82.29

SECTION B
SCALE 1:200

0 8 16 24m
1:200

NOTES:

GENERAL

1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF CITY OF TSHWANE, STANDARD SPECIFICATIONS FOR CIVIL ENGINEERING WORKS.
2. THE CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.
3. A SITE INSPECTION IS TO BE ARRANGED WITH THE RELEVANT SERVICE PROVIDERS, POINTING OUT THE EXTENT OF THE WORKS, TO ENSURE THAT ALL SERVICES ARE ACCOUNTED FOR PRIOR TO THE COMMENCEMENT OF PROPOSED CONSTRUCTION.

   CONTRACTOR TO LIAISE WITH THE CITY OF TSHWANE MUNICIPALITY W.R.T. THE REINSTATEMENT OF ROAD SURFACING AND SIDEWALKS.
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRAWINGS:
   4.1. 1600073-08-81-C-003-SETTING OUT LAYOUT
   4.2. 1600073-08-81-C-500-EXISTING SERVICES LAYOUT
   4.3. 1600073-08-81-C-501-EARTHWORKS LAYOUT

EARTHWORKS

1. REMOVE ALL VEGETATION & ROOTS.
2. REMOVE TOPSOIL TO AN APPROXIMATE DEPTH OF 150mm.
3. REMOVE UNSUITABLE SUBGRADE MATERIAL AS ORDERED BY THE ENGINEER, ALL IN ACCORDANCE WITH SABS 1200 C.
4. COMPACT IN-SITU MATERIAL TO 93% MOD AASHTO DENSITY.
5. G7 MATERIAL FOR FILL TO BE IMPORTED OR SOURCED FROM ON SITE OPERATIONS AND COMPACTED TO 93% MOD AASHTO DENSITY IN MAX. 150mm LAYERS.
6. DENSITY TESTS TO BE UNDERTAKEN BY THE CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO PLACING OF CONSECUTIVE LAYERS.
7. THE TRANSITIONS BETWEEN SOFT, INTERMEDIATE AND HARD MATERIALS SHOWN ARE ONLY INDICATIVE.

FOR TENDER

WGS 84/ LO 29

No.	DESCRIPTION / REVISIONS	DATE
A	ISSUED FOR TENDER PURPOSES	2019-07-04

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME: R:\.....			
DATE DATUM	2019-06-26	**CLIENT**	
SCALE SKAAL	1:200		
DESIGNED BY ONTWERP DEUR	ZG	**FOR ILISO CONSULTING**	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	ZG	**PROJECT ENGINEER**	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	**CONTENT AND ACCURACY**	**DESIGN COMPLIANCE**	**PROJECT COMPLIANCE**

PROJECT

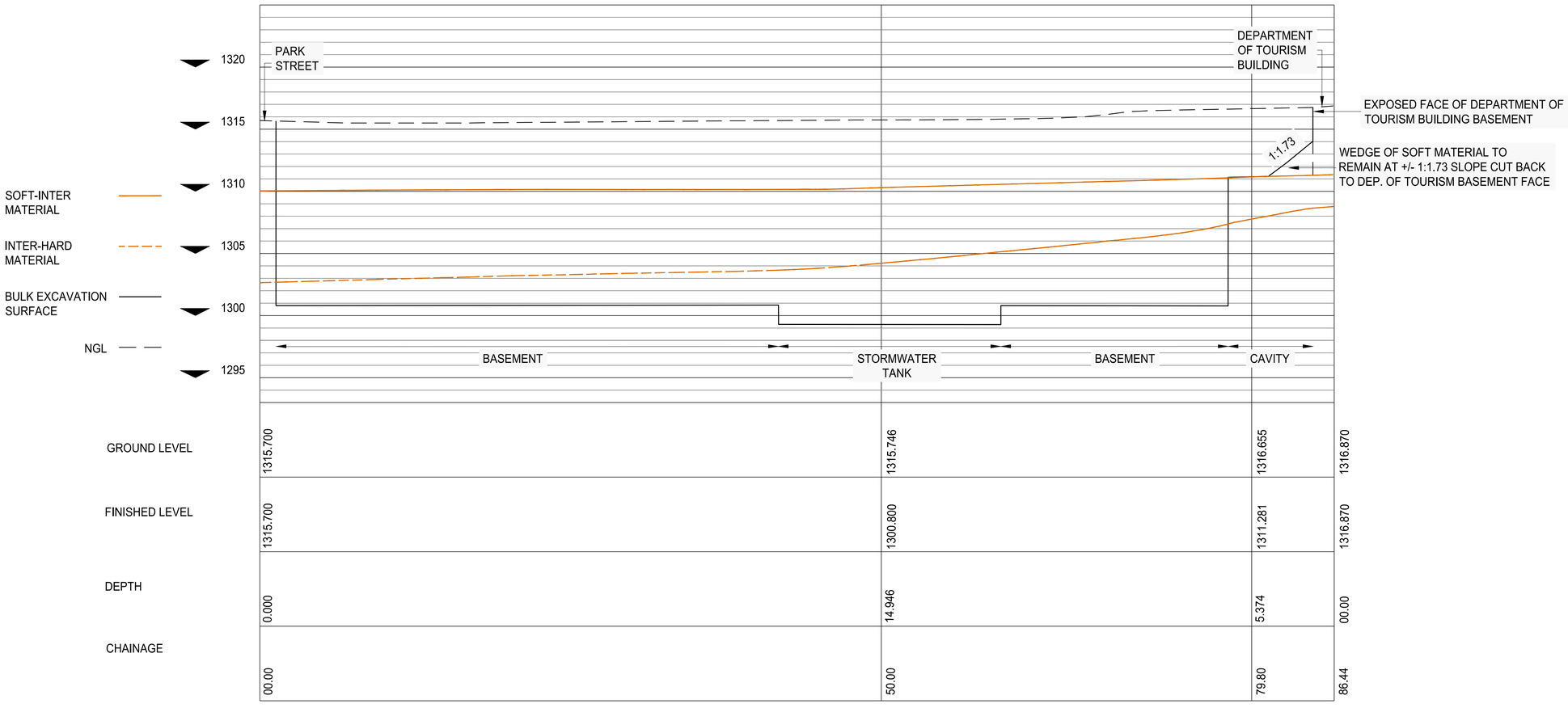
SUNNYSIDE OFFICE DEVELOPMENT

TITLE

BULK EARTHWORKS - SECTION B
SHEET 2 OF 11

PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073-08-81-C-511		A

M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-501-510-522-RA-Earthworks layout and Sections.dwg
Jul 10, 2019 - 10:05am



SECTION C
SCALE 1: 200

0 8 16 24m
1:200

M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-501-510-522-RA-Earthworks layout and Sections.dwg
Jul 10, 2019 - 10:14am

NOTES:

GENERAL

1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF CITY OF TSHWANE, STANDARD SPECIFICATIONS FOR CIVIL ENGINEERING WORKS.

2. THE CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.

3. A SITE INSPECTION IS TO BE ARRANGED WITH THE RELEVANT SERVICE PROVIDERS, POINTING OUT THE EXTENT OF THE WORKS, TO ENSURE THAT ALL SERVICES ARE ACCOUNTED FOR PRIOR TO THE COMMENCEMENT OF PROPOSED CONSTRUCTION.

   CONTRACTOR TO LIAISE WITH THE CITY OF TSHWANE MUNICIPALITY W.R.T. THE REINSTATEMENT OF ROAD SURFACING AND SIDEWALKS.

4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRAWINGS:
   4.1. 1600073-08-81-C-003-SETTING OUT LAYOUT
   4.2. 1600073-08-81-C-500-EXISTING SERVICES LAYOUT
   4.3. 1600073-08-81-C-501-EARTHWORKS LAYOUT

EARTHWORKS

1. REMOVE ALL VEGETATION & ROOTS.

2. REMOVE TOPSOIL TO AN APPROXIMATE DEPTH OF 150mm.

3. REMOVE UNSUITABLE SUBGRADE MATERIAL AS ORDERED BY THE ENGINEER, ALL IN ACCORDANCE WITH SABS 1200 C.

4. COMPACT IN-SITU MATERIAL TO 93% MOD AASHTO DENSITY.

5. G7 MATERIAL FOR FILL TO BE IMPORTED OR SOURCED FROM ON SITE OPERATIONS AND COMPACTED TO 93% MOD AASHTO DENSITY IN MAX. 150mm LAYERS.

6. DENSITY TESTS TO BE UNDERTAKEN BY THE CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO PLACING OF CONSECUTIVE LAYERS.

7. THE TRANSITIONS BETWEEN SOFT, INTERMEDIATE AND HARD MATERIALS SHOWN ARE ONLY INDICATIVE.

FOR TENDER

WGS 84/ LO 29

No.	DESCRIPTION / REVISIONS	DATE
A	ISSUED FOR TENDER PURPOSES	2019-07-04

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME: R:\.....			
DATE DATUM	2019-06-26	**CLIENT**	
SCALE SKAAL	1:200		
DESIGNED BY ONTWERP DEUR	ZG	**FOR ILISO CONSULTING**	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	ZG	**PROJECT ENGINEER**	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	**CONTENT AND ACCURACY**	**DESIGN COMPLIANCE**	**PROJECT COMPLIANCE**

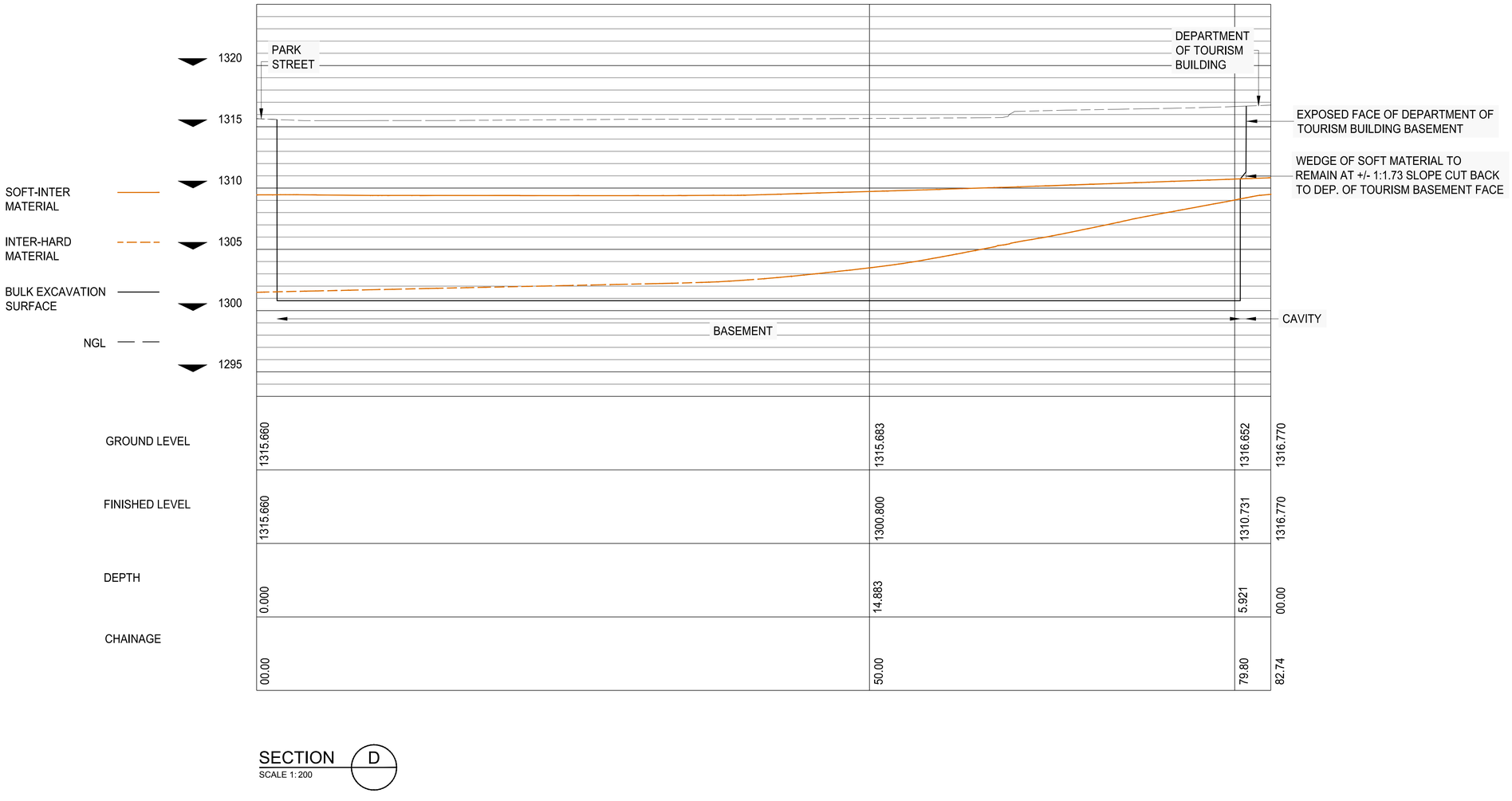
PROJECT

SUNNYSIDE OFFICE DEVELOPMENT

TITLE

BULK EARTHWORKS - SECTION C
SHEET 3 OF 11

PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073-08-81-C-512		A



SECTION D
SCALE 1: 200

0 8 16 24m
1:200

NOTES:

GENERAL

1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF CITY OF TSHWANE, STANDARD SPECIFICATIONS FOR CIVIL ENGINEERING WORKS.

2. THE CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.

3. A SITE INSPECTION IS TO BE ARRANGED WITH THE RELEVANT SERVICE PROVIDERS, POINTING OUT THE EXTENT OF THE WORKS, TO ENSURE THAT ALL SERVICES ARE ACCOUNTED FOR PRIOR TO THE COMMENCEMENT OF PROPOSED CONSTRUCTION.

   CONTRACTOR TO LIAISE WITH THE CITY OF TSHWANE MUNICIPALITY W.R.T. THE REINSTATEMENT OF ROAD SURFACING AND SIDEWALKS.

4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRAWINGS:
   4.1. 1600073-08-81-C-003-SETTING OUT LAYOUT
   4.2. 1600073-08-81-C-500-EXISTING SERVICES LAYOUT
   4.3. 1600073-08-81-C-501-EARTHWORKS LAYOUT

EARTHWORKS

1. REMOVE ALL VEGETATION & ROOTS.

2. REMOVE TOPSOIL TO AN APPROXIMATE DEPTH OF 150mm.

3. REMOVE UNSUITABLE SUBGRADE MATERIAL AS ORDERED BY THE ENGINEER, ALL IN ACCORDANCE WITH SABS 1200 C.

4. COMPACT IN-SITU MATERIAL TO 93% MOD AASHTO DENSITY.

5. G7 MATERIAL FOR FILL TO BE IMPORTED OR SOURCED FROM ON SITE OPERATIONS AND COMPACTED TO 93% MOD AASHTO DENSITY IN MAX. 150mm LAYERS.

6. DENSITY TESTS TO BE UNDERTAKEN BY THE CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO PLACING OF CONSECUTIVE LAYERS.

7. THE TRANSITIONS BETWEEN SOFT, INTERMEDIATE AND HARD MATERIALS SHOWN ARE ONLY INDICATIVE.

FOR TENDER

WGS 84/ LO 29

No.	DESCRIPTION / REVISIONS	DATE
A	ISSUED FOR TENDER PURPOSES	2019-07-04

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME: R:\....			
DATE DATUM	2019-06-26	**CLIENT**	
SCALE SKAAL	1:200		
DESIGNED BY ONTWERP DEUR	ZG	**FOR ILISO CONSULTING**	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	ZG	**PROJECT ENGINEER**	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	**CONTENT AND ACCURACY**	**DESIGN COMPLIANCE**	**PROJECT COMPLIANCE**

PROJECT

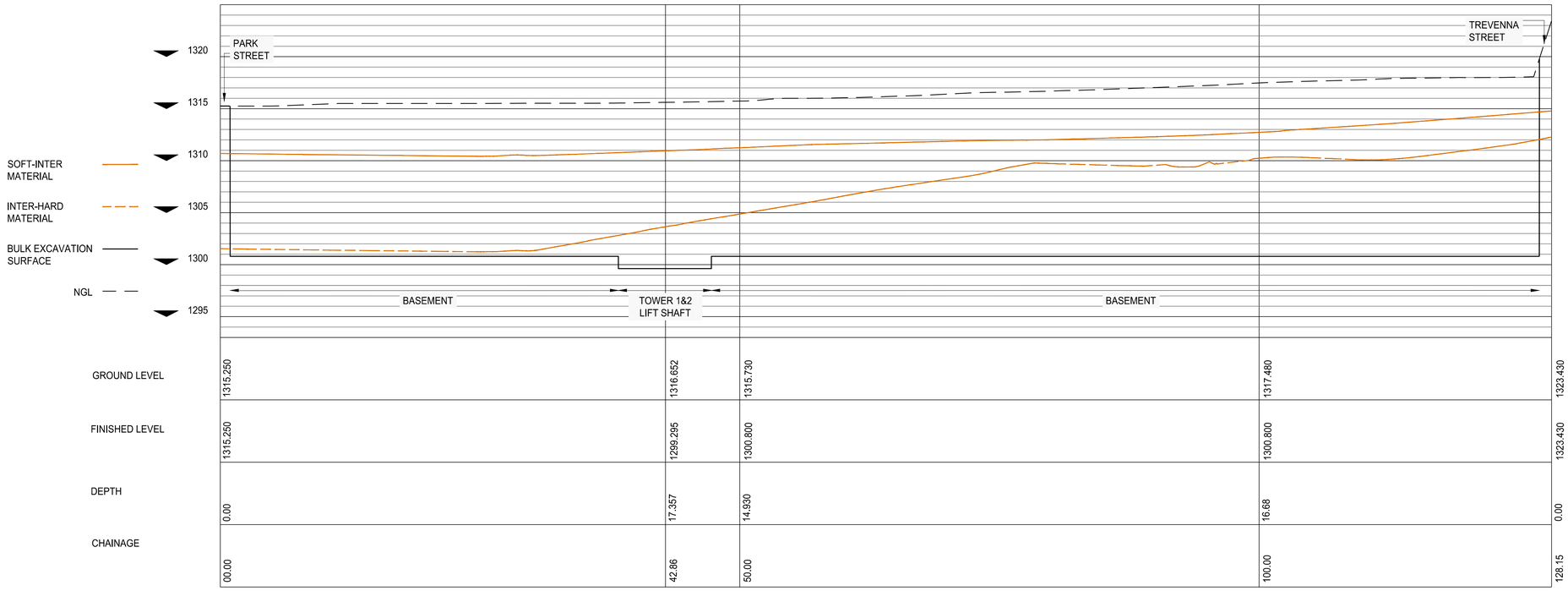
SUNNYSIDE OFFICE DEVELOPMENT

TITLE

BULK EARTHWORKS - SECTION D
SHEET 4 OF 11

PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073-08-81-C-513		A

M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-501-510-522-RA-Earthworks layout and Sections.dwg
Jul 10, 2019 - 10:15am



SECTION E
SCALE 1: 250

0 10 20 30m
1:250

NOTES:

GENERAL

1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF CITY OF TSHWANE, STANDARD SPECIFICATIONS FOR CIVIL ENGINEERING WORKS.

2. THE CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.

3. A SITE INSPECTION IS TO BE ARRANGED WITH THE RELEVANT SERVICE PROVIDERS, POINTING OUT THE EXTENT OF THE WORKS, TO ENSURE THAT ALL SERVICES ARE ACCOUNTED FOR PRIOR TO THE COMMENCEMENT OF PROPOSED CONSTRUCTION.

   CONTRACTOR TO LIAISE WITH THE CITY OF TSHWANE MUNICIPALITY W.R.T. THE REINSTATEMENT OF ROAD SURFACING AND SIDEWALKS.

4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRAWINGS:
   4.1. 1600073-08-81-C-003-SETTING OUT LAYOUT
   4.2. 1600073-08-81-C-500-EXISTING SERVICES LAYOUT
   4.3. 1600073-08-81-C-501-EARTHWORKS LAYOUT

EARTHWORKS

1. REMOVE ALL VEGETATION & ROOTS.

2. REMOVE TOPSOIL TO AN APPROXIMATE DEPTH OF 150mm.

3. REMOVE UNSUITABLE SUBGRADE MATERIAL AS ORDERED BY THE ENGINEER, ALL IN ACCORDANCE WITH SABS 1200 C.

4. COMPACT IN-SITU MATERIAL TO 93% MOD AASHTO DENSITY.

5. G7 MATERIAL FOR FILL TO BE IMPORTED OR SOURCED FROM ON SITE OPERATIONS AND COMPACTED TO 93% MOD AASHTO DENSITY IN MAX. 150mm LAYERS.

6. DENSITY TESTS TO BE UNDERTAKEN BY THE CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO PLACING OF CONSECUTIVE LAYERS.

7. THE TRANSITIONS BETWEEN SOFT, INTERMEDIATE AND HARD MATERIALS SHOWN ARE ONLY INDICATIVE.

FOR TENDER

WGS 84/ LO 29

No.	DESCRIPTION / REVISIONS	DATE
A	ISSUED FOR TENDER PURPOSES	2019-07-04

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME: R:\.....			
DATE DATUM	2019-06-26	**CLIENT**	
SCALE SKAAL	1:250		
DESIGNED BY ONTWERP DEUR	ZG	**FOR ILISO CONSULTING**	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	ZG	**PROJECT ENGINEER**	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	**CONTENT AND ACCURACY**	**DESIGN COMPLIANCE**	**PROJECT COMPLIANCE**

PROJECT

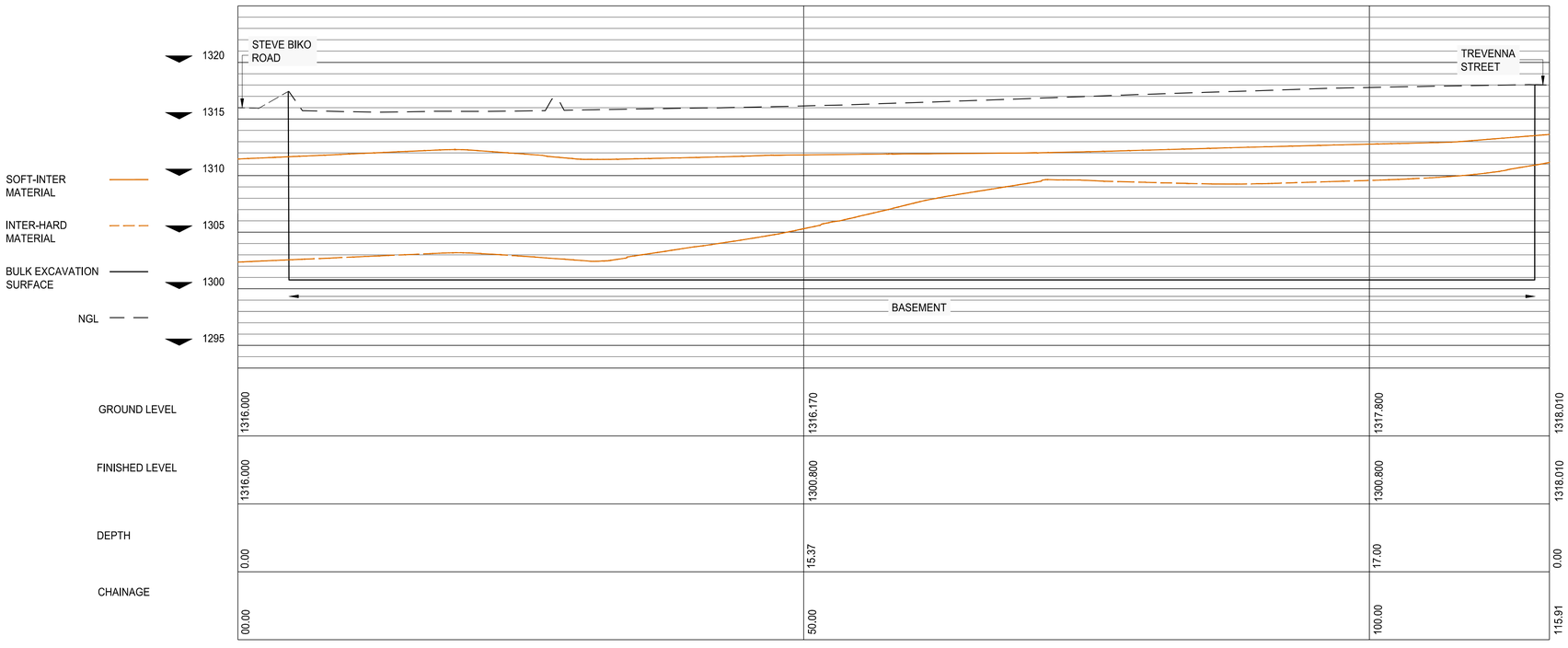
SUNNYSIDE OFFICE DEVELOPMENT

TITLE

BULK EARTHWORKS - SECTION E
SHEET 5 OF 11

PAPER SIZE	PROJECT NO. / DRWG. NO.	REV.
A1	1600073-08-81-C-514	A

M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-501-510-522-RA-Earthworks layout and Sections.dwg
Jul 10, 2019 - 10:17am



SECTION F
SCALE 1: 250

0 10 20 30m
1:250

NOTES:

GENERAL

1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF CITY OF TSHWANE, STANDARD SPECIFICATIONS FOR CIVIL ENGINEERING WORKS.

2. THE CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.

3. A SITE INSPECTION IS TO BE ARRANGED WITH THE RELEVANT SERVICE PROVIDERS, POINTING OUT THE EXTENT OF THE WORKS, TO ENSURE THAT ALL SERVICES ARE ACCOUNTED FOR PRIOR TO THE COMMENCEMENT OF PROPOSED CONSTRUCTION.

   CONTRACTOR TO LIAISE WITH THE CITY OF TSHWANE MUNICIPALITY W.R.T. THE REINSTATEMENT OF ROAD SURFACING AND SIDEWALKS.

4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRAWINGS:
   4.1. 1600073-08-81-C-003-SETTING OUT LAYOUT
   4.2. 1600073-08-81-C-500-EXISTING SERVICES LAYOUT
   4.3. 1600073-08-81-C-501-EARTHWORKS LAYOUT

EARTHWORKS

1. REMOVE ALL VEGETATION & ROOTS.

2. REMOVE TOPSOIL TO AN APPROXIMATE DEPTH OF 150mm.

3. REMOVE UNSUITABLE SUBGRADE MATERIAL AS ORDERED BY THE ENGINEER, ALL IN ACCORDANCE WITH SABS 1200 C.

4. COMPACT IN-SITU MATERIAL TO 93% MOD AASHTO DENSITY.

5. G7 MATERIAL FOR FILL TO BE IMPORTED OR SOURCED FROM ON SITE OPERATIONS AND COMPACTED TO 93% MOD AASHTO DENSITY IN MAX. 150mm LAYERS.

6. DENSITY TESTS TO BE UNDERTAKEN BY THE CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO PLACING OF CONSECUTIVE LAYERS.

7. THE TRANSITIONS BETWEEN SOFT, INTERMEDIATE AND HARD MATERIALS SHOWN ARE ONLY INDICATIVE.

FOR TENDER

WGS 84/ LO 29

No.	DESCRIPTION / REVISIONS	DATE
A	ISSUED FOR TENDER PURPOSES	2019-07-04

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME: R:\...			
DATE DATUM	2019-06-26	**CLIENT**	
SCALE SKAAL	1:250		
DESIGNED BY ONTWERP DEUR	ZG	**FOR ILISO CONSULTING**	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	ZG	**PROJECT ENGINEER**	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	**CONTENT AND ACCURACY**	**DESIGN COMPLIANCE**	**PROJECT COMPLIANCE**

PROJECT

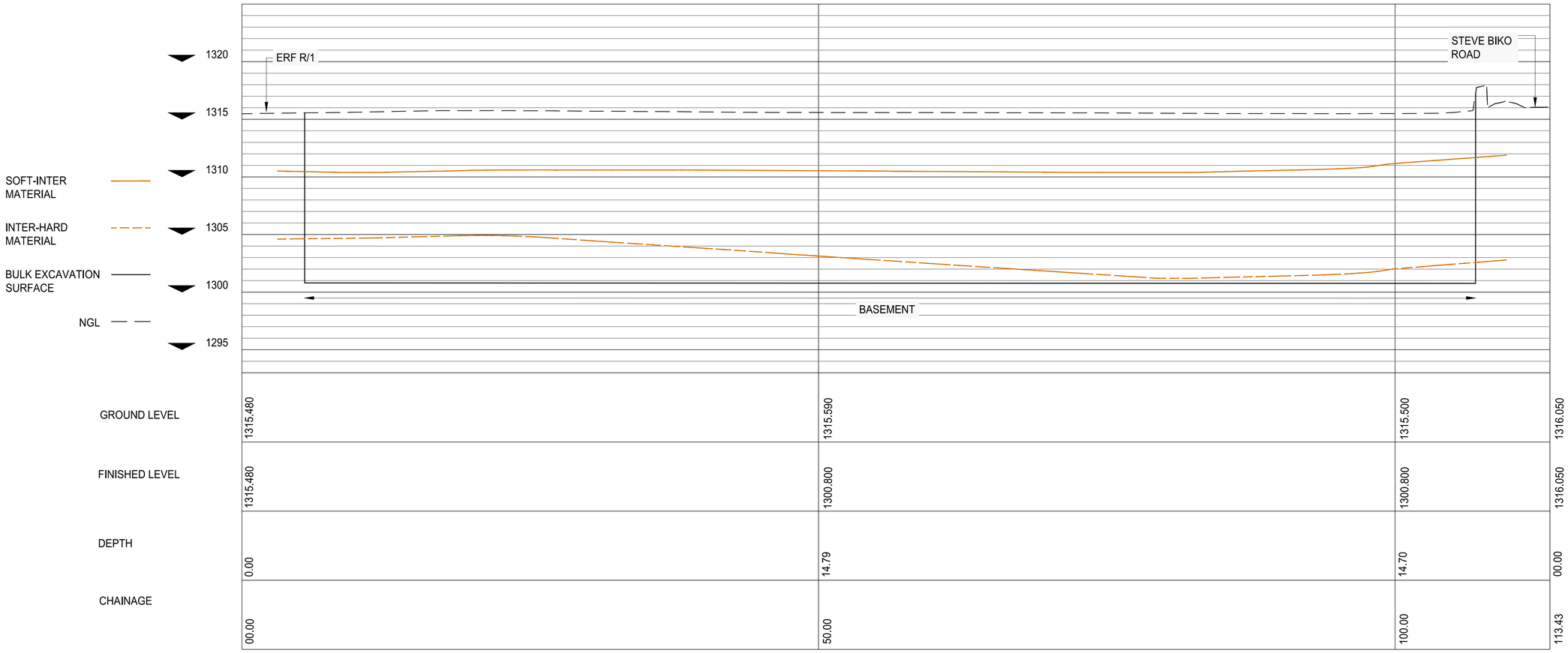
SUNNYSIDE OFFICE DEVELOPMENT

TITLE

BULK EARTHWORKS - SECTION F
SHEET 6 OF 11

PAPER SIZE	PROJECT NO. DRWG. NO.	REV.
A1	1600073-08-81-C-515	A

M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-501-510-522-RA-Earthworks layout and Sections.dwg
Jul 10, 2019 - 10:28am



SECTION 1
SCALE 1: 200

0 8 16 24m
1:200

NOTES:

GENERAL

1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF CITY OF TSHWANE, STANDARD SPECIFICATIONS FOR CIVIL ENGINEERING WORKS.

2. THE CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.

3. A SITE INSPECTION IS TO BE ARRANGED WITH THE RELEVANT SERVICE PROVIDERS, POINTING OUT THE EXTENT OF THE WORKS, TO ENSURE THAT ALL SERVICES ARE ACCOUNTED FOR PRIOR TO THE COMMENCEMENT OF PROPOSED CONSTRUCTION.

   CONTRACTOR TO LIAISE WITH THE CITY OF TSHWANE MUNICIPALITY W.R.T. THE REINSTATEMENT OF ROAD SURFACING AND SIDEWALKS.

4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRAWINGS:
   4.1. 1600073-08-81-C-003-SETTING OUT LAYOUT
   4.2. 1600073-08-81-C-500-EXISTING SERVICES LAYOUT
   4.3. 1600073-08-81-C-501-EARTHWORKS LAYOUT

EARTHWORKS

1. REMOVE ALL VEGETATION & ROOTS.

2. REMOVE TOPSOIL TO AN APPROXIMATE DEPTH OF 150mm.

3. REMOVE UNSUITABLE SUBGRADE MATERIAL AS ORDERED BY THE ENGINEER, ALL IN ACCORDANCE WITH SABS 1200 C.

4. COMPACT IN-SITU MATERIAL TO 93% MOD AASHTO DENSITY.

5. G7 MATERIAL FOR FILL TO BE IMPORTED OR SOURCED FROM ON SITE OPERATIONS AND COMPACTED TO 93% MOD AASHTO DENSITY IN MAX. 150mm LAYERS.

6. DENSITY TESTS TO BE UNDERTAKEN BY THE CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO PLACING OF CONSECUTIVE LAYERS.

7. THE TRANSITIONS BETWEEN SOFT, INTERMEDIATE AND HARD MATERIALS SHOWN ARE ONLY INDICATIVE.

FOR TENDER

WGS 84/ LO 29

No.	DESCRIPTION / REVISIONS	DATE
A	ISSUED FOR TENDER PURPOSES	2019-07-04

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME: R:\.....			
DATE DATUM	2019-06-26	**CLIENT**	
SCALE SKAAL	1:200		
DESIGNED BY ONTWERP DEUR	ZG	**FOR ILISO CONSULTING**	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	ZG	**PROJECT ENGINEER**	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	**CONTENT AND ACCURACY**	**DESIGN COMPLIANCE**	**PROJECT COMPLIANCE**

PROJECT

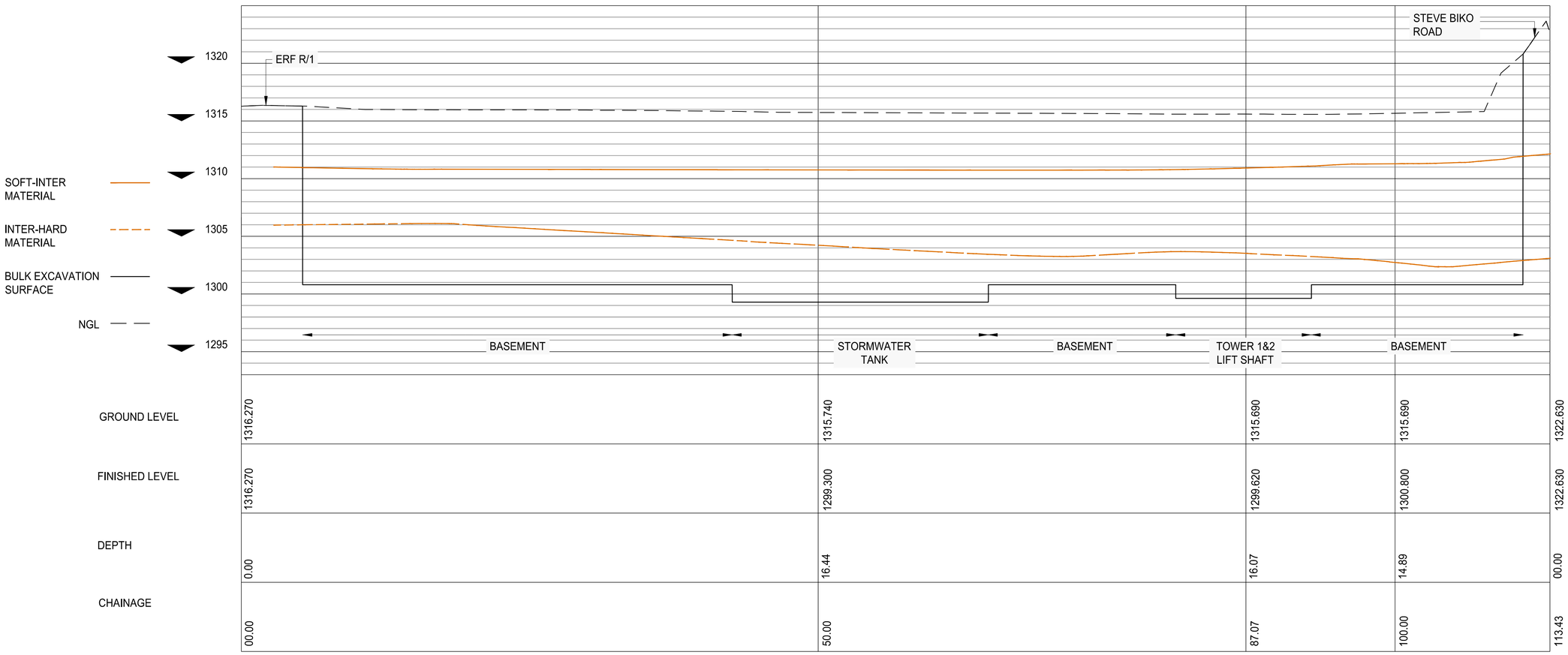
SUNNYSIDE OFFICE DEVELOPMENT

TITLE

BULK EARTHWORKS - SECTION 1
SHEET 7 OF 11

PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073-08-81-C-516		A

M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-501-510-522-RA-Earthworks layout and Sections.dwg
Jul 10, 2019 - 10:32am



SECTION 2
SCALE 1: 200

0 8 16 24m
1:200

NOTES:

GENERAL

1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF CITY OF TSHWANE, STANDARD SPECIFICATIONS FOR CIVIL ENGINEERING WORKS.

2. THE CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.

3. A SITE INSPECTION IS TO BE ARRANGED WITH THE RELEVANT SERVICE PROVIDERS, POINTING OUT THE EXTENT OF THE WORKS, TO ENSURE THAT ALL SERVICES ARE ACCOUNTED FOR PRIOR TO THE COMMENCEMENT OF PROPOSED CONSTRUCTION.

   CONTRACTOR TO LIAISE WITH THE CITY OF TSHWANE MUNICIPALITY W.R.T. THE REINSTATEMENT OF ROAD SURFACING AND SIDEWALKS.

4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRAWINGS:
   4.1. 1600073-08-81-C-003-SETTING OUT LAYOUT
   4.2. 1600073-08-81-C-500-EXISTING SERVICES LAYOUT
   4.3. 1600073-08-81-C-501-EARTHWORKS LAYOUT

EARTHWORKS

1. REMOVE ALL VEGETATION & ROOTS.

2. REMOVE TOPSOIL TO AN APPROXIMATE DEPTH OF 150mm.

3. REMOVE UNSUITABLE SUBGRADE MATERIAL AS ORDERED BY THE ENGINEER, ALL IN ACCORDANCE WITH SABS 1200 C.

4. COMPACT IN-SITU MATERIAL TO 93% MOD AASHTO DENSITY.

5. G7 MATERIAL FOR FILL TO BE IMPORTED OR SOURCED FROM ON SITE OPERATIONS AND COMPACTED TO 93% MOD AASHTO DENSITY IN MAX. 150mm LAYERS.

6. DENSITY TESTS TO BE UNDERTAKEN BY THE CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO PLACING OF CONSECUTIVE LAYERS.

7. THE TRANSITIONS BETWEEN SOFT, INTERMEDIATE AND HARD MATERIALS SHOWN ARE ONLY INDICATIVE.

FOR TENDER

WGS 84/ LO 29

No.	DESCRIPTION / REVISIONS	DATE
A	ISSUED FOR TENDER PURPOSES	2019-07-04

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME: R:\.....			
DATE DATUM	2019-06-26	**CLIENT**	
SCALE SKAAL	1:200		
DESIGNED BY ONTWERP DEUR	ZG	**FOR ILISO CONSULTING**	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	ZG	**PROJECT ENGINEER**	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	**CONTENT AND ACCURACY**	**DESIGN COMPLIANCE**	**PROJECT COMPLIANCE**

PROJECT

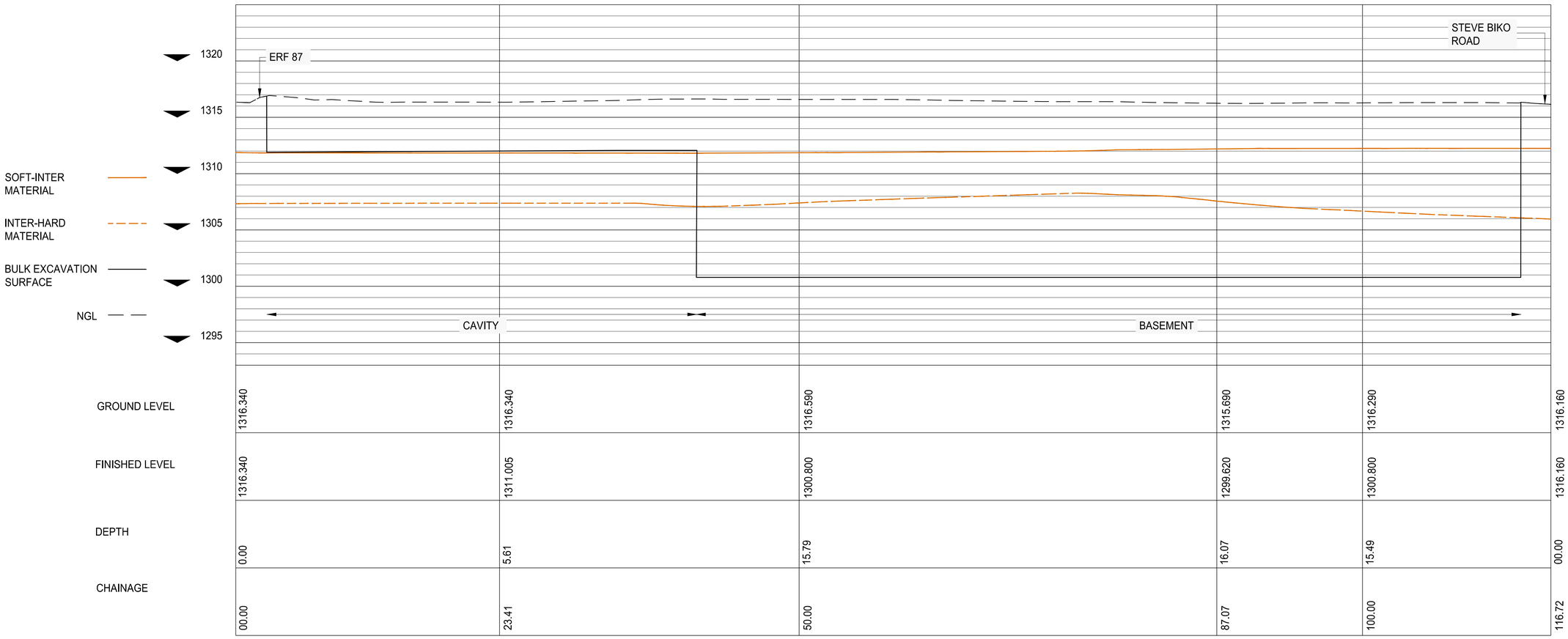
SUNNYSIDE OFFICE DEVELOPMENT

TITLE

BULK EARTHWORKS - SECTION 2
SHEET 8 OF 11

PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073-08-81-C-517		A

M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-501-510-522-RA-Earthworks layout and Sections.dwg
Jul 10, 2019 - 10:34am



GROUND LEVEL	1316.340	1316.340	1316.590	1315.690	1316.290	1316.160
FINISHED LEVEL	1316.340	1311.005	1300.800	1299.620	1300.800	1316.160
DEPTH	0.00	5.61	15.79	16.07	15.49	00.00
CHAINAGE	00.00	23.41	50.00	87.07	100.00	116.72

SECTION 3
SCALE 1: 200

0 8 16 24m
1:200

NOTES:

GENERAL

1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF CITY OF TSHWANE, STANDARD SPECIFICATIONS FOR CIVIL ENGINEERING WORKS.

2. THE CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.

3. A SITE INSPECTION IS TO BE ARRANGED WITH THE RELEVANT SERVICE PROVIDERS, POINTING OUT THE EXTENT OF THE WORKS, TO ENSURE THAT ALL SERVICES ARE ACCOUNTED FOR PRIOR TO THE COMMENCEMENT OF PROPOSED CONSTRUCTION.

   CONTRACTOR TO LIAISE WITH THE CITY OF TSHWANE MUNICIPALITY W.R.T. THE REINSTATEMENT OF ROAD SURFACING AND SIDEWALKS.

4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRAWINGS:
   4.1. 1600073-08-81-C-003-SETTING OUT LAYOUT
   4.2. 1600073-08-81-C-500-EXISTING SERVICES LAYOUT
   4.3. 1600073-08-81-C-501-EARTHWORKS LAYOUT

EARTHWORKS

1. REMOVE ALL VEGETATION & ROOTS.

2. REMOVE TOPSOIL TO AN APPROXIMATE DEPTH OF 150mm.

3. REMOVE UNSUITABLE SUBGRADE MATERIAL AS ORDERED BY THE ENGINEER, ALL IN ACCORDANCE WITH SABS 1200 C.

4. COMPACT IN-SITU MATERIAL TO 93% MOD AASHTO DENSITY.

5. G7 MATERIAL FOR FILL TO BE IMPORTED OR SOURCED FROM ON SITE OPERATIONS AND COMPACTED TO 93% MOD AASHTO DENSITY IN MAX. 150mm LAYERS.

6. DENSITY TESTS TO BE UNDERTAKEN BY THE CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO PLACING OF CONSECUTIVE LAYERS.

7. THE TRANSITIONS BETWEEN SOFT, INTERMEDIATE AND HARD MATERIALS SHOWN ARE ONLY INDICATIVE.

FOR TENDER

WGS 84/ LO 29

No.	DESCRIPTION / REVISIONS	DATE
A	ISSUED FOR TENDER PURPOSES	2019-07-04

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME: R:\.....			
DATE DATUM	2019-06-26	**CLIENT**	
SCALE SKAAL	1:200		
DESIGNED BY ONTWERP DEUR	ZG	**FOR ILISO CONSULTING**	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	ZG	**PROJECT ENGINEER**	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	**CONTENT AND ACCURACY**	**DESIGN COMPLIANCE**	**PROJECT COMPLIANCE**

PROJECT

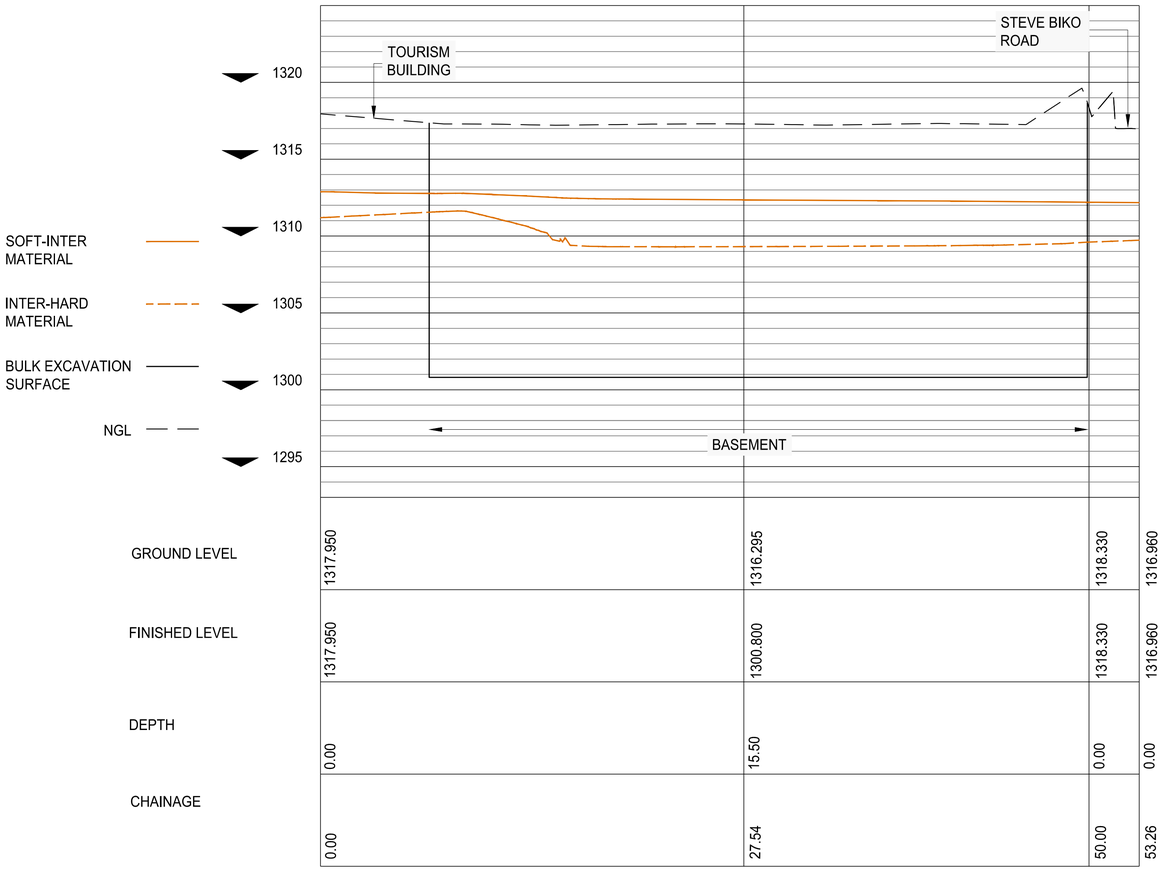
SUNNYSIDE OFFICE DEVELOPMENT

TITLE

BULK EARTHWORKS - SECTION 3
SHEET 9 OF 11

PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073-08-81-C-518		A

M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-501-510-522-RA-Earthworks layout and Sections.dwg
Jul 10, 2019 - 10:37am



SECTION 4
SCALE 1:200

0 8 16 24m
1:200

NOTES:

GENERAL

1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF CITY OF TSHWANE, STANDARD SPECIFICATIONS FOR CIVIL ENGINEERING WORKS.

2. THE CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.

3. A SITE INSPECTION IS TO BE ARRANGED WITH THE RELEVANT SERVICE PROVIDERS, POINTING OUT THE EXTENT OF THE WORKS, TO ENSURE THAT ALL SERVICES ARE ACCOUNTED FOR PRIOR TO THE COMMENCEMENT OF PROPOSED CONSTRUCTION.

   CONTRACTOR TO LIAISE WITH THE CITY OF TSHWANE MUNICIPALITY W.R.T. THE REINSTATEMENT OF ROAD SURFACING AND SIDEWALKS.

4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRAWINGS:
   4.1. 1600073-08-81-C-003-SETTING OUT LAYOUT
   4.2. 1600073-08-81-C-500-EXISTING SERVICES LAYOUT
   4.3. 1600073-08-81-C-501-EARTHWORKS LAYOUT

EARTHWORKS

1. REMOVE ALL VEGETATION & ROOTS.

2. REMOVE TOPSOIL TO AN APPROXIMATE DEPTH OF 150mm.

3. REMOVE UNSUITABLE SUBGRADE MATERIAL AS ORDERED BY THE ENGINEER, ALL IN ACCORDANCE WITH SABS 1200 C.

4. COMPACT IN-SITU MATERIAL TO 93% MOD AASHTO DENSITY.

5. G7 MATERIAL FOR FILL TO BE IMPORTED OR SOURCED FROM ON SITE OPERATIONS AND COMPACTED TO 93% MOD AASHTO DENSITY IN MAX. 150mm LAYERS.

6. DENSITY TESTS TO BE UNDERTAKEN BY THE CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO PLACING OF CONSECUTIVE LAYERS.

7. THE TRANSITIONS BETWEEN SOFT, INTERMEDIATE AND HARD MATERIALS SHOWN ARE ONLY INDICATIVE.

FOR TENDER

WGS 84/ LO 29

No.	DESCRIPTION / REVISIONS	DATE
A	ISSUED FOR TENDER PURPOSES	2019-07-04

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME: R:\.....			
DATE DATUM	2019-06-26	**CLIENT**	
SCALE SKAAL	1:200		
DESIGNED BY ONTWERP DEUR	ZG	**FOR ILISO CONSULTING**	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	ZG	**PROJECT ENGINEER**	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	**CONTENT AND ACCURACY**	**DESIGN COMPLIANCE**	**PROJECT COMPLIANCE**

PROJECT

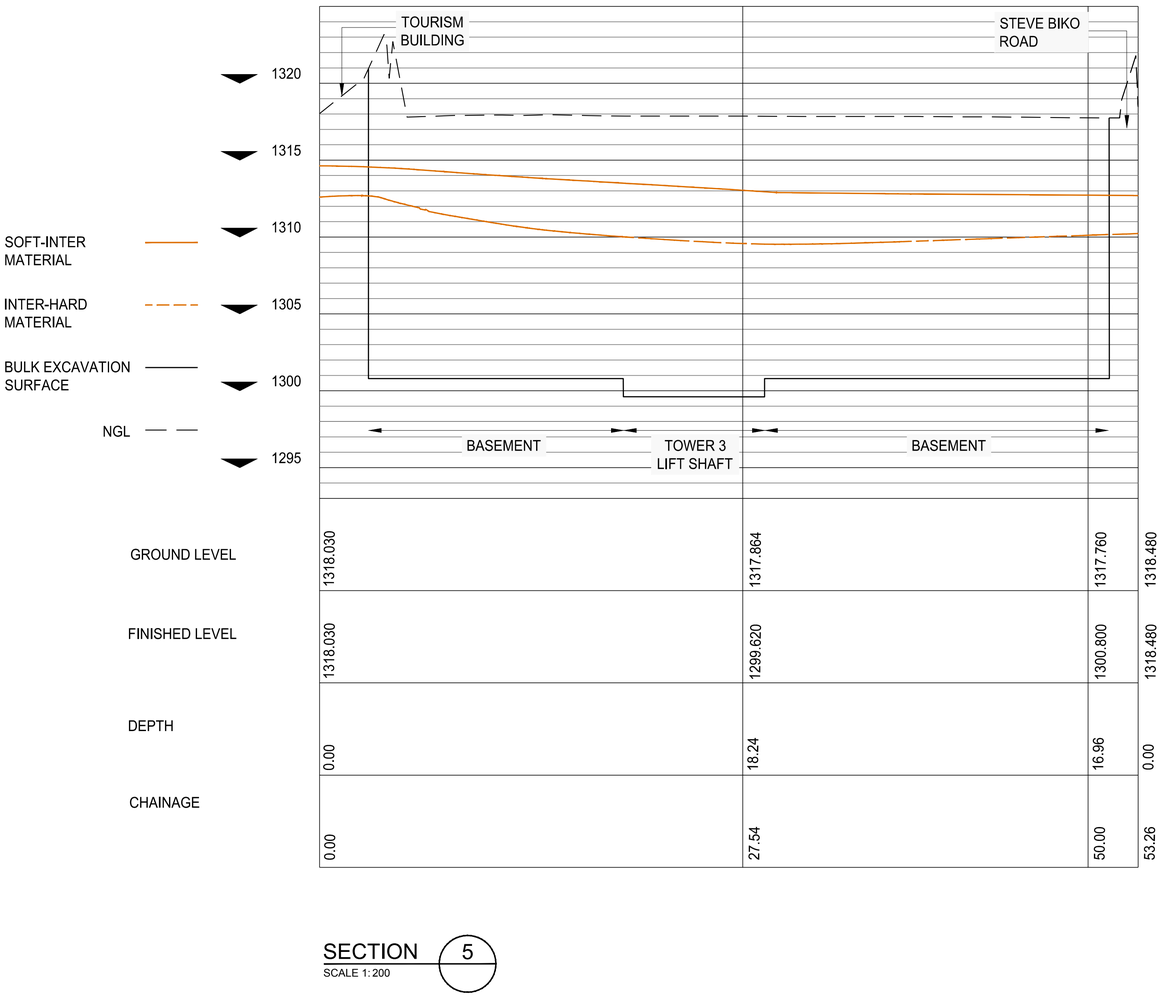
SUNNYSIDE OFFICE DEVELOPMENT

TITLE

BULK EARTHWORKS - SECTION 4
SHEET 10 OF 11

PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073-08-81-C-519		A

M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-501-510-522-RA-Earthworks layout and Sections.dwg
Jul 10, 2019 - 10:37am



SECTION 5
SCALE 1: 200

0 8 16 24m
1:200

NOTES:

GENERAL

1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF CITY OF TSHWANE, STANDARD SPECIFICATIONS FOR CIVIL ENGINEERING WORKS.

2. THE CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.

3. A SITE INSPECTION IS TO BE ARRANGED WITH THE RELEVANT SERVICE PROVIDERS, POINTING OUT THE EXTENT OF THE WORKS, TO ENSURE THAT ALL SERVICES ARE ACCOUNTED FOR PRIOR TO THE COMMENCEMENT OF PROPOSED CONSTRUCTION.

   CONTRACTOR TO LIAISE WITH THE CITY OF TSHWANE MUNICIPALITY W.R.T. THE REINSTATEMENT OF ROAD SURFACING AND SIDEWALKS.

4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRAWINGS:
   4.1. 1600073-08-81-C-003-SETTING OUT LAYOUT
   4.2. 1600073-08-81-C-500-EXISTING SERVICES LAYOUT
   4.3. 1600073-08-81-C-501-EARTHWORKS LAYOUT

EARTHWORKS

1. REMOVE ALL VEGETATION & ROOTS.

2. REMOVE TOPSOIL TO AN APPROXIMATE DEPTH OF 150mm.

3. REMOVE UNSUITABLE SUBGRADE MATERIAL AS ORDERED BY THE ENGINEER, ALL IN ACCORDANCE WITH SABS 1200 C.

4. COMPACT IN-SITU MATERIAL TO 93% MOD AASHTO DENSITY.

5. G7 MATERIAL FOR FILL TO BE IMPORTED OR SOURCED FROM ON SITE OPERATIONS AND COMPACTED TO 93% MOD AASHTO DENSITY IN MAX. 150mm LAYERS.

6. DENSITY TESTS TO BE UNDERTAKEN BY THE CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO PLACING OF CONSECUTIVE LAYERS.

7. THE TRANSITIONS BETWEEN SOFT, INTERMEDIATE AND HARD MATERIALS SHOWN ARE ONLY INDICATIVE.

FOR TENDER

WGS 84/ LO 29

No.	DESCRIPTION / REVISIONS	DATE
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
A	ISSUED FOR TENDER PURPOSES	2019-07-04

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME: R:\.....			
DATE DATUM	2019-06-26	**CLIENT**	
SCALE SKAAL	1:200		
DESIGNED BY ONTWERP DEUR	ZG	**FOR ILISO CONSULTING**	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	ZG	**PROJECT ENGINEER**	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	**CONTENT AND ACCURACY**	**DESIGN COMPLIANCE**	**PROJECT COMPLIANCE**

PROJECT

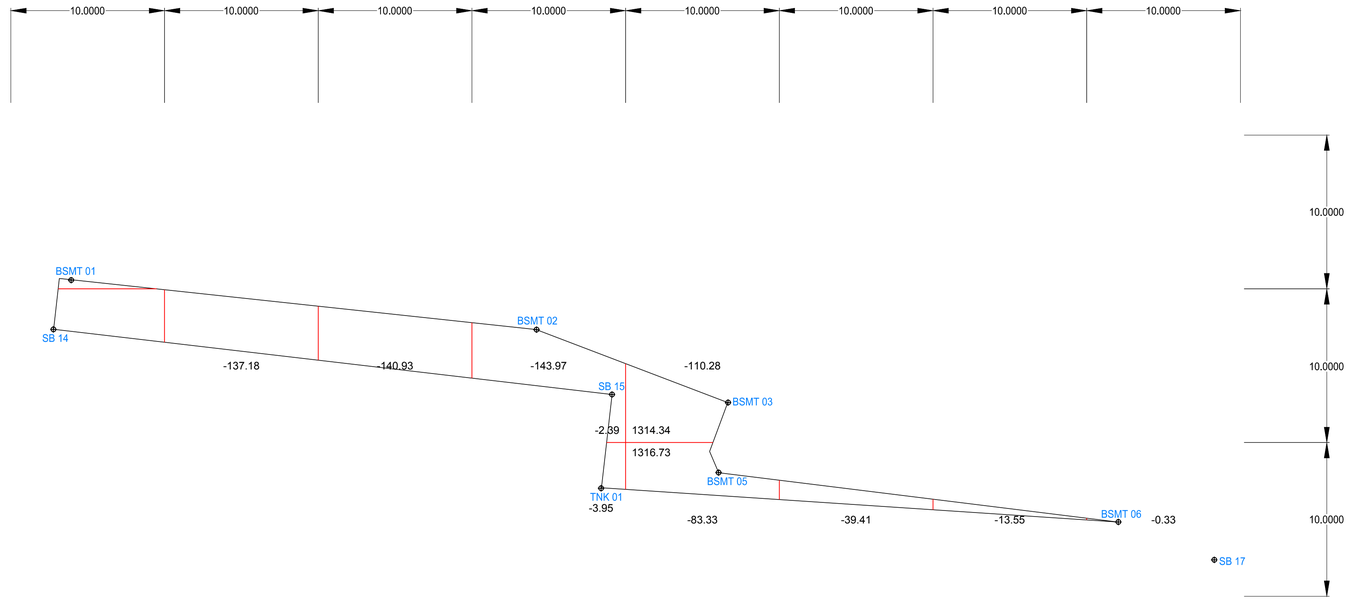
SUNNYSIDE OFFICE DEVELOPMENT

TITLE

BULK EARTHWORKS - SECTION 5
SHEET 11 OF 11

PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073-08-81-C-520		A

M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-501-510-522-RA-Earthworks layout and Sections.dwg
Jul 10, 2019 - 10:38am



0.0	0.1
0.0	532.4
0.0	140.6
Fill	Cut

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fill								
672.9	0.0	137.2	140.9	147.9	193.6	39.4	13.5	0.3
Cut								

DEPTH OF EXCAVATION AT GRID INTERSECTION POINT

CUT OR FILL VOLUME BETWEEN GRID AND/OR SITE BOUNDARY

BOTTOM OF EXCAVATION LEVEL AT GRID INTERSECTION POINT

NATURAL GROUND LEVEL AT GRID INTERSECTION POINT

0 20 40 60m

1:500

NOTES:

GENERAL

1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF CITY OF TSHWANE, STANDARD SPECIFICATIONS FOR CIVIL ENGINEERING WORKS.

2. THE CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.

3. A SITE INSPECTION IS TO BE ARRANGED WITH THE RELEVANT SERVICE PROVIDERS, POINTING OUT THE EXTENT OF THE WORKS, TO ENSURE THAT ALL SERVICES ARE ACCOUNTED FOR PRIOR TO THE COMMENCEMENT OF PROPOSED CONSTRUCTION.

   CONTRACTOR TO LIAISE WITH THE CITY OF TSHWANE MUNICIPALITY W.R.T. THE REINSTATEMENT OF ROAD SURFACING AND SIDEWALKS.

4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRAWINGS:
   4.1. 1600073-08-81-C-003-SETTING OUT LAYOUT
   4.2. 1600073-08-81-C-500-EXISTING SERVICES LAYOUT
   4.3. 1600073-08-81-C-501-EARTHWORKS LAYOUT
   4.4. 1600073-08-81-C-504-EARTHWORKS CROSS SECTIONS

EARTHWORKS

1. REMOVE ALL VEGETATION & ROOTS.

2. REMOVE TOPSOIL TO AN APPROXIMATE DEPTH OF 150mm.

3. REMOVE UNSUITABLE SUBGRADE MATERIAL AS ORDERED BY THE ENGINEER, ALL IN ACCORDANCE WITH SABS 1200 C.

4. COMPACT IN-SITU MATERIAL TO 93% MOD AASHTO DENSITY.

5. G7 MATERIAL FOR FILL TO BE IMPORTED OR SOURCED FROM ON SITE OPERATIONS AND COMPACTED TO 93% MOD AASHTO DENSITY IN MAX. 150mm LAYERS.

6. DENSITY TESTS TO BE UNDERTAKEN BY THE CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO PLACING OF CONSECUTIVE LAYERS.

FOR TENDER

WGS 84/ LO 29

No.	DESCRIPTION / REVISIONS	DATE
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
A	ISSUED FOR TENDER PURPOSES	2019-07-05

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME:
R:\.....

DATE DATUM	2019-06-26	**CLIENT**	
SCALE SKAAL	1:100		
DESIGNED BY ONTWERP DEUR	ZG	**FOR ILISO CONSULTING**	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	ZG	**PROJECT ENGINEER**	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	**CONTENT AND ACCURACY**	**DESIGN COMPLIANCE**	**PROJECT COMPLIANCE**

PROJECT

SUNNYSIDE OFFICE DEVELOPMENT

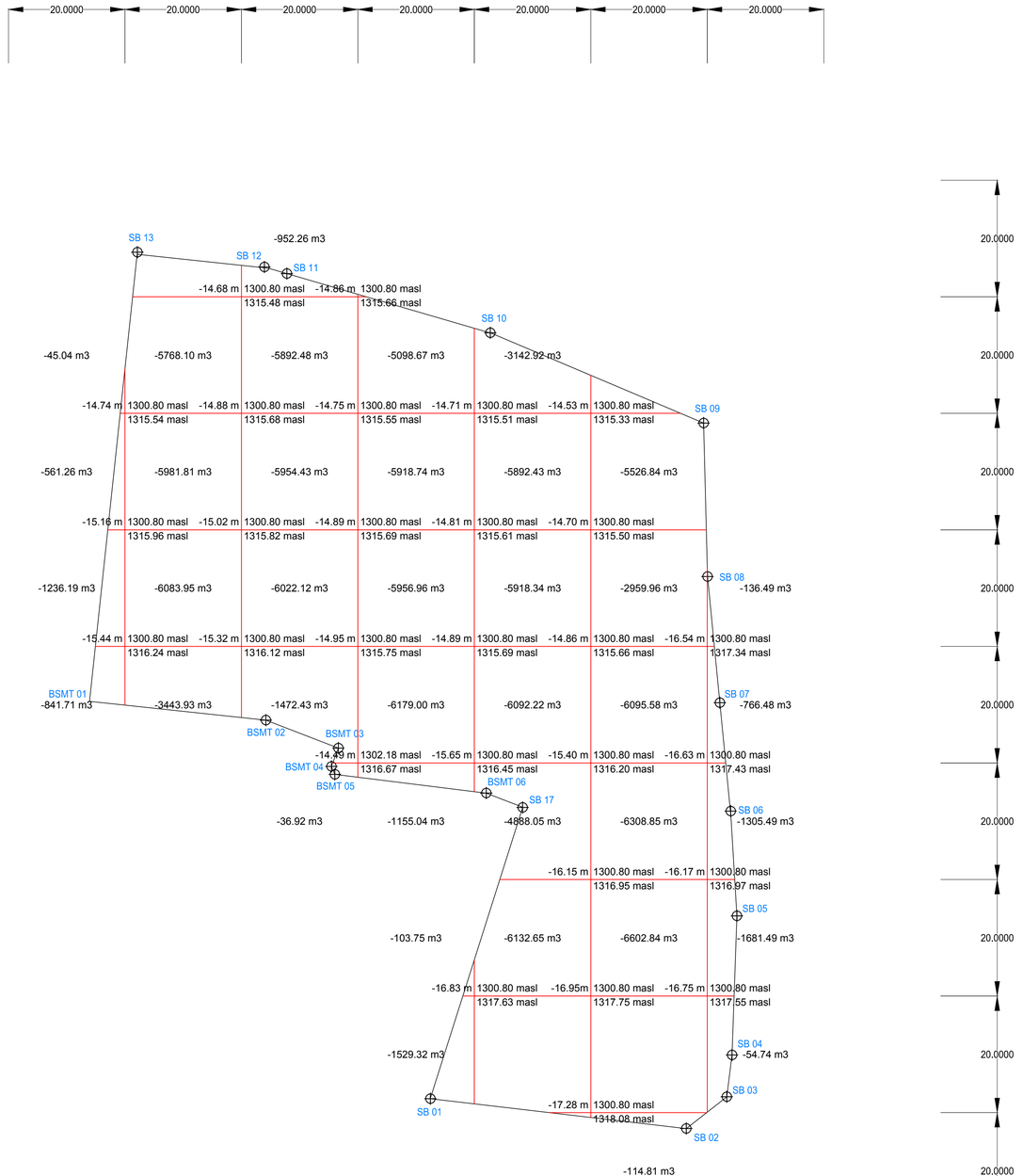
TITLE

EARTHWORKS CONSTRUCTION PLAN - CAVITY

PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073-08-81-C-506		A

M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-503-505-RA-Localised Earthworks Construction Plan.dwg
Jul 10, 2019 - 11:18am

0.0	952.3
0.0	19947.2
0.0	29835.5
0.0	28314.0
0.0	24891.3
0.0	13694.4
0.0	14520.7
0.0	1584.1
0.0	114.8
Fill	Cut



0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fill							
133854.3	2684.2	21277.8	20330.7	25941.5	32066.6	27608.9	3944.7
Cut							

LEGEND

CUT OR FILL VOLUME BETWEEN GRID AND/OR SITE BOUNDARY

DEPTH OF EXCAVATION AT GRID INTERSECTION POINT | BOTTOM OF EXCAVATION LEVEL AT GRID INTERSECTION POINT

NATURAL GROUND LEVEL AT GRID INTERSECTION POINT

0 20 40 60m

1:500

NOTES:

GENERAL

1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF CITY OF TSHWANE, STANDARD SPECIFICATIONS FOR CIVIL ENGINEERING WORKS.
2. THE CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.
3. A SITE INSPECTION IS TO BE ARRANGED WITH THE RELEVANT SERVICE PROVIDERS, POINTING OUT THE EXTENT OF THE WORKS, TO ENSURE THAT ALL SERVICES ARE ACCOUNTED FOR PRIOR TO THE COMMENCEMENT OF PROPOSED CONSTRUCTION.

   CONTRACTOR TO LIAISE WITH THE CITY OF TSHWANE MUNICIPALITY W.R.T. THE REINSTATEMENT OF ROAD SURFACING AND SIDEWALKS.
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRAWINGS:
   4.1. 1600073-08-81-C-003-SETTING OUT LAYOUT
   4.2. 1600073-08-81-C-500-EXISTING SERVICES LAYOUT
   4.3. 1600073-08-81-C-501-EARTHWORKS LAYOUT
   4.4. 1600073-08-81-C-510-520-EARTHWORKS CROSS SECTIONS

EARTHWORKS

1. REMOVE ALL VEGETATION & ROOTS.
2. REMOVE TOPSOIL TO AN APPROXIMATE DEPTH OF 150mm.
3. REMOVE UNSUITABLE SUBGRADE MATERIAL AS ORDERED BY THE ENGINEER, ALL IN ACCORDANCE WITH SABS 1200 C.
4. COMPACT IN-SITU MATERIAL TO 93% MOD AASHTO DENSITY.
5. G7 MATERIAL FOR FILL TO BE IMPORTED OR SOURCED FROM ON SITE OPERATIONS AND COMPACTED TO 93% MOD AASHTO DENSITY IN MAX. 150mm LAYERS.
6. DENSITY TESTS TO BE UNDERTAKEN BY THE CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO PLACING OF CONSECUTIVE LAYERS.
7. EARTHWORKS SHOWN HEREIN EXCLUDE LOCALIZED EARTHWORKS FOR STORMWATER TANK AND LIFT SHAFTS.

FOR TENDER

WGS 84/ LO 29

No.	DESCRIPTION / REVISIONS	DATE
A	ISSUED FOR TENDER PURPOSES	2019-07-04

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886
www.nakogroup.com

COMPUTER FILE NAME: R:\.....			
DATE DATUM	2019-06-26	CLIENT	
SCALE SKAAL	1:500		
DESIGNED BY ONTWERP DEUR	ZG	FOR ILISO CONSULTING	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	ZG	PROJECT ENGINEER	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	CONTENT AND ACCURACY	DESIGN COMPLIANCE	PROJECT COMPLIANCE

PROJECT

SUNNYSIDE OFFICE DEVELOPMENT

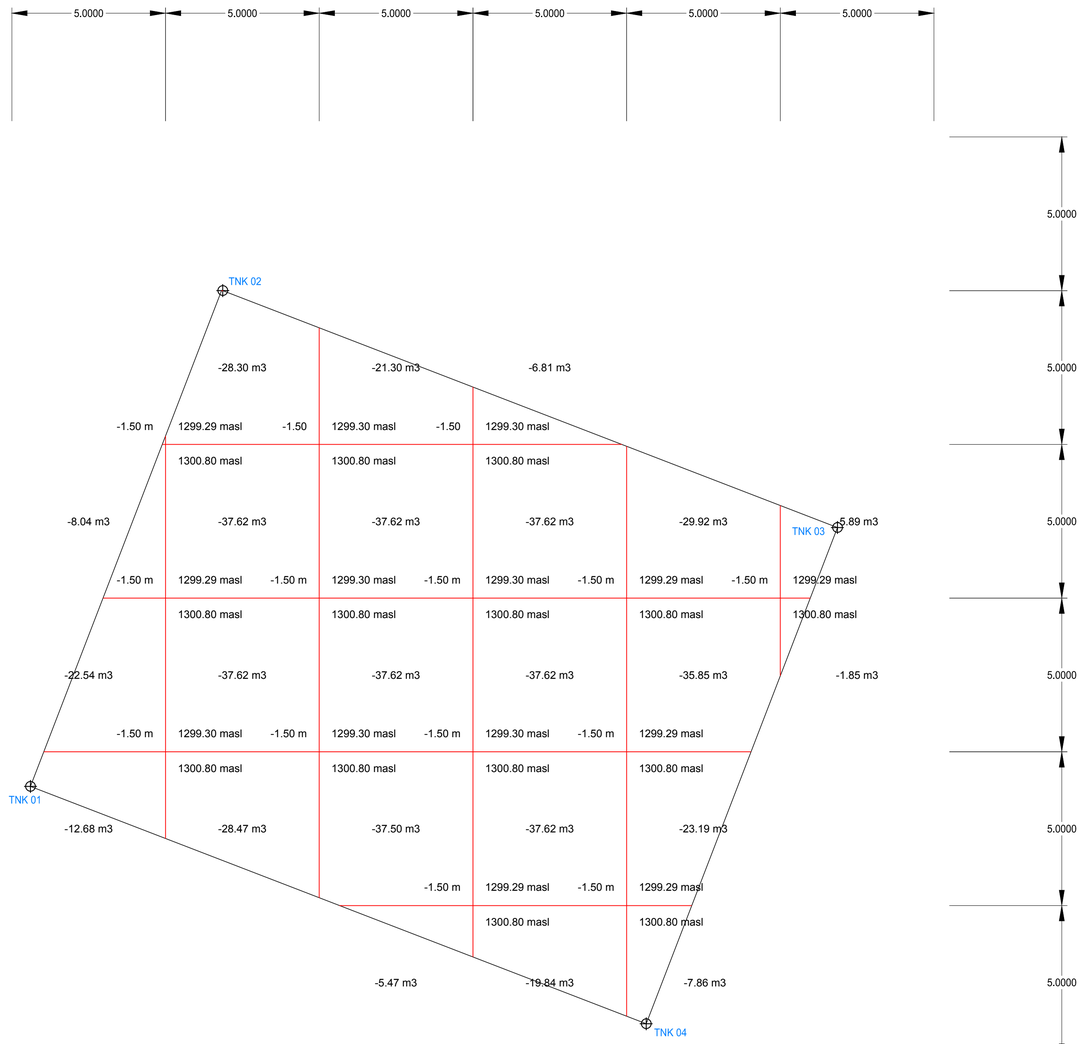
TITLE

BULK EARTHWORKS CONSTRUCTION PLAN

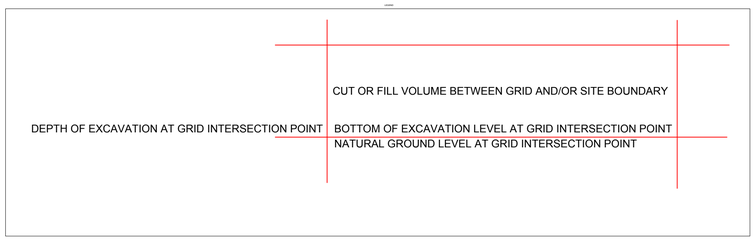
PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073-08-81-C-502		A

M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-502-RA-Bulk Earthworks Construction Plan.dwg
Jul 10, 2019 - 11:21am

0.0	0.0
0.0	56.4
0.0	156.7
0.0	173.1
0.0	139.5
0.0	33.2
Fill	Cut



NOTE LEVELS AND QUANTITIES SHOWN ARE DETERMINED FROM THE BOTTOM OF BULK EXCAVATIONS, NOT FROM NGL. REFER TO 1600073-08-81-C-502.



0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fill						
558.9	43.3	132.0	139.5	139.5	96.8	7.7
Cut						

0 4 8 12m

1:100

NOTES:

GENERAL

1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF CITY OF TSHWANE, STANDARD SPECIFICATIONS FOR CIVIL ENGINEERING WORKS.
2. THE CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.
3. A SITE INSPECTION IS TO BE ARRANGED WITH THE RELEVANT SERVICE PROVIDERS, POINTING OUT THE EXTENT OF THE WORKS, TO ENSURE THAT ALL SERVICES ARE ACCOUNTED FOR PRIOR TO THE COMMENCEMENT OF PROPOSED CONSTRUCTION.

   CONTRACTOR TO LIAISE WITH THE CITY OF TSHWANE MUNICIPALITY W.R.T. THE REINSTATEMENT OF ROAD SURFACING AND SIDEWALKS.
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRAWINGS:
   - 4.1. 1600073-08-81-C-003-SETTING OUT LAYOUT
   - 4.2. 1600073-08-81-C-500-EXISTING SERVICES LAYOUT
   - 4.3. 1600073-08-81-C-501-EARTHWORKS LAYOUT
   - 4.4. 1600073-08-81-C-504-EARTHWORKS CROSS SECTIONS

EARTHWORKS

1. REMOVE ALL VEGETATION & ROOTS.
2. REMOVE TOPSOIL TO AN APPROXIMATE DEPTH OF 150mm.
3. REMOVE UNSUITABLE SUBGRADE MATERIAL AS ORDERED BY THE ENGINEER, ALL IN ACCORDANCE WITH SABS 1200 C.
4. COMPACT IN-SITU MATERIAL TO 93% MOD AASHTO DENSITY.
5. G7 MATERIAL FOR FILL TO BE IMPORTED OR SOURCED FROM ON SITE OPERATIONS AND COMPACTED TO 93% MOD AASHTO DENSITY IN MAX. 150mm LAYERS.
6. DENSITY TESTS TO BE UNDERTAKEN BY THE CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO PLACING OF CONSECUTIVE LAYERS.

FOR TENDER

WGS 84/ LO 29

No.	DESCRIPTION / REVISIONS	DATE
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
A	ISSUED FOR TENDER PURPOSES	2019-07-04

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME:
R:\.....

DATE DATUM	2019-06-26	**CLIENT**	
SCALE SKAAL	1:100		
DESIGNED BY ONTWERP DEUR	ZG	**FOR ILISO CONSULTING**	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	ZG	**PROJECT ENGINEER**	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	**CONTENT AND ACCURACY**	**DESIGN COMPLIANCE**	**PROJECT COMPLIANCE**

PROJECT

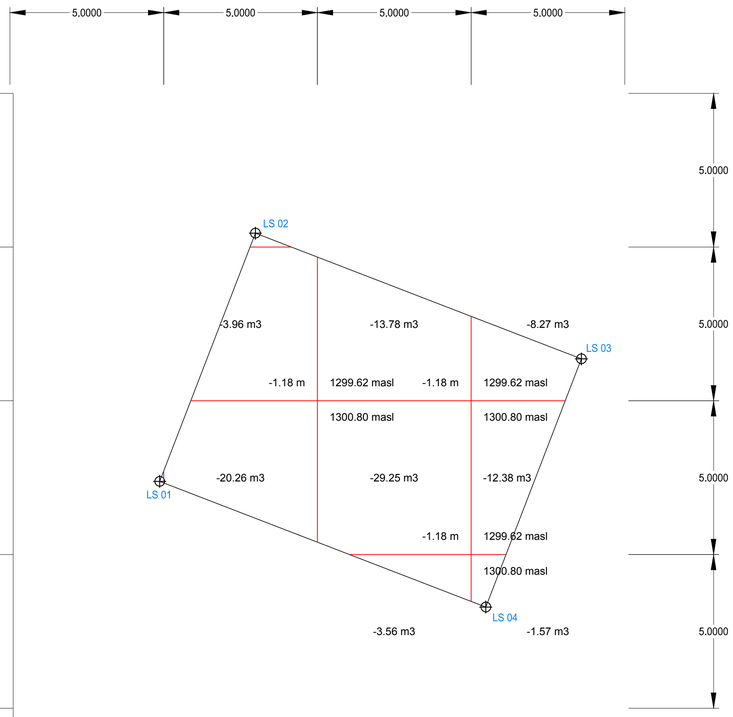
SUNNYSIDE OFFICE DEVELOPMENT

TITLE

LOCALIZED EARTHWORKS CONSTRUCTION PLAN - STORMWATER TANK

PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073-08-81-C-503		A

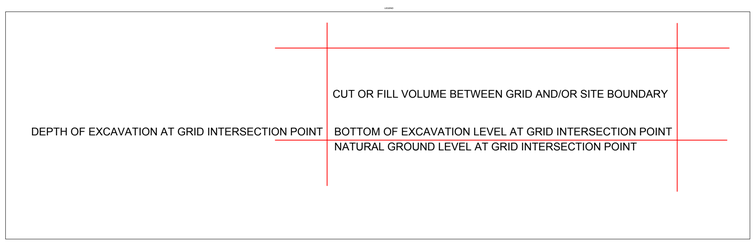
M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-503-505-RA-Localised Earthworks Construction Plan.dwg
Jul 10, 2019 - 11:12am



0.0	0.0
0.0	26.0
0.0	61.9
0.0	5.1
Fill	Cut

0.0	0.0	0.0	0.0	0.0
Fill				
93.0	0.0	24.2	46.6	22.2
Cut				

NOTE LEVELS AND QUANTITIES SHOWN ARE DETERMINED FROM THE BOTTOM OF BULK EXCAVATIONS, NOT FROM NGL. REFER TO 1600073-08-81-C-502.



NOTES:

GENERAL

1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF CITY OF TSHWANE, STANDARD SPECIFICATIONS FOR CIVIL ENGINEERING WORKS.
2. THE CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.
3. A SITE INSPECTION IS TO BE ARRANGED WITH THE RELEVANT SERVICE PROVIDERS, POINTING OUT THE EXTENT OF THE WORKS, TO ENSURE THAT ALL SERVICES ARE ACCOUNTED FOR PRIOR TO THE COMMENCEMENT OF PROPOSED CONSTRUCTION.

   CONTRACTOR TO LIAISE WITH THE CITY OF TSHWANE MUNICIPALITY W.R.T. THE REINSTATEMENT OF ROAD SURFACING AND SIDEWALKS.
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRAWINGS:
   - 4.1. 1600073-08-81-C-003-SETTING OUT LAYOUT
   - 4.2. 1600073-08-81-C-500-EXISTING SERVICES LAYOUT
   - 4.3. 1600073-08-81-C-501-EARTHWORKS LAYOUT
   - 4.4. 1600073-08-81-C-504-EARTHWORKS CROSS SECTIONS

EARTHWORKS

1. REMOVE ALL VEGETATION & ROOTS.
2. REMOVE TOPSOIL TO AN APPROXIMATE DEPTH OF 150mm.
3. REMOVE UNSUITABLE SUBGRADE MATERIAL AS ORDERED BY THE ENGINEER, ALL IN ACCORDANCE WITH SABS 1200 C.
4. COMPACT IN-SITU MATERIAL TO 93% MOD AASHTO DENSITY.
5. G7 MATERIAL FOR FILL TO BE IMPORTED OR SOURCED FROM ON SITE OPERATIONS AND COMPACTED TO 93% MOD AASHTO DENSITY IN MAX. 150mm LAYERS.
6. DENSITY TESTS TO BE UNDERTAKEN BY THE CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO PLACING OF CONSECUTIVE LAYERS.

FOR TENDER

WGS 84/ LO 29

No.	DESCRIPTION / REVISIONS	DATE
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
A	ISSUED FOR TENDER PURPOSES	2019-07-04

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME: R:\.....			
DATE DATUM	2019-06-26	**CLIENT**	
SCALE SKAAL	1:100		
DESIGNED BY ONTWERP DEUR	ZG	**FOR ILISO CONSULTING**	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	ZG	**PROJECT ENGINEER**	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	**CONTENT AND ACCURACY**	**DESIGN COMPLIANCE**	**PROJECT COMPLIANCE**

PROJECT

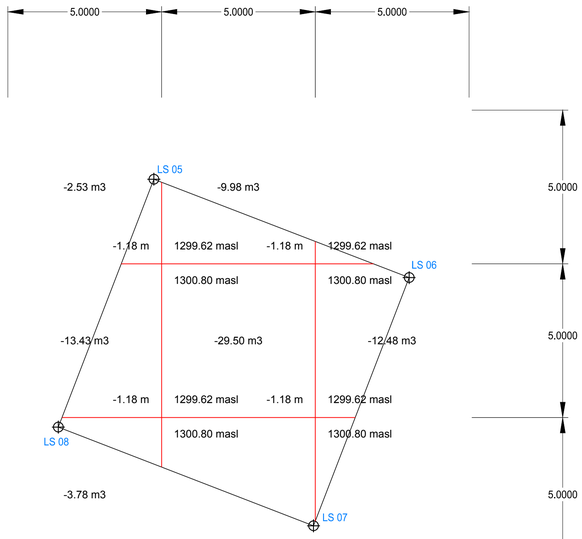
SUNNYSIDE OFFICE DEVELOPMENT

TITLE

LOCALIZED EARTHWORKS CONSTRUCTION PLAN - TOWER 1 & 2 LIFT SHAFTS

PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073-08-81-C-504		A

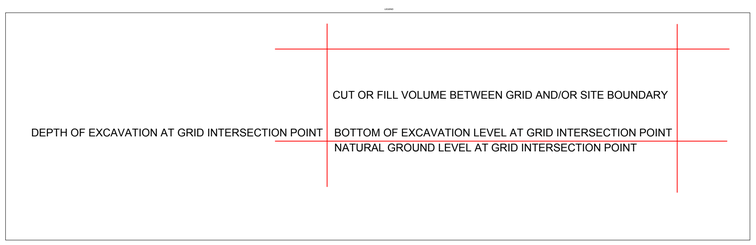
M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-503-505-RA-Localised Earthworks Construction Plan.dwg
Jul 10, 2019 - 11:14am



0.0	12.5
0.0	55.4
0.0	3.8
Fill	Cut

0.0	0.0	0.0	0.0
Fill			
71.7	19.7	39.5	12.5
Cut			

NOTE LEVELS AND QUANTITIES SHOWN ARE DETERMINED FROM THE BOTTOM OF BULK EXCAVATIONS, NOT FROM NGL. REFER TO 1600073-08-81-C-502.



NOTES:

GENERAL

1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF CITY OF TSHWANE, STANDARD SPECIFICATIONS FOR CIVIL ENGINEERING WORKS.

2. THE CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.

3. A SITE INSPECTION IS TO BE ARRANGED WITH THE RELEVANT SERVICE PROVIDERS, POINTING OUT THE EXTENT OF THE WORKS, TO ENSURE THAT ALL SERVICES ARE ACCOUNTED FOR PRIOR TO THE COMMENCEMENT OF PROPOSED CONSTRUCTION.

   CONTRACTOR TO LIAISE WITH THE CITY OF TSHWANE MUNICIPALITY W.R.T. THE REINSTATEMENT OF ROAD SURFACING AND SIDEWALKS.

4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRAWINGS:
   4.1. 1600073-08-81-C-003-SETTING OUT LAYOUT
   4.2. 1600073-08-81-C-500-EXISTING SERVICES LAYOUT
   4.3. 1600073-08-81-C-501-EARTHWORKS LAYOUT
   4.4. 1600073-08-81-C-504-EARTHWORKS CROSS SECTIONS

EARTHWORKS

1. REMOVE ALL VEGETATION & ROOTS.

2. REMOVE TOPSOIL TO AN APPROXIMATE DEPTH OF 150mm.

3. REMOVE UNSUITABLE SUBGRADE MATERIAL AS ORDERED BY THE ENGINEER, ALL IN ACCORDANCE WITH SABS 1200 C.

4. COMPACT IN-SITU MATERIAL TO 93% MOD AASHTO DENSITY.

5. G7 MATERIAL FOR FILL TO BE IMPORTED OR SOURCED FROM ON SITE OPERATIONS AND COMPACTED TO 93% MOD AASHTO DENSITY IN MAX. 150mm LAYERS.

6. DENSITY TESTS TO BE UNDERTAKEN BY THE CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO PLACING OF CONSECUTIVE LAYERS.

FOR TENDER

WGS 84/ LO 29

No.	DESCRIPTION / REVISIONS	DATE
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
A	ISSUED FOR TENDER PURPOSES	2019-07-04

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME: R:\....			
DATE DATUM	2019-06-26	**CLIENT**	
SCALE SKAAL	1:100		
DESIGNED BY ONTWERP DEUR	ZG	**FOR ILISO CONSULTING**	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	ZG	**PROJECT ENGINEER**	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	**CONTENT AND ACCURACY**	**DESIGN COMPLIANCE**	**PROJECT COMPLIANCE**

PROJECT

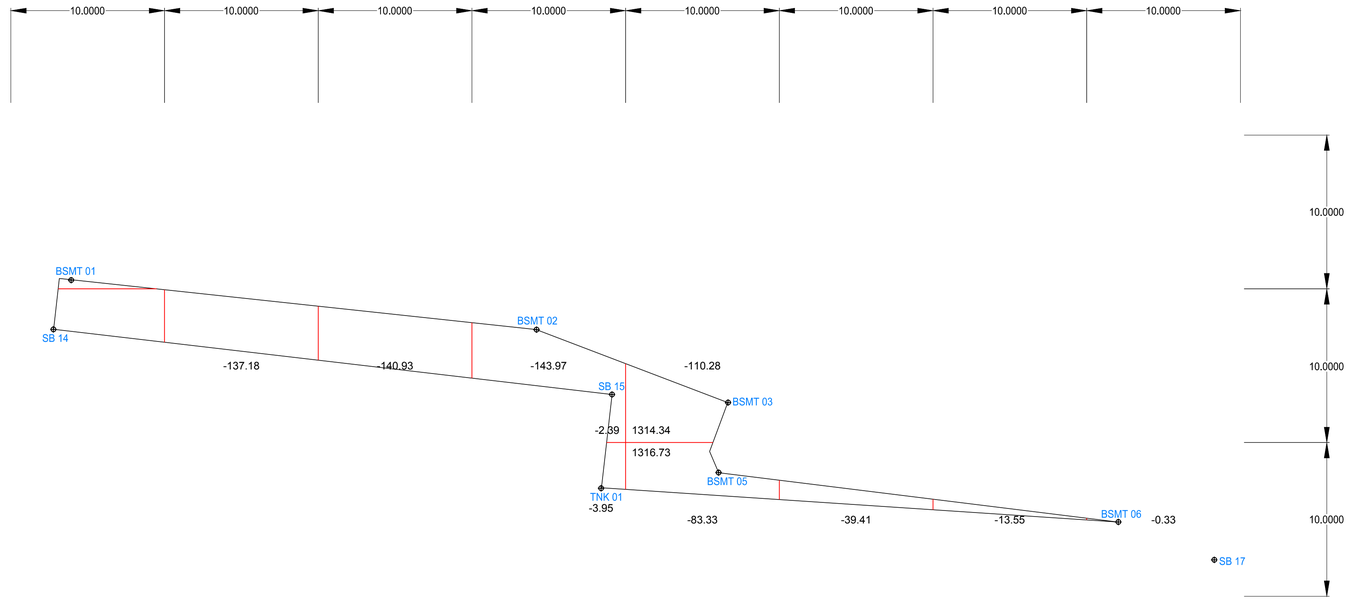
SUNNYSIDE OFFICE DEVELOPMENT

TITLE

LOCALIZED EARTHWORKS CONSTRUCTION PLAN - TOWER 3 LIFT SHAFT

PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073-08-81-C-505		A

M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-503-505-RA-Localised Earthworks Construction Plan.dwg
Jul 10, 2019 - 11:16am



0.0	0.1
0.0	532.4
0.0	140.6
Fill	Cut

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fill								
672.9	0.0	137.2	140.9	147.9	193.6	39.4	13.5	0.3
Cut								

DEPTH OF EXCAVATION AT GRID INTERSECTION POINT

CUT OR FILL VOLUME BETWEEN GRID AND/OR SITE BOUNDARY

BOTTOM OF EXCAVATION LEVEL AT GRID INTERSECTION POINT

NATURAL GROUND LEVEL AT GRID INTERSECTION POINT

0 20 40 60m

1:500

NOTES:

GENERAL

1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF CITY OF TSHWANE, STANDARD SPECIFICATIONS FOR CIVIL ENGINEERING WORKS.

2. THE CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.

3. A SITE INSPECTION IS TO BE ARRANGED WITH THE RELEVANT SERVICE PROVIDERS, POINTING OUT THE EXTENT OF THE WORKS, TO ENSURE THAT ALL SERVICES ARE ACCOUNTED FOR PRIOR TO THE COMMENCEMENT OF PROPOSED CONSTRUCTION.

   CONTRACTOR TO LIAISE WITH THE CITY OF TSHWANE MUNICIPALITY W.R.T. THE REINSTATEMENT OF ROAD SURFACING AND SIDEWALKS.

4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRAWINGS:
   4.1. 1600073-08-81-C-003-SETTING OUT LAYOUT
   4.2. 1600073-08-81-C-500-EXISTING SERVICES LAYOUT
   4.3. 1600073-08-81-C-501-EARTHWORKS LAYOUT
   4.4. 1600073-08-81-C-504-EARTHWORKS CROSS SECTIONS

EARTHWORKS

1. REMOVE ALL VEGETATION & ROOTS.

2. REMOVE TOPSOIL TO AN APPROXIMATE DEPTH OF 150mm.

3. REMOVE UNSUITABLE SUBGRADE MATERIAL AS ORDERED BY THE ENGINEER, ALL IN ACCORDANCE WITH SABS 1200 C.

4. COMPACT IN-SITU MATERIAL TO 93% MOD AASHTO DENSITY.

5. G7 MATERIAL FOR FILL TO BE IMPORTED OR SOURCED FROM ON SITE OPERATIONS AND COMPACTED TO 93% MOD AASHTO DENSITY IN MAX. 150mm LAYERS.

6. DENSITY TESTS TO BE UNDERTAKEN BY THE CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO PLACING OF CONSECUTIVE LAYERS.

FOR TENDER

WGS 84/ LO 29

No.	DESCRIPTION / REVISIONS	DATE
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
A	ISSUED FOR TENDER PURPOSES	2019-07-05

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME:
R:\.....

DATE DATUM	2019-06-26	**CLIENT**	
SCALE SKAAL	1:100		
DESIGNED BY ONTWERP DEUR	ZG	**FOR ILISO CONSULTING**	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	ZG	**PROJECT ENGINEER**	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	**CONTENT AND ACCURACY**	**DESIGN COMPLIANCE**	**PROJECT COMPLIANCE**

PROJECT

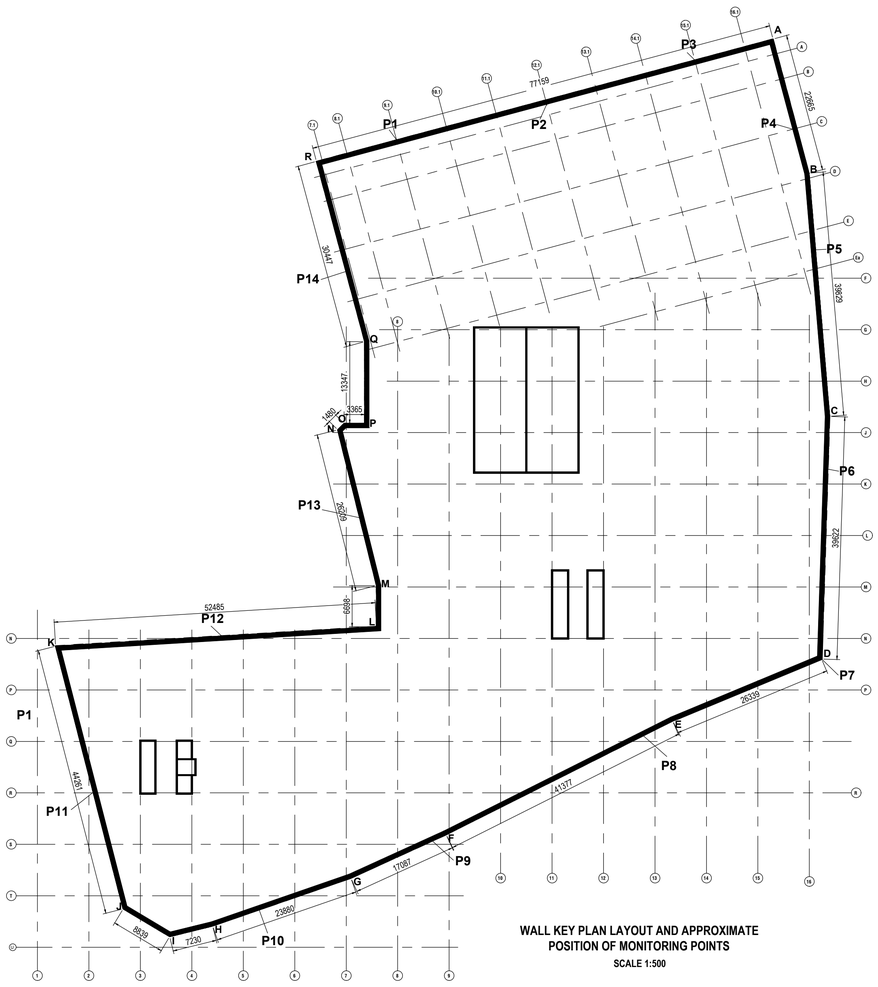
SUNNYSIDE OFFICE DEVELOPMENT

TITLE

EARTHWORKS CONSTRUCTION PLAN - CAVITY

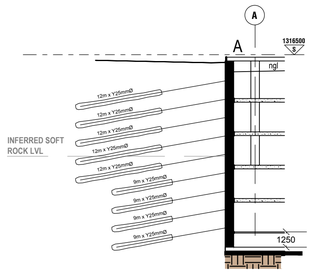
PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073-08-81-C-506		A

M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-503-505-RA-Localised Earthworks Construction Plan.dwg
Jul 10, 2019 - 11:18am



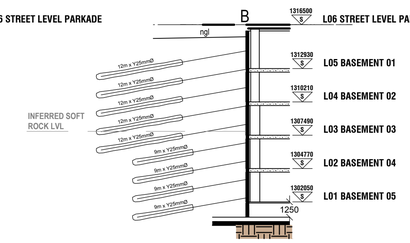
WALL KEY PLAN LAYOUT AND APPROXIMATE POSITION OF MONITORING POINTS

SCALE 1:500



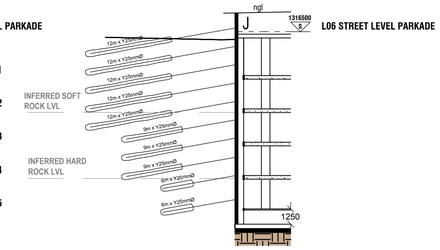
WALL SECTION AT A

SCALE 1:250



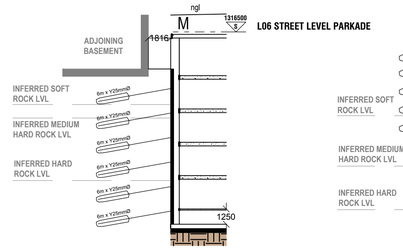
WALL SECTION AT B

SCALE 1:250



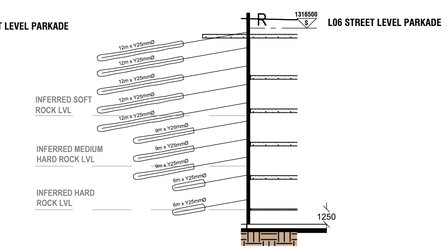
WALL SECTION AT J

SCALE 1:250



WALL SECTION AT M

SCALE 1:250

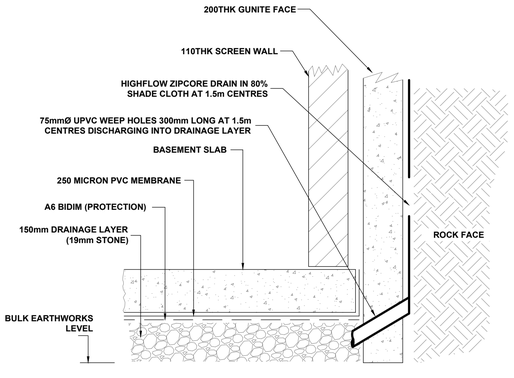


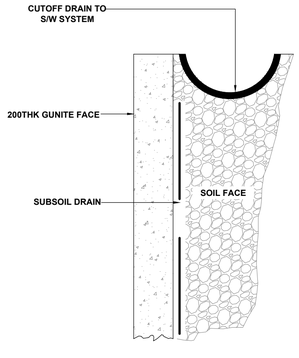
WALL SECTION AT R

SCALE 1:250

DETAIL OF SUBSOIL AT BASEMENT LEVEL

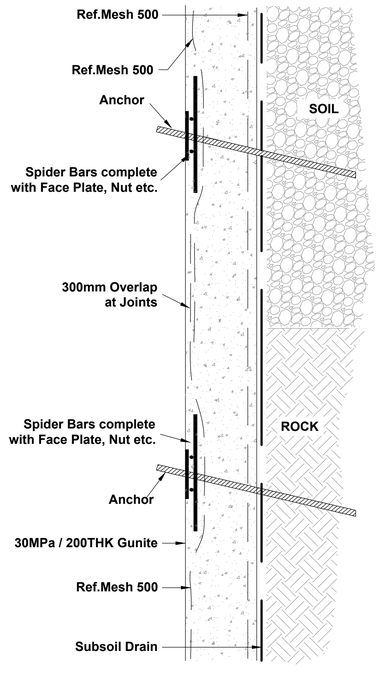
NOT TO SCALE





DETAIL AT TOP OF SHOTCRETE WALL

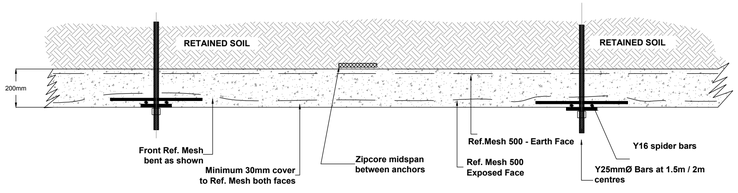
NOT TO SCALE



GUNITE DETAIL AT SOIL / ROCK INTERFACE

TYPICAL SHOTCRETE METHODOLGY

1. ONCE EXCAVATED FACE HAS BEEN PREPARED, ANCHORS ARE TO BE DRILLED AND INSTALLED.
2. ANCHOR COLLAR TO BE KEPT CLEAR AND FREE OF ANY OBSTRUCTIONS OR DIRT.
3. PLACE AND SECURE 1ST LAYER OF REF. MESH WITH ADDITIONAL REINFORCING (IF NECESSARY) TEMPORARILY.
4. PLACE AND FIX SUBSOIL DRAIN BEHIND REF. MESH. EXTEND WHERE NECESSARY.
5. 1ST APPLICATION OF SHOTCRETE INCLUDING 30mm COVER TO UNDERSIDE OF REF. MESH. CONTRACTOR TO ALLOW UP TO 50mm OF ADDITIONAL DENTAL WORK TO UNDERSIDE OF REF. MESH.
6. REPEAT SHOTCRETE APPLICATION UNTIL 125mm THICKNESS IS ACHIEVED.
7. PLACE 2ND LAYER OF REF. MESH WITH ADDITIONAL REINFORCING (IF NECESSARY) INCLUDING SPIDER BARS, FACE PLATES AND NUT. TIGHTEN NUT BEND REF MESH TO ACHIEVE 30mm COVER TO FRONT FACE. USE SPACES TO ACHIEVE CORRECT COVER.
8. LOAD TEST ANCHORS TO 100% OF WORKING LOAD AND LOCK OFF LOAD AT 50% OF WORKING LOAD.
9. TEMPORARY ANCHORS CAN BE LEFT IN PLACE OR CUT AND REMOVED ONCE PROPPING BY FLOOR SLABS HAS BEEN FINALISED.
10. HIGH YIELD TEMPORARY ANCHOR REINFORCING BARS MUST BE COMPLETE WITH THREADED ENDS CAPABLE OF ACCOMMODATING WASHERS, FACE PLATES AND NUT.

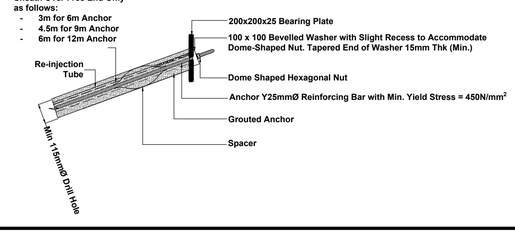


SHOTCRETE DETAIL FOR SOIL / ROCK FACE

NOT TO SCALE

ANCHOR DETAIL

NOT TO SCALE



FOR TENDER

No.	DESCRIPTION / REVISIONS	DATE	
A	ISSUED FOR TENDER	2019/07/22	RM

NAKO ILISO

THE ESTUARIES
11 Ox::ow Crescent P.O. Box
305, Centur:: Cit:;, 7446 E-mail : iliso@ :: iliso.com
Tel: +27 (0)21 525 1800 / Fax: +27 (0)86 000 356

www.nakogroup.com

COMPUTER FILE NAME: R:\...			
DATE DATUM	2019/07/17	CLIENT	
SCALE SKAAL	AS SHOWN		
DESIGNED BY ONTWERP DEUR	MP	FOR ILISO CONSULTING	
CHECKED BY NAGESIEN DEUR	CK		
DRAWN BY GETEKEN DEUR	MP	PROJECT ENGINEER	
CHECKED BY NAGESIEN DEUR	RM		
QUALITY CHECKS	CONTENT AND ACCURACY	DESIGN COMPLIANCE	PROJECT COMPLIANCE

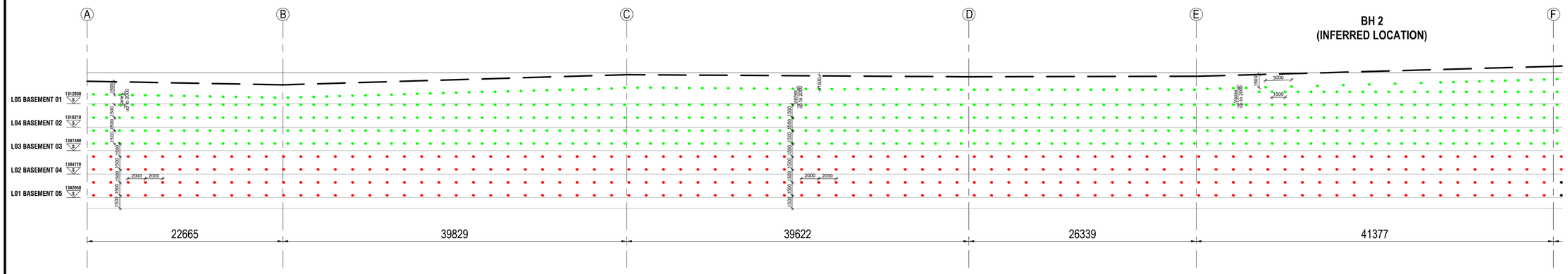
PROJECT

SUNNYSIDE OFFICE DEVELOPMENT

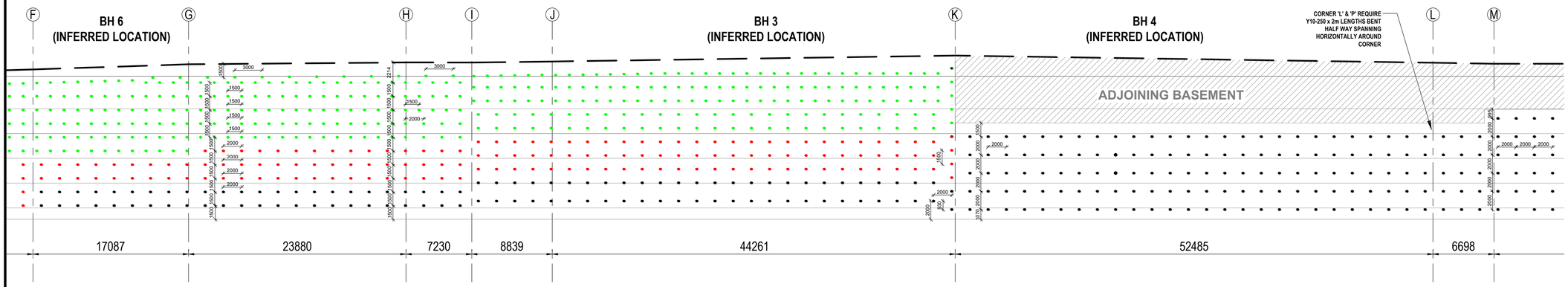
TITLE

LATERAL SUPPORT LAYOUT, SECTIONS AND DETAILS

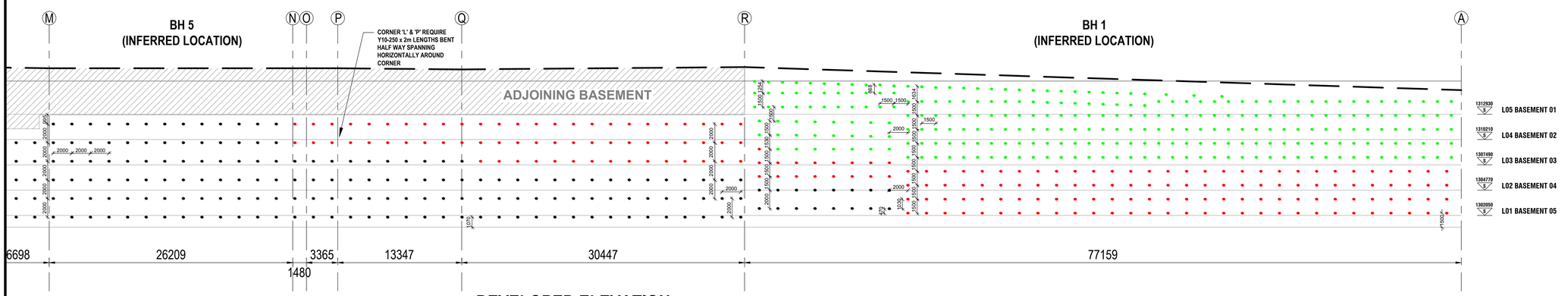
PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073	LS-T-01	A



DEVELOPED ELEVATION
SCALE 1:250



DEVELOPED ELEVATION
SCALE 1:250



DEVELOPED ELEVATION
SCALE 1:250

ANCHORS

- Y25mmØ Reinforcing Bar x 12m x No. 1174
- Y25mmØ Reinforcing Bar x 9m x No. 694
- Y25mmØ Reinforcing Bar x 6m x No. 416

FOR TENDER

No.	DESCRIPTION / REVISIONS	DATE	
A	ISSUED FOR TENDER	2019/07/22	RM

NAKO ILISO

THE ESTUARIES
11 Ox::ow Crescent P.O. Box
305, Centur::.Cit:.; 7446 E-mail : iliscpt:. iliso.com
Tel: +27 (0)21 525 1800 / Fax: +27 (0)86 000 356

www.nakogroup.com

COMPUTER FILE NAME: R:\.....			
DATE DATUM	2019/07/17	CLIENT	
SCALE SKAAL	AS SHOWN		
DESIGNED BY ONTWERP DEUR	MP	FOR ILISO CONSULTING	
CHECKED BY NAGESIEN DEUR	CK		
DRAWN BY GETEKEN DEUR	MP	PROJECT ENGINEER	
CHECKED BY NAGESIEN DEUR	RM		
QUALITY CHECKS	CONTENT AND ACCURACY	DESIGN COMPLIANCE	PROJECT COMPLIANCE

PROJECT

SUNNYSIDE OFFICE DEVELOPMENT

TITLE

LATERAL SUPPORT WALL ELEVATIONS

PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073	LS-T-02	A

EARTHWORKS

1. BLAST PLAN SUBMITTED BY CONTRACTOR TO CLIENT MUST BE REVIEWED BY INDEPENDANT 3RD PARTY BLASTING CONSULTANTS WHO WILL AUDIT, MONITOR AND REPORT THEREON AS WELL.
2. PEAK PARTICLE VELOCITY LIMITS:
   - 2.1. AT THE WALL EXCAVATION = 84mm/s
   - 2.2. AT BUILDINGS AND SERVICES = 50mm/s
   - 2.3. FOR SERVERS AND OTHER SENSITIVE EQUIPMENT = 12mm/s
3. SUFFICIENT SOFT MATERIAL WILL NEED TO STOCKPILED ON SITE OR IMPORTED TO SERVE AS 1.5m COVER MATERIAL FOR A 10m WIDE STRIP AROUND THE PERIMETER OF THE SITE FOR THE BLASTING OPERATION.
4. CONTRACTOR TO ENSURE NO FLY ROCK WHATSOEVER WHEN CARRYING OUT THE BLAST.
5. DUST SUPPRESSION SYSTEM TO BE FITTED TO DRILLING EQUIPMENT.
6. CORES FROM BOREHOLES BH1 TO BH6 ARE AVAILABLE FOR INSPECTION BY THE CONTRACTOR AT ILISO-NAKO OFFICES IN CENTURION.
7. CONTRACTOR TO MAKE ALLOWANCE FOR CONTROLLING AND MANAGING GROUNDWATER DURING CONSTRUCTION.
8. CONTRACTOR TO MANAGE AND DIVERT ALL SURFACE WATER RUNOFF SUCH THAT IT DOES NOT FLOW INTO THE OPEN EXCAVATION.
9. CONTRACTOR TO MAKE PROVISION AND TAKE THE NECESSARY PRECAUTIONS TO CONTROL DUST POLLUTION DURING BLASTING AND ALL DRILLING OPERATIONS AND SHOTCRETE.

LATERAL SUPPORT NOTES:

1. ALL WORK TO COMPLY STRICTLY WITH LATERAL SUPPORT CODE OF PRACTICE 1989 "LATERAL SUPPORT IN SURFACE EXCAVATION".
2. STAGES OF EXCAVATION TO COMPLY STRICTLY WITH INSTALLATION OF EACH ROW OF SOIL NAILS / ROCK BOLTS. I.E. MINIMUM DEPTH OF EACH STAGE OF EXCAVATION TO BE LIMITED TO 500mm BELOW ROW OF NAILS / BOLT TO BE INSTALLED.
3. UNDER NO CIRCUMSTANCES ARE EXCAVATIONS TO EXCEED 2m DEPTHS BEFORE SECURING THE FACE WITH SOIL NAILS / ROCK BOLTS.
4. CONTRACTOR TO ENSURE THAT BOTTOM ROW OF ANCHORS ARE NOT LESS THAN 1.5m FROM BASE OF EXCAVATION UNLESS SHOWN OTHERWISE ON DRAWINGS.
5. LATERAL SUPPORT COMPRISES SHOTCRETE FACE REINFORCED WITH STEEL MESH AND SECURED TO THE EXCAVATED FACE WITH SOIL ANCHORS / ROCK BOLTS.
6. ESTIMATED AREA OF LATERAL SUPPORT = 7 133m^2
7. HIGH YIELD BARS SUPPLIED IN 25mm DIAMETER WITH MINIMUM YIELD STRESS = 450N/mm^2. QUANTITIES AS SHOWN IN THE PROJECT DRAWINGS AND SUMMARIZED BELOW:
   - 7.1. HIGH YIELD REINFORCING BARS
     - 7.1.1. Y25mmØ x 12m = 1174
     - 7.1.2. Y25mmØ x 9m = 694
     - 7.1.3. Y25mmØ x 6m = 416
8. MINIMUM ANCHOR GROUT = 20MPa AT 7 DAYS AND 30MPa AT 28 DAYS.
9. MINIMUM THICKNESS OF GUNITE FACE 200mm.
10. COVER TO REF. MESH REINFORCEMENT 30mm FOR BOTH FACES.
11. MESH TO BE HELD IN POSITION WITH SPACER BLOCKS
12. SHOTCRETE FACE REINFORCED WITH REF. MESH 395 BOTH FACES.
13. MINIMUM FACE PLATE 200mm x 200mm WITH 2Y16's SPIDER BARS AT EACH ANCHOR.
14. MINIMUM SHOTCRETE STRENGTH = 30MPa AT 28 DAYS.
15. ANCHORS TO BE PULLED AND STRESSED TO 50kN LOAD BEFORE TIGHTENING. PERIODIC CHECKS TO BE CARRIED OUT ON ANCHORS WITH DEEPENING OF EXCAVATIONS AND ALL LOOSE ANCHORS TO BE RE-STRESSED AND TIGHTENED TO SAME.
16. CONSULTANT MAY RELAX STRESSING OF ANCHORS IN MEDIUM HARD TO HARD ROCK.
17. ON COMPLETION OF THE PROJECT ANCHORS MAY BE LEFT IN PLACE OR DE-STRESSED AND CUT OFF .
18. ANCHOR DRILL HOLE DIAMETER NOT LESS THAN 115mmØ.
19. GUNITE FACE TROWELED AND FINISHED OFF WITH 3m STRAIGHT EDGE. CONTRACTOR TO MAKE ALLOWANCE FOR 25mm OVERSPRAY IN ORDER TO ACHIEVE THE REQUIRED FACE FINISH.
20. SUBSOIL DRAINS COMPRISE 200mm WIDE ZIPCORE WRAPPED IN DOUBLE LAYER OF 80% SHADE CLOTH AT 1.5m CENTRES ON NAILED WALL AND LINKED TO SUB-SURFACE DRAINAGE SYSTEM. ENGINEER MAY REQUEST ADDITIONAL HERRING BONE LAYOUT IN AREAS OF HIGH GROUNDWATER FLOW.
21. ZIPCORE IS A HIGH FLOW HIGH STRENGTH ROBUST PREFORMED DRAINAGE SYSTEM CONSISTING OF HORIZONTALLY ALIGNED SINGLE CUSPATED HIGH DENSITY POLYETHYLENE SHEET.

ANCHORS

- Y25mmØ Reinforcing Bar x 12m x No. 1174
- Y25mmØ Reinforcing Bar x 9m x No. 694
- Y25mmØ Reinforcing Bar x 6m x No. 416

DESIGN PARAMETERS

1.	RESIDUAL / FILL / ALLUVIAL	:	pHi = 27°	Cohesion = 15kPa		
2.	COMPLETELY WEATHERED VERY SOFT ROCK	:	pHi = 27°	Cohesion = 20kPa		
3.	HIGHLY WEATHERED SOFT ANDESITE ROCK	:	UCS = 5MPa	GSI = 30	mi = 25	d = 0.7
4.	MODERATELY WEATHERED MEDIUM HARD ANDESITE ROCK	:	UCS = 12.5MPa	GSI = 45	mi = 25	d = 0.7
5.	SLIGHTLY WEATHERED HARD ANDESITE ROCK	:	UCS = 32.9MPa	GSI = 50	mi = 25	d = 0.7

6. INTERNAL WEDGE STABILITY FoS > 1.3 (Temporary)
7. OVERALL EXCAVATION STABILITY FoS > 2.0
8. SURCHARGE LOADING = 20kPa.
9. GROUNDWATER LEVEL 5.5m TO 6m BELOW EXISTING GROUND LEVEL.
10. NO TRAFFIC LOADING WITHIN 2m OF THE EXCAVATED FACE DURING CONSTRUCTION.

QUALITY CONTROL:

1. THE CONTRACTOR SHALL INSTALL A SERIES OF MONITORING PEGS / TARGETS (P1 TO P14) ON THE PERIMETER OF THE EXCAVATION AT DISTANCES NOT EXCEEDING 40m HORIZONTALLY.
2. IN ADDITION, TARGETS ARE TO BE FIXED ONTO THE NEIGHBOURING BASEMENT TO MONITOR THE SAME AT 40m INTERVALS.
3. HORIZONTAL AND VERTICAL READINGS OF THE PEGS ARE TO BE TAKEN BEFORE EXCAVATION COMMENCES.
4. READINGS OF ALL PEGS TO BE TAKEN ON A WEEKLY BASIS AS EXCAVATION PROGRESSES.
5. WHERE PREDICTED MOVEMENTS ARE EXCEEDED, THE FREQUENCY OF OBSERVATION SHALL BE INCREASED.
6. AFTER THE BULK EXCAVATION AND LATERAL SUPPORT CONTRACT HAS BEEN COMPLETED, READINGS (WHERE POSSIBLE) ARE TO BE TAKEN ON A DECREASING FREQUENCY (MINIMUM FORTNIGHT) UNTIL THE BASEMENT CONSTRUCTION HAS BEEN COMPLETED, I.E. LEVEL 06 STREET LEVEL PARKADE.
7. ALL PEGS ARE TO BE PROTECTED AGAINST DAMAGE AND SHOULD REMAIN ACCESSIBLE DURING THE MONITORING PERIOD.
8. MONITORING RESULTS TO BE CONVERTED IN GRAPH FORMAT AND SUPPLIED TO THE ENGINEER FOR REVIEW AND COMMENT ON A WEEKLY BASIS.
9. MAXIMUM PERMISSIBLE MOVEMENT OF EXCAVATION FACE ANYWHERE ALONG THE HEIGHT OF THE EXCAVATION:
   - 9.1. HORIZONTALLY = 25mm
   - 9.2. VERTICAL = 25mm
10. PULLOUT TESTS ON WORKING ANCHORS ARE TO BE UNDERTAKEN AS FOLLOWS:
    - 10.1. FIVE (5) PULLOUT TESTS FOR THE 25mm HIGH YIELD BARS x 12m LONG ANCHORS IN THE SOFT MATERIAL TESTED TO 120kN.
    - 10.2. FIVE (5) PULLOUT TESTS FOR THE 25mm HIGH YIELD BARS x 9m LONG ANCHORS IN THE HIGHLY WEATHERED SOFT ROCK TESTED TO 120kN.
    - 10.3. FIVE (5) PULLOUT TESTS FOR THE 25mm HIGH YIELD BARS x 6m LONG ANCHORS IN THE MODERATELY WEATHERED MEDIUM HARD ROCK TESTED TO 120kN.
11. IN ADDITION TO THE INITIAL PULLOUT TESTS, CONTRACTOR TO ALLOW FOR 10% OF ALL WORKING ANCHORS TO BE TESTED TO 120kN
12. THE CONTRACTOR IS TO ALLOW FOR THESE PULLOUT TESTS IN HIS PRICING AND PROGRAMME.
13. FINAL TEST REGIME WILL BE PROVIDED BY THE ENGINEER BEFOREHAND. NOTWITHSTANDING, ANCHORS WILL BE TESTED IN LOAD INCREMENTS OF 20% UP TO LOAD REQUIRED AND DE-STRESSED IN THE SAME INCREMENTS. ANCHORS SUBJECTED TO TWO (2) LOAD CYCLES.
14. NO ANCHORS TO BE STRESSED UNTIL GROUT STRENGTH HAS REACHED A MINIMUM STRENGTH OF 25MPa
15. SUFFICIENT CUBES TO BE TAKEN FROM EACH DAYS GROUT / SHOTCRETE IN ORDER FOR 7 DAYS AND 28 DAYS CUBE CRUSHING TESTS TO BE UNDERTAKEN. RESULTS OF THESE TESTS TO BE FORWARDED TO THE ENGINEER FOR APPROVAL.
16. ENGINEER WILL REQUEST CONTRACTOR TO TAKE A MINIMUM OF 15 CORES THROUGH THE GUNITE FACE TO ENSURE THAT THE MINIMUM SHOTCRETE THICKNESS OF 200mm HAS BEEN ACHIEVED.
17. VERTICAL ALIGNMENT OF ANCHOR ROWS MAY BE ADJUSTED UNIFORMLY UP OR DOWN BY 250mm TO AVOID CLASHING WITH POSITION OF FLOOR SLABS.

FOR TENDER

No.	DESCRIPTION / REVISIONS	DATE	
A	ISSUED FOR TENDER	2019/07/22	RM

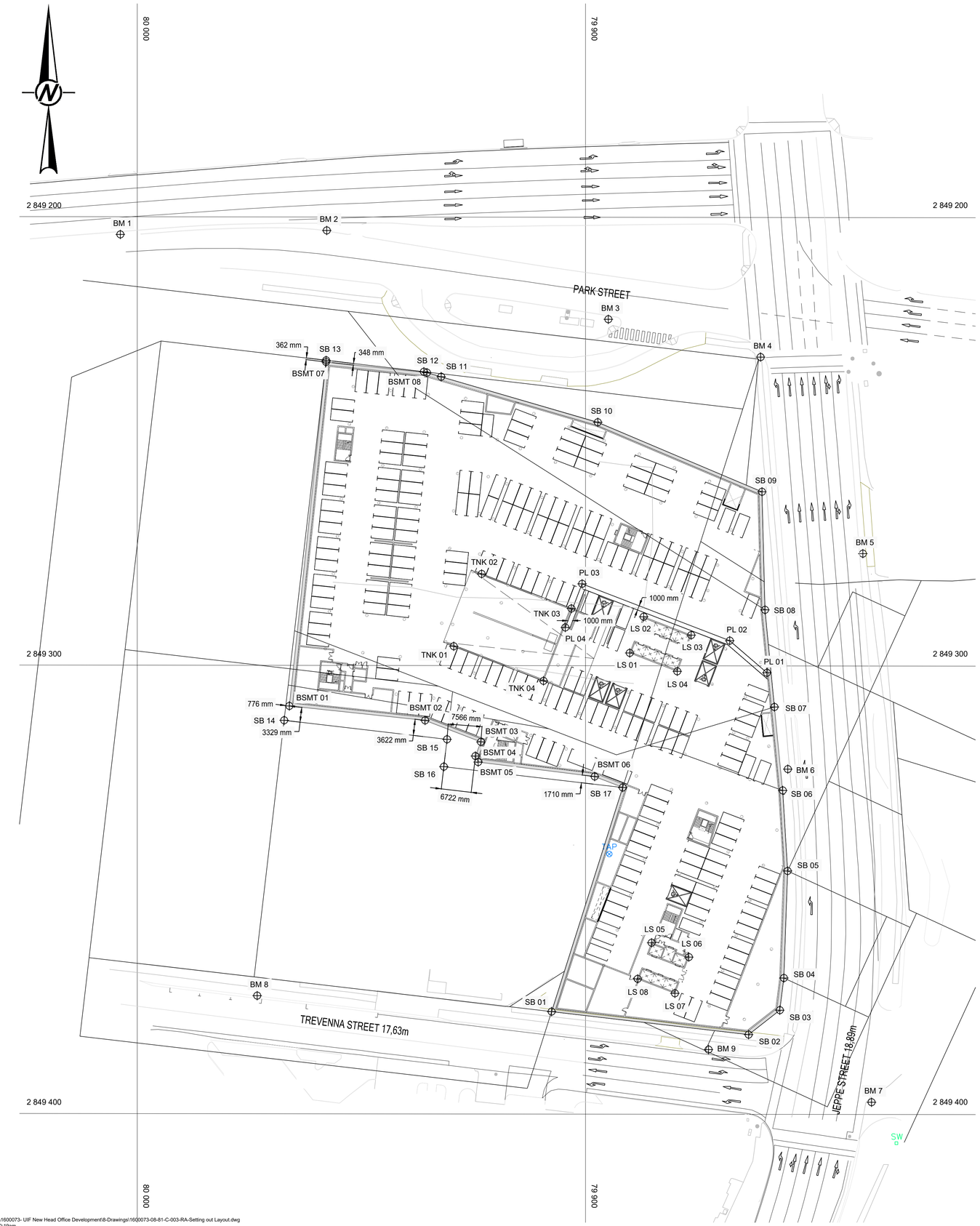
NAKO ILISO
THE ESTUARIES
11 Ox::ow Crescent P.O. Box
305, Centur::Cit:; 7446 E-mail : iliosopt:: iliso.com
Tel: +27 (0)21 525 1800 / Fax: +27 (0)86 000 356
www.nakogroup.com

COMPUTER FILE NAME: R:\....			
DATE DATUM	2019/07/17	CLIENT	
SCALE SKAAL	AS SHOWN		
DESIGNED BY ONTWERP DEUR	MP	FOR ILISO CONSULTING	
CHECKED BY NAGESIEN DEUR	CK		
DRAWN BY GETEKEN DEUR	MP	PROJECT ENGINEER	
CHECKED BY NAGESIEN DEUR	RM		
QUALITY CHECKS	CONTENT AND ACCURACY	DESIGN COMPLIANCE	PROJECT COMPLIANCE

PROJECT
SUNNYSIDE OFFICE DEVELOPMENT

TITLE
LATERAL SUPPORT NOTES

PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073	LS-S-03	A



COORDINATE LIST WSG 84 - Lo 29				
POINT	YLo	XLo	Z	DESCRIPTION
BENCHMARKS				
BM 1	80003.784	2849204.281	1315.087	NAIL IN PAVING
BM 2	79957.716	2849203.393	1315.460	HILTI
BM 3	79894.897	2849223.207	1316.073	HILTI
BM 4	79860.935	2849231.631	1316.314	HILTI
BM 5	79838.120	2849275.463	1316.109	HILTI
BM 6	79854.863	2849323.525	1316.282	HILTI
BM 7	79836.188	2849397.817	1318.144	HILTI
BM 8	79973.249	2849374.048	1317.542	HILTI
BM 9	79872.556	2849386.067	1317.955	12mm IRON PEG IN PAVING

SETTING OUT AT GROUND LEVEL

COORDINATE LIST WSG 84 - Lo 29			
POINT	YLo	XLo	DESCRIPTION
SITE BOUNDARY			
SB 01	79907.556	2849377.606	BOUNDARY LINE
SB 02	79863.609	2849382.729	BOUNDARY LINE
SB 03	79856.651	2849377.278	BOUNDARY LINE
SB 04	79855.746	2849370.105	BOUNDARY LINE
SB 05	79854.906	2849346.240	BOUNDARY LINE
SB 06	79855.993	2849328.273	BOUNDARY LINE
SB 07	79857.844	2849309.660	BOUNDARY LINE
SB 08	79859.959	2849288.003	BOUNDARY LINE
SB 09	79860.630	2849261.670	BOUNDARY LINE
SB 10	79897.265	2849246.179	BOUNDARY LINE
SB 11	79932.200	2849236.020	BOUNDARY LINE
SB 12	79936.057	2849234.896	BOUNDARY LINE
SB 13	79957.860	2849232.350	BOUNDARY LINE
SB 14	79967.230	2849312.640	BOUNDARY LINE
SB 15	79930.887	2849316.879	BOUNDARY LINE
SB 16	79931.599	2849322.977	BOUNDARY LINE
SB 17	79891.705	2849327.630	BOUNDARY LINE
BASEMENT BOUNDARY			
BSMT 01	79966.074	2849309.434	BASEMENT
BSMT 02	79935.798	2849312.659	BASEMENT
BSMT 03	79923.344	2849317.459	BASEMENT
BSMT 04	79924.554	2849320.599	BASEMENT
BSMT 05	79923.954	2849321.951	BASEMENT
BSMT 06	79897.946	2849325.169	BASEMENT
BSMT 07	79957.901	2849232.709	BASEMENT
BSMT 08	79935.362	2849235.110	BASEMENT

SETTING OUT AT BOTTOM OF BULK EXCAVATION

TANK BOUNDARY			
TNK 01	79929.393	2849296.126	STORMWATER TANK
TNK 02	79923.172	2849279.984	STORMWATER TANK
TNK 03	79903.142	2849287.703	STORMWATER TANK
TNK 04	79909.363	2849303.846	STORMWATER TANK
LIFT SHAFTS			
LS 01	79890.130	2849297.621	LIFT SHAFT
LS 02	79887.019	2849289.550	LIFT SHAFT
LS 03	79876.413	2849293.637	LIFT SHAFT
LS 04	79879.524	2849301.709	LIFT SHAFT
LS 05	79885.253	2849362.248	LIFT SHAFT
LS 06	79876.948	2849365.449	LIFT SHAFT
LS 07	79880.059	2849373.520	LIFT SHAFT
LS 08	79888.360	2849370.310	LIFT SHAFT
PIPELINE TRENCH			
PL 01	79859.524	2849302.032	1m WIDE TRENCH
PL 02	79867.817	2849294.887	1m WIDE TRENCH
PL 03	79900.751	2849282.194	1m WIDE TRENCH
PL 04	79904.509	2849291.945	1m WIDE TRENCH

0 20 40 60m

1:500

NOTES:

1. READ THIS DRAWING IN CONJUNCTION WITH 1600073-08-81-C-501 - EARTHWORKS LAYOUT AND 1600073-08-81-C-502 - EARTHWORKS CROSS SECTIONS.
2. DIMENSIONS ARE SHOWN FOR:
   - 2.1. WHERE THE POSITION OF THE BASEMENT EXCAVATION DEVIATES FROM THE SITE BOUNDARY (I.E. BSMT 01 - BSMT 08).
   - 2.2. THE POSITION OF THE STORMWATER PIPELINE TRENCH (I.E. PL 01 - PL -02).
3. THE ENGINEER MUST BE NOTIFIED IMMEDIATELY REGARDING ALL DISCREPANCIES BETWEEN COORDINATES AND SETTING OUT DIMENSIONS.

FOR TENDER

WGS 84/ LO 29

No.	DESCRIPTION / REVISIONS	DATE
A	ISSUED FOR TENDER PURPOSES	2019-06-28

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME: R:\.....			
DATE DATUM	2018-10-15	**CLIENT**	
SCALE SKAAL	1:500		
DESIGNED BY ONTWERP DEUR	ZG	**FOR ILISO CONSULTING**	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	ZG	**PROJECT ENGINEER**	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	**CONTENT AND ACCURACY**	**DESIGN COMPLIANCE**	**PROJECT COMPLIANCE**

PROJECT

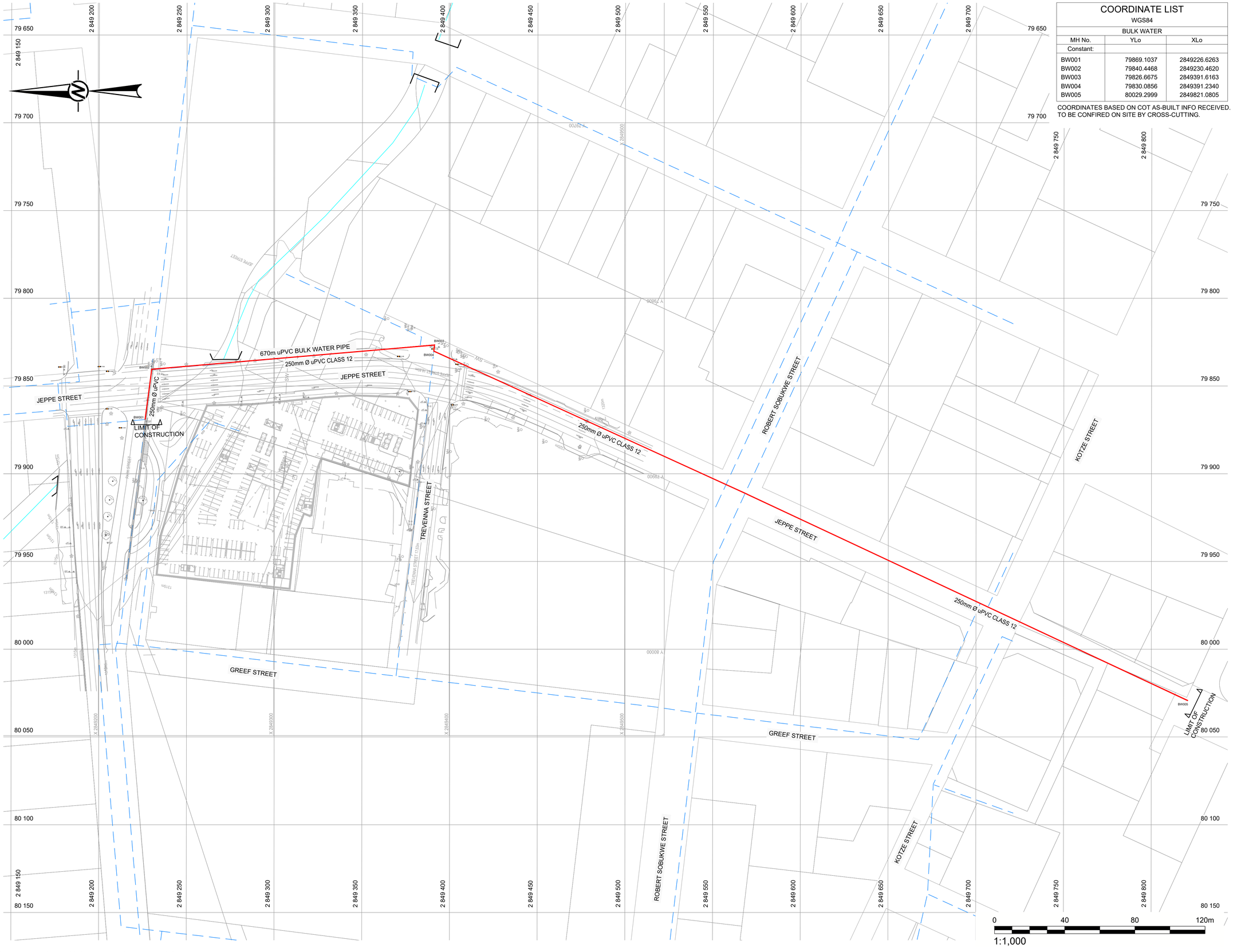
SUNNYSIDE OFFICE DEVELOPMENT

TITLE

SETTING OUT LAYOUT

PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073-08-81-C-003		A

M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-003-RA-Setting out Layout.dwg
Jul 02, 2019 - 10:19am



COORDINATE LIST

WGS84

BULK WATER		
MH No.	YLo	XLo
Constant:		
BW001	79869.1037	2849226.6263
BW002	79840.4468	2849230.4620
BW003	79826.6675	2849391.6163
BW004	79830.0856	2849391.2340
BW005	80029.2999	2849821.0805

COORDINATES BASED ON COT AS-BUILT INFO RECEIVED. TO BE CONFIRED ON SITE BY CROSS-CUTTING.

LEGEND

- EXISTING PIPE
- NEW PIPE
- NEW VALVE
- NEW WATER METER

NOTES:

1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF SANS 1200, STANDARDISED SPECIFICATIONS FOR CIVIL ENGINEERING CONSTRUCTION.
2. SPECIAL ATTENTION IS TO BE DRAWN TO CLAUSE SABS 1200 - 5.7, SAFETY.
3. THE POSITIONS & LEVELS OF EXISTING SERVICES ARE APPROXIMATE AND ARE TO BE VERIFIED ON SITE BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.
4. THE CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.
5. A SITE INSPECTION IS TO BE ARRANGED WITH THE RELEVANT SERVICE PROVIDERS, POINTING OUT THE EXTENT OF THE WORKS, TO ENSURE THAT ALL SERVICES ARE ACCOUNTED FOR PRIOR TO THE COMMENCEMENT OF PROPOSED CONSTRUCTION.
6. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE CITY OF TSHWANE'S STANDARD DETAILS AS PROVIDED BY THE ENGINEER.
7. 250mmØ uPVC CLASS 12 PIPELINE IS TO REPLACE EXISTING 160mmØ uPVC PIPELINE ALONG SAME ALIGNMENT. ALL EXISTING CONNECTIONS SHALL BE REINSTATED ON THE NEW PIPELINE.
8. THE EXISTING PIPELINE SHALL BE DECOMMISSIONED ONCE THE NEW PIPELINE HAS BEEN TESTED AND COMMISSIONED.
9. FINAL ALIGNMENT AND LAYING OF PIPE TO BE CONFIRMED FOLLOWING CROSS CUTTING ALOGN PROPOSED ROUTE.

FOR TENDER

HARTEBEESHOEK 1994 / LO 29

No.	DESCRIPTION / REVISIONS	DATE
A	ISSUED FOR TENDER PURPOSES	2019-06-28

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME: R:\.....			
DATE DATUM	2018-05-09	CLIENT	
SCALE SKAAL	1:1000		
DESIGNED BY ONTWERP DEUR	ZG	FOR ILISO CONSULTING	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	ZG	PROJECT ENGINEER	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	CONTENT AND ACCURACY	DESIGN COMPLIANCE	PROJECT COMPLIANCE

PROJECT

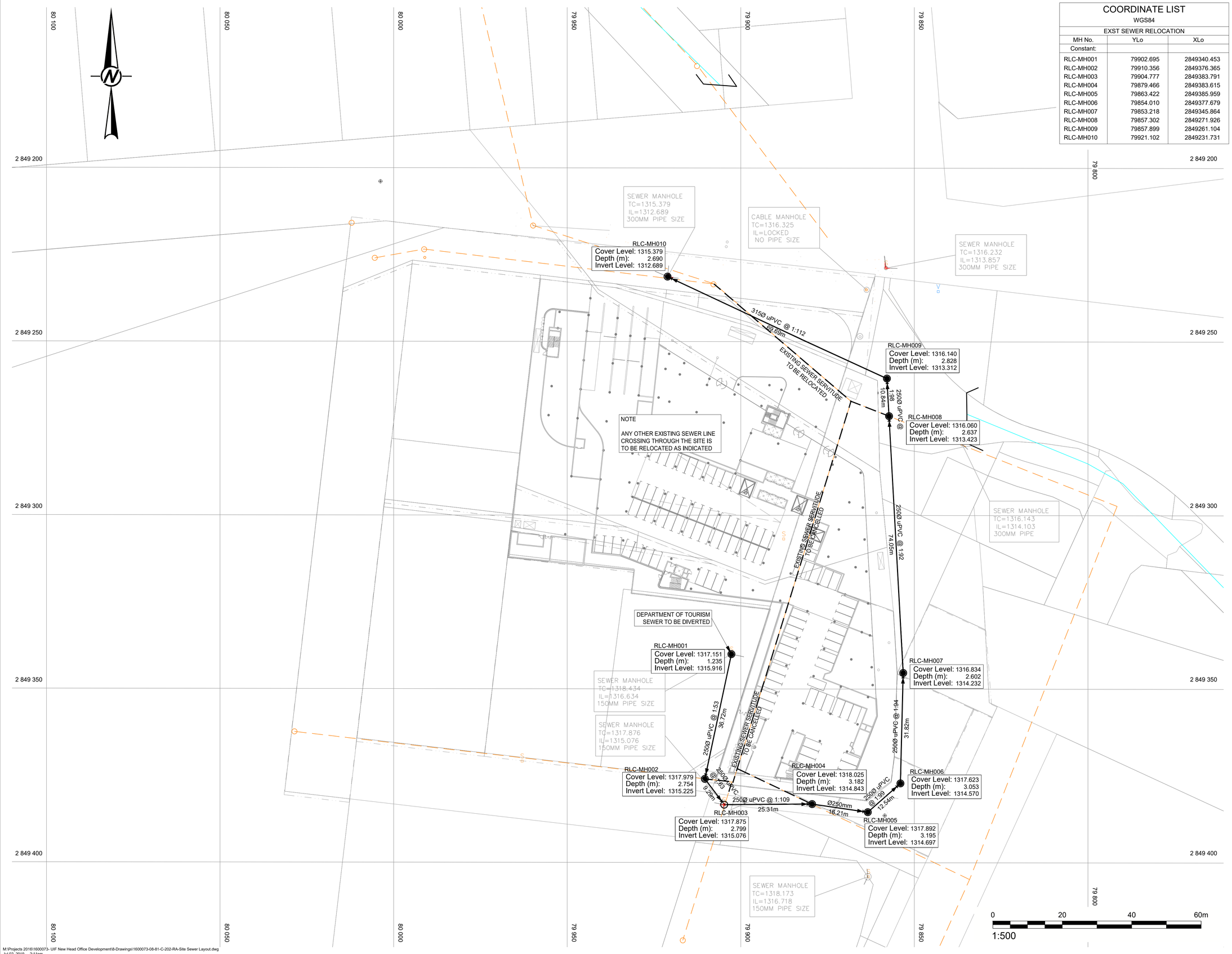
SUNNYSIDE OFFICE DEVELOPMENT

TITLE

BULK WATER PIPELINE UPGRADE LAYOUT

PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073-08-81-C-101		A

M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-101-RA-Bulk Water Layout.dwg
Jul 02, 2019 - 11:44am



COORDINATE LIST

WGS84

EXST SEWER RELOCATION

MH No.	YLo	XLo
Constant:		
RLC-MH001	79902.695	2849340.453
RLC-MH002	79910.356	2849376.365
RLC-MH003	79904.777	2849383.791
RLC-MH004	79879.466	2849383.615
RLC-MH005	79863.422	2849385.959
RLC-MH006	79854.010	2849377.679
RLC-MH007	79853.218	2849345.864
RLC-MH008	79857.302	2849271.926
RLC-MH009	79857.899	2849261.104
RLC-MH010	79921.102	2849231.731

LEGEND

- EXISTING SEWER PIPE
- EXISTING SEWER SERVITUDE
- PROPOSED SEWER PIPE

NOTES:

1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF SANS 1200, STANDARDISED SPECIFICATIONS FOR CIVIL ENGINEERING CONSTRUCTION.
2. THE POSITIONS & LEVELS OF EXISTING SERVICES ARE APPROXIMATE AND ARE TO BE VERIFIED ON SITE BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.
3. THE CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.
4. A SITE INSPECTION IS TO BE ARRANGED WITH THE RELEVANT SERVICE PROVIDERS, POINTING OUT THE EXTENT OF THE WORKS, TO ENSURE THAT ALL SERVICES ARE ACCOUNTED FOR PRIOR TO THE COMMENCEMENT OF PROPOSED CONSTRUCTION.
5. CONTRACTOR TO LIAISE WITH CITY OF TSHWANE W.R.T. THE REINSTATEMENT OF ROAD SURFACING AND SIDEWALKS.
6. THIS LAYOUT DRAWING IS TO BE READ IN CONJUNCTION WITH THE CITY OF TSHWANE'S STANDARD DETAILS DRAWINGS AS PROVIDED BY THE ENGINEER.
7. ALL SEWER 2.8m FROM SITE BOUNDARY UNLESS OTHERWISE SHOWN.
8. ALL SEWER PIPES TO BE uPVC 400kPa (SABS 1606).

FOR TENDER

HARTEBEESHOEK 1994 / LO 29

No.	DESCRIPTION / REVISIONS	DATE
A	ISSUED FOR TENDER PURPOSES	2019-06-28

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME: R:\.....			
DATE **DATUM**	2018-10-15	**CLIENT**	
SCALE **SKAAL**	1:500		
DESIGNED BY ONTWERP DEUR	ZG	**FOR ILISO CONSULTING**	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	ZG	**PROJECT ENGINEER**	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	**CONTENT AND ACCURACY**	**DESIGN COMPLIANCE**	**PROJECT COMPLIANCE**

PROJECT

SUNNYSIDE OFFICE DEVELOPMENT

TITLE

PROPOSED SITE SEWER LAYOUT

PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073-08-81-C-202		A

M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-202-RA-Site Sewer Layout.dwg
Jul 02, 2019 - 2:11pm

COORDINATE LIST		
WGS84		
Tourism building		
MH No.	YLo	XLo
Constant:		
CAT001	79904.126	2849363.494
-MH002	79909.190	2849379.406
-MH003	79900.615	2849396.003
-MH004	79836.575	2849404.367
-MH005	79830.632	2849406.942

LEGEND

- EXISTING STORMWATER PIPE
- PROPOSED STORMWATER PIPE
- PROPOSED STORMWATER V-DRAIN
- PROPOSED CATCHPIT
- PROPOSED STORMWATER MANHOLE
- EXISTING STORMWATER MANHOLE

NOTES:

1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF SANS 1200, STANDARDISED SPECIFICATIONS FOR CIVIL ENGINEERING CONSTRUCTION.
2. THE POSITIONS & LEVELS OF EXISTING SERVICES ARE APPROXIMATE AND ARE TO BE VERIFIED ON SITE BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.
3. THE CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF PROPOSED CONSTRUCTION.
4. A SITE INSPECTION IS TO BE ARRANGED WITH THE RELEVANT SERVICE PROVIDERS, POINTING OUT THE EXTENT OF THE WORKS, TO ENSURE THAT ALL SERVICES ARE ACCOUNTED FOR PRIOR TO THE COMMENCEMENT OF PROPOSED CONSTRUCTION.
5. CONTRACTOR TO LIAISE WITH CITY OF TSHWANE W.R.T. THE REINSTATEMENT OF ROAD SURFACING AND SIDEWALKS.
6. THIS LAYOUT DRAWING IS TO BE READ IN CONJUNCTION WITH THE CITY OF TSHWANE'S STANDARD DETAILS DRAWINGS AS PROVIDED BY THE ENGINEER.
7. REFER TO DRW 1600073-08-81-C-310 FOR STORMWATER CONCRETE V-DRAIN DETAILS.
8. ALL STORMWATER 1.225m FROM ROAD EDGE UNLESS OTHERWISE SHOWN.

FOR TENDER

HARTEBEESHOEK 1994 / LO 29

No.	DESCRIPTION / REVISIONS	DATE
A	ISSUED FOR TENDER PURPOSES	2019-06-28

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME: R:\.....			
DATE DATUM	2018-10-15	**CLIENT**	
SCALE SKAAL	1:500		
DESIGNED BY ONTWERP DEUR	LM	**FOR ILISO CONSULTING**	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	LM	**PROJECT ENGINEER**	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	**CONTENT AND ACCURACY**	**DESIGN COMPLIANCE**	**PROJECT COMPLIANCE**

PROJECT

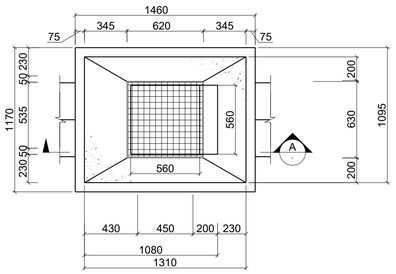
SUNNYSIDE OFFICE DEVELOPMENT

TITLE

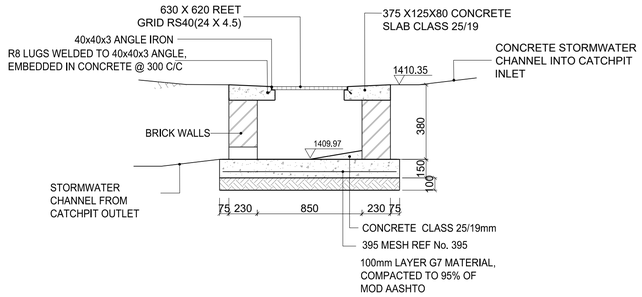
PROPOSED STORMWATER LAYOUT (TOURISM BUILDING)

PAPER SIZE	PROJECT NO.	DRWG. NO.	REV.
A1	1600073-08-81-C-301		A

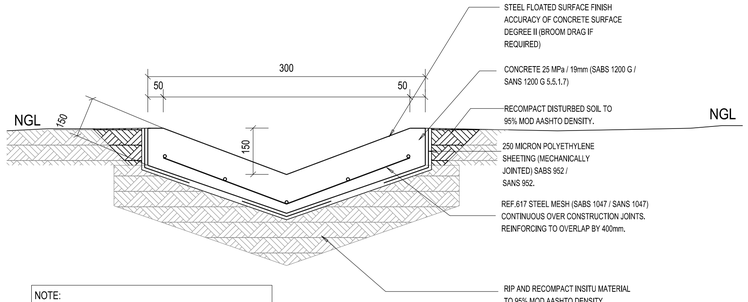
M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-301-RA-Stormwater Layout.dwg
Jul 02, 2019 - 10:24am



STORMWATER CATCHPIT PLAN
NTS



STORMWATER CATCHPIT ELEVATION
NTS



NOTE:
1. D - VARIABLE FROM 50mm TO INDICATED MAXIMUM DEPTH.
2. STEEL REINFORCING TO BE REF. 395 IN AREAS WITH NO VEHICLE TRAFFIC.
3. EXPANSION JOINT BETWEEN CANAL AND WALL ONLY IF INDICATED.

CAST IN ALTERNATIVE SECTIONS
1,5m LONG WITH EXPANSION JOINTS
AT 18m. SEE STANDARD DETAIL FOR
EXPANSION JOINT - TYPE NO DT 04/S

STORMWATER CONCRETE V-DRAIN
IN AREAS WITH VEHICLE TRAFFIC
SCALE 1:15

M:\Projects 2016\1600073- UIF New Head Office Development\8-Drawings\1600073-08-81-C-310-RA-Stormwater Details.dwg
Jul 02, 2019 - 10:22am

FOR TENDER

No.	DESCRIPTION / REVISIONS	DATE
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
A	ISSUED FOR TENDER PURPOSES	2019-06-28

PUBLIC INVESTMENT CORPORATION

NAKO ILISO

HEAD OFFICE
203 Witch Hazel Avenue, Highveld Technopark , Centurion,0157, South Africa
P.O. Box 68735, Highveld, 0169, South Africa
Tel: +27 (0)12 685 0900 / Fax: +27 (0)12 665 1886

www.nakogroup.com

COMPUTER FILE NAME:
R:\...

DATE DATUM	2018-10-15	**CLIENT**	
SCALE SKAAL	1:500		
DESIGNED BY ONTWERP DEUR	LM	**FOR ILISO CONSULTING**	
CHECKED BY NAGESIEN DEUR	RN		
DRAWN BY GETEKEN DEUR	LM	**PROJECT ENGINEER**	
CHECKED BY NAGESIEN DEUR	RN		
QUALITY CHECKS	**CONTENT AND ACCURACY**	**DESIGN COMPLIANCE**	**PROJECT COMPLIANCE**

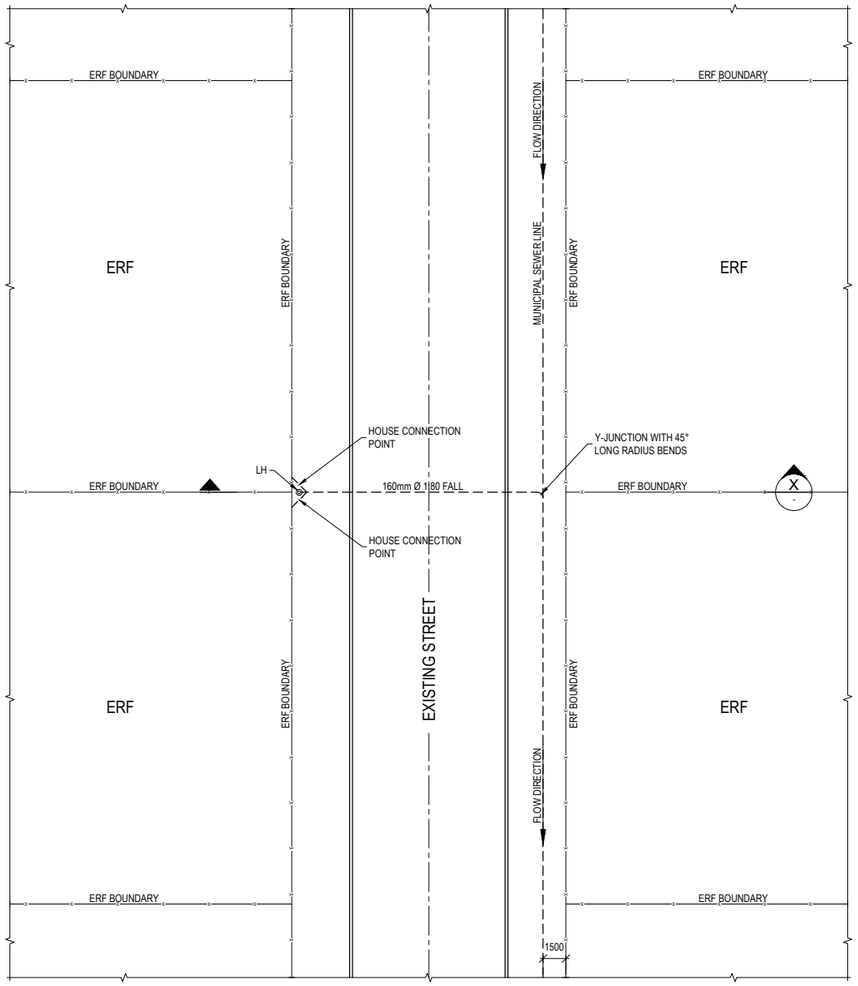
PROJECT

SUNNYSIDE OFFICE DEVELOPMENT

TITLE

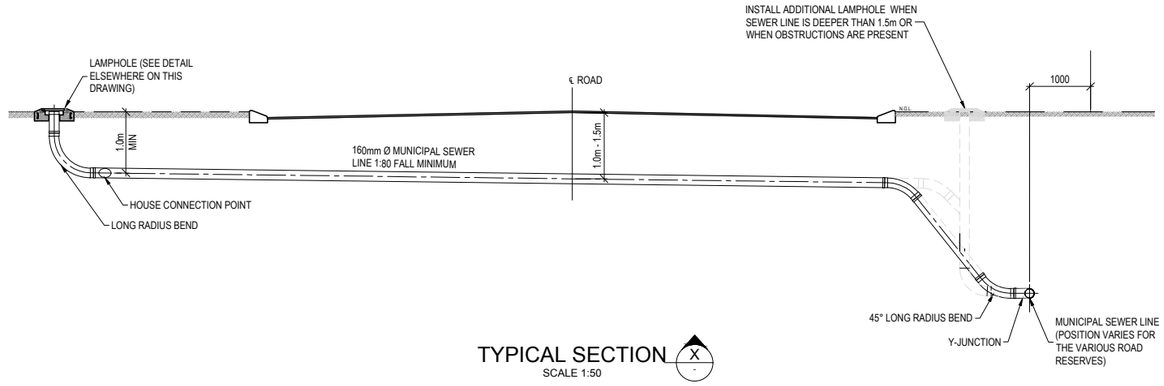
STORMWATER DETAILS

PAPER SIZE	PROJECT NO. DRWG. NO.	REV.
A1	1600073-08-81-C-310	A

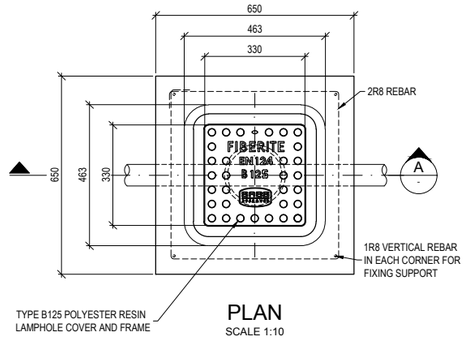


TYPICAL SEWER LAYOUT
FOR ERVEN WITH NO
MID-BLOCK SEWERS

SCALE 1:200



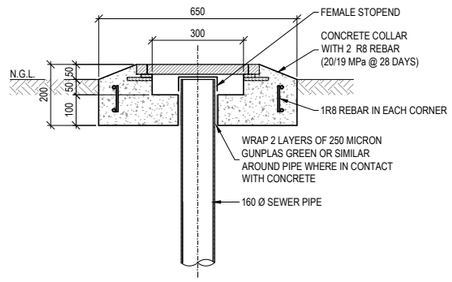
TYPICAL SECTION X
SCALE 1:50



PLAN
SCALE 1:10

BENDING SCHEDULE						
TYPE & SIZE	QTY	CUTTING LENGTH (mm)	SHAPE CODE	A (mm)	B (mm)	MASS (kg)
R8	2	2150	60	550	550	1.70
R8	4	85	20			0.14

MUNICIPAL VALVE



SECTION A
SCALE 1:10

TYPICAL LAMPHOLE DETAIL

NOTES AND SPECIFICATIONS

GENERAL

1. ALL MATERIAL AND WORKMANSHIP MUST COMPLY WITH THE REQUIREMENTS OF THE LATEST RELEVANT SANS STANDARD
2. ALL DIMENSIONS ARE IN mm (UNLESS OTHERWISE SPECIFIED)
3. DO NOT SCALE FROM THESE DRAWINGS
4. ALL DIMENSIONS TO BE CHECKED AND APPROVED ON SITE
5. ALL CONSTRUCTION TO BE DONE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, THIRD EDITION 2005 AND THE STANDARD COT DETAIL DRAWINGS
6. THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE STANDARD DRAWINGS (IF APPLICABLE)
7. THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, SERIES 3
8. THE SIGNATURE OR INITIALS ON THIS DRAWING OF ANY DIRECTOR OF THE WATER AND SANITATION DEPARTMENT, IN NO WAY, REMOVES ANY RESPONSIBILITY WHATSOEVER FROM THE CONSULTANT
9. THE CONSULTANT REMAINS RESPONSIBLE TO ENSURE THAT ALL THE GUIDELINES, STANDARD DRAWINGS, STANDARDS AND SPECIFICATIONS OF THE WATER AND SANITATION DEPARTMENT HAVE BEEN MET AND ARE COMPLIED WITH
10. FINAL POSITION OF SERVICES TO BE DETERMINED ON SITE
11. SEWERS INSTALLED WITHIN PROPERTIES ARE USUALLY PLACED 1.2m FROM ERF BOUNDARY UNLESS OTHERWISE SPECIFIED
12. SEWERS INSTALLED WITHIN THE ROAD RESEVE BOUNDARY MUST BE POSITIONED IN ACCORDANCE WITH THE APPLICABLE SERVICES LAYOUT DRAWING

PARTICULAR

1. LH = LAMPHOLE
2. MAXIMUM 3 DWELLING UNITS ON NEW SEWER LINE
3. TYPE B125 POLYESTER RESIN LAMPHOLE COVER AND FRAME IN ACCORDANCE WITH SANS 50124 (SABS EN124)

CITY OF TSHWANE
IGNITING EXCELLENCE
P O BOX 1022
PRETORIA
0001
CITY OF TSHWANE
WATER AND SANITATION
DEPARTMENT

AMENDMENTS

NO	DATE	APPROVED	DESCRIPTION	PAR
□				

WATER AND SANITATION

FOR INTERNAL APPROVAL - RECEIVED SIGN WHEN APPLICABLE

DIRECTOR: WATER AND SANITATION - PLANNING (ACTING)
E.J VICTOR — NAME — Prof. Reg. No — SIGNATURE — JAN 2017 DATE

REGIONAL DIRECTOR: (1,2,3,4,5,6 or 7)
NAME — Prof. Reg. No — SIGNATURE — DATE

DIRECTOR: SYSTEM DEVELOPMENT
NAME — Prof. Reg. No — SIGNATURE — DATE

DIRECTOR: BULK WATER
NAME — Prof. Reg. No — SIGNATURE — DATE

DIRECTOR: INFRASTRUCTURE PROVISION
NAME — Prof. Reg. No — SIGNATURE — DATE

DIRECTOR: WASTE WATER TREATMENT
NAME — Prof. Reg. No — SIGNATURE — DATE

CONSULTANT DETAIL

I □□□□□□□□□□□□□□□□□□□□□□□□ Prof Reg No. □□□□□□□□□□□□□□□□□□□□
HEREBY CERTIFY THAT THE SERVICES WILL/HAVE BEEN INSTALLED ACCORDING TO NOTE 9 OF THE ABOVE NOTES AND TO THE DRAWING

SIGNATURE DATE

CONSULTANT DRAWING NUMBER: A REVISION

DESIGNED
NAME: ____ Pr Eng. Prof Reg No: ____
SIGNATURE: ____ DATE: ____

DRAWN
NAME: M. M. BURGER
SIGNATURE: ____ DATE: MARCH 2016

CHECKED
NAME: ____ Pr Eng. Prof Reg No: ____
SIGNATURE: ____ DATE: ____

INFORMATION OFFICE CHECKED
NAME: ____
SIGNATURE: ____ DATE: ____

DESIGN OFFICE APPROVAL
NAME: T.F HILDER Prof Reg No: 880539
SIGNATURE: ____ DATE: JAN 2017

CONTRACT No. 315-02
PROJECT No. 315-02
SHEET No. 1 OF
PAPER SIZE A1
SCALE 1:100
DATE 20.01.2016

PROJECT STATUS

RECEIVED SIGN WHEN APPLICABLE

○ CONCEPT DRAWING ○ TENDER DRAWING ○ APPROVED CONSTRUCTION DRAWING ○ AS BUILT DRAWING

PROJECT ENGINEER of COT:
NAME: ____ Pr Eng. Prof Reg No: ____
SIGNATURE: ____ DATE: ____

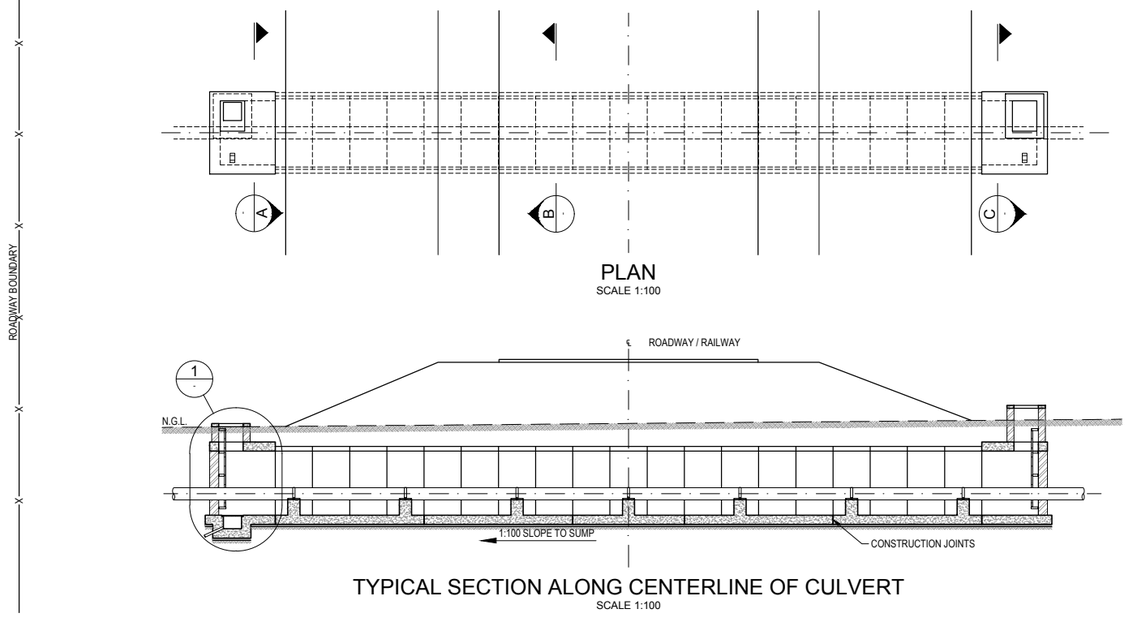
INSPECTOR OF WORKS of COT:
NAME: ____ Prof Reg No: ____
SIGNATURE: ____ DATE: ____

LOCATION OF PROJECT:

DESCRIPTION OF PROJECT:
STANDARD DRAWING : LAMPHOLE DETAIL & SEWER LAYOUT FOR ERVEN WITH NO MID-BLOCK SEWERS

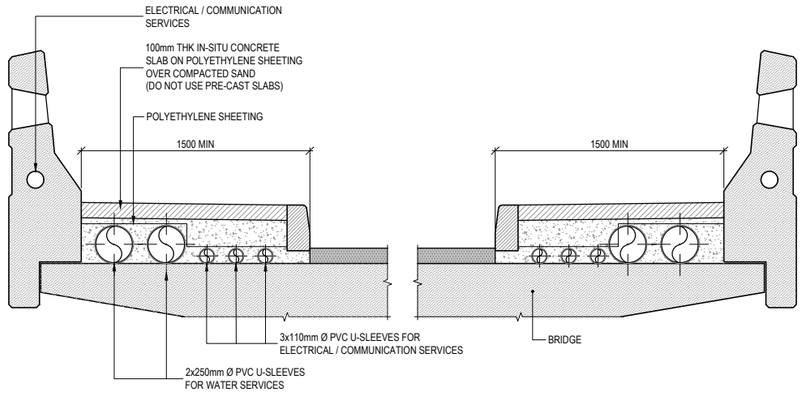
WBS No. :

COT DRAWING NUMBER: 7515-S209 A REVISION



PLAN
SCALE 1:100

TYPICAL SECTION ALONG CENTERLINE OF CULVERT
SCALE 1:100



TYPICAL SLEEVE INSTALLATION LAYOUT IN SIDEWALK OF BRIDGE / CULVERT
SCALE 1:20

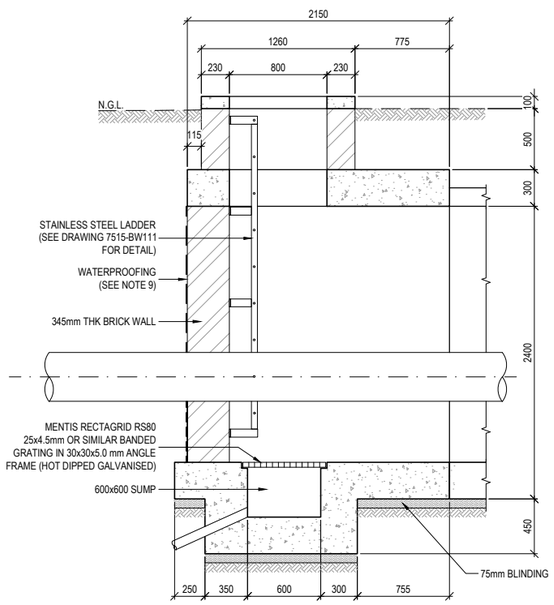
NOTES AND SPECIFICATIONS

GENERAL

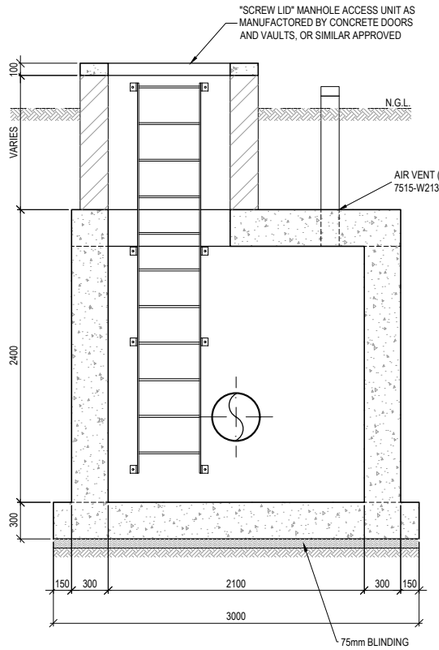
1. ALL MATERIAL AND WORKMANSHIP MUST COMPLY WITH THE REQUIREMENTS OF THE LATEST RELEVANT SANS STANDARD
2. ALL DIMENSIONS ARE IN mm (UNLESS OTHERWISE SPECIFIED)
3. DO NOT SCALE FROM THESE DRAWINGS
4. ALL DIMENSIONS TO BE CHECKED AND APPROVED ON SITE
5. ALL CONSTRUCTION TO BE DONE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, THIRD EDITION 2005 AND THE STANDARD COT DETAIL DRAWINGS
6. THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE STANDARD DRAWINGS (IF APPLICABLE)
7. THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, SERIES 4
8. THE SIGNATURE OR INITIALS ON THIS DRAWING OF ANY DIRECTOR OF THE WATER AND SANITATION DEPARTMENT, IN NO WAY, REMOVES ANY RESPONSIBILITY WHATSOEVER FROM THE CONSULTANT
9. THE CONSULTANT REMAINS RESPONSIBLE TO ENSURE THAT ALL THE GUIDELINES, STANDARD DRAWINGS, STANDARDS AND SPECIFICATIONS OF THE WATER AND SANITATION DEPARTMENT HAVE BEEN MET AND ARE COMPLIED WITH
10. FINAL POSITION OF SERVICES TO BE DETERMINED ON SITE

PARTICULAR

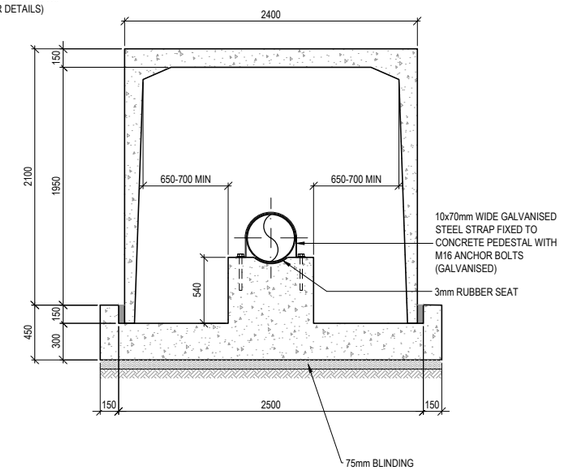
1. SERVICE DUCTS
   - 1.1 SERVICE DUCTS MAY BE EITHER SAND FILLED VOIDS COVERED BY IN-SITU CONCRETE SLABS, WITH OR WITHOUT INDIVIDUAL DUCTS FOR SERVICES, OR SOLID CONCRETE SIDEWALKS WITH DUCTS
   - 1.2 IF THE PROVISION OF SERVICES IS UNLIKELY, SAND FILLED VOIDS SHALL BE USED
   - 1.3 PRECAST PAVING SLABS OR BLOCKS SHALL NOT BE USED
2. CAST IN-SITU CONCRETE (MIN 20/19 MPa) OVER OVER SLEEVES IN ALTERNATE PANELS, MAXIMUM 2m WIDE



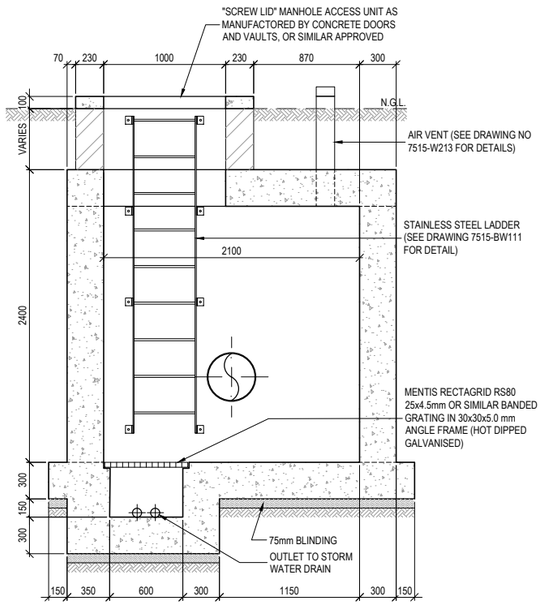
DETAIL 1
SCALE 1:25



SECTION A
SCALE 1:25



SECTION B
SCALE 1:25



SECTION C
SCALE 1:25

NOTE :
1. TYPICAL LAYOUT FOR 2.1 x 2.1m RECTANGULAR CULVERT - DIMENSIONS VARY FOR OTHER SIZES AND TYPES
2. THIS IS ONLY A SCHEMATIC LAYOUT TO SHOW WHAT IS REQUIRED. A DETAILED DESIGN MUST BE EXECUTED BY A PROFESSIONAL ENGINEER.

CITY OF TSHWANE
IGNITING EXCELLENCE
P O BOX 1022
PRETORIA
0001
CITY OF TSHWANE
WATER AND SANITATION DEPARTMENT

AMENDMENTS

NO	DATE	APPROVED	DESCRIPTION	PAR
0				

WATER AND SANITATION
FOR INTERNAL APPROVAL - RECEIVED SIGN WHEN APPLICABLE

DIRECTOR: WATER AND SANITATION - PLANNING (ACTING)
E.J VICTOR — NAME — Prof. Reg. No — SIGNATURE — JAN 2017 DATE

REGIONAL DIRECTOR: (1,2,3,4,5,6 or 7)
NAME — Prof. Reg. No — SIGNATURE — DATE

DIRECTOR: SYSTEM DEVELOPMENT
NAME — Prof. Reg. No — SIGNATURE — DATE

DIRECTOR: BULK WATER
NAME — Prof. Reg. No — SIGNATURE — DATE

DIRECTOR: INFRASTRUCTURE PROVISION
NAME — Prof. Reg. No — SIGNATURE — DATE

DIRECTOR: WASTE WATER TREATMENT
NAME — Prof. Reg. No — SIGNATURE — DATE

CONSULTANT DETAIL

I ..... Prof Reg No. .....
HEREBY CERTIFY THAT THE SERVICES WILL/HAVE BEEN INSTALLED ACCORDING TO NOTE 9 OF THE ABOVE NOTES AND TO THE DRAWING
SIGNATURE DATE

CONSULTANT DRAWING NUMBER: 0 REVISION

DESIGNED
NAME: ____ Pr Eng. Prof Reg No: ____
SIGNATURE: ____ DATE: ____

DRAWN
NAME: M. M. BURGER
SIGNATURE: ____ DATE: FEBRUARY 2016

CHECKED
NAME: ____ Pr Eng. Prof Reg No: ____
SIGNATURE: ____ DATE: ____

INFORMATION OFFICE CHECKED
NAME: ____
SIGNATURE: ____ DATE: ____

DESIGN OFFICE APPROVAL
NAME: T.F HILDER Prof Reg No: 880539
SIGNATURE: ____ DATE: JAN 2017

CONTRACT No. --
PROJECT No. --
SHEET No. --
PAPER SIZE A1
SCALE AS SHOWN
DATE FEB 2016

PROJECT STATUS
RECEIVED SIGN WHEN APPLICABLE
○ CONCEPT DRAWING ○ TENDER DRAWING ○ APPROVED CONSTRUCTION DRAWING ○ AS BUILT DRAWING

PROJECT ENGINEER of COT:
NAME: ____ Pr Eng. Prof Reg No: ____
SIGNATURE: ____ DATE: ____

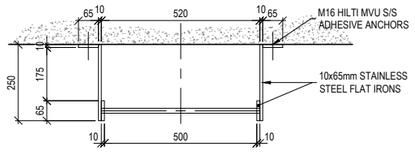
INSPECTOR OF WORKS of COT:
NAME: ____ Prof Reg No: ____
SIGNATURE: ____ DATE: ____

LOCATION OF PROJECT:

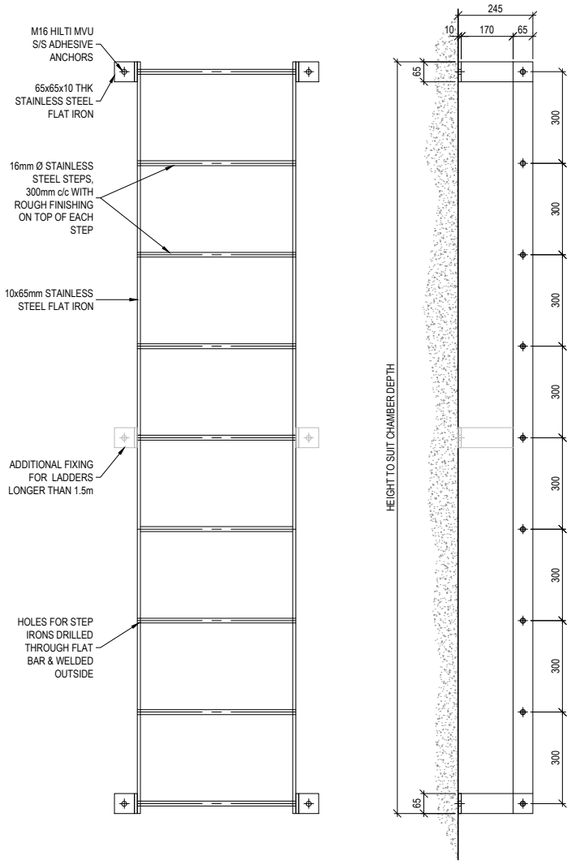
DESCRIPTION OF PROJECT:
STANDARD DRAWING :
SLEEVES & CULVERTS FOR PIPE CROSSINGS AT BRIDGES, ROADS & RAILWAY LINES

WBS No. :

COT DRAWING NUMBER: 7515-W214
0 REVISION



PLAN
SCALE 1:10

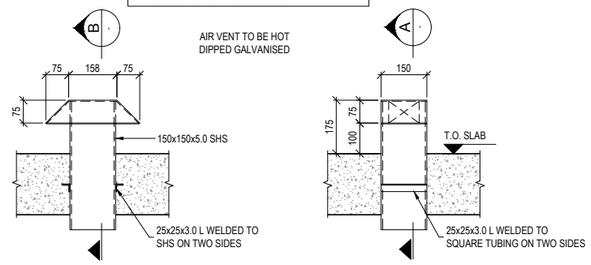


FRONT ELEVATION
SCALE 1:10

SECTION
SCALE 1:10

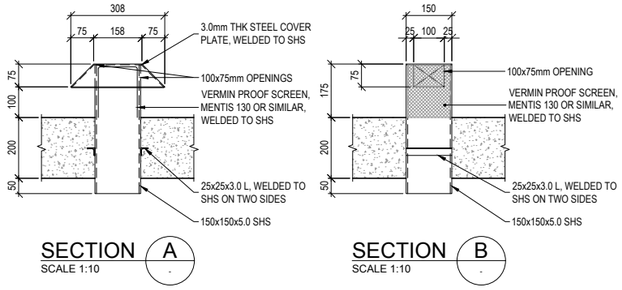
TYPICAL ACCESS LADDER FOR CHAMBERS

NOTE :
PROVIDE TWO AIR VENTS TO EACH VALVE CHAMBER ONE SHORT AND ONE WXTENDED AS SHOWN ON STANDARD VALVE CHAMBER DRAWINGS.



FRONT ELEVATION
SCALE 1:10

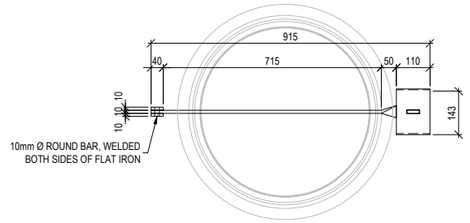
SIDE ELEVATION
SCALE 1:10



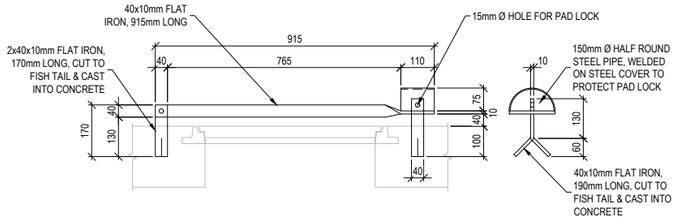
SECTION A
SCALE 1:10

SECTION B
SCALE 1:10

DETAIL - VERMIN PROOF AIR VENT



PLAN
SCALE 1:10



ELEVATION
SCALE 1:10

LOCKING DEVICE FOR ROUND ACCESS MANHOLE COVERS

NOTES AND SPECIFICATIONS

GENERAL

1. ALL MATERIAL AND WORKMANSHIP MUST COMPLY WITH THE REQUIREMENTS OF THE LATEST RELEVANT SANS STANDARD
2. ALL DIMENSIONS ARE IN mm (UNLESS OTHERWISE SPECIFIED)
3. DO NOT SCALE FROM THESE DRAWINGS
4. ALL DIMENSIONS TO BE CHECKED AND APPROVED ON SITE
5. ALL CONSTRUCTION TO BE DONE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, THIRD EDITION 2005 AND THE STANDARD COT DETAIL DRAWINGS
6. THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE STANDARD DRAWINGS (IF APPLICABLE)
7. THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, SERIES 4
8. THE SIGNATURE OR INITIALS ON THIS DRAWING OF ANY DIRECTOR OF THE WATER AND SANITATION DEPARTMENT, IN NO WAY, REMOVES ANY RESPONSIBILITY WHATSOEVER FROM THE CONSULTANT
9. THE CONSULTANT REMAINS RESPONSIBLE TO ENSURE THAT ALL THE GUIDELINES, STANDARD DRAWINGS, STANDARDS AND SPECIFICATIONS OF THE WATER AND SANITATION DEPARTMENT HAVE BEEN MET AND ARE COMPLIED WITH
10. FINAL POSITION OF SERVICES TO BE DETERMINED ON SITE

CITY OF TSHWANE
IGNITING EXCELLENCE
P O BOX 1022
PRETORIA
0001

CITY OF TSHWANE
WATER AND SANITATION
DEPARTMENT

AMENDMENTS

NO	DATE	APPROVED	DESCRIPTION	PAR
□				

WATER AND SANITATION
FOR INTERNAL APPROVAL - RECEIVED SIGN WHEN APPLICABLE

DIRECTOR: WATER AND SANITATION - PLANNING (ACTING) E.J VICTOR — JAN 2017
NAME Prof. Reg. No SIGNATURE DATE

REGIONAL DIRECTOR: (1,2,3,4,5,6 or 7)
NAME Prof. Reg. No SIGNATURE DATE

DIRECTOR: SYSTEM DEVELOPMENT
NAME Prof. Reg. No SIGNATURE DATE

DIRECTOR: BULK WATER
NAME Prof. Reg. No SIGNATURE DATE

DIRECTOR: INFRASTRUCTURE PROVISION
NAME Prof. Reg. No SIGNATURE DATE

DIRECTOR: WASTE WATER TREATMENT
NAME Prof. Reg. No SIGNATURE DATE

CONSULTANT DETAIL

I □□□□□□□□□□□□□□□□□□□□□□□□□□ Prof Reg No.□□□□□□□□□□□□□□□□□□□□□□□□
HEREBY CERTIFY THAT THE SERVICES WILL/HAVE BEEN INSTALLED ACCORDING TO NOTE 9 OF THE ABOVE NOTES AND TO THE DRAWING
SIGNATURE DATE

CONSULTANT DRAWING NUMBER: 0 REVISION

DESIGNED
NAME: Pr Eng. Prof Reg No:
SIGNATURE: DATE:

DRAWN
NAME: M. M. BURGER
SIGNATURE: DATE: FEBRUARY 2016

CHECKED
NAME: Pr Eng. Prof Reg No:
SIGNATURE: DATE:

INFORMATION OFFICE CHECKED
NAME:
SIGNATURE: DATE:

DESIGN OFFICE APPROVAL
NAME: T.F HILDER Prof Reg No: 880539
SIGNATURE: DATE: JAN 2017

CONTRACT No. --
PROJECT No. --
SHEET No. --
PAPER SIZE A1
SCALE AS SHOWN
DATE FEB 2016

PROJECT STATUS
RECEIVED SIGN WHEN APPLICABLE

○ CONCEPT DRAWING ○ TENDER DRAWING ○ APPROVED CONSTRUCTION DRAWING ○ AS BUILT DRAWING

PROJECT ENGINEER of COT:
NAME: Pr Eng. Prof Reg No:
SIGNATURE: DATE:

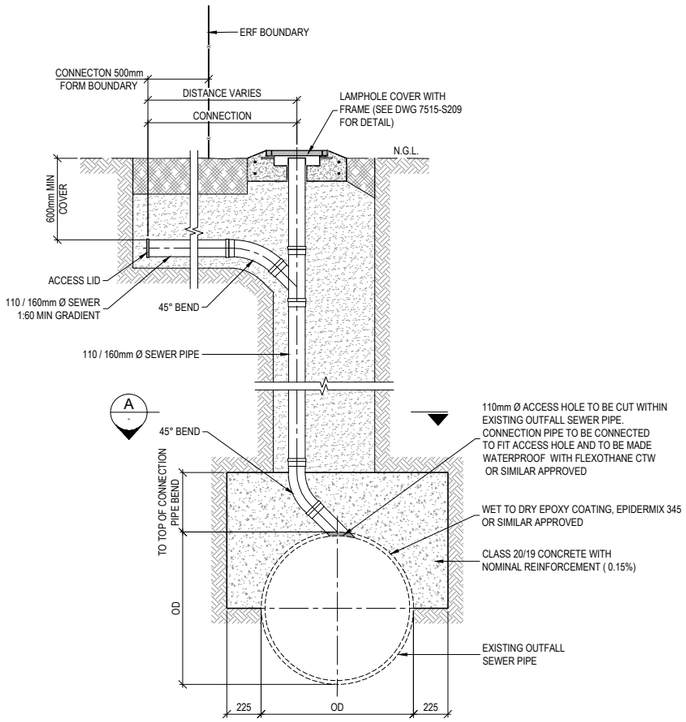
INSPECTOR OF WORKS of COT:
NAME: Prof Reg No:
SIGNATURE: DATE:

LOCATION OF PROJECT:

DESCRIPTION OF PROJECT:
STANDARD DRAWING :
TYPICAL DETAILS

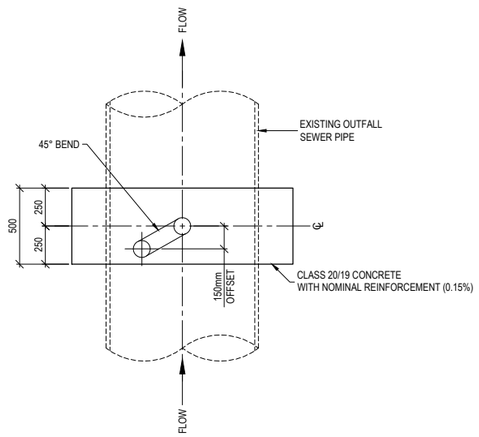
WBS No. :

COT DRAWING NUMBER: 7515-W216 0 REVISION



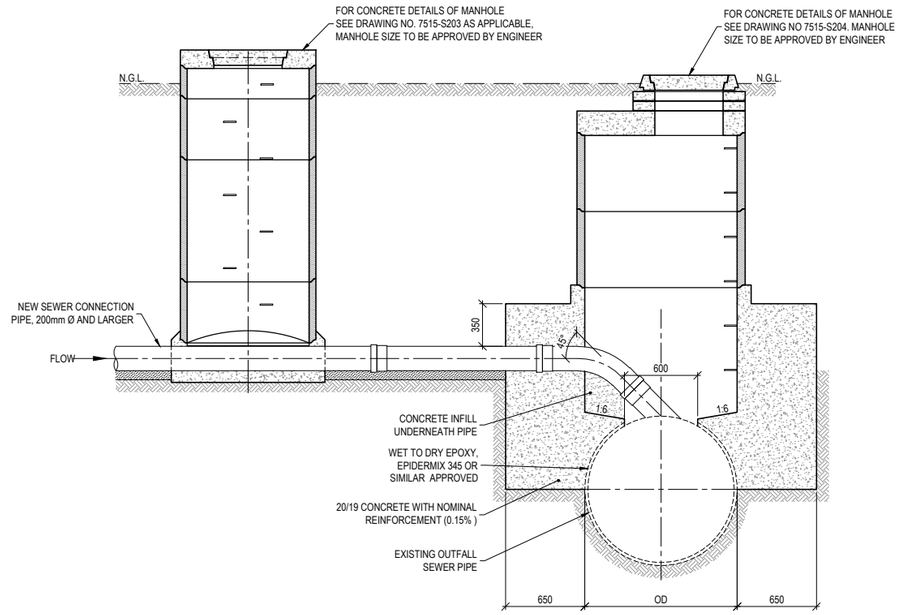
SECTION SHOWING DETAIL OF HOUSE CONNECTION INTO SEWERS LARGER THAN 300mm Ø

SCALE 1:20



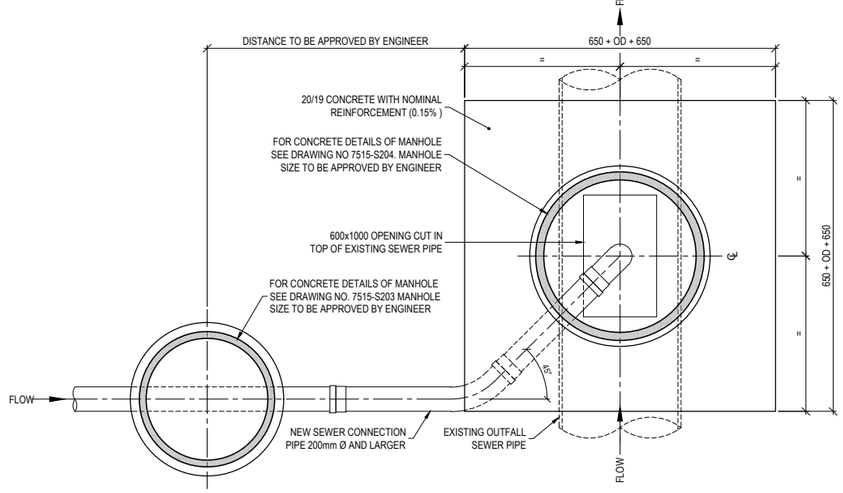
SECTION A
SCALE 1:20

110 / 160mm Ø CONNECTION TO OUTFALL SEWER PIPE



SECTION SHOWING TYPICAL DETAIL OF CONNECTION SEWER PIPE INTO OUTFALL SEWER PIPE

SCALE 1:25



PLAN SHOWING TYPICAL DETAIL OF CONNECTION SEWER PIPE INTO OUTFALL SEWER PIPE

SCALE 1:25

SEWER PIPES 200mm Ø & LARGER CONNECTION TO OUTFALL SEWER PIPE

NOTES AND SPECIFICATIONS

GENERAL

1. ALL MATERIAL AND WORKMANSHIP MUST COMPLY WITH THE REQUIREMENTS OF THE LATEST RELEVANT SANS STANDARD
2. ALL DIMENSIONS ARE IN mm (UNLESS OTHERWISE SPECIFIED)
3. DO NOT SCALE FROM THESE DRAWINGS
4. ALL DIMENSIONS TO BE CHECKED AND APPROVED ON SITE
5. ALL CONSTRUCTION TO BE DONE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, THIRD EDITION 2005 AND THE STANDARD COT DETAIL DRAWINGS
6. THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE STANDARD DRAWINGS (IF APPLICABLE)
7. THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, SERIES 3
8. THE SIGNATURE OR INITIALS ON THIS DRAWING OF ANY DIRECTOR OF THE WATER AND SANITATION DEPARTMENT, IN NO WAY, REMOVES ANY RESPONSIBILITY WHATSOEVER FROM THE CONSULTANT
9. THE CONSULTANT REMAINS RESPONSIBLE TO ENSURE THAT ALL THE GUIDELINES, STANDARD DRAWINGS, STANDARDS AND SPECIFICATIONS OF THE WATER AND SANITATION DEPARTMENT HAVE BEEN MET AND ARE COMPLIED WITH
10. FINAL POSITION OF SERVICES TO BE DETERMINED ON SITE
11. SEWERS INSTALLED WITHIN PROPERTIES ARE USUALLY PLACED 1.2m FROM ERF BOUNDARY UNLESS OTHERWISE SPECIFIED
12. SEWERS INSTALLED WITHIN THE ROAD RESERVE BOUNDARY MUST BE POSITIONED IN ACCORDANCE WITH THE APPLICABLE SERVICES LAYOUT DRAWING

CITY OF TSHWANE
IGNITING EXCELLENCE
P O BOX 1022
PRETORIA
0001

CITY OF TSHWANE
WATER AND SANITATION DEPARTMENT

AMENDMENTS

NO	DATE	APPROVED	DESCRIPTION	PAR
□				

WATER AND SANITATION
FOR INTERNAL APPROVAL - RECEIVED SIGN WHEN APPLICABLE

	NAME	Prof. Reg. No	SIGNATURE	DATE
DIRECTOR: WATER AND SANITATION - PLANNING (ACTING)	E.J VICTOR			JAN 2017
REGIONAL DIRECTOR: (1,2,3,4,5,6 or 7)				
DIRECTOR: SYSTEM DEVELOPMENT				
DIRECTOR: BULK WATER				
DIRECTOR: INFRASTRUCTURE PROVISION				
DIRECTOR: WASTE WATER TREATMENT				

CONSULTANT DETAIL

I ..... Prof Reg No. .....
HEREBY CERTIFY THAT THE SERVICES WILL/HAVE BEEN INSTALLED ACCORDING TO NOTE 9 OF THE ABOVE NOTES AND TO THE DRAWING
SIGNATURE DATE

CONSULTANT DRAWING NUMBER: A REVISION

DESIGNED
NAME: ____ Pr Eng. Prof Reg No: ____
SIGNATURE: ____ DATE: ____

DRAWN
NAME: M. M. BURGER
SIGNATURE: ____ DATE: NOVEMBER 2016

CHECKED
NAME: ____ Pr Eng. Prof Reg No: ____
SIGNATURE: ____ DATE: ____

INFORMATION OFFICE CHECKED
NAME: ____
SIGNATURE: ____ DATE: ____

DESIGN OFFICE APPROVAL
NAME: T.F HILDER Prof Reg No: 880539
SIGNATURE: ____ DATE: JAN 2017

CONTRACT No. 315-02
PROJECT No. 315-02
SHEET No. 1 OF
PAPER SIZE A1
SCALE 1:100
DATE 20.01.2016

PROJECT STATUS
RECEIVED SIGN WHEN APPLICABLE

○ CONCEPT DRAWING ○ TENDER DRAWING ○ APPROVED CONSTRUCTION DRAWING ○ AS BUILT DRAWING

PROJECT ENGINEER of COT:
NAME: ____ Pr Eng. Prof Reg No: ____
SIGNATURE: ____ DATE: ____

INSPECTOR OF WORKS of COT:
NAME: ____ Prof Reg No: ____
SIGNATURE: ____ DATE: ____

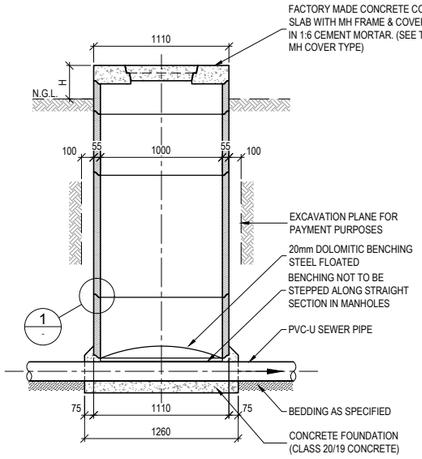
LOCATION OF PROJECT:

DESCRIPTION OF PROJECT:
STANDARD DRAWING :
TYPICAL SEWER CONNECTIONS TO EXISTING OUTFALL SEWER

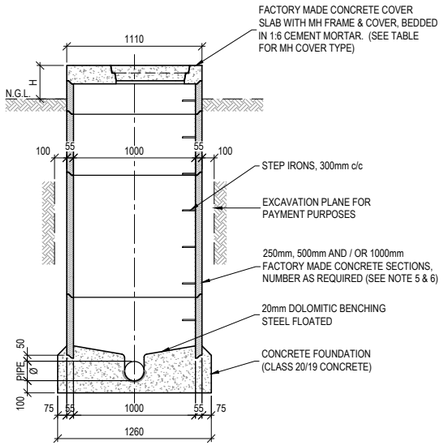
WBS No. :

COT DRAWING NUMBER: 7515-S210 A REVISION

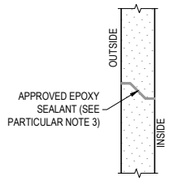
ALTERNATIVE LAYOUT WITH SPACERS



SECTION A
SCALE 1:25



SECTION B
SCALE 1:25



DETAIL 1
SCALE 1:5

MANHOLE COVERS AND FRAMES
SANS 50124 (SABS EN 124)

POSITION OF MANHOLE	FRAME AND COVER TYPE
CARRIAGEWAY	560mm Ø CLASS D400 POLYESTER RESIN
STREET RESERVE	560mm Ø CLASS B125 POLYESTER RESIN OR TYPE 4 CONCRETE REPLACEMENT
ERVEN	560mm Ø CLASS B125 POLYESTER RESIN OR TYPE 4 CONCRETE REPLACEMENT
GENERAL	ONLY 560mm Ø, CLASS D400 POLYESTER RESIN MAY BE USED FOR SEWERS 300mm Ø AND LARGER

NOTE : CAST IRON COVERS AND FRAMES ARE USED ONLY WITH WRITTEN INSTRUCTIONS FROM THE ENGINEER

MANHOLE CHAMBER SIZES

NOMINAL Ø (mm)	USAGE
1000	150 ND PIPES WITH STRAIGHT THROUGH MANHOLES UP TO 1.25m DEEP
1250	BENDS IN MANHOLES, LARGER PIPES & MANHOLES BETWEEN 1.25m & 3.0m DEEP
1500	LARGER PIPES & MANHOLES DEEPER THAN 3.0 m

NOTE : MANHOLE CHAMBER SIZES TO BE APPROVED BY THE EXECUTIVE DIRECTOR : WATER AND SANITATION

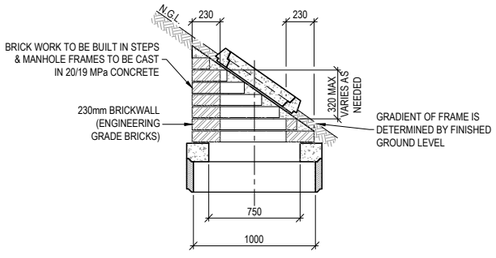
NOTES AND SPECIFICATIONS

GENERAL

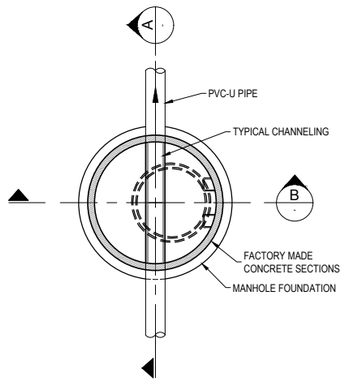
1. ALL MATERIAL AND WORKMANSHIP MUST COMPLY WITH THE REQUIREMENTS OF THE LATEST RELEVANT SANS STANDARD
2. ALL DIMENSIONS ARE IN mm (UNLESS OTHERWISE SPECIFIED)
3. DO NOT SCALE FROM THESE DRAWINGS
4. ALL DIMENSIONS TO BE CHECKED AND APPROVED ON SITE
5. ALL CONSTRUCTION TO BE DONE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, THIRD EDITION 2005 AND THE STANDARD COT DETAIL DRAWINGS
6. THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE STANDARD DRAWINGS (IF APPLICABLE)
7. THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, SERIES 3
8. THE SIGNATURE OR INITIALS ON THIS DRAWING OF ANY DIRECTOR OF THE WATER AND SANITATION DEPARTMENT, IN NO WAY, REMOVES ANY RESPONSIBILITY WHATSOEVER FROM THE CONSULTANT
9. THE CONSULTANT REMAINS RESPONSIBLE TO ENSURE THAT ALL THE GUIDELINES, STANDARD DRAWINGS, STANDARDS AND SPECIFICATIONS OF THE WATER AND SANITATION DEPARTMENT HAVE BEEN MET AND ARE COMPLIED WITH
10. FINAL POSITION OF SERVICES TO BE DETERMINED ON SITE
11. SEWERS INSTALLED WITHIN PROPERTIES ARE USUALLY PLACED 1.2m FROM ERF BOUNDARY UNLESS OTHERWISE SPECIFIED
12. SEWERS INSTALLED WITHIN ROAD RESERVE BOUNDARY MUST BE POSITIONED IN ACCORDANCE WITH THE APPLICABLE SERVICES LAYOUT DRAWING

PARTICULAR

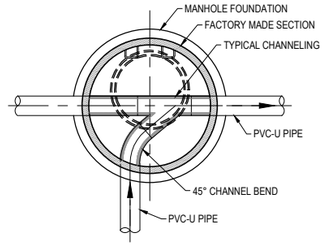
1. STEP IRONS TO BE COPOLYMER POLYPROPYLENE ENCAPSULED 12mm HIGH TENSILE STEEL BAR, "CALCAMITE" OR SIMILAR
2. TYPICAL VALUES FOR H
   H = 50 - 75mm WITHIN ERVEN & ROAD RESERVES
   = 250mm LOW COST HOUSING DEVELOPMENTS & UNDEFINED ROADWAYS
   = 500mm OPEN VELD OR ROAD RESERVES WHERE POSITION OF MANHOLES CAN BE CONCEALED BY LONG GRASS OR OTHER GROWTH
3. CONCRETE SECTIONS MUST BE FIXED WITH AN APPROVED EPOXY SEALER SUCH AS EPIDERMIX 344 OR PROSTRUCT 687



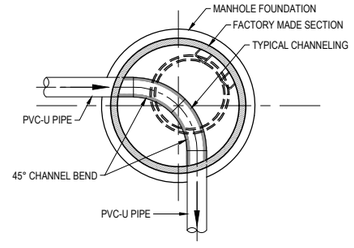
TYPICAL SECTION
SCALE 1:25
BUILT IN MANHOLE FRAME AT FINISHED SLOPED SIDEWALKS
(WITH WRITTEN PERMISSION FROM THE ENGINEER ONLY)



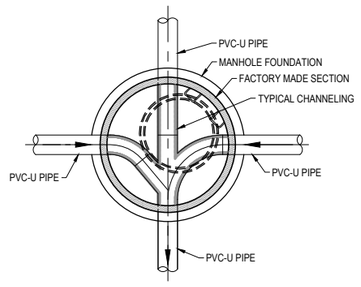
PLAN
SCALE 1:25
(TYPICAL EXAMPLE OF THROUGH CONNECTION IN MANHOLE)



PLAN
SCALE 1:25
(TYPICAL EXAMPLE OF 90° CONNECTION IN MANHOLE)



PLAN
SCALE 1:25
(TYPICAL EXAMPLE OF 90° BEND IN MANHOLE)



PLAN
SCALE 1:25
(TYPICAL EXAMPLE OF SIDE CONNECTIONS IN MANHOLE)

TYPICAL MANHOLE LAYOUTS SHOWING POSITIONS OF MANHOLE FRAME, STEPS & CHANNELING

CITY OF TSHWANE
IGNITING EXCELLENCE
P O BOX 1022
PRETORIA
0001

CITY OF TSHWANE
WATER AND SANITATION DEPARTMENT

AMENDMENTS

NO	DATE	APPROVED	DESCRIPTION	PAR
□				

WATER AND SANITATION
FOR INTERNAL APPROVAL - RECEIVED SIGN WHEN APPLICABLE

DIRECTOR: WATER AND SANITATION - PLANNING(ACTING) E.J VICTOR — JAN 2017
REGIONAL DIRECTOR: (1,2,3,4,5,6 or 7)
DIRECTOR: SYSTEM DEVELOPMENT
DIRECTOR: BULK WATER
DIRECTOR: INFRASTRUCTURE PROVISION
DIRECTOR: WASTE WATER TREATMENT

(NAME / Prof. Reg. No / SIGNATURE / DATE)

CONSULTANT DETAIL

I ..... Prof Reg No. .....
HEREBY CERTIFY THAT THE SERVICES WILL/HAVE BEEN INSTALLED ACCORDING TO NOTE 9 OF THE ABOVE NOTES AND TO THE DRAWING
SIGNATURE DATE
CONSULTANT DRAWING NUMBER: A REVISION

DESIGNED
NAME: _____ Pr Eng. Prof Reg No: _____
SIGNATURE: _____ DATE: _____

DRAWN
NAME: M. M. BURGER
SIGNATURE: _____ DATE: MARCH 2016

CHECKED
NAME: _____ Pr Eng. Prof Reg No: _____
SIGNATURE: _____ DATE: _____

INFORMATION OFFICE CHECKED
NAME: _____
SIGNATURE: _____ DATE: _____

DESIGN OFFICE APPROVAL
NAME: T.F HILDER Prof Reg No: 880539
SIGNATURE: _____ DATE: JAN 2017

CONTRACT No.	315-02
PROJECT No.	315-02
SHEET No.	1 OF
PAPER SIZE	A1
SCALE	1:100
DATE	20.01.2016

PROJECT STATUS
RECEIVED SIGN WHEN APPLICABLE

○ CONCEPT DRAWING ○ TENDER DRAWING ○ APPROVED CONSTRUCTION DRAWING ○ AS BUILT DRAWING

PROJECT ENGINEER of COT:
NAME: _____ Pr Eng. Prof Reg No: _____
SIGNATURE: _____ DATE: _____

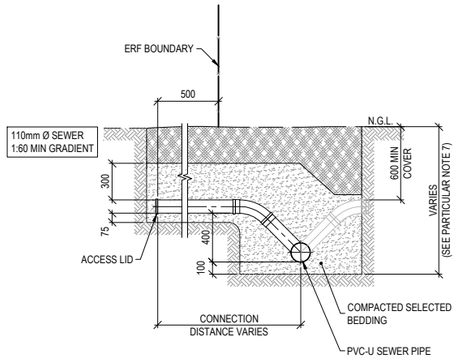
INSPECTOR OF WORKS of COT:
NAME: _____ Prof Reg No: _____
SIGNATURE: _____ DATE: _____

LOCATION OF PROJECT:

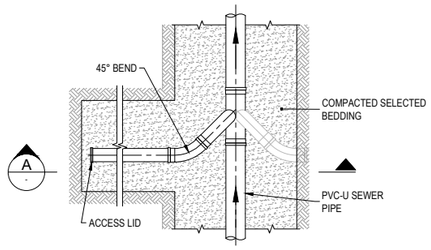
DESCRIPTION OF PROJECT:
STANDARD DRAWING :
MANHOLE DETAILS FOR SEWER PIPES UP TO 300mm NOMINAL DIAMETER

WBS No. :

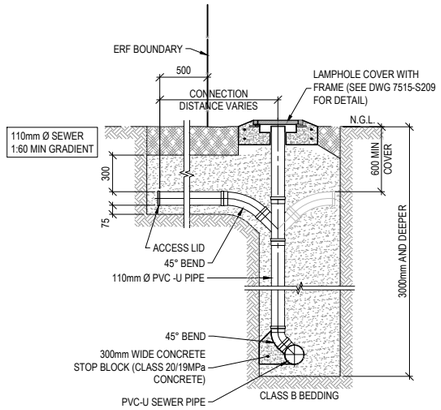
COT DRAWING NUMBER: 7515-S203 A REVISION



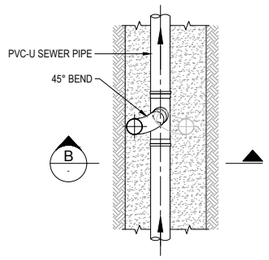
SECTION A
SCALE 1:25



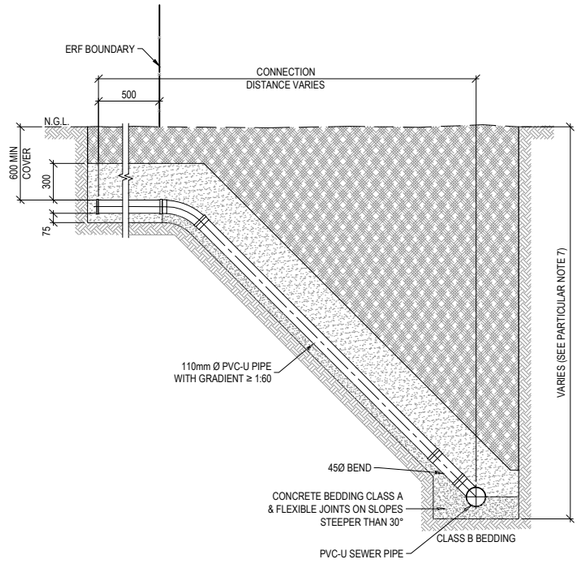
PLAN
PLAN - HOUSE CONNECTION TYPE A
SCALE 1:25



SECTION B
SCALE 1:25



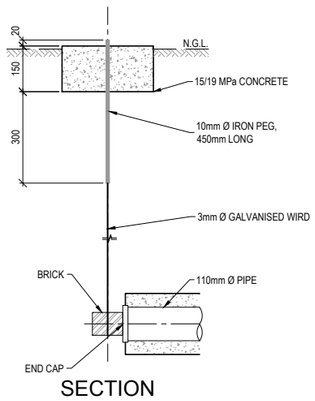
PLAN
HOUSE CONNECTION TYPE B



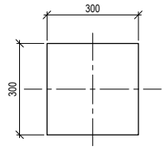
SECTION
HOUSE CONNECTION TYPE C
SCALE 1:25

PLAN
HOUSE CONNECTION TYPE D
SCALE 1:25
(CONNECTION AT MANHOLE)

TYPICAL SECTION SHOWING DETAIL
OF HOUSE CONNECTION ONTO SEWERS
LARGER THAN 300 mm Ø
SCALE 1:25



SECTION



PLAN
HOUSE CONNECTION
MARKER BLOCK
SCALE 1:20

NOTES AND SPECIFICATIONS

GENERAL

1. ALL MATERIAL AND WORKMANSHIP MUST COMPLY WITH THE REQUIREMENTS OF THE LATEST RELEVANT SANS STANDARD
2. ALL DIMENSIONS ARE IN mm (UNLESS OTHERWISE SPECIFIED)
3. DO NOT SCALE FROM THESE DRAWINGS
4. ALL DIMENSIONS TO BE CHECKED AND APPROVED ON SITE
5. ALL CONSTRUCTION TO BE DONE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, THIRD EDITION 2005 AND THE STANDARD COT DETAIL DRAWINGS
6. THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE STANDARD DRAWINGS (IF APPLICABLE)
7. THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, SERIES 3
8. THE SIGNATURE OR INITIALS ON THIS DRAWING OF ANY DIRECTOR OF THE WATER AND SANITATION DEPARTMENT, IN NO WAY, REMOVES ANY RESPONSIBILITY WHATSOEVER FROM THE CONSULTANT
9. THE CONSULTANT REMAINS RESPONSIBLE TO ENSURE THAT ALL THE GUIDELINES, STANDARD DRAWINGS, STANDARDS AND SPECIFICATIONS OF THE WATER AND SANITATION DEPARTMENT HAVE BEEN MET AND ARE COMPLIED WITH
10. FINAL POSITION OF SERVICES TO BE DETERMINED ON SITE
11. SEWERS INSTALLED WITHIN PROPERTIES ARE USUALLY PLACED 1.2m FROM ERF BOUNDARY UNLESS OTHERWISE SPECIFIED
12. SEWERS INSTALLED WITHIN THE ROAD RESERVE BOUNDARY MUST BE POSITIONED IN ACCORDANCE WITH THE APPLICABLE SERVICES LAYOUT DRAWING

PARTICULAR

1. HOUSE CONNECTION TYPE A IS BUILT WHERE SEWER IS SHALLOWER THAN 3.0m AND IS GENERALLY USED
2. HOUSE CONNECTION TYPE B IS BUILT WHERE SEWER IS DEEPER THAN 3.0m
3. HOUSE CONNECTION TYPE C IS ONLY TO BE BUILT ON WRITTEN INSTRUCTION FROM THE ENGINEER
4. HOUSE CONNECTION TYPE B IS ALSO BUILT WHERE SEWER IS SITUATED UNDER CARRIAGEWAY AND DEEPER THAN 3.0m
5. IN CASES WHERE SEWER UNDER CARRIAGEWAY IS SHALLOWER THAN 3.0m. TYPE A OR TYPE C HOUSE CONNECTION IS TO BE BUILT
6. HOUSE CONNECTION TYPE D IS BUILT WHERE HOUSE CONNECTION AND MANHOLE POSITION COINCIDE
7. MINIMUM COVER FOR MAIN SEWER IS 1000mm
8. PVC PIPES AND FITTINGS SHALL COMPLY WITH SANS 1601 FOR STIFFNESS CLASS 400 PIPES
9. POLYESTER RESIN LAMPHOLE COVER AND FRAME TO BE IN ACCORDANCE WITH SANS 50124 (SABS EN124)
10. CONNECTION FOR LARGE RESIDENTIAL BUSUNESS AND INDUSTRIAL STANDS MUST BE 160mm Ø

CITY OF TSHWANE
IGNITING EXCELLENCE
P O BOX 1022
PRETORIA
0001
CITY OF TSHWANE
WATER AND SANITATION
DEPARTMENT

AMENDMENTS

NO	DATE	APPROVED	DESCRIPTION	PAR
□				

WATER AND SANITATION
FOR INTERNAL APPROVAL - RECEIVED SIGN WHEN APPLICABLE

	NAME	Prof. Reg. No	SIGNATURE	DATE
DIRECTOR: WATER AND SANITATION - PLANNING (ACTING)	E.J VICTOR			JAN 2017
REGIONAL DIRECTOR: (1,2,3,4,5,6 or 7)				
DIRECTOR: SYSTEM DEVELOPMENT				
DIRECTOR: BULK WATER				
DIRECTOR: INFRASTRUCTURE PROVISION				
DIRECTOR: WASTE WATER TREATMENT				

CONSULTANT DETAIL

I □□□□□□□□□□□□□□□□□□□□□□□□□□□□ Prof Reg No.□□□□□□□□□□□□□□□□□□□□□□□□□□□□
HEREBY CERTIFY THAT THE SERVICES WILL/HAVE BEEN INSTALLED ACCORDING TO NOTE 9 OF THE ABOVE NOTES AND TO THE DRAWING
SIGNATURE DATE
CONSULTANT DRAWING NUMBER: A REVISION

DESIGNED
NAME: _____ Pr Eng. Prof Reg No: _____
SIGNATURE: _____ DATE: _____

DRAWN
NAME: M. M. BURGER
SIGNATURE: _____ DATE: MARCH 2016

CHECKED
NAME: _____ Pr Eng. Prof Reg No: _____
SIGNATURE: _____ DATE: _____

INFORMATION OFFICE CHECKED
NAME: _____
SIGNATURE: _____ DATE: _____

DESIGN OFFICE APPROVAL
NAME: T.F HILDER Prof Reg No: 880539
SIGNATURE: _____ DATE: JAN 2017

CONTRACT No. 315-02
PROJECT No. 315-02
SHEET No. 1 OF
PAPER SIZE A1
SCALE 1:100
DATE 20.01.2016

PROJECT STATUS
RECEIVED SIGN WHEN APPLICABLE
○ CONCEPT DRAWING ○ TENDER DRAWING ○ APPROVED CONSTRUCTION DRAWING ○ AS BUILT DRAWING

PROJECT ENGINEER of COT:
NAME: _____ Pr Eng. Prof Reg No: _____
SIGNATURE: _____ DATE: _____

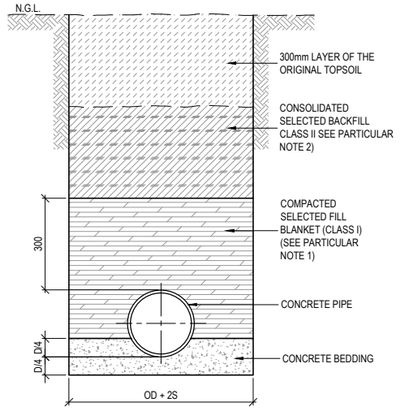
INSPECTOR OF WORKS of COT:
NAME: _____ Prof Reg No: _____
SIGNATURE: _____ DATE: _____

LOCATION OF PROJECT:

DESCRIPTION OF PROJECT:
STANDARD DRAWING :
SEWER HOUSE CONNECTION
DETAILS

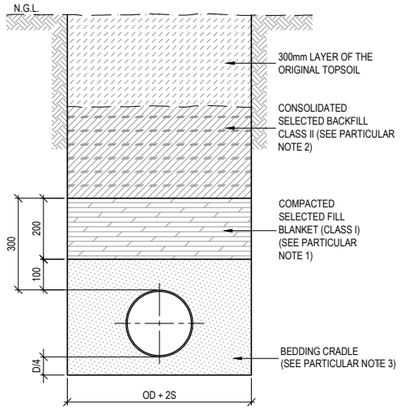
WBS No. :

COT DRAWING NUMBER: 7515-S206 A REVISION

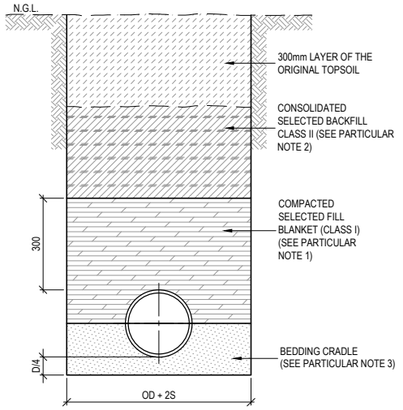


CLASS A BEDDING
FOR RIGID PIPE LINE
SCALE 1:10

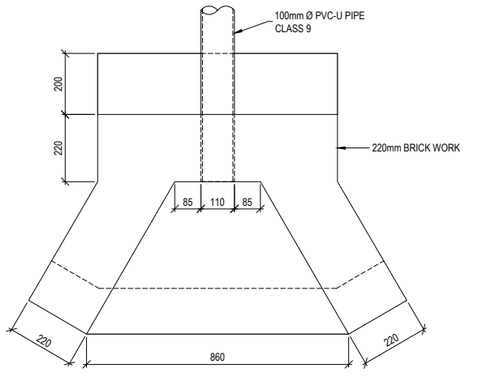
S = 200mm FOR PIPES WITH OD ≤ 620mm
S = 450mm FOR PIPES WITH OD > 620mm



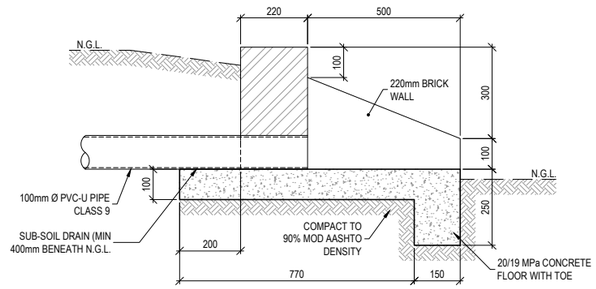
CLASS B BEDDING
FOR FLEXIBLE PIPE LINE
SCALE 1:10



CLASS B BEDDING
FOR RIGID PIPE LINE
SCALE 1:10

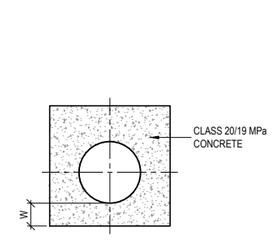


PLAN

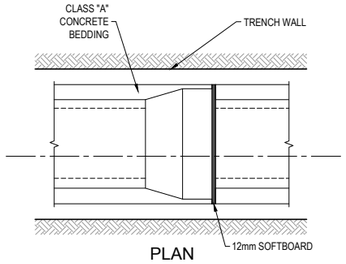


ELEVATION

OUTLET STRUCTURE FOR SUB-SOIL DRAINS
SCALE 1:10

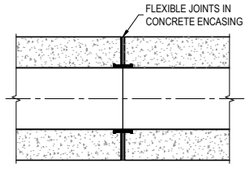


CROSS SECTION



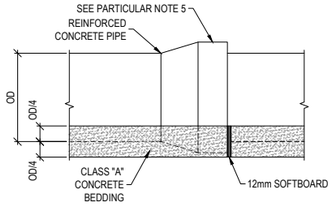
PLAN

CONCRETE ENCASING :
W = 100mm FOR PIPES ≤ 225mm NOMINAL DIAMETER
W = 150mm FOR PIPES BETWEEN 225mm & 525mm
W = D/4 FOR PIPES ≥ 600mm NOMINAL DIAMETER



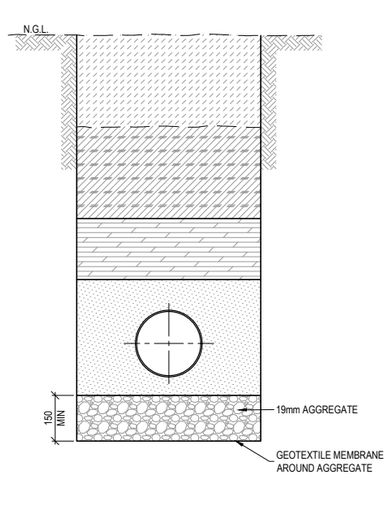
LONG SECTION

PIPE ENCASING DETAIL
SCALE 1:10



SIDE ELEVATION

CLASS "A" BEDDING DETAIL
SCALE 1:10



TYPICAL SUBSURFACE DRAINS
SCALE 1:10

NOTES AND SPECIFICATIONS

GENERAL

1. ALL MATERIAL AND WORKMANSHIP MUST COMPLY WITH THE REQUIREMENTS OF THE LATEST RELEVANT SANS STANDARD
2. ALL DIMENSIONS ARE IN mm (UNLESS OTHERWISE SPECIFIED)
3. DO NOT SCALE FROM THESE DRAWINGS
4. ALL DIMENSIONS TO BE CHECKED AND APPROVED ON SITE
5. ALL CONSTRUCTION TO BE DONE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, THIRD EDITION 2005 AND THE STANDARD COT DETAIL DRAWINGS
6. THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE STANDARD DRAWINGS (IF APPLICABLE)
7. THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, SERIES 3
8. THE SIGNATURE OR INITALS ON THIS DRAWING OF ANY DIRECTOR OF THE WATER AND SANITATION DEPARTMENT, IN NO WAY, REMOVES ANY RESPONSIBILITY WHATSOEVER FROM THE CONSULTANT
9. THE CONSULTANT REMAINS RESPONSIBLE TO ENSURE THAT ALL THE GUIDELINES, STANDARD DRAWINGS, STANDARDS AND SPECIFICATIONS OF THE WATER AND SANITATION DEPARTMENT HAVE BEEN MET AND ARE COMPLIED WITH
10. FINAL POSITION OF SERVICES TO BE DETERMINED ON SITE
11. SEWERS INSTALLED WITHIN PROPERTIES ARE USUALLY PLACED 1.2m FROM ERF BOUNDARY UNLESS OTHERWISE SPECIFIED
12. SEWERS INSTALLED WITHIN THE ROAD RESERVE BOUNDARY MUST BE POSITIONED IN ACCORDANCE WITH THE APPLICABLE SERVICES LAYOUT DRAWING

PARTICULAR

1. SELECTED BACKFILL CLASS I : IMPLIES APPROVED SELECTED MATERERIAL FROM TRENCH EXCAVATION, FREE FROM STONES AND WITH AN OPTIMUM MOISTURE CONTENT
2. SELECTED BACKFILL CLASS II : IMPLIES SELECTED BACKFILL FROM TRENCH EXCAVATION, WHICH SHALL NOT CONTAIN ANY STONES LARGER THAN 150mm Ø
3. CLASS B BEDDING CRADLE SHALL CONSIST OF AN APPROVED SELECTED GRAVEL MATERIAL WITH A PI NOT EXCEEDING 6, FREE FROM STONES EXCEEDING 20mm, ORGANIC MATTER & LUMPS OF CLAY
4. CLASS A BEDDING / ENCASING CONCRETE BETWEEN JOINTS SHALL BE POURED IN ONE CONTINUOUS OPERATION USING CLASS 20/19 MPa CONCRETE
5. FLEXIBLE JOINTS MUST BE PROVIDED AT EACH PIPE JOINT IN A CLASS A CONCRETE BEDDING / ENCASING, WITH A 12mm THK SOFTBOARD PLACED VERTICALLY FOR THE ENTIRE CONCRETE AREA. PIPE JOINTS MUST BE SEALED WITH WET CLAY TO PREVENT SLUSH FROM PENETRATING THE JOINT
6. EXCEPT FOR THE 300mm BACKFILL ON THE TOP OF THE PIPE, THE BALANCE OF THE TRENCH MAY BE BACKFILLED WHEN THE CLASS A BEDDING / ENCASING HAS OBTAINED THE COMPRESSIVE STRENGTH OF 15 MPa

CITY OF TSHWANE
IGNITING EXCELLENCE

P O BOX 1022
PRETORIA
0001

CITY OF TSHWANE
WATER AND SANITATION DEPARTMENT

AMENDMENTS

NO	DATE	APPROVED	DESCRIPTION	PAR
1				

WATER AND SANITATION

FOR INTERNAL APPROVAL - RECEIVED SIGN WHEN APPLICABLE

	NAME	Prof. Reg. No	SIGNATURE	DATE
DIRECTOR: WATER AND SANITATION - PLANNING(ACTING)	E.J VICTOR			JAN 2017
REGIONAL DIRECTOR: (1,2,3,4,5,6 or 7)				
DIRECTOR: SYSTEM DEVELOPMENT				
DIRECTOR: BULK WATER				
DIRECTOR: INFRASTRUCTURE PROVISION				
DIRECTOR: WASTE WATER TREATMENT				

CONSULTANT DETAIL

I □□□□□□□□□□□□□□□□□□□□□□□□□□Prof Reg No.□□□□□□□□□□□□□□□□□□□□□□□□□□
HEREBY CERTIFY THAT THE SERVICES WILL/HAVE BEEN INSTALLED ACCORDING TO NOTE 9 OF THE ABOVE NOTES AND TO THE DRAWING

SIGNATURE DATE

CONSULTANT DRAWING NUMBER: A REVISION

DESIGNED	NAME: R. P. AINSLIE	Pr Eng.	Prof Reg No: 810370
	SIGNATURE:	DATE: MARCH 2016	
DRAWN	NAME: M. M. BURGER		
	SIGNATURE:	DATE: MARCH 2016	
CHECKED	NAME:	Pr Eng.	Prof Reg No:
	SIGNATURE:	DATE:	
INFORMATION OFFICE CHECKED	NAME:		
	SIGNATURE:	DATE:	
DESIGN OFFICE APPROVAL	NAME: T.F HILDER	Prof Reg No: 880539	
	SIGNATURE:	DATE: JAN 2017	

CONTRACT No.	315-02
PROJECT No.	315-02
SHEET No.	1 OF
PAPER SIZE	A1
SCALE	1:100
DATE	20.01.2016

PROJECT STATUS

RECEIVED SIGN WHEN APPLICABLE

○ CONCEPT DRAWING ○ TENDER DRAWING ○ APPROVED CONSTRUCTION DRAWING ○ AS BUILT DRAWING

PROJECT ENGINEER of COT:
NAME: Pr Eng. Prof Reg No:
SIGNATURE: DATE:

INSPECTOR OF WORKS of COT:
NAME: Prof Reg No:
SIGNATURE: DATE:

LOCATION OF PROJECT:

DESCRIPTION OF PROJECT:
STANDARD DRAWING :
SEWER PIPE TRENCHES
AND BEDDING DETAILS

WBS No. :

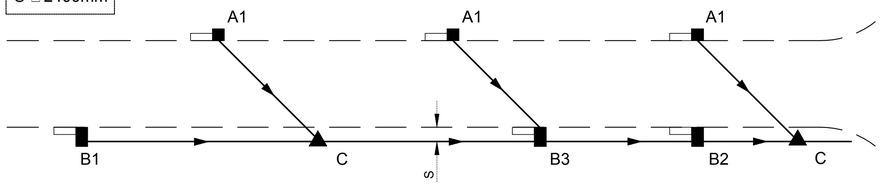
COT DRAWING NUMBER: 7515-S205 A REVISION

TYPICAL JUNCTION BOX CONFIGURATIONS

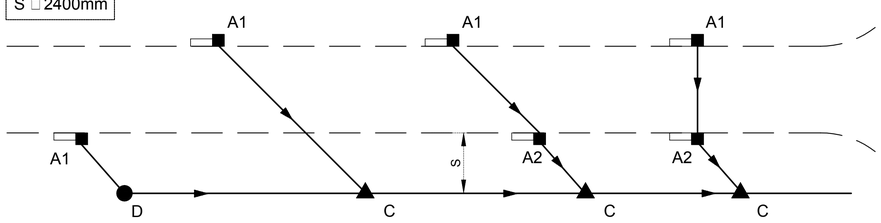
LEGEND:

- A– TYPE JUNCTION BOX TO CONNECT CATCHPIT WITH PIPES, SIZE: 900mm x 600mm
- B– TYPE JUNCTION BOX TO CONNECT CATCHPIT WITH PIPES, SIZE: 900mm x VARIES
- 1 CONNECTING 1 PIPE TO JUNCTION BOX AT CATCHPIT
- 2 CONNECTING 2 PIPES TO JUNCTION BOX AT CATCHPIT
- 3 CONNECTING 3 PIPES TO JUNCTION BOX AT CATCHPIT
- C– TYPE JUNCTION BOX CONNECTING 3 PIPES (NO CATCHPIT), SIZE VARIES
- D– TYPE JUNCTION BOX CONNECTING 2 PIPES (NO CATCHPIT), SIZE VARIES
- ROAD EDGE
- STORMWATER PIPE AND DIRECTION OF FLOW
- CATCHPIT
- S DISTANCE FROM ROAD EDGE TO FURTHEST WALL OF PIPE OF CULVERT

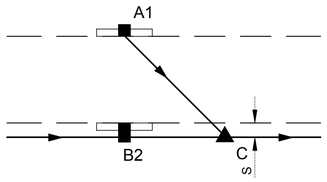
S □ 2400mm



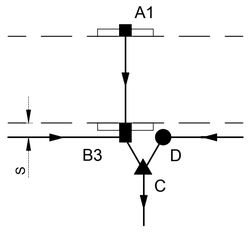
S □ 2400mm



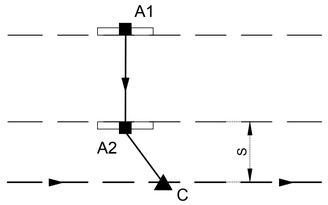
LOW POINT, S □ 2400mm



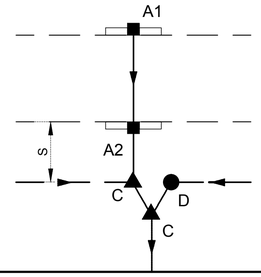
LOW POINT, S □ 2400mm



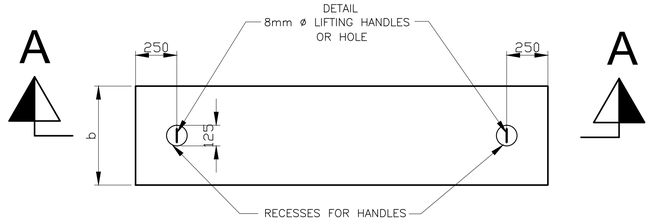
LOW POINT, S □2400mm



LOW POINT, S □ 2400mm

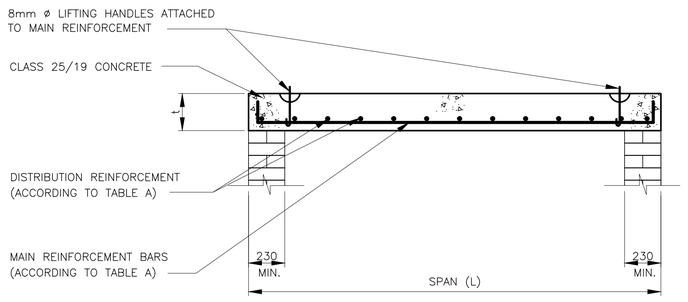


PRECAST COVER SLAB FOR JUNCTION BOXES



PLAN OF PRECAST COVER SLAB

SCALE 1: 20



SECTION A-A

SCALE 1: 20

TABLE A: PRECAST COVER SLAB REINFORCEMENT DETAILS

Span (mm) L	Thickness (mm) t	Main Reinforcement	
		□□450	□□600
Up to 500	125	4Y12 -125	5Y12 -125
Up to 1000	150	5Y12 -100	5Y12 - 125
Up to 1250	150	4Y16 -125	5Y12 - 125
Up to 1500	175	4Y 16 -125	5Y12 - 125
Up to 1750	175	4Y16 -125	5Y16 - 125
Up to 2000	200	4Y16 -125	5Y16 - 125
Up to 2250	200	4Y 16 -125	5Y16 - 125
Up to 2500	200	5Y16 -100	5Y16 - 125
Up to 2750	225	5Y16 -100	5Y16 - 125
Up to 3000	225	5Y16 -100	6Y16 - 125
Distri□ution reinforcement: Y10 □ars □ 125 c/c for all spans			
Refer to notes for □ending details.			

NOTES AND SPECIFICATIONS

1. JUNCTION BOX CONFIGURATION

1.1 S□m□ols used to indicate the junction □ox t□pes are onl□for purposes of this drawing, and not applica□le to working drawings.

2. PRECAST COVER SLABS

2.1 Concrete to □e class 25/19 (25MPa)
2.2 Concrete to □e cured for a minimum period of 7 da□s.
2.3 Minimum cover to reinforcement □ 20mm
2.4 Lifting handles as specified or otherwise approved □□the Engineer.
2.5 Reinforcement
i) T□pe, □ar and spacing as specified in Ta□le A.
ii) Main reinforcement to □e shape code 38, with hook length (A dimension) not less than t - 60, except for sla□s with a span not exceeding 1000mm, where no hooks are re□uired and shape code 20 is used.
2.6 Also refer to section 502, 702, 703 and 704 of the Standard Specifications for Municipal Civil Engineering Works, 3rd Edition, 2005.

AMENDMENTS

NR.	DATE	APPROVED	DESCRIPTION	PAR.

DESIGNED: P. A. ODENDAAL Pr.Eng. (SIGNATURE / DATE)
DRAWN: S. AUDIE
DESIGN CHECKED BY: P. A. ODENDAAL Pr.Eng. (SIGNATURE / DATE)
INFRASTRUCTURE TECHNICAL INFORMATION MANAGEMENT: D.J. CHALMERS (SIGNATURE / DATE)

PROJECT STATUS

○ CONCEPT DRAWING ○ TENDER DRAWING ○ APPROVED FOR CONSTRUCTION DRAWING ○ AS BUILT DRAWING

PROJECT ENGINEER (CONSULTANT)
INITIALS AND SURNAME / SIGNATURE AND Pr. No. / DATE
INSPECTOR OF WORKS (CITY OF TSHWANE):
INITIALS AND SURNAME / SIGNATURE AND Pr. No. / DATE

CONSULTANT DETAIL

CITY OF TSHWANE
ROADS AND TRANSPORT DEPARTMENT

Mr P. I. Lettonkane
STRATEGIC EXECUTIVE DIRECTOR
P.O. BOX 1409
PRETORIA
0001

Ms. L. V. Kegakilwe-Piki
EXECUTIVE DIRECTOR
P.O. BOX 1409
PRETORIA
0001

DRAWING APPROVED BY EXECUTIVE DIRECTOR
Ms. L. V. Kegakilwe-Piki
SIGNATURE: DATE:

LOCATION OF PROJECT:

TYPICAL STANDARD DETAILS

DESCRIPTION OF PROJECT

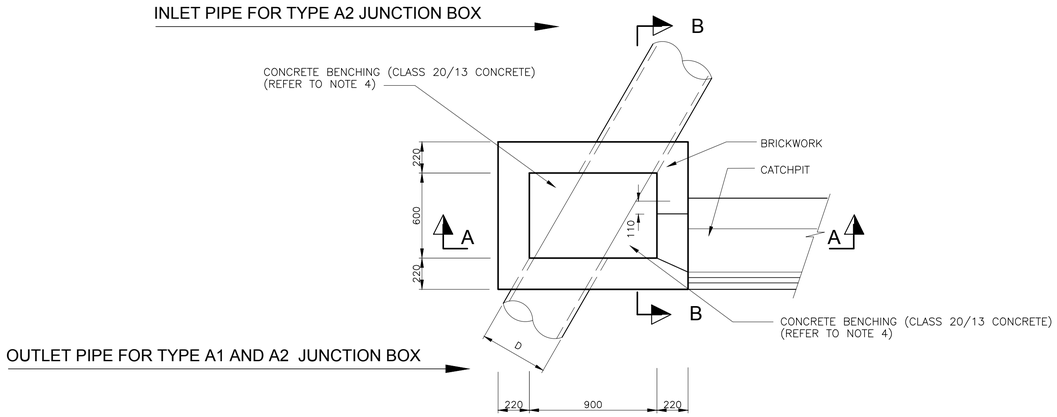
JUNCTION BOX AND MANHOLE DETAILS

TYPICAL JUNCTION BOX CONFIGURATION AND COVER SLAB DETAIL

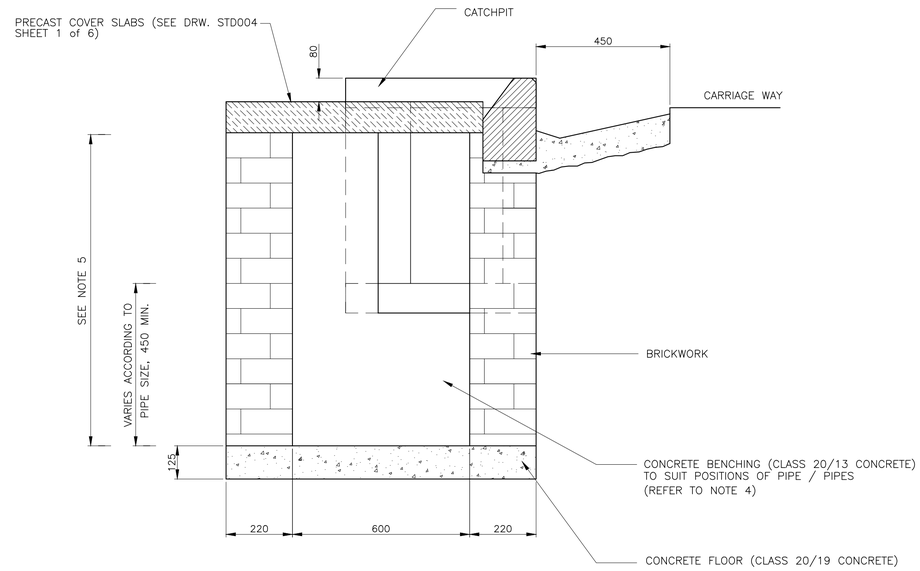
CONTRACT No. :
PROJECT No. :
DATE : MAY 2013
SCALE : AS SHOWN
ORIGINAL PAPER SIZE: A1
DRAWING NO. STD004
SHEET NO: 1 OF 7
REVISION 0

ROADS AND STORMWATER
For Internal Approval
RECEIVED
SIGN WHEN APPLICABLE
DIRECTOR: INFRASTRUCTURE PROVISION (SIGNATURE / DATE)
DIRECTOR: INFRASTRUCTURE CONSTRUCTION (PROJECT) MANAGEMENT (SIGNATURE / DATE)
DIRECTOR: INFRASTRUCTUREASSET MANAGEMENT (SIGNATURE / DATE)
DIRECTOR: TRANSPORT INFRASTRUCTURE PLANNING (SIGNATURE / DATE)
DIRECTOR: INTELLIGENT TRANSPORT SYSTEN AND TRAFFIC ENGINEERING ENGINEERING (SIGNATURE / DATE)
DIRECTOR: INFRASTRUCTURE MAINTENANCE MANAGEMENT (MM) (SIGNATURE / DATE)

0 10 20 40 60 80m
SCALE 1:1000

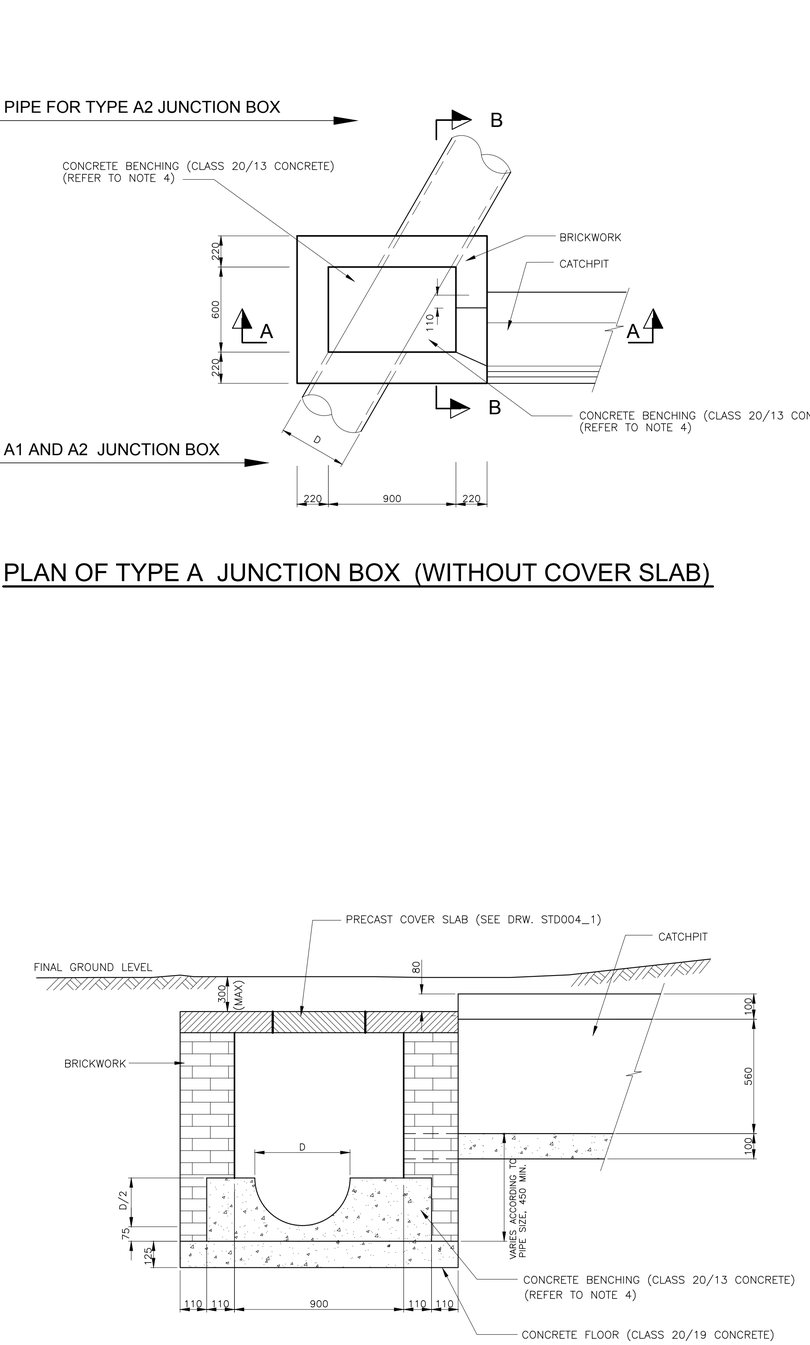


PLAN OF TYPE A JUNCTION BOX (WITHOUT COVER SLAB)



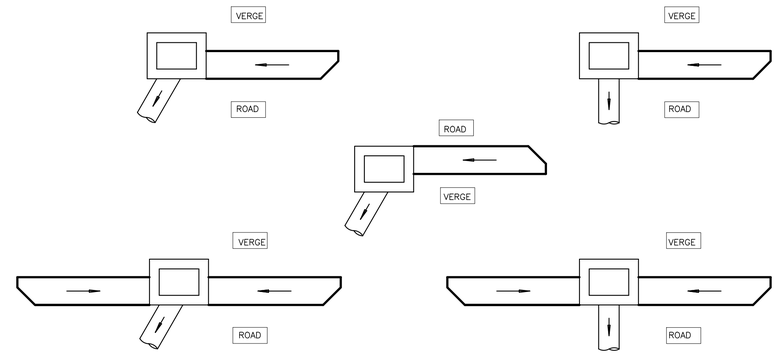
SECTION B-B

(CONCRETE BENCHING NOT SHOWN)

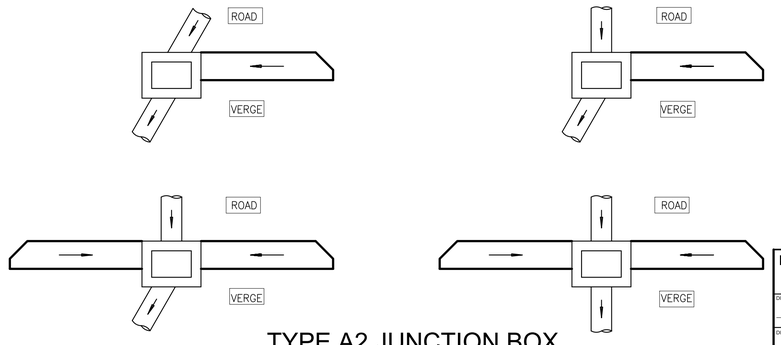


SECTION A-A

(INLET / OUTLET PIPES NOT SHOWN)



TYPE A1 JUNCTION BOX



TYPE A2 JUNCTION BOX

NOTES AND SPECIFICATIONS

1. All stormwater pipes to □e laid soffit to soffit
2. Minimum pipe diameter of pipes is 450mm.
3. Maximum angle between adjoining pipes is 60°.
4. Where a pipe wall is at least 75mm from the nearest junction □ox wall, the concrete □encing can □e started adjacent to the dou□le □rick wall.
5. Where the total depth of the junction □ox (invert level to finished ground level) exceeds 2,0m a structural design must □e su□mitted □□a professional engineer,
6. All □ricks shall compl□with SANS 227 and shall □e engineering units of class FBS (face □rick standard) with a nominal compressive strength of 12 MPA.
7. Also refer to Section 502 of the Standard Specifications forMunicipal Civil Engineering Works, 3rd Edition, 2005.

AMENDMENTS

NR.	DATE	APPROVED	DESCRIPTION	PAR.

DESIGNED: J.G. JANSEN VAN VUUREN Pr.Tech. — SIGNATURE / DATE

DRAWN: S. AUDIE

DESIGN CHECKED BY: P. A. ODENDAAL Pr.Eng. — SIGNATURE / DATE

INFRASTRUCTURE TECHNICAL INFORMATION MANAGEMENT: D.J. CHALMERS — SIGNATURE / DATE

PROJECT STATUS

○ CONCEPT DRAWING ○ TENDER DRAWING ○ APPROVED FOR CONSTRUCTION DRAWING ○ AS BUILT DRAWING

PROJECT ENGINEER (CONSULTANT)

INITIALS AND SURNAME / SIGNATURE AND Pr. No. / DATE

INSPECTOR OF WORKS (CITY OF TSHWANE):

INITIALS AND SURNAME / SIGNATURE AND Pr. No. / DATE

CONSULTANT DETAIL

CITY OF TSHWANE

ROADS AND TRANSPORT DEPARTMENT

Mr P. I. Letlonkane — STRATEGIC EXECUTIVE DIRECTOR — P.O. BOX 1409 PRETORIA 0001

Ms. L. V. Kegakilwe-Piki — EXECUTIVE DIRECTOR — P.O. BOX 1409 PRETORIA 0001

DRAWING APPROVED BY EXECUTIVE DIRECTOR
Ms. L. V. Kegakilwe-Piki
SIGNATURE: ..... DATE: .....

ROADS AND STORMWATER
For Internal Approval

RECIEVED
SIGN WHEN APPLICABLE

DIRECTOR: INFRASTRUCTURE PROVISION — SIGNATURE / DATE

DIRECTOR: INFRASTRUCTURE CONSTRUCTION (PROJECT) MANAGEMENT — SIGNATURE / DATE

DIRECTOR: INFRASTRUCTUREASSET MANAGEMENT — SIGNATURE / DATE

DIRECTOR: TRANSPORT INFRASTRUCTURE PLANNING — SIGNATURE / DATE

DIRECTOR: INTELLIGENT TRANSPORT SYSTEN AND TRAFFIC ENGINEERING ENGINEERING — SIGNATURE / DATE

DIRECTOR: INFRASTRUCTURE MAINTENANCE MANAGEMENT (IMM) — SIGNATURE / DATE

0 10 20 40 60 80m
SCALE 1:1000

LOCATION OF PROJECT:

TYPICAL STANDARD DETAILS

DESCRIPTION OF PROJECT

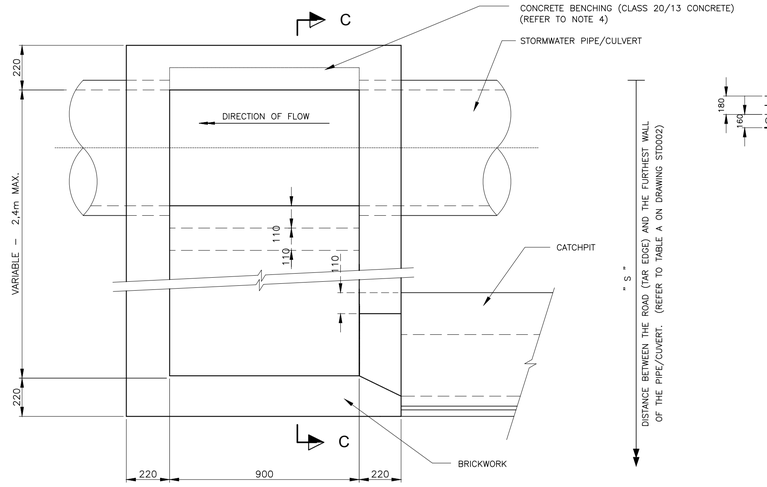
JUNCTION BOX AND MANHOLE DETAILS:

TYPE A JUNCTION BOX

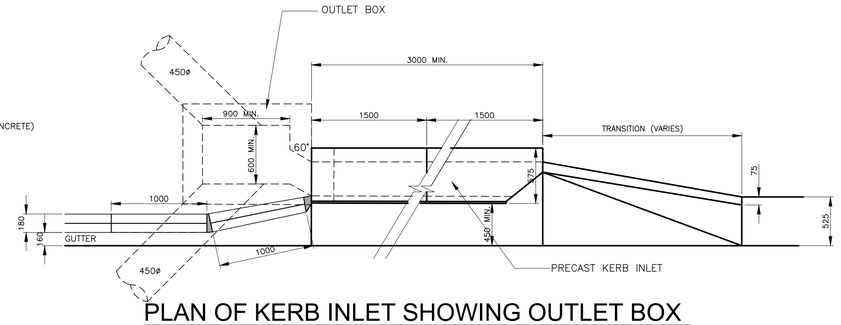
CONTRACT No. : — PROJECT No. :

DATE : MAY 2013 — SCALE : AS SHOWN — ORIGINAL PAPER SIZE: A1

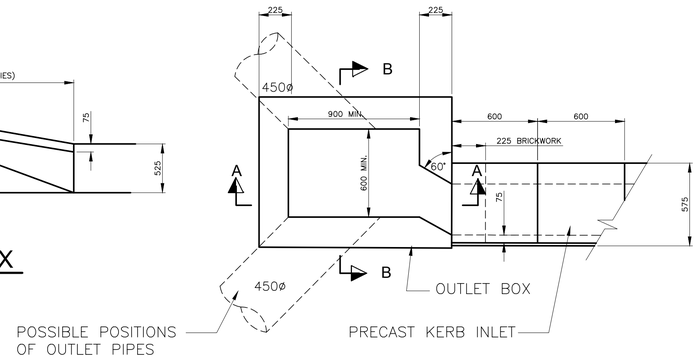
DRAWING NO. STD004 — SHEET NO: 2 OF 7 — REVISION 0



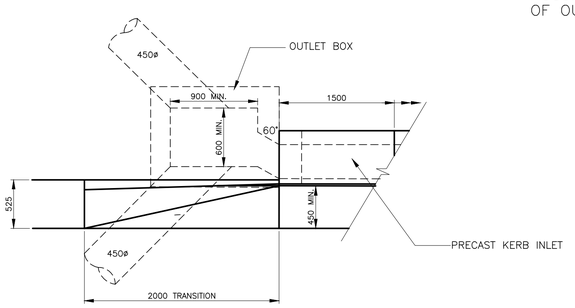
PLAN OF TYPE B JUNCTION BOX (WITHOUT COVER SLAB)



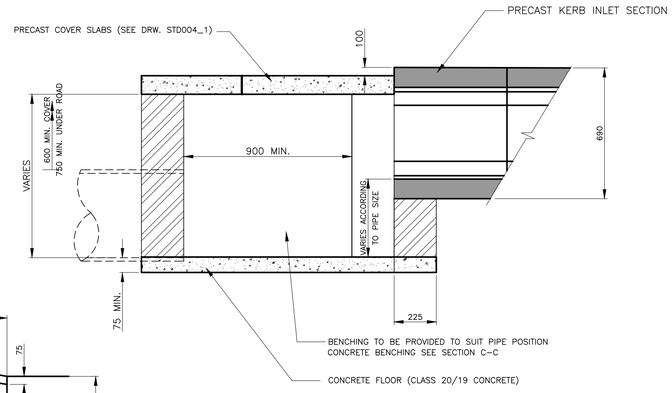
PLAN OF KERB INLET SHOWING OUTLET BOX POSITION UNDER VERTICAL KERB



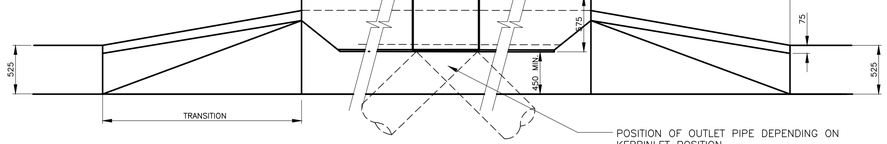
PLAN OF KERB INLET NOT DISCHARGING DIRECTLY INTO MAIN STORMWATER DRAIN (WITHOUT COVER)



PLAN OF KERB INLET SHOWING OUTLET BOX POSITION UNDER SLOPIMG KERB



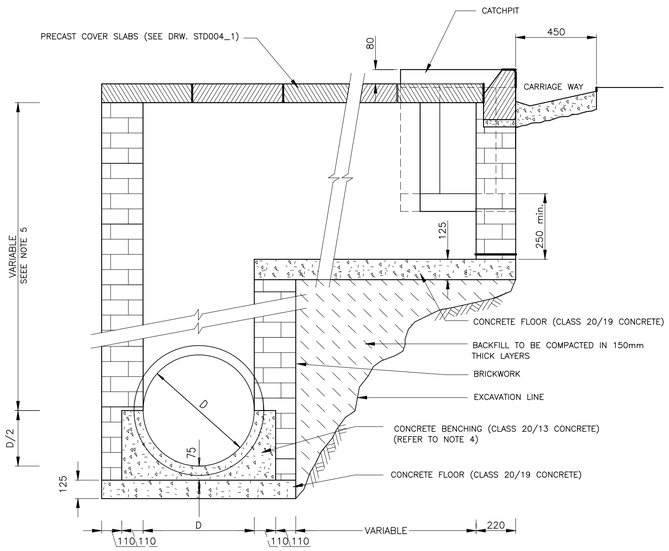
SECTION A-A



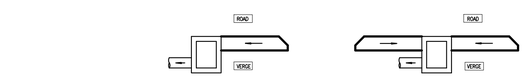
PLAN OF KERB INLET AT A LOW POINT SHOWING POSITION OF OUTLET BOX

NOTE:

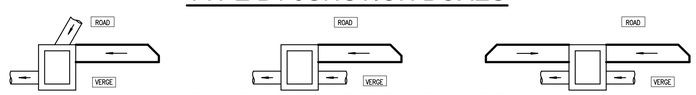
WHERE PROVISION IS MADE FOR FUTURE ROAD WIDENING AND THE MAIN DRAIN IS CONSTRUCTED AWAY FROM THE CURRENT EDGE OF ROAD THE MAXIMUM LENGTH OF THE JUNCTION BOX IS TO BE LIMITED TO 3,0m WHICH A A PIPE IS TO BE PROVIDED BETWEEN THE KERB INLET JUNCTION BOX AND THE MAIN STORMWATER DRAIN.



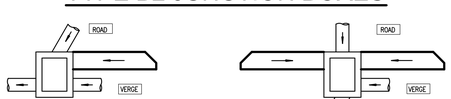
SECTION C-C



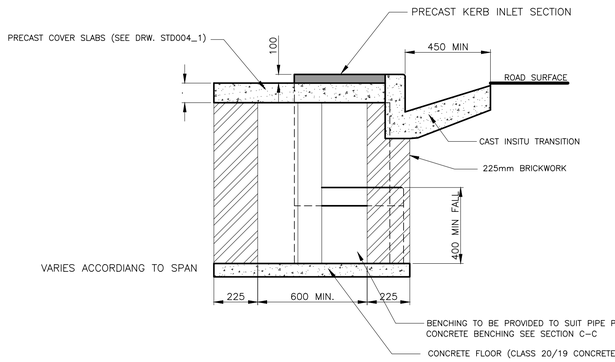
TYPE B1 JUNCTION BOXES



TYPE B2 JUNCTION BOXES



TYPE B3 JUNCTION BOXES



SECTION B-B

NOTES AND SPECIFICATIONS

1. All stormwater pipes to □e laid soffit to soffit
2. Minimum pipe diameter of all pipes is 450mm.
3. Maximum angle between adjoining pipes is 60°.
4. Where a pipe wall is at least 75mm from the nearest junction □ox wall, the concrete □encing can □e started adjacent to the dou□le □rick wall.
5. Where the total depth of the junction □ox (invert level to finished ground level) exceeds 2,0m a structural design must □e su□mitted □□a professional engineer.
6. All □ricks shall compl□with SANS 227 and shall □e engineering units of class FBS (face □rick standard) with a nominal compressive strength of 12 MPA.
7. Also refer to Section 502 of the Standard Specifications for Municipal Civil Engineering Works, 3rd Editiion, 2005.

AMENDMENTS

NR.	DATE	APPROVED	DESCRIPTION	PAR.

DESIGNED: J.G. JANSEN VAN VUUREN Pr.Tech. — SIGNATURE / DATE

DRAWN: S. AUDIE

DESIGN CHECKED BY: P. A. ODENDAAL Pr.Eng. — SIGNATURE / DATE

INFRASTRUCTURE TECHNICAL INFORMATION MANAGEMENT: D.J. CHALMERS — SIGNATURE / DATE

PROJECT STATUS

○ CONCEPT DRAWING ○ TENDER DRAWING ○ APPROVED FOR CONSTRUCTION DRAWING ○ AS BUILT DRAWING

PROJECT ENGINEER (CONSULTANT)

INITIALS AND SURNAME / SIGNATURE AND Pr. No. / DATE

INSPECTOR OF WORKS (CITY OF TSHWANE):

INITIALS AND SURNAME / SIGNATURE AND Pr. No. / DATE

CONSULTANT DETAIL

CITY OF TSHWANE

ROADS AND TRANSPORT DEPARTMENT

Mr P. I. Letlonkane — STRATEGIC EXECUTIVE DIRECTOR — P.O. BOX 1409 PRETORIA 0001

Ms. L. V. Kegakilwe-Piki — EXECUTIVE DIRECTOR — P.O. BOX 1409 PRETORIA 0001

DRAWING APPROVED BY EXECUTIVE DIRECTOR
Ms. L. V. Kegakilwe-Piki

SIGNATURE: DATE:

LOCATION OF PROJECT:

TYPICAL STANDARD DETAILS

DESCRIPTION OF PROJECT

JUNCTION BOX AND MANHOLE DETAILS:

TYPE B JUNCTION BOX

ROADS AND STORMWATER
For Internal Approval
RECIEVED
SIGN WHEN APPLICABLE

DIRECTOR: INFRASTRUCTURE PROVISION — SIGNATURE / DATE

DIRECTOR: INFRASTRUCTURE CONSTRUCTION (PROJECT) MANAGEMENT — SIGNATURE / DATE

DIRECTOR: INFRASTRUCTURE/ASSET MANAGEMENT — SIGNATURE / DATE

DIRECTOR: TRANSPORT INFRASTRUCTURE PLANNING — SIGNATURE / DATE

DIRECTOR: INTELLIGENT TRANSPORT SYSTEM AND TRAFFIC ENGINEERING ENGINEERING — SIGNATURE / DATE

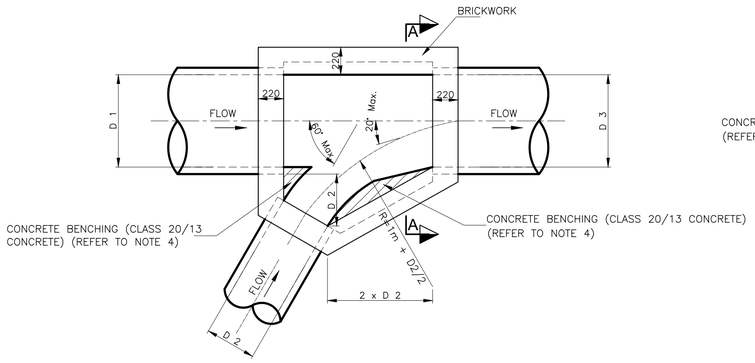
DIRECTOR: INFRASTRUCTURE MAINTENANCE MANAGEMENT (MM) — SIGNATURE / DATE

0 10 20 40 60 80m
SCALE 1:1000

CONTRACT No. : / PROJECT No. :

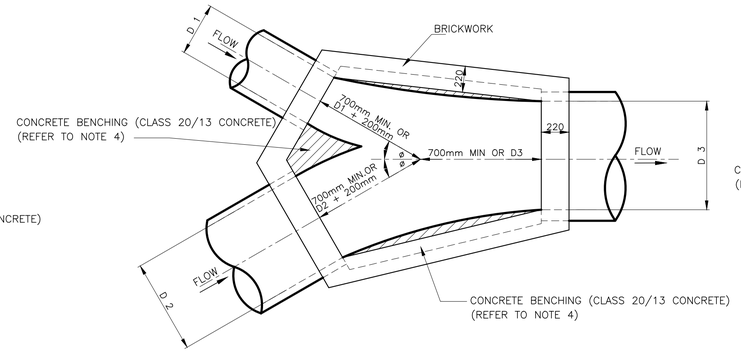
DATE : MAY 2013 / SCALE : AS SHOWN / ORIGINAL PAPER SIZE: A1

DRAWING NO. STD004 / SHEET NO: 3 OF 7 / REVISION 0



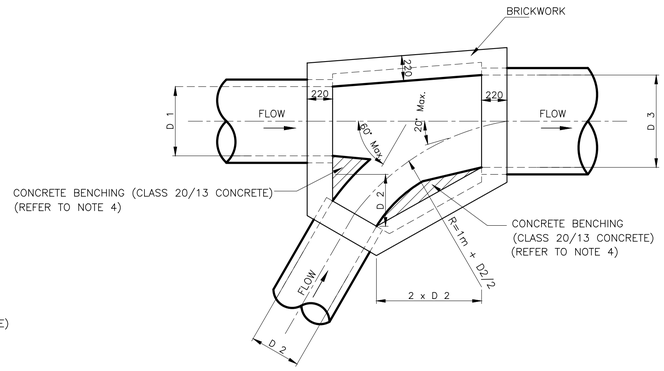
PLAN OF TYPE C JUNCTION BOX (WITHOUT COVER SLAB)

D 1 ≠ D 3 AND D 2 VARIES



PLAN OF TYPE C JUNCTION BOX (WITHOUT COVER SLAB)

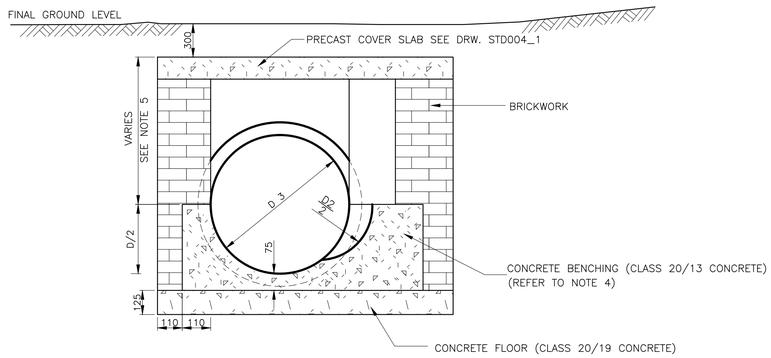
D 1 ≠ D2 ≠ D 3 AND Ø < 30°



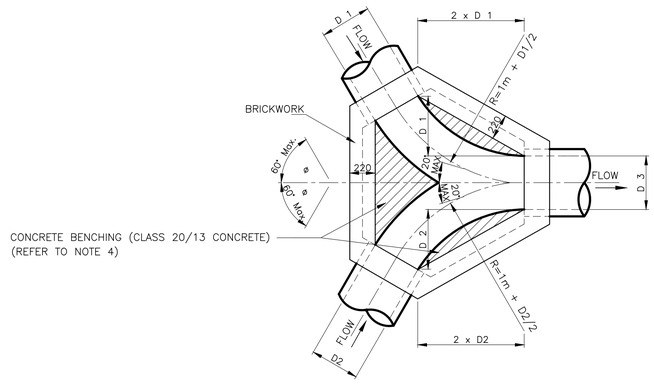
PLAN OF TYPE C JUNCTION BOX

(WITHOUT COVER SLAB)

D 1 ≠ D 3 AND D 2 VARIES



SECTION A-A



PLAN OF TYPE C JUNCTION BOX (WITHOUT COVER SLAB)

D 1 = D2 = D 3 AND Ø ≯ 30°

NOTES AND SPECIFICATIONS

1. All stormwater pipes to □e laid soffit to soffit
2. Minimum pipe diameter of all pipes is 450mm.
3. Maximum angle between adjoining pipes is 60°.
4. Where a pipe wall is at least 75mm from the nearest junction □ox wall, the concrete □encing can □e started adjacent to the dou□le □rick wall.
5. Where the total depth of the junction □ox (invert level to finished ground level) exceeds 2.0m a structural design must □e su□mitted □□a professional engineer.
6. All □ricks shall compl□with SABS 227 and shall □e engineering units of class FBS (face □rick standard) with a nominal compressive strength of 12 MPA.
7. Also refer to Section 502 of the Standard Specifications for Municipal Civil Engineering Works, 1991.

AMENDMENTS

NR.	DATE	APPROVED	DESCRIPTION	PAR.

DESIGNED
J.G. JANSEN VAN VUUREN Pr.Tech.
SIGNATURE DATE

DRAWN
S. AUDIE

DESIGN CHECKED BY
P. A. ODENDAAL Pr.Eng.
SIGNATURE DATE

INFRASTRUCTURE TECHNICAL INFORMATION MANAGEMENT
D.J. CHALMERS
SIGNATURE DATE

PROJECT STATUS

○ CONCEPT DRAWING ○ TENDER DRAWING ○ APPROVED FOR CONSTRUCTION DRAWING ○ AS BUILT DRAWING

PROJECT ENGINEER (CONSULTANT)
INITIALS AND SURNAME SIGNATURE AND Pr. No. DATE

INSPECTOR OF WORKS (CITY OF TSHWANE):
INITIALS AND SURNAME SIGNATURE AND Pr. No. DATE

CONSULTANT DETAIL

CITY OF TSHWANE
ROADS AND TRANSPORT DEPARTMENT

Mr P. I. Letlonkane
STRATEGIC EXECUTIVE DIRECTOR
P.O. BOX 1409
PRETORIA
0001

Ms. L. V. Kegakilwe-Piki
EXECUTIVE DIRECTOR
P.O. BOX 1409
PRETORIA
0001

DRAWING APPROVED BY EXECUTIVE DIRECTOR
Ms. L. V. Kegakilwe-Piki
SIGNATURE: DATE:

LOCATION OF PROJECT:

TYPICAL STANDARD DETAILS

DESCRIPTION OF PROJECT

JUNCTION BOX AND MANHOLE DETAILS:

TYPE C JUNCTION BOX

ROADS AND STORMWATER
For Internal Approval
RECEIVED
SIGN WHEN APPLICABLE

DIRECTOR: INFRASTRUCTURE PROVISION
SIGNATURE DATE

DIRECTOR: INFRASTRUCTURE CONSTRUCTION (PROJECT) MANAGEMENT
SIGNATURE DATE

DIRECTOR: INFRASTRUCTUREASSET MANAGEMENT
SIGNATURE DATE

DIRECTOR: TRANSPORT INFRASTRUCTURE PLANNING
SIGNATURE DATE

DIRECTOR: INTELLIGENT TRANSPORT SYSTEN AND TRAFFIC ENGINEERING ENGINEERING
SIGNATURE DATE

DIRECTOR: INFRASTRUCTURE MAINTENANCE MANAGEMENT (IMM)
SIGNATURE DATE

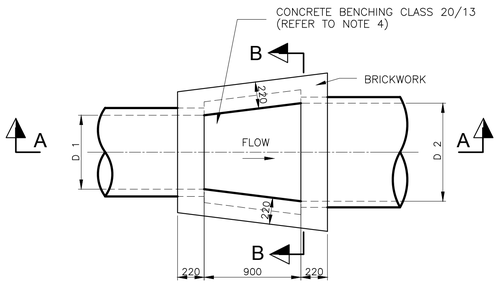
0 10 20 40 60 80m
SCALE 1:1000

DRAWING::LOCATION

CONTRACT No. :
PROJECT No. :

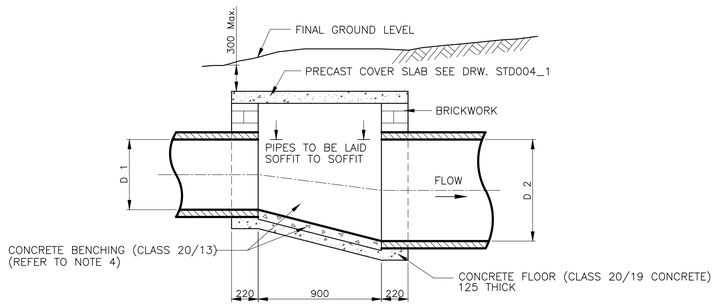
DATE : MAY 2013
SCALE : AS SHOWN
ORIGINAL PAPER SIZE: A1

DRAWING NO. STD004
SHEET NO: 4 OF 7
REVISION 0



PLAN OF TYPE D JUNCTION BOX (WITHOUT COVER SLAB)

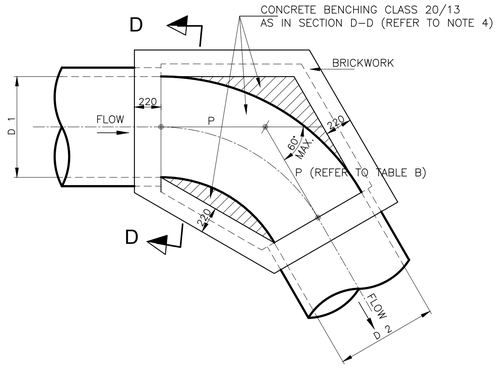
D 1 □ D 2



SECTION A-A

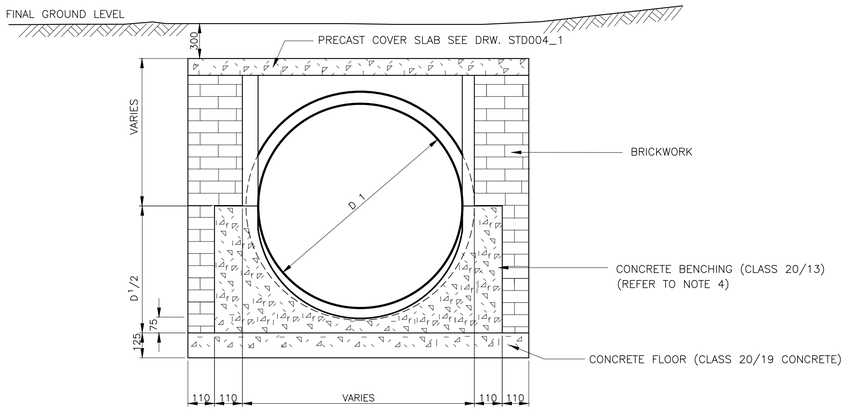
TABEL B

D 2 DIAMETER OF DOWN STREAM PIPE	DISTANCE P
450	700
525	700
600	750
675	780
750	800
825	825
900	850
1050	870
1200	925
1350	1000
1500	1100

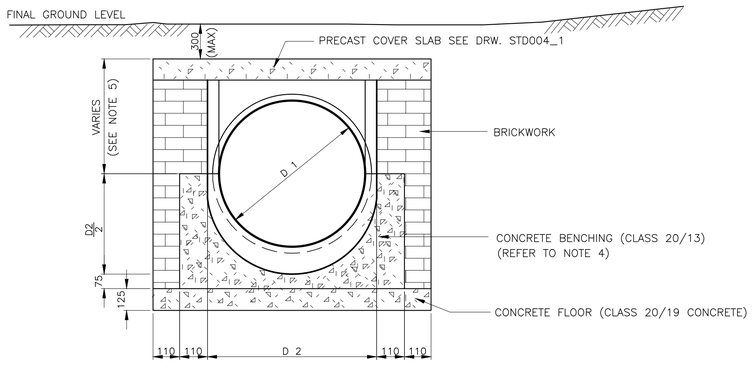


PLAN OF TYPE D JUNCTION BOX (WITHOUT COVER SLAB)

D 1□ D 2 OR D 1 □ D 2



SECTION D-D



SECTION B-B

NOTES AND SPECIFICATIONS

1. All stormwater pipes to □e laid soffit to soffit
2. Minimum pipe diameter of all pipes is 450mm.
3. Maximum angle between adjoining pipes is 60°.
4. Where a pipe wall is at least 75mm from the nearest junction □ox wall, the concrete □encing can □e started adjacent to the dou□le □rick wall.
5. Where the total depth of the junction □ox (invert level to finished ground level) exceeds 2,0m a structural design must □e su□mitted □□ a professional engineer.
6. All □ricks shall compl□with SABS 227 and shall □e engineering units of class FBS (face □rick standard) with
7. Also refer to Section 502 of the Standard Specifications for Municipal Civil Engineering Works, 1991.

AMENDMENTS

NR.	DATE	APPROVED	DESCRIPTION	PAR.

DESIGNED: J.G. JANSEN VAN VUUREN Pr.Tech. — SIGNATURE / DATE

DRAWN: S. AUDIE

DESIGN CHECKED BY: P. A. ODENDAAL Pr.Eng. — SIGNATURE / DATE

INFRASTRUCTURE TECHNICAL INFORMATION MANAGEMENT: D.J. CHALMERS — SIGNATURE / DATE

PROJECT STATUS

○ CONCEPT DRAWING ○ TENDER DRAWING ○ APPROVED FOR CONSTRUCTION DRAWING ○ AS BUILT DRAWING

PROJECT ENGINEER (CONSULTANT)

INITIALS AND SURNAME / SIGNATURE AND Pr. No. / DATE

INSPECTOR OF WORKS (CITY OF TSHWANE):

INITIALS AND SURNAME / SIGNATURE AND Pr. No. / DATE

CONSULTANT DETAIL

CITY OF TSHWANE
ROADS AND TRANSPORT DEPARTMENT

Mr P. I. Letlonkane
STRATEGIC EXECUTIVE DIRECTOR
P.O. BOX 1409
PRETORIA
0001

Ms. L. V. Kegakilwe-Piki
EXECUTIVE DIRECTOR
P.O. BOX 1409
PRETORIA
0001

DRAWING APPROVED BY EXECUTIVE DIRECTOR
Ms. L. V. Kegakilwe-Piki
SIGNATURE: DATE:

LOCATION OF PROJECT:

TYPICAL STANDARD DETAILS

DESCRIPTION OF PROJECT

JUNCTION BOX AND MANHOLE DETAILS:

TYPE D JUNCTION BOX

CONTRACT No. :

PROJECT No. :

DATE : MAY 2013

SCALE : AS SHOWN

ORIGINAL PAPER SIZE: A1

DRAWING NO. STD004

SHEET NO: 5 OF 7

REVISION 0

ROADS AND STORMWATER
For Internal Approval

RECEIVED
SIGN WHEN APPLICABLE

DIRECTOR: INFRASTRUCTURE PROVISION — SIGNATURE / DATE

DIRECTOR: INFRASTRUCTURE CONSTRUCTION (PROJECT) MANAGEMENT — SIGNATURE / DATE

DIRECTOR: INFRASTRUCTUREASSET MANAGEMENT — SIGNATURE / DATE

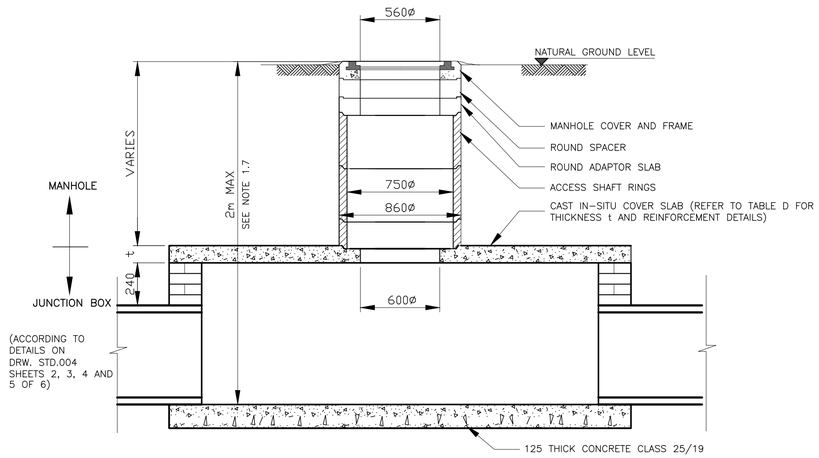
DIRECTOR: TRANSPORT INFRASTRUCTURE PLANNING — SIGNATURE / DATE

DIRECTOR: INTELLIGENT TRANSPORT SYSTEM AND TRAFFIC ENGINEERING ENGINEERING — SIGNATURE / DATE

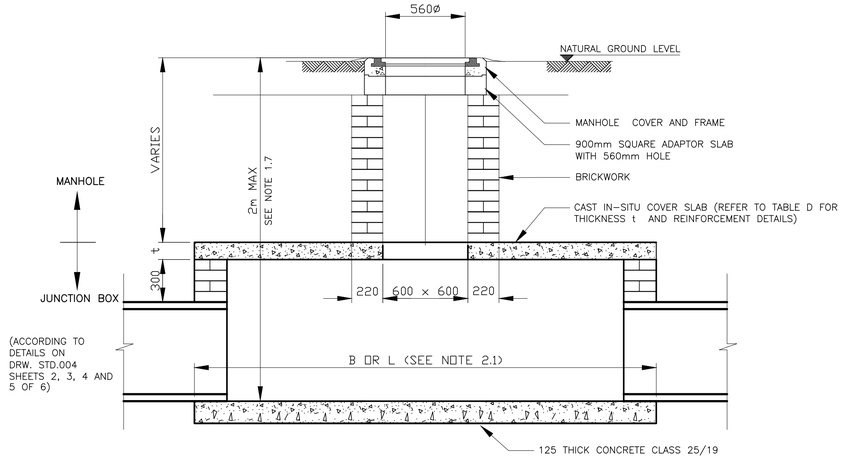
DIRECTOR: INFRASTRUCTURE MAINTENANCE MANAGEMENT (BMM) — SIGNATURE / DATE

0 10 20 40 60 80m
SCALE 1:1000

TYPICAL CROSS SECTION THROUGH JUNCTION BOX AND MANHOLE

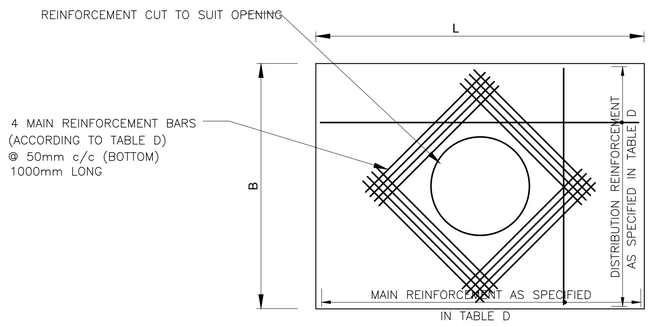


MANHOLE WITH PRECAST SHAFT

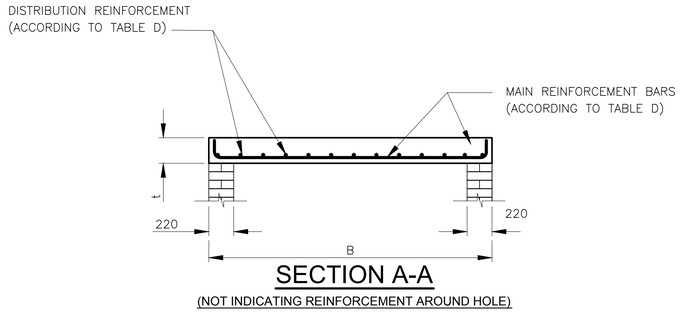


MANHOLE WITH MASONARY SHAFT

TABLE D: REINFORCEMENT DETAILS FOR CAST IN-SITU COVER SLABS (Note: B □ L)		
Span (B) (mm)	Thickness (t) (mm)	Main Reinforcement
Up to 1500	175	Y12 - 120
Up to 2500	200	Y16 - 150
Up to 3000	225	Y16 - 150
□3000	Design to □e su□mitted	
Distri□ution reinforcement: Y12 □ars □ 200 c/c		
Refer to notes for □ending details.		

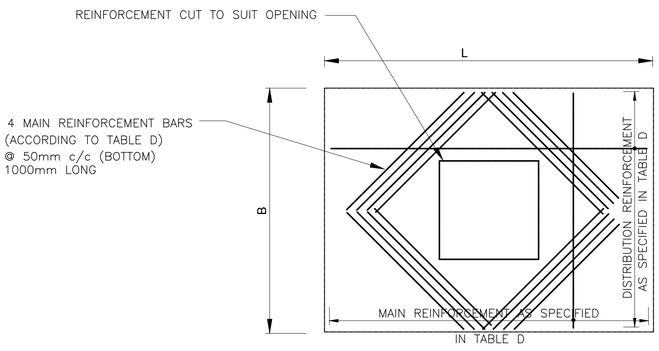


CAST INSITU COVER SLAB FOR CIRCULAR SHAFT SECTION



SECTION A-A

(NOT INDICATING REINFORCEMENT AROUND HOLE)



CAST INSITU COVER SLAB FOR S□UARE SHAFT SECTION

NOTES AND SPECIFICATIONS

1. MANHOLE

1.1 All precast manhole sections shall compl□with the relevant re□uirements of SANS 1294.

1.2 No step irons shall □e re□uired unless otherwise indicated on the drawings.

1.3 Dimensions of precast manhole sections are approximate and ma□var□slightl□according to different manufacturer's specifications.

1.4 Position of manholes shall □e directl□a□ove the PI of adjoining stormwater pipes.

1.5 The function of the com□ination precast concrete/cast iron manhole cover is to replace lost cast iron covers, unless otherwise specified.

1.6 All concrete manhole covers shall have the letters "SW" formed or engraved on top. Each letter shall □e 50mm wide, 75mm high and 5mm thick.

1.7 Where the total depth of the junction □ox/manhole com□ination (invert level to finished ground level) exceeds 2,0m, a structural design must □e su□mitted □□a professional engineer.

1.8 All □ricks shall compl□with SANS 227 and shall □e engineering units of class FBS (Face □rick Standard) with a nominal compressive strenght of 12 MPa.

2. CAST IN-SITU COVER SLABS

2.1 Measurement B is alwa□s smaller than L.

2.2 Concrete to □e class 25/19.

2.3 Concrete to □e cured for a minimum period of 7 da□s.

2.4 Minimum cover to reinforcement is 20mm.

2.5 T□pe, □ar and spacing of reinforcement as specified in Ta□le D.

2.6 Main reinforcement to □e shape code 38, with hook length (A- dimension) not less than t minus 60, except for sla□s with a span not exceeding 1000, where no hooks are re□uired and shape code 20 is used.

AMENDMENTS

NR.	DATE	APPROVED	DESCRIPTION	PAR.

DESIGNED: P. A. ODENDAAL Pr.Eng. (SIGNATURE / DATE)
DRAWN: S. AUDIE
DESIGN CHECKED BY: P. A. ODENDAAL Pr.Eng. (SIGNATURE / DATE)
INFRASTRUCTURE TECHNICAL INFORMATION MANAGEMENT: D.J. CHALMERS (SIGNATURE / DATE)

PROJECT STATUS

○ CONCEPT DRAWING ○ TENDER DRAWING ○ APPROVED FOR CONSTRUCTION DRAWING ○ AS BUILT DRAWING

PROJECT ENGINEER (CONSULTANT)
INITIALS AND SURNAME / SIGNATURE AND Pr. No. / DATE
INSPECTOR OF WORKS (CITY OF TSHWANE):
INITIALS AND SURNAME / SIGNATURE AND Pr. No. / DATE

CONSULTANT DETAIL

CITY OF TSHWANE
ROADS AND TRANSPORT DEPARTMENT

Mr P. I. Letlonkane
STRATEGIC EXECUTIVE DIRECTOR
P.O. BOX 1409
PRETORIA
0001

Ms. L. V. Kegakilwe-Piki
EXECUTIVE DIRECTOR
P.O. BOX 1409
PRETORIA
0001

DRAWING APPROVED BY EXECUTIVE DIRECTOR
Ms. L. V. Kegakilwe-Piki
SIGNATURE: DATE:

LOCATION OF PROJECT:

TYPICAL STANDARD DETAILS

DESCRIPTION OF PROJECT

JUNCTION BOX AND MANHOLE DETAILS

MANHOLE

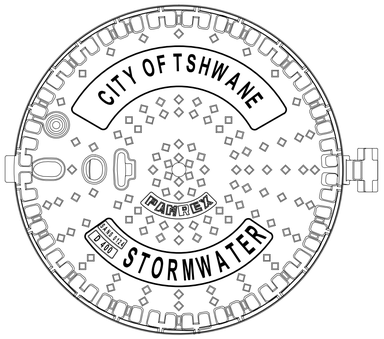
ROADS AND STORMWATER
For Internal Approval
RECEIVED SIGN WHEN APPLICABLE
DIRECTOR: INFRASTRUCTURE PROVISION (SIGNATURE / DATE)
DIRECTOR: INFRASTRUCTURE CONSTRUCTION (PROJECT) MANAGEMENT (SIGNATURE / DATE)
DIRECTOR: INFRASTRUCTUREASSET MANAGEMENT (SIGNATURE / DATE)
DIRECTOR: TRANSPORT INFRASTRUCTURE PLANNING (SIGNATURE / DATE)
DIRECTOR: INTELLIGENT TRANSPORT SYSTEN AND TRAFFIC ENGINEERING ENGINEERING (SIGNATURE / DATE)
DIRECTOR: INFRASTRUCTURE MAINTENANCE MANAGEMENT (IMM) (SIGNATURE / DATE)

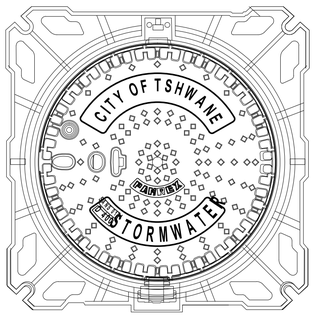
0 10 20 40 60 80m
SCALE 1:1000

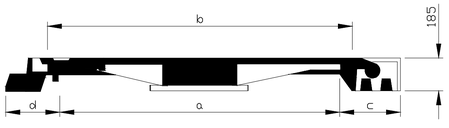
CONTRACT No. :
PROJECT No. :
DATE : MAY 2013
SCALE : AS SHOWN
ORIGINAL PAPER SIZE: A1
DRAWING NO. STD004
SHEET NO: 6 of 7
REVISION 0

CITY OF TSHWANE

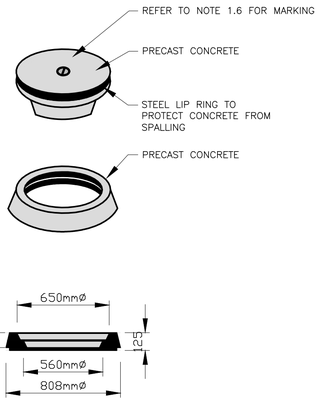
SANS 1214
D400
STORMWATER



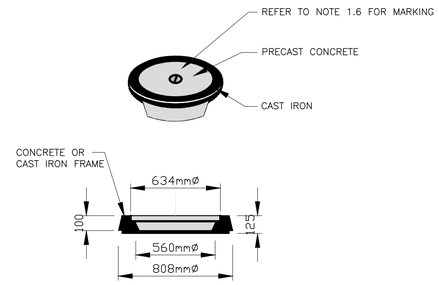




MANHOLE FRAME AND COVER PRECAST CONCRETE



PRECAST CONCRETE FRAME AND COVER
(ONLY ON SIDEWALKS)



COMBINATION PRECAST CONCRETE / CAST IRON FRAME AND COVER
(SEE NOTE 1.5)

TABLE C: USE OF MANHOLES AT JUNCTION BOXES

APPLICATION	TYPE OF COVER AND FRAME
At junction □oxes falling underneath the carriagewa□s of roads (including pedestrian streets), hard shoulders . and parking areas.	SANS class D 400 Ductile Iron
At least ever□ 100m on long inaccessi□le stormwater lines.	SANS T□pe 4 Precast Concrete Medium dut□or SANS class C 250 Ductile Iron
At junction □oxes falling underneath □lock or concrete paving on the sidewalk..	SANS T□pe 4 Precast Concrete Medium dut□or SANS class C 250 Ductile Iron
At junction □oxes where the stormwater line changes course	SANS T□pe 4 Precast Concrete Medium dut□or SANS class C 250 Ductile Iron
At junction □oxes indicated otherwise on the drawings or specified □□the Engineer.	SANS T□pe 4 Precast Concrete as specified or SANS 50124 Ductile Iron as specified

NOTES AND SPECIFICATIONS

1. MANHOLE

1.1 All precast manhole sections shall compl□with the relevant re□uirements of SANS 1294.

1.2 No step irons shall □e re□uired unless otherwise indicated on the drawings.

1.3 Dimensions of precast manhole sections are approximate and ma□var□slightl□according to different manufacturer's specifications.

1.4 Position of manholes shall □e directl□a□ove the PI of adjoining stormwater pipes.

1.5 The function of the com□ination precast concrete/cast iron manhole cover is to replace lost cast iron covers, unless otherwise specified.

1.6 All concrete manhole covers shall have the letters "SW" formed or engraved on top. Each letter shall □e 50mm wide, 75mm high and 5mm thick.

1.7 All ductile iron manhole sections shall compl□with the relevant re□uirements of SANS 50124.

1.8 Dimensions of ductile iron manhole sections are approximate and may vary slightly according to different manufacturer's specifications.

1.9 All ductile iron manhole covers shall have the wording: "CITY OF TSHWANE" as well as "STORMWATER" cast into the cover. Each letter shall □e □□mm wide and □□mm high and □□mm thick.

1.10 All ductile iron manhole covers to □e supplied with a s□uare frame. Installations with a round frame onl□to □e used with a circular precast shaft or if approved □□the Engineer in writing.

1.11 All ductile iron manhole covers shall □e hinged and incorporate a 90 degree □ocking s□stem to prevent accidental closure.

1.12 All ductile iron manhole covers shall □e fitted with an anti-theft device to prevent the cover from □eing completel□removed from the frame.

1.11 All ductile iron manhole covers in the roadwa□shall □e installed with the hinge in the direction of the oncoming traffic (See Fig □□)

2. CAST IN-SITU COVER SLABS

2.1 Measurement B is alwa□s smaller than L.

2.2 Concrete to □e class 25/19.

2.3 Concrete to □e cured for a minimum period of 7 da□s.

2.4 Minimum cover to reinforcement is 20mm.

2.5 T□pe, □ar and spacing of reinforcement as specified in Ta□le D.

2.6 Main reinforcement to □e shape code 38, with hook length (A- dimension) not less than t minus 60, except for sla□s with a span not exceeding 1000, where no hooks are re□uired and shape code 20 is used.

AMENDMENTS

NR.	DATE	APPROVED	DESCRIPTION	PAR.

DESIGNED: P. A. ODENDAAL Pr.Eng. (SIGNATURE / DATE)
DRAWN: S. AUDIE
DESIGN CHECKED BY: P. A. ODENDAAL Pr.Eng. (SIGNATURE / DATE)
INFRASTRUCTURE TECHNICAL INFORMATION MANAGEMENT: D.J. CHALMERS (SIGNATURE / DATE)

PROJECT STATUS

○ CONCEPT DRAWING ○ TENDER DRAWING ○ APPROVED FOR CONSTRUCTION DRAWING ○ AS BUILT DRAWING

PROJECT ENGINEER (CONSULTANT)
INITIALS AND SURNAME / SIGNATURE AND Pr. No. / DATE

INSPECTOR OF WORKS (CITY OF TSHWANE):
INITIALS AND SURNAME / SIGNATURE AND Pr. No. / DATE

CONSULTANT DETAIL

CITY OF TSHWANE
ROADS AND TRANSPORT DEPARTMENT

Mr P. I. Letlonkane
STRATEGIC EXECUTIVE DIRECTOR
P.O. BOX 1409
PRETORIA
0001

Ms. L. V. Kegakilwe-Piki
EXECUTIVE DIRECTOR
P.O. BOX 1409
PRETORIA
0001

DRAWING APPROVED BY EXECUTIVE DIRECTOR
Ms. L. V. Kegakilwe-Piki
SIGNATURE: ..... DATE: .....

LOCATION OF PROJECT:

TYPICAL STANDARD DETAILS

DESCRIPTION OF PROJECT

JUNCTION BOX AND MANHOLE DETAILS

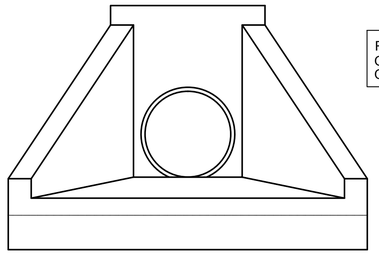
MANHOLE

ROADS AND STORMWATER
For Internal Approval
RECEIVED
SIGN WHEN APPLICABLE

DIRECTOR: INFRASTRUCTURE PROVISION (SIGNATURE / DATE)
DIRECTOR: INFRASTRUCTURE CONSTRUCTION (PROJECT) MANAGEMENT (SIGNATURE / DATE)
DIRECTOR: INFRASTRUCTUREASSET MANAGEMENT (SIGNATURE / DATE)
DIRECTOR: TRANSPORT INFRASTRUCTURE PLANNING (SIGNATURE / DATE)
DIRECTOR: INTELLIGENT TRANSPORT SYSTEN AND TRAFFIC ENGINEERING ENGINEERING (SIGNATURE / DATE)
DIRECTOR: INFRASTRUCTURE MAINTENANCE MANAGEMENT (MM) (SIGNATURE / DATE)

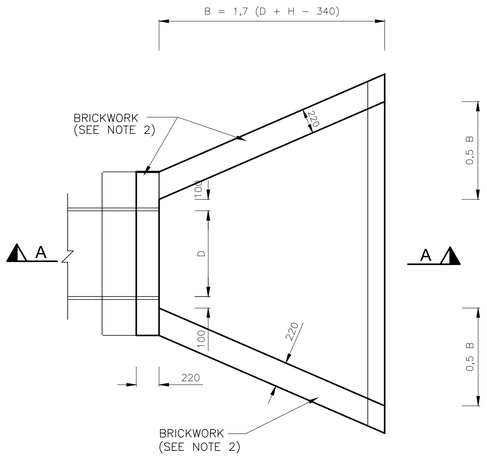
0 10 20 40 60 80m
SCALE 1:1000

CONTRACT No. :
PROJECT No. :
DATE : MAY 2013
SCALE : AS SHOWN
ORIGINAL PAPER SIZE: A1
DRAWING NO. STD004
SHEET NO: 7 of 7
REVISION 0

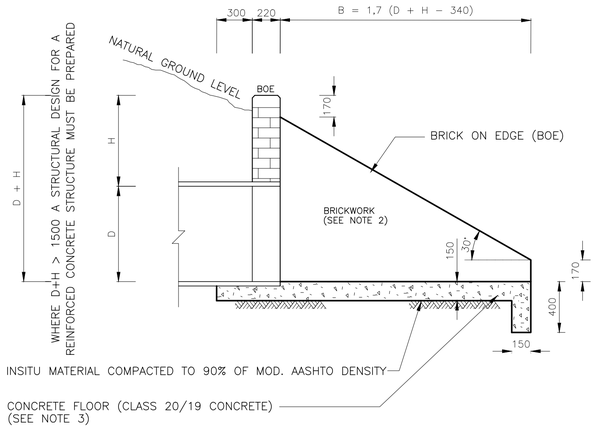


REFER TO NOTE 1 FOR APPLICATION OF TYPICAL STORMWATER OUTLET STRUCTURE

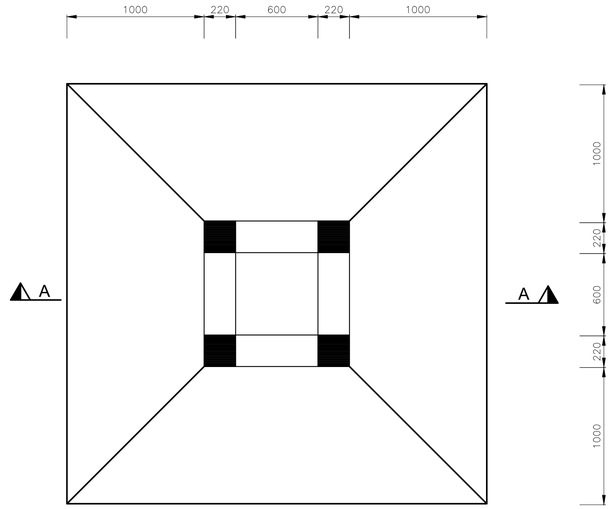
ELEVATION OF TYPICAL STORMWATER OUTLET STRUCTURE



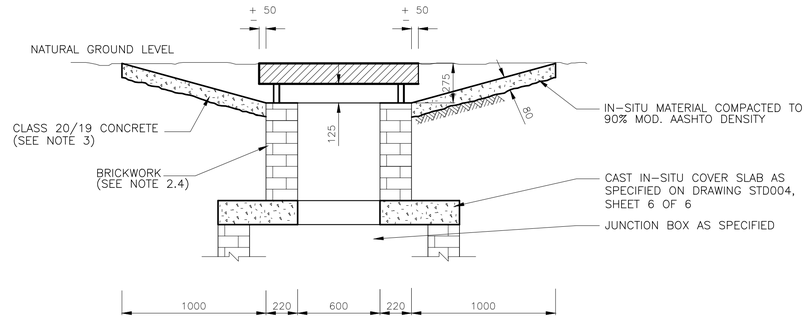
PLAN OF TYPICAL STORMWATER OUTLET STRUCTURE



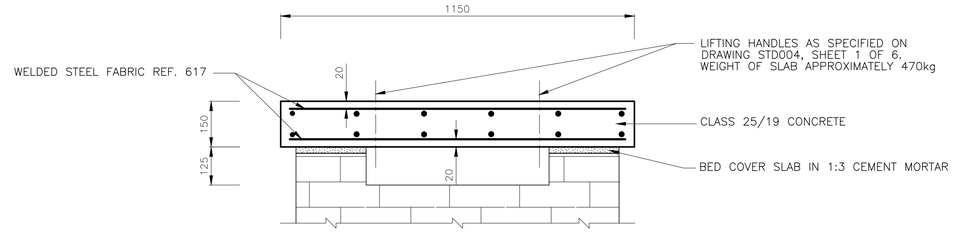
SECTION A-A



PLAN OF FIELD INLET (Without cover sla□)



SECTION B-B



DETAIL OF PRECAST COVER SLAB

NOTES AND SPECIFICATIONS

1. APPLICATION OF TYPICAL OUTLET STRUCTURE

1.1 THE TYPICAL STORMWATER OUTLET STRUCTURE MAY ONLY BE USED WHERE:
- SPECIFIED BY THE ENGINEER
- THE FLOW VELOCITY AT THE OUTLET PERMITS THE USE
- D + H □ 1500

1.2 FOR HIGHER FLOW VELOCITIES THE STRUCTURE MUST BE MODIFIED OR ANOTHER TYPE OF STRUCTURE MUST BE USED, ACCORDING TO THE SPECIFICATIONS OF THE ENGINEER.

1.3 NO SCOURING OR EROSION MAY OCCUR DOWNSTREAM OF THE OUTLET STRUCTURE.

1.4 FOR LARGER STRUCTURES A STRUCTURAL REINFORCED CONCRETE DESIGN IS RE□UIRED.

2. MASONRY WALLS OF OUTLET STRUCTURE

2.1 MASONRY WALLING SHALL CONFORM IN ALL RESPECTS TO THE RE□UIREMENTS OF SANS 10164-1

2.2 MORTAR SHALL BE CLASS II (COMPRESSIVE STRENGTH OF 7 MPa AT 28 DAYS).

2.3 THE RE□UIREMENTS SET OUT IN APPENDIX B OF SANS 10164-1: SHALL BE ADHERED TO UNLESS OTHERWISE APPROVED OR DIRECTED BY THE ENGINEER.

2.4 ALL BRICKS SHALL COMPLY WITH SANS 227 AND SHALL BE ENGINEERING UNITS OF CLASS FBS (FACE BRICK STANDARD) WITH A NOMINAL COMPRESSIVE STRENGTH OF 12 MPa.

3. CONCRETE

3.1 ALL CONCRETE TO BE CURED FOR A MINIMUM PERIOD OF 7 DAYS.

NATURAL GROUND

TYPICAL

AMENDMENTS

NR.	DATE	APPROVED	DESCRIPTION	PAR.

DESIGNED: P. A. ODENDAAL Pr.Eng. — SIGNATURE — DATE
DRAWN: S. AUDIE
DESIGN CHECKED BY: P. A. ODENDAAL Pr.Eng. — SIGNATURE — DATE
INFRASTRUCTURE TECHNICAL INFORMATION MANAGEMENT: D.J. CHALMERS — SIGNATURE — DATE

PROJECT STATUS

○ CONCEPT DRAWING ○ TENDER DRAWING ○ APPROVED FOR CONSTRUCTION DRAWING ○ AS BUILT DRAWING

PROJECT ENGINEER (CONSULTANT)
INITIALS AND SURNAME — SIGNATURE AND Pr. No. — DATE
INSPECTOR OF WORKS (CITY OF TSHWANE):
INITIALS AND SURNAME — SIGNATURE AND Pr. No. — DATE

CONSULTANT DETAIL

CITY OF TSHWANE
ROADS AND TRANSPORT DEPARTMENT

Mr P. I. Letlonkane — STRATEGIC EXECUTIVE DIRECTOR — P.O. BOX 1409 PRETORIA 0001
Ms. L. V. Kegakilwe-Piki — EXECUTIVE DIRECTOR — P.O. BOX 1409 PRETORIA 0001

DRAWING APPROVED BY EXECUTIVE DIRECTOR
Ms. L. V. Kegakilwe-Piki
SIGNATURE: DATE:

LOCATION OF PROJECT:

TYPICAL STANDARD DETAILS

DESCRIPTION OF PROJECT

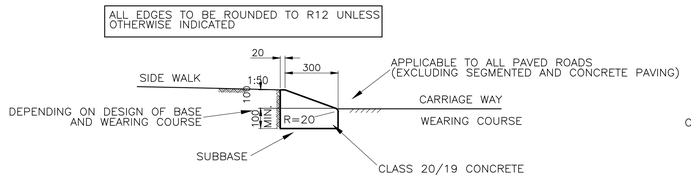
STORMWATER INLET & OUTLET STRUCTURES
FIELD INLET AND STORMWATER OUTLET

CONTRACT No. : — PROJECT No. :
DATE : MAY 2013 — SCALE : AS SHOWN — ORIGINAL PAPER SIZE: A1
DRAWING NO. STD005 — SHEET NO: 1 OF 1 — REVISION 0

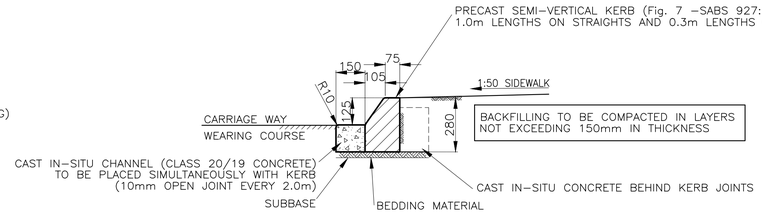
ROADS AND STORMWATER
For Internal Approval
RECEIVED (SIGN WHEN APPLICABLE)

DIRECTOR: INFRASTRUCTURE PROVISION — SIGNATURE — DATE
DIRECTOR: INFRASTRUCTURE CONSTRUCTION (PROJECT) MANAGEMENT — SIGNATURE — DATE
DIRECTOR: INFRASTRUCTUREASSET MANAGEMENT — SIGNATURE — DATE
DIRECTOR: TRANSPORT INFRASTRUCTURE PLANNING — SIGNATURE — DATE
DIRECTOR: INTELLIGENT TRANSPORT SYSTEN AND TRAFFIC ENGINEERING ENGINEERING — SIGNATURE — DATE
DIRECTOR: INFRASTRUCTURE MAINTENANCE MANAGEMENT (MM) — SIGNATURE — DATE

0 10 20 40 60 80m
SCALE 1:1000

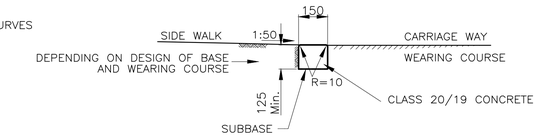


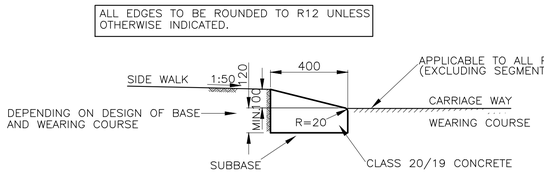
300 SLOPING KERB



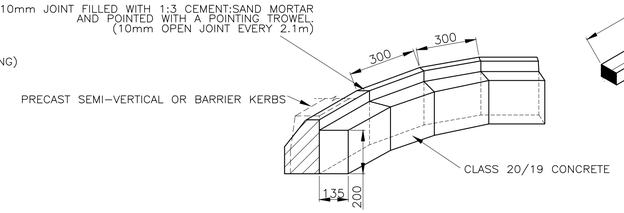
SEMI-VERTICAL KERB WITH CHANNEL

(FIG. 7 - SABS 927:1969)



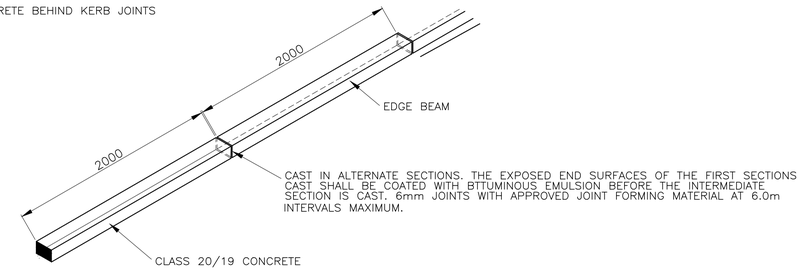


400 SLOPING KERB

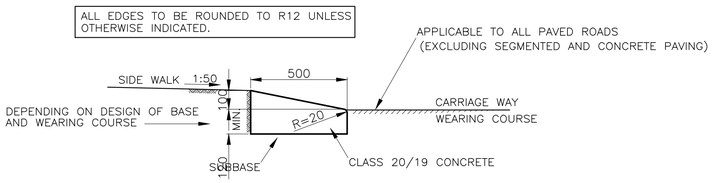


SEMI-VERTICAL / BARRIER KERBS ON CURVED SECTIONS

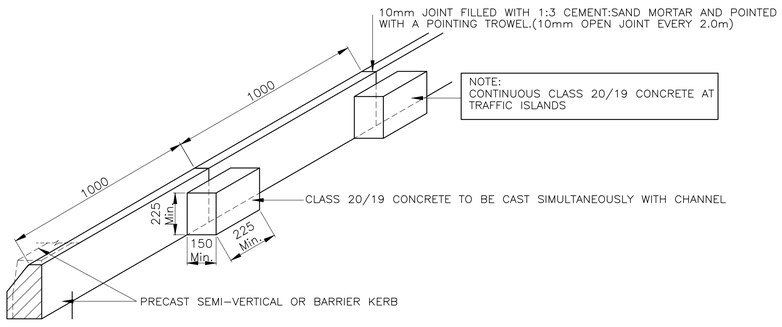
(Note: To be used up to and including a 15m Radius)



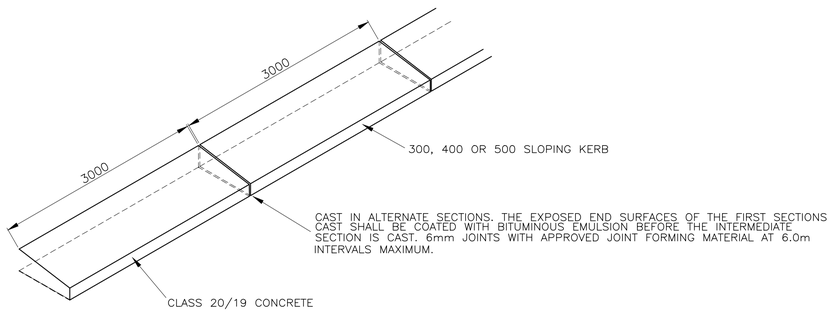
EDGE BEAM



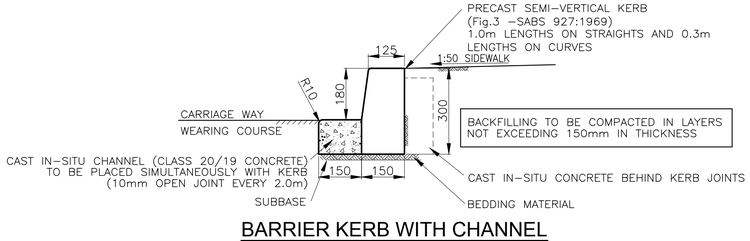
500 SLOPING KERB



SEMI-VERTICAL / BARRIER KERBS ALONG STRAIGHT SECTIONS



DETAIL OF SLOPING KERB



BARRIER KERB WITH CHANNEL

(FIG. 3 - SABS 927:1969)

TABLE A: KERBS TO BE USED FOR ROAD CONSTRUCTION

APPLICATION		TYPE OF KERB					
		300 Sloping Ker□	400 Sloping Ker□	500 Sloping Ker□	Edge Beam	Semi-vertical Ker□ (Fig.7) with channel	Barrier Ker□ (Fig.3) with channel
Roads up to 5m wide.	Straights and curves	⊗			⊗ (See Note 1.)		
	Bellmouths (See Note 2 at the □ottom)	⊗					
Road wider than 5m and up to 6m wide.	Straights and curves		⊗		⊗ (See Note 1.)		
	Bellmouths (See Note 2 at the □ottom)		⊗				
Road wider than 6m	Straights and curves			⊗			
	Bellmouths (See Note 2 at the □ottom)					⊗	
Bus and Taxi □a□s.							⊗
Where vehicles crossing the ker□ is discouraged.						⊗	
Where vehicles crossing the ker□ is prohi□ited.							⊗
Joint □etween asphalt and □lock paving					⊗		
Temporall□edge restraint in asphalt paving to □e removed when road is extended.					⊗		

NOTES: 1) An edge □eam shall □e constructed on the high side of roads with a single cross-fall.

2) At the intersection of roads with different road widths, the □ellmouths shall □e constructed with ker□s prescri□ed for the □ellmouths of the wider roads.

NOTES AND SPECIFICATIONS

1. KERBS - GENERAL

1.1 Refer to Ta□le A for the usage of ker□s

1.2 Also refer to Section 503 of the Standard Specifications for Municipal Civil Engineering Works, 3rd Edition, 2005.

2. CAST IN-SITU CONCRETE

2.1 Concrete to □e class 20/19.

2.2 Concrete to □e cured for a minimum period of 7 da□s.

2.3 All concrete to □e used for sloping ker□s or edge □eams shall have a slump not greater than 60mm.

2.4 Where there is a difference □etween the top of the su□□ase and the □ottom of the cast insitu ker□s of less than 75mm, such difference shall □e made up with the same concrete as specified for the ker□, otherwise compacted su□□ase material shall □e used.

2.5 The use of a machine to place cast in-situ ker□s must first □e approved □□ the Engineer.

3. PRECAST KERBS

3.1 All precast ker□s shall compl□ with the re□uirements of SANS 927.

3.2 The □edding material on which precast ker□ing is constructed shall □e according to the Standard Specification for Municipal Civil Engineering Works, 3rd Edition, 2005.

AMENDMENTS

NR.	DATE	APPROVED	DESCRIPTION	PAR.

DESIGNED: P.A. ODENDAAL Pr.Eng. — DRAWN: S. AUDIE

DESIGN CHECKED BY: L.G. JOHANNES Pr. Eng.

INFRASTRUCTURE TECHNICAL INFORMATION MANAGEMENT: D.J. CHALMERS

PROJECT STATUS

○ CONCEPT DRAWING ○ TENDER DRAWING ○ APPROVED FOR CONSTRUCTION DRAWING ○ AS BUILT DRAWING

PROJECT ENGINEER (CONSULTANT)

INITIALS AND SURNAME — SIGNATURE AND Pr. No. — DATE

INSPECTOR OF WORKS (CITY OF TSHWANE):

INITIALS AND SURNAME — SIGNATURE AND Pr. No. — DATE

CONSULTANT DETAIL

CITY OF TSHWANE
ROADS AND TRANSPORT DEPARTMENT

Mr P. I. Letlonkane, STRATEGIC EXECUTIVE DIRECTOR, P.O. BOX 1409, PRETORIA, 0001

Ms. L. V. Kegakilwe-Piki, EXECUTIVE DIRECTOR, P.O. BOX 1409, PRETORIA, 0001

DRAWING APPROVED BY EXECUTIVE DIRECTOR
Ms. L. V. Kegakilwe-Piki
SIGNATURE: DATE:

LOCATION OF PROJECT:

TYPICAL STANDARD DETAILS

DESCRIPTION OF PROJECT

KERBING DETAILS

SLOPING KERB, SEMI-VERTICAL KERBS AND EDGE BEAM

ROADS AND STORMWATER
For Internal Approval

RECEIVED
SIGN WHEN APPLICABLE

DIRECTOR: INFRASTRUCTURE PROVISION — SIGNATURE — DATE

DIRECTOR: INFRASTRUCTURE CONSTRUCTION (PROJECT) MANAGEMENT — SIGNATURE — DATE

DIRECTOR: INFRASTRUCTUREASSET MANAGEMENT — SIGNATURE — DATE

DIRECTOR: TRANSPORT INFRASTRUCTURE PLANNING — SIGNATURE — DATE

DIRECTOR: INTELLIGENT TRANSPORT SYSTEM AND TRAFFIC ENGINEERING ENGINEERING — SIGNATURE — DATE

DIRECTOR: INFRASTRUCTURE MAINTENANCE MANAGEMENT (IMM) — SIGNATURE — DATE

CONTRACT No. :

PROJECT No. :

DATE : MAY 2013

SCALE : AS SHOWN

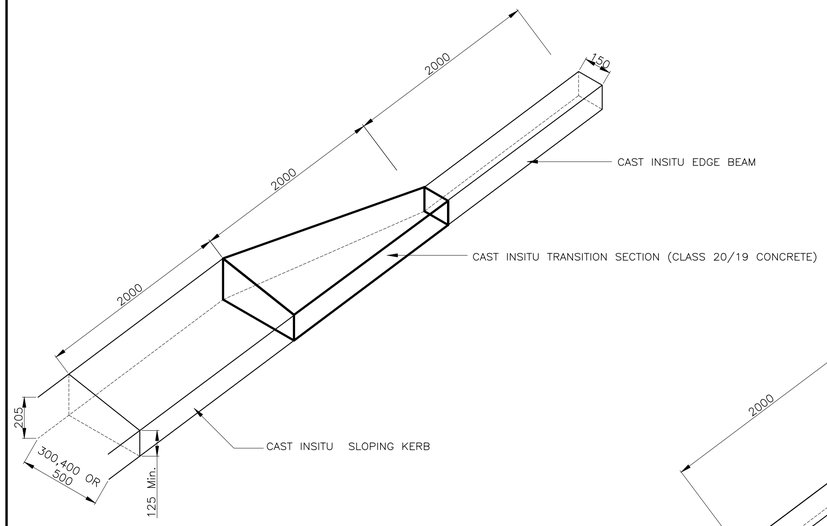
ORIGINAL PAPER SIZE: A1

0 10 20 40 60 80m
SCALE 1:1000

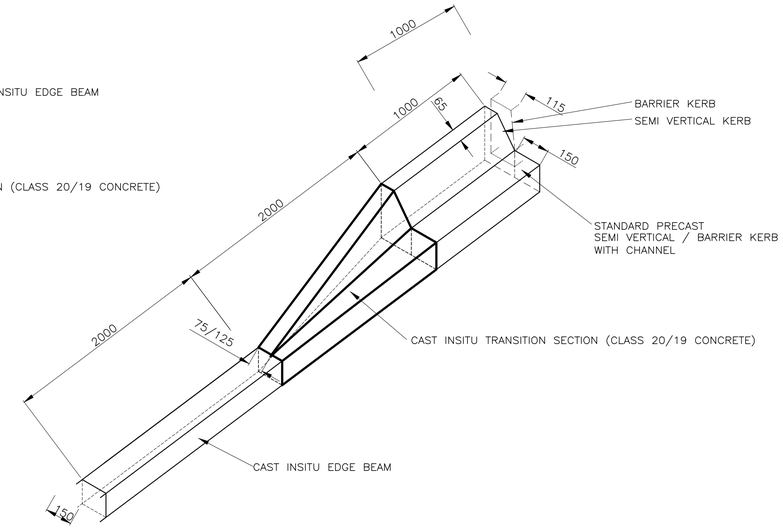
DRAWING NO. STD007

SHEET NO: 1 OF 2

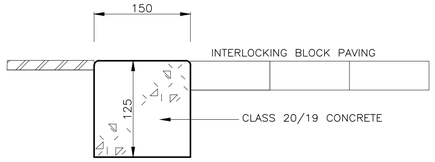
0 REVISION



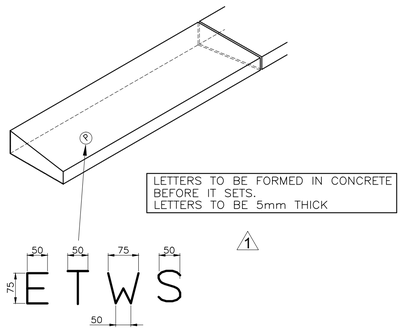
TRANSITION FROM SLOPING KERB
TO EDGE BEAM



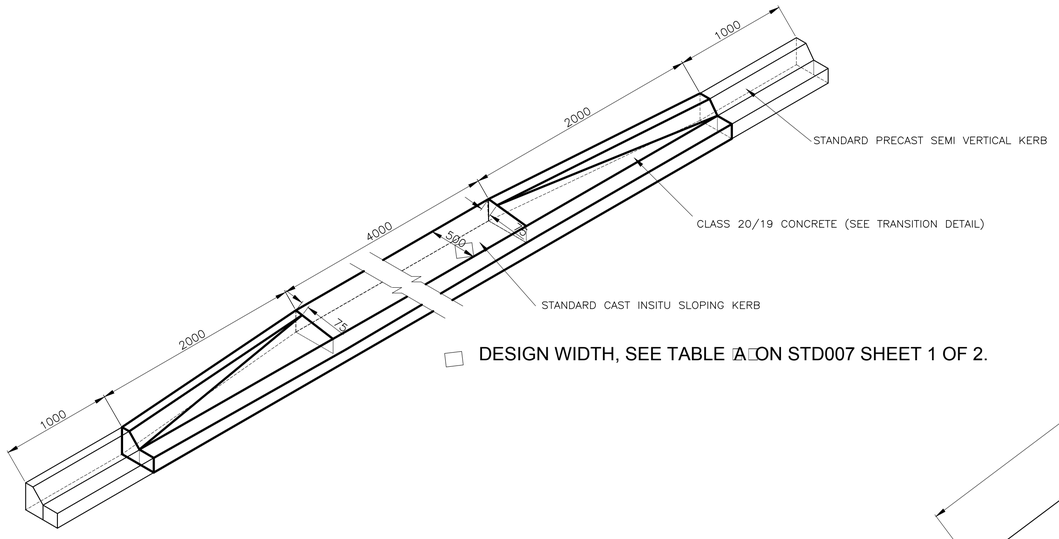
TRANSITION FROM SEMI VERTICAL / BARRIER KERB
TO EDGE BEAM



TYPICAL SECTION OF EDGE BEAM AT THE
TRANSITION OF TWO TYPES OF PAVING

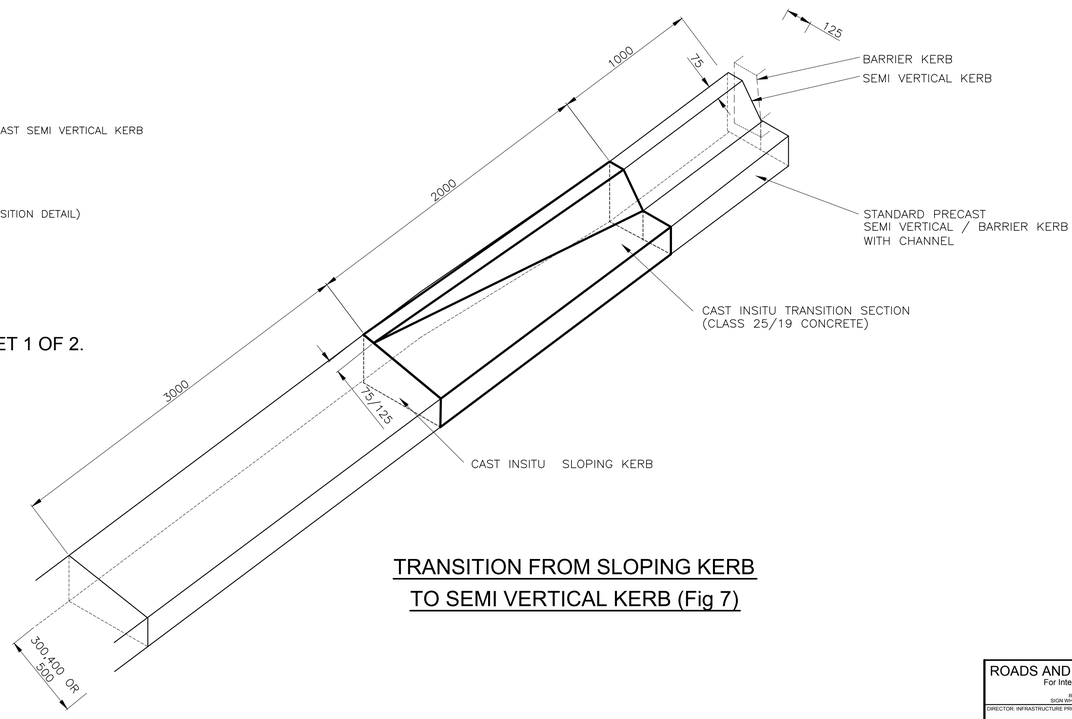


DETAIL FOR THE IDENTIFICATION OF SLEEVE POSITIONS



☐ DESIGN WIDTH, SEE TABLE A☐ON STD007 SHEET 1 OF 2.

DETAIL OF VEHICLE ENTRANCE
IN SEMI VERTICAL KERBING



TRANSITION FROM SLOPING KERB
TO SEMI VERTICAL KERB (Fig 7)

NOTES AND SPECIFICATIONS

1. KERBS - GENERAL

1.1 Refer to Ta☐le A on Sheet 1 of Drawing STD007 for the application of ker☐s.

1.2 The 20mm lip on all ker☐s is applica☐le to paved roads except where ☐lock or concrete paving is used.

1.3 Also refer to Section 503 of the Standard Specifications for Municipal Civil Engineering Works, 3rd Edition, 2005.

2. CAST IN-SITU CONCRETE

2.1 Concrete to ☐e class 20/19.

2.2 Concrete to ☐e cured for a minimum period of 7 da☐s.

2.3 All concrete to ☐e used for sloping ker☐s or edge ☐eams shall have a slump not greater than 60mm.

2.4 Where there is a difference ☐etween the top of the su☐ase and the ☐ottom of the cast insitu ker☐s of less than 75mm, such difference shall ☐e made up with the same concrete as specified for the ker☐, otherwise compacted su☐ase material shall ☐e used.

2.5 The use of a machine to place cast insitu ker☐s must first ☐e approved ☐☐the Engineer.

3. PRECAST KERBS

3.1 All precast ker☐s shall compl☐with the re☐uirements of SANS 927.

3.2 The ☐edding material on which precast ker☐ing is constructed shall ☐e according to the Standard Specification for Municipal Civil Engineering Works, 3rd Edition, 2005.

AMENDMENTS

NR.	DATE	APPROVED	DESCRIPTION	PAR.

DESIGNED: P.A. ODENDAAL Pr.Eng. — SIGNATURE / DATE
DRAWN: S. AUDIE
DESIGN CHECKED BY: P.A. ODENDAAL Pr.Eng. — SIGNATURE / DATE
INFRASTRUCTURE TECHNICAL INFORMATION MANAGEMENT: D.J. CHALMERS — SIGNATURE / DATE

PROJECT STATUS

○ CONCEPT DRAWING ○ TENDER DRAWING ○ APPROVED FOR CONSTRUCTION DRAWING ○ AS BUILT DRAWING

PROJECT ENGINEER (CONSULTANT):
INITIALS AND SURNAME / SIGNATURE AND Pr. No / DATE
INSPECTOR OF WORKS (CITY OF TSHWANE):
INITIALS AND SURNAME / SIGNATURE AND Pr. No. / DATE

CONSULTANT DETAIL

CITY OF TSHWANE
ROADS AND TRANSPORT DEPARTMENT

Mr P. I. Letlonkane — STRATEGIC EXECUTIVE DIRECTOR — P.O. BOX 1409 PRETORIA 0001
Ms. L. V. Kegakilwe-Piki — EXECUTIVE DIRECTOR — P.O. BOX 1409 PRETORIA 0001

DRAWING APPROVED BY EXECUTIVE DIRECTOR
Ms. L. V. Kegakilwe-Piki
SIGNATURE: DATE:

LOCATION OF PROJECT:

TYPICAL STANDARD DETAILS

DESCRIPTION OF PROJECT

KERBING DETAILS

TRANSITION SECTIONS AND VEHICLE ENTRANCE

CONTRACT No. : | PROJECT No. :

DATE : MAY 2013 | SCALE : AS SHOWN | ORIGINAL PAPER SIZE: A1

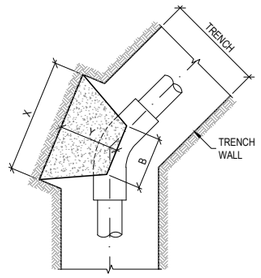
DRAWING NO. STD007 | SHEET NO: 2 OF 2 | 0 REVISION

ROADS AND STORMWATER
For Internal Approval
RECIEVED SIGN WHEN APPLICABLE

DIRECTOR: INFRASTRUCTURE PROVISION — SIGNATURE / DATE
DIRECTOR: INFRASTRUCTURE CONSTRUCTION (PROJECT) MANAGEMENT — SIGNATURE / DATE
DIRECTOR: INFRASTRUCTUREASSET MANAGEMENT — SIGNATURE / DATE
DIRECTOR: TRANSPORT INFRASTRUCTURE PLANNING — SIGNATURE / DATE
DIRECTOR: INTELLIGENT TRANSPORT SYSTEN AND TRAFFIC ENGINEERING ENGINEERING — SIGNATURE / DATE
DIRECTOR: INFRASTRUCTURE MAINTENANCE MANAGEMENT (MM) — SIGNATURE / DATE

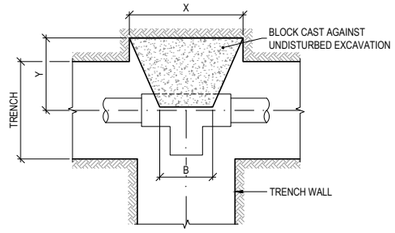
0 10 20 40 60 80m
SCALE 1:1000

DRAWING LOCATION



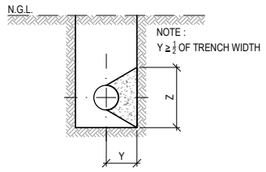
THRUST BLOCK FOR 45° BEND
SCALE 1:25

NOMINAL PIPE DIAMETER Ø (mm)	AREA REQUIRED (m²)	DIMENSIONS (m)				AREA PROVIDED (m²)	VOL (m³)
		B	Z	X	Y		
75	0.061	0.300	0.400	0.400	0.350	0.160	0.049
110	0.109	0.300	0.500	0.500	0.375	0.250	0.075
160	0.245	0.300	0.500	0.500	0.400	0.250	0.080
200	0.435	0.300	0.600	0.800	0.400	0.480	0.132
250	0.680	0.350	0.650	1.100	0.450	0.715	0.212
300	0.979	0.400	0.700	1.400	0.500	0.980	0.315
> 300	SEE PARTICULAR NOTE 5						

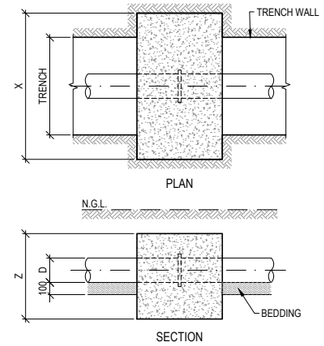


THRUST BLOCK FOR TEE-PIECE
SCALE 1:25

NOMINAL PIPE DIAMETER Ø (mm)	AREA REQUIRED (m²)	DIMENSIONS (m)				AREA PROVIDED (m²)	VOL (m³)
		B	Z	X	Y		
75	0.079	0.150	0.400	0.400	0.350	0.160	0.039
110	0.141	0.200	0.500	0.500	0.375	0.250	0.066
160	0.318	0.300	0.500	0.700	0.400	0.350	0.100
200	0.565	0.300	0.600	1.000	0.400	0.600	0.156
250	0.833	0.350	0.650	1.400	0.450	0.910	0.256
300	1.272	0.400	0.700	1.900	0.500	1.330	0.403
> 300	SEE PARTICULAR NOTE 5						

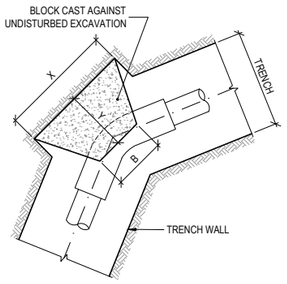


TYPICAL SECTION FOR 22.5° & 45° BEND
SCALE 1:25



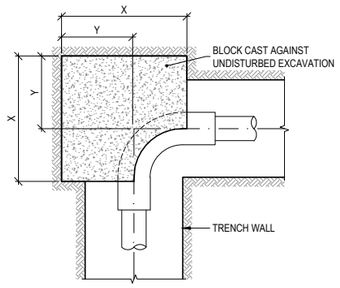
THRUST BLOCK FOR PUDDLE FLANGE
SCALE 1:25

NOMINAL PIPE DIAMETER Ø (mm)	AREA REQUIRED (m²)	TRENCH WIDTH (m)	DIMENSIONS (m)			AREA PROVIDED (m²)	VOL (m³)
			X	Y	Z		
75	0.078	0.475	0.875	0.500	0.575	0.410	0.250
110	0.139	0.500	0.900	0.500	0.600	0.420	0.270
160	0.312	0.550	0.950	0.700	0.650	0.450	0.420
200	0.555	0.600	1.000	0.700	0.900	0.740	0.610
250	0.867	0.650	1.250	1.000	0.950	0.950	1.140
300	1.250	0.700	1.500	1.000	1.000	1.250	1.430
> 300	SEE PARTICULAR NOTE 5						



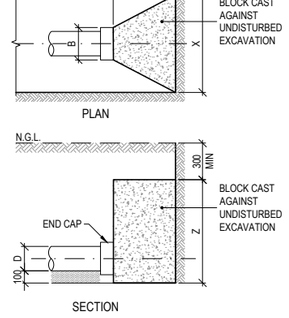
THRUST BLOCK FOR 22.5° BEND
SCALE 1:25

NOMINAL PIPE DIAMETER Ø (mm)	AREA REQUIRED (m²)	DIMENSIONS (m)				AREA PROVIDED (m²)	VOL (m³)
		B	Z	X	Y		
75	0.031	0.300	0.400	0.400	0.350	0.160	0.049
110	0.055	0.300	0.500	0.500	0.375	0.250	0.075
160	0.124	0.300	0.500	0.500	0.400	0.250	0.080
200	0.220	0.300	0.600	0.600	0.400	0.360	0.108
250	0.344	0.350	0.650	0.650	0.450	0.423	0.146
300	0.496	0.400	0.700	0.800	0.500	0.560	0.210
> 300	SEE PARTICULAR NOTE 5						



THRUST BLOCK FOR 90° BEND
SCALE 1:25

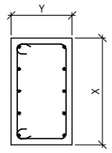
NOMINAL PIPE DIAMETER Ø (mm)	AREA REQUIRED (m²)	DIMENSIONS (m)			AREA PROVIDED (m²)	VOL (m³)
		Z	X	Y		
75	0.078	0.400	0.350	0.350	0.140	0.049
110	0.139	0.500	0.380	0.375	0.190	0.072
160	0.314	0.500	0.650	0.400	0.330	0.211
200	0.576	0.600	1.000	0.400	0.600	0.600
250	0.871	0.650	1.400	0.450	0.910	1.274
300	1.225	0.700	1.800	0.500	1.260	2.268
> 300	SEE PARTICULAR NOTE 5					



THRUST BLOCK FOR DEAD END
SCALE 1:25

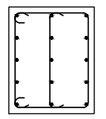
NOMINAL PIPE DIAMETER Ø (mm)	AREA REQUIRED (m²)	DIMENSIONS (m)				AREA PROVIDED (m²)	VOL (m³)
		B	Z	X	Y		
75	0.078	0.075	0.300	0.475*	0.200	0.140	0.017
110	0.139	0.100	0.300	0.500*	0.200	0.150	0.018
160	0.312	0.150	0.600	0.550*	0.200	0.330	0.063
200	0.555	0.200	0.650	0.600*	0.200	0.570	0.076
250	0.867	0.250	0.700	1.250	0.500	0.880	0.263
300	1.248	0.300	0.750	1.700	0.700	1.280	0.525
> 300	SEE PARTICULAR NOTE 5 * = TRENCH WIDTH						

THRUST BLOCK THICKNESS = 500mm
CONCRETE CLASS = 25MPa
HORIZONTAL REBAR = Y10 @ 200
VERTICAL REBAR = 2 LAYERS Y10 @ 200
75mm COVER OVER REINFORCEMENT



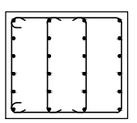
PLAN
(75mm Ø & 110mm Ø PIPES)

THRUST BLOCK THICKNESS = 700mm
CONCRETE CLASS = 25MPa
HORIZONTAL REBAR = Y12 @ 200
VERTICAL REBAR = 3 LAYERS Y12 @ 200
75mm COVER OVER REINFORCEMENT



PLAN
(160mm Ø & 200mm Ø PIPES)

THRUST BLOCK THICKNESS = 1000mm
CONCRETE CLASS = 25MPa
HORIZONTAL REBAR = Y12 @ 150
VERTICAL REBAR = 4 LAYERS Y12 @ 150
75mm COVER OVER REINFORCEMENT



PLAN
(250mm Ø & 300mm Ø PIPES)

REINFORCEMENT DETAILS FOR PUDDLE FLANGE THRUST BLOCKS

NOTES AND SPECIFICATIONS

GENERAL

1. ALL MATERIAL AND WORKMANSHIP MUST COMPLY WITH THE REQUIREMENTS OF THE LATEST RELEVANT SANS STANDARD
2. ALL DIMENSIONS ARE IN mm (UNLESS OTHERWISE SPECIFIED)
3. DO NOT SCALE FROM THESE DRAWINGS
4. ALL DIMENSIONS TO BE CHECKED AND APPROVED ON SITE
5. ALL CONSTRUCTION TO BE DONE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, THIRD EDITION 2005 AND THE STANDARD COT DETAIL DRAWINGS
6. THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE STANDARD DRAWINGS (IF APPLICABLE)
7. THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, SERIES 4
8. THE SIGNATURE OR INITIALS ON THIS DRAWING OF ANY DIRECTOR OF THE WATER AND SANITATION DEPARTMENT, IN NO WAY, REMOVES ANY RESPONSIBILITY WHATSOEVER FROM THE CONSULTANT
9. THE CONSULTANT REMAINS RESPONSIBLE TO ENSURE THAT ALL THE GUIDELINES, STANDARD DRAWINGS, STANDARDS AND SPECIFICATIONS OF THE WATER AND SANITATION DEPARTMENT HAVE BEEN MET AND ARE COMPLIED WITH
10. FINAL POSITION OF SERVICES TO BE DETERMINED ON SITE

PARTICULAR

CONCRETE THRUST BLOCKS

1. THRUST BLOCK DIMENSIONS ON THIS DRAWING ARE ONLY APPLICABLE UNDER THE FOLLOWING CONDITIONS :
   - UNDISTURBED SAND-GROUND MIXTURES OR DENSE UNIFORM SAND WITH A BEARING CAPACITY OF AT LEAST 150 kPa
   - UNSUBMERGED CONDITIONS
   - MAXIMUM INTERNAL PIPE PRESSURE OF 18 BAR

   IF THE CONTRACTOR IS NOT IN A POSITION TO IDENTIFY THE ABOVE CONDITIONS, AN ENGINEERING GEOLOGIST OR AN ENGINEER MUST BE CONSULTED. IN ALL OTHER CONDITIONS THE ACTUAL IN-SITU BEARING PRESSURE SHALL BE CALCULATED AND THE THRUST BLOCK DESIGNED BY THE ENGINEER.
2. CONCRETE PUDDLE FLANGES - 25/19
   OTHER - 15/19
3. HALF THE DEPTH OF THE THRUST BLOCK TO BE PLACED BELOW THE PIPE AXIS
4. KEEP CONCRETE AWAY FROM THE COUPLINGS & THE PIPE JOINTS
5. THRUST BLOCKS FOR PIPE Ø LARGER THAN 300mm Ø & HIGHER TEST PRESSURE THAN 18 BAR SHALL BE DESIGNED BY THE ENGINEER

CITY OF TSHWANE
IGNITING EXCELLENCE
P O BOX 1022
PRETORIA
0001

CITY OF TSHWANE
WATER AND SANITATION DEPARTMENT

AMENDMENTS

NO	DATE	APPROVED	DESCRIPTION	PAR
0				

WATER AND SANITATION
FOR INTERNAL APPROVAL - RECEIVED SIGN WHEN APPLICABLE

	NAME	Prof. Reg. No	SIGNATURE	DATE
DIRECTOR: WATER AND SANITATION - PLANNING (ACTING)	E.J VICTOR			JAN 2017
REGIONAL DIRECTOR: (1,2,3,4,5,6 or 7)				
DIRECTOR: SYSTEM DEVELOPMENT				
DIRECTOR: BULK WATER				
DIRECTOR: INFRASTRUCTURE PROVISION				
DIRECTOR: WASTE WATER TREATMENT				

CONSULTANT DETAIL

I [redacted] Prof Reg No. [redacted]
HEREBY CERTIFY THAT THE SERVICES WILL/HAVE BEEN INSTALLED ACCORDING TO NOTE 9 OF THE ABOVE NOTES AND TO THE DRAWING

SIGNATURE DATE

CONSULTANT DRAWING NUMBER: 0 REVISION

DESIGNED
NAME: R.P AINSLIE Pr Eng. Prof Reg No: 810370
SIGNATURE: DATE: FEBRUARY 2016

DRAWN
NAME: M. M. BURGER
SIGNATURE: DATE: FEBRUARY 2016

CHECKED
NAME: Pr Eng. Prof Reg No:
SIGNATURE: DATE:

INFORMATION OFFICE CHECKED
NAME:
SIGNATURE: DATE:

DESIGN OFFICE APPROVAL
NAME: T.F HILDER Prof Reg No: 880539
SIGNATURE: DATE: JAN 2017

CONTRACT No. --
PROJECT No. -
SHEET No. --
PAPER SIZE A1
SCALE AS SHOWN
DATE FEB 2016

PROJECT STATUS
RECEIVED SIGN WHEN APPLICABLE

○ CONCEPT DRAWING ○ TENDER DRAWING ○ APPROVED CONSTRUCTION DRAWING ○ AS BUILT DRAWING

PROJECT ENGINEER of COT:
NAME: Pr Eng. Prof Reg No:
SIGNATURE: DATE:

INSPECTOR OF WORKS of COT:
NAME: Prof Reg No:
SIGNATURE: DATE:

LOCATION OF PROJECT:

DESCRIPTION OF PROJECT:

STANDARD DRAWING : THRUST BLOCKS

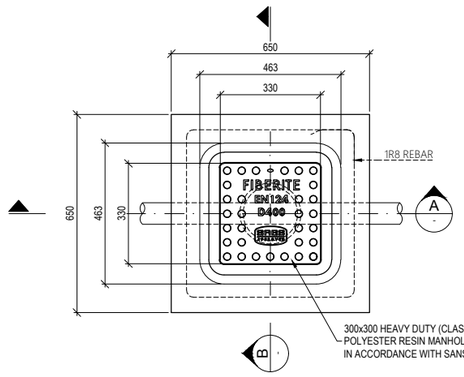
WBS No. :

COT DRAWING NUMBER: 7515-W210 0 REVISION

TYPE B - SPECIAL :

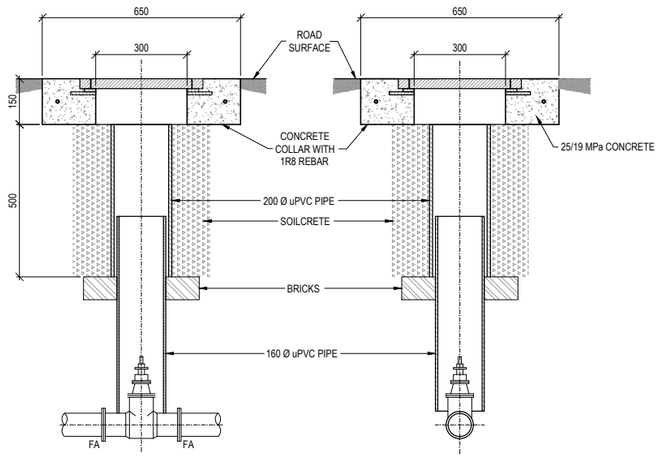
ONLY TO BE USED FOR :

- MAINTENANCE
- WITHIN ROADWAY
- FIRE HYDRANT CONNECTIONS LARGER THAN 200 Ø
- OR IF SPECIFIED BY ENGINEER



PLAN
SCALE 1:10

BENDING SCHEDULE						
TYPE & SIZE	QTY	CUTTING LENGTH (mm)	SHAPE CODE	A (mm)	B (mm)	MASS (kg)
R8	1	2150	60	550	550	0.85



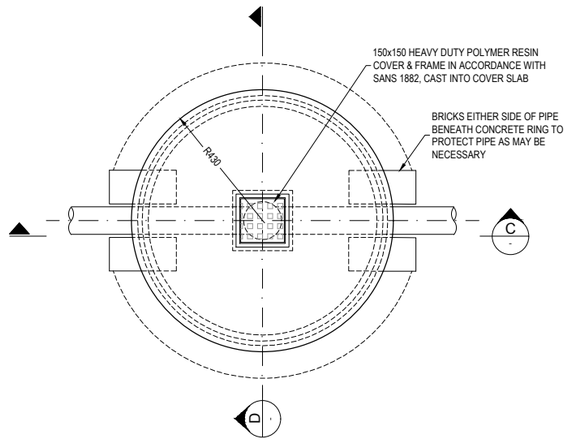
SECTION A
SCALE 1:10

SECTION B
SCALE 1:10

POLYESTER RESIN VALVE CHAMBER

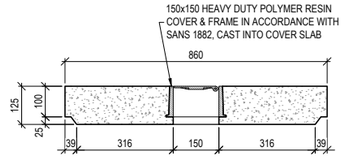
TYPE A - STANDARD :

FOR USE WITHIN SIDE WALKS

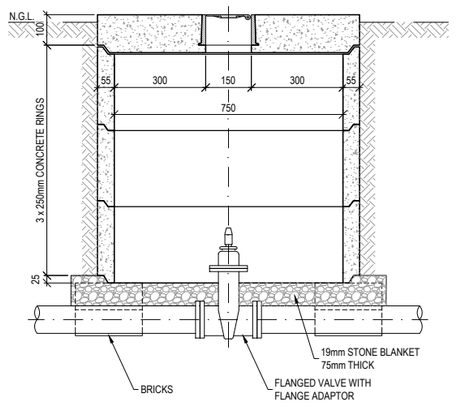


PLAN
SCALE 1:10

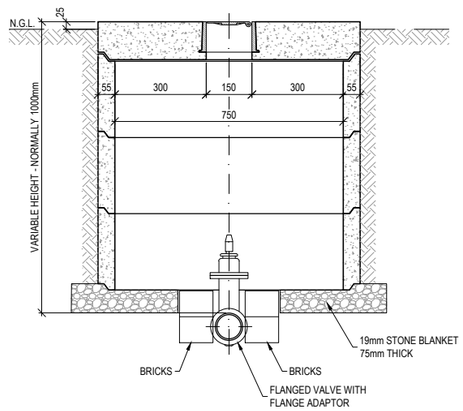
PRE-CAST CONCRETE VALVE CHAMBER RINGS			
INNER Ø (mm)	EFFECTIVE LENGTH (mm)	WALL THICKNESS (mm)	OUTER Ø (mm)
750	250, 500, 1000	55	860



CONCRETE COVER SLAB DETAIL
SCALE 1:10



SECTION C
SCALE 1:10



SECTION D
SCALE 1:10

CONCRETE RING VALVE CHAMBER

NOTES AND SPECIFICATIONS

GENERAL

1. ALL MATERIAL AND WORKMANSHIP MUST COMPLY WITH THE REQUIREMENTS OF THE LATEST RELEVANT SANS STANDARD
2. ALL DIMENSIONS ARE IN mm (UNLESS OTHERWISE SPECIFIED)
3. DO NOT SCALE FROM THESE DRAWINGS
4. ALL DIMENSIONS TO BE CHECKED AND APPROVED ON SITE
5. ALL CONSTRUCTION TO BE DONE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, THIRD EDITION 2005 AND THE STANDARD COT DETAIL DRAWINGS
6. THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE STANDARD DRAWINGS (IF APPLICABLE)
7. THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, SERIES 4
8. THE SIGNATURE OR INITIALS ON THIS DRAWING OF ANY DIRECTOR OF THE WATER AND SANITATION DEPARTMENT, IN NO WAY, REMOVES ANY RESPONSIBILITY WHATSOEVER FROM THE CONSULTANT
9. THE CONSULTANT REMAINS RESPONSIBLE TO ENSURE THAT ALL THE GUIDELINES, STANDARD DRAWINGS, STANDARDS AND SPECIFICATIONS OF THE WATER AND SANITATION DEPARTMENT HAVE BEEN MET AND ARE COMPLIED WITH
10. FINAL POSITION OF SERVICES TO BE DETERMINED ON SITE

PARTICULAR

1. PAINT 400x300mm BLOCK ON KERBING OPPOSITE VALVE WITH WHITE ROAD MARKING PAINT
2. ALL RSV VALVES TO BE FLANGED NON RISING SPINDLE, ANTI-CLOCKWISE CLOSING WITH CAP TOP
3. STEEL PIPES MUST BE WRAPPED WITH CANUSA-CPS WRAPID TAPE
4. STAINLESS STEEL BOLTS & NUTS TO BE USED
5. MANHOLE COVER SPECIFICATIONS :
   - WITHIN ROADWAY : CLASS D400 MANHOLE COVER IN ACCORDANCE WITH SANS 50124, POLYESTER RESIN OR SIMILAR
   - WITHIN SIDEWALK : HEAVY DUTY COVER & FRAME IN ACCORDANCE WITH SANS 1882, POLYMER RESIN OR SIMILAR

CITY OF TSHWANE
IGNITING EXCELLENCE
P O BOX 1022
PRETORIA
0001
CITY OF TSHWANE
WATER AND SANITATION
DEPARTMENT

AMENDMENTS

NO	DATE	APPROVED	DESCRIPTION	PAR
0				

WATER AND SANITATION

FOR INTERNAL APPROVAL - RECEIVED SIGN WHEN APPLICABLE

DIRECTOR: WATER AND SANITATION - PLANNING (ACTING) — E.J VICTOR — JAN 2017
REGIONAL DIRECTOR: (1,2,3,4,5,6 or 7)
DIRECTOR: SYSTEM DEVELOPMENT
DIRECTOR: BULK WATER
DIRECTOR: INFRASTRUCTURE PROVISION
DIRECTOR: WASTE WATER TREATMENT

(NAME / Prof. Reg. No / SIGNATURE / DATE)

CONSULTANT DETAIL

I ..... Prof Reg No. .....
HEREBY CERTIFY THAT THE SERVICES WILL/HAVE BEEN INSTALLED ACCORDING TO NOTE 9 OF THE ABOVE NOTES AND TO THE DRAWING
SIGNATURE DATE

CONSULTANT DRAWING NUMBER: 0 REVISION

DESIGNED

NAME: ____ Pr Eng. Prof Reg No: ____
SIGNATURE: ____ DATE: ____

DRAWN

NAME: M. M. BURGER
SIGNATURE: ____ DATE: JANUARY 2016

CHECKED

NAME: ____ Pr Eng. Prof Reg No: ____
SIGNATURE: ____ DATE: ____

INFORMATION OFFICE CHECKED

NAME: ____
SIGNATURE: ____ DATE: ____

DESIGN OFFICE APPROVAL

NAME: T.F HILDER Prof Reg No: 880539
SIGNATURE: ____ DATE: JAN 2017

CONTRACT No.	PROJECT No.	SHEET No.	PAPER SIZE	SCALE	DATE
315-02	315-02	-	A1	-	JAN 2016

PROJECT STATUS

RECEIVED SIGN WHEN APPLICABLE

○ CONCEPT DRAWING ○ TENDER DRAWING ○ APPROVED CONSTRUCTION DRAWING ○ AS BUILT DRAWING

PROJECT ENGINEER of COT: NAME: ____ Pr Eng. Prof Reg No: ____ SIGNATURE: ____ DATE: ____

INSPECTOR OF WORKS of COT: NAME: ____ Prof Reg No: ____ SIGNATURE: ____ DATE: ____

LOCATION OF PROJECT:

DESCRIPTION OF PROJECT:

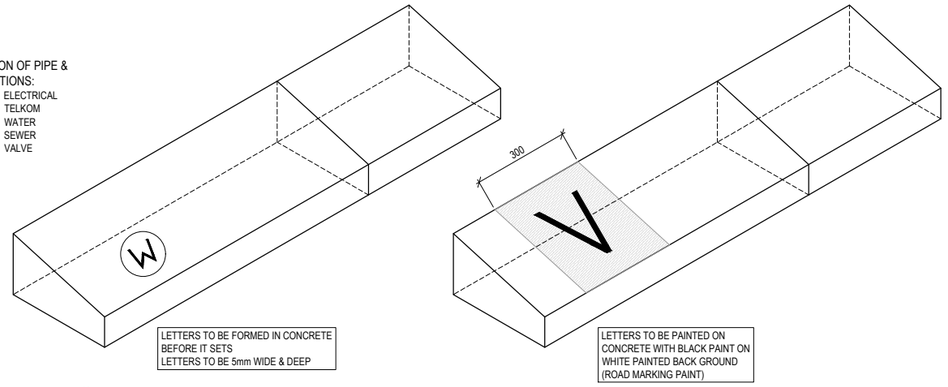
STANDARD DRAWING:
VALVE CHAMBERS

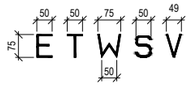
WBS No. :

COT DRAWING NUMBER: 7515-W203 — 0 REVISION

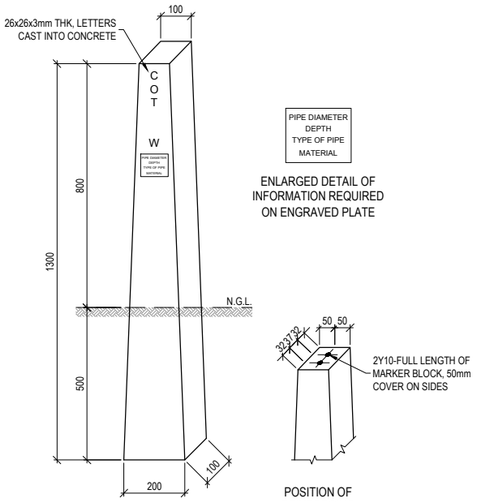
IDENTIFICATION OF PIPE & SLEEVE POSITIONS:

E	=	ELECTRICAL
T	=	TELKOM
W	=	WATER
S	=	SEWER
V	=	VALVE

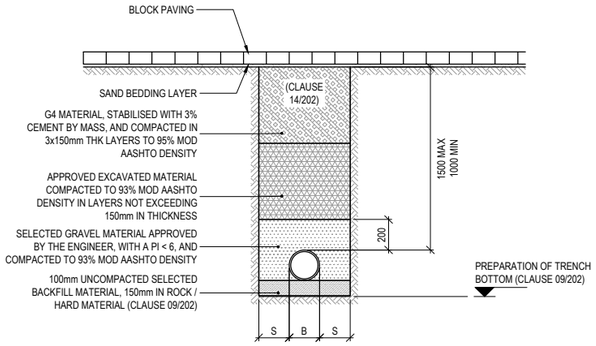




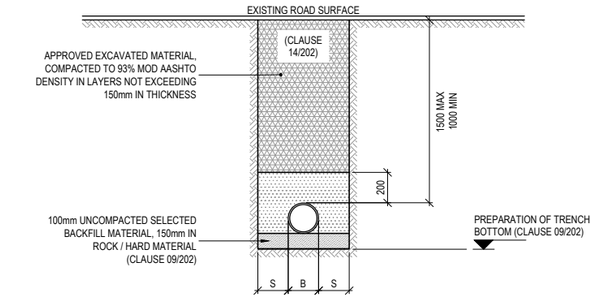
MARKERS ON CONCRETE KERBS
SCALE 1:10



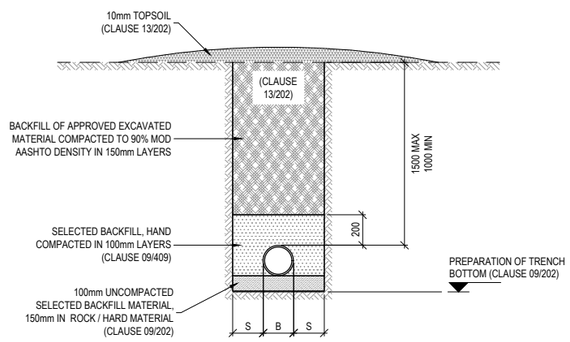
CONCRETE MARKER BLOCK
SCALE 1:10



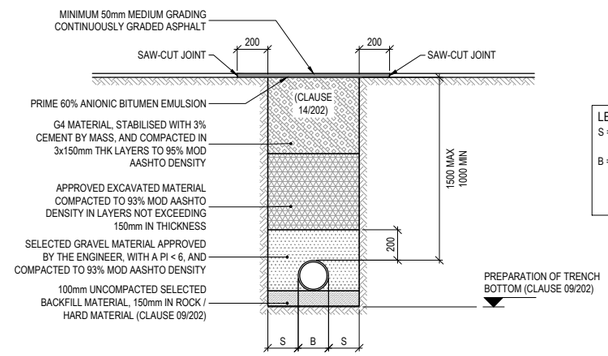
TRENCHING
A) PAVED AREAS



TRENCHING
B) GRAVEL ROADS



TRENCHING
C) SIDE WALKS



TRENCHING
C) SURFACED ROADS

LEGEND:
S = WORKING SPACE EACH SIDE OF PIPE, MIN 200mm (CLAUSE 04.01/202)
B = OD OF PIPE (CLAUSE 00/999) - REFERENCE IN STANDARD SPECIFICATION (CLAUSE NUMBER / SECTION NUMBER)

TYPICAL BEDDING & BACKFILL DETAILS FOR WATER PIPES
SCALE 1:20

NOTES AND SPECIFICATIONS

GENERAL

1. ALL MATERIAL AND WORKMANSHIP MUST COMPLY WITH THE REQUIREMENTS OF THE LATEST RELEVANT SANS STANDARD
2. ALL DIMENSIONS ARE IN mm (UNLESS OTHERWISE SPECIFIED)
3. DO NOT SCALE FROM THESE DRAWINGS
4. ALL DIMENSIONS TO BE CHECKED AND APPROVED ON SITE
5. ALL CONSTRUCTION TO BE DONE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, THIRD EDITION 2005 AND THE STANDARD COT DETAIL DRAWINGS
6. THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE STANDARD DRAWINGS (IF APPLICABLE)
7. THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, SERIES 4
8. THE SIGNATURE OR INITIALS ON THIS DRAWING OF ANY DIRECTOR OF THE WATER AND SANITATION DEPARTMENT, IN NO WAY, REMOVES ANY RESPONSIBILITY WHATSOEVER FROM THE CONSULTANT
9. THE CONSULTANT REMAINS RESPONSIBLE TO ENSURE THAT ALL THE GUIDELINES, STANDARD DRAWINGS, STANDARDS AND SPECIFICATIONS OF THE WATER AND SANITATION DEPARTMENT HAVE BEEN MET AND ARE COMPLIED WITH
10. FINAL POSITION OF SERVICES TO BE DETERMINED ON SITE

CITY OF TSHWANE
IGNITING EXCELLENCE
P O BOX 1022
PRETORIA
0001

CITY OF TSHWANE
WATER AND SANITATION DEPARTMENT

AMENDMENTS

NO	DATE	APPROVED	DESCRIPTION	PAR
0				

WATER AND SANITATION
FOR INTERNAL APPROVAL - RECEIVED SIGN WHEN APPLICABLE

	NAME	Prof. Reg. No	SIGNATURE	DATE
DIRECTOR: WATER AND SANITATION - PLANNING (ACTING)	E.J VICTOR			JAN 2017
REGIONAL DIRECTOR: (1,2,3,4,5,6 or 7)				
DIRECTOR: SYSTEM DEVELOPMENT				
DIRECTOR: BULK WATER				
DIRECTOR: INFRASTRUCTURE PROVISION				
DIRECTOR: WASTE WATER TREATMENT				

CONSULTANT DETAIL

I □□□□□□□□□□□□□□□□□□□□□□ Prof Reg No.□□□□□□□□□□□□□□□□□□□□
HEREBY CERTIFY THAT THE SERVICES WILL/HAVE BEEN INSTALLED ACCORDING TO NOTE 9 OF THE ABOVE NOTES AND TO THE DRAWING
SIGNATURE DATE

CONSULTANT DRAWING NUMBER: 0 REVISION

DESIGNED	NAME:	Pr Eng. Prof Reg No:	
	SIGNATURE:	DATE:	
DRAWN	NAME: M. M. BURGER		
	SIGNATURE:	DATE: FEBRUARY 2016	
CHECKED	NAME:	Pr Eng. Prof Reg No:	
	SIGNATURE:	DATE:	
INFORMATION OFFICE CHECKED	NAME:		
	SIGNATURE:	DATE:	
DESIGN OFFICE APPROVAL	NAME: T.F HILDER	Prof Reg No: 880539	
	SIGNATURE:	DATE: JAN 2017	

CONTRACT No.	--
PROJECT No.	-
SHEET No.	--
PAPER SIZE	A1
SCALE	AS SHOWN
DATE	FEB 2016

PROJECT STATUS
RECEIVED SIGN WHEN APPLICABLE

○ CONCEPT DRAWING ○ TENDER DRAWING ○ APPROVED CONSTRUCTION DRAWING ○ AS BUILT DRAWING

PROJECT ENGINEER of COT:
NAME: Pr Eng. Prof Reg No:
SIGNATURE: DATE:

INSPECTOR OF WORKS of COT:
NAME: Prof Reg No:
SIGNATURE: DATE:

LOCATION OF PROJECT:

DESCRIPTION OF PROJECT:
STANDARD DRAWING :
MARKERS, TYPICAL BEDDING AND BACKFILL DETAILS FOR WATER PIPES

WBS No. :

COT DRAWING NUMBER: 7515-W211 0 REVISION

SPECIFICATION FOR OCCUPATIONAL AND HEALTH AND SAFETY

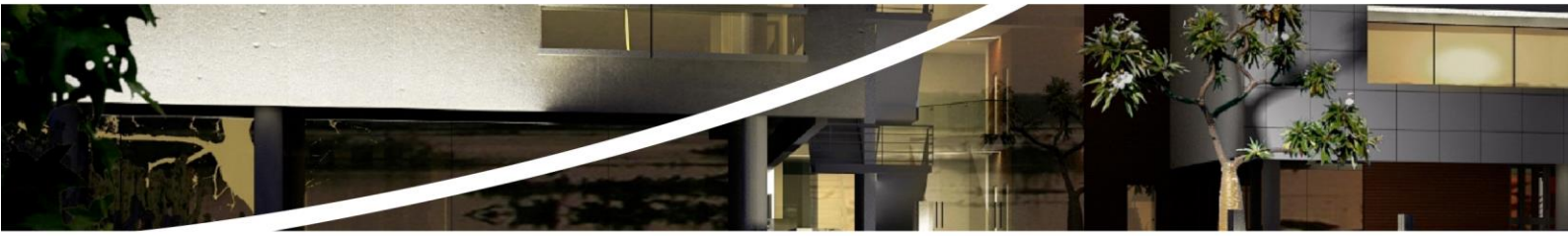
CONSTRUCTION HEALTH AND SAFETY SPECIFICATION

FOR

THE SUNNYSIDE OFFICE DEVELOPMENT PROJECT, AT SUNNYSIDE, IN PRETORIA, JOHANNESBURG, WITHIN THE CITY OF TSHWANE METROPOLITAN MUNICIPALITY

AUGUST 2019

PREPARED BY:
TRIVIRON PROJECT MANAGEMENT (PTY) LTD
Triviron House
Whitby Manor Office Estate
167 14th Road
Noordwyk
Midrand
1687
(011) 318 8393



I. INTRODUCTION

1. Philosophy

This specification has been prepared as a guideline without being prescriptive, constraining the competitive advantage or interfering with the legal obligations of the responding parties.

The specification accordingly provides for:

- Independent periodic audits to ensure an unbiased pursuit of health and safety,
- Follow-up audits to ensure the implementation of prescribed remedial actions,
- The review of the efficiency and effectiveness of the Contractor's Health and Safety Plan,
- The preparation of regular reports of inspections and accidents to enable the tracking of changes in health and safety performance,
- The monitoring of conditions on a continuously pro-active basis to ensure that hazards are without delay identified, assessed and remedied should it threaten the health and safety of persons and property,
- Ad-hoc inspections to ensure that health and safety is pursued with dedication and not out of intimidation or coercion, and
- Development of all aspects of the Contractor's Health and Safety Plan.

The essential intention of this specification is the preservation and entrenchment of health and safety as a core value of all involved during the construction period.

2. Project Information

Project name: The Sunnyside Office Development Project

Client : Public Investment Corporation

3. Key Role Players

PROJECT MANAGERS: CSM Consulting Services (Pty) Ltd

QUANTITY SURVEYORS: BTKM / MMQS Joint Venture

ARCHITECTS: Iqhayiya Design Workshop/ GLH Joint Venture

CIVIL/STRUCTURAL ENGINEERS: Nako Iliso Group

ELECTRICAL ENGINEERS: Plantech/Raphal Joint Venture

MECHANICAL ENGINEERS: Aurecon

WET SERVICES: Aurecon

FIRE ENGINEERING: Aurencon

GREEN CONSULTANT: Solid Green Consulting/Imkhita JV

HEALTH AND SAFETY CONSULTANT: Triviron Project Management

4. Description of work

The scope of works includes the following:

1. **Bulk earthworks**

Bulk excavation for the construction of a 5-level super basement. Mass earthworks to include excavation of soft, intermediate and hard material (including blasting or other suitably approved techniques).

2. **Lateral support**

The geometry of the bulk excavations require vertical sides around the perimeter of the site for the full basement depth. The cores drilled indicated three prominent layers at varying depths: Soft material

encountered to a depth of approximately 5m deep. Intermediate material to a depth of approximately 10m and hard rock material to the bottom of the basement approximately 15m deep.

The lateral support design requires temporary soil and rock Y25 anchors to be used at approximately 1.5m spacing vertically and horizontally. A 200mm thick reinforced gunite wall with mesh ref 395 on each face is be constructed incrementally deeper as the excavation progresses (as shown on drawings 1600073-LS-T-01 to 03 Rev 0). Provide a high flow wick drains in the form of Zipcore with 80% Shade cloth at the back of the gunite wall. Once the building frame is constructed in the basement, the reinforced concrete floors will butt against the gunite walls and accommodate the lateral forces. The temporary anchors can then be de-stressed.

3. **Cross cutting for wayleave approval**

Exposure of existing underground municipal services and the survey thereof in accordance with the requirements for City of Tshwane (CoT) wayleave approval process. The survey information is to be provided to the engineer for finalization of the construction drawings of the municipal services requiring upgrade or relocation. The construction drawings are to be submitted to CoT by the engineer for final approval of the drawings and wayleave applications. Contractors must therefore programme their works accordingly to factor in this approval process. Cross cut positions to be determined by the engineer and contractor following appointment of the contractor. Indicative positions provided as per Drawing 1600073-08-81-C010.

4. **Sewer Relocation**

There is an existing and operational municipal sewer pipeline (250mm diameter) that runs through an existing servitude through the proposed development site. This sewer line is to be replaced by a new pipeline (220m length, 250mm diameter and 70m length, 315mm diameter) along a new route around the development site (as shown on Drawing 1600073-08-81-C202 rev A).

5. **Municipal Water Upgrade**

Classification - Public

As part of the rezoning agreement for the new development, the existing municipal water pipeline (672m length, 160mm diameter) along Jeppe Street is to be upgraded (to a 250mm diameter) along the same route in Jeppe Street (as shown on Drawing 1600073-08-81-C101 rev A).

6. **Stormwater diversion**

Stormwater runoff generated from the National Department of Tourism building on the neighbouring property drains onto the new development site. Stormwater is to therefore be diverted away from the site onto Trevenna Street into a new municipal pipeline (115m length, 450mm diameter) that joins into the existing municipal system on Jeppe Street (as shown on Drawing 1600073-08-81-C301 rev A).

Standards and

5. Description of site

The corner of Jeppe and Trevenna streets in Sunnyside, Pretoria

6. Summary of Risks identified during the Design Stage

ACTIVITY	HAZARD
Design	Designers have not considered relevant legislation or SANS while designing
Construction Work Permit application	Consultants not submitting relevant docs on time Application File not completed on time Delay in construction programme
Site establishment	Site area restrictions Unplanned congestion Incorrect equipment usage Personnel not inducted
Deep Excavation	Falling into excavations Collapsing of excavations DCP test not done proper
Blasting of Hard Rock	Not adhering to the Explosive Act Working without blasting permit Working without notifying neighbours Excessive noise Dust
Traffic Accommodations	Causing of traffic in the nearby road Causing accidents in the nearby road Mobile plant blocking the road
Scaffolding	Personnel falling Incorrectly erected scaffolding Structure collapse Objects and equipment falling
Handling of material	Hand injuries Back injuries
oil and fuel spillage	Soil contamination Ground pollution
Hoarding and Barricading	Injuries Public entering construction site
Storage of material and equipment	Falling objects Loose stacking
Waste Management	Fires Accumulation of waste Fires
Material Deliveries	Vehicle collisions Damage to property
Movement of construction plant and vehicles	Height restrictions Vehicle collisions Damage to property
Working at heights	Falls from heights Falling objects
Electrical work	Electrocution
Hot work	Fumes Electrocution Flying debris
Storage of fuels	Fires Environmental impact
Installation and commissioning of lifts	Insufficient Signage Insufficient barricading Installers not competent
Cranes	Defective crane

	Crane not load tested Incompetent operators Lifting load heavier than required Failure of lifting equipment
Lifting of heavy machinery	Incompetent rigger Defective lifting equipment use Failure of lifting equipment
Bulk installation of fuel tank	Not done as per legislation requirement Bund wall not provided Bund wall not sufficient to carry the volume

7. Requirements at Tender Stage

The Principal Contractor, when submitting his tender must do the following:

1. make provision for the cost of health and safety measures during the construction process;
2. submit a project-specific organogram with key personnel CV's and responsibilities;
3. submit a company OHS Policy;
4. submit a project specific Fall Protection Plan;
5. submit a project specific Health and Safety Plan; and
6. submit a project method statement.

8. Requirements on Appointment

The Principal Contractor is required to do the following prior to site establishment:

1. Sign the Client's OHS Act Section 37(2) Mandatary Agreement;
2. Sign and accept the Clients Construction Regulations 5(1)(k) Principal Contractor Appointment; and
3. Submit a project-specific Safety File for review and approval by the Client prior to commencement of works on site.

II. INTERPRETATIONS

1. Applications

This document is to be read and understood in conjunction with the following, inter- alia:

1. Occupational Health and Safety Act 85 of 1993 (OHS Act)
2. All regulations published in terms of the OHS Act
3. Construction Regulations, 2014
4. Lift, Escalator and Passenger Conveyor Regulations
5. SABS codes referred to by the OHS Act
6. Contract Documents
7. Basic Conditions of Employment Act (Act 75 of 1997)
8. National Environmental Management Act 107 of 1998 and all Regulations
9. Compensation for Occupational Injuries and Diseases (COID) Act No.130 of 1993
10. Relevant SANS Standards
11. Explosive Act
12. Explosive regulations

2. Definitions

The most important definitions in The OHS Act and Regulations pertaining to this specification document are hereby extracted.

"Purpose of the OHS Act" –

To provide for the health and safety of persons at work and the health and safety of persons in connection with the use of plant and machinery; the protection of persons other than persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work; to establish an advisory council for occupational health and safety; and to provide for matters connected therewith.

"Agent" –
means any person who acts as a representative for a client;
"Client" –
means any person for whom construction work is performed;

''Construction Work'' is defined as any work in connection with –

(a) The construction, erection, alteration, renovation, repair, demolition or dismantling of or addition to a building or any similar structure; or
(b) The construction, erection, maintenance, demolition or dismantling of any bridge, dam, canal, road, railway, runway, sewer or water reticulation system; or the moving of earth, clearing of land, the making of excavation, piling, or any similar civil engineering structure or type of work;

"Contractor" –

means an employer, as defined in Section 1 of The OHS Act, who performs construction work and includes Principal Contractors;

''Demolition work'' –
means a method to dismantle, wreck, break, pull down or knock down of a structure or part thereof by way of manual labour, machinery, or the use of explosives;

"Health and Safety File" –

means a file, or other record in permanent form, containing the information required as contemplated in the regulations;

"Health and Safety Plan" –

means a site, activity or project specific documented plain in accordance with the client's health and safety specification;

"Health and Safety Specification" –

means a site, activity or project specific document prepared by the client pertaining to all health and safety requirements related to construction work;

"Method Statement" –

means a document detailing the key activities to be performed in order to reduce as reasonably as practicable the hazards identified in any risk assessment;

"Principal Contractor" –

means an employer, as defined in section 1 of The OHS Act who performs construction work and is appointed by the client to be in overall control and management of a part of or the whole of a construction site;

"Risk Assessment" –

means a programme to determine any risk associated with any hazard at a construction site, in order to identify the steps needed to be taken to remove, reduce or control such hazard.

"Blaster" –

means a person who is in possession of a valid permit referred to in section 9(1)(a) of the Act.

"Blasting Material" –

means any explosive used for the purpose of blasting.

3. Purpose of the Specifications

The purpose of this specification document is the following:
To provide the relevant Principal Contractor with any information other than the standard conditions pertaining to construction sites which might affect the health and safety of persons at work and the health and safety of persons in connection with the use of plant and machinery; and to protect persons other than persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work during the carrying out of construction work for the New UIF head office development project , located on The corner of Jeppe and Trevenna streets in Sunnyside, Pretoria.

- The Principal Contractor is to be briefed on the significant health and safety aspects of the project and to be provided with information and requirements on inter alia:
  1. safety considerations affecting the site of the project and its environment;
  2. health and safety aspects of the associated structures and equipment;
  3. submissions on health and safety matters required from the Principal Contractor(and their contractors); and
  4. the Principal Contractor's health & safety plan.

- To serve to ensure that the Principal Contractor is fully aware of what is expected from them with regards to The OHS Act and the Regulations made there-under including the applicable safety standards, and in particular, in terms of Section 8 of The OHS Act.

- To inform the Principal Contractor that The OHS Act in its entirety shall apply to the contract to which this specification document applies. The Construction Regulations promulgated on 07 February 2014 and incorporated into the above Act shall apply to any person involved in construction work pertaining to this project, as will The OHS Act.

4. Implementation of the Site Specific Health and Safety Specifications

The Principal Contractor is to ensure compliance with the provisions of the Occupational Health and Safety Act & all relevant Regulations, by all employees, other contractors and any person/s who may have access to the site.

The objective of the specifications is to assist Principal Contractors entering into contracts with the Client to comply with the Occupational Health and Safety (OHS) Act, No. 85 of 1993.

Compliance with this document does not absolve the Principal Contractor from complying with minimum legal requirements and the Principal Contractor remains responsible for the health and safety of his employees and those of his Mandataries. Principal and other Contractors should therefore insist that the Specification form part of any contract that they may have with other Contractors and/or Suppliers.

5. Measurement and Allowance for Occupational Health and Safety Costs

The Principal Contractor shall ensure that health and safety costs are adequately measured and provided for in the implementation of the project. Provisions for health safety are mandatory in the advancement of health and safety on the project.

III. MINIMUM ADMINISTRATIVE REQUIREMENTS

In line with the Occupational Health and Safety Act 85 of 1993, the Principal Contractor will be expected to comply with the following health and safety administrative requirements:

1. Application of Construction Regulations 2014

The Principal Contractor and other contractors shall perform the Works in accordance with the requirements of the Occupational Health and Safety Act, 1993 and Construction Regulations, 2014.

2. Compensation of Occupational Injuries and Diseases Act 130 of 1993 (COIDA)

The Principal Contractor shall, prior to commencing with works on site provide the Client with proof of registration with and good standing with the compensation fund or with a licensed compensation insurer as contemplated in the Compensation for Occupational Injuries and Diseases Act, 1883 (Act No. 130 of 1993).

3. Occupational Health and Safety (OHS) Policy and Plan

The Principal Contractor shall submit a Health and Safety Policy signed by the Chief Executive Officer of their company. The policy must outline management commitment to safety and also state safety objectives and how they will be achieved and implemented by the company.
The Principal Contractor shall submit a Health and Safety Plan for the approval of the Client.

Each Health and Safety Plan shall indicate the following:

- A copy of the content to be used for Induction training.
- Attendance registers must be included as proof of training provided for:
    - Induction training
    - Safe work procedure training
    - Risk assessment outcome training
- Method of informing visitors and other persons entering the site of hazards prevalent on site.
- Method of providing personal protective equipment to visitors and non-employees.
- Methodology to be used in the issuing and communication of written instructions/safe work procedures.

The Principal Contractor shall identify and formulate emergency procedures in the event an incident does occur. The emergency procedures thus identified shall also be included in the Principal Contractor's OHS plan.

Signed copies of the following legal appointments must be provided in the Health and Safety File with proof of competency (where applicable):

APPOINTMENT	**OHS-ACT / REGULATION REFERENCE**
Section 16.2 appointment	Section 16.2
Construction Manager	CR 8(1)
Construction Supervisor	CR 8(7)
Excavation Supervisor	CR 13(1)
Safety Officer **Registered with the SACPCMP**	CR 8(5)
Assistant Supervisor	CR 8(8)
Incident Investigator	GAR 9(2)
First Aiders	GSR 3
Fire Fighters	ER 9 & CR 27(h)
Risk Assessor	HCS Reg; CR 9
SHE Representative.	Section 17.

The Principal Contractor shall ensure that a copy of the Principal Contractor's Health and Safety Plan is always available on request to an employee, inspector or contractor.

4. Appointment of Competent Site Personnel

The Principal Contractor's CEO shall take responsibility for the appointment of competent site staff for the duration of the project. If the CEO is not personally involved in the project, the OHS responsibilities are to be delegated accordingly to a competent staff member.

Knowledge and training in OHS is required, and certificates indicating OHS training as well as experience are to be included in CV's, in addition to formal qualifications.

The Principal Contractor & other contractors are to make all Health & Safety appointments as required by the Construction & other Regulations and Occupational Health and Safety Act, and keep such appointments available for scrutiny on site. The Principal Contractor must keep a comprehensive & updated list of all contractors appointed for sub-contract work.

Several appointments or designations of responsible and /or competent people in specific areas of construction work are required by The OHS Act and Regulations. The following competent appointments, where applicable, in terms of the Construction Regulations are required to ensure compliance to The OHS Act, Regulations and Safety Standards.

Required appointments as per the Construction Regulations:-

Item	Regulation	Appointment	Responsible Person
1.	5(1)(k)	Principal contractor for each phase or project	Client
2.	5(3)(b)	Contractor	Principal Contractor
3.	5(11)	Contractor	Contractor
4.	8(1)	Construction Manager	Contractor
5.	8(2)	Assistant Construction Manager	Contractor
6.	8(7)	Construction supervisor	Contractor
7.	8(8)	Construction supervisor sub-ordinates	Contractor
8.	8(5)	Construction Health and Safety Officer	Contractor
9.	9(1)	Person to carry out risk assessment	Contractor
10.	9(3)	Trainer/Instructor	Contractor
11.	10(1)(a)	Fall protection planner	Contractor
12.	11(1)(b)	Professional engineer or technologist	Contractor
13.	12 (2)	Formwork & support work supervisor	Contractor
14.	12 (3)(a)	Formwork & support work examiner	Contractor
15.	13(1)	Excavation supervisor	Contractor
16.	13(2)(k)	Explosives expert	Contractor
17.	14(1)	Supervisor demolition work	Contractor
18.	14(2)	Demolition expert	Contractor
19.	14(11)	Explosives expert	Contractor
20.	16(1)	Scaffold supervisor	Contractor
21.	17(1)	Suspended platform supervisor	Contractor
22.	17(2)(c)	Compliance plan developer	Contractor
23.	17(8)(a)	Suspended platform expert	Contractor
24.	17(13)	Outrigger expert	Contractor
25.	19(6)	Material hoist inspector	Contractor
26.	20(1)	Batch plant supervisor	Contractor
27.	20(2)	Batch plant operator	Contractor
28.	21(2)(b)	Power tool expert	Contractor
29.	21 (2)(g)(i)	Power tool controller	Contractor
30.	22(e)	Tower crane operator	Contractor
31.	23(1)(d)(i)	Construction vehicle and mobile plant operator	Contractor
32.	23(1)(k)	Construction vehicle and mobile plant inspector	Contractor
33.	24(d)	Temporary electrical installations inspector	Contractor
34.	24 (e)	Temporary electrical installations controller	Contractor

35.	28 (a)	Stacking and storage supervisor	Contractor
36.	29 (h)	Fire equipment inspector	Contractor

This list may be used as a reference or tool to determine which components of The OHS Act and Regulations would be applicable to the site. This list must not be assumed to be exclusive or comprehensive.

- **Construction Supervision**
  Competent Construction Managers must be appointed to manage part or all of the works, and have training and/or experience in their area of responsibility.
  All site supervisors must show evidence of appropriate training in OHS, and an understanding or training in their areas of responsibility.

- **Construction Health and Safety Officer**
  The Principal Contractor must appoint a full-time Construction Health and Safety Officer for the duration of the project. The Construction Health and Safety Officer is required to be registered with the South African Council for the Project and Construction Management Professions (SACPCMP) as a Construction Health and Safety Officer.

  This person may not have any other responsibilities on site besides those related to Health and Safety.

- **Health and Safety Representatives**
  All contractors are to arrange for Health and Safety representatives to be appointed in terms of 17(1) of the Occupational Health and Safety Act. Where the Principal Contractor employs more than 20 (twenty) persons (including the employees of other Contractors (sub-contractors) he has to appoint 1 (one) OHS representative for every 50 (fifty) employees or part thereof. General Administrative Regulation 6 requires that the appointment or election and subsequent designation of the OHS representatives be conducted in consultation with employee representatives or employees. OHS representatives shall be designated in writing and the designation shall include the area of responsibility of the person and term of the designation.

  The Principal Contractor is to form one or more Safety Committee/s, on which these elected Health &Safety representatives be members, together with those nominated by the contractors (of similar or fewer numbers).

5. Health Risks and Medical Surveillance

In line with the requirements of the Construction Regulations 2014, the Principal Contractor shall cause all personnel under his jurisdiction to undergo a medical fitness examination prior to commencements of work. This medical examination shall be undertaken by a qualified Occupational Health Doctor or Nurse. Medicals from General Practitioners shall be not accepted.

6. OHS Organogram

The Principal Contractor shall submit an organogram, outlining the Health and Safety site management structure, including those of all other Contractors. In cases where appointments have not been made, the organogram shall reflect the intended positions, and the names shall be filled in as and when the appointments are made.

The organogram shall be updated whenever there are any changes in the site management structure and/or personnel. A copy shall be attached to the Health and Safety Plan.

The Principal Contractor shall keep a “live” legal appointments register, which shall be updated as necessary and submitted on a monthly basis for the duration of the project.

7. Emergency Preparedness and Management

The Principal Contractor shall prepare a detailed emergency procedure prior to commencement of work on site and it shall be included in, and form part of the Health and Safety Plan. The procedure shall be updated whenever changes occur and it shall detail the emergency response plans.

The Emergency Plans/Procedures must be compiled in careful consideration and assessment of the physical site and the baseline risk assessment.

The emergency procedures shall, but not be limited to the following key elements:

- List of key competent personnel on site;
- Details of the nearest emergency services, including their physical addresses and phone numbers;
- Probable Emergency Register and actions or steps to be taken in the event of each specific type of probable emergency;
- Information on hazardous materials/situations that may be encountered on site.

The Emergency Plan must also indicate applicable methods on how casualties will be evacuated from site for further stabilization and treatment.

Emergency procedures shall include, but shall not be limited to, fire, spills, accidents to employees, use of hazardous substances, bomb threats, major incidents/accidents and social unrests.

A contact list of all service providers (Fire Department, Ambulance, Police, Medical and Hospital, etc.) must be maintained and be readily available to site personnel at all times i.e. it must not be located in an area which may be inaccessible outside of normal working hours.

The Principal Contractor shall advise the Client and the Engineer in writing forthwith, and thereafter at the project Health and Safety meetings, of any emergencies that occurred, together with a record of the action taken. Copies of all reports on emergencies shall be kept in the Project Health and Safety File.

8. Fire risk

The execution of the works on the project may give rise to fire risks due to the nature and presence of sources of ignition. These include electrical components and combustible materials which may be used as part of construction or that may be produced and redundant waste. The Principal Contractor shall therefore take appropriate actions to ensure that fire is prevented on the site.

Smoking on the site on any other areas of the mall establishment building is strictly prohibited.
The Principal Contractor shall further ensure that flammable gas cylinders, flammable liquids and fuels are kept in such a manner so as not to cause fires on site.

Fire protection measures must be put in place. Fire extinguishers must be provided at strategic points and kept in a working and serviceable condition at all times.

9. Accident and Incident Reporting and Investigations

The Client or his Agent shall have the right to stop any contractor from executing any construction work which is not in accordance with the Principal Contractor's Health and Safety Plan for the site or which poses a threat to the health and safety of persons.

The Principal Contractor shall be responsible for the investigation of all accidents/incidents where employees and non-employees were injured to the extent that they had to be referred for medical treatment by a doctor, hospital or clinic. The results of the investigation shall be entered into an accident/incident register.

The Principal Contractor shall be responsible for the investigation of all minor and non-injury incidents as described in Section 24(1) (b) & (c) of the OHS Act and keeping a record of the results of such investigations including the steps taken to prevent similar accidents in future.

The Principal Contractor shall report all incidents, where an employee is injured on duty to the extent that he/she:

- Dies;
- becomes unconscious;
- loses a limb or part of a limb;
- is injured or becomes ill to such a degree that he/she is likely either to die or to suffer a permanent physical defect or likely to be unable for a period of at least 14 days either to work or continue with the activity for which he/she was usually employed;

OR where:

- a major incident occurred;
- the health or safety of any person was endangered;
- where a dangerous substance was spilled;
- the uncontrolled release of any substance under pressure took place;
- machinery or any part of machinery fractured or failed resulting in flying, falling or uncontrolled moving objects;
- machinery ran out of control,

to the Provincial Director of the Department of Labour within seven days and at the same time to the Client and/or its Agent on its behalf.

The Principal Contractor is required to report all incidents, accidents and/or near-misses as part of their project reporting on a monthly basis.

10. General Record Keeping

The Principal Contractor and all Contractors shall keep and maintain health and safety records to demonstrate compliance with this specification, the approved Health and Safety Plan, the OHS Act, and the Regulations. The Principal Contractor shall ensure that all records of incidents/accidents, training, inspections, audits, etc. are kept in the Project OHS File stored in a suitable place on site. The Principal Contractor must ensure that every Contractor opens its own OHS file, maintains the file, makes it available to the Principal Contractor and other authorised persons on request; and sends copies of the relevant documentation to the Principal Contractor.

The Principal Contractor shall maintain an up to date register of each Contractor engaged in construction work on site giving the Contractors' name and the Responsible Persons' contact details and the number of employees on site. As these details may be subject to frequent change, the register must be updated at least weekly. The register is to be available for inspection; and must be submitted monthly to the Client.

11. Health and Safety File

The Principal Contractor shall keep a comprehensive Health and Safety File at the site containing all relevant documentation required in terms of the Act. The Principal Contractor shall regularly update the Health and Safety File and record all items such as induction courses, training, representatives, registrations, a copy of the Health and Safety Plan, record of incidents and accidents, etc.

The Health and Safety File will remain the property of the Client and/or its Agent on its behalf throughout the period of the project and shall be consolidated and handed over to the Client and/or its Agent on its behalf at the time of completion of the project.

As required by Construction Regulation 7(1) (b), the Principal Contractor and other Contractors shall each keep an OHS file on site.

The following list is not exhaustive and shall only be used as a guide:

- Construction Work Permit (To be provided by the Client prior to site establishment)

- Proof of Public Liability Insurance
- Latest copy of OHS Act (General Administrative Regulation 4)
- All contractors who work on the site must be registered, and in good standing, with the Compensation Fund or other approved Insurer. The Principal Contractor and all other contractors must provide written proof to the Client that they are in good standing with the Compensation Fund or other licenced Insurer
- OHS plan agreed with the Client including the underpinning risk assessments and method statements (Construction regulation 9)
- Signed OHS Act Section 37(2) Agreement
- Copies of OHS committee and other relevant minutes
- Designs/drawings
- A list of Contractors (sub-contractors) including copies of the agreements between the parties and the type of work being done by each Contractor
- Legal Appointment/designation forms - the competency of each member of the OHS Team must be provided and should include knowledge, training, experience & qualifications specific to the appointment.
- Principal Contractor Organogram indicating the Principal Contractors team.
- All checklists and registers

12. Appointment of Competent Contractors

The Principal Contractor is to ensure compliance with the Clients minimum standards and all legislative requirements.

The same Health and safety standards required for the Principal Contractor are to be applied to all sub/contractors on site.

IV. GENERAL RISK MANAGEMENT

1. OHS Induction, Awareness and Competency

The Principal Contractor shall ensure that all site personnel, including those of all other Contractors, undergo risk-specific OHS induction training before starting work. A record of attendance at every induction session shall be kept in the Project Health and Safety File. A risk-specific induction manual must be compiled by the Principal Contractor, on which all entry inductions will be based. A suitable venue must be made available by the Principal Contractor to accommodate this training.

The Principal Contractor shall identify relevant competency required by the OHS Act and ensure that all employees are appropriately trained and have acquired the necessary training or competency certificates.

The Principal Contractor shall conduct on site periodic toolbox talks, preferably weekly and/or before any hazardous work takes place. The Toolbox talks shall cover the relevant activity and attendance registers must be kept and signed by all attendees.

All competent persons shall have the knowledge, experience, training, and qualifications specific to the work they have been appointed to supervise, control and/or carry out. This will have to be assessed on a regular basis by, for example, periodic OHS audits, progress meetings, etc. The Principal Contractor will be responsible for ensuring that only competent Contractors are appointed to carry out specific tasks.

2. OHS Signage

The Contractor shall provide adequate on-site Health and Safety signage including, but not limited to, 'no unauthorized entry', 'beware of overhead work', 'hard hat area', 'beware: moving machinery' and "Workmen above'. Signage shall be posted up at all entrances to site as well as on site in strategic locations e.g. access routes, scaffolding, and other potential risk areas/operations.

Temporary signage is to include, but not be limited to, the following:

- *Report to the site office*
- *Warning*
- *Construction site – keep out*
- *Site office*

- *First aid* box positions
- *Fire extinguishers*
- *Assembly point*: .

Signage shall also be erected in the work areas on site indicating that a construction site is being entered into and OHS requirements should be adhered to.

All signage shall be in accordance with the requirements of the General Safety Regulations or SANS requirements, as amended.

3. Public and Site Visitor Health and Safety

Both the Client and the Principal Contractor have a duty in terms of the OHS Act to do all that is reasonably practicable to prevent members of the public and site visitors from being adversely affected by the construction activities.

The Principal Contractor shall ensure that every person working on or visiting the site, as well as the public in general, shall be made aware of the dangers likely to arise from site activities, including the precautions to be taken to avoid or minimize those dangers. Appropriate OHS notices and signs shall be posted up, but this shall not be the only measure taken.

Site visitors must be briefed on the hazards and risks they may be exposed to and what measures are in place or should be taken to control these hazards and risks. A record of these inductions/briefings shall be kept in the Project OHS File

4. Personal Protective Equipment (PPE) and clothing

The Principal Contractor shall provide a procedure for how PPE is managed and issued within the company.

The wearing of the identified SANS approved PPE at all times is mandatory and all PPE issued shall be in line with the activities carried out on site.

Sufficient quantities of PPE shall be made available for visitors (hard hats and reflective vests) and new employees as any person found on site without the necessary PPE will be removed until PPE has been supplied.

5. Fire Extinguishers and Fire Fighting Equipment

The Principal Contractor and all other relevant Contractors shall provide adequate, regularly serviced fire-fighting equipment located at strategic points on site, specific to the classes of fire likely to occur. The appropriate notices and signs must be posted up as required.

6. First Aiders and First Aid Equipment

The Principal Contractor and all other Contractors shall appoint First Aider(s) in writing. All Contractors with more than 10 employees shall have a trained, certified First Aider on site at all times. The appointed First Aider(s) are to be sent for accredited first aid training. Copies of the valid First Aid certificates for each First Aider are to be kept in the Project H&S File. The Principal Contractor shall provide an on-site First Aid Station with First Aid facilities, including first aid boxes adequately stocked at all times. All Contractors with more than 5 employees shall supply their own first aid box(es).

7. Discipline, Alcohol Abuse and other illicit Drugs Abuse

Alcohol and drug/other substance abuse have been shown to be a problem in the construction industry. No alcohol or other drugs will be allowed on site. No person may be under the influence of alcohol or any other drugs while on the construction site. Any person on prescription drugs must inform his/her superior, who shall in turn report this to the Principal Contractor forthwith. Any person suffering from any illness/condition that may have a negative effect on his/her safety performance must report this to his/her superior, who shall in turn report this to the Principal Contractor forthwith. Any person suspected of being under the influence of alcohol or other drugs must be sent home immediately, to report back the next day

for a preliminary inquiry. A full disciplinary procedure must be followed by the Contractor concerned and details of the disciplinary action taken must be forwarded to the Client for his records.

8. Management of plant, construction vehicles and equipment

Attention is drawn to the high volume of pedestrians and live traffic who walk and drive around the site. Special care must be taken to protect them from injury by construction plant and vehicles. The principal contractor shall ensure that all persons in its employ, all contractors, and all those that are visiting the site are aware and comply with the site speed (20km/h) and height restriction(s). Separate vehicle and pedestrian access routes shall be provided, maintained, controlled, and enforced.

The Principal Contractor shall ensure that all necessary road signage, vehicle control mechanisms, Flagmen and other traffic accommodation requirements are strictly adhered to for the whole duration of the project.

"Construction Plant" includes all types of plant including but not limited to, cranes, piling rigs, pay loaders, excavators, road vehicles, tractor loader backhoe (TLB), and all lifting equipment. The principal contractor and all relevant contractors shall inspect and keep records of inspections of the construction plant used on site. Only authorized/competent persons are to use machinery and such operations must be under proper supervision.

All construction plant operators shall be in possession of valid medical certificates of fitness issued by an accredited occupational health practitioner to prove they are physically and psychologically fit to operate such machinery.

The principal contractor shall ensure that all hired plant and machinery used on site is safe for use. The principal contractor shall ensure that operators hired with machinery are competent and that certificates (competence and medical) are kept on site in the health & safety file. All relevant sub-contractors must ensure the same. Under no circumstances should persons be transported as passengers of a construction vehicle/plant, unless it is for construction work purposes and a suitable safe seating is provided in the machine.

All construction vehicles involved in this project shall have rotating lights, full-functioning reverse alarms, and a black-on-yellow background sticker or similar; clearly printed "Construction Vehicle" on the rear. The use of head lights during working hours is mandatory.
Where construction vehicles interface with public motorists and pedestrians, proper care and control must be exercised by the contractor by means of Flagmen or as deemed necessary.

9. Communication on site

All OHS communication during the project between the OHS Agent and the Principal Contractor will be communicated verbally on site and in writing, including the issues and responses to non-conformances and OHS audit results.

Communication to the office workers should be established as failure to address issues of concern timeously will be considered a serious offence.

10. Care of Workers on Site (Welfare Facilities)

Adequate welfare facilities must be provided by the Principal Contractor on site for the workers at all times. This includes, but is not limited to, toilets, changing facilities, hand washing facilities, potable water and decent eating areas. The facilities must be located within reasonable distances or placed strategically for ease of access.

The use of existing toilets within the shopping mall are not allowed unless they are demarcated to construction workers and only on written approval.

11. Electrical Equipment

In addition to the requirements of the Electrical Machinery Regulations and the General Machinery Regulations, any electrical distribution board used for construction work shall be fitted with suitable earth

leakage protection. Leads must be firmly and properly connected, and plug sockets shall be in good and safe condition.

All electrical apparatus, other than electrical hand tools, shall have a physical 'lock-out' system which will prevent any operation other than that authorized by a supervisor and a 'lock-out' sign shall be displayed when apparatus is not in use.

Method statements and safe work procedure will be required for all work involving electrical apparatus.

12. Temporary Works

Where the Principal Contractor designs and executes temporary works, the applicable legislation of the Construction Regulations 12 must be fully complied with.

13. Temporary Stacking and Storage

The Principal Contractor shall keep a neat and tidy site at all times. All materials to be stacked neatly and so arranged to prevent such stacks from collapsing. All walkways, work areas, public places must be kept clear of all clutter. The Principal Contractor shall further ensure that materials stacked at the work front do not hamper movement and block access and exit routes. No stacking allowed at escape routes.

14. Hoarding

The Principal Contractor must take necessary steps to prevent access by unauthorised persons including existing tenants and the general public to the construction site. Contractors must not commence with works on site unless reasonable steps have been taken to prevent access by unauthorised persons at site.

A method statement must be compiled explaining how demarcation will be concluded on site to prevent unauthorised access into the construction area.

15. Site Safety and Security

The Principal Contractor shall only access and exit the premises through the checkpoints designated by the Client, and shall ensure that all their personnel observe the security rules of the Client at all times, and shall not permit any person who is not directly associated with the work from entering the site areas.

The Principal Contractor shall ensure that no hindrance, hazard, annoyance or inconvenience is inflicted on other Contractors, the Clients tenants or the general public. Where such situations are unavoidable, the Principal Contractor shall notify the Client and the Project Team in advance.

The Principal Contractor shall provide their own security for their Site Office, Laydown areas and Material Storage Areas. The Principal Contractors site security shall manage and record personnel access on site, visitor's access, deliveries and collections.

16. Excavation & Foundations

The depths of the trenches required for pipelines is at a maximum depth of 4-5m deep. Technical method statements linking to the HIRA are to be created for each activity and guide the excavation processes needed for the connections to sewage, electrical supply, cable and pipe laying, as well as box cuts for foundations of each of the structures. Shoring may be required. Slopes of excavations are to be carefully considered and close monitoring of conditions is required. The geotechnical report and the PCs Engineers are to ensure the stability of excavations are managed. As far as possible excavations for pipes, cables or similar should not be open for more than a day. No danger tape is allowed to be used for

excavation demarcation. Excavations shall be protected using rigid fencing and / or snow netting or plastic mesh as necessary. Competent supervision is required, with experience in the type of excavations to be done. Registers and inspections are to be completed according to organisational standards and procedures. Appropriate signage and PPE as outlined in the HIRA are to be provided.Foundations may be required for a number of structures. Method statements and HIRAs, management of ready-mix concrete Suppliers, or own vehicles will be required. PCs are to ensure traffic accommodation, separation of pedestrians and vehicles, and planning for access control. General housekeeping is to be controlled by each site supervisor / team leader. Areas used for stacking and storage are to be noted on a plan, and appropriately maintained. Poor housekeeping will not be tolerated and a 'clean as you go' approach is to be adopted.

Dust suppression and silica monitoring, during all activities that include cutting and grinding of any cement, grouts etc., as identified by the CHSMs or CHSOs for each PC. Method statements, SWP and DSTIs are to be part of daily activities and each task planned.

17. Blasting

The Principal Contractor shall ensure that the sub-contractor that will be appointed for the Blasting of the hard rock must be in full compliance with the OHSAct and Explosion Regulations and the Explosion Act. Sandblasting, chemical blasting and other aspects have been identified as possibly being required given the need to clean inner surfaces of the tanks, as well as breaking up large areas of concrete slabs. Other means of processes not identified in this health and safety specification need to be included and linked to the technical method statements, and risk assessments;

V. RISK ASSESSMENTS

1. Hazard Identification and Risk Assessment (HIRA)

This section of the specification provides guidelines for the Principal Contractor in preparation of risk assessments in order to ensure compliance with Regulation 9 of the Construction Regulations 2014. This section highlights the principles related to the preparation of suitable and sufficient risk assessments.

Principal Contractor staff intending to prepare risk assessments should be trained and suitably experienced in the application of risk assessments principles.

A suitable and sufficient risk assessment is an assessment which:

- Accounts for risks that are likely to arise during the construction of the works,
- Enables the development and implementation of systems to manage the risks,
- Remains valid for a reasonable period of time,
- Provides a basis for training of employees, and
- Improves working procedures and introduce long term controls.

The requirements of the Construction Regulations will not be satisfied by a single risk assessment exercise that holds good for all time. The risk assessment process on the works shall be an ongoing process.

The objectives of risk assessments are to:

- Identify the risks that are mostly in need of reduction,
- Identify the various options for achieving such reduction,
- Identify the risks that require careful ongoing management, and

- Identify the nature of the required ongoing attention.

2. Types of Risk Assessments

- **Types of Risk Assessments**
  In order to ensure compliance with the Construction Regulations, the Contractor will be required to carry out the following three types of risk assessments:

  - **Baseline risk assessments**
    The Contractor will be required to carry out a risk assessment before the commencement of construction activities on the works. This baseline risk assessment will form part of the Contractor's Health and Safety Plan. The risks and hazards to which persons, plant, vehicles and facilities may be exposed during the construction of the works should be identified and evaluated. Measures to reduce or control these risks or hazards should be defined during this assessment. The effectiveness of the measures defined and the baseline risk assessment prepared shall be monitored and reviewed from time to time to ensure that it remains relevant and accurate.

  - **Issue-based risk assessments**
    The Contractor will be required to carry out separate risk assessments during construction of the works when methods and procedures are varied, for example when:
    - Designs are amended,
    - New machines are introduced,
    - Plant is periodically cleaned and maintained,
    - Plant is started-up or shut-down,
    - Systems of work change or operations alter,
    - Incidents or near-misses occur, or
    - New tasks

  - **Continuous risk assessments**
    The Occupational Health and Safety Act specifically requires that employers shall provide and maintain working environments that are safe and without risk to health. The general awareness of hazards needs to be raised as work ethic to maintain a safe and risk-free environment on an ongoing basis. This is achieved by continuous risk assessments, the most important form of risk assessment that takes place as an integral part of day-to-day management. Examples of continuous risk assessments include:
    - Regular audits,
    - Maintaining general hazard awareness,
    - Pre-work risk assessment

3. Methodology for the Preparation of Risk Assessments

The Contractor shall in the preparation of his risk assessments, follow the following general principles:

- Employ a team of suitably qualified individuals with appropriately varied and relevant experience in risk assessment,
- The appointed risk assessor shall lead the risk assessment,
- Provide the team with background data, scope of work, potential hazards and underlying causes, and
- Where necessary, co-opt expert personnel for complex risk assessments and aspects of risk assessments that require expert judgment,
- Institute an ongoing system of identifying aspects of the work that require risk assessment, and
- Conduct risk assessments in workshops of the team or by individual members of the team under guidance of the leader as appropriate to the situation.

The process of carrying out a risk assessment consists of a number of well-defined steps. These steps improve decision-making by providing a greater understanding of the risks and their impacts. The main steps or elements of the risk assessment process are as follows:

- Consider scope and nature or risks involved, determine purpose and physical and legal bounds of assessment and define risk evaluating criteria,
- Systematically identify risks,

- Analyze risks with regard to causes, likelihood of occurrence and possible consequences against the background of existing controls and its effectiveness,
- Evaluate risks in terms of pre-established criteria to determine need and priority for attention,
- Treat risks through a process of risk elimination, substitution, controlling risk at source, risk mitigation such as training and as far as risk remains, provide personal protective equipment (PPE),
- Monitor and review progress and performance in terms of management system, and
- Communicate and consult.

The Contractor shall ensure that the risk assessment compiled as part of his Health and Safety Plan contains at least these items.

i. Risk Identification

The Contractor should regard this step of the risk assessment as the most important. Subsequent analysis and evaluation of risks and the development of risk control measures are wasted if the risks or hazards on the Works are not carefully identified.

The Contractor should bear the following principles in mind when identifying the risks:

- Systematically address all risks or hazards on the Works,
- Review all aspects of the work, but consider only those that have a potential to cause harm,
- Rank the risks identified in order of importance and then use appropriately advanced techniques to deal with major risks,
- Deal mainly with major risks and don't obscure these with unimportant information, especially minor risks,
- Address what actually happens in the workplace during the work activity
- Consider all persons that may be affected,
- Highlight those groups and individuals who may particularly be at risk, and
- Review the adequacy and effectiveness of existing safety controls and measures

ii. Risk Analysis

In this step, the Contractor will be required to analyze the risks identified by determining each risks frequency and magnitude or severity of the consequence of the risk or hazard.

The frequency of occurrence of a hazard may be expressed as the number of times that it may occur in a year, decade, lifetime, century, or longer period, according to comparative human experience. The magnitude of the likely consequence of a hazard may be expressed in terms of the degree of incapacitation, number of people or costs involved. The frequency of occurrence of a hazard and the magnitude of its consequence may be compounded as the risk that it poses.

iii. Risk Evaluation

In this step the Contractor will be required to compare the assessed risk with similar risks previously experienced for the purpose of deciding how to treat the risk. A useful systematic approach for this purpose is as follows:

- If the assessed risk exceeds similar risks that have occurred in the past and that are considered to be unacceptable, the assessed risk would require treatment depending upon its magnitude as discussed in Section 4.4.5, or
- If the assessed risk exceeds similar historical risks that are acceptable, treatment of the assessed risk will depend on the extent by which it exceeds the historical risks, or
- If the assessed risk is less than historical risks that are unacceptable, treatment of the assessed risk will depend on the extent by which it is less than the historical risks, or

- If the assessed risk is less than historical risks that are acceptable, the assessed risk would also be acceptable and would not require any treatment.

iv. Risk Treatment

In this step, the Contractor will select and implement appropriate measures for dealing with risk. Typically measures comprise the following:

- Elimination by changing designs, procedures, management methods, etc., applicable to high frequency–high consequence risks, or
- Reduction by changing designs, procedures, management methods, etc., applicable to high frequency–high consequence risks, or
- Minimization by changing designs, procedures, management methods, etc., applicable to high frequency–low consequence risks, or
- Transfer or share whole or part of the risk to another party by insurance, contractual arrangements or organizational structures, applicable to low frequency–high consequence risks, or
- Control to ensure that risks do not increase, applicable to low frequency–high consequence risks, or
- Retention together with provision of monitoring and personal protective equipment, applicable to low frequency–low consequence residual risks after reduction, or
- Acceptance without particular action other than provision of personal protective equipment, applicable to low frequency–low consequence risks.
-
- The following principles enable the optimum treatment to be determined:
-
- Avoid risks altogether if possible by using different approaches, substances or methods of work,
- Combat risks at source rather than by adopting secondary measures,
- Adapt work to the individual rather than the individual to the work, that is, in the design consider the people and their attributes that will operate the system
- Take advantage of technological and technical progress,
- Risk prevention measures must be part of a coherent policy and approach to safety management that involves performance measurement, goal setting, feedback and analysis,
- Give preference to measures that protect the whole work force,
- Ensure that those for whom protection is provided understand what they need to do to make sure that the protection works, and
- Ensure that measures to control risks are an accepted part of an active health and safety culture supported by all levels of the organization; single risk reduction initiatives invariably fail.

v. Monitoring and Review

It is necessary to monitor risks, the effectiveness of the risk treatment plan and the strategies and management system set up to control implementation. Control of the risk management program entails the setting of standards, monitoring actual performance, comparing the performance with the standards and correcting any deviations from the standard. Risks and the effectiveness of the control measures need to be monitored to ensure changing circumstances do not alter risk priorities. Few risks remain static.

Ongoing review is essential to ensure that the management plan remains relevant. Factors that affect the likelihood and consequences of an outcome may change, as may factors that affect the suitability or cost of the various treatment options. If an accident occurs, or if more is learnt about the hazards in the workplace, the risk assessment may need to be reviewed or modified. Hazards may be observed that have not been anticipated or previously identified and which may require appropriate measures to be taken. After an accident has occurred, it is important to determine whether it was predicted, whether preventive measures were identified, and if so, why they did not work, whether the risk assessment is still suitable and sufficient if it failed to predict

the accident, whether to the decision to accept a predicted risk as tolerable is still valid, why the accident occurred and what should be done to prevent similar accidents occurring again. It is therefore necessary to regularly repeat the risk management cycle, the time between reviews being dependent on the nature of the risks and the degree of change likely to take place in the work activity. Review is an integral part of the risk management treatment plan.

vi. Communication and Consultation

The Contractor will be required to communicate and consult with internal and external stakeholders during each step of the risk assessment process. Stakeholders will include all employees and tenants.

Effective communication will ensure that those responsible for implementing the risk management process and those with a vested interest, understand the basis on which decisions are made and why particular actions are taken. It will also ensure that the perceptions of all those involved are noted and accommodated during the process.

4. Project Baseline Risk Assessment

A Baseline Risk Assessment has been prepared by the Construction Health and Safety Agent and will be made available to the Principal Contractor on appointment.

VI. COMPLIANCE MONITORING AND MANAGEMENT

1. Auditing

The Health and Safety Consultant, appointed by the Client, shall conduct monthly Health and Safety audits of the construction work operations including a full audit of physical site activities as well as an audit of the administration of health and safety.

The Principal Contractor is obligated to conduct similar audits internally and on appointed sub-contractors. Detailed reports of the audit findings shall be reported on at all levels of project management meetings. Copies of all audit reports shall be kept in the Project Health and Safety File.

The Principal Contractor must not only comply with the requirements of the Occupational Health and Safety Act, and the Construction Regulations, but also with this Specification and his Health and Safety Plan. The Client or his Agent shall carry out audits on a monthly basis.

The following will form a basis for the monthly compliance audits:

i. Administrative & Legal Requirements
ii. Education, Training & Promotion
iii. Public Safety & Emergency Preparedness
iv. Personal Protective Equipment
v. Housekeeping
vi. Scaffolding, Formwork & Support work
vii. Ladders
viii. Electrical Safeguarding
ix. Emergency/Fire Prevention & Protection
x. Excavations & Demolition
xi. Tools
xii. Cranes
xiii. Personnel & Material Hoists
xiv. Transport & Materials Handling
xv. Site Plant & Machinery
xvi. Plant & Storage Yards/Site Workshops Specifics
xvii. Health & Hygiene
xviii. Physical site condition assessment

ANNEXURE A - ACKNOWLEDGEMENT OF RECEIPT OF HEALTH AND SAFETY SPECIFICATION

PROJECT: THE SANDTON CITY CHECKERS HYPER RECONFIGURATION PROJECT, AT SANDTON CITY SHOPPING MALL

Acknowledgement of Receipt of the Construction Health and Safety Specifications:

I, _____representing

(Full name)

_____

(Company Name)

_____

(professional service/discipline)

as _____

(role on project)

Have satisfied myself with the content of the Construction Health and Safety Specification and shall comply with all obligations / requirements in respect thereof.

_____ _____

Signature of CONSULTANT/DESIGNER DATE

_____ _____

Signature of CLIENT / CLIENT'S AGENT DATE

ANNEXURE B - HEALTH AND SAFETY COSTING GUIDELINE

ITEMS COSTED		ESTIMATED COST
1.	PERSONAL PROTECTIVE EQUIPMENT	
	Overalls	**R**
	Hard hats and safety glasses	**R**
	Safety boots/shoes	**R**
	Visors / gloves	**R**
	Other	**R**
TOTAL		**R**
2.	FIRE FIGHTING	
	Fire Extinguishers	**R**
	Training	**R**
	Surveys	**R**
	Other	**R**
TOTAL		**R**
3.	HEALTH AND SAFETY PERSONNEL	

	CHS Manager	**R**
	CHS Officer	**R**
	Full time Safety Representative	**R**
	Fire Watchers	**R**
	First Aiders	**R**
	External Auditors costs	**R**
TOTAL		**R**
4.	FACILITIES	
	Provision of Ablutions facilities	**R**
	Service and maintenance of ablutions facilities	**R**
	Provision of eating areas	**R**
	Provision of change room areas	**R**
TOTAL		**R**

ITEMS COSTED		**ESTIMATED COST**
5.	FALL PREVENTION AND PROTECTION	
	Safety harness with double lanyards	**R**
	Lanyard extenders	**R**

	Lifelines and vertical fall arrest systems	**R**
	Scaffolding	**R**
	Temporary hand railing material and kick boards	**R**
TOTAL		**R**
6.	LIFTING MACHINERY AND EQUIPMENT	
	Annual inspections and load testing as per legal requirement	**R**
	Certification of all lifting gear during the project	**R**
	Third party inspections	**R**
	Other	**R**
TOTAL		**R**
7.	INSURANCES	
	Public Liability insurance	**R**
	COID cover for the project	**R**
	Other	**R**
TOTAL		**R**
8.	FIRST AID	

	First aid boxes	**R**
	Rescue equipment	**R**
	Replenishment of boxes and other supplies	**R**
	Other	**R**
TOTAL		**R**

ITEMS COSTED		**ESTIMATED COST**
9.	TRAINING	
	Health and Safety representatives	**R**
	H&S Supervisory	**R**
	First Aider	**R**
	Fire Fighter	**R**
	Legal Liability	**R**
	Risk Assessment	**R**
	Incident & Accident investigator	**R**
	Other	**R**

TOTAL		**R**
10.	SIGNAGE	
	All signage as required by law: warning, mandatory and information	**R**
	Posters for Awareness	**R**
	Other	**R**
TOTAL		**R**
11.	ELECTRICAL	
	Locks required for lockouts	**R**
	Tags	**R**
	Permit Books	**R**
	Callipers	**R**
	Key Safes	**R**
	COC	**R**
TOTAL		**R**
GRAND TOTAL WHICH COULD BE USED IN THE TENDER		**R**
This list is not exhaustive and contractor may expand all levels to include all relevant H&S Expenditure		

ANNEXURE C - OHS RETURNABLES

	OHS RETURNABLES	Contractor	Consultants
1.	**Letter of Good Standing**	√	
2.	**Project OHS Organogram**	√	
3.	**Proof of Public Liability Insurance**	√	
4.	**Professional Indemnity Insurance**		√
5.	**Construction Health & Safety Plan**	√	
6.	**Signed Annexure A of OHS Specification by Designers/Consultants**		√
7.	**Completed Annexure B of OHS Specification by Contractor**	√	
8.	**Completed Annexure C of OHS Specification by Contractor**	√	
9.	**Appointment Letter**		√
10.	**Competency and CV of Lead Consultant**		√
11.	**Proof of Professional Registrations e.g. SACPCMP, ECSA, SACAP etc.**		√
12.	**Competency & CV of Contractor Site Management & Construction Health and Safety Officer**	√	

13.	**Project Method Statement**	√	

OHS BASELINE RISK ASSESSMENT

FOR

THE SUNNYSIDE OFFICE DEVELOPMENT PROJECT, AT SUNNYSIDE, IN PRETORIA, JOHANNESBURG, WITHIN THE CITY OF TSHWANE METROPOLITAN MUNICIPALITY

AUGUST 2019

PREPARED BY:
TRIVIRON PROJECT MANAGEMENT (PTY) LTD
Triviron House
Whitby Manor Office Estate
167 14th Road
Noordwyk
Midrand
1687
(011) 318 8393

Table of Contents

1 PURPOSE

To identify Occupational Health and Safety (OHS) hazards and assess/evaluate associated OHS risks according to a formal, systematic methodology and holistic approach and to implement necessary control measures to facilitate effective risk reduction.

2 DEFINITIONS

2.1 AIA

Approved Inspection Authority, approved by the Department of Labour.

2.2 Acceptable Risk

Acceptable risk is a risk that has been reduced to a level that can be tolerated by the organization, taking into account legal obligations, corporate directives and / or guidelines.

2.3 Competent Person

A competent person is conversant with theoretical and practical knowledge of the required subject matter.

2.4 Hazard

A Hazard is an energy source, situation, object, substance, condition or activity with the potential to cause harm, injury or ill health (and damage).

2.5 Hazard Identification

Hazard identification is the process of recognizing hazards and defining its characteristics, in terms of identifying risks.

2.6 OHS

Occupational Health and Safety

2.7 OHS Act

Occupational Health and Safety Act, Act 85 of 1993

2.8 Risk

A risk is a combination of the likelihood/ probability of an occurrence of a hazard or exposure(s) and the severity/ consequence of injury, harm or ill health that can be caused by the hazard.

2.9 Risk Assessment

Risk assessment is the process of evaluating risk(s) arising from a hazard(s), taking into consideration the adequacy of any existing control measures, and deciding whether or not the risk(s) is acceptable.

3 RESPONSIBILITY

All designated Line Management.

4 REFERENCES

4.1 Section 8 – Occupational Health and Safety Act, Act 85 of 1993

4.2 Construction Regulation 9 – Occupational Health and Safety Act, Act 85 of 1993

5 PROCEDURE

5.1 All activities, products and services (including contractors), which may have an impact on operations and activities shall be evaluated. The following shall be considered as a minimum:

5.1.1 Routine, non-routine, abnormal and emergency scenarios/ activities

5.1.2 On and off-site activities, installations and impacts: design, infrastructure, equipment, materials, resources.

5.1.3 New projects, changes and/ or modifications to equipment, operations or systems

5.1.4 Human behaviours, safety culture

5.1.5 Management of change – changes in the organizational structure, activities and/ or operations (prior to such changes)

5.2 The following methodology shall be applied:

5.2.1 Formal identification and documentation of process flows for each department and designation – including activities, inputs and outputs, major installations, resources required, contractors used, legal responsibilities, etc. All processes prescribed shall be documented.

5.2.2 Identify and evaluate hazards and risks according to point 6 (Instructions) below.

5.2.3 Determine and document control measures according to the following order of hierarchy (Annexure 3):

- Elimination
- Substitution
- Engineering controls: maintenance, monitoring
- Administrative Controls: signage, warnings, training, safe work procedures
- PPE

5.2.4 Compile an OHS risk profile.

6 INSTRUCTIONS

6.1 Evaluate each health and safety risk, as applicable, (according to a worst case scenario) against the Risk Criteria descriptions in the Annexure 1 - Consequence and Likelihood.

Note: each hazard may have different risks impacting health and safety respectively.

6.2 Select the most appropriate description and record the corresponding numerical value against the specific health and safety risk.

6.3 From the allocated consequence level, follow the grid line down to where it meets the allocated likelihood grid line, to obtain a raw risk rating numerical value:

6.3.1 the maximum risk rating that can be derived is 25

6.3.2 the minimum risk rating that can be derived is 1

6.4 Record control measures developed and implemented to manage risks.

6.5 Sort health and safety risks according to the following ranges to develop a health and safety risk profile:

6.5.1	Low Risks	-	Values 1 - 5
6.5.2	Medium Risks	-	Values 6 - 12
6.5.3	High Risks	-	Value 13 – 20
6.5.4	Major Risks	-	Value 21 – 25

6.6 Identify and record additional control measures to reduce risks to an ‘acceptable risk’ level. Implement accordingly.

7 REVIEW

Assessments shall be documented and reviewed at least annually, and/ or after incidents, non-conformances, change of statutory requirements, audit results, surveys, and management of change.

8 RECORDS

8.1 OHS hazard identification and risk assessments

8.2 Occupational hygiene surveys

8.3 Management of change assessments/ evaluations

APPENDIX 1: RISK EVALUATION CRITERIA

RISK MATRIX		CONSEQUENCE				
Risk Type		1 Minor	2 Low	3 Medium	4 High	5 Major
Harm to People – Safety (S)		First aid injury	Medical treatment injury	Lost time injury	Permanent disability or single fatality	More than one permanent disability or multiple fatalities
Harm to People – Health (H)		Temporary discomfort	Temporary alterations / limitations (no lost time)	Reversible impact on health (lost time)	Irreversible impact on health with loss of quality of life or single fatality	Irreversible impact on health with loss of quality of life of more than one person or multiple fatalities
Environmental Impact (E)		Limited to small area (few meters); low sensitivity (industrial area)	Reduced area (hundreds of meters); no sensitive species/habitat	Impact on an extended area (kilometres); sensitive (scarce / valuable environment)	Environmentally sensitive area (endangered species / habitats)	Permanent impact; highly sensitive area (endangered species, wetlands, protected habitats)
LIKELIHOOD	Considering exposure to that hazard (number of people and frequency of the tasks)	RISK VALUE				
5 (Almost Certain)	The unwanted event is almost certain to happen once or more than once in a six month period.	Medium 11	High 16	High 20	Major 23	Major 25
4 (Likely)	There is a high probability that the unwanted event will occur. The unwanted event has occurred or is likely to occur once per year.	Medium 7	Medium 12	High 17	Major 21	Major 24
3 (Possible)	It is possible that the unwanted event can occur, less than once a year	Low 4	Medium 8	High 13	High 18	Major 22
2 (Unlikely)	There is a low probability for the unwanted event to occur. The unwanted event has occurred or is likely to occur not more than once every 1 to 5 years.	Low 2	Low 5	Medium 9	High 14	High 19
1 (Rare)	There is a very low probability for unwanted event to occur. There are no records of the event occurring or it is highly unlikely that it will occur within the next 5 to 10 years.	Low 1	Low 3	Medium 6	Medium 10	High 15

APPENDIX 2: HAZARD IDENTIFICATION AND RISK ASSESSMENT

HAZARD IDENTIFICATION AND RISK ASSESSMENT FORM2										
No.	**TASK / ACTIVITY**	**HAZARD/ ENERGY**	**UNWANTED EVENT/ RISK**	**LIKELIHOOD**	**CONSEQUENCE**	**RISK VALUE**	**CONTROLS**	**LIKELIHOOD**	**CONSEQUENCE**	**RISK VALUE**
1.	Mandatory Agreements	Section 37(2) Agreements and CR5(1)k not signed	Non compliance to section 37(2) of th OHSAct 85 of 1993	2	3	9	• The 37(2) agreement and CR5(1)k need to be signed before works starts	2	2	5
2.	Statutory permits	Permit application takes 30 working days	Permit not approved on time and delay The start date of project	2	3	9	• Immediately after appointment of the contractor the permit need to be applied for • Contractor need to corparate with all documents that will be required for permit application	2	2	5
3.	Off-loading machinery	Heavy loads	Vehicles and machines may fall over or ‘’run away” causing severe injuries	1	4	10	• Only an experienced operator may load and off-load machinery.	1	3	6
4.	Erecting fence/ Barricading construction area	Sharp wire, hand tools, manual labour	Performing manual labour with hand tools in the presence of sharp edges may result in hand, finger and possibly lower arm injuries	1	2	3	• Sufficient hand protection must be worn when working with wire. • Hand tools must be inspected on a monthly basis and defective tools must be destroyed.	1	1	1

HAZARD IDENTIFICATION AND RISK ASSESSMENT FORM										
No.	**TASK / ACTIVITY**	**HAZARD/ ENERGY**	**UNWANTED EVENT/ RISK**	**LIKELIHOOD**	**CONSEQUENCE**	**RISK VALUE**	**CONTROLS**	**LIKELIHOOD**	**CONSEQUENCE**	**RISK VALUE**
5.	Stacking of material	Stacks	Stacks may collapse or fall over if not built and maintained correctly	2	3	9	• Building and breaking of stacks must be done under the supervision of an experienced person. • All stacking and storage activities must conform to CR 28.	2	2	5
6.		Stacking on upper level	Structure may collapse	2	5	19	• The designers must indicate the safe work load for upper levels and the supervisor must ensure that it is not exceeded.	2	4	14
7.	Operating mobile construction equipment/vehicles	Moving machinery	Machine may collide with other machines hit pedestrians resulting in severe injurie	3	3	13	• All construction vehicles must conform to CR 23.	4	2	8
8.			Fuel and oil spillages may result in ground pollution or polluting existing ground finshes.	4	1	7	• Pre-usedinspections must be conducted on all construction vehicles and any deviations must be rectified as soon as possible.	2	1	2
9.	Operating generators	Using a generator	Long exposure to noise may result in hearing loss.	1	3	6	• Generators must be placed in an area away from the labourers.	1	1	1
			Possible fires	2	2	4	• Personnel to have fire extinguishers on standby while operating generators.	2	1	1
10.	Operating lifting machinery	Lifting Operations	Falling material Crushing by materials Hand Injuries Toppling Crane	3	4	18	• Competent persons (crane driver and banksmen). • Inspections and certificates to be in place for all equipment. • Materials properly packaged and slung. • Access to lifting area to be restricted.	2	3	9

HAZARD IDENTIFICATION AND RISK ASSESSMENT FORM										
No.	**TASK / ACTIVITY**	**HAZARD/ ENERGY**	**UNWANTED EVENT/ RISK**	**LIKELIHOOD**	**CONSEQUENCE**	**RISK VALUE**	**CONTROLS**	**LIKELIHOOD**	**CONSEQUENCE**	**RISK VALUE**
11.	Electrical extension cables, other portable electrical equipment and electrical installations	Electrocution	Broken insulation, sub-standard connections and broken plugs may result in electrocution. Electric fire	2	4	14	• Regular inspections by an appointed person. • All electrical tools to be in a good condition. • Electrical installations register to be maintained by a competent person • All electrical installations to conform to CR 24.	2	2	5
12.	Mixing of Mortar	Working with mortar	Caustic contamination with mortar .	3	2	8	• PPE for mortar to include gloves. • Safe working platforms required • Safe means of access to be provided.	1	2	3
13.	Using angle grinder, circular saw, mitre saw	Rotating disc/blade	Incorrect usage and using fractured dics may cause injuries. Noise Induced Hearing Loss	3	3	13	• The correct discs must be used. • Hearing protection must be worn. • Monthly inspections on all tools. • Trained personnel.	2	2	5
14.	Using portable electrical equipment/tools	High noise levels	Long exposure to noise may result in hearing loss.	2	2	5	• Hearing protection to be worn.	1	1	1
15.	Using electrical tools/equipment	Moving parts	Moving or damaged parts or incorrec usage may result in injuries	2	2	5	• Appropriate PPE. • Regular inspections on all equipment/tools.	2	2	5

HAZARD IDENTIFICATION AND RISK ASSESSMENT FORM										
No.	**TASK / ACTIVITY**	**HAZARD/ ENERGY**	**UNWANTED EVENT/ RISK**	**LIKELIHOOD**	**CONSEQUENCE**	**RISK VALUE**	**CONTROLS**	**LIKEHOOD**	**CONSEQUENCE**	**RISK VALUE**
16.	Noise and dust from site activity	Noise and dust	Long-term exposure to high levels of dust can result in lung disease; Long-term exposure to high levels of noise may result in hearing loss.	1	3	6	• Hearing protection to be worn where applicable. • Respiratory protection must be warn where there is a high level of dust and/or when working with tools creating dust. • Areas to be dampened down to minimize dust. • Where possible, dust extraction fans to be installed.	1	1	1
17.	Using ladders	Working at heights Defective ladder Uninspected ladder	Ladder may collapse or person may fall resulting in injuries	2	3	9	• Ladders to be inspected regularly. • Correct usage of ladders to be promoted.	1	1	1
18.	Using hand tools	Hand tools Defective hand tools Uninspected hand tools	Improper usage or unsafe condition of tools may result in injuries	3	1	4	• Regular inspections of tools. • Tools to be maintained in a good condition. • Awareness of the correct usage of tools to be promoted.	1	1	1

HAZARD IDENTIFICATION AND RISK ASSESSMENT FORM										
No.	**TASK / ACTIVITY**	**HAZARD/ ENERGY**	**UNWANTED EVENT/ RISK**	**LIKELIHOOD**	**CONSEQUENCE**	**RISK VALUE**	**CONTROLS**	**LIKELIHOOD**	**CONSEQUENCE**	**RISK VALUE**
19.	Hot work	Heat and flammable substances	Hot surfaces may cause burn wounds and flammable substances may cause fire	2	4	14	• Appropriate PPE to be worn. • Fire extinguishers always kept in close proximity to hot work being performed.	2	1	2
20.	Handling Hazardous Chemical Substances (HCS)	Hazardous chemicals	Flammable and combustible chemicals may cause fires, Chemicals may be consumed if kept in unlabeled containers.	3	3	13	• Always refer to MSDS for instructions on usage, hazards and precautions. • Appropriate PPE to be worn. • Create awareness through toolbox talks. • Labelling all Hazardous Chemical Substance containers.	2	2	5
21.	Storage of Hazardous Chemical Substance	Hazardous chemicals	Flammable and combustible chemicals may cay cause fires.	3	4	18	• Well ventilated hazardous chemicals substance storage must be provided. • Safety signs to be displayed on the hazardous chemical store. • Separating hazardous chemical substance that will ignite when stored together. • Create awareness through toolbox talks	2	3	9

HAZARD IDENTIFICATION AND RISK ASSESSMENT FORM										
No.	**TASK / ACTIVITY**	**HAZARD/ ENERGY**	**UNWANTED EVENT/ RISK**	**LIKELIHOOD**	**CONSEQUENCE**	**RISK VALUE**	**CONTROLS**	**LIKELIHOOD**	**CONSEQUENCE**	**RISK VALUE**
22.	Re-fuelling plant and motorized equipment	Flammable fumes	Source of ignition may result in fire	2	3	9	• Flammable liquids to be stored safely. • Smoking rules to be enforced on site.	1	2	3
23.	Noise and dust from site activity	Nosie and dust	Long-term exposure to high levels of dust can result in lung disease; Long-term exposure to high levels of noise may result in hearing loss.	1	3	6	• Hearing protection to be worn where applicable. • Respiratory protection must be warn where there is a high level of dust and/or when working with tools creating dust. • Areas to be dampened down to minimize dust.	2	1	2
24.	Waste management and cluttering	Redundant materials	Space limitations and tripping hazards	3	2	8	• Personnel to continuously remove waste for disposal to prevent accumulation. • Designated temporal waste storage to be allocated for waste. Combustible materials to be kept away from sources of ignition	2	2	5
25.		Material and tools	Material and tools may fall injuring persons below	3	2	8	• Working at heights to be carried out according to specifications of the fall protection plan. • Appropriate PPE to be worn.	1	2	3

HAZARD IDENTIFICATION AND RISK ASSESSMENT FORM										
No.	**TASK / ACTIVITY**	**HAZARD/ ENERGY**	**UNWANTED EVENT/ RISK**	**LIKELIHOOD**	**CONSEQUENCE**	**RISK VALUE**	**CONTROLS**	**LIKELIHOOD**	**CONSEQUENCE**	**RISK VALUE**
26	Manual labour and ergonomics	Heavy loads and uncomfortable positions.	Muscle and other injuries	3	2	8	• Safe manual handling techniques to be applied. • Create awareness for safe manual handling through tool box talks. • Appropriate PPE to be worn.	1	1	1
27.	Supply of welfare facilities	Dirty facilities, Unhygienic conditions.	Illness and disease may be contracted	4	2	12	• Regular inspections to be conducted. • Rules to keep facilities hygienic to be enforced. • Awareness through toolbox talks.	2	1	2
28.	Alcohol and unlawful substance	Unsafe act.	Employee might compromise the safety of other employees	2	3	9	• Breathalyzing equipment to be used when employees access the site. • Toolbox talks on alcohol and substance abuse to be communicated to create awareness on dangers relating to alcohol and substance abuse in the workplace. • Site rules to be enforced.	1	2	3
29.	Open edges and platforms.	Unprotected/demarcated edges and platforms.	Falling from heights Material and tools may fall injuring persons below	4	4	21	• Solid barricading to be used. • Regular inspection to be conducted. • Signage to be displayed where there is open edges and platforms.	3	4	18
30.	Theft	Theft	Theft of equipment and material on site.	2	1	2	• Security personnel to control access on site. • Regular inspections to be conducted. • No accommodation on site.	1	1	1

No.	TASK / ACTIVITY	HAZARD/ ENERGY	UNWANTED EVENT/ RISK	LIKELIHOOD	CONSEQUENCE	RISK VALUE	CONTROLS	LIKELIHOOD	CONSEQUENCE	RISK VALUE
31.	Public Safety	Unauthorized entry	The public accessing the site without authorization, exposing them to dangerous activities on site.	4	3	13	• Security personnel to control access on site. • All safety signs to be visible and to be monitored continuously. • Appropriate hoarding, netting, barriers to be installed as necessary to protect the public. • Overhead gantries and platforms to protect walkways from falling objects.	2	2	5
32.	Emergency Preparedness	Employees/visitors unprepared in an event of emergency	Employees/visitors not knowing what to do in an event of emergency.	3	3	13	• Emergency procedure to be communicated to all personnel on site. • Emergency equipment to be inspected and tested regularly. • Emergency evacuation sign to be displayed.	2	2	5
33.	Vehicle movement and interfacing	Moving vehicles	Vehicle collision Pedestrian hit by a car, Damage to property	3	3	13	• Vehicle operators to observe a speed limit of 20 at all entrance and exit points. • Operators to observe lanes provided and all directional signage. • Vehicles to be parked only at designated parking areas. No parking at exit and entrance points	2	2	5

34	Working on scaffolding	Falling from heights. Scaffolding collapse. Scaffolding not inspected. Scaffolding not erected according to sans 10083.	Serious injury to employees. Fatalities Property damage	5	5	25	• Employees to be trained on working at heights • Scaffolding erecters, inspectors and supervisors to be competent • Scaffolding to comply with SANS 10085 and have copy of the sans 10085 on site. • Scaffolding to be inspected every 7days and after any inclement weather. • Employees to be medically fit	5	3	15

GREEN BUILDING SPECIFICATIONS

Sunnyside Labour Campus
Roles and Responsibility of the Bulk Earthworks Contractor
May 2019

Solid Green cc. | 2010/167229123 | www.solidgreen.co.za
B2 House, Green Desk, 8 Tyrwhitt Ave, Rosebank, 2196
Po Box 960, Parklands, 2121, Johannesburg
Tel:0114472797 | Fax: 086 567 5675 | VAT: 4760257214

Table of Content

1. Introduction

The project has the option to pursue a 4-star, 5-star or 6- star Green Star SA Office v1.1 rating for the office development. This document outlines the roles and responsibilities of the Contractor to achieve this.

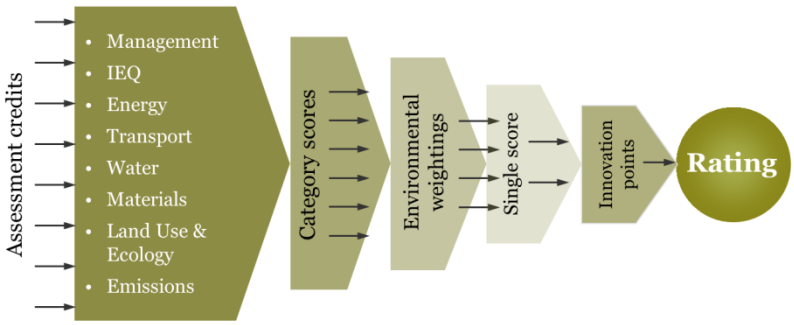
2. Green Building Council and Green Star SA Tool

In 2007, an independent organisation called the 'Green Buildings Council of South Africa' (GBCSA) was established under the umbrella of the World Green Building Council. The intention of this organisation is to release a rating system called the 'Green Star SA Rating Tool', which independently assesses the level of environmental design attributes of a building at design stage and then again at the as built stage. The tool is directly based on the Australian Green Star tool, which has combined aspects from similar global tools in the USA (LEED) and UK (BREEAM). The ratings awarded by the Green Building Councils across the world are highly regarded by leading sustainability practitioners, and are the most independent quantitative environmental rating tools for the design of buildings.

The GBCSA allows free access and use of the rating tool, which is downloadable from their website (www.gbcsa.org.za). They allow projects to do self-assessments using the tool, but not to promote a rating as achieved, which can only be done after an independent assessment by the GBCSA. The self-assessment allows projects to target a certain rating level, based on their design.

Green Star is an environmental building rating tool, which sets standards and benchmarks for environmental friendly or green buildings. The tool measures the 'Greenness' of the building by means of a set of criteria and requirements. Green Star SA consists of nine environmental impact categories; namely:

- Management
- Indoor Environmental Quality
- Energy
- Transport
- Water
- Materials
- Land Use and Ecology
- Emissions
- Innovation



Each category is divided into credits,
each of which addresses an initiative that improves the building environmental performance. Points are awarded in each credit for actions that demonstrate that the project has met the overall objectives of the requirements.

The category score is then calculated as a percentage of the points achieved and the total available points. After the category score is calculated an environmental weighting factor is applied to reach a single score.

The following ratings are available:

4-star rating	45-59 points	Best Practice
5-star rating	60-74 points	South African Excellence
6-star rating	75+ points	World Leadership

There are two succeeding ratings;

- "**Design Rating**" which can be obtained at the end of the design stage. The building can then be marketed as a Green Star SA certified building, which can have significant marketing benefits for the building owner.
- "**As Built Rating**" which can be obtained in the post-construction phase.

The Credit Criteria remains the same for both ratings, the difference is the types of documentation that needs to be submitted to justify the credit. Example 1 illustrates this.

Example 1: Man-07 Waste Management.
Credit Criteria:
Up to three points are awarded where:

- The contractor implements a Waste Management Plan (WMP), retains waste records and issues quarterly reports to the building owner; AND
- A percentage (by mass) of all demolition and construction waste is reused or recycled as follows:
  - One point for 30% of the waste;
  - Two points for 50% of the waste; and
  - Three points for 75% of the waste

For the DESIGN rating the submission should include "Extracts from the contract or tender documentation' that stipulates that the contractor is required to recycle construction and demolition waste. For the AS BUILT rating the submission should include a short report from the contractor confirming compliance with the Credit Criteria and the actual Waste Management Plan that has been implemented.

Table 1:Man-07 Waste Management documentation requirements

Green star SA Office v1.1 DESIGN	Green Star SA Office v1.1 AS BUILT
• Extracts from the contract/tender documentation	• Short report
	• Waste Management Plan

3. Green Star SA Technical Manual & Course

It is required that the contractor obtains a copy of the Green Star Office v1.1 Technical Manual. The Technical Manual outlines all Credits; Aim of Credit, Credit Criteria, Documentation Requirements, Additional Guidance, Background and References and the Green Star rating process. A copy of this manual should be keep on site **at all times,**

It is required that an employee from the contractor attends the Green Star SA- New Built course and completes the Green Star SA accredited professional exam. This person will be responsible for the documentation collection by the contractor as outlined in this document. The course is organised by the Green Building Council of South Africa. The exam can be taken online. The course provides an understanding of the Green Star rating system and its application to projects. Once the employee passes the exam, he/she becomes a Green Star SA Accredited Professional. More information can be found on the GBCSA website: http://www.gbcsa.org.za/education/education.php

This document contains extracts from the Green Building Council of South Africa's *Green Star South Africa Office v1.1 Technical Manual*, first edition, November 2014. Should there be any discrepancies, the Technical Manual takes precedence.

4. Specifications

Wherever in the project there is no specification given to the contractor for an application or material the contractor is required in all cases to obtain approval from the relevant design professional before implementation.

5. Green Star SA Credit Summary

The tables on the next two pages are the credit summary of the Green Star SA Tool and the points that are relevant to the Contractor **(in bold)** and those points that are targeted by the project.

MAN-06 Environmental Management
MAN-07 Waste Management
MAT-05 Concrete
MAT-06 Steel

6. MANAGEMENT

MAN-01 GREEN STAR ACCREDITED PROFESSIONAL

The Contractor needs to be aware that the client has appointed Solid Green Consulting as the Green Star Accredited Professional. Solid Green is responsible for the implementation of the Green Star process and the certification of the building. Solid Green will be interacting with the contractor to ensure the contractor is implementing the EMP (Man-06) and the WMP (Man-07) as well as all other activities as outlined below. Wherever the contractor needs clarification on its activities related to Green Star please contact Nomamfengu Mbele, at Solid Green Office: 011 477 2797 or noma@solidgreen.co.za

MAN-06 ENVIRONMENTAL MANAGEMENT

A comprehensive, project specific Environmental Management Plan will be required to be adhered to. This is be in accordance with Section 3 of the New South Wales (Australia) Environmental Management System guidelines 2007. An internal audit trail is to be kept as evidence for ongoing compliance.

MAN-07 WASTE MANAGEMENT

The Contractor is required to recycle or reuse all demolition and construction waste, excluding any waste that is not normally sent to landfill such as soil (from land clearing and excavation activities), land clearing debris, and waste that legally must be withheld from general construction waste (i.e. asbestos)

1. Implement a project-specific **Waste Management Plan <u>(prior to on site commencement)</u>**
    a. Confirm plan is in line with the project-specific Environmental Management Plan for all waste from the beginning of demolition to the end of construction
    b. State
        i. What types of waste are collected for recycling or for reuse
        ii. How recycling and reuse occurs
        iii. How all generated waste is monitored
        iv. Who is responsible for the various aspects of the plan, including instructions to employees and sub-contractors on recycling and reuse procedures
    c. Reuse and/or recycle a minimum of **<u>70%, by mass,</u>** of all waste
        i. Require all subcontractors relevant to the project to reuse and/or recycle to reach the minimum percentage target
    d. Comply to either informal recycling or bulk recycling
        i. Informal recycling
            1. Where utilized, the waste material must be weighted beforehand and a record of the informal recycle collectors must be kept including their acknowledgement of collection of such materials and quantities
        ii. Bulk recycling
            1. If a sub-contractor is engaged to sort and recycle waste on the project's behalf and does it on a 'bulk' basis, not on a project basis, the credit can be claimed if the sub-contractor can provide evidence of diverting the percentage of waste on average

e. Measure all waste by mass, however if waste is measured by volume rather than mass, the contractor must convert the results to mass using the densities given in Table Man-7.1 from page 33 of the Technical Manual. Density values for other solid waste types have to be approved by the project Green Star SA Accredited Professional.

Solid Waste Type	Density (kg/m³)
Cardboard	60
Gypsum wallboard	300
Rubble	830
Steel	600
Wood	180
Mixed waste	210

Table Man-7.2: Densities to be assumed for different solid waste types
Extract from the *Green Star SA Office v1 Technical Manual*, First Edition, November 2008, p. 33

f. Exclude calculating any waste that is not normally sent to landfill such as
   i. Soil (from land clearing and excavation activities)
   ii. Land clearing debris
   iii. Waste that legally must be withheld from general construction waste (i.e. asbestos)

g. Provide an electronic copy of the final approved document and any subsequent revisions to the Green Star SA Accredited Professional and Project Manager

2. Prepare **Quarterly Reports**
   a. Account for all waste on a quarterly basis from the beginning of demolition to the end of construction
   b. Tabulate all categories of all waste (i.e. wood, metal, concrete, general) with their corresponding quantities, by mass, and indicate how they were reused, recycled, or sent to the landfill
   c. Sum all waste reused and recycled quantities, by mass, to indicate the total diverted from landfill and divided by the total generated waste to indicate the diversion percentage to landfill
   d. Reference appended receipts and other appropriate waste records (i.e. evidence of reuse) stating the total amount, by mass, of all waste generated and the percentage reused, recycled, or sent to the landfill
   e. Provide electronic copies of the final approved documents and any subsequent revisions to the Building Owner, Green Star SA Accredited Professional and Project Manager

3. Prepare **Short Report**
   a. Account for all waste from the beginning of demolition to the end of construction
   b. Tabulate all categories of all waste (i.e. wood, metal, concrete, general) with their corresponding quantities, by mass, and indicate how they were reused, recycled, or sent to the landfill
   c. Sum all waste reused and recycled quantities, by mass, to indicate the total diverted from landfill and divided by the total generated waste to indicate the diversion percentage to landfill
   d. Reference appended receipts and other appropriate records (i.e. evidence of reuse) stating the total amount, by mass, of all waste generated and the percentage reused, recycled, or sent to the landfill
   e. Confirm the minimum **70%, by mass,** of all waste reused and/or recycled once it has been reached
   f. Provide an electronic copy of the final approved document and any subsequent revisions to the Building Owner, Green Star SA Accredited Professional and Project Manager

7. MATERIALS

MAT-05 CONCRETE

Concrete is defined as all concrete in the project, including non-structural uses such as paving, footpaths, kerbs, channels, gutters. Industrial waste product must not come from industrial facilities co-fired with hazardous waste blast furnace and includes blast furnace slag (a waste product from steel manufacturing using a blast furnace which can be used as an aggregate or cement replacement), fly ash, silica fume.

The contractor is required to provide costing for two concrete design mixes for all concrete applications in the project:

1) Concrete mix design as per common practice; and
2) Concrete mix design according to the Green Star SA MAT-05 specifications as defined below.

Concrete Specifications

1. Reduce the absolute quantity of Portland cement, as an average across all concrete mixes, by substituting it with industrial waste product(s) or oversized aggregate by 30% as an average across all concrete mixes (in-situ, precast, stressed).

The Contractor is required to prepare a **Confirmation Letter** stipulating:

1. Concrete mixes and volumes
2. The quantities of Portland cement, industrial waste product and aggregate (both recycled and non-recycled) applied to site; and
3. That no industrial waste product came from industrial facilities co-fired with hazardous waste.

Note that this Confirmation Letter must be in line with the Short Report prepared by the Structural Engineer.

The Contractor is required to obtain a **Confirmation Letter** from each supplier stipulating:

a. Confirm the quantities of Portland cement, industrial waste product and aggregate (both recycled and non-recycled) applied to the site
b. Confirm that no industrial waste product came from industrial facilities co-fired with hazardous waste
c. Nominate the proportion of recycled aggregate to be used, where applicable
d. Confirm the recycled aggregate is classified as Class 1 RCA, in accordance with the Australian code HB 155-2002 “Guide to the Use of Recycled Concrete and Masonry Materials”
e. Provide to Contractor, Green Star Accredited Professional and Structural Engineer

MAT-06 STEEL

This credit stimulates recycled steel in the project in lieu of virgin steel.

- A building predominantly framed in structural steel (>50% by cost compared with the reinforced/precast/stressed concrete framing component), one point is awarded where: 60% of all structural steel, by mass, in the project either has a post-consumer recycled content greater than 40%, or is reused;

OR

- A building predominantly framed in reinforced/precast/stressed concrete (>50% by cost compared with the structural steel framing component), one point is awarded where: 60% of all reinforcing/stressing steel, by mass, in the project either has a post-consumer recycled content greater than 90%, or is reused.

An additional two points are awarded where: 90% of all steel (total of structural steel, reinforcing/stressing steel and steel products), by mass, in the project either has a post-consumer recycled content greater than 60%, or is reused.

If the material cost of steel represents less than 1% of the project’s total contract value, this credit is ‘Not Applicable’ and is excluded from the Points Available, used to calculate the Materials Category Score. Type ‘na’ in the appropriate 'No. of Points Achieved' column of the rating tool.

Steel: includes structural steel, concrete reinforcement steel (i.e. stressed, in situ, pre-cast), steel products (i.e. hot rolled beams, columns, angles, mullions, cold-formed products (i.e. purlins, girts, cladding, profiled steel decking)), excludes pre-existing steel that is retained in a refurbishment project.

Recycled content: average proportions of post-consumer content and a weighted average of all steel on the project is acceptable.

Post-consumer recycled content: the product composition that contains a percentage of material diverted from the product user’s waste stream and excludes materials reutilised (i.e. rework, regrind, or scrap) generated in a process and capable of being reclaimed within the same process that generated it.

The contractor must insure for this project that the following is true:

- The average recycled content of all the steel (total of structural, reinforcing/stressing steel and steel products), in the project must be 54% (on average)

1. The Contractor is required to prepare a **Confirmation Letter** stipulating
   - All of the applications of steel installed within the building structure;
   - The product used for each type of application; and
   - The total amount (by mass) of steel used for each application within the building structure.

   Note that this Confirmation Letter must be in line with the Short Report prepared by the Structural Engineer.

2. The Contractor must obtain **Confirmation Letter(s)** from the supplier(s) stipulating:
   - The total quantity of steel supplied to the project; and
   - The post-consumer recycled content of each steel product supplied to the project (via product-specific evidence such as Materials' Data Sheets).

.

8.

Documentation Summary

DOCUMENTS REQUIRED FOR THE DESIGN RATING

MAN-07 Waste Management	**Short report** from the contractor confirming compliance with the Credit Criteria by tabulating all categories of waste (wood, metal, concrete, general, etc.) with their corresponding quantities and indicating how they were reused / recycled. The reused/recycled quantities are to be summed to indicate the total diverted from landfill and divided by the total generated waste to indicate the diversion percentage to landfill. The short report should reference appended receipts and other appropriate records (e.g. evidence of reuse) stating the total amount (by mass) of waste generated and the percentage reused/recycled.
	Waste Management Plan used for the site, describing how all generated waste is monitored, which types of waste will be collected for recycling or for reuse, how recycling will occur, and who is responsible for the various aspects of the plan. The waste management plan should include instructions to crew and sub-contractors on recycling and reuse procedure. The waste management plan is to be developed prior to construction start, and is to be implemented for the entire construction duration.

DOCUMENTS REQUIRED FOR THE AS BUILT RATING

MAN-07 Waste Management	**Short report** from the contractor confirming compliance with the Credit Criteria by tabulating all categories of waste (wood, metal, concrete, general, etc.) with their corresponding quantities and indicating how they were reused / recycled. The reused/recycled quantities are to be summed to indicate the total diverted from landfill and divided by the total generated waste to indicate the diversion percentage to landfill. The short report should reference appended receipts and other appropriate records (e.g. evidence of reuse) stating the total amount (by mass) of waste generated and the percentage reused/recycled.
	Waste Management Plan used for the site, describing how all generated waste is monitored, which types of waste will be collected for recycling or for reuse, how recycling will occur, and who is responsible for the various aspects of the plan. The waste management plan should include instructions to crew and sub-contractors on recycling and reuse procedure. The waste management plan is to be developed prior to construction start, and is to be implemented for the entire construction duration.
MAT-05 Concrete	**Confirmation(s) from supplier(s):** • Of the quantities of Portland cement, industrial waste product and aggregate (both recycled and non-recycled) supplied to site; • That no industrial waste product came from industrial facilities co-fired with hazardous waste; and
	Confirmation from the contractor that all of the concrete used on site complies with the Credit Criteria by identifying all concrete uses in the project and describing the mix and product used.
MAT-06 Steel	**Confirmation(s) from the supplier(s)** of: • The total quantity of steel supplied to the project; and • The post-consumer recycled content of each steel product supplied to the project (via product-specific evidence such as Materials' Data Sheets).
	Confirmation(s) from the contractor(s) of: • All of the applications of steel installed within the building structure; • The product used for each type of application; and • The total amount (by mass) of steel used for each application within the building structure.

We hereby confirm content of this document has been accepted and will be implemented.

BULK EARTHWORKS CONTRACTOR NAME:

SIGNATURE: _____

GEOTECHNICAL REPORT

- *Site Investigations*
- *Slope Stability*
- *Rock Mechanics*
- *Soil Mechanics*
- *Foundations*
- *Borrow Pits and Materials*
- *Roads*
- *Groundwater*
- *NHBRC*
- *Geotechnical Instrumentation*

Findings of a Deep Geotechnical Investigation for the Proposed UIF Buildings in Trevenna, Pretoria, Gauteng

Client: Geomech Africa & NAKO Group

Reference: 16-1370R02

Dated: 14 March 2017

GCS Geotechnical
63 Wessels Street
Rivonia
Cell: +27 (0)82 567 1561
ninow@gcs-sa.biz
www.gcs-sa.biz

Findings of a Deep Geotechnical Investigation for the Proposed UIF Buildings in Trevenna, Pretoria, Gauteng

Reference: 16-1370R02 **Date: 14 March 2017**

TABLE OF CONTENTS

Findings of a Deep Geotechnical Investigation for the Proposed UIF Buildings in Trevenna, Pretoria, Gauteng

Reference: 16-1370R02 **Date: 14 March 2017**

EXECUTIVE SUMMARY

This report presents the findings of a deep geotechnical investigation for the proposed UIF development in Trevenna, Pretoria CBD, Gauteng, and presents the conclusions and recommendations for proposed excavations, potential soil movement, foundations, water ingress, earthworks and lateral support.

The most critical aspects of this site in relation to the proposed development is the presence of closely jointed bedrock at between 15 and 18 m depth that will likely require blasting.

Fieldwork conducted on site suggested that the site is underlain by fill, alluvium and ferruginised alluvium, residual Andesite soils and weathered to fresh Andesite lava from around 5 m depth. Beneath this depth, the geology transitions to fresh Andesite lava with increasing depth.

Soft excavation over the site (in terms of SABS 1200 D) is expected to around 4.5 to 5 m (based on the test pits and boreholes). Beneath this depth, intermediate excavation is anticipated together with localised boulder and hard excavation due to irregular hard rock pinnacles and corestones, to around 8.5 m, beneath which heavy ripping and blasting is anticipated.

Deep excavation sidewalls will require appropriate lateral support, possibly in the form of semi-contiguous piles and gunite arches or soil nails and reinforced gunite.

The heavily-loaded columns (10,000 kN) will require large reinforced pad or spread footings, founded directly onto moderately to slightly weathered Andesite lava bedrock, at approximately 15 m depth (or BEL).

The rock mass ranges from poor (Class IV) to fair (Class III) with an average of fair (Class III) through the entire set of borehole profiles. The GSI is 27-53, with an average of 43, and designated as fair (Class III).

*Finally, the ground conditions described in this report refer specifically to those encountered at the test pit and borehole positions advanced on site. It is therefore possible that conditions at variance with those discussed above may be encountered elsewhere on the site. In this regard it is critical that materials management be maintained continuously on site and that **GCS Geotechnical** carry out periodic inspections of the site during construction to ensure that any variation in the anticipated ground conditions can be assessed and revised recommendations subsequently provided in order to avoid unnecessary delays and expense. Furthermore it is important that the construction phase of the project be treated as an augmentation of the geotechnical investigation.*

Findings of a Deep Geotechnical Investigation for the Proposed UIF Buildings in Trevenna, Pretoria, Gauteng

Reference: 16-1370R02 **Date: 14 March 2017**

Definitions and Abbreviations

Commercial:

GCS Geotechnical	GCS Geotechnical (Pty.) Ltd.

Technical:

CH	Chainage (metres)
mbgl	metres below ground level
masl	metres above sea level
NGL	Natural Ground Level
FL	Foundation Level
BH	Borehole
SPT	Standard Penetration Test
N	SPT N value (blows per 300 mm)
TLB	Tractor-mounted Loader Backhoe
TP	Test Pit
DCP	Dynamic Cone Penetrometer
EABC	Estimated Allowable Bearing Capacity
G1-G10	Standard classification of natural road building materials (TRH 14)
CBR	California Bearing Ratio
MDD	Maximum Dry Density (kg/m3)
MADD	Modified AASHTO Dry Density
OMC	Optimum moisture Content (%)
PI	Plasticity Index
LL	Liquid Limit
LS	Linear Shrinkage
RMR	Rock Mass Rating
GSI	Geological Strength Index
mi	Hoek-Brown Constant (origin & texture dependent)
RQD	Rock Quality Designation (%)
FF	Fracture frequency
UCS	Unconfined Compressive Strength (MPa)
C (c')	Cohesion (kPa) – total stress and (effective stress)
Φ (Φ')	Friction Angle (degrees) – total stress and (effective stress)
Kv	Modulus of Subgrade Reaction (MN/mm or kPa/mm)
CFA	Continuous Flight Auger (pile type)
DCI	Driven Cast In situ (pile type)
Cv	Coefficient of Consolidation (m2/yr)
Mv	Modulus of Compressibility (m2/MN)
MC1	Moisture Content Before Test (%)
MC2	Moisture Content After Test (%)
ρ	Dry Density (kg/m3)
VSR	Very soft rock
SR	Soft rock
MHR	Medium hard rock
HR	Hard rock
VHR	Very hard rock

Findings of a Deep Geotechnical Investigation for the Proposed UIF Buildings in Trevenna, Pretoria, Gauteng

Reference: 16-1370R02 **Date: 14 March 2017**

1. INTRODUCTION & TERMS OF REFERENCE

At the request of Mr. Neil Mackintosh of Geomech Africa (hereafter referred to as Geomech), and on behalf of Mr Johan Thompson of NAKO-Iliso, ***GCS Geotechnical*** (hereafter referred to as GCS) was asked to provide a proposal and cost estimate quotation for the undertaking of the logging and reporting for a deep geotechnical investigation for the proposed UIF Building on 17 October 2016. The appointment was accepted and finalized on the 8 December 2016. Drilling commenced on 2 February 2017.

2. AVAILABLE INFORMATION

The following information was drawn upon for the purposes of the investigation:

- The 1:250 000 Geological Series Map of Pretoria – *2528* (1978),
- Purnell (1994): The Engineering Geology of Central Pretoria
- Google Earth Map of the site,
- Guidelines for Soil and Rock Logging in South Africa (2nd Impression - 2002), and
- SABS 1200 D – Earthworks,
- Franki: A Guide to Practical Geotechnical Engineering in Southern Africa (3rd ed., 1995)

The table below shows the available published physiographical data pertaining to the site.

Table 2-1: Summary of Available Desk Study Information

Parameter	Value	Reference
Development	Basements & multi-storey	NAKO-Iliso
Site coordinates	25°44'57.00"S / 28°12'12.82"E	NAKO-Iliso
Weinerts N-value	2-5	Weinert (1974)
Climatic Region	Moderate	TRH 2 (1978)
Rainfall	700-750 mm	http://waterresourceswr2012.co.za/
Temperature	2-28 ˚C	http://www.saexplorer.co.za/
Evaporation	1750 mm	After DWAF (1986)
Water Balance	Deficit	Schulze (1985)
Weathering Type	Slight disintegration & moderate decomposition with frost action	Fookes et al (1971)
Geology	Andesite and agglomerate of the Hekpoort Formation	1: 250 000 Geological Map Series of Pretoria – 2528 (1978).
Soil Cover	Fill, alluvium and residual in-situ soils	-
Origin	Transported and residual	-
Topography	Approximately 1: 40 – 1: 50	Garmap SA Topo & Rec 2012.1
Drainage	West to the Apies River channel, east to the Walker Spruit	Garmap SA Topo & Rec 2012.1
Drainage Region	Quaternary Catchment: A23D	http://waterresourceswr2012.co.za/
Hydrogeology	0.1-0.5 l/sec; Intergranular and Fractured.	Hydrogeological Map Series (2526) - Johannesburg (1999)
Groundwater depth	Unknown	-
Erodibility Index	16-20 (Low)	WRC (1992)
Seismic Intensity	VI (MMS)	Fernandez et al (1972)
Liquefaction	Unlikely (<50 cm/s2)	Welland (2002)

3. SITE DESCRIPTION

The site is located in Trevenna, Pretoria, Gauteng, and is located on what appears to be an old, partially demolished building site, with assumed shallow foundations still in-situ. The site is adjacent to and west of Steve Biko Road, and bound by Park Street to the north. The Department of Tourism building is directly southwest of the site along Trevenna Street. The site is also situated adjacent to a block of flats on the western perimeter boundary.

At present the site is being utilised as an informal parking lot. The site is vegetated by large trees along its northern perimeter boundary, along Park Street, and in the south-eastern area, near the junction of Trevenna and Steve Biko Streets.

No overhead services were noted on site, although manhole covers suggested that subsurface services may be present. Their orientation and types are unknown.

The central coordinates for the site are 25°44'57.00"S and 28°12'12.82"E.

4. GEOLOGY

Based on the 1:250 000 Geological Map Series titled, "*Pretoria - 2528"* (1978), the site is underlain by Andesite lava and agglomerate of the Hekpoort Formation, and their associated residual soils. Transported alluvium is also present overlying the residual soils, due to the proximity of the existing confluence of the Apies River and Walker Spruit.

Site work also indicated the presence of a fill horizon extending from the surface to depths between 0.8 and 1 m, beneath which ferruginised alluvium was present.

5. FIELDWORK

Test pits (hereafter referred to as TP's) were excavated on site using a TLB-excavator provided by Geomech, for the purpose of better understanding the general engineering properties of the subsurface soils, to assess the in-situ soil for material usage, and to determine lateral support parameters.

Diamond rotary-cored boreholes were drilled on site in order to determine the soil strength parameters, obtain undisturbed soil samples for shearbox testing, aid in lateral support design and to determine the depth and competency of the bedrock. Of critical concern is the bedrock competency at between 15 and 18 m depth, which will be the foundation base level for the proposed 5-storey basement parking and 22-storey building.

5.1 Test Pits

Three TP's were excavated on site with a TLB-excavator, in order to better understand the general nature and engineering parameters of the subsurface soils.

The results of the TP's indicated termination depths at between 3.5 and 3.9 m below existing ground level, with an average depth in the region of 3.7 m, across the site. These test pits were terminated by the engineering geologist on site, during the shallow investigation. Test pits were excavated in order to assess materials for potential usage in road layerworks for internal roads.

Detailed profiles are provided in Appendix A, with summaries of the varying conditions tabulated below:

Table 5-1a: Summary of Shallow Investigation – Northern Half

Depth		Description	Excavatibility (SABS 1200D)	EABC (kPa)	Kv (kPa/mm)	C (kPa)	E (MPa)
From (m)	To (m)						
Fill							
0	0.9	Slightly moist yellow to dark brown LOOSE to MEDIUM DENSE silty fine to coarse **SAND** with bricks, plant roots plastic and glass	soft	50-100	25-55	-	10-25
Partially Ferruginised Alluvium							
0.9	3.9	Slightly moist yellow brown mottled black MEDIUM DENSE to DENSE shattered gravelly clayey **SAND** with ferricrete nodules.	Soft	150-300	55-100	-	25-35

EABC = estimated allowable bearing capacity (ignoring collapse potential)
Kv = modulus of subgrade reaction
C = cohesion
E = elastic modulus
NB. Tabulated depths are an average across the site. For more detailed Pit specific depths, refer to the TP Log

Table 5-1b: Summary of Shallow Investigation – Southern Half

Depth		Description	Excavatibility (SABS 1200D)	EABC (kPa)	Kv (kPa/mm)	C (kPa)	E (MPa)
From (m)	To (m)						
Fill							
0	1.1	Slightly moist yellow to dark brown LOOSE to MEDIUM DENSE silty fine to coarse **SAND** with bricks, plant roots plastic and glass	soft	50-150	25-55	-	10-25
Partially Ferruginised Alluvium							
1.1	3.7	Slightly moist becoming moist yellow brown mottled black SOFT to FIRM shattered sand gravelly **CLAY** with minor friable ferricrete nodules	Soft	50-100	25-40	18-72	-

EABC = estimated allowable bearing capacity (ignoring collapse potential)
Kv = modulus of subgrade reaction
C = cohesion
E = elastic modulus
NB. Tabulated depths are an average across the site. For more detailed Pit specific depths, refer to the TP Log

5.2 Rotary-Core Boreholes

Six diamond rotary-core boreholes were drilled on site, one at each of the proposed structure footprints, and then an additional three along the areas that will be at or near to the edge of the mass excavation, but also falling on or near to the proposed building footprints.

Boreholes were drilled using the NXC system and with NWD4 drilling equipment, producing intact cores of 52 mm diameter. Temporary casing was also used in instances where water-loss was occurring, and where the stability of the surrounding materials was low.

Standard Penetration Tests (or SPT's) were advanced at approximately 1.5 m intervals until refusal, in order to determine the SPT N-value, which may be used for design purposes. These tests are conducted by allowing a 62.5 kg (140 lb) hammer fall from a height of 760

mm onto an anvil, driving a cylindrical rod with attached split Raymond Spoon into the ground, in order to retrieve an undisturbed soil sample and measure the in situ consistency.

Shelby Tube samples were retrieved using thin-walled cylindrical tubes, hydraulically advanced into soft, generally semi-cohesive to cohesive materials, and twisted, cutting the sample off, and retaining an undisturbed soil sample, which is then waxed on both ends to maintain the in-situ moisture content. These samples may be used for shearbox testing to determine lateral support design parameters, such as the soils internal effective friction angle (φ') and effective cohesion (c').

6. GROUNDWATER

Groundwater seepage was encountered in TP2 excavated on site at a depth of 3.7 m, although during periods of increased rainfall during summer months, the probability of an increase and a rise in the localised groundwater table may occur, over the site.

Water rest level was measured at about 6 m below surface in all boreholes.

7. LABORATORY TESTING

Laboratory tests have been scheduled on soil samples recovered from the site.

The following tests are being carried out:

- Two foundation indicator tests (PSD, hydrometer and Atterberg Limits),
- Two moisture-density (MOD AASHTO) tests and California-Bearing Ratio (CBR) tests,
- Eight unconfined compressive strength (UCS) tests, and
- Six quick unconsolidated-undrained (U-U) shearbox tests.

Detailed laboratory test results are provided in the Appendix, and a summary provided, in part, in tabular form as below:

Table 7-1: Summary of Foundation Indicators

TP	Depth (m-m)	LL	PI	GM	PE*	CBR* (%)	Classifications		
							TRH14	PRA	USCS
Fill									
1	0-0.8	35	14	1.8	Low	25	G6-G7	A.2.6	GM
Ferruginised Alluvium									
2	1.1-3.7	30	14	1.21	Low	17	G7-G9	A.6	GM

***CBR estimated from PI-GM relationship**
***PE – Potential Expansiveness**

Table 7-2: Summary of Compaction Tests

TP	Depth (m-m)	MDD (kg/m3)	OMC (%)	Swell (%)	CBR (%)				
					90	93	95	98	100
Fill									
1	0-0.8	1803	16.5	0.75	3	4	6	9	12
Ferruginised Alluvium									
2	1.1-3.7	1930	13.5	0.5	6	10	14	23	32

MDD = maximum dry density
OMC = optimum moisture content

Table 7-3: Summary of UCS Test Results Andesite Lava

BH No.	Depth (m-m)	Density (g/cm^3)	UCS Value (MPa)	Rock Strength
Bulk Earthworks				
1	13.70-13.93	2.76	97.1	Very hard rock
4	11.90-12.23	2.85	195.6	Very hard rock
6	10.22-10.52	2.78	39.8	Hard rock
5	10.20-10.46	2.91	40.4	Hard rock
	14.69-14.90	2.76	32.9	Hard rock
Foundations				
3	15.10-15.40	2.81	107.0	Very hard rock
2	18.66-18.98	2.85	163.6	Very hard rock
6	16.50-16.82	2.81	41.4	Hard rock

Table 7-4: Summary of Shearbox Test Results

BH No.	Depth (m)	Average Initial MC	Average Final MC	Results	
				Friction Angle (φ')	Cohesion (c')
Residual Andesite					
1	4.50-5.05	22.6	28.8	28.5	20.9
Alluvium and Ferruginised Alluvium					
2	3-3.55	6.4	16	20.5	24.2
4	1.5-1.79	22.2	24.6	33.7	16.5
5	3-3.36	21.9	23.5	30	22.1
6	1.5-2.05	20.9	24.8	18.3	29.9
	3-3.4	31.9	25.7	26.2	1.5

Table 7-5: Materials Classification and Recommended Usage

Material Description	Classification	Recommended Usage
Fill	PI = 14 GM = 1.8 Classification: A.2.6; GM; G6-G7; Low potential expansiveness	Materials may be used on site as lower subbase to upper selected layers (G6-G7)
Alluvium and ferruginised Alluvium	PI = 14 GM = 1.21 Classification: A.6; GM; G7-G9; Low potential expansiveness	Materials may be used on site as upper to lower selected layers (G7-G9)

8. DEVELOPMENT RECOMMENDATIONS

8.1 Materials Usage

The soils encountered on site range between an intermediate thickness of loose to medium dense silty gravelly fine to coarse sandy fill with bricks, bottles, plastic and rubble. Underlying the fill horizon is an alluvial silty gravelly sand or sandy clay, which was noted to be partially ferruginised in places.

In terms of materials usage, the following can be anticipated (pending laboratory results):

- The fill qualifies as lower subbase to upper selected layers (G6-G7)
- The partially ferruginised alluvium qualifies as upper to lower selected layers (G7-G9)

8.2 Soil Movement

In terms of soil movement on site, both the fill and the alluvium proved to be of low potential expansiveness, and so no heave would be expected if these materials are reused.

However, due to the nature of the structures envisaged for the site, the majority of the soil materials will likely be cut and carted off site, and thus be of little concern. Having said this, the materials have qualified as G6-G9 usage for internal road layerworks.

8.3 Excavatability & Earthworks

Across the site, soft excavation (in terms of SABS 1200 D) is anticipated to depths in excess of 3.5 to 4 m in the ferruginised alluvial and assumed residual andesite soils beneath this depth. Once into weathered and fresh andesite bedrock, intermediate to hard excavation and blasting should be allowed for to depths of approximately 15 m below ground level.

8.4 Foundations

Founding conditions over the site, for the purpose the commercial development which will include deep basements with multiple-storey buildings above, are anticipated to be homogeneous at BEL or 15 m below ground level within weathered Andesite bedrock. The envisaged column loads will be 10,000 kN.

Table 8-4: Anticipated Construction Details

Depth		Description	EABC (kPa)	Earthworks Recommendations	Foundation Recommendations
From (m)	To (m)				
Fill					
0	0.9	Slightly moist yellow to dark brown LOOSE to MEDIUM DENSE silty fine to coarse **SAND** with bricks, plant roots plastic and glass	50-150	• Cut and stockpile for later usage in road layerworks • Lateral support required	N/A
Alluvium or partially ferruginised alluvium					
0.9	4.5	Slightly moist yellow brown mottled black MEDIUM DENSE to DENSE shattered gravelly clayey **SAND** with ferricrete nodules. or Slightly moist becoming moist yellow brown mottled black SOFT to FIRM shattered sand gravelly **CLAY** with minor friable ferricrete nodules	50-200	• Cut and either stockpile for later usage in road layerworks, or spoil off site • Lateral support required	N/A
Residual Andesite lava					
4.5	5	Orange to yellow brown mottled grey LOOSE or SOFT silty gravelly fine to medium **SAND** or sandy **SILT**	200-300	• Cut and stockpile for possible later usage in road layerworks • Lateral support required	N/A
Weathered Andesite lava					
5	8.5	Yellow to olive brown to dark blue grey highly to completely weathered closely jointed fine to coarse-grained VERY SOFT ROCK to SOFT ROCK	500–1000	• Heavy Ripping to possible blasting	N/A
Moderately to slightly weathered Andesite lava					
8.5	20+	Dark blue grey banded white moderately to slightly weathered closely jointed fine to coarse-grained MEDIUM HARD ROCK to HARD ROCK	3000+	• Blasting (possibly chemical blasting)	• Reinforced pad foundations at nominal depth below BEL

EABC = estimated allowable bearing capacity (ignoring collapse potential)

8.5 Rock Mass Characteristics

In order to determine the 'actual' rock mass characteristics, a Rock Mass Rating system (After Bieniawski, 1989) was used and considers the following rock properties:

- Uniaxial compressive strength
- Rock Quality Designation (RQD)
- Spacing of discontinuities
- Condition of discontinuities
- Groundwater (assume dry or 15)
- Adjustment for orientation (assume good and 0)

Using the rock strength results, and rock mass structure (fracture, spacing, RQD and joint conditions), the Rock Mass Rating (RMR) can be estimated. Once this has been determined, then the Geological Strength Index (GSI) as proposed by Hoek & Brown (1997), is determined by using the following relationship:

GSI = RMR – 5

Table 8.5a: Rock Mass Rating (RMR) Parameters (Andesite lava)

RMR Parameters	Value Range & (average)	Rating & (average)
UCS (MPa)	32.9-195.6 (89.7)	4-12 (7)
RQD (%)	10.1-36.7 (22.6)	3-8 (3)
Spacing of joints	53-71 (61)	5-8 (8)
Condition of joints	Fair	10-20 (20)
Water	Assume dry	15
TOTAL RMR		**37-63 (53)**

The range and average total suggests a poor (Class IV) to good (Class II) rock mass class range, with an average of fair (Class III) through the entire set of borehole profiles. The GSI is 32-58, with an average of 48.

The analysis of the rock mass parameters is summarised as follows:

Table 8.5b: Summary of Rock Mass Parameters (Andesite Lava)

Input Parameters			Output Parameters			
GSI	UCS (MPa)	mi	Φ (°)	C (kPa)	σ (MPa)	E (GPa)
32	33	19	32.1	1.2	4.4	2.0
48	90	19	36.6	4.2	16.9	8.5
58	196	19	39.4	11.2	47.0	15.9

8.6 Lateral Support Design

With the proposed construction of deep basement levels, lateral support design parameters will be essential for the cost effective design and construction of a safe, permanent excavation.

Based on the rotary-cored boreholes, Shelby tube samples were obtained from depths ranging between 1.5 and 5 m depths, in alluvial and residual Andesite soils.

The following parameters were obtained from shearbox test results and empirically:

Table 8.6: Lateral Support Design Parameters

Design Parameters	Values
Effective friction angle (φ'):	18.3-33.7˚
Effective cohesion (c'):	1.5-29.9 kPa
Bulk density:	2029.5-2047.8 kg/m^3
K_o	0.3-0.6
K_a	0.25-0.4
K_p	2.5-4

It is suggested that due to the nature of the excavation, the deep excavation sidewalls will require appropriate lateral support, possibly in the form of semi-contiguous piles and gunite arches or soil nails and reinforced gunite.

8.7 Drainage

For the promotion of a stable site, especially in the areas of unconsolidated soils in combination with deep excavations and high column loads, it is important that adequate drainage, both surface and subsurface, be designed and constructed so that no water ingress into the subsurface soils and/or constructed layerworks, especially in and around proposed foundation bases, is possible. Drainage should be such that any rainfall is diverted to the nearest stormwater drainage system. Areas of potential pooling or damming of surface runoff on site should be carefully designed and sloped so as to be removed from site. Once foundation excavations have been opened, they are to be rapidly blinded with concrete, so as to prevent any potential water ingress having an impact on the potential deterioration of the exposed subsurface geology.

A ground water level of about 6 m below surface should be expected and therefore continuous pumping of deep excavations will be required during the bulk earthworks operation. Adequate drainage behind basement walls will be required and also a permanent de-watering pumping system to keep the basement dry during its lifetime.

9. CONCLUSIONS & RECOMMENDATIONS

General

- This report presents the findings of a shallow geotechnical investigation for the proposed commercial development in Trevenna, Pretoria CBD, Gauteng, and presents the conclusions and recommendations for proposed excavations, potential soil movement, and earthworks.

- The most critical aspects of this site in relation to the proposed development is the presence of closely jointed bedrock below 15 m depth that will likely require blasting.

Geology & Ground Conditions

- Fieldwork conducted on site suggested that the site is underlain by fill, alluvium and ferruginised alluvium, residual andesite soils and weathered to fresh Andesite lava from around 5 m depth. Beneath this depth, the geology transitions to fresh Andesite lava with increasing depth.

Excavatability & Earthworks

- Soft excavation over the site (in terms of SABS 1200 D) to around 4.5 to 5 m (based on the test pits and boreholes). Beneath this depth, intermediate excavation is anticipated together with localised boulder and hard excavation due to irregular hard rock pinnacles and corestones, to around 8.5 m, beneath which heavy ripping and blasting is anticipated.

Foundations

- The heavily-loaded columns will require large reinforced pad or spread footings, founded directly onto moderately to slightly weathered Andesite lava bedrock, at approximately 15 m depth. The estimated allowable bearing capacity is 1.5 MPa.

Rock Mass Rating

- The range and average total suggests a poor (Class IV) to fair (Class III) rock mass, with an average of fair (Class III) through the entire set of borehole profiles. The GSI is 32-58, with an average of 48.

Lateral Support Design

- It is suggested that due to the nature of the excavation, the deep excavation sidewalls will require appropriate lateral support measures, possibly in the form of semi-contiguous piles and gunite arches or soil nails and reinforced gunite.

Further Investigations

- This report comprises the results of both a limited shallow investigation and a deep drilling investigation to determine depth to competent bedrock and allowable rock bearing capacities, lateral support parameters and the presence and level of the groundwater.

Finally, the ground conditions described in this report refer specifically to those encountered at the test pit and borehole positions advanced on site. It is therefore possible that conditions at variance with those discussed above may be encountered elsewhere on the site. In this regard it is critical that materials management be maintained continuously on site and that ***GCS Geotechnical*** carry out periodic inspections of the site during construction to ensure that any variation in the anticipated ground conditions can be assessed and revised recommendations subsequently provided in order to avoid unnecessary delays and expense. Furthermore it is important that the construction phase of the project be treated as an augmentation of the geotechnical investigation.

14 March 2017

For GCS Geotechnical

ninow@gcs-sa.biz
www.gcs-sa.biz

Appendix A
Test Pit Profiles

63 Wessels Road, Rivonia, 2128 P.O Box 2597, Rivonia, 2128 South Africa
Tel: +27 (0) 11 803 5726 Fax: +27 (0) 11 803 5745 Web: www.gcs-sa.biz

Project:	UIF Building
Client:	Geomech Africa
Location:	Gauteng
Project No.:	16-1370
Engineering Geologist:	WK

Hole No.:	TP 1
Start date:	1/31/2017
End date:	1/31/2017
Coordinates:	28° 12' 13.7549" E
	25° 44' 56.4413" S

(Hand held GPS)

Depth (m)	Lithology	Depth (m)	Material Description
0 – 0.8			Slightly moist, orange to grey black, **MEDIUM DENSE** to **DENSE** (pp = 20 - 50 mm), fine to medium grained silty SAND. Fill, with abundant gravel and sand, plastic and glass.
0.8 – 2.6			Slightly moist, grey yellow brown mottled yellow and white, **FIRM** (pp < 20 mm), slickensided, silty CLAY. Alluvium.
2.6 – 2.8			Slightly moist, yellow brown, **SOFT** (pp = 30 - 50 mm), friable, shattered, gravelly sandy CLAY. Partially ferruginised Alluvium.
2.8 – 3.4			Slightly moist, grey, **FIRM** (pp < 15 mm), slickensided, silty CLAY. Alluvium.
3.4 – 3.8			

PP - Sidewall Geological Pick Penetration

Notes:

Final depth:	3.50 m
Groundwater:	No Groundwater Seepage
Sidewall stability:	No Sidewall Collapse
Samples:	2x Bulk @ 0 - 0.8 m

Photos taken and Pit backfilled

GCS Geotechnical Engineering

63 Wessels Road, Rivonia, 2128 P.O Box 2597, Rivonia, 2128 South Africa
Tel: +27 (0) 11 803 5726 Fax: +27 (0) 11 803 5745 Web: www.gcs-sa.biz

Project:	UIF Building
Client:	Geomech Africa
Location:	Gauteng
Project No.:	16-1370
Engineering Geologist:	WK

Hole No.:	TP 2
Start date:	1/31/2017
End date:	1/31/2017
Coordinates:	28° 12' 13.9941" E
	25° 44' 58.8122" S

(Hand held GPS)

Depth (m)	Lithology	Depth (m)	Material Description
0 – 1			Slightly moist, yellow dark brown, **LOOSE** to **MEDIUM DENSE** (pp = 20 - 50 mm), coarse to fine grained silty SAND. Fill, with abundant bricks and plant roots.
1 – 3.8			Slightly moist, yellow brown, **MEDIUM DENSE** to **DENSE** (pp < 10 mm) at depth, shattered near the top, gravelly SAND becoming clayey SAND. Ferruginised Alluvium with ferricrete nodules.

PP - Sidewall Geological Pick Penetration

Notes:

Final depth:	3.70 m
Groundwater:	Groundwater Seepage at 3.70 m
Sidewall stability:	No Sidewall Collapse
Samples:	2x Bulk @ 1.1 - 3.7 m

Photos taken and Pit backfilled

GCS Geotechnical Engineering

63 Wessels Road, Rivonia, 2128 P.O Box 2597, Rivonia, 2128 South Africa
Tel: +27 (0) 11 803 5726 Fax: +27 (0) 11 803 5745 Web: www.gcs-sa.biz

Project:	UIF Building
Client:	Geomech Africa
Location:	Gauteng
Project No.:	16-1370
Engineering Geologist:	WK

Hole No.:	TP 3
Start date:	1/31/2017
End date:	1/31/2017
Coordinates:	28° 12' 11.6486" E
	25° 44' 57.5639" S

(Hand held GPS)

Depth (m)	Lithology	Depth (m)	Material Description
0 – 0.8			Slightly moist, yellow dark brown, **LOOSE** to **MEDIUM DENSE** (pp = 20 - 50 mm), coarse to fine grained silty SAND. Fill, with abundant bricks and plant roots.
0.8 – 3.8			Slightly moist, yellow brown, **MEDIUM DENSE** to **DENSE** (pp < 10 mm) at depth, shattered near the top, gravelly SAND becoming clayey SAND. Ferruginised Alluvium with ferricrete nodules.

PP - Sidewall Geological Pick Penetration

Notes:

Final depth: 3.90 m
Groundwater: No Groundwater Seepage
Sidewall stability: No Sidewall Collapse
Samples: No Samples
Photos taken and Pit backfilled

Appendix B
Rotary-Core Borehole Profiles

GCS Geotechnical Engineering
63 Wessels Road, Rivonia, 2128 P.O Box 2597, Rivonia, 2128 South Africa
Tel: +27 (0) 11 803 5726 Fax: +27 (0) 11 803 5745 Web: www.gcs-sa.biz

GeoGroup

Project:	UIF Building	Borehole start date:	2/2/2017
Client:	Geomechanics	Date logged:	15-16/02/2017
Location:	Pretoria, Gauteng	Coordinates:	25 deg 44' 56.8" S
Project No.:	16-1370		28 deg 12' 11.4" E
Geologist:	WK		
Borehole No.:	BH-1		
Contractor:	Geomechanics		

Depth (m)	Drilling method	Material Recovery (%)	Core Recovery (%)	RQD (%)	SPT-N Value	UCS (MPa)	Fracture Frequency	Joint set No.	Joint inclination (deg.)	Joint spacing	Joint shape	Joint roughness	Weath-ering (%)	Depth (m)	Lithology Description	Lithology	Samples	Elevation (mamsl)
0	NXC	63	0										-	0	Dark brown to dark orange to red brown, silty fine SAND with abundant gravels and cobbles. Fill.			0
	NXC	63	0															
	SPT	100	0		N=7													
2	NWD4	64	0										80 - 100	2	Orange to yellow brown mottled grey, **LOOSE** or **SOFT**, silty gravelly fine to medium SAND or sandy SILT. Residual Andesite.			-2
	SPT	100	0		N=75													
4	NWD4	70	0											4				-4
	SHEL BY	100	0															
	SPT	100	0		N=42		15		0-10 20-30 40-50	C M M	IRR IRR IRR	RJ RJ RJ	80 - 100		Yellow to olive brown speckled and streaked white, completely weathers, fine to coarse grained, closely jointed, **VERY SOFT** ROCK. ANDESITE with coarse quartz veins. (Brecciated).			
	SHEL BY	90	90				>20							6				-6
	SPT	77	77		N=55		>20											
	NWD4	100	100				>20		0-10 20-30 40-50 60-70 70-80	C C M M M	IRR IRR IRR UND IRR	RJ RJ RJ RJ RJ	60 - 80		Dark blue grey to black banded and streaked white and brown, highly weathered, fine to coarse grained, closely jointed, **SOFT** ROCK. ANDESITE (Brecciated with quartz veins).			
8	NWD4	90	90				>20							8				-8
	NWD4	98	98				>20											
			94				>20		0-10 20-30 40-50 60-70 70-80	C C C M M	IRR IRR IRR-P LA IRR IRR	RJ RJ SRJ RJ RJ	40 - 60		Dark blue grey to black mottled white, moderately weathered, closely jointed, fine grained to coarse grained **MEDIUM HARD** ROCK. ANDESITE.			
10							>20							10				-10
	NWD4	97	97				13											
	NWD4	100	100	54			>20											
12	NWD4	100	100	95			>20							12				-12
	NWD4	97	97	53			>20											
	NWD4	100	100	0			15		0-10 20-30 40-50 60-70 70-80	C C C M W	IRR IRR IRR-P LA IRR-S TE IRR	RJ RJ RJ RJ RJ	20 - 40		Dark blue grey banded white, slightly weathered, closely jointed, fine to coarse grained, **HARD** ROCK. ANDESITE.			
14	NWD4	98	98	39			13							14				-14
	NWD4	100	100	29			12											
	NWD4	99	99	79			8											
16														16				-16
18														18				-18
20														20				-20
22														22				-22

ROCK FABRIC
MF-massive
BF-bedded
FF-foliated
CF-cleaved
SF-schistose
GF-gneissose
LF-laminated

GRAIN SIZE
FG-fine grained
MG-medium grained
CG-coarse grained

JOINT SPACING
VC-very closely jointed
C-closely jointed
M-medium jointed
W-widely jointed
VW-very widely jointed

JOINT ROUGHNESS
SJ-smooth joint
SRJ-slighty rough joint
MRJ-medium rough joint
RJ-rough joint
VRJ-very rough joint

JOINT SHAPE
CUR-curvilinear
PLA-planar
UND-undulating
STE-stepped
IRR-irregular

ROCK HARDNESS
EHR-extremely hard rock
VHR-very hard rock
HR-hard rock
MHR-medium hard rock
SR-soft rock
VSR-very soft rock

Borehole No.: **BH-1**

PHOTOGRAPHIC LOG		
Client Name: Geomechanics	Site Location: Trevenna, Pretoria	Project Name: UIF Buildings
Borehole No.: Rotary BH-1	Date Logged: 15-16/02/2017	Project No.: 16-1370
Box No.: 1 of 4 Depth (m): 0.00-7.07		
Box No.: 2 of 4 Depth (m): 7.07-12.90		
Box No.: 3 of 4 Depth (m): 12.90-18.10		
Box No.: 4 of 4 Depth (m): 18.10-20.02		

GCS Geotechnical Engineering
63 Wessels Road, Rivonia, 2128 P.O Box 2597, Rivonia, 2128 South Africa
Tel: +27 (0) 11 803 5726 Fax: +27 (0) 11 803 5745 Web: www.gcs-sa.biz

GeoGroup

Project:	UIF Building	Borehole start date:	2/6/2017
Client:	Geomechanics	Date logged:	15-16/02/2017
Location:	Pretoria, Gauteng	Coordinates:	25 deg 44' 56.8" S
Project No.:	16-1370		28 deg 12' 13.7" E
Geologist:	WK		
Borehole No.:	BH-2		
Contractor:	Geomechanics		

Depth (m)	Drilling method	Material Recovery (%)	Core Recovery (%)	RQD (%)	SPT-N Value	UCS (MPa)	Fracture Frequency	Joint set No.	Joint inclination (deg.)	Joint spacing	Joint shape	Joint roughness	Weath-ering (%)	Depth (m)	Lithology Description	Lithology	Samples	Elevation (mamsl)
0	NXC	69												0	CONCRETE Block.			0
	NXC	59													Dark grey to dark red brown, silty fine to medium **SAND** with minor fine gravels. Fill.			
	SPT	100			N=11													
2	NWD4	19													Orange to grey brown, **MEDIUM DENSE**, silty clayey fine to medium SAND with friable rounded gravels. Partially ferruginised, Alluvium.			-2
	SHEL BY	100																
	SPT	100			N=11													
4	NWD4	46											80 - 100		Orange brown cream white, **MEDIUM DENSE**, silty sandy GRAVEL. Residual Andesite.			-4
	SPT	100			N=19													
	NWD4	86					>20											
6	NWD4	40					>20		0-10 20-30 40-50	C C C	IRR IRR IRR	RJ RJ RJ	80 - 100		Dark grey brown completely weathered, closely jointed, fine grained, **VERY SOFT** ROCK. ANDESITE (exposed as sandy fine to coarse gravel).			-6
	SPT	100			N=REF		>20											
8	NWD4	72					>20											-8
	NWD4	95	95				>20											
	NWD4	51	51				>20											
	NWD4	95	95				>20											
10	NWD4	82	82				>20		0-10 20-30 40-50 70-80	C C C W	IRR IRR IRR IRR	RJ RJ RJ RJ	60 - 80		Dark brown grey speckled white, streaked yellow, highly weathered, fine to medium grained, very closely jointed, **SOFT** ROCK. Brecciated amygdaloidal ANDESITE.			-10
	NWD4	71	71				>20											
	NWD4	96	96				>20											
	NWD4	100	100				>20											
12	NWD4	77	77				>20											-12
	NWD4	80	80	14			>20											
	NWD4	100	100	0			>20											
14	NWD4	100	100	37			16		0-10 20-30 40-50	C C C	IRR IRR IRR	RJ RJ RJ	40 - 60		Dark green grey speckled white, moderately weathered, closely jointed, fine grained, **MEDIUM HARD** ROCK. Amygdaloidal ANDESITE.			-14
	NWD4	100	100	20			15											
16	NWD4	100	100	0			>20											-16
	NWD4	98	98	53			>20		0-10 20-30 40-50 70-80	M C M W	PLA PLA PLA IRR-P LA	RJ RJ RJ RJ	20 - 40		Dark green to blue grey, slightly weathered, closely to medium jointed, fine grained, **HARD** ROCK ANDESITE.			-18
	NWD4	95	95	28			14											
18							15											
20																		-20
22																		-22

ROCK FABRIC
MF-massive
BF-bedded
FF-foliated
CF-cleaved
SF-schistose
GF-gneissose
LF-laminated

GRAIN SIZE
FG-fine grained
MG-medium grained
CG-coarse grained

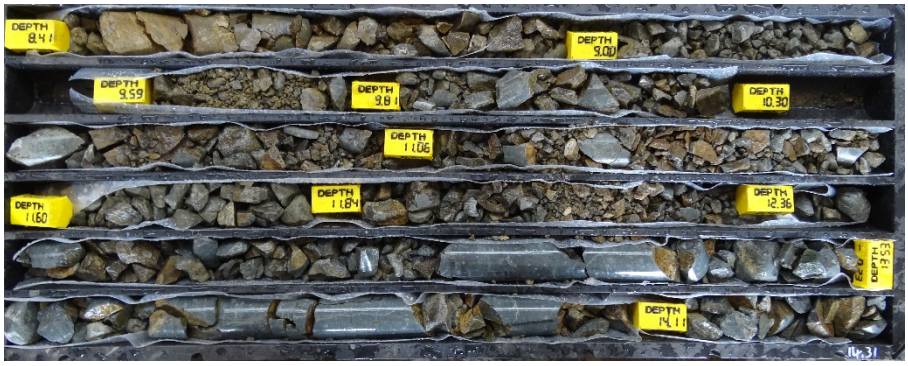
JOINT SPACING
VC-very closely jointed
C-closely jointed
M-medium jointed
W-widely jointed
VW-very widely jointed

JOINT ROUGHNESS
SJ-smooth joint
SRJ-slighty rough joint
MRJ-medium rough joint
RJ-rough joint
VRJ-very rough joint

JOINT SHAPE
CUR-curvilinear
PLA-planar
UND-undulating
STE-stepped
IRR-irregular

ROCK HARDNESS
EHR-extremely hard rock
VHR-very hard rock
HR-hard rock
MHR-medium hard rock
SR-soft rock
VSR-very soft rock

Borehole No.: **BH-2**

PHOTOGRAPHIC LOG		
Client Name: Geomechanics	Site Location: Trevenna, Pretoria	Project Name: UIF Buildings
Borehole No.: Rotary BH-12	Date Logged: 15-16/02/2017	Project No.: 16-1370
Box No.: 1 of 4 Depth (m): 0.00 - 8.24		
Box No.: 2 of 4 Depth (m): 8.24 - 14.31		
Box No.: 3 of 4 Depth (m): 14.31-19.49		
Box No.: 4 of 4 Depth (m): 19.49-20.06		

GCS Geotechnical Engineering
63 Wessels Road, Rivonia, 2128 P.O Box 2597, Rivonia, 2128 South Africa
Tel: +27 (0) 11 803 5726 Fax: +27 (0) 11 803 5745 Web: www.gcs-sa.biz

GeoGroup

Project:	UIF Building	Borehole start date:	2/7/2017
Client:	Geomechanics	Date logged:	15-16/02/2017
Location:	Pretoria, Gauteng	Coordinates:	25 deg 44' 59.3" S
Project No.:	16-1370		28 deg 12' 13.8" E
Geologist:	WK		
Borehole No.:	BH-3		
Contractor:	Geomechanics		

Depth (m)	Drilling method	Material Recovery (%)	Core Recovery (%)	RQD (%)	SPT-N Value	UCS (MPa)	Fracture Frequency	Joint set No.	Joint inclination (deg.)	Joint spacing	Joint shape	Joint roughness	Weath-ering (%)	Depth (m)	Lithology Description
0	NXC	47													Dark grey to black mottled orange, silty clayey fine SAND. Fill. Cream white speckled blue, CONCRETE (Possible foundation).
	NWD4	90													
	SPT	100			N=79										
2	NWD4	100													Dark orange brown, **VERY DENSE**, silty clayey gravelly fine to coarse SAND. Partially ferruginised Alluvium.
	SPT	100			N=61										
4	NWD4	100													
	SPT	100			N=30		-						80-100		Orange brown, **MEDIUM DENSE**, silty sandy GRAVEL. Residual Andesite.
	NWD4	100	35				>20		0-10 20-30 40-50	C C C	IRR IRR IRR	RJ RJ RJ			Orange to yellow brown mottled cream, completely weathered, closely jointed, fine grained, **VERY SOFT** ROCK. ANDESITE.
6	SPT	100	0		N=REF		>20								
	NWD4	100	85				>20		0-10 20-30 40-50 60-70	C C C W	IRR-P LA IRR-P LA IRR-P LA IRR	RJ RJ RJ RJ			Orange to grey brown, highly weathered, fine to medium grained, closely jointed, **SOFT** ROCK. Vesicular ANDESITE.
8	NWD4	98	98				>20								
	NWD4	100	100				>20								
10	NWD4	98	98				>20		0-10 20-30 40-50 60-70	M C C M-W	IRR PLA PLA PLA	RJ RJ RJ RJ			Dark green grey, moderately weathered, closely jointed, fine grained, **MEDIUM HARD** ROCK. ANDESITE.
	NWD4	99	99	56			18								
12	NWD4	100	100	66			11								
	NWD4	100	100	74			14								
14	NWD4	100	100	87			7		0-10 20-30 40-50	C C C	IRR IRR IRR	RJ RJ RJ			Dark green to blue grey, slightly weathered, fine to coarse grained, medium jointed, **HARD** ROCK. Amygdaloidal ANDESITE.
16							6								
							4								
18							7								
							2								
20															
22															

Lithology | Samples | Elevation (mamsl)

0 -2 -4 -6 -8 -10 -12 -14 -16 -18 -20 -22

ROCK FABRIC
MF-massive
BF-bedded
FF-foliated
CF-cleaved
SF-schistose
GF-gneissose
LF-laminated

GRAIN SIZE
FG-fine grained
MG-medium grained
CG-coarse grained

JOINT SPACING
VC-very closely jointed
C-closely jointed
M-medium jointed
W-widely jointed
VW-very widely jointed

JOINT ROUGHNESS
SJ-smooth joint
SRJ-slighty rough joint
MRJ-medium rough joint
RJ-rough joint
VRJ-very rough joint

JOINT SHAPE
CUR-curvilinear
PLA-planar
UND-undulating
STE-stepped
IRR-irregular

ROCK HARDNESS
EHR-extremely hard rock
VHR-very hard rock
HR-hard rock
MHR-medium hard rock
SR-soft rock
VSR-very soft rock

Borehole No.: **BH-3**

PHOTOGRAPHIC LOG

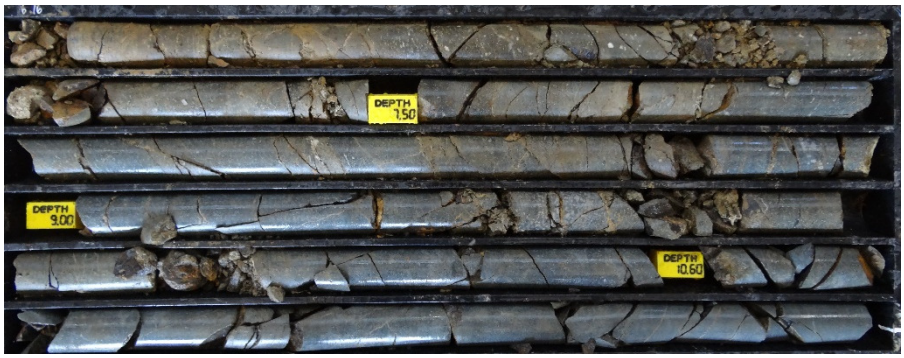
Client Name: Geomechanics	Site Location: Trevenna, Pretoria	Project Name: UIF Buildings
Borehole No.: Rotary BH-3	Date Logged: 15-16/02/2017	Project No.: 16-1370

Box No.: 1 of 4

Depth (m): 0.00-6.16

Box No.: 2 of 4

Depth (m): 6.16-11.73



Box No.: 3 of 4

Depth (m): 11.73-16.99

Box No.: 4 of 4

Depth (m): 16.99-18.20

GCS Geotechnical Engineering
63 Wessels Road, Rivonia, 2128 P.O Box 2597, Rivonia, 2128 South Africa
Tel: +27 (0) 11 803 5726 Fax: +27 (0) 11 803 5745 Web: www.gcs-sa.biz

GeoGroup

Project:	UIF Building	Borehole start date:	07/02/2017
Client:	Geomechanics	Date logged:	15-16/02/2017
Location:	Pretoria, Gauteng	Coordinates:	25 deg 44' 58.9" S
Project No.:	16-1370		28 deg 12' 13.3" E
Geologist:	WK		
Borehole No.:	BH-4		
Contractor:	Geomechanics		

Depth (m)	Drilling method	Material Recovery (%)	Core Recovery (%)	RQD (%)	SPT-N Value	UCS (MPa)	Fracture Frequency	Joint set No.	Joint inclination (deg.)	Joint spacing	Joint shape	Joint roughness	Weath-ering (%)	Depth (m)	Lithology Description
0	NXC	70												0	Dark red brown to orange brown mottled grey, **DENSE**, fine sandy clayey gravelly SILT. Fill (partially ferruginised).
	NWD4	100													
	SHEL	100													
2	BY	100			N=44								80-100	-2	Orange brown speckled black and grey, **DENSE**, silty gravelly fine SAND. Partially ferruginised Residual Andesite.
	SPT														
	NWD4	100													
	SPT	100			N=53		>20		0-10 40-50 70-80	C C M	IRR IRR IRR	RJ RJ RJ	80-100		Orange brown to dark green grey, completely weathered, fine to coarse grained, closely jointed, **VERY SOFT** ROCK. ANDESITE (exposed as clayey silty GRAVEL/residual Andesite with moderately to slightly weathered zones.
4	NWD4	100	18				>20							-4	
	NWD4	64	35				>20		0-10 40-50 70-80	C C M	IRR IRR IRR	RJ RJ RJ	60-80		Dark green grey streaked and mottled yellow, highly weathered, closely jointed, fine grained **SOFT** ROCK. ANDESITE.
	NWD4	100	100				>20								
6	NWD4	83	83	15			17							-6	
	NWD4	84	84	14			>20		0-10 40-50 70-80 20-30	C C W C-M	IRR IRR-P LA IRR-P LA IRR-P LA	RJ SRJ SRJ SRJ	40-60		Dark green to dark blue grey mottled white, moderately weathered, closely jointed, fine-grained, **MEDIUM HARD** ROCK. ANDESITE.
	NWD4	60	60	0			>20								
	NWD4	81	81	0			>20								
8	NWD4	100	100	10			>20							-8	
	NWD4	100	100	13			>20								
10	NWD4	66	66	24			>20							-10	
	NWD4	100	100	57			14								
	NWD4	100	100	0			14								
12	NWD4	100	100	11			>20							-12	
	NWD4	88	88	7			>20		0-10 40-50 70-80 20-30 60-70	C C W C-M W	PLA-I RR PLA PLA-I RR PLA PLA-I RR	SRJ SRJ SRJ SRJ SRJ SRJ	20-40		Dark blue grey streaked white, slightly weathered, closely to medium jointed, fine to coarse **HARD** ROCK. ANDESITE.
14	NWD4	91	91	65			18							-14	
	NWD4	99	99	11			15								
16	NWD4	74	74	0			11							-16	
							>20								
18							10							-18	
20														-20	
22														-22	

Depth (m)	Drilling method	Material Recovery (%)	Core Recovery (%)	RQD (%)	SPT-N Value	UCS (MPa)	Fracture Frequency	Joint set No.	Joint inclination (deg.)	Joint spacing	Joint shape	Joint roughness	Weath-ering (%)	Depth (m)	Lithology Description	Lithology	Samples	Elevation (mamsl)

ROCK FABRIC
MF-massive
BF-bedded
FF-foliated
CF-cleaved
SF-schistose
GF-gneissose
LF-laminated

GRAIN SIZE
FG-fine grained
MG-medium grained
CG-coarse grained

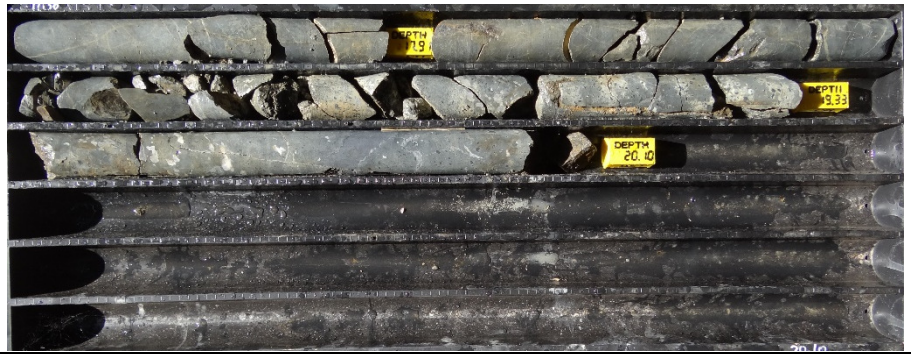
JOINT SPACING
VC-very closely jointed
C-closely jointed
M-medium jointed
W-widely jointed
VW-very widely jointed

JOINT ROUGHNESS
SJ-smooth joint
SRJ-slighty rough joint
MRJ-medium rough joint
RJ-rough joint
VRJ-very rough joint

JOINT SHAPE
CUR-curvilinear
PLA-planar
UND-undulating
STE-stepped
IRR-irregular

ROCK HARDNESS
EHR-extremely hard rock
VHR-very hard rock
HR-hard rock
MHR-medium hard rock
SR-soft rock
VSR-very soft rock

Borehole No.: **BH-4**

PHOTOGRAPHIC LOG		
Client Name: Geomechanics	Site Location: Trevenna, Pretoria	Project Name: UIF Buildings
Borehole No.: Rotary BH-4	Date Logged: 15-16/02/2017	Project No.: 16-1370
Box No.: 1 of 4 Depth (m): 0.00-5.57		
Box No.: 2 of 4 Depth (m): 5.57-11.84		
Box No.: 3 of 4 Depth (m): 11.84-17.36		
Box No.: 4 of 4 Depth (m): 17.86-20.10		

PHOTOGRAPHIC LOG

Client Name: Geomechanics	Site Location: Trevenna, Pretoria	Project Name: UIF Buildings
Borehole No.: Rotary BH-5	Date Logged: 15-16/02/2017	Project No.: 16-1370

Box No.: 1 of

Depth (m): 0.00-6.74

Box No.: 2 of 4

Depth (m): 6.74-13.46

Box No.: 3 of 4

Depth (m): 13.46-18.71

Box No.: 4 of 4

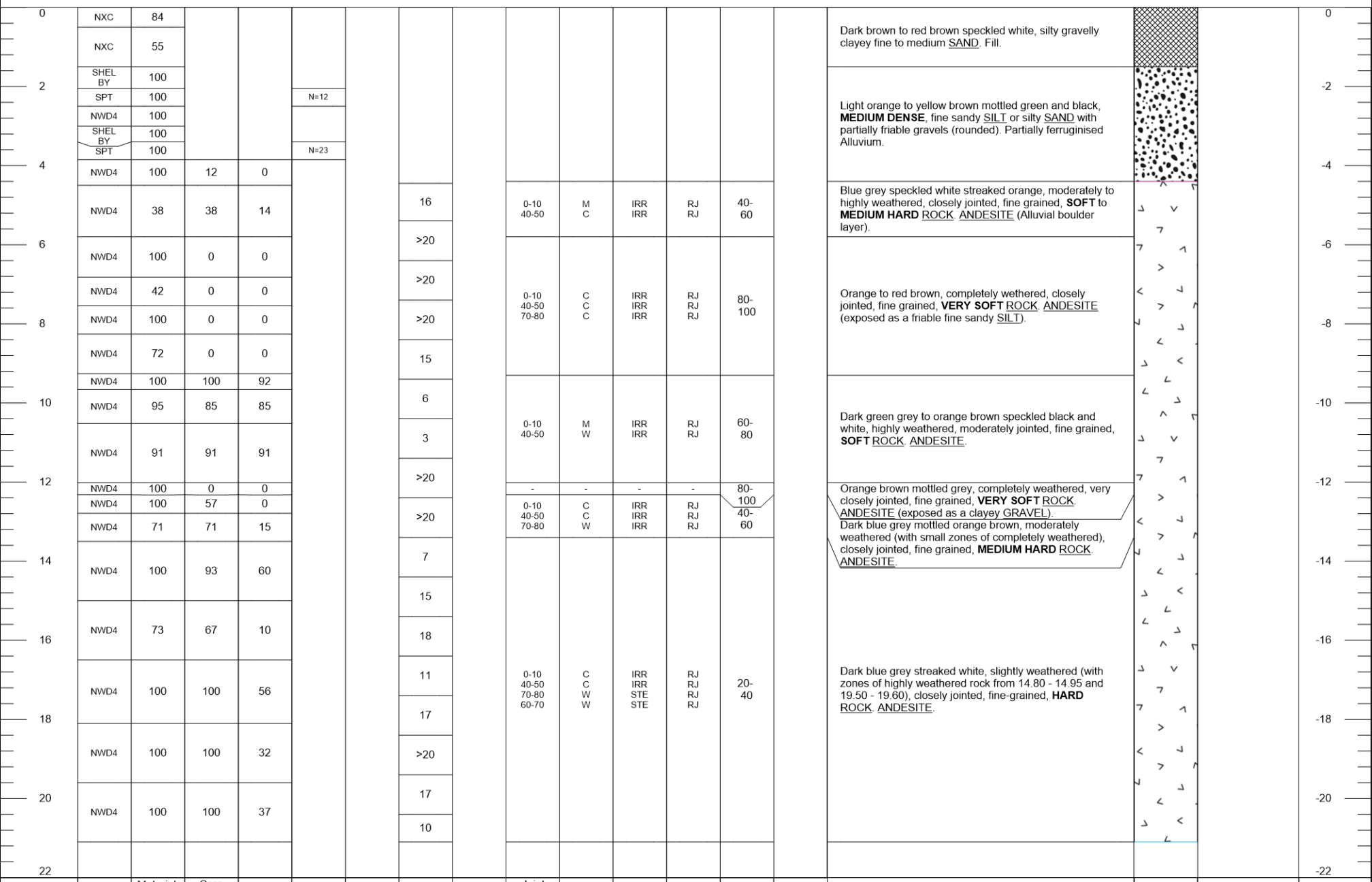
Depth (m): 18.71-2012

GCS Geotechnical Engineering

63 Wessels Road, Rivonia, 2128 P.O Box 2597, Rivonia, 2128 South Africa
Tel: +27 (0) 11 803 5726 Fax: +27 (0) 11 803 5745 Web: www.gcs-sa.biz

GeoGroup

Project:	UIF Building	Borehole start date:	11/02/2017
Client:	Geomechanics	Date logged:	15-16/02/2017
Location:	Pretoria, Gauteng	Coordinates:	25 deg 44' 57.2" S
Project No.:	16-1370		28 deg 12' 14.2" E
Geologist:	WK		
Borehole No.:	BH-6		
Contractor:	Geomechanics		



Depth (m)	Drilling method	Material Recovery (%)	Core Recovery (%)	RQD (%)	SPT-N Value	UCS (MPa)	Fracture Frequency	Joint set No.	Joint inclination (deg.)	Joint spacing	Joint shape	Joint roughness	Weath-ering (%)	Depth (m)	Lithology Description
0	NXC	84												0	Dark brown to red brown speckled white, silty gravelly clayey fine to medium SAND. Fill.
	NXC	55													
	SHEL BY	100													
2	SPT	100			N=12									-2	Light orange to yellow brown mottled green and black, **MEDIUM DENSE**, fine sandy SILT or silty SAND with partially friable gravels (rounded). Partially ferruginised Alluvium.
	NWD4	100													
	SHEL BY	100													
	SPT	100			N=23										
4	NWD4	100	12	0										-4	
	NWD4	38	38	14			16		0-10 40-50	M C	IRR IRR	RJ RJ	40-60		Blue grey speckled white streaked orange, moderately to highly weathered, closely jointed, fine grained, **SOFT** to **MEDIUM HARD** ROCK. ANDESITE (Alluvial boulder layer).
6	NWD4	100	0	0			>20							-6	
	NWD4	42	0	0			>20		0-10 40-50 70-80	C C C	IRR IRR IRR	RJ RJ RJ	80-100		Orange to red brown, completely wethered, closely jointed, fine grained, **VERY SOFT** ROCK. ANDESITE (exposed as a friable fine sandy SILT).
8	NWD4	100	0	0			>20							-8	
	NWD4	72	0	0			15								
	NWD4	100	100	92											
10	NWD4	95	85	85			6		0-10 40-50	M W	IRR IRR	RJ RJ	60-80	-10	Dark green grey to orange brown speckled black and white, highly weathered, moderately jointed, fine grained, **SOFT** ROCK. ANDESITE.
	NWD4	91	91	91			3								
							>20								
12	NWD4	100	0	0					-	-	-	-	80-100	-12	Orange brown mottled grey, completely weathered, very closely jointed, fine grained, **VERY SOFT** ROCK. ANDESITE (exposed as a clayey GRAVEL).
	NWD4	100	57	0			>20		0-10 40-50 70-80	C C W	IRR IRR IRR	RJ RJ RJ	40-60		Dark blue grey mottled orange brown, moderately weathered (with small zones of completely weathered), closely jointed, fine grained, **MEDIUM HARD** ROCK. ANDESITE.
	NWD4	71	71	15											
14	NWD4	100	93	60			7							-14	
							15								
	NWD4	73	67	10			18								
16														-16	
	NWD4	100	100	56			11		0-10 40-50 70-80 60-70	C C W W	IRR IRR STE STE	RJ RJ RJ RJ	20-40		Dark blue grey streaked white, slightly weathered (with zones of highly weathered rock from 14.80 - 14.95 and 19.50 - 19.60), closely jointed, fine-grained, **HARD** ROCK. ANDESITE.
18							17							-18	
	NWD4	100	100	32			>20								
							17								
20	NWD4	100	100	37			10							-20	
22														-22	

Depth (m)	Lithology	Samples	Elevation (mamsl)

ROCK FABRIC
MF-massive
BF-bedded
FF-foliated
CF-cleaved
SF-schistose
GF-gneissose
LF-laminated

GRAIN SIZE
FG-fine grained
MG-medium grained
CG-coarse grained

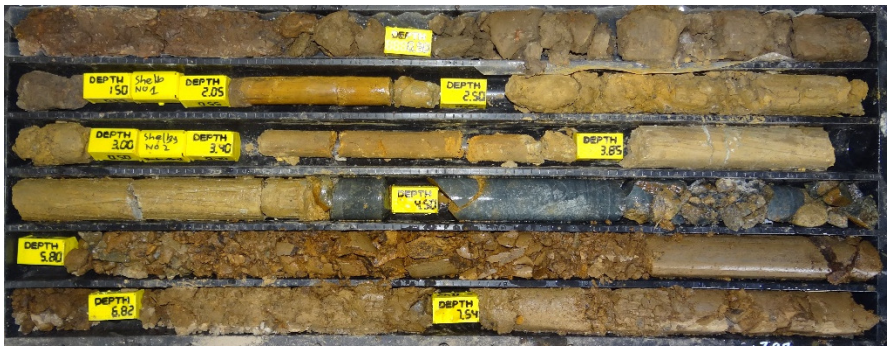
JOINT SPACING
VC-very closely jointed
C-closely jointed
M-medium jointed
W-widely jointed
VW-very widely jointed

JOINT ROUGHNESS
SJ-smooth joint
SRJ-slighty rough joint
MRJ-medium rough joint
RJ-rough joint
VRJ-very rough joint

JOINT SHAPE
CUR-curvilinear
PLA-planar
UND-undulating
STE-stepped
IRR-irregular

ROCK HARDNESS
EHR-extremely hard rock
VHR-very hard rock
HR-hard rock
MHR-medium hard rock
SR-soft rock
VSR-very soft rock

Borehole No.: **BH-6**

PHOTOGRAPHIC LOG		
Client Name: Geomechanics	Site Location: Trevenna, Pretoria	Project Name: UIF Buildings
Borehole No.: Rotary BH-6	Date Logged: 15-16/02/2017	Project No.: 16-1370
Box No.: 1 of 4 Depth (m): 0.00-7.99		
Box No.: 2 of 4 Depth (m): 7.99-12.46		
Box No.: 3 of 4 Depth (m): 12.46-17.47		
Box No.: 4 of 4 Depth (m): 17.47-21.10		

Appendix C
Laboratory Test Results

Geopractica
SOILS & MATERIALS TESTING
P.O.BOX 227, MARAISBURG, 1700
TEL: (011) 674 1325
FAX: (011) 674 4513
e mail: lab@geopractica.co.za

FOUNDATION INDICATOR

Client	GCS GEOTECHNICAL ENGINEERING		
Location	UIF BUILDING TP 1 @ 0.0 - 0,8m		
Date	02 FEBRUARY 2017	Test No	130A
Job No	17023	Checked By	EB

SIEVE ANALYSIS

Values are expressed as a percentage of total sample

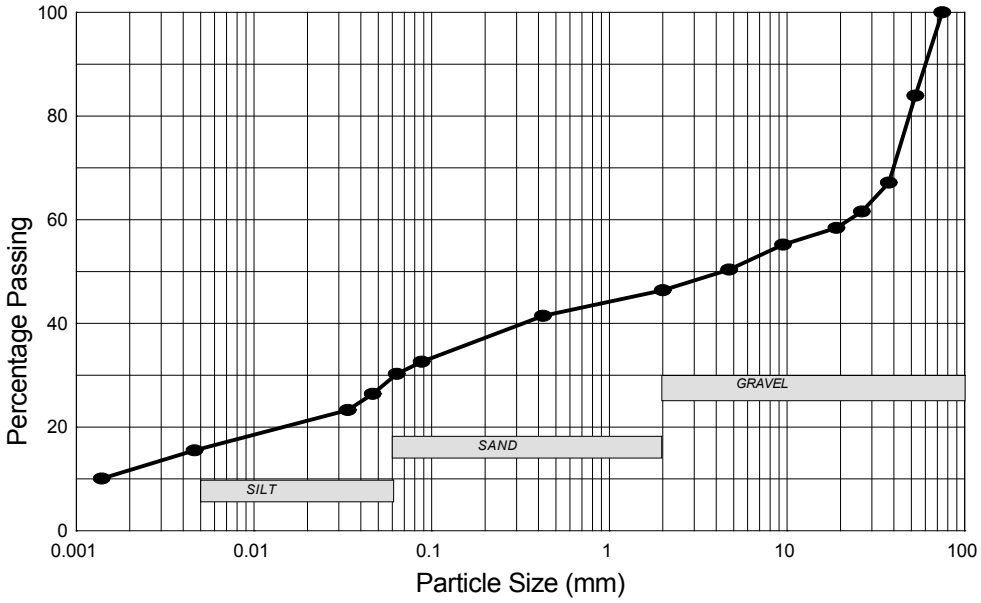
Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	83.98
37.50	67.18
26.50	61.61
19.00	58.46
9.50	55.22
4.75	50.44
2.00	46.40
0.425	41.47

HYDROMETER ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0881	32.62
0.0637	30.29
0.0467	26.41
0.0339	23.30
0.0047	15.53
0.0014	10.10

GRADING ANALYSIS



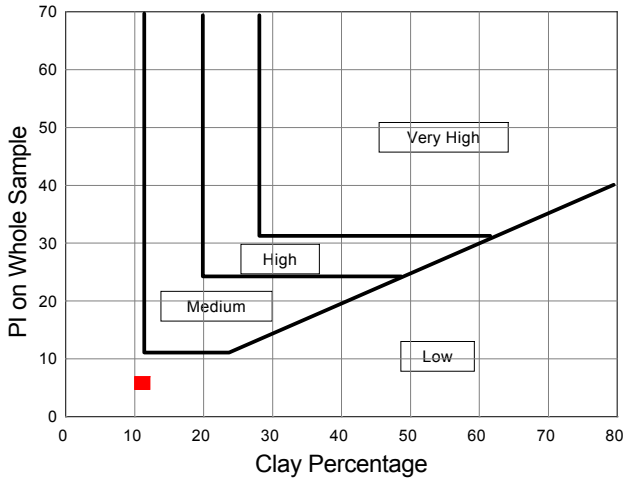
ATTERBERG LIMITS & OTHER VALUES

Liquid Limit	35
Plastic Limit	21
Plastic Index	14
Linear Shrinkage	7
Grading Modulus	1.80
Moisture Content	11.99
PI on Whole Sample	6
PRA Classification	A.2.6
Unified Classification	SC

ESTIMATED COMPOSITION (As BS 1377)

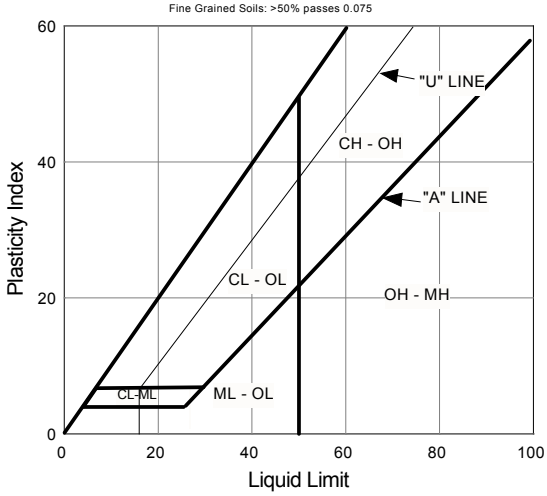
Clay (<0.002)	11.10
0.002 < Silt < 0.06	18.34
0.06 < Sand < 2.0	16.96
Gravel > 2.0	53.60
% less than 0.075	31.37

ACTIVITY CHART



PLASTICITY CHART

Fine Grained Soils: >50% passes 0.075



Signed by: Colin Dalton
Date: 2017.02.09 08:49:44 +02

Geopractica
SOILS & MATERIALS TESTING
P.O.BOX 227, MARAISBURG, 1700
TEL: (011) 674 1325
FAX: (011) 674 4513
e mail: lab@geopractica.co.za

FOUNDATION INDICATOR

Client	GCS GEOTECHNICAL ENGINEERING		
Location	UIF BUILDING TP 2 @ 1.1 - 3,7m		
Date	02 FEBRUARY 2017	Test No	132A
Job No	17023	Checked By	EB

SIEVE ANALYSIS

Values are expressed as a percentage of total sample

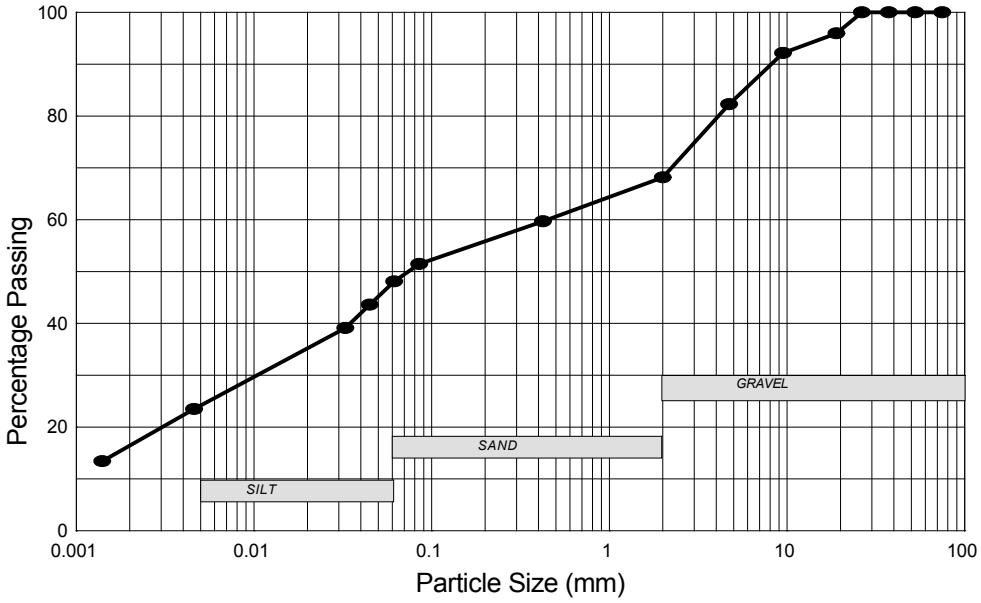
Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	95.96
9.50	92.21
4.75	82.28
2.00	68.19
0.425	59.74

HYDROMETER ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0854	51.47
0.0618	48.11
0.0451	43.63
0.0328	39.16
0.0046	23.49
0.0014	13.43

GRADING ANALYSIS



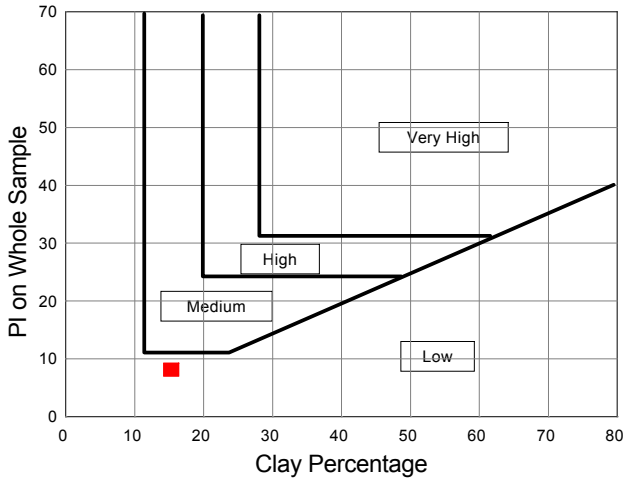
ATTERBERG LIMITS & OTHER VALUES

Liquid Limit	30
Plastic Limit	16
Plastic Index	14
Linear Shrinkage	7
Grading Modulus	1.21
Moisture Content	12.68
PI on Whole Sample	8
PRA Classification	A.6
Unified Classification	SC

ESTIMATED COMPOSITION (As BS 1377)

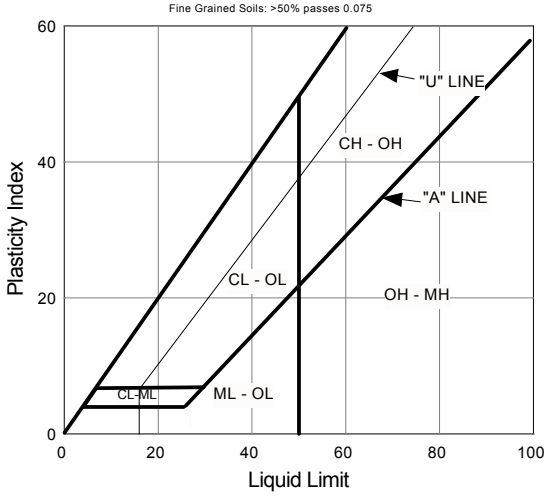
Clay (<0.002)	15.30
0.002 < Silt < 0.06	32.32
0.06 < Sand < 2.0	20.56
Gravel > 2.0	31.81
% less than 0.075	49.99

ACTIVITY CHART



PLASTICITY CHART

Fine Grained Soils: >50% passes 0.075



Signed by: Colin Dalton
Date: 2017.02.09 08:50:27 +02

Geopractica
SOILS & MATERIALS TESTING
P.O.BOX 227, MARAISBURG, 1700
TEL: (011) 674 1325
FAX: (011) 674 4513
e mail: lab@geopractica.co.za

C.B.R. DETERMINATION

Client	GCS GEOTECHNICAL ENGINEERING		
Location	UIF BUILDING TP 1 @ 0,0 - 0,8m		
Date	02 FEBRUARY 2017	Test No	131A
Job No	17023	Checked By	EB
Calibration Date	18 August 2015	Calibration Certificate	9010

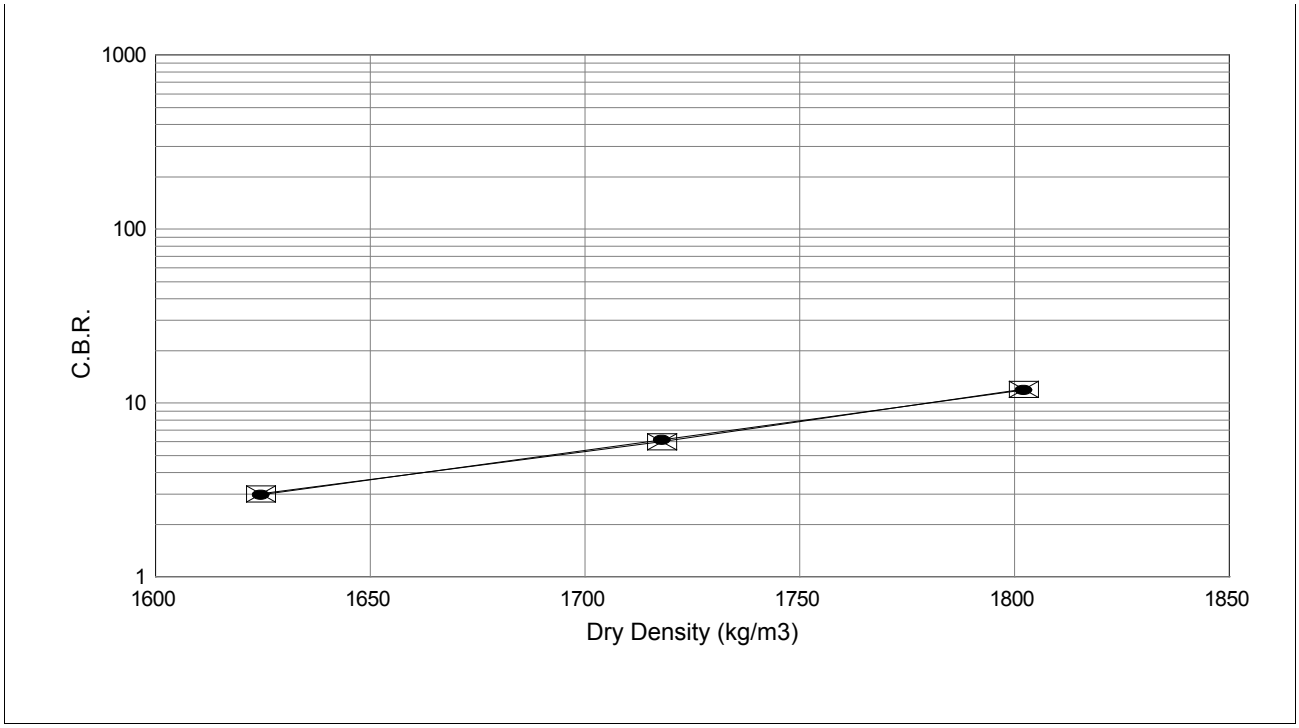
Direct Results from Test Procedure

Maximum Dry Density (kg/m3)	1803	Optimum Moisture Content (%)	16.5

Percentage Mod AASHTO	99.9	95.3	90.1
CBR @ 2.54mm	12	6	3
CBR @ 5.08mm	11	6	3
CBR@ 7.62mm	11	5	3
Average Moisture Content (%)	16.8		
Percentage Swell	0.65	0.71	0.88

Interpolated Results

Percentage Mod AASHTO	90	93	95	98	100
CBR	3	4	6	9	12



Signed by: Colin Dalton
Date: 2017.02.09 08:50:04 +02

Programed Data
Revision No 4 (1/5/2010)

Geopractica
SOILS & MATERIALS TESTING
P.O.BOX 227, MARAISBURG, 1700
TEL: (011) 674 1325
FAX: (011) 674 4513
e mail: lab@geopractica.co.za

C.B.R. DETERMINATION

Client	GCS GEOTECHNICAL ENGINEERING		
Location	UIF BUILDING TP 2 @ 1,1 - 3,7m		
Date	02 FEBRUARY 2017	Test No	133A
Job No	17023	Checked By	EB
Calibration Date	18 August 2015	Calibration Certificate	9010

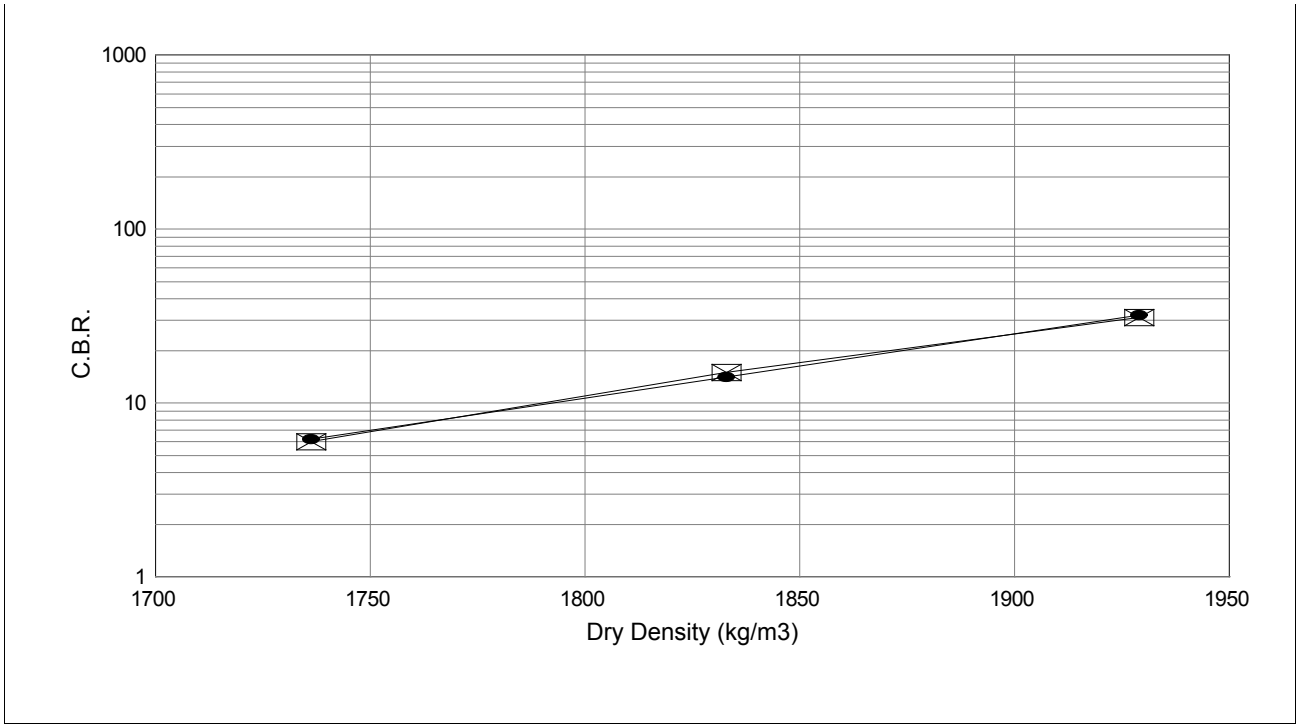
Direct Results from Test Procedure

Maximum Dry Density (kg/m3)	1930	Optimum Moisture Content (%)	13.5

Percentage Mod AASHTO	99.9	95.0	89.9
CBR @ 2.54mm	31	15	6
CBR @ 5.08mm	32	15	7
CBR@ 7.62mm	32	16	7
Average Moisture Content (%)	13.7		
Percentage Swell	0.37	0.48	0.65

Interpolated Results

Percentage Mod AASHTO	90	93	95	98	100
CBR	6	10	14	23	32



Signed by: Colin Dalton
Date: 2017.02.09 08:50:57 +02

Programed Data
Revision No 4 (1/5/2010)

ROCKLAB REPORT **CONFIDENTIAL**
2017-GCS-GEOTECHNICAL-01

Issued by:

ROCKLAB
(ROCK MECHANICS & EXCAVATION LABORATORIES)
230 ALBERTUS STREET
LA MONTAGNE 0184
PRETORIA
SOUTH AFRICA
TEL: +27 12 813 4910
E-MAIL: CHENJ@ROCKLAB.CO.ZA

RESULTS OF ROCK PROPERTIES TESTS

Sampling site: UIF Building

BY

DR J. F. CHEN

Submitted to:

GCS GEOTECHJHICAL ENGINEERING

24 FEBRUARY 2017

C O N T E N T S

TABLE 1 RESULTS OF UNIAXIAL COMPRESSIVE STRENGTH TESTS

ROCKLAB
DIVISION OF SOILLAB (PTY) LTD
Tel: 0027 12 813 4910
E-mail: Chenj@rocklab.co.za

Client: GCS Geotechnical Engineering

Sampling Site: UIF Building, Job no 16-1370

24-02-2017

SPECIMEN PARTICULARS					SPECIMEN DIMENSIONS					SPECIMEN TEST RESULTS			
Rocklab Specimen No. 6806-	BH No	Depth m	Depth m	Rock Description	Diameter mm	Height mm	Ratio of Height to Diameter	Mass g	Density g/cm³	Failure Load kN	Strength (UCS) MPa	Failure Code	Note
UCS-01	BH 1	13.70	13.93	Slightly weathered fine to coarse grained hard rock	51.99	138.1	2.7	809.56	2.76	206.2	97.1	4B	
UCS-02	BH 2	18.66	18.98	Slightly weathered fine-grained hard rock	51.97	134.8	2.6	815.65	2.85	347.1	163.6	2B	
UCS-03	BH 3	15.10	15.40	Slightly weathered fine to coarse-grained amygdaloidal hard rock	52.29	137.2	2.6	828.83	2.81	229.7	107.0	5B	
UCS-04	BH 4	11.90	12.23	Slightly weathered fine to coarse-grained hard rock	52.26	137.4	2.6	839.36	2.85	419.5	195.6	0B	
UCS-05	BH 5	10.20	10.46	Moderately weathered fine-grained Medium hard rock	52.09	136.6	2.6	846.35	2.91	86.0	40.4	5B	
UCS-06	BH 5	14.69	14.90	Sligthly weathered fine-grained hard rock	51.86	133.1	2.6	775.67	2.76	69.6	32.9	0B	
UCS-07	BH 6	10.22	10.52	Highly weathered fine-grained soft rock	52.08	138.6	2.7	821.30	2.78	84.7	39.8	3B	
UCS-08	BH 6	16.50	16.82	Slightly weathered fine-grained hard rock	52.00	137.0	2.6	818.36	2.81	88.0	41.4	0B	

Note: All tests were conducted according to the ISRM's (International Society for Rock Mechanics) specification.

APPENDIX 1

CLASSIFICATION OF ROCK SPECIMEN FAILURE MODE INFLUENCED / NOT INFLUENCED BY DISCONTINUITIES DURING COMPRESSION TESTING

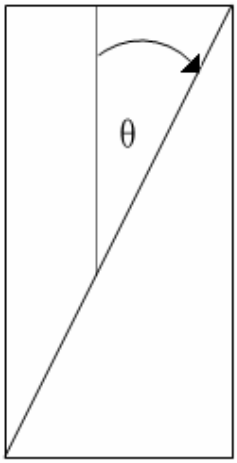
FAILURE NOT INFLUENCED BY DISCONTINUITIES (INTACT)

TYPE CODE	DESCRIPTION OF SUB CODES	
	A	B
X	SLIDING SHEAR FAILURE	COMPLETE CONE DEVELOPMENT
Y	SPLITTING	BREAKING INTO A LOT OF PIECES

FAILURE INFLUENCED BY DISCONTINUITIES

TYPE CODE	DESCRIPTION OF SUB CODES	
	A	B
	PARTIAL FAILURE ON DISCONTINUITY	FAILURE COMPLETELY ON DISCONTINUITY
1	AT 0-10° TO AXIS	AT 0-10° TO AXIS
2	AT 11-20° TO AXIS	AT 11-20° TO AXIS
3	AT 21-30° TO AXIS	AT 21-30° TO AXIS
4	AT 31-40° TO AXIS	AT 31-40° TO AXIS
5	AT 41-50° TO AXIS	AT 41-50° TO AXIS
6	AT 51-70° TO AXIS	AT 51-70° TO AXIS
7	AT 71-90° TO AXIS	AT 71-90° TO AXIS
0	Multiple Discontinuities	Multiple Discontinuities

Example: Failure Type3B: Failure completely on a discontinuity with an orientation of between 21° and 30° to the specimen axis.



Shearbox

Project:	16-1370 UIF Building
Client:	GCS
Geolab Job Nr:	G17-0042
Test Method:	ASTM 3080-72

Sample Nr:	BH 1
Sample Depth:	4.5-5.05m_SB
Date:	2017-03-07

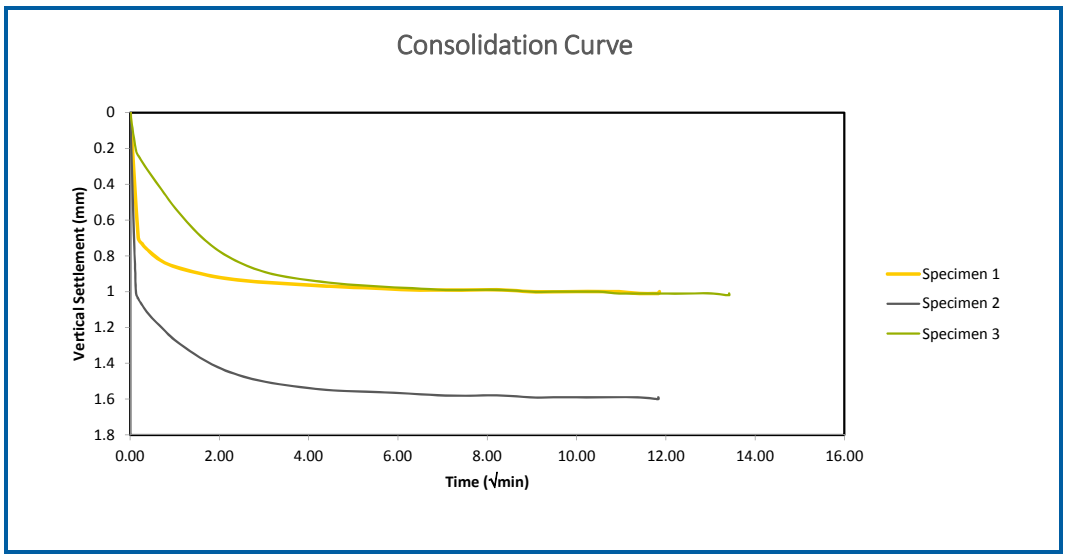
Results		
ϕ' =	**28.5**	**°**
c' =	**20.9**	**kPa**

Sampling Method:	Shelby Tube
Disturbed/Undist:	Undisturbed
Remoulded To:	-

Initial Sample Details	1	2	3	
Sample Height:	20	20	20	mm
Sample Diameter:	60	60	60	mm
Sample Mass	115.0	114.4	115.0	g
Dry Density:	1659.1	1650.4	1659.1	kg/m³
Density:	2033.6	2023.0	2033.6	kg/m³
Void Ratio:	0.557	0.565	0.557	
Moisture Content:	22.6	22.6	22.6	%
Specific Gravity		2.583		kg/m³

Shear Stage	1	2	3	
Rate of Shear:	0.003	0.003	0.003	mm/min
Normal Stress at Failure:	74.0	149.0	286.0	kPa
Max Shear Stress:	60.8	101.9	175.8	kPa
Strain at Failure:	4.1	4.7	7.1	%

Final Sample Details	1	2	3	
Moisture Content:	27.9	30.3	28.2	%



GEOLAB
Part of the SMEC Group

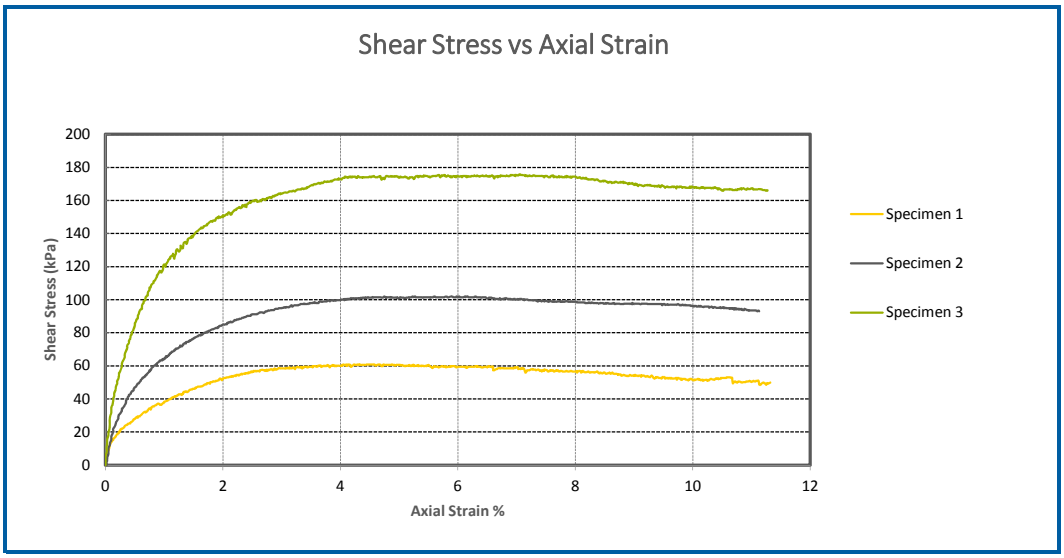
Geotechnical Laboratory
T +27 12 813 4936
E geolab@soillab.co.za
Geolab
www.soillab.co.za

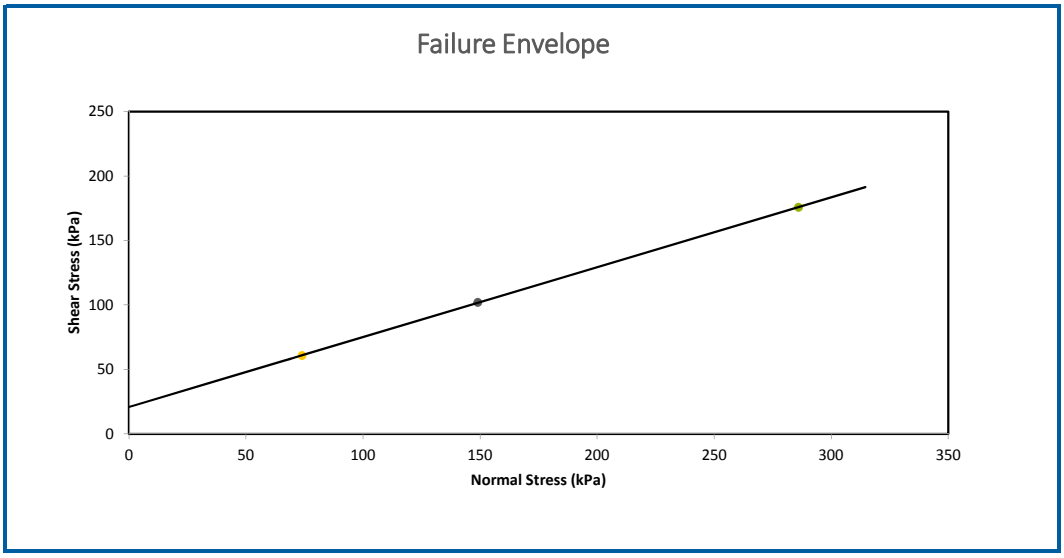
Shearbox

Project:	16-1370 UIF Building
Client:	GCS
Geolab Job Nr:	G17-0042
Test Method:	ASTM 3080-72

Sample Nr:	BH 1
Sample Depth:	4.5-5.05m_SB
Date:	2017-03-07

Results		
ϕ' =	**28.5**	**°**
c' =	**20.9**	**kPa**





GEOLAB
Part of the SMEC Group

Geotechnical Laboratory
T +27 12 813 4936
E geolab@soillab.co.za
Geolab
www.soillab.co.za

Shearbox

Project:	16-1370 UIF Building
Client:	GCS
Geolab Job Nr:	G17-0042
Test Method:	ASTM 3080-72

Sample Nr:	BH 2
Sample Depth:	3.0-3.55m_SB
Date:	2017-03-07

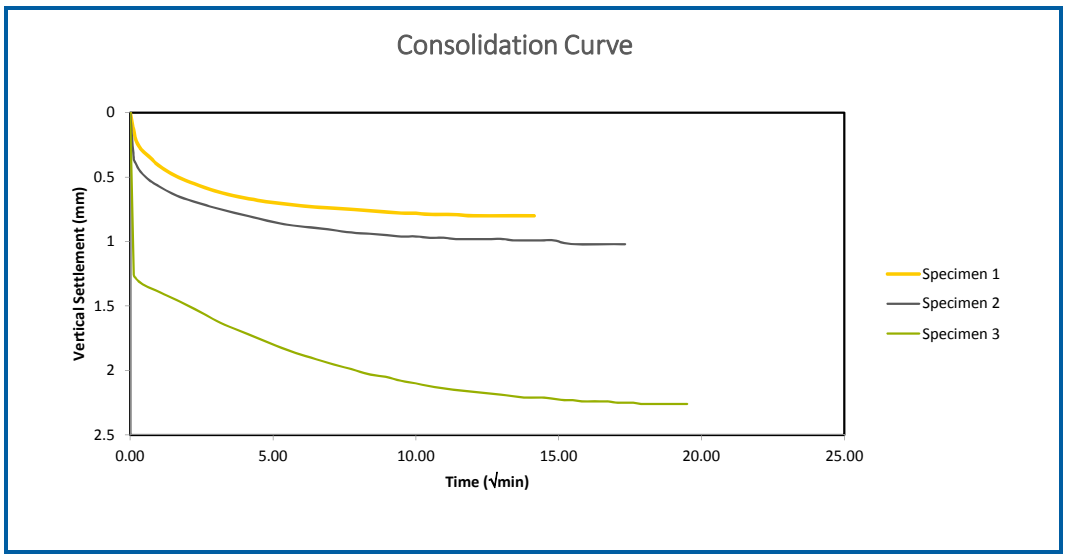
Results		
ϕ' =	**20.5**	**°**
c' =	**24.2**	**kPa**

Sampling Method:	Shelby Tube
Disturbed/Undist:	Undisturbed
Remoulded To:	-

Initial Sample Details	1	2	3	
Sample Height:	20	20	20	mm
Sample Diameter:	60	60	60	mm
Sample Mass	115.2	115.2	115.1	g
Dry Density:	1914.9	1914.9	1913.2	kg/m³
Density:	2037.2	2037.2	2035.4	kg/m³
Void Ratio:	0.330	0.330	0.331	
Moisture Content:	6.4	6.4	6.4	%
Specific Gravity		2.547		kg/m³

Shear Stage	1	2	3	
Rate of Shear:	0.001	0.001	0.001	mm/min
Normal Stress at Failure:	74.0	148.0	273.0	kPa
Max Shear Stress:	48.1	85.6	124.1	kPa
Strain at Failure:	2.2	2.5	2.8	%

Final Sample Details	1	2	3	
Moisture Content:	16.9	15.9	15.3	%



GEOLAB
Part of the SMEC Group

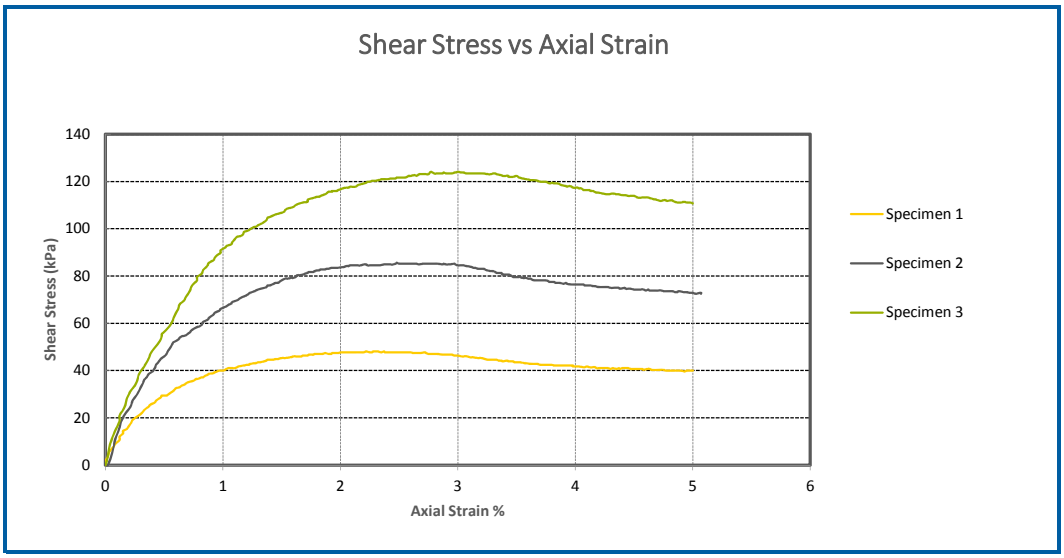
Geotechnical Laboratory
T +27 12 813 4936
E geolab@soillab.co.za
Geolab
www.soillab.co.za

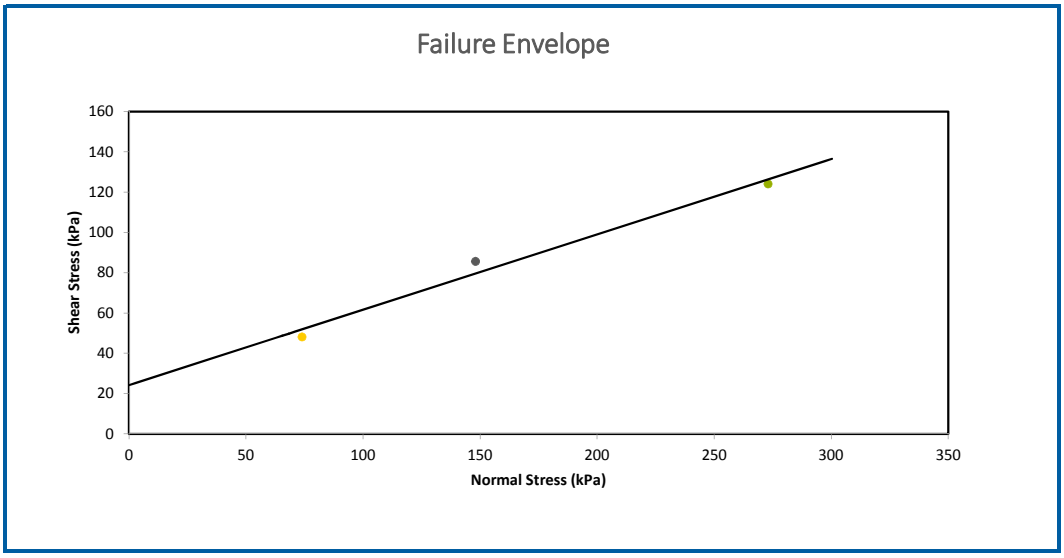
Shearbox

Project:	16-1370 UIF Building
Client:	GCS
Geolab Job Nr:	G17-0042
Test Method:	ASTM 3080-72

Sample Nr:	BH 2
Sample Depth:	3.0-3.55m_SB
Date:	2017-03-07

Results		
ϕ' =	**20.5**	**°**
c' =	**24.2**	**kPa**





GEOLAB
Part of the SMEC Group

Geotechnical Laboratory
T +27 12 813 4936
E geolab@soillab.co.za
Geolab
www.soillab.co.za

Shearbox

Project:	16-1370 UIF Building
Client:	GCS
Geolab Job Nr:	G17-0042
Test Method:	ASTM 3080-72

Sample Nr:	BH 4
Sample Depth:	1.5-1.79m_SB
Date:	2017-03-07

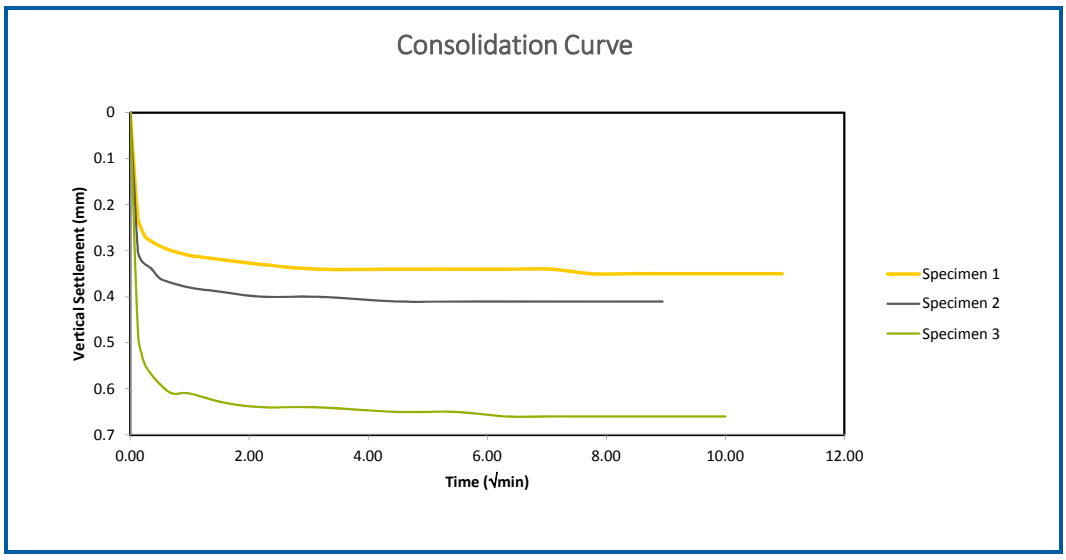
Results		
ϕ' =	**33.7**	**°**
c' =	**16.5**	**kPa**

Sampling Method:	Shelby Tube
Disturbed/Undist:	Undisturbed
Remoulded To:	-

Initial Sample Details	1	2	3	
Sample Height:	20	20	20	mm
Sample Diameter:	60	60	60	mm
Sample Mass	114.6	115.1	114.6	g
Dry Density:	1658.6	1665.8	1658.6	kg/m³
Density:	2026.6	2035.4	2026.6	kg/m³
Void Ratio:	0.654	0.646	0.654	
Moisture Content:	22.2	22.2	22.2	%
Specific Gravity		2.742		kg/m³

Shear Stage	1	2	3	
Rate of Shear:	0.003	0.003	0.003	mm/min
Normal Stress at Failure:	75.0	150.0	274.0	kPa
Max Shear Stress:	59.8	127.0	194.9	kPa
Strain at Failure:	5.0	3.2	6.3	%

Final Sample Details	1	2	3	
Moisture Content:	26.3	24.4	23.0	%



GEOLAB
Part of the SMEC Group

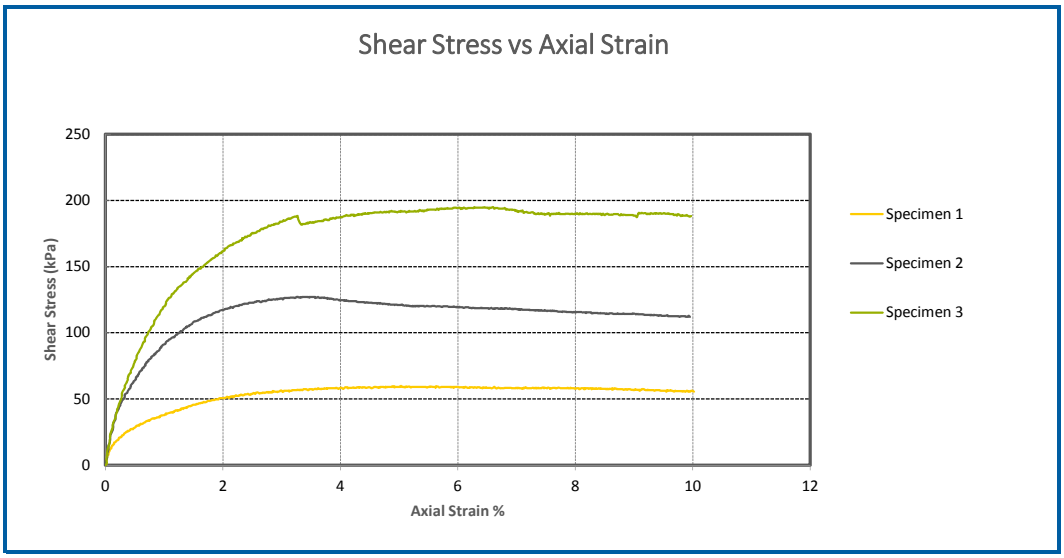
Geotechnical Laboratory
T +27 12 813 4936
E geolab@soillab.co.za
Geolab
www.soillab.co.za

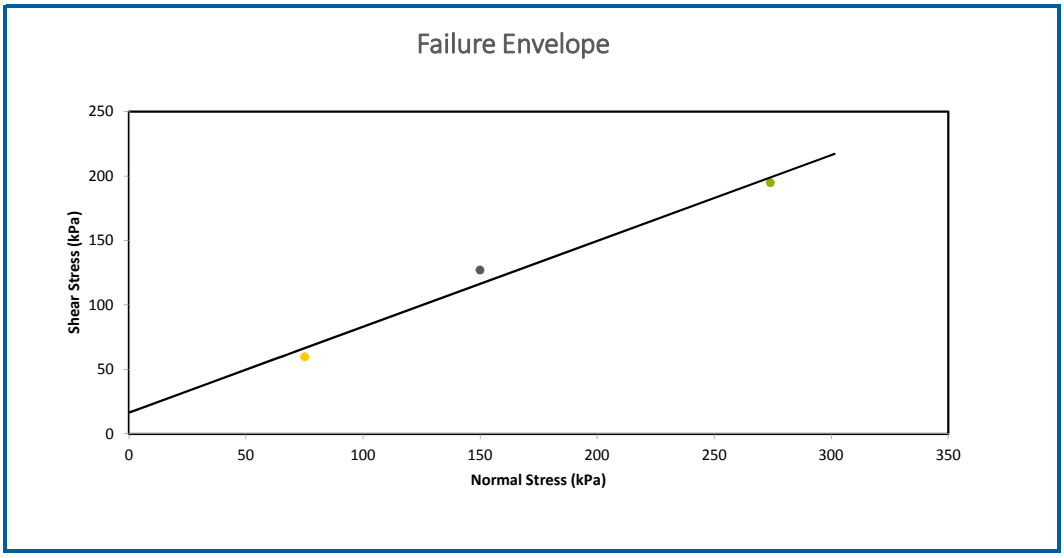
Shearbox

Project:	16-1370 UIF Building
Client:	GCS
Geolab Job Nr:	G17-0042
Test Method:	ASTM 3080-72

Sample Nr:	BH 4
Sample Depth:	1.5-1.79m_SB
Date:	2017-03-07

Results		
ϕ' =	**33.7**	**°**
c' =	**16.5**	**kPa**





Geotechnical Laboratory
T +27 12 813 4936
E geolab@soillab.co.za
Geolab
www.soillab.co.za

Shearbox

Project:	16-1370 UIF Building
Client:	GCS
Geolab Job Nr:	G17-0042
Test Method:	ASTM 3080-72

Sample Nr:	BH 5
Sample Depth:	3.0-3.36m_SB
Date:	2017-03-08

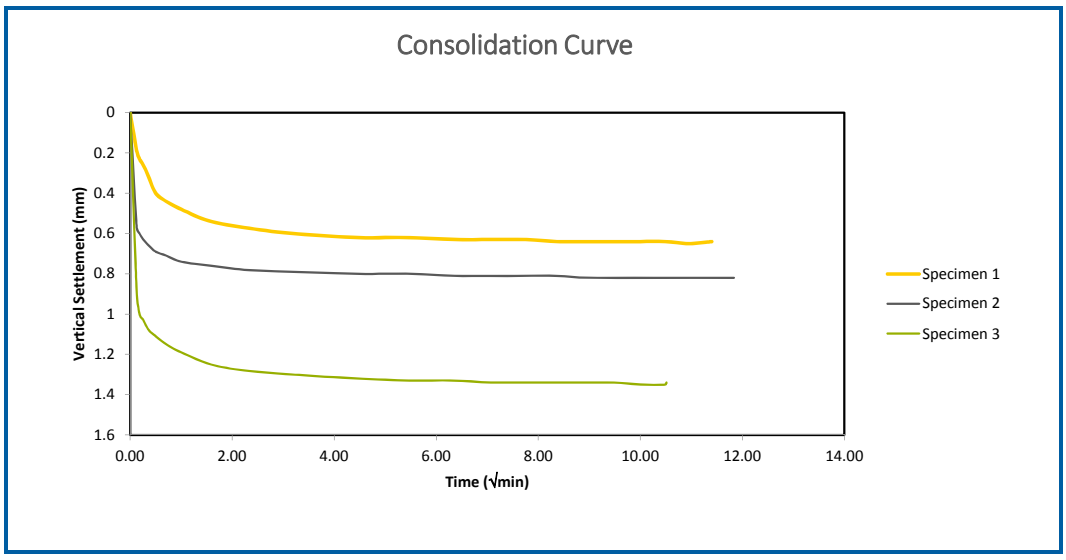
Results		
ϕ' =	**30.0**	**°**
c' =	**22.1**	**kPa**

Sampling Method:	Shelby Tube
Disturbed/Undist:	Undisturbed
Remoulded To:	-

Initial Sample Details	1	2	3	
Sample Height:	20	20	20	mm
Sample Diameter:	60	60	60	mm
Sample Mass	114.4	115.8	115.6	g
Dry Density:	1659.3	1679.6	1676.7	kg/m³
Density:	2023.0	2047.8	2044.3	kg/m³
Void Ratio:	0.642	0.622	0.625	
Moisture Content:	21.9	21.9	21.9	%
Specific Gravity		2.725		kg/m³

Shear Stage	1	2	3	
Rate of Shear:	0.003	0.003	0.003	mm/min
Normal Stress at Failure:	75.0	149.0	300.0	kPa
Max Shear Stress:	62.6	112.5	194.2	kPa
Strain at Failure:	4.9	4.1	3.6	%

Final Sample Details	1	2	3	
Moisture Content:	25.3	23.0	22.2	%



GEOLAB
Part of the SMEC Group

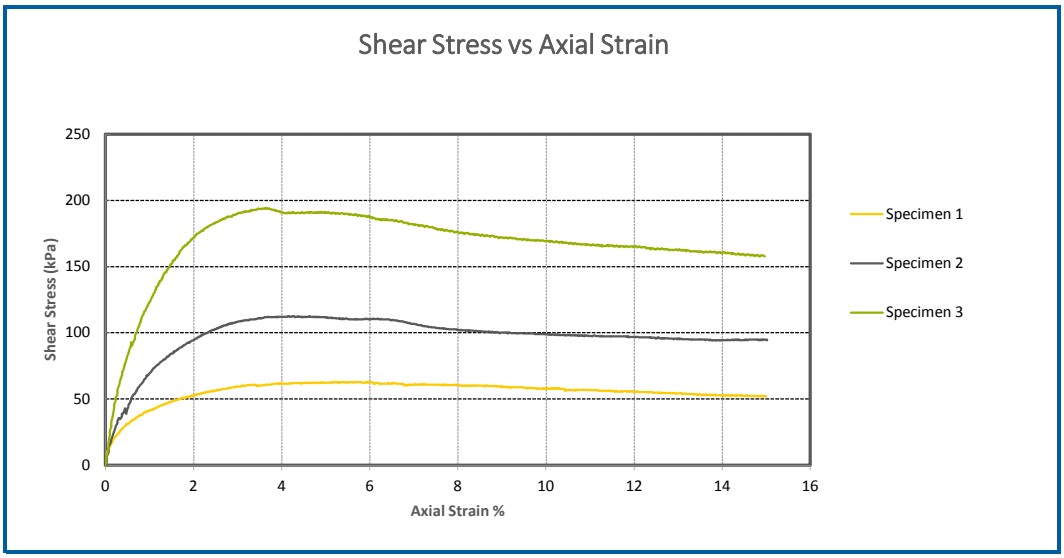
Geotechnical Laboratory
T +27 12 813 4936
E geolab@soillab.co.za
Geolab
www.soillab.co.za

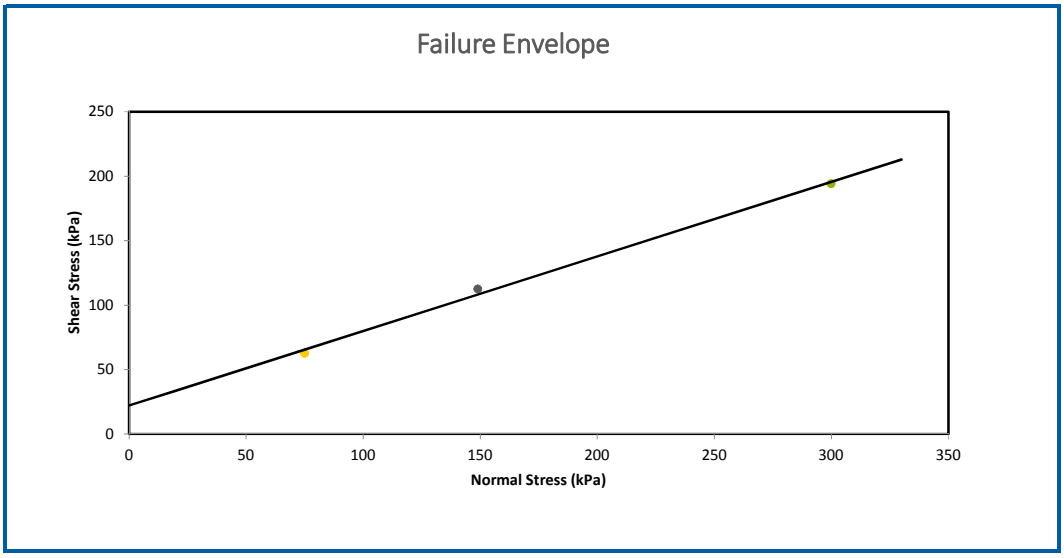
Shearbox

Project:	16-1370 UIF Building
Client:	GCS
Geolab Job Nr:	G17-0042
Test Method:	ASTM 3080-72

Sample Nr:	BH 5
Sample Depth:	3.0-3.36m_SB
Date:	2017-03-08

Results		
ϕ' =	**30.0**	**°**
c' =	**22.1**	**kPa**





Geotechnical Laboratory
T +27 12 813 4936
E geolab@soillab.co.za
Geolab
www.soillab.co.za

Shearbox

Project:	16-1370 UIF Building
Client:	GCS
Geolab Job Nr:	G17-0042
Test Method:	ASTM 3080-72

Sample Nr:	BH 6
Sample Depth:	1.5-2.05m_SB
Date:	2017-03-09

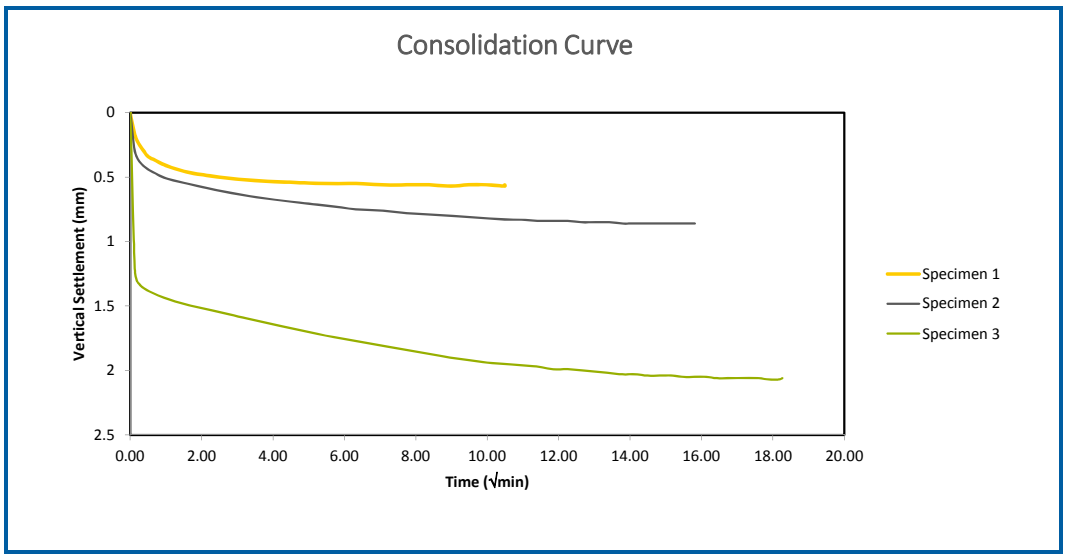
Results		
ϕ' =	**18.3**	**°**
c' =	**29.9**	**kPa**

Sampling Method:	Shelby Tube
Disturbed/Undist:	Undisturbed
Remoulded To:	-

Initial Sample Details	1	2	3	
Sample Height:	20	20	20	mm
Sample Diameter:	60	60	60	mm
Sample Mass	113.4	115.1	115.7	g
Dry Density:	1658.5	1683.3	1692.1	kg/m³
Density:	2005.4	2035.4	2046.0	kg/m³
Void Ratio:	0.611	0.587	0.579	
Moisture Content:	20.9	20.9	20.9	%
Specific Gravity		2.671		kg/m³

Shear Stage	1	2	3	
Rate of Shear:	0.001	0.001	0.001	mm/min
Normal Stress at Failure:	74.0	147.0	282.0	kPa
Max Shear Stress:	54.8	77.8	123.4	kPa
Strain at Failure:	4.1	2.3	3.1	%

Final Sample Details	1	2	3	
Moisture Content:	27.1	24.4	22.9	%



GEOLAB
Part of the SMEC Group

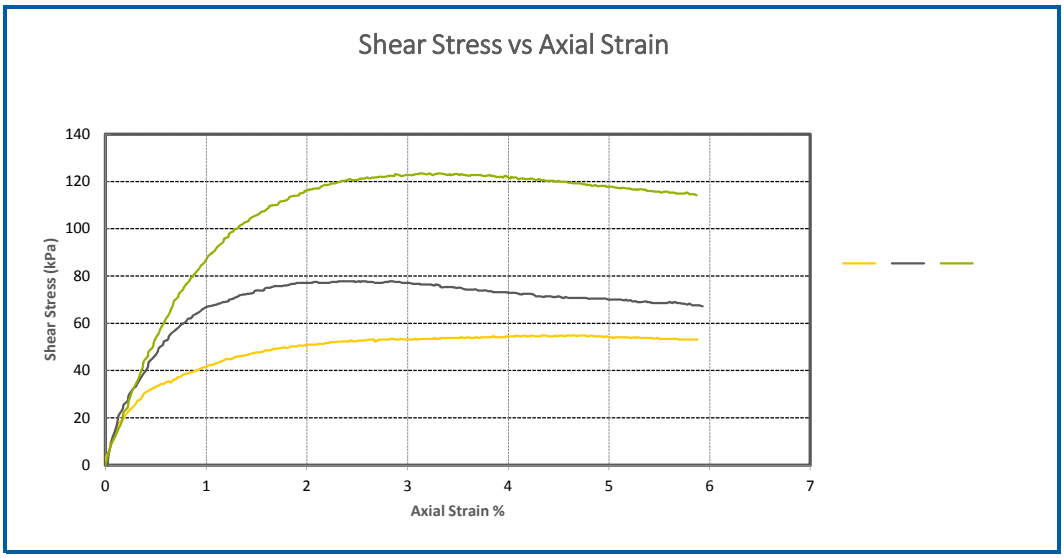
Geotechnical Laboratory
T +27 12 813 4936
E geolab@soillab.co.za
Geolab
www.soillab.co.za

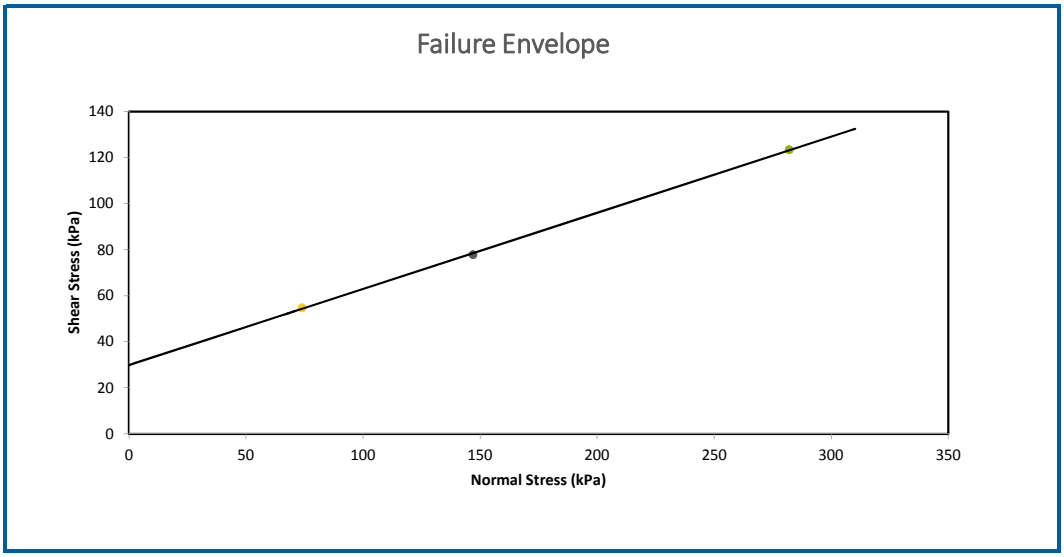
Shearbox

Project:	16-1370 UIF Building
Client:	GCS
Geolab Job Nr:	G17-0042
Test Method:	ASTM 3080-72

Sample Nr:	BH 6
Sample Depth:	1.5-2.05m_SB
Date:	2017-03-09

Results		
ϕ' =	**18.3**	**°**
c' =	**29.9**	**kPa**





Part of the SMEC Group

Geotechnical Laboratory
T +27 12 813 4936
E geolab@soillab.co.za
Geolab
www.soillab.co.za

Shearbox

Project:	16-1370 UIF Building
Client:	GCS
Geolab Job Nr:	G17-0042
Test Method:	ASTM 3080-72

Sample Nr:	BH 6
Sample Depth:	3.0-3.4m_SB
Date:	2017-03-09

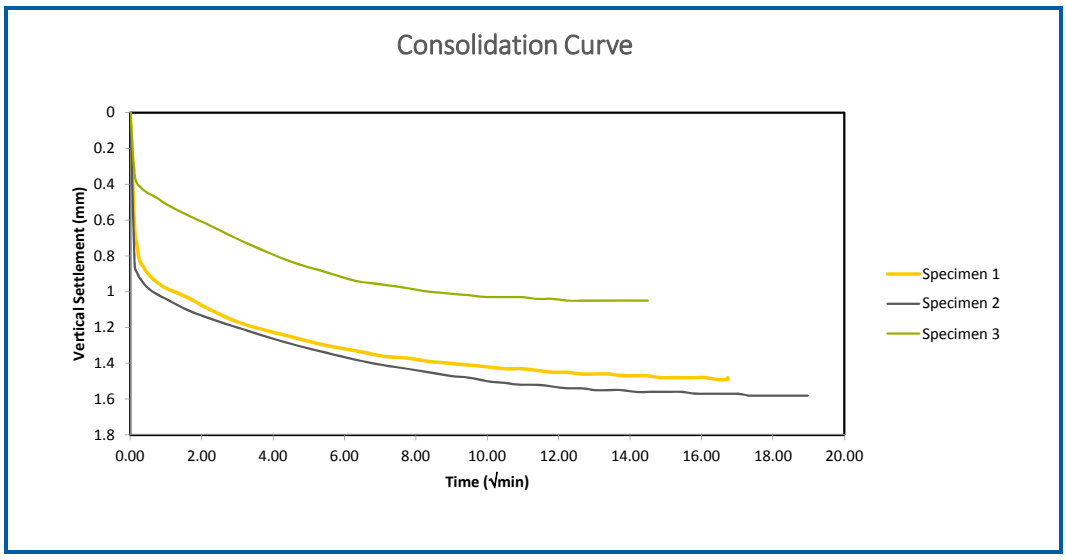
Results		
ϕ' =	**26.2**	**°**
c' =	**1.5**	**kPa**

Sampling Method:	Shelby Tube
Disturbed/Undist:	Undisturbed
Remoulded To:	-

Initial Sample Details	1	2	3	
Sample Height:	20	20	20	mm
Sample Diameter:	60	60	60	mm
Sample Mass	109.1	115.5	115.3	g
Dry Density:	1462.6	1548.4	1545.7	kg/m³
Density:	1929.3	2042.5	2039.0	kg/m³
Void Ratio:	0.738	0.642	0.645	
Moisture Content:	31.9	31.9	31.9	%
Specific Gravity		2.542		kg/m³

Shear Stage	1	2	3	
Rate of Shear:	0.001	0.001	0.001	mm/min
Normal Stress at Failure:	75.0	150.0	275.0	kPa
Max Shear Stress:	37.5	76.7	136.2	kPa
Strain at Failure:	3.7	2.5	2.7	%

Final Sample Details	1	2	3	
Moisture Content:	28.6	24.6	23.9	%



GEOLAB
Part of the SMEC Group

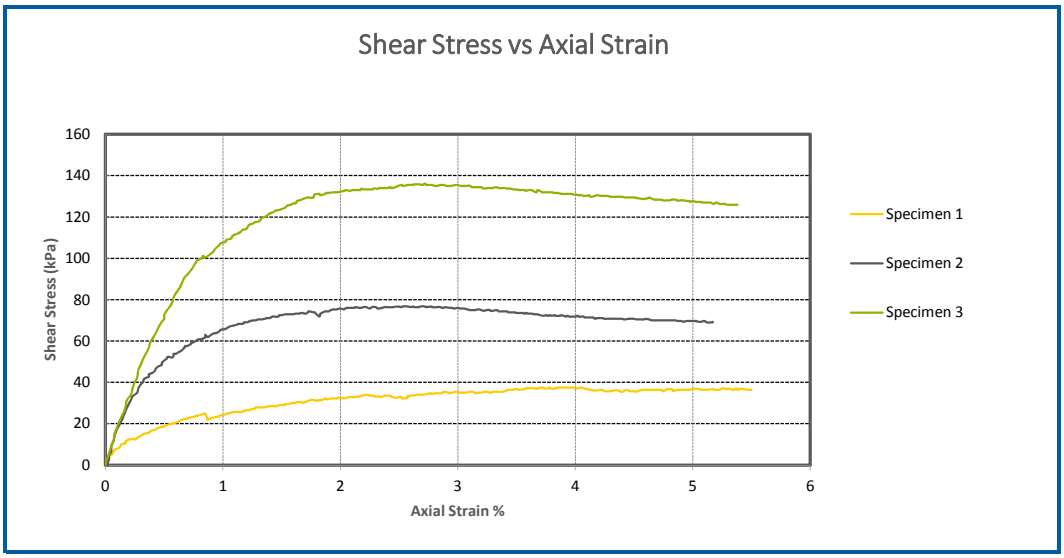
Geotechnical Laboratory
T +27 12 813 4936
E geolab@soillab.co.za
Geolab
www.soillab.co.za

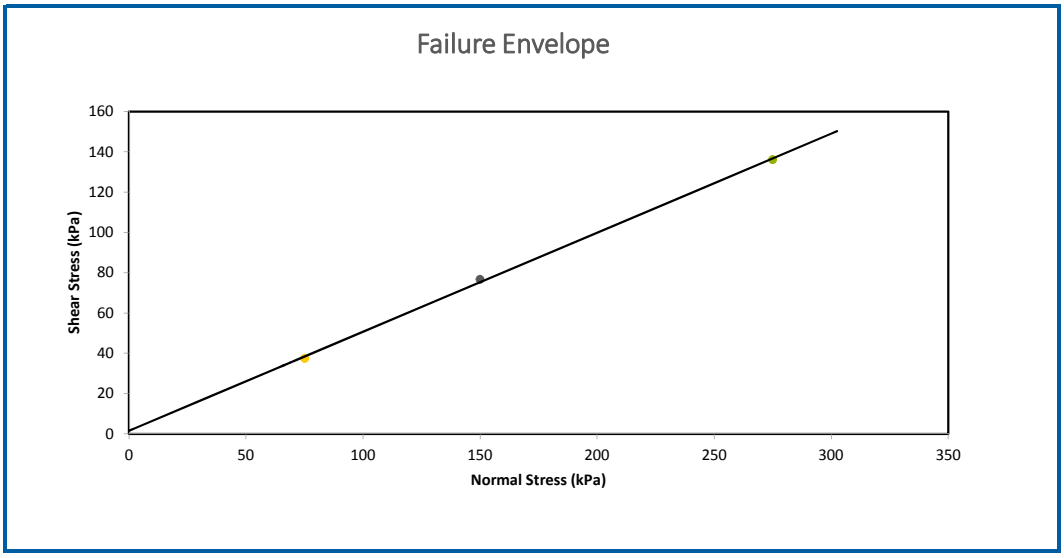
Shearbox

Project:	16-1370 UIF Building
Client:	GCS
Geolab Job Nr:	G17-0042
Test Method:	ASTM 3080-72

Sample Nr:	BH 6
Sample Depth:	3.0-3.4m_SB
Date:	2017-03-09

Results		
ϕ' =	**26.2**	**°**
c' =	**1.5**	**kPa**





GEOLAB
Part of the SMEC Group

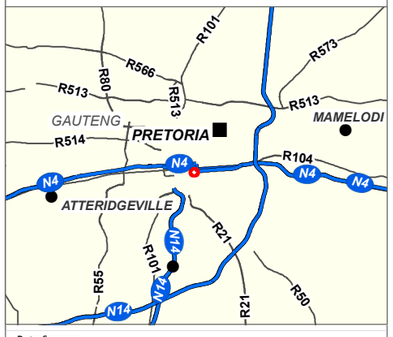
Geotechnical Laboratory
T +27 12 813 4936
E geolab@soillab.co.za
Geolab
www.soillab.co.za

Figure 1
Site Plan

UIF NEW HEAD OFFICE DEVELOPMENT - SITE PLAN

LEGEND

- Test Pits
- Boreholes



Data Sources:
Google Earth™ mapping service: 2017
Imagery Date: 31/12/2009

0 10 20 40 Meters

SCALE: 1:800

FIGURE NO.:	-	MAP NUMBER:	16-1370-01-V2
DRAWN BY:	JF VERMEULEN GIS TECHNICIAN	REVIEWED BY:	W KRETZINGER ENGINEERING GEOLOGIST
DATUM: PROJECTION:	WGS84 GEOGRAPHIC	DATE:	02 MARCH 2017
PROJECT: CLIENT:	UIF NEW HEAD OFFICE DEVELOPMENT GEOMECH AFRICA		

GCS Water & Environmental Consultants
63 Wessel Road Woodmead
PO Box 2597 Rivonia 2128
South Africa

Tel: +27 (0) 11 803 5726
Fax: +27 (0) 11 803 5745
E-mail: jhb@gcs-sa.biz
www.gcs-sa.biz

Figure 2
Geological Plan

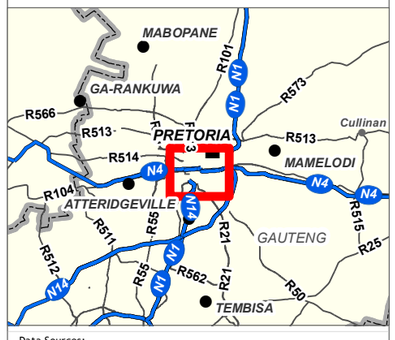
UIF NEW HEAD OFFICE DEVELOPMENT - GEOLOGY

LEGEND

- Site Location
- Indifferentiated linear structure; diabase (di), dolerite (do), syenite dyke (s)
- Fault

LITHOLOGY:

- ~ Alluvium
- di Diabase (from Vaalian to post - Mogolian age)
- Vdq Quartzite (Daspoort)
- Vha Volcanic rocks (Sedimentary Column); Andesite, agglomerate in places (Igneous Column)
- Vmd Dolomite; chert ( )
- Vt Shale, siltstone, conglomerate in places; quartzite ( )
- S Syenite
- Vsi Shale, carbonaceous in places, hornfels, chert
- Vst Shale in places ferruginous



Data Sources:
Council for Geoscience
1:250 000 Geological Series: 2528

0 0.5 1 2 Kilometers

SCALE: 1:40 000

FIGURE NO.:	-	MAP NUMBER:	16-1370-02
DRAWN BY:	JF VERMEULEN GIS TECHNICIAN	REVIEWED BY:	W KRETZINGER ENGINEERING GEOLOGIST
DATUM: PROJECTION:	WGS84 GEOGRAPHIC	DATE:	03 FEBRUARY 2016
PROJECT:	UIF NEW HEAD OFFICE DEVELOPMENT		
CLIENT:	GEOMECH AFRICA		

GCS Water & Environmental Consultants
63 Wessel Road Woodmead
PO Box 2597 Rivonia 2128
South Africa
Tel: +27 (0) 11 803 5726
Fax: +27 (0) 11 803 5745
E-mail: jhb@gcs-sa.biz
www.gcs-sa.biz

HYDROGEOLOGICAL STUDY

20 Years of Water & Environmental Science

HYDROGEOLOGICAL INVESTIGATION

FOR

SUNNYSIDE LABOUR CAMPUS PLANNED DEVELOPMENT

GPT Reference Number: SJSNS-18-3597
Client Reference Number: GPT-Q-4362
Version: Final
Date: September 2018

Compiled for:

SEATON THOMSON AND ASSOCIATES

Geo Pollution Technologies - Gauteng (Pty) Ltd
81 Rauch Avenue
Georgeville
0184

P.O. Box 38384
Garsfontein East
0060

Tel: *+27 (0)12 804 8120*
Fax: *+27 (0)12 804 8140*

GEO Pollution Technologies

Report Type:	Hydrogeological Study Report for Water Use License Application
Project Title:	Hydrogeological Study for Sunnyside
Compiled For:	Seaton Thomson and Associates
Compiled By:	S. C. Nkosi, M.Sc., Cand.Sci.Nat.
Reviewed By:	M. Burger; M.Sc., Pr.Sci.Nat.
GPT Reference:	SJSNS-18-3593
Version:	Final
Date:	September 2018
Distribution List (Current Version):	Seaton Thomson and Associates
	Mr. B. Gardner (e-copy)

Disclaimer:

The results and conclusions of this report are limited to the Scope of Work agreed between GPT and the Client for whom this investigation has been conducted. All assumptions made, and all information contained within this report and its attachments depend on the accessibility to and reliability of relevant information, including maps, previous reports and word-of-mouth, from the Client and Contractors. All work conducted by GPT is done in accordance with the GPT Standard Operating Procedures. GPT is an ISO 9001 accredited Company.

Declaration:

I hereby declare:

1. I have no vested interest (present or prospective) in the project that is the subject of this report as well as its attachments. I have no personal interest with respect to the parties involved in this project.
2. I have no bias with regard to this project or towards the various stakeholders involved in this project.
3. I have not received, nor have I been offered, any significant form of inappropriate reward for compiling this report.

(*electronic signature*)
S. C. Nkosi, MSc, Cand.Sci.Nat.
Candidate Natural Scientist (No. 100105/13)
Geo Pollution Technologies – Gauteng (Pty) Ltd
This report was reviewed by:

(electronic signature)
M. Burger; M.Sc., Pr.Sci.Nat
Professional Natural Scientist (No 400296/12)
Geo Pollution Technologies – Gauteng (Pty) Ltd

Customer Satisfaction:

Feedback regarding the technical quality of this report (i.e. methodology used, results discussed and recommendations made), as well as other aspects, such as timeous completion of project and value of services rendered, can be posted onto GPT's website at address: http://www.gptglobal.com/feedback.htm.

EXECUTIVE SUMMARY

Geo Pollution Technologies (Pty) Ltd (GPT) was appointed by Seaton Thomson and Associates (Seaton) to conduct a hydrogeological investigation for the proposed development in the Sunnyside Labour Campus located on Property of Sunnyside in Pretoria. The proposed development entails the construction of a building with a basement below the expected groundwater depth.

The following scope of work was addressed by the study:

- Quantify the current groundwater status quo.
- Description of the unconfined aquifer (Water table aquifer)
- Impacts of dewatering on the flow regime as well as estimation of groundwater seepage rates.
- Aquifer classification and vulnerability assessment.

The following was concluded from the actions performed to address the scope of work:

Site Location and Site Information

The area is characterised by a flat topography and in the area of the site the slope is more or less in the order of 1:100 (0.01).

Locally, surface drainage is towards the Apies River that flows from south to north eventually flowing into the Pienaars River, a tributary of the Crocodile River. The proposed area is located with the Limpopo Water Management Area in quaternary catchment, A23D, characterised by urban development near the central business district of the City of Tshwane. The Apies River is sustained by springs and baseflow from dolomitic springs at the Pretoria Fountains. The Apies River is canalised for the majority of its course in urban areas and integrated with the stormwater drainage in the city.

The proposed site of development is located in the summer rainfall region of Southern Africa with precipitation usually occurring in the form of convectional thunderstorms. The average annual rainfall (measured over a period of 76 years) is approximately 573 mm, with the high rainfall months between November and March.

Geological and Hydrogeological Setting

The proposed site of development is underlain by Hekpoort Formation rocks which comprise of andesitic lavas which commonly weather/decompose into clayey material with zones of weathering extending between 10 and 30 m. Excavation and bore drilling exposed andesite rock with a zone of weathering of up to 10.5 m. The degrees of weathering and fracturing decrease with depth. Amygdoidal basalt was found to underlie the andesitic bedrock at some places below the zone of weathering and are thought to be competent bedrock.

Hekpoort Formation Lavas rocks typically act as secondary aquifers (intergranular and fractured rock aquifers). However, the multi-layered weathering system present on these rocks could prove to have up to two aquifer systems present in the form of a shallow, weathered aquifer with a weathered, intergranular soft rock base associated with the contact of fresh bedrock and the weathering zone; and a fractured bedrock aquifer. The aquifers commonly weather/decompose into clayey material with zones of weathering extending between 10 and 30 m. Groundwater development in this formation of the Pretoria Group (Transvaal Supergroup) are associated with fractured zone (faults, fractures, contact zones, and joints) below the zone of weathering. Borehole yield commonly ranges

between 2 and 2.5 l/s, depending on recharge potential controlled by the permeability of the vadose zone. Static water levels typically lie between 5 and 30 mbgl. Water is generally of acceptable quality with mean pH and EC values of 7.5 and 52 mS/m, respectively.

The commonly expected values of porosity and permeability for igneous rock types, similar to those present in the Hekpoort Formation Lavas, are 0.05 (porosity) and 10^{-5} $m.d^{-1}$ (hydraulic conductivity, K) respectively. The maximum K value given to Hekpoort Formation andesitic lavas is 0.032 $m.d^{-1}$.

Results of the Investigation

A hydrocensus survey was carried out on the 12 September 2018 in order to locate and identify water resources and water users on the property under investigation and the immediate surroundings of the area. The following features, all of which were sampled, were identified:

- An excavation situated ± 100 southwest of the proposed development (Trevenna site)
- The Walkerspruit, a tributary of the Apies River, upstream of the Sunnyside site;
- The Apies River upstream and downstream of the site.

The groundwater level measurements recorded during the geotechnical survey were consulted. Water levels in three piezometers ranged between a minimum of 2.25 m and a maximum of 8.5 m below ground level. The average depth to water level was found to be 4.9 m.

The direction of groundwater flow is northerly and north-westerly, towards the Walkerspruit and Apies River (naturally).

Water Quality Assessment

The analytical results are compared with the maximum recommended concentrations for domestic use as defined by the SANS 241-1: 2015 or the general authorisation wastewater limits applicable to wastewater discharge to the water resource. The following observations were made:

- None of the constituents analysed for exceed the SANS standards.
- None of the constituents analysed for exceed the wastewater limits applicable to wastewater discharge to the water resource

The samples were also analysed for hydrocarbon compounds. The following observations were made:

- No concentrations of the targeted hydrocarbon compounds analysed for were detected in the excavation sample and the Apies River upstream of the site.
- Unidentified hydrocarbon compounds were detected in the Walkerspruit and Apies River downstream of the site. The source of which is unknown.

Aquifer Classification and Vulnerability Assessment

The GDT calculated a vulnerability value of 54% for the aquifer which is classified as medium. Based on information collected during the hydrocensus it can be concluded that the aquifer system in the study area can be classified as a "Minor Aquifer System". A Groundwater Quality Management Index of 4 was estimated for the study area from the ratings for the Aquifer System Management Classification. According to this estimate a medium-level groundwater protection is required for the aquifer.

Groundwater Seepage Rate

There was limited information in terms of groundwater for the development, however detailed work has been done at the Trevenna site situated ± 100 southwest of the proposed Sunnyside development. Estimating groundwater into the Trevenna excavation for the building foundation during construction took into consideration hydrogeological and hydraulic parameters, the size of the excavation, and the duration of dewatering for construction purposes. The method used to estimate groundwater inflow into the excavation was Darcy's Law (Q= KiA).

The volume of groundwater inflow was estimated for the range of hydraulic conductivities given as the average (0.01 md^{-1}) and the maximum (0.032 md^{-1}) K-values for Hekpoort Formation andesite. The estimated groundwater inflow into the current extent of the excavation at Trevenna are:

- Based on average K-value :16 m^3d^{-1};
- Based on maximum K-value: 54 m^3d^{-1}.

During construction groundwater inflow will have to be dewatered at a rate more than inflow. This will trigger the following water uses 21 (j):

"*Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people*."

However, as the water qualities and dewatering volumes are not expected to exceed the following general authorisations[1], the water can be abstracted and discharged into the Apies River:

1. *may remove up to 100 cubic meters of water on any given day, if the removing of water -*

    a. the water does not impact on the water resource or any other persons water use, property or land;

    b. is not detrimental to the health and safety of the public in the vicinity of the activity; and

    c. does not detrimentally impact on the stability or health of the surrounding ecological functioning of the hydrologically linked water resources

    d. the removal of water is not harmful or potentially harmful to human health, or to any water resource.

Lowering of Groundwater Levels

The aim of dewatering is to lower the water table around the excavation so as to form a cone of depression around the excavation. In this way the activity will lead to lowering of the water table. However, due to a high demand for water supply, the main water supply for the population of Pretoria is derived from surface water sources. No groundwater users were identified within the immediate area surrounding the proposed site of development.

Impacts on Water Quality

[1] Revision of general authorisations in terms of section 39 of the National Water Act, 1998 (ACT 36 of 1998), No, 665. September 2013

Water inflows removed from construction areas will be pumped into the municipal stormwater drainage system which is eventually released into the Apies River downstream. Dewatering at the site of planned development is not expected to impact on water quality of the immediate catchment area negatively. It is expected that the current status quo will be maintained in the receiving streams and rivers. The current water quality on site is of acceptable quality (drinking water quality).

Management Options

The following management options are suggested:

- Ensure that the appropriate design facilities (berms, storm water channels etc.) are constructed to ensure clean and dirty water are separated at the site of development.
- Water removed from underground may be disposed of into Apies River and its tributaries, provided that it has not been in contact with waste or waste water. The water quality of the water removed due to construction related activities must be monitored on a monthly basis, to ensure that the quality of water leaving the site is of acceptable quality.
- The monitoring results must be interpreted monthly by a qualified hydrogeologist and the monitoring network should be audited annually to ensure efficiency.
- Clean and dirty water systems should be separated to prevent cross-contamination.

Recommendations

Based on the findings of the study and the nature of the proposed activity, the following recommendations are made:

- Before construction, the water in the pit should be pumped out are rate less than 100 m^3/day, with daily volume measurements.
- During construction any additional seepage should be continually pumped out. As it is permissible to discharge into the Apies River, with weekly quality monitoring of the following parameters:
    - pH
    - Electrical conductivity
    - Faecal coliforms
- Monthly quality monitoring of the following parameters:
    - pH
    - Electrical conductivity
    - Faecal coliforms
    - Ammonia as Nitrogen
    - Nitrate as Nitrogen
    - Chlorine as free chlorine
    - Suspended solids
    - Ortho -phosphate
    - Fluoride
    - Soap, oil and grease
    - Dissolved Arsenic

  - Dissolved Cadmium
  - Dissolved Chromium
  - Dissolved Copper
  - Dissolved Cyanide
  - Dissolved Iron
  - Dissolved Lead
  - Dissolved Manganese
  - Mercury and its compounds
  - Dissolved Selenium
  - Dissolved Zinc
  - Boron
- If the groundwater cannot be used in the building it is recommended that the basement be waterproofed to block groundwater influx or discharged to the stormwater system. The discharge will then have to adhere to the monitoring requirements outlined above.

TABLE OF CONTENTS

LIST OF FIGURES

Page

LIST OF TABLES

Page

LIST OF APPENDICES

LIST OF ABBREVIATIONS

Abbreviation	Explanation
ARD	Acid Rock Drainage
BPG	Best Practice Guidelines
CMS	Catchment Management Strategy
CSM	Conceptual Site Model
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
IWRMP	Integrated Water Resources Management Plan
IWRM	Integrated Water Resources Management
Km^2	Square Kilometre
L/s	Litres per second
mamsl	Metres above mean sea level
Ml/d	Megalitres per day
m	meter
mm	Millimetre
mm/a	Millimetres per annum
mS/m	Millisiemens per metre
m^3	Cubic metre
MAP	Mean Annual Precipitation
MPRDA	Mining and Petroleum Resources Development Act (Act No. 73 of 2002) 1989)
NEMA	National Environmental Management Act (Act No. 107 of 1998)
NWA	National Water Act (Act No. 36 of 1998)
ppm	Parts per million
RDM	Resource Directed Measures
RQO	Resource Quality Objective
RWQO	Resource Water Quality Objective
TDS	Total Dissolved Solids
WMA	Water Management Area
WMP	Water Management Plan

DEFINITIONS

Definition	Explanation
Aquiclude	A geologic formation, group of formations, or part of formation through which virtually no water moves
Aquifer	A geological formation which has structures or textures that hold water or permit appreciable water movement through them. Source: National Water Act (Act No. 36 of 1998).
Borehole	Includes a well, excavation, or any other artificially constructed or improved underground cavity which can be used for the purpose of intercepting, collecting or storing water in or removing water from an aquifer; observing and collecting data and information on water in an aquifer; or recharging an aquifer. Source: National Water Act (Act No. 36 of 1998).
Boundary	An aquifer-system boundary represented by a rock mass (e.g. an intruding Igneous dyke) that is not a source of water and resulting in the formation of compartments in aquifers.
Cone of Depression	The depression of hydraulic head around a pumping borehole caused by the withdrawal of water.
Confining Layer	A body of material of low hydraulic conductivity that is stratigraphically adjacent to one or more aquifers; it may lie above or below the aquifer.
Dolomite Aquifer	See “Karst” Aquifer
Drawdown	The distance between the static water level and the surface of the cone of depression.
Fractured Aquifer	An aquifer that owes its water-bearing properties to fracturing.
Groundwater	Water found in the subsurface in the saturated zone below the water table.
Groundwater Divide or Groundwater Watershed	The boundary between two groundwater basins which is represented by a high point in the water table or piezometric surface.
Groundwater Flow	The movement of water through openings in sediment and rock; occurs in the zone of saturation in the direction of the hydraulic gradient.
Hydraulic Conductivity	Measure of the ease with which water will pass through the earth's material; defined as the rate of flow through a cross-section of one square metre under a unit hydraulic gradient at right angles to the direction of flow (m/d).
Hydraulic Gradient	The rate of change in the total hydraulic head per unit distance of flow in a given direction.
Infiltration	The downward movement of water from the atmosphere into the ground.
Intergranular Aquifer	A term used in the South African map series referring to aquifers in which groundwater flows in openings and void spaces between grains and weathered rock.
Karst (Karstic)	The type of geomorphological terrain underlain by carbonate rocks where significant solution of the rock has occurred due to flowing groundwater.

Definition	Explanation
Karst (Karstic) Aquifer	A body of soluble rock that conducts water principally via enhanced (conduit or tertiary) porosity formed by the dissolution of the rock. The aquifers are commonly structured as a branching network of tributary conduits, which connect together to drain a groundwater basin and discharge to a perennial spring.
Monitoring	The regular or routine collection of groundwater data (e.g. water levels, water quality and water use) to provide a record of the aquifer response over time.
Observation Borehole	A borehole used to measure the response of the groundwater system to an aquifer test.
Phreatic Surface	The surface at which the water level is in contact with the atmosphere: the water table.
Piezometric Surface	An imaginary or hypothetical surface of the piezometric pressure or hydraulic head throughout all or part of a confined or semi-confined aquifer; analogous to the water table of an unconfined aquifer.
Porosity	Porosity is the ratio of the volume of void space to the total volume of the rock or earth material.
Production Borehole	A borehole specifically designed to be pumped as a source of water supply.
Recharge	The addition of water to the saturated zone, either by the downward percolation of precipitation or surface water and/or the lateral migration of groundwater from adjacent aquifers.
Recharge Borehole	A borehole specifically designed so that water can be pumped into an aquifer in order to recharge the ground-water reservoir.
Saturated Zone	The subsurface zone below the water table where interstices are filled with water under pressure greater than that of the atmosphere.
Specific Capacity	The rate of discharge from a borehole per unit of drawdown, usually expressed as m3/d•m.
Specific Yield	The ratio of the volume of water that drains by gravity to that of the total volume of the saturated porous medium.
Storativity	The volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head.
Transmissivity	Transmissivity is the rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient. It is expressed as the product of the average hydraulic conductivity and thickness of the saturated portion of an aquifer.
Unsaturated Zone (Also Termed Vadose Zone)	That part of the geological stratum above the water table where interstices and voids contain a combination of air and water.
Watershed (Also Termed Catchment)	Catchment in relation to watercourse or watercourses or part of a watercourse means the area from which any rainfall will drain into the watercourses or part of a watercourse through surface flow to a common point or points. Source: National Water Act (Act No. 36 of 1998).
Water Table	The upper surface of the saturated zone of an unconfined aquifer at which pore pressure is equal to that of the atmosphere.

HYDROGEOLOGICAL INVESTIGATION

PROPOSED SUNNYSIDE LABOUR CAMPUS DEVELOPMENT

1 INTRODUCTION

Geo Pollution Technologies (Pty) Ltd (GPT) was appointed by Seaton Thomson and Associates (Seaton) to conduct a hydrogeological investigation for the proposed development in the Sunnyside Labour Campus located on Property in Sunnyside, Pretoria. The proposed development entails the construction of an office campus for the Public Investment Corporation with a 5-storey basement of up to 15 m in depth.

The investigation was conducted within the framework of the National Water Act (Act 36 of 1998). The study was undertaken in support of a general authorisation application for removing and discharging of water found underground for the safe and efficient construction of building foundations (section 4)[2]. The activity is covered under section 21 (j) of the National Water Act. A general authorisation replaces the need to apply for a water use licence provided that the water use is within the limits and conditions as prescribed in the general authorisation, as follows:

- Water removed from underground may not exceed 100 m^3/day, and may be discharged into a water resource, disposed of or re-used in accordance with the relevant sections of the general authorisation. It is understood that water removed from excavations will be discharged into a water resource
- Removing and discharging the water does not negatively impact water resource quality and quantity; public health and safety; and the ecological functioning of any hydrologically linked water resources.

The proposed site of development at Sunnyside is located about 100 m from the site at Trevenna with an existing excavation. The two sites are located within the same catchment area on the same geological formation, it is thus inferred that data collected at Trevenna is applicable to the Sunnyside site as well.

2 GEOGRAPHICAL SETTING

2.1 Site Location, Topography and Drainage

The proposed site of development is located in Sunnyside in the central business district (CBD) of Pretoria in the Tshwane Metropolitan Area in the Gauteng Province (Figure 1).

The topography (shown in Figure 2) can normally be used as a good first approximation of the hydraulic gradient in the unconfined aquifer (water table aquifer). This discussion will focus on the slope and direction of fall of the area under investigation, features that are important from a groundwater point of view.

The area is characterised by a flat topography and in the area of the site the slope is more or less in the order of 1:100 (0.01).

Locally, surface drainage is towards the Apies River that flows from south to north eventually flowing into the Pienaars River, a tributary of the Crocodile River. The proposed area is located with the

2

Limpopo Water Management Area in quaternary catchment, A23D, characterised by urban development near the central business district of the City of Tshwane. The Apies River is sustained by springs and baseflow from dolomitic springs at the Pretoria Fountains. The Apies River is canalised for the majority of its course in urban areas and integrated with the stormwater drainage in the city.

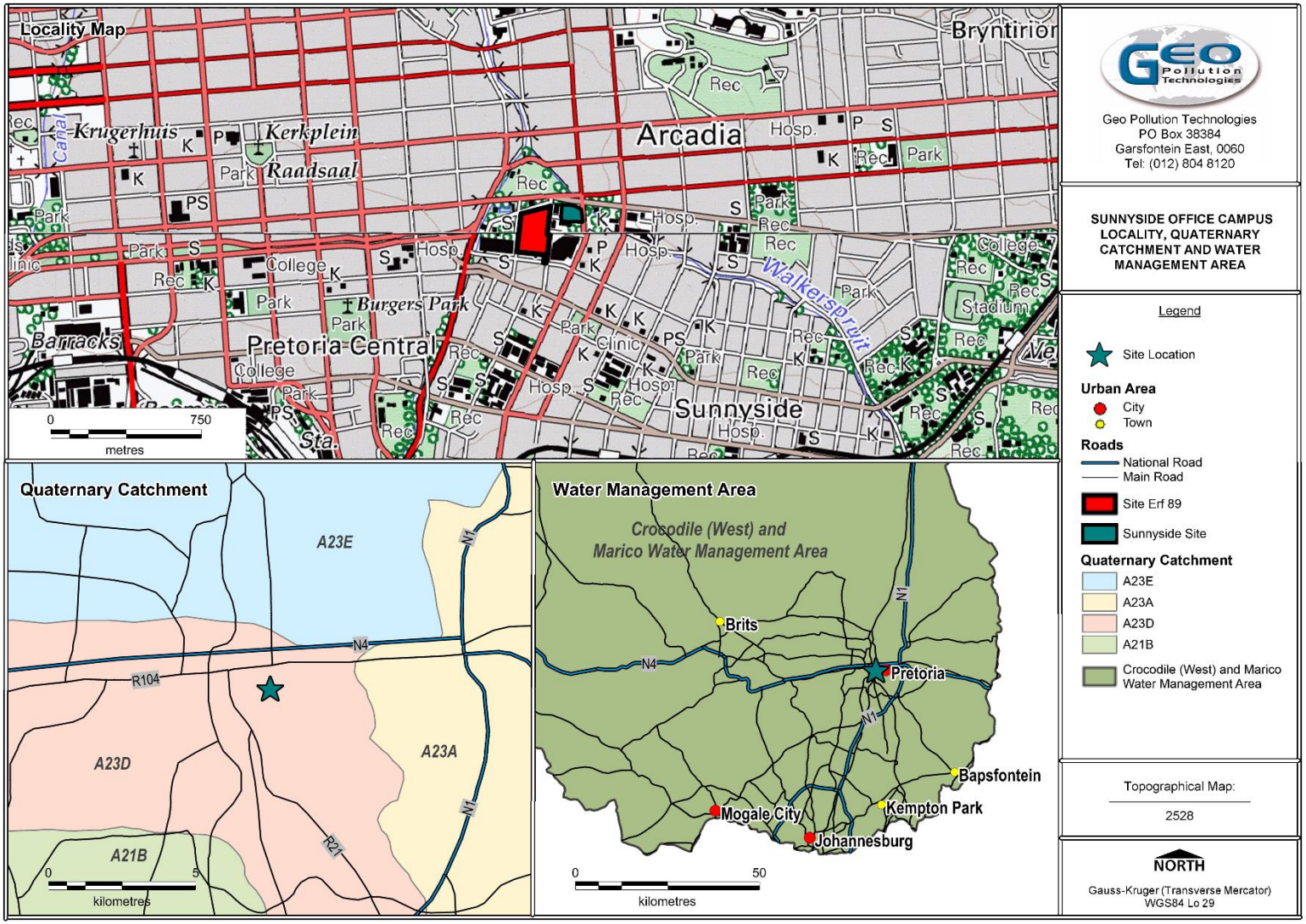


Figure 1: Site Location and Quaternary Catchment Boundaries

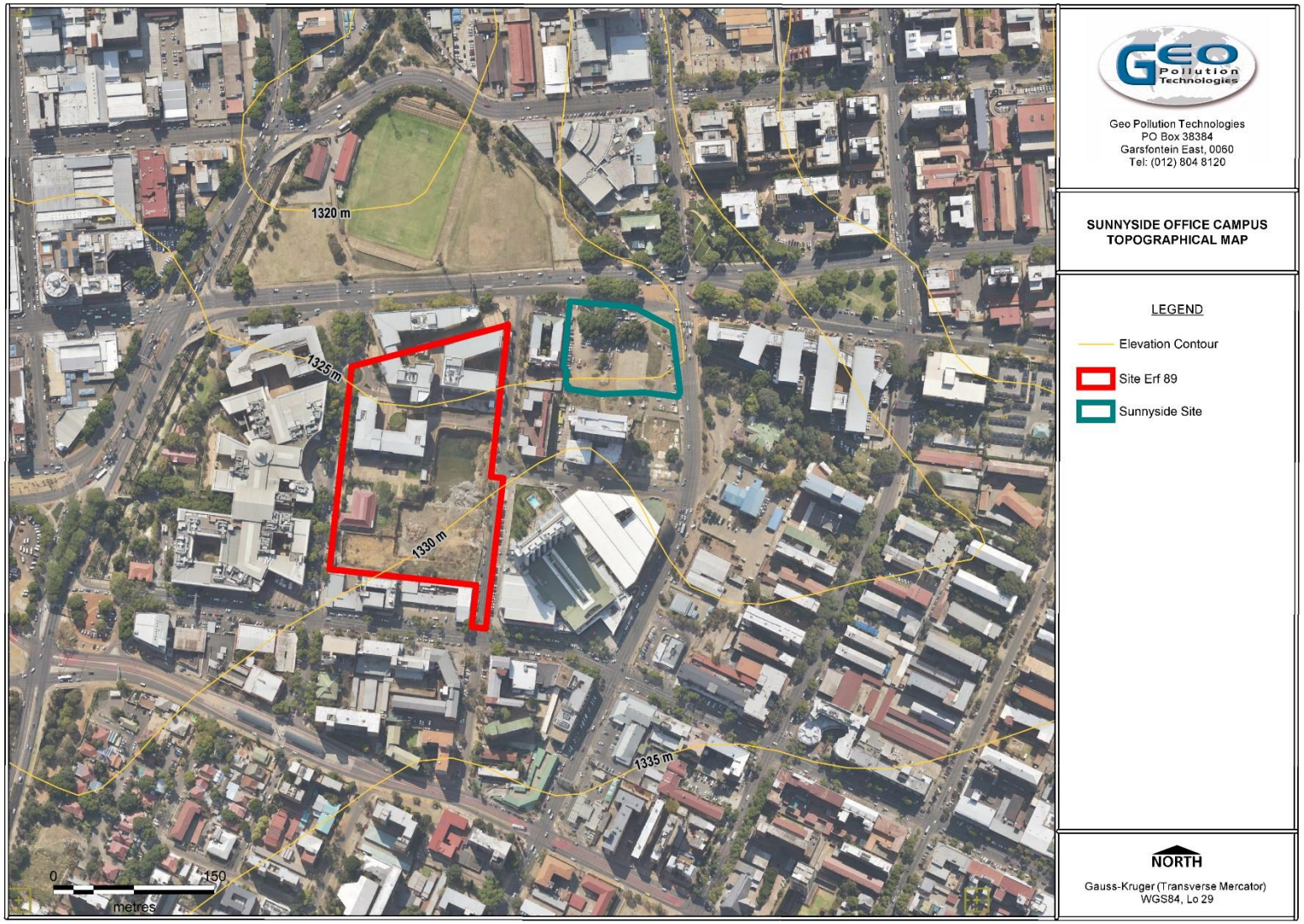


Figure 2: Site Topography

2.2 Climate

Climatic data was obtained from the DWS weather station Roodeplaat Dam (rainfall data and evaporation data) for the Pretoaria area (Table 1)[3]. The proposed site of development is located in the summer rainfall region of Southern Africa with precipitation usually occurring in the form of convectional thunderstorms. The average annual rainfall (measured over a period of 76 years) is approximately 573 mm, with the high rainfall months between November and March.

Table 1: Climatic Data

Month	Average Monthly Rainfall (mm)	Mean Monthly Evaporation (mm)
January	110	194.7
February	84	178.5
March	73	185.1
April	29	170.3
May	8	153.1
June	0	108.7
July	0	108.7
August	1	128.5
September	10	168
October	54	204.6
November	99	232.1
December	105	218.7
Annual	573	1600

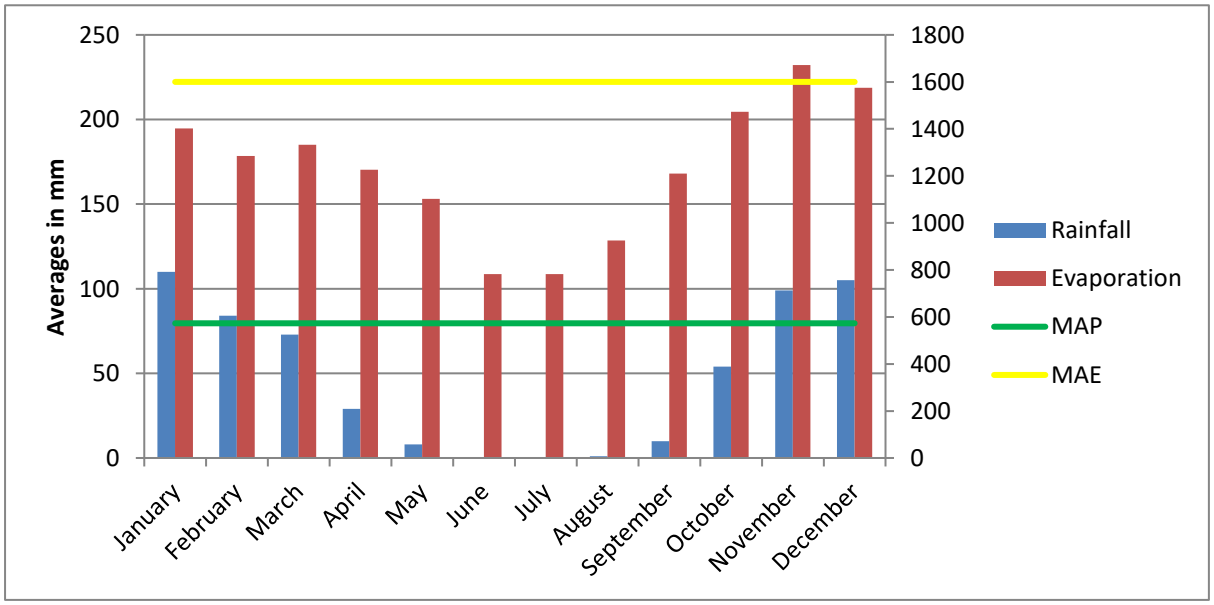


Figure 3: Climatic data representation

[3] Department of Water Affairs (DWA): www.dwa.gov.za

3 SCOPE OF WORK

The scope of work as required by the hydrogeological study should as a minimum include the following:

- Desk-top study to confirm the environmentally sensitive consideration, for groundwater only
- Review the Geotechnical Reports for soil conditions and water levels.

3.1 Project Objectives

Within the scope of work the groundwater study aimed to address the following:

- Quantify the current groundwater status quo.
- Description of the unconfined aquifer (Water table aquifer)
- Impacts of dewatering on the flow regime as well as estimation of groundwater seepage rates.
- Aquifer classification and vulnerability assessment.

4 METHODOLOGY

4.1 Desk Study

This entailed the gathering of information through the collation, scrutiny and evaluation of available and relevant meteorological, geographical, geological, hydrogeological and water quality data.

4.2 Hydrocensus

The hydrocensus was done as a site familiarisation exercise and the collection of data from the study area and surrounding environments. It comprised a census of key boreholes, wells, springs and any other groundwater related information.

4.3 Sampling and Chemical Analyses

The sampling and analyses conducted for the study are discussed in the following paragraphs.

4.3.1 Surface water sampling

Surface water was sampled in accordance with the GPT Standard Operating Procedure for surface water sampling[4]. In summary, the procedure is to the lower a bailer as far as possible within the surface water body and fill with water at a depth ensuring that as little as possible floating material or bottom mud is collected.

4.3.2 Surface water analysis

The following surface water cation/anion parameters as listed in Table 2 were analysed by an accredited laboratory for interpretation.

[4] Available on request from morne@gptglobal.com

Table 2: Surface water Parameters Analysed

Variable	Unit	Analytical method
pH		Selective electrode
Electrical Conductivity	mS/m	Selective electrode
Total Dissolved Solids (TDS)	mg/ℓ	Calculation
Calcium as Ca	mg/ℓ	ICP-OES Scan
Magnesium as Mg	mg/ℓ	ICP-OES Scan
Sodium as Na	mg/ℓ	ICP-OES Scan
Potassium as K	mg/ℓ	ICP-OES Scan
Chloride as Cl	mg/ℓ	Photometry
Sulphate as SO4	mg/ℓ	Photometry
Nitrate (as NO_3) Nitrate (NO3 as N)	mg/ℓ	Photometry
Fluoride as F	mg/ℓ	Photometry
Phosphate as PO_4	mg/ℓ	Photometry
Aluminium as Al	mg/ℓ	ICP-OES Scan
Iron as Fe	mg/ℓ	ICP-OES Scan
Manganese as Mn	mg/ℓ	ICP-OES Scan
Copper as C	mg/ℓ	ICP-OES Scan

4.3.3 Groundwater sampling

Groundwater was sampled in accordance with the GPT's Standard Operating Procedure for groundwater sampling[5] by bailing. Before the bailed sample is collected an electrical conductivity (EC) profile down the hole is considered to detect changes in EC. EC profiles, compared with the construction logs of monitoring wells are then used to determine the optimum sampling depth of each hole. The sample was taken at a depth where the EC reaches a maximum. The bailer is then lowered to the prescribed depth and the sample taken.

4.3.4 Groundwater analysis

The following groundwater cation/anion parameters as listed in Table 3 were analysed by an accredited laboratory for interpretation.

[5] Available on request from morne@gptglobal.com

Table 3: Groundwater Parameters Analysed

Variable	Unit	Analytical method
pH		Selective electrode
Electrical Conductivity	mS/m	Selective electrode
Total Dissolved Solids (TDS)	mg/ℓ	Calculation
Calcium as Ca	mg/ℓ	ICP-OES Scan
Magnesium as Mg	mg/ℓ	ICP-OES Scan
Sodium as Na	mg/ℓ	ICP-OES Scan
Potassium as K	mg/ℓ	ICP-OES Scan
Chloride as Cl	mg/ℓ	Photometry
Sulphate as SO4	mg/ℓ	Photometry
Nitrate (as NO_3) Nitrate (NO3 as N)	mg/ℓ	Photometry
Fluoride as F	mg/ℓ	Photometry
Phosphate as PO_4	mg/ℓ	Photometry
Aluminium as Al	mg/ℓ	ICP-OES Scan
Iron as Fe	mg/ℓ	ICP-OES Scan
Manganese as Mn	mg/ℓ	ICP-OES Scan
Copper as C	mg/ℓ	ICP-OES Scan

4.4 Groundwater Recharge Calculations

Recharge to the shallow, unconfined aquifer was calculated using the RECHARGE program developed by the Institute for Groundwater Studies at the University of the Free State, South Africa. The calculated recharge percentage equates to approximately 7%.

Table 4: Recharge calculation for the shallow unconfined aquifer

Recharge Estimation			
Method	**mm/a**	**% of rainfall**	**Certainty (Very High = 5; Low = 1)**
Chloride	24.8	3.5	4
Various schematic maps			
Soil	38.0	3.0	3
Geology	25.6	3.5	3
Vegter	45.0	2.9	3
Acru	20.0	3.6	3
Harvest Potential	50.0	3.6	3

4.5 Groundwater Availability Assessment

The proposed site of development is underlain by Hekpoort Formation fractured aquifers which comprise of andesitic lavas which commonly weather/decompose into clayey material with zones of weathering extending between 10 and 30 m. Groundwater development in this formation of the Pretoria Group (Transvaal Supergroup) is associated with fractured zone (faults, fractures, contact

zones, and joints) below the zone of weathering. Borehole yield commonly ranges between 2 and 2.5 l/s, depending on recharge potential controlled by the permeability of the vadose zone. Static water levels typically lie between 5 and 30 mbgl. Water is generally of acceptable quality with mean pH and EC values of 7.5 and 52 mS/m, respectively.[6]

5 Desk study

A desk study was done on all available information pertaining to groundwater situation at proposed site of development at Sunnyside.

5.1 Information Reviewed

The following information sources were reviewed:

- Geological Map (Scale 1:250 000) published by the Council for Geoscience, Pretoria 2528.
- National Groundwater Database (NGDB) information managed by DWA (2005).
- Geosure (PTY) Ltd, 2018. Interim Report to Public Investment Corporation SOC Ltd on the Results of a Geotechnical Investigation for the Sunnyside Labour Campus at 70 Meintjies Street in Pretoria, Gauteng. Contract Report. Ref.: JHB024-18.R01 Revision 1.
- Department of Water Affairs and Forestry, 2000. An Explanation of the the 1:500 000 General Hydrogeological Map, Johannesburg 2526. Edited by Barnad, H. C. Government Priniting Works. Pretoria.

5.2 Activity Description

All proposed development will be located within the Property in Sunnyside. The proposed development will entail the construction of an office campus for the PIC. It is understood that as of yet, no plans are in place.

6 PREVAILING GROUNDWATER CONDITIONS

6.1 Geology

6.1.1 Regional Geology

The investigated area falls within the 2528 Pretoria 1:250 000 geology series maps. An extract of these maps is shown in Figure 4.

The proposed site of development is underlain by the Hekpoort Formation Lavas of the Pretoria Group of the Transvaal Supergroup. Pretoria Group strata dip at about 25° to the west, following the emplacement geometry of the Bushveld Igneous Complex layered igneous intrusion.

The Hekpoort Formation is also classified as a layered igneous intrusion, with a maximum thickness of up to 1100 m. The formation is of Archean age and predates the implacement of the Bushveld Igneous Complex.

The Hekpoort Formation consists of a thick sequence of basaltic/andestici lavas in which coarser-grained rocks occur mainly at the base. The occurrence of interbedded sedimentary rocks is common

[6] Department of Water Affairs and Forestry, 2000. An Explanation of the the 1:500 000 General Hydrogeological Map, Johannesburg 2526. Edited by Barnad, H. C. Government Priniting Works. Pretoria.

at places. The Hekpoort rocks have at places undergone metamorphism up to greenschist facies.A number of linear, i.e. dykes and faults are present in the area.

6.1.2 Local Geology

The proposed site of development is underlain by Hekpoort Formation rocks which comprise of andesitic lavas which commonly weather/decompose into clayey material with zones of weathering extending between 10 and 30 m. Excavation and bore drilling exposed andesite rock with a zone of weathering of up to 10.5 m. The degrees of weathering and fracturing decrease with depth. Amygdoidal basalt was found to underlie the andesitic bedrock at some places below the zone of weathering and are thought to be competent bedrock. The local rocks as observed on site are pictured below in Figure 4.

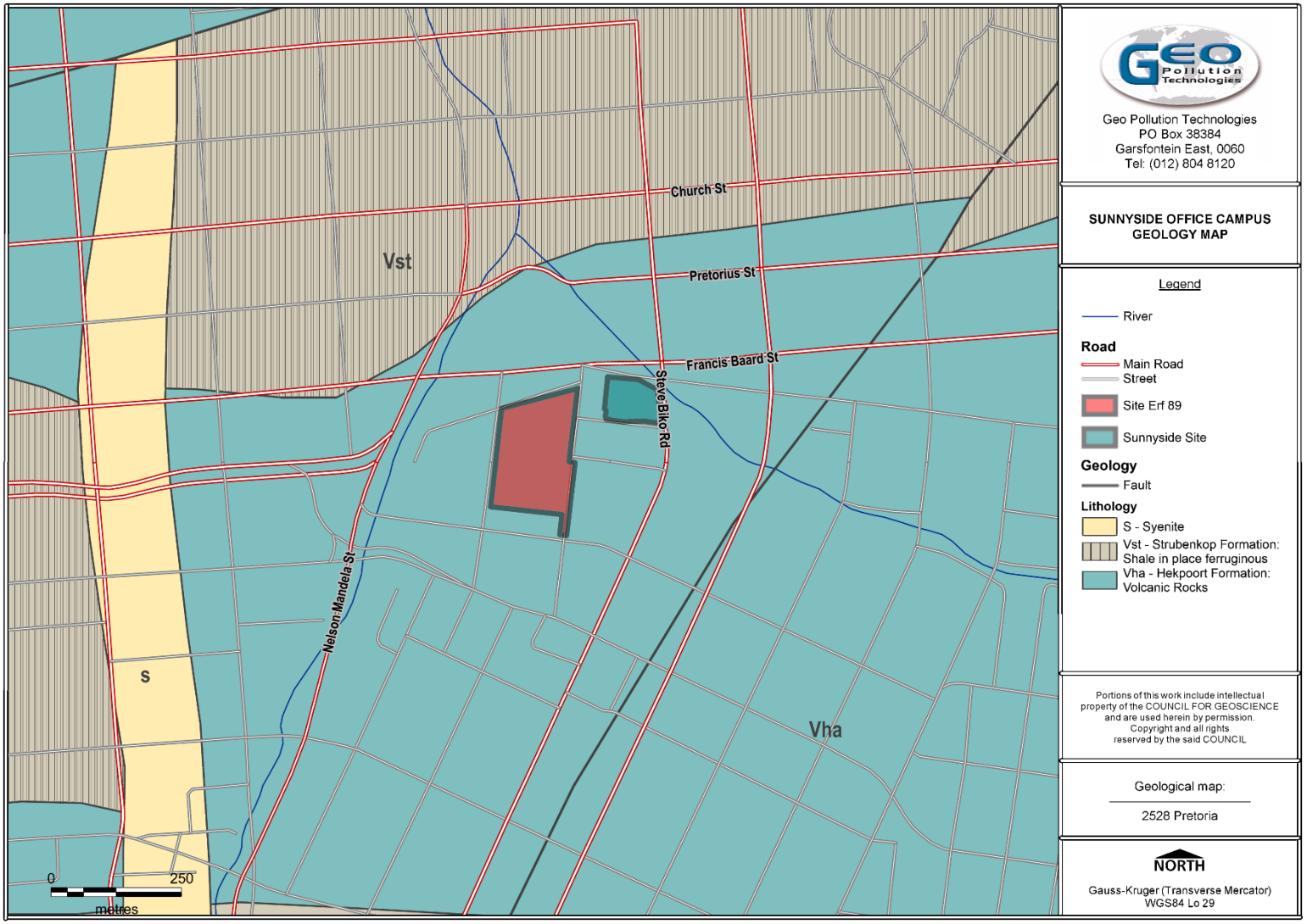


Figure 4: Regional Geology Map (1:250 000 geology series map)

6.2 Hydrogeology

According to the 1:500 000 General Hydrogeological Map the Hekpoort Formation Lavas rocks typically act as secondary aquifers (intergranular and fractured rock aquifers). However, the multi-layered weathering system present on these rocks could prove to have up to two aquifer systems present in the form of a shallow, saprolitic aquifer with a weathered, intergranular soft rock base associated with the contact of fresh bedrock and the weathering zone; and a fractured bedrock aquifer. These aquifer systems are discussed below.

6.2.1 Unsaturated Zone - Shallow, saprolitic aquifer

The main source of recharge into the shallow aquifer is rainfall that infiltrates the aquifer through the unsaturated (vadose) zone. Vertical movement of water is faster than lateral movement in this system as water moves predominantly under the influence of gravity. This aquifer comprises of clayey sediment underlain by weathered andesite. The hydraulic conductivity of this aquifer ranges between 10^{-8} and 10^{-2} $m.d^{-1}$ and porosity ranges between 0.4 and 0.7 for residual clay and andesite.

6.2.2 Saturated Zone - Fractured, bedrock aquifer

The proposed site of development is underlain by Hekpoort Formation fractured aquifers comprises of andesitic lava which commonly weather/decompose into clayey material with zones of weathering extending between 10 and 30 m. Groundwater development in this formation of the Pretoria Group (Transvaal Supergroup) are associated with fractured zone (faults, fractures, contact zones, and joints) below the zone of weathering. Borehole yield commonly ranges between 2 and 2.5 l/s, depending on recharge potential controlled by the permeability of the vadose zone. Static water levels typically lie between 5 and 30 mbgl. Water is generally of acceptable quality with mean pH and EC values of 7.5 and 52 mS/m, respectively.

Igneous intrusions in the form of dykes and sills are often encountered in this area. The dykes are found to run in a north-northeast/south-southwest direction and can serve both as aquifers and aquifuges. Thick, unbroken dykes inhibit the flow of water, while the baked and cracked contact zones can be highly conductive. These structures thus tend to dominate the flow of groundwater. Unfortunately, their location and properties are rather unpredictable. Their influence on the flow of groundwater is incorporated by using higher than usual flow parameters for the rocks of the aquifer.

6.2.3 Hydraulic Conductivity

Both the porosity and the hydraulic conductivity[7] of the Hekpoort Formation Lavas fractured aquifers are known to be low. The commonly expected values of porosity and permeability for igneous rock types, similar to those present in the Hekpoort Formation Lavas, are 0.05 (porosity) and 10^{-5} $m.d^{-1}$ (hydraulic conductivity, K) respectively. The maximum K value given to Hekpoort Formation andesitic lavas is 0.032 $m.d^{-1}$[8]. Movement of groundwater in this aquifer will be preferential in secondary structures such as joints, faults and fractures.

[7] Measure of the ease with which water will pass through the earth's material; defined as the rate of flow through a cross-section of one square metre under a unit hydraulic gradient at right angles to the direction of flow (m/d).

[8] Department of Water Affairs and Forestry, 2000. An Explanation of the the 1:500 000 General Hydrogeological Map, Johannesburg 2526. Edited by Barnad, H. C. Government Priniting Works. Pretoria.

7 RESULTS

A hydrocensus survey was carried out on the 12 September 2018 in order to locate and identify water resources and water users on the property under investigation and the immediate surroundings of the area. The following features, all of which were sampled, were identified:

- The excavation at the Trevenna located about 70 m from the proposed site of development in Sunnsyide;
- The Walkerspruit, a tributary of the Apies River, upstream of the Sunnyside site;
- The Apies River upstream and downstream of the site.

A summary of the hydrocensus survey is tabled in (Table 5) and the positions of the water sampling points are shown in Figure 6 and current status is shown in Figure 5.

Table 5: Hydrocensus Summary

Sample ID	Latitude	Longitude	Owner/Locality	Source	Flow status	Use	Comments
Trevenna Excavation	-25.74977	28.201826	Trevenna	Groundwater (and rainwater)	Stagnant	None	Groundwater seepage into excavation
Surface water							
Sample ID	**Latitude**	**Longitude**	**Owner**	**Source**	**Flow status**	**Use**	**Comments**
Apies Upstream	-25.75019	28.198922	Tshwane Metro	Spring	Low velocity flow	Unknown	Canalised
Apies Downstream	-25.74545	28.201463	Tshwane Metro	Spring	Low velocity flow	Unknown	Canalised
Walkerspruit Downstream	-25.75011	28.205944	Tshwane Metro	Surface drainage	Low velocity flow	Unknown	Canalised

Sunnyside Excavation

Apies Upstream

Apies Downstream

Walkerspruit Upstream

Figure 5: Status of Water Sampling Positions

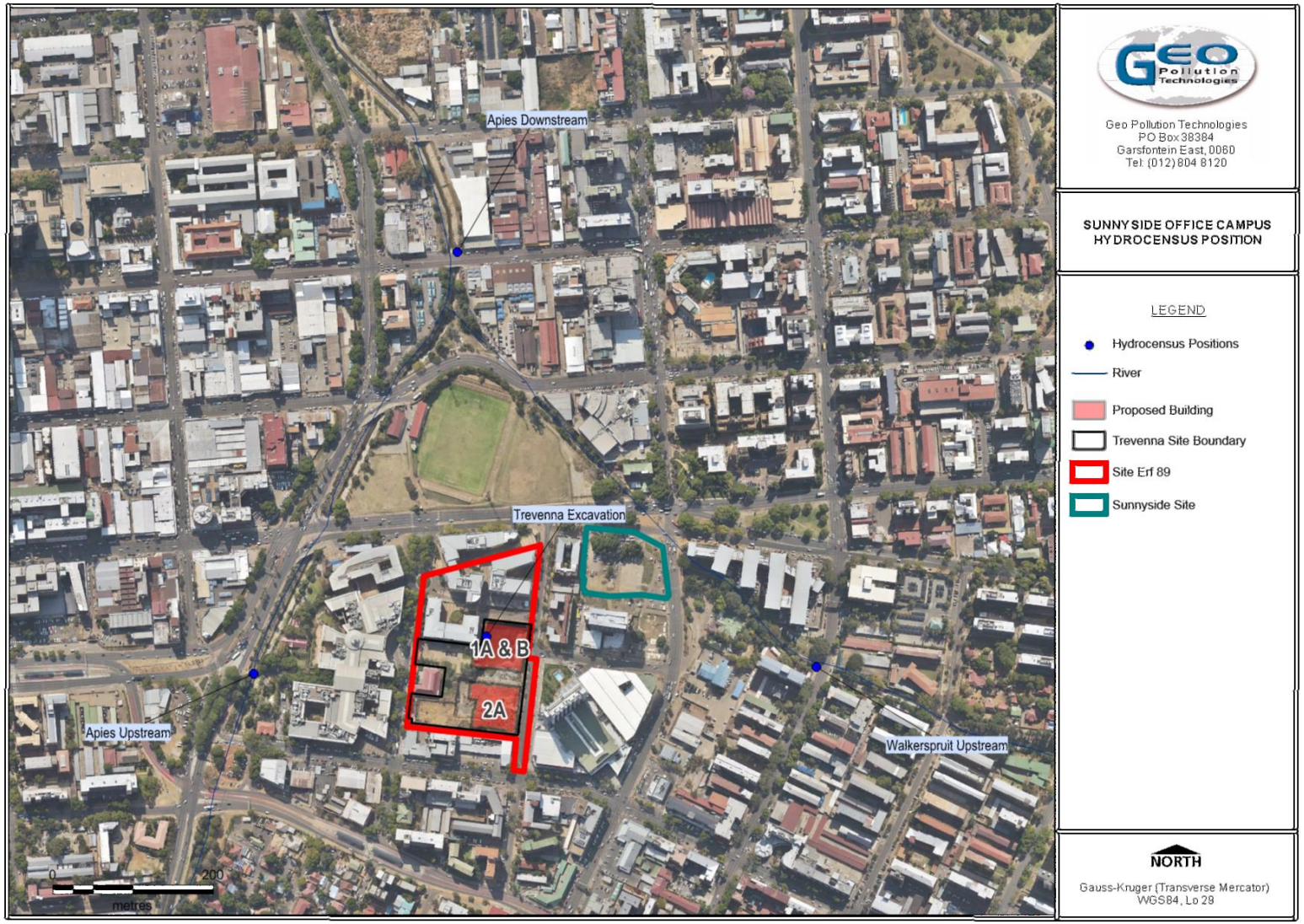


Figure 6: Position of Water Sampling Positions

7.1 Groundwater Levels

During the hydrocensus, no boreholes were available for groundwater level measurement. The groundwater level measurements recorded during the geotechnical survey were consulted. Water levels in three piezometers ranged between a minimum of 2.25 m and a maximum of 8.5 m below ground level (Table 6). The average depth to water level was found to be 4.9 m.

In general, a good relationship should exist between topography and static groundwater level, i.e. groundwater flows from higher relief areas to low-lying areas emulating topographical gradients. This relationship can be used to distinguish between boreholes with water levels at rest, and boreholes with anomalous groundwater levels due to disturbances such as pumping or local hydrogeological heterogeneities. The water table in the excavated area is expected to have been lowered by the diggings, which directs flow towards the excavation.

The water level elevations have been contoured and are displayed in Figure 7. Groundwater flow direction should be perpendicular to these contours and inversely proportional to the distance between contours. The areas where the water table has a shallow gradient, the contours are spaced further apart than the areas where the water table has a steep gradient. The direction of groundwater flow is northerly and north-westerly, towards the Walkerspruit and Apies River (naturally).

Table 6: Available groundwater level statistics

Geotechnical Borehole	Latitude	Longitude	Elevation (mamsl)	Depth (m)	SWL (mbgl)	SWL (mamsl)
BH1	-25.7496	28.202319	1319	20	4	1315
BH2	-25.7505	28.201819	1315	12.75	2.25	1312.75
BH3	-25.7507	28.200928	1319	20	8.5	1310.5
Average					4.92	1312.75

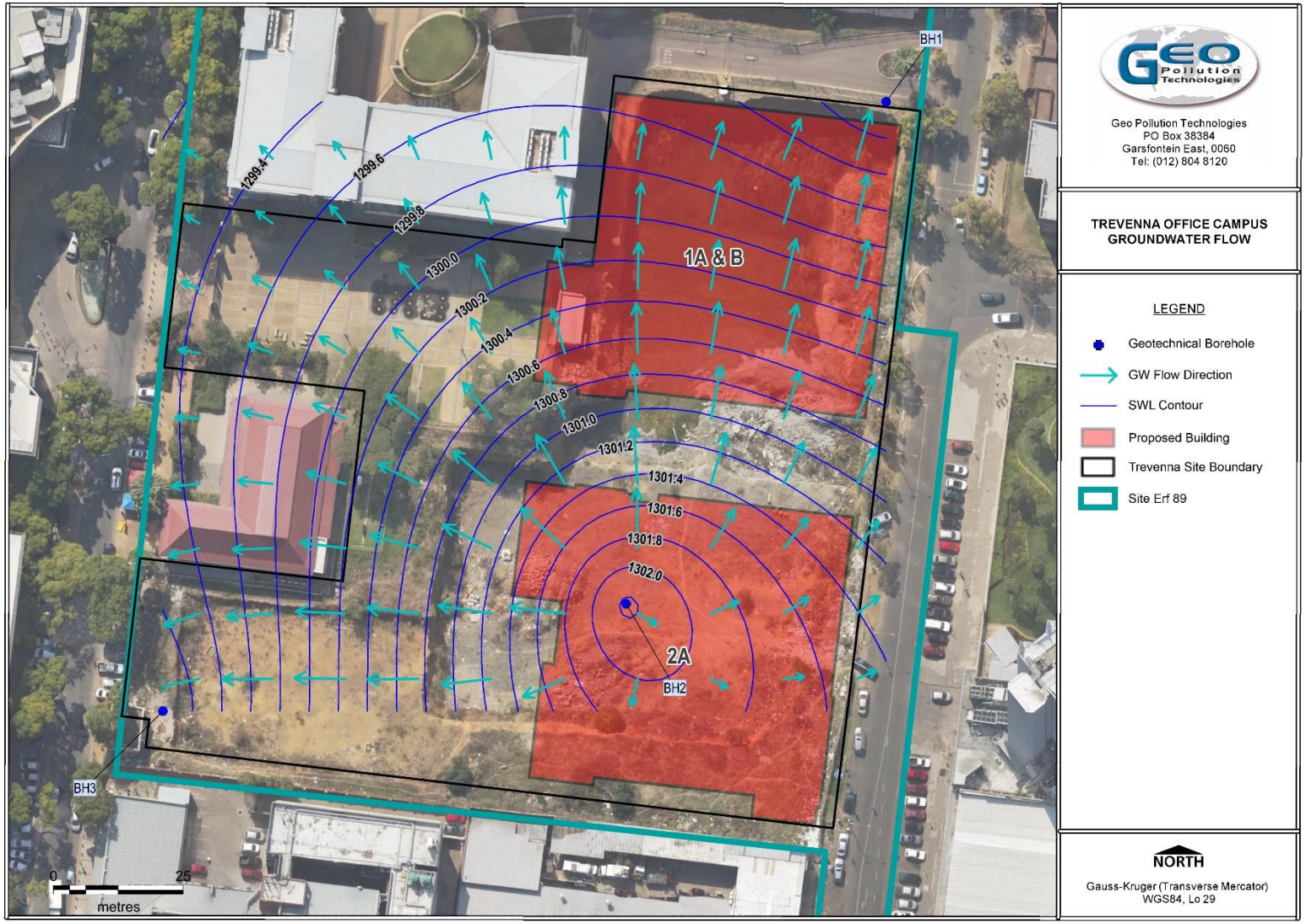


Figure 7: Hydraulic gradient of the water table aquifer (unconfined aquifer)

7.2 Water Quality

A water sample was collected from the excavation, which is representative of groundwater seepage into the excavation.

The analytical results are compared with the maximum recommended concentrations for domestic use as defined by the SANS 241-1: 2015 target water quality limits Table 7. The SANS 241-1: 2015 standard is applicable to all water services institutions and sets numerical limits for specific determinants to provide the minimum assurance necessary that the drinking water is deemed to present an acceptable health risk for lifetime consumption. Colours of individual cells refer to the drinking water classification of the specific groundwater sample. The following observations were made:

- None of the constituents analysed for exceed the SANS standards.

The samples were also analysed for hydrocarbon compounds, the results of the analysis are listed in Table 8. The following observations were made:

- No concentrations of the targeted hydrocarbon compounds analysed for were detected in the excavation sample and the Apies River upstream of the site.
- Unidentified hydrocarbon compounds were detected in the Walkerspruit and Apies River downstream of the site. The source of which is unknown.

7.2.1 Spatial analysis of water quality

The pie charts Figure 8 show both the individual ions present in a water sample and the total ion concentrations in meq/ℓ or mg/ℓ. The scale for the radius of the circle represents the total ion concentrations, while the subdivisions represent the individual ions. It is very useful in making quick comparisons between waters from different sources and presents the data in a convenient manner for visual inspection. From the tables and figures the following can be deduced:

- All the samples show high proportions of HCO_3^- and Ca^{2+}, bicarbonate type waters are typical of fresh, unpolluted water.

Table 7: Water qualities compared to SANS 241-1:2015 guidelines for human consumption

SANS 241:2015 Guidelines		Unit	Risk	Sunnyside Excavation	Apies Upstream	Apies Downstream	Walkespruit Upstream	SANS 241 Lower Limit	SANS 241 Upper Limit
pH	pH	pH Units	Aesthetic	7.99	8.18	7.88	7.86	5	9.7
Electrical Conductivity	EC	mS/m	Aesthetic	49.6	45.6	51	52.5		
Total Dissolved Solids	TDS	mg/l	Aesthetic	296	268	288	282		
Calcium	Ca	mg/l	Not determined	38.6	49.8	43.2	31.4		
Chloride	Cl	mg/l	Aesthetic	23.8	19.9	32.5	45.4		300
Fluoride	F	mg/l	Chronic health	0.331	0.12	0.189	0.25		1.5
Potassium	K	mg/l	Not determined	1.47	1.41	5.34	11.1		
Magnesium	Mg	mg/l	Not determined	35.6	30.7	25.3	16.7		
Sodium	Na	mg/l	Aesthetic	17.7	13	27.2	41.5		200
Ammonia as NH3	NH3	mg/l	Not determined	BDL	BDL	7.77	21.4		
Ammonia as N	NH3 as N	mg/l	Not determined	BDL	BDL	6.39	17.6		
Nitrite	NO2	mg/l	Not determined	BDL	0.079	0.579	0.014		
Nitrite as N	NO2 as N	mg/l	Acute health	BDL	0.024	0.176	0.004		0.9
Nitrate	NO3	mg/l	Not determined	BDL	12.5	1.33	0.168		
Nitrate as N	NO3 as N	mg/l	Acute health	BDL	2.82	0.301	BDL		11
Phosphate	PO4	mg/l	Not determined	0.167	0.189	1.35	3.32		
Phosphate as P	PO4 as P	mg/l	Not determined	0.055	0.062	0.438	1.08		
Sulphate	SO4	mg/l	Aesthetic/Acute health	21.1	15	21.9	30	250	500
Aluminium	Al	mg/l	Operational	BDL	BDL	BDL	BDL		0.3
Iron	Fe	mg/l	Aesthetic/Chronic health	BDL	BDL	BDL	0.09	0.3	2
Manganese	Mn	mg/l	Aesthetic/Chronic health	0.07	BDL	0.06	0.08	0.1	0.4
Zinc	Zn	mg/l	Aesthetic	BDL	BDL	BDL	BDL		5
Copper	Cu	mg/l	Chronic health	BDL	BDL	BDL	BDL		2
Concentration deemed to present an unacceptable health risk for lifetime consumption									
Cr6+ human consumption limit obtained from South African DWA, Water Quality Guidelines, 1996									
BDL = Below detection limit									

Table 8: Water analysis results for targeted hydrocarbon compounds

	Sample no.	Sunnyside Excavation	Apies Upstream	Walkerspruit Upstream	Apies Downstream
	Sample depth (mbgl)	Surface	Surface	Surface	Surface
Gasoline Range Organics	Benzene	BDL	BDL	BDL	BDL
	Toluene	BDL	BDL	BDL	BDL
	Ethylbenzene	BDL	BDL	BDL	BDL
	Xylenes	BDL	BDL	BDL	BDL
	MTBE	BDL	BDL	BDL	BDL
	TAME	BDL	BDL	BDL	BDL
	Naphthalene	BDL	BDL	BDL	BDL
	1,2,4 Trimethyl benzene	BDL	BDL	BDL	BDL
	1,3,5 Trimethyl benzene	BDL	BDL	BDL	BDL
Poly Aromatic Compounds	Acenaphthene	BDL	BDL	BDL	BDL
	Acenaphthylene	BDL	BDL	BDL	BDL
	Fluorene	BDL	BDL	BDL	BDL
	Phenanthrene	BDL	BDL	BDL	BDL
	Anthracene	BDL	BDL	BDL	BDL
	Fluoranthene	BDL	BDL	BDL	BDL
	Pyrene	BDL	BDL	BDL	BDL
Diesel Range Organics	TPH Aliphatic C_8-C_{10}	NA	NA	NA	NA
	TPH Aliphatic C_{10}-C_{12}	BDL	BDL	BDL	BDL
	TPH Aliphatic C_{12}-C_{16}	BDL	BDL	BDL	BDL
	TPH Aliphatic C_{16}-C_{20}	BDL	BDL	BDL	BDL
	TPH Aliphatic C_{10}-C_{14}	BDL	BDL	BDL	BDL
	*TPH Aliphatic C_{15}-C_{36}	BDL	BDL	0.048	0.031
	Total VPHs Identified	BDL	BDL	BDL	BDL
	Estimated VPHs Unidentified	BDL	BDL	0.048	0.031
	Estimated TOTAL VPHs	BDL	BDL	0.048	0.031
* Assuming unidentified compounds fall in this range					
All values in mg/l					
BDL = Below Detection Limit					

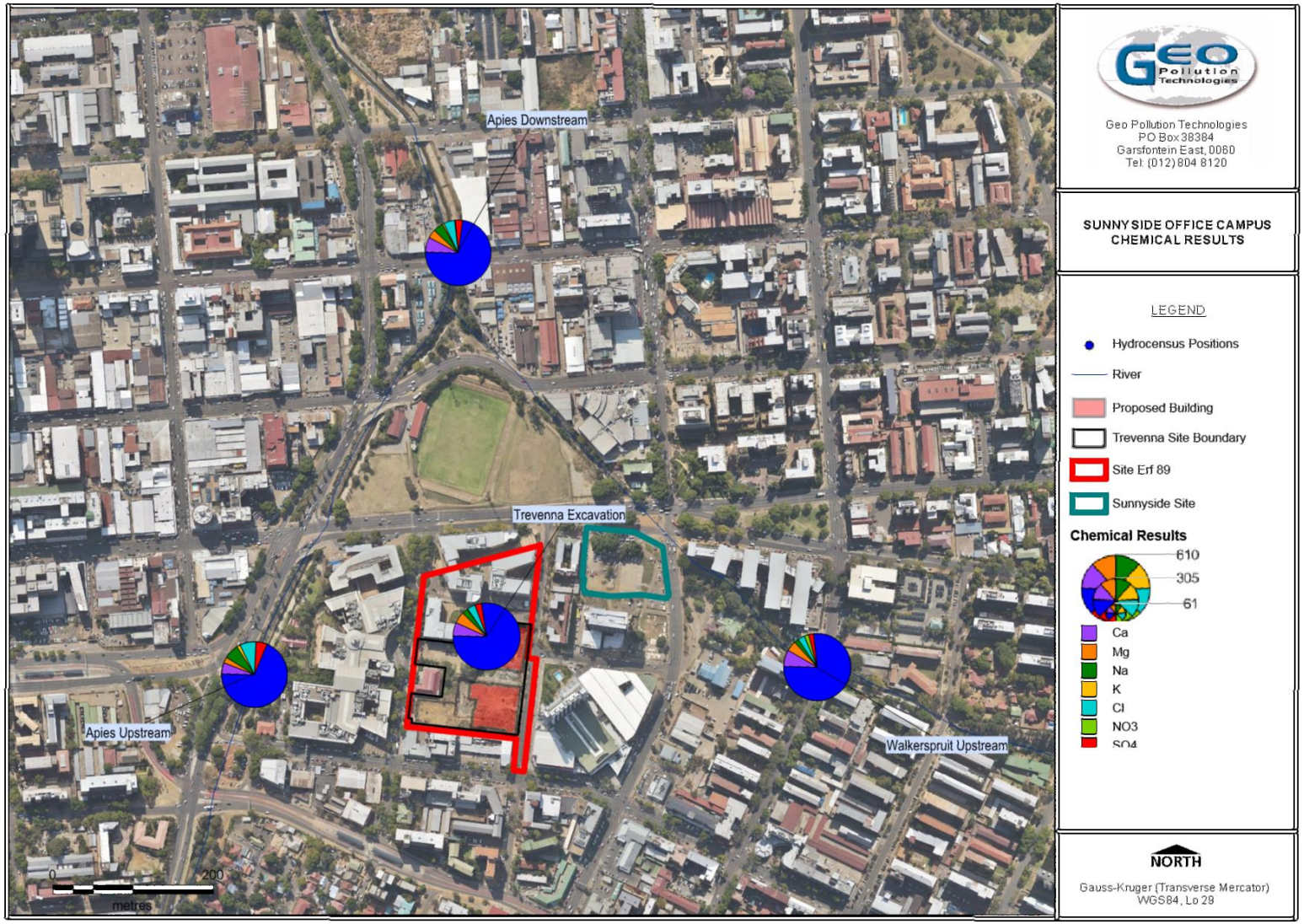


Figure 8: Pie Charts for major ions in water samples

8 AQUIFER CHARACTERISATION

The term aquifer refers to a strata or group of interconnected strata comprising of saturated earth material capable of conducting groundwater and of yielding usable quantities of groundwater to boreholes and /or springs (Vegter, 1994). In the light of South Africa's limited water resources, it is important to discuss the aquifer sensitivity in terms of the boundaries of the aquifer, its vulnerability, classification and finally protection classification, as this will help to provide a framework in the groundwater management process.

8.1 Aquifer Vulnerability

Aquifer vulnerability assessment indicates the tendency or likelihood for contamination to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer. Stated in another way, it is a measure of the degree of insulation that the natural and manmade factors provide to keep contamination away from groundwater.

- Vulnerability is high if natural factors provide little protection to shield groundwater from contaminating activities at the land surface.
- Vulnerability is low if natural factors provide relatively good protection and if there is little likelihood that contaminating activities will result in groundwater degradation.

The following factors have an effect on groundwater vulnerability:

- Depth to groundwater: Indicates the distance and time required for pollutants to move through the unsaturated zone to the aquifer.
- Recharge: The primary source of groundwater is precipitation, which aids the movement of a pollutant to the aquifer.
- Aquifer media: The rock matrices and fractures which serve as water bearing units.
- Soil media: The soil media (consisting of the upper portion of the vadose zone) affects the rate at which the pollutants migrate to groundwater.
- Topography: Indicates whether pollutants will run off or remain on the surface allowing for infiltration to groundwater to occur.
- Impact of the vadose zone: The part of the geological profile beneath the earth's surface and above the first principal water-bearing aquifer. The vadose zone can retard the progress of the contaminants.

The Groundwater Decision Tool (GDT) was used to quantify the vulnerability of the aquifer underlying the site using the below assumptions.

- Depth to groundwater below the site was estimated from water levels measured during the hydrocensus inferred to be at mean of ~4.9 mbgl.
- Groundwater recharge of ~45 mm/a (7% recharge),
- Tuff/clay soil vadose zone
- Gradient of 1.6% were assumed and used in the estimation.

The aquifer vulnerability for a contaminant released from surface to a specified position in the groundwater system after introduction at some location above the uppermost aquifer was determined using the criteria described below and assuming a worst-case scenario:

- Highly vulnerable (> 60), the natural factors provide little protection to shield groundwater from contaminating activities at the land surface.
- Medium Vulnerable = 30 to 60%, the natural factors provide some protection to shield groundwater from contaminating activities at the land surface, however based on the contaminant toxicity mitigation measures will be required to prevent any surface contamination from reaching the groundwater table.
- Low Vulnerability (< 30 %), natural factors provide relatively good protection and if there is little likelihood that contaminating activities will result in groundwater degradation
- The GDT calculated a vulnerability value of 54%, which is medium.

8.2 Aquifer Classification

The aquifer(s) underlying the subject area were classified in accordance with "A South African Aquifer System Management Classification, December 1995."

The main aquifers underlying the area were classified in accordance with the Aquifer System Management Classification document[9]. The aquifers were classified by using the following definitions:

- Sole Aquifer System: An aquifer which is used to supply 50% or more of domestic water for a given area, and for which there is no reasonably available alternative sources should the aquifer be impacted upon or depleted. Aquifer yields and natural water quality are immaterial.
- Major Aquifer System: Highly permeable formations, usually with a known or probable presence of significant fracturing. They may be highly productive and able to support large abstractions for public supply and other purposes. Water quality is generally very good (Electrical Conductivity of less than 150 mS/m).
- Minor Aquifer System: These can be fractured or potentially fractured rocks which do not have a high primary permeability, or other formations of variable permeability. Aquifer extent may be limited and water quality variable. Although these aquifers seldom produce large quantities of water, they are important for local supplies and in supplying base flow for rivers.
- Non-Aquifer System: These are formations with negligible permeability that are regarded as not containing groundwater in exploitable quantities. Water quality may also be such that it renders the aquifer unusable. However, groundwater flow through such rocks, although imperceptible, does take place, and needs to be considered when assessing the risk associated with persistent pollutants.

Based on information collected during the hydrocensus it can be concluded that the aquifer system in the study area can be classified as a "Minor Aquifer System".

In order to achieve the Aquifer System Management and Second Variable Classifications, as well as the Groundwater Quality Management Index, a points scoring system as presented in Table 9 and Table 10 was used.

Table 9: Ratings – Aquifer System Management and Second Variable Classifications

[9] Department of Water Affairs and Forestry & Water Research Commission (1995). A South African Aquifer System Management Classification. WRC Report No. KV77/95.

Aquifer System Management Classification		
Class	Points	Study area
Sole Source Aquifer System:	6	
Major Aquifer System:	4	
Minor Aquifer System:	2	2
Non-Aquifer System:	0	
Special Aquifer System:	0 – 6	
Second Variable Classification (Weathering/Fracturing)		
Class	Points	Study area
High:	3	
Medium:	2	2
Low:	1	

Table 10: Ratings - Groundwater Quality Management (GQM) Classification System

Aquifer System Management Classification		
Class	Points	Study area
Sole Source Aquifer System:	6	
Major Aquifer System:	4	
Minor Aquifer System:	2	2
Non-Aquifer System:	0	
Special Aquifer System:	0 – 6	
Aquifer Vulnerability Classification		
Class	Points	Study area
High:	3	
Medium:	2	2
Low:	1	

As part of the aquifer classification, a Groundwater Quality Management (GQM) Index is used to define the level of groundwater protection required. The GQM Index is obtained by multiplying the rating of the aquifer system management and the aquifer vulnerability. The GQM index for the study area is presented in Table 11.

The vulnerability, or the tendency or likelihood for contamination to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer, in terms of the above, is classified as **medium.**

The level of groundwater protection based on the Groundwater Quality Management Classification:

GQM Index = Aquifer System Management x Aquifer Vulnerability

= 2 x 2= 4

Table 11: GQM Index for the Study Area

GQM Index	Level of Protection	Study Area
<1	Limited	
1 – 3	Low Level	
3 – 6	Medium Level	4
6 – 10	High Level	
>10	Strictly Non-Degradation	

8.3 Aquifer Protection Classification

A Groundwater Quality Management Index of 4 was estimated for the study area from the ratings for the Aquifer System Management Classification. According to this estimate a medium-level groundwater protection is required for the aquifer. Reasonable and sound groundwater protection measures based on the modelling will therefore be recommended to ensure that no cumulative pollution affects the aquifer, even in the long term.

DWS's water quality management objectives are to protect human health and the environment. Therefore, the significance of this aquifer classification is that measures must be taken to limit the risk to the following environments.

- The protection of the underlying aquifer.
- The receiving streams and rivers within the catchment area.

9 GROUNDWATER SEEPAGE RATE

Estimating groundwater into the Trevenna excavation for the building foundation during construction took into consideration hydrogeological and hydraulic parameters, the size of the excavation, and the duration of dewatering for construction purposes. The method used to estimate groundwater inflow into the excavation was Darcy's Law. Darcy's Law states that the velocity of flow in a porous medium is directly proportional to the permeability coefficient and hydraulic gradient. Darcy's Law is given in equation 1 below:

$$Q = KiA \quad (1)$$

Where, Q is the groundwater inflow (m^3/d^{-1}); K is the hydraulic conductivity of the medium (md^{-1}); *i* is the hydraulic gradient (unitless); and A is the surface area (m^2).

Table 12: Parameters for the Estimation of Groundwater Seepage Rates

Parameter	Value	Unit	Reference
Area	2 256	m^2	Based on the flooded perimeter of the excavated area
Volume of water in excavation	1692	m^3	Based on the flooded area of the of the excavation
Hydraulic conductivity	0.01 - 0.032	md^{-1}	Department of Water Affairs and Forestry, 2000
Hydraulic gradient	0.75	-	Geosure (PTY) Ltd, 2018. Geotechnical investigation.

9.1 Groundwater Inflow Estimation

Based on the method explained above the volume of groundwater inflow was estimated for the range of hydraulic conductivities given in Table 12 above, i.e. the average (0.01 md^{-1}) and the maximum (0.032 md^{-1}) K-values for Hekpoort Formation andesite. The estimated groundwater inflow into the current extent of the excavation at Sunnyside are listed in Table 13.

Table 13: Parameters for the Estimation of Groundwater Seepage Rates

Inflow Estimation	Value	Unit
Based on average K-value	16	m^3d^{-1}
Based on maximum K-value	54	m^3d^{-1}

The dewatering rates required to keep the excavation dry should exceed the groundwater inflow rate, but not exceed 100 m^3d^{-1} as prescribed in the general authorisation.

10 HYDROGEOLOGICAL IMPACTS

The aim of this section is to assess the likely hydrogeological impacts that activities related to the development might have on the receiving environment. The typical operational stages that will be considered in this section are:

- Construction Phase: Preparations at the specific site before actual operations commence.
- Operational Phase: The conditions expected to prevail during the operation of the site.

10.1 Construction Phase Impacts

It is accepted for the purposes of this document that the construction phase will consist of preparations of the foundation and 5-storey basement, which will be approximately 15 m deep.

10.1.1 Impacts in groundwater quantity

The aim of dewatering is to lower the water table around the excavation so as to form a cone of depression around the excavation. In this way the activity will lead to lowering of the water table. However, due to a high demand for water supply, the main water supply for the population of Pretoria is derived from surface water sources. No groundwater users were identified within the immediate area surrounding the proposed site of development.

10.1.2 Impacts on water quality

Water inflows removed from construction areas will be pumped into the municipal stormwater drainage system which is eventually released into the Apies River downstream. Dewatering at the site of planned development is not expected to impact on water quality of the immediate catchment area negatively. It is expected that the current status quo will be maintained in the receiving streams and rivers. The current water quality on site is of acceptable quality (drinking water quality).

10.1.3 Groundwater management

Impact prevention starts in the planning phase of an operation through evaluation of plans and, aimed at understanding the potential impacts of alternative working methodologies and a conscious effort to select, design and implement the alternatives that maximise the ability to prevent pollution. Pre-establishment of an operation, typical pollution prevention considerations include those shown below:

- Groundwater inflow may render the work dangerous, water level and inflow monitoring should be instituted. Ponded or running water should always be removed by the installation of sump pump(s). It is understood that currently water is to be pumped out to stormwater drainage eventually ending up in the Apies River.

10.1.4 Key considerations

There relevant key considerations prior to development are:

- Pollution prevention: Deterioration of water quality must be prevented wherever possible and minimised where complete prevention is not possible.
- Conservation: Unnecessary losses of water and consumptive use of water must be minimised.

11 GROUNDWATER SYSTEM RESPONSE MONITORING

Groundwater levels: The response of water levels to removing water to ensure the safe continuation of an activity is monitored. Static water levels are also used to determine the flow direction and hydraulic gradient within an aquifer. Where possible all of the above-mentioned borehole's water levels need to be recorded during each monitoring event.

11.1.1 Monitoring Frequency

In the operational phase and closure phase, weekly water level monitoring and monthly water quality monitoring is recommended. A monitoring programme should be dynamic to accommodate the expansion of infrastructure and/or addition of potential pollution sources.

11.2 Monitoring Boreholes/Observation Wells

DWAF (1998) states that "A monitoring hole must be such that the section of the groundwater most likely to be polluted first, is suitably penetrated to ensure the most realistic monitoring result."[10]

The monitoring boreholes as piezometers can be utilised for water level monitoring during construction. However, the monitoring positions should be based on construction plans and the layout of the site of development.

11.3 Water Quality Monitoring

The quality of water discharged should be monitored for the following parameters within the framework of SANS 241: 2015 Part 1[11].

Suggested Parameters for Detection Monitoring:

- Physical parameters:
    - pH and Electrical Conductivity (EC).
- Chemical determinands:
    - Alkalinity (Total Alkalinity), Ammonia (NH3 as N), Chemical Oxygen Demand (COD), Chlorides (Cl), Nitrate (NO3 as N), pH, Potassium (K), Total Dissolved Solids (TDS), Suspended solids, Turbidity, Calcium (Ca), Fluoride (F), Magnesium (Mg), Sodium (Na), Sulphate (SO4), Orthophosphate (PO_4 as P).

[10] Department of Water Affairs and Forestry (DWAF). (1998). Minimum Requirements for the Water Monitoring at Waste Management Facilities. CTP Book Printers. Cape Town.

[11] South Africa Bureau of Standards (SABS), 2015. South African National Standard (SANS) 241 Part 1: Microbiological, physical, aesthetic and chemical determinands, Edition 2. Pretoria, 2015. pp 17.

12 RISK ASSESSMENT

12.1.1 Assessment Criteria

The criteria for the description and assessment of groundwater impacts were drawn from the EIA Regulations, published by the Department of Environmental Affairs and Tourism (April 1998) in terms of the NEMA[12].

In order to determine the significance of an impact, the following criteria would be used: extent, duration, intensity and probability. The extent and probability criteria have five parameters, with a scaling of 1 to 5. Intensity also has five parameters, but with a weighted scaling.

The assessment of the intensity of the impact is a relative evaluation within the context of all the activities and other impacts within the framework of the project. The intensity rating is weighted as 2 since this is the critical issue in terms of the overall risk and impact assessment (thus the scaling of 2 to 10, with intervals of 2). The intensity is thus measured as the degree to which the project affects or changes the environment.

The level of detail as depicted in the EIA regulations was fine-tuned by assigning specific values to each impact. In order to establish a coherent framework within which all impacts could be objectively assessed, it was necessary to establish a rating system, which was applied consistently to all the criteria. For such purposes, each aspect was assigned a value, ranging from one (1) to five (5), depending on its definition. This assessment is a relative evaluation within the context of all the activities and the other impacts within the framework of the project. An explanation of the impact assessment criteria is defined below in Table 14.

[12] Guideline document EIA regulations (April 1998): Implementation of sections 21, 22 and 26 of the environment conservation act.

Table 14: Explanation of the EIA criteria

Criteria	Description
Nature	Includes a description of what causes the effect, what will be affected and how it will be affected.
Extent	The physical and spatial scale of the impact.
Duration	The lifetime of the impact is measured in relation to the lifetime of the proposed development.
Intensity	Examining whether the impact is destructive or benign, whether it destroys the impacted environment, alters its functioning, or slightly alters the environment itself.
Probability	This describes the likelihood of the impacts actually occurring. The impact may occur for any length of time during the lifecycle of the activity, and not at any given time.
Status	Description of the impact as positive, negative or neutral.
Significance	A synthesis of the characteristics described above and assessed as low, medium or high. A distinction will be made for the significance rating without the implementation of mitigation measures and with the implementation of mitigation measures.
Confidence	This is the level of knowledge/information that the environmental impact practitioner or a specialist had in his/her judgement.
Reversibility	Examining whether the impacted environment can be returned to its pre-impacted state once the cause of the impact has been removed.
Replaceability	Examining if an irreplaceable resource is impacted upon
Cumulative	Synthesis of different impacts in concert, considering the knock-on impacts thereof.

12.1.2 Nature and Status

The nature of the impact is the consideration of what the impact will be and how it will be affected. This description is qualitative and gives an overview of what is specifically being considered. That is, the nature considers 'what is the cause, what is affected, and how is it affected. The status is thus given as being positive, negative or neutral, and is deemed to be either direct or indirect in impact.

12.1.3 Extent

The physical and spatial scale of the impact is classified in Table 15.

12.1.4 Duration

The lifetime of the impact is measured in relation to the lifetime of the project, as per Table 16.

12.1.5 Intensity

This will be a relative evaluation within the context of all the activities and the other impacts within the framework of the project, as per Table 17.

12.1.6 Probability

This describes the likelihood of the impacts actually occurring. The impact may occur for any length of time during the lifecycle of the activity, and not at any given time. The probability classes are rated in Table 18.

12.1.7 Level of Significance

The level of significance is expressed as the sum of the area exposed to the risk (extent), the length of time that exposure may occur over in total (duration), the severity of the exposure (intensity) and the likelihood of the event occurring (probability). This leads to a range of significance values running from 'no impact' to 'extreme'.

The significance of the impacts has been determined as the consequence of the impact occurring (reflection of chance of occurring, what will be affected (extent), how long will it be affected, and how intense is the impact) as affected by the probability of it occurring, this translates to the following formula:

Significance value = (Extent + Duration + Intensity) x Probability

Each impact is considered in turn and assigned a rating calculated using the results of this formula and presented as a final rating classification according to Table 16. A distinction will be made for the significance rating of (a) without the implementation of mitigation measures, and, (b) with the implementation of mitigation measures.

12.1.8 Identifying Potential Impacts with Mitigation Measures

In order to gain a comprehensive understanding of the overall significance of the impact, after implementation of the mitigation measures, it will be necessary to re-evaluate the impact. Significance with mitigation is rated on the following scale as contemplated in Table 19 below.

Low (L): The impact is mitigated to the point where it is of limited importance.

Medium (M): Notwithstanding the successful implementation of the mitigation measures, to reduce the negative impacts to acceptable levels, the negative impact will remain of significance. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw.

High (H): The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded as high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high significance, after mitigation could render the entire development option or entire project proposal unacceptable.

12.1.9 Impact Assessment

Based on the impact assessment criteria as detailed in the preceding paragraph an impact rating is given in Table 17. The table also summarises all the groundwater related EMP's and should be implemented during the planned activties.

Table 15: Impact Extent

Criteria	Description	Scoring	Sunnyside Labour Campus Development
Without Mitigation (WOM)			
Footprint	The impacted area extends only as far as the activity, such as footprint occurring within the total site area.	1	1
Site	The impact could affect the whole, or a significant portion of the site.	2	
Local	Impact could affect the adjacent landowners.	3	
Regional	Impact could affect the wider area around the site, that is, from a few kilometres, up to the wider Council region	4	
National	Impact could have an effect that expands throughout a significant portion of South Africa – that is, as a minimum has an impact across provincial borders.	5	
With Mitigation (WM)			
Footprint	The impacted area extends only as far as the activity, such as footprint occurring within the total site area.	1	1
Site	The impact could affect the whole, or a significant portion of the site.	2	
Local	Impact could affect the adjacent landowners.	3	
Regional	Impact could affect the wider area around the site, that is, from a few kilometres, up to the wider Council region	4	
National	Impact could have an effect that expands throughout a significant portion of South Africa – that is, as a minimum has an impact across provincial borders.	5	

Table 16: Impact Duration

Criteria	Description	Scoring	Sunnyside Labour Campus Development
Without Mitigation (WOM)			
Short term	The impact will either disappear with mitigation or will be mitigated through a natural process in a period shorter than any of the development phases (i.e. less than 2 years).	1	1
Short to Medium term	The impact will be relevant through to the end of the construction phase (i.e. less than 5 years).	2	
Medium term	Impact will last up to the end of the development phases, where after it will be entirely negated (i.e. related to each phase development thus less than 10 years).	3	
Long term	The impact will continue or last for the entire operational lifetime of the development but will be mitigated by direct human action or by natural processes thereafter (i.e. during decommissioning) (i.e. more than 10 years, or a maximum of 60 years).	4	
Permanent	This is the only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient (i.e. will remain once the site is closed).	5	
With Mitigation (WM)			
Short term	The impact will either disappear with mitigation or will be mitigated through a natural process in a period shorter than any of the development phases (i.e. less than 2 years).	1	1
Short to Medium term	The impact will be relevant through to the end of the construction phase (i.e. less than 5 years).	2	
Medium term	Impact will last up to the end of the development phases, where after it will be entirely negated (i.e. related to each phase development thus less than 10 years).	3	
Long term	The impact will continue or last for the entire operational lifetime of the development but will be mitigated by direct human action or by natural processes thereafter (i.e. during decommissioning) (i.e. more than 10 years, or a maximum of 60 years).	4	
Permanent	This is the only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient (i.e. will remain once the site is closed).	5	

Table 17: Impact Intensity

Criteria	Description	Scoring	Sunnyside Labour Campus Development
Without Mitigation (WOM)			
Low	The impact alters the affected environment in such a way that the natural processes or functions are not affected.	2	4
Low-Medium	The impact alters the affected environment in such a way that the natural processes or functions are slightly affected.	4	
Medium	The affected environment is altered, but functions and processes continue, albeit in a modified way.	6	
Medium-High	The affected environment is altered, and the functions and processes are modified immensely.	8	
High	Function or process of the affected environment is disturbed to the extent where the function or process temporarily or permanently ceases.	10	
With Mitigation (WM)			
Low	The impact alters the affected environment in such a way that the natural processes or functions are not affected.	2	2
Low-Medium	The impact alters the affected environment in such a way that the natural processes or functions are slightly affected.	4	
Medium	The affected environment is altered, but functions and processes continue, albeit in a modified way.	6	
Medium-High	The affected environment is altered, and the functions and processes are modified immensely.	8	
High	Function or process of the affected environment is disturbed to the extent where the function or process temporarily or permanently ceases.	10	

Table 18: Impact Probability

Criteria	Description	Scoring	Sunnyside Labour Campus Development
Without Mitigation (WOM)			
Improbable	The possibility of the impact occurring is none, due either to the circumstances, design or experience (less than 24% chance of occurring).	1	2
Possible	The possibility of the impact occurring is very low, either due to the circumstances, design or experience (25 – 49%).	2	
Likely	There is a possibility that the impact will occur to the extent that provisions must therefore be made (50 – 69%).	3	
Highly likely	It is most likely that the impacts will occur at some stage of the Development. Plans must be drawn up before carrying out the activity (70 – 89%).	4	
Definite	The impact will take place regardless of any prevention plans, and only mitigation actions or contingency plans to contain the effect can be relied upon (90 – 100%).	5	
With Mitigation (WM)			
Improbable	The possibility of the impact occurring is none, due either to the circumstances, design or experience (less than 24% chance of occurring).	1	1
Possible	The possibility of the impact occurring is very low, either due to the circumstances, design or experience (25 – 49%).	2	
Likely	There is a possibility that the impact will occur to the extent that provisions must therefore be made (50 – 69%).	3	
Highly likely	It is most likely that the impacts will occur at some stage of the Development. Plans must be drawn up before carrying out the activity (70 – 89%).	4	
Definite	The impact will take place regardless of any prevention plans, and only mitigation actions or contingency plans to contain the effect can be relied upon (90 – 100%).	5	

Table 19: Impact Significance

Criteria	Description	Scoring	Sunnyside Labour Campus Development
Without Mitigation (WOM)			
No Impact	There is no impact.	0-9	12
Low	The impacts are less important, but some mitigation is required to reduce the negative impacts.	10 - 24	
Medium	The impacts are important and require attention; mitigation is required to reduce the negative impacts.	30 - 49	
Medium to High	The impacts are of medium to high importance; mitigation is necessary to reduce negative impacts.	50 - 74	
High	The impacts are of high importance and mitigation is essential to reduce the negative impacts	75 - 89	
Extreme	The impacts present a fatal flaw, and alternatives must be considered.	90 - 100	
With Mitigation (WM)			
No Impact	There is no impact.	0-9	4
Low	The impacts are less important, but some mitigation is required to reduce the negative impacts.	10 - 24	
Medium	The impacts are important and require attention; mitigation is required to reduce the negative impacts.	30 -49	
Medium to High	The impacts are of medium to high importance; mitigation is necessary to reduce negative impacts.	50 - 74	
High	The impacts are of high importance and mitigation is essential to reduce the negative impacts	75 - 89	
Extreme	The impacts present a fatal flaw, and alternatives must be considered.	90 - 100	

12.2 Mitigation Measures

The suggested mitigation measures for the operation are summarised in the following paragraphs based on the risk assessment performed.

12.2.1 Lowering of Groundwater Levels

The mitigation measures/management measures applicable to the lowering of groundwater levels during operations are listed in Table 20.

Table 20: Mitigation Measures for the Management of Groundwater Level Lowering

Significance Rating (WOM)	Impact	Management Options	Significance Rating (WM)
8	Lowering of Groundwater Levels	Ensure that the appropriate design facilities (berms, storm water channels etc.) are constructed to ensure clean and dirty water is separated at the site of development.	8
		Groundwater monitoring boreholes/piezometers should be installed at pre-determined positions based on infrastructure layout, to monitor the response of the groundwater regime to dewatering.	
		Monitor static groundwater levels on a weekly basis or as needed in all boreholes/piezometers during dewatering activities.	
		The water quality of the water removed due to construction related activities must be monitored on a monthly basis, to ensure that the quality of water leaving the site is of acceptable quality.	
		The monitoring results must be interpreted monthly by a qualified hydrogeologist and the monitoring network should be audited annually to ensure efficiency.	
		Clean and dirty water systems should be separated to prevent cross-contamination.	

13 CONCLUSIONS AND RECOMMENDATIONS

Geo Pollution Technologies (Pty) Ltd (GPT) was appointed by Seaton Thomson and Associates (Seaton) to conduct a hydrogeological investigation for the proposed development in the Sunnyside Labour Campus located on Property of Sunnyside in Pretoria. The proposed development entails the construction of a building with a basement below the expected groundwater depth.

13.1 Site Location and Site Information

The area is characterised by a flat topography and in the area of the site the slope is more or less in the order of 1:100 (0.01).

Locally, surface drainage is towards the Apies River that flows from south to north eventually flowing into the Pienaars River, a tributary of the Crocodile River. The proposed area is located with the Limpopo Water Management Area in quaternary catchment, A23D, characterised by urban development near the central business district of the City of Tshwane. The Apies River is sustained by springs and baseflow from dolomitic springs at the Pretoria Fountains. The Apies River is canalised for the majority of its course in urban areas and integrated with the stormwater drainage in the city.

The proposed site of development is located in the summer rainfall region of Southern Africa with precipitation usually occurring in the form of convectional thunderstorms. The average annual rainfall (measured over a period of 76 years) is approximately 573 mm, with the high rainfall months between November and March.

13.2 Geological and Hydrogeological Setting

The proposed site of development is underlain by Hekpoort Formation rocks which comprise of andesitic lavas which commonly weather/decompose into clayey material with zones of weathering extending between 10 and 30 m. Excavation and bore drilling exposed andesite rock with a zone of weathering of up to 10.5 m. The degrees of weathering and fracturing decrease with depth. Amygdoidal basalt was found to underlie the andesitic bedrock at some places below the zone of weathering and are thought to be competent bedrock.

Hekpoort Formation Lavas rocks typically act as secondary aquifers (intergranular and fractured rock aquifers). However, the multi-layered weathering system present on these rocks could prove to have up to two aquifer systems present in the form of a shallow, weathered aquifer with a weathered, intergranular soft rock base associated with the contact of fresh bedrock and the weathering zone; and a fractured bedrock aquifer. The aquifers commonly weather/decompose into clayey material with zones of weathering extending between 10 and 30 m. Groundwater development in this formation of the Pretoria Group (Transvaal Supergroup) are associated with fractured zone (faults, fractures, contact zones, and joints) below the zone of weathering. Borehole yield commonly ranges between 2 and 2.5 l/s, depending on recharge potential controlled by the permeability of the vadose zone. Static water levels typically lie between 5 and 30 mbgl. Water is generally of acceptable quality with mean pH and EC values of 7.5 and 52 mS/m, respectively.

The commonly expected values of porosity and permeability for igneous rock types, similar to those present in the Hekpoort Formation Lavas, are 0.05 (porosity) and 10^{-5} $m.d^{-1}$ (hydraulic conductivity, K) respectively. The maximum K value given to Hekpoort Formation andesitic lavas is 0.032 $m.d^{-1}$.

13.3 Results of the Investigation

A hydrocensus survey was carried out on the 12 September 2018 in order to locate and identify water resources and water users on the property under investigation and the immediate surroundings of the area. The following features, all of which were sampled, were identified:

- The excavation at the Trevenna site;
- The Walkerspruit, a tributary of the Apies River, upstream of the Sunnyside site;
- The Apies River upstream and downstream of the site.

The groundwater level measurements recorded during the geotechnical survey were consulted. Water levels in three piezometers ranged between a minimum of 2.25 m and a maximum of 8.5 m below ground level. The average depth to water level was found to be 4.9 m.

The direction of groundwater flow is northerly and north-westerly, towards the Walkerspruit and Apies River (naturally).

13.4 Water Quality Assessment

The analytical results are compared with the maximum recommended concentrations for domestic use as defined by the SANS 241-1: 2015 or the general authorisation wastewater limits applicable to wastewater discharge to the water resource. The following observations were made:

- None of the constituents analysed for exceed the SANS standards.
- None of the constituents analysed for exceed the wastewater limits applicable to wastewater discharge to the water resource

The samples were also analysed for hydrocarbon compounds. The following observations were made:

- No concentrations of the targeted hydrocarbon compounds analysed for were detected in the excavation sample and the Apies River upstream of the site.
- Unidentified hydrocarbon compounds were detected in the Walkerspruit and Apies River downstream of the site. The source of which is unknown.

13.5 Aquifer Classification and Vulnerability Assessment

The GDT calculated a vulnerability value of 54% for the aquifer which is classified as medium. Based on information collected during the hydrocensus it can be concluded that the aquifer system in the study area can be classified as a "Minor Aquifer System". A Groundwater Quality Management Index of 4 was estimated for the study area from the ratings for the Aquifer System Management Classification. According to this estimate a medium-level groundwater protection is required for the aquifer.

13.6 Groundwater Seepage Rate

Estimating groundwater into the Trevenna excavation for the building foundation during construction took into consideration hydrogeological and hydraulic parameters, the size of the excavation, and the duration of dewatering for construction purposes. The method used to estimate groundwater inflow into the excavation was Darcy's Law (Q= KiA).

The volume of groundwater inflow was estimated for the range of hydraulic conductivities given as the average (0.01 md^{-1}) and the maximum (0.032 md^{-1}) K-values for Hekpoort Formation andesite. The estimated groundwater inflow into the current extent of the excavation at Trevenna are:

- Based on average K-value :16 m^3d^{-1};
- Based on maximum K-value: 54 m^3d^{-1}.

During construction groundwater inflow will have to be dewatered at a rate more than inflow. This will trigger the following water uses 21 (j):

"*Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people*."

However, as the water qualities and dewatering volumes are not expected to exceed the following general authorisations[13], the water can be abstracted and discharged into the Apies River:

1. *may remove up to 100 cubic meters of water on any given day, if the removing of water -*

    a. the water does not impact on the water resource or any other persons water use, property or land;

    b. is not detrimental to the health and safety of the public in the vicinity of the activity; and

    c. does not detrimentally impact on the stability or health of the surrounding ecological functioning of the hydrologically linked water resources

    d. the removal of water is not harmful or potentially harmful to human health, or to any water resource.

13.7 Lowering of Groundwater Levels

The aim of dewatering is to lower the water table around the excavation so as to form a cone of depression around the excavation. In this way the activity will lead to lowering of the water table. However, due to a high demand for water supply, the main water supply for the population of Pretoria is derived from surface water sources. No groundwater users were identified within the immediate area surrounding the proposed site of development.

13.8 Impacts on Water Quality

Water inflows removed from construction areas will be pumped into the municipal stormwater drainage system which is eventually released into the Apies River downstream. Dewatering at the site of planned development is not expected to impact on water quality of the immediate catchment area negatively. It is expected that the current status quo will be maintained in the receiving streams and rivers. The current water quality on site is of acceptable quality (drinking water quality).

The following management options are suggested:

- Ensure that the appropriate design facilities (berms, storm water channels etc.) are constructed to ensure clean and dirty water are separated at the site of development.

[13] Revision of general authorisations in terms of section 39 of the National Water Act, 1998 (ACT 36 of 1998), No, 665. September 2013

- Water removed from underground may be disposed of into Apies River and its tributaries, provided that it has not been in contact with waste or waste water. The water quality of the water removed due to construction related activities must be monitored on a monthly basis, to ensure that the quality of water leaving the site is of acceptable quality.
- The monitoring results must be interpreted monthly by a qualified hydrogeologist and the monitoring network should be audited annually to ensure efficiency.
- Clean and dirty water systems should be separated to prevent cross-contamination.

13.9 Recommendations

Based on the findings of the study and the nature of the proposed activity, the following recommendations are made:

- Before construction, the water in the pit should be pumped out are rate less than 100 m^3/day, with daily volume measurements.
- During construction any additional seepage should be continually pumped out. As it is permissible to discharge into the Apies River, with weekly quality monitoring of the following parameters:
    - pH
    - Electrical conductivity
    - Faecal coliforms
- Monthly quality monitoring of the following parameters:
    - pH
    - Electrical conductivity
    - Faecal coliforms
    - Ammonia as Nitrogen
    - Nitrate as Nitrogen
    - Chlorine as free chlorine
    - Suspended solids
    - Ortho -phosphate
    - Fluoride
    - Soap, oil and grease
    - Dissolved Arsenic
    - Dissolved Cadmium
    - Dissolved Chromium
    - Dissolved Copper
    - Dissolved Cyanide
    - Dissolved Iron
    - Dissolved Lead
    - Dissolved Manganese
    - Mercury and its compounds

  - Dissolved Selenium
  - Dissolved Zinc
  - Boron
- If the groundwater cannot be used in the building it is recommended that the basement be waterproofed to block groundwater influx or discharged to the stormwater system. The discharge will then have to adhere to the monitoring requirements outlined above.

APPENDIX I: LABORATORY CERTIFICATE OF ANALYSIS

This page was left intentionally blank

STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS

CITY OF TSHWANE METROPOLITAN MUNICIPALITY

STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS

ISSUED BY:

The General Manager
Water & Sanitation
P O Box 1022
PRETORIA
0001

The General Manager
Roads & Stormwater
P O Box 1409
PRETORIA
0001

Munitoria
Cnr Vermeulen and
Van *d*er Walt Streets
Pretoria
0002

Third Edition 2005

CITY OF TSHWANE METROPOLITAN MUNICIPALITY

STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS

ISSUED BY:

The General Manager
Water & Sanitation
P O Box 1022
PRETORIA
0001

The General Manager
Roads & Stormwater
P O Box 1409
PRETORIA
0001

Munitoria
Cnr Vermeulen and
Van *d*er Walt Streets
Pretoria
0002

Third Edition 2005

CITY OF TSHWANE METROPOLITAN MUNICIPALITY

STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS

CONTENTS

Definitions and Interpretation

Words relating to any gender shall include the other genders

SERIES 0 : GENERAL

SECTION 001 : GENERAL REQUIREMENTS AND CHARGES

CONTENTS

01 SCOPE

This section covers the principles, responsibilities and requirements applicable to the Contract as a whole, to certain tender conditions, as well as to all work and costs involved in the establishment of the Contractor's organization, camps and construction equipment on the Site, and their removal after completion of the work.

02 APPLICATION

This section, like the General Conditions of Contract and Special Conditions of Contract, contains requirements of a general nature and as such also deals with matters covered by the General Conditions of Contract and Special Conditions of Contract. This section applies to all sections of these Specifications.

This section does not intend to alter or replace the General Conditions of Contract and Special Conditions of Contract in any way but purports to complement them by providing more specific details and requirements and it should therefore be read in conjunction with both these documents.

Where reference is made in these Specifications to the General Conditions of Contract only, such reference shall also imply reference to the Special Conditions of Contract, and vice versa.

03 ABBREVIATIONS

For the purposes of these Specifications the abbreviations listed below shall apply and shall have the meanings as given. Abbreviations of units of measurement shall be the standard abbreviations as set out in the SI system. Where necessary, further abbreviations and their meanings will be shown on the Drawings or given elsewhere in the Specifications.

AASHTO	:	American Association of State Highway and Transportation Officials
ASTM	:	American Society for Testing and Materials
BS	:	British Standards Institution
CBR	:	California Bearing Ratio
CP	:	British Standard Code of Practice
CSIR	:	Council for Scientific and Industrial Research
CKS	:	SANS Co-ordinating Specification
OMC	:	Optimum Moisture Content
PI	:	Plasticity Index
SANS	:	South African National Standards published by Standards, South Africa, a division of SABS Holdings (Pty) Ltd.
TMH	:	Technical Methods for Highways of the National Institute for Transport and Road Research.
WISA	:	Water Institute of South Africa

04 CONTRACT RATES

04.01 Contract rates

In computing the final Contract Price, payments shall be based only on the actual quantities of authorized work done in accordance with the Specifications, the Drawings and the Engineer's instructions.

The Contract rates shall apply, subject to the provisions of the General Conditions of Contract and Special Conditions of Contract, irrespective of whether the actual quantities are more or less than the scheduled quantities.

Where reference is made in these Specifications to a tendered rate, price or lump sum, it shall be construed to mean the rate, price or lump sum accepted by the Employer by the acceptance of the Tender.

04.02 Rates to be inclusive

The Contractor shall accept the payment for which provision is made in the Contract and as represented by the rates tendered by him in the Schedule of Quantities as payment in full for executing, completing and maintaining the work as specified and described in the pay items, for procuring, furnishing, installing and/or placing all materials, for labour, supervision, plant, tools and equipment, for wastage, transport, loading and off-loading, handling, storage, maintenance, temporary work, testing, quality control including process control, overheads and profit, for all risks, liabilities and obligations described or implied in the Contract, for Regional Services levies, for all fees, taxes, levies and other charges and amounts in respect of patented and other protected rights, for all other incidentals necessary for the completion of the work and maintenance during the defects liability period as well as for any items of work listed in the pay item description. Value Added Tax (VAT) shall be calculated and added separately.

This subclause shall fully apply to all pay items, except where the requirements may have been specifically amended in a particular case.

04.03 Pay items

The descriptions under the pay items in each section of the Specifications, which indicate the work for which allowance should be made in the tendered rates for such pay items, are for the guidance of the Contractor and do not necessarily repeat all the details of work and materials required by and described in the Specifications. The pay items for each section shall be deemed to cover payment collectively for all the work specified in that section.

The description in the pay items shall be read in conjunction with the relevant documents of the Contract and the Contractor shall, when tendering, make allowance for his rates to be all-inclusive as specified in subclause 04.02 above. Value Added Tax (VAT) shall however be shown separately.

04.04 Rate only items

Opposite an item in the Schedule of Quantities where no quantity is given but where a "rate only" is required, the Contractor shall fill in a rate or price which will constitute payment for any work that may be required under this item. Such "rate only" items shall be used where it is anticipated that little or no work will be required under the item, or where the item is an alternative to another item where a quantity is given, or for variations in rates of application or mix proportions in certain items of work.

04.05 The meanings of certain words and phrases

Where one or more of the words "supply", "procure", "provide" or "furnish" (material) are used, it shall mean the supply and delivery to the point of use of all materials of any kind whatsoever required for the work covered by the particular pay item, including all tax, purchase costs, claims, damages, royalties and transport costs involved, but excluding overhaul where this is applicable. In the case of borrow materials, stone and sand, it shall also include all negotiations with the owners concerned, excavation, producing, preparing, processing, testing, hauling and delivering the material to the point of use, as well as the construction, repair, maintenance and making good after completion of all access roads, and all work required for the opening, using and finishing off of borrow pits when this is not covered by other pay items in the Schedule of Quantities.

The phrase "placing material" shall, in the case of earthworks and roadworks, mean the off-loading, spreading, blending, processing, watering, mixing, shaping and compaction (where specified) of the material in the embankment, road or parking area prism, pavement layers, shoulders, sidewalks, banks and bypasses, as well as the procurement, supply, application and admixing of water, the breaking down of oversize material, the removal of oversize material which cannot be broken down, the correcting of irregular or uneven surfaces or deficient thickness, finishing off to within the specified tolerances, refilling test holes, and the maintaining of the completed work. In the case of asphalt courses and bituminous treatments, it shall also mean the heating and spraying of binder, the spreading of aggregate or asphalt mixtures, rolling, compacting, finishing off to within the specified tolerances, and maintaining the completed work.

"Concrete work" shall mean the supply of all materials, the manufacturing, placing, compacting, curing, testing and repairing of the concrete, the finishing of the concrete surfaces, and the construction of contraction and construction joints.

Where the phrase "The tendered rate shall include full compensation..." or any similar phrase is used in the description of a pay item, the word "include" shall not signify that the compensation is limited to the items of work or cost listed but that the compensation covers, inter alia, the items listed.

05 ALTERNATIVE OFFERS

The Tenderer may, when so permitted in the Project Specifications, submit prices with his Tender for designs prepared by him or on behalf of him as alternatives to the structures, systems, layouts, materials, etc, included in the Tender Documents.

When submitting alternatives, the Tenderer shall in any case complete the pricing of the Schedule of Quantities for the original design. Should the Contractor fail to comply with this requirement, the Tender may not be given further consideration.

Unless the contrary is stipulated in the alternative offer, it shall be assumed that the acceptance of the alternative offer does not constitute an amendment to the time for completion tendered for the original design.

All alternative designs shall be submitted with the Tender, and no alternative designs submitted after the closing date of the tender will be considered when tenders are adjudicated.

Alternative offers submitted and agreed to in writing during the currency of the Contract shall be dealt with as an amendment to the original Contract. It will not constitute a variation in terms of the General Conditions of Contract unless specifically so agreed.

In order to enable the Employer to adjudicate such alternative offers, the following requirements shall be complied with:

05.01 Design specifications

The designs shall be executed in strict accordance with the codes of practice and the requirements specified in the Project Specifications or as prescribed by the Engineer for the type of alternative offered. Where no such specifications are given, the Tenderer shall obtain the Engineer's requirements before submitting his alternative offer.

05.02 Calculations

Preliminary calculations and all relevant data shall be submitted with the Tender. Such calculations shall be set out in a clear and logical manner in order to facilitate their checking. A full description of the design assumptions and codes of practice used shall accompany the calculations.

05.03 Drawings

Drawings of the alternative designs, prepared in accordance with the requirements of SANS 10143, shall, when applicable, also be submitted with the Tender. These drawings shall be to a suitable scale. Sufficient large-scale sections and other details shall also be submitted to show up clearly all dimensions. Foundation levels and sizes shall also be given in the case of structures.

05.04 Further details

If the Engineer should find that the calculations and drawings submitted for alternative designs are not sufficiently complete for proper evaluation, it may mean that no further consideration will be given to such alternative designs. The Engineer, however, reserves the right to call on the Tenderer to submit such further calculations and drawings as may be required.

If such further details are not submitted within ten days of being requested, the alternative designs may not be given further consideration.

05.05 Completion of accepted alternative design

If the Tender for an alternative design is accepted by the Engineer, a complete set of working drawings, conforming in all respects to the requirements of the Engineer, shall be submitted for approval before construction may be proceeded with. The Engineer will indicate which drawings are acceptable and which are not.

Drawings submitted by the Contractor and which are accepted and signed by the Engineer shall form an integral part of the Contract Documents. Drawings not accepted and signed by the Engineer shall neither be permitted on the Site of Works for construction purposes nor be used for the manufacture of any item. Notwithstanding the approval and/or acceptance and signing of the drawings, the Contractor shall take full responsibility for all details, discrepancies, omissions, errors, etc, in respect of the said drawings as well as for the integrity of the design. The Contractor shall submit only fully completed drawings and shall not be entitled to claim for delays resulting from the submission of incomplete drawings. The Engineer shall require a period of four to eight weeks, depending on circumstances, for reviewing the complete drawing(s).

Separate payment will not be made for the design, preparation and submission of drawings, and all such costs shall be included in the rates tendered for the relevant pay items of the alternative offer.

05.06 Acceptance of alternative designs

Tenderers shall note that the acceptance of a Tender which includes alternative designs signifies that the alternative designs have been approved only in principle and on the basis of an examination of the broad details supplied with the Tender. Once the Tender has been accepted, the Contractor shall supply detailed working drawings and calculations which shall be checked by the Engineer. Should the design not comply with all the requirements specified, or not be in accordance with accepted design practice or applicable codes, or should there be obvious deficiencies that would prejudice its intended function or structural integrity, the Contractor shall suitably amend the designs in accordance with the Engineer's instructions. Such amendments shall not entitle the Contractor to adjust the price or prices tendered for the alternative designs offered.

05.07 Responsibility for design

The Contractor shall be held solely responsible for conforming to the specified design requirements and for the integrity and functionality of the alternative design offered. He shall be liable for all damages, direct and consequential, resulting from the design which has proved to be deficient in any respect, regardless of when this deficiency is discovered.

As regards the design of the alternative, Tenderers are referred to the Engineering Profession Act, 2000 (Act 46 of 2000).

The Tenderer shall offer to take out Professional Indemnity Insurance and the amount offered and the period for which it will be maintained shall be indicated by the Tenderer in a covering letter to his Tender. Allowance shall be made in the rates or amounts tendered for the alternative for the cost of such insurance.

The Engineer's approval of the design will neither relieve the Contractor of his responsibilities as stated above nor will it constitute an assumption of any such responsibilities or liabilities by the Engineer on behalf of the Contractor.

05.08 Basis of payment for alternative designs

The Tenderer shall submit his price for each alternative design by way of a lump-sum price, together with a fully priced Schedule of Quantities, in accordance with the measurement and payment clauses of the relevant sections of the Specifications, suitably amended where necessary, showing how the lump sum is made up.

This Schedule of Quantities shall be used for purposes of monthly progress payments as the work proceeds, up to a maximum equal to the lump sum tendered for the alternative offer.

The tendered lump sum shall, if accepted, be the full and inclusive price for the alternative, which sum shall not be subject to alteration, except as provided hereinafter.

Tenderers who have submitted Tenders for alternative designs that do not conform to the design requirements may be requested to modify such designs in order to conform to the design requirements, but no alteration to the tendered lump sum for the structure will be allowed on account of such modifications. Furthermore, alterations to the tendered lump sum will not be allowed on account of any errors in the quantities, extensions or additions in the Schedule of Quantities.

Where the Engineer requires modifications in the design for reasons other than failure to conform to the design requirements or errors in designs, as for example foundation conditions which differ materially from those indicated by the test holes, the Contractor shall effect such modifications. Where this results in a variation in the quantities of work to be done, such variations in quantities shall be valued in accordance with the rates and prices in the Schedule of Quantities and the tendered lump sum for the structure shall be adjusted upwards or downwards, depending on whether the modifications result in an increase or decrease in the quantity of work done.

06 APPROVAL

Approval of any material or plant and its operation, or of any construction procedure to be used, shall not imply any relaxation of the requirements governing the quality of the materials or of the finished work, or relieve the Contractor of his responsibilities under the Contract.

Approval which had been granted to the Contractor in the past regarding certain practices not wholly in accordance with these Specifications shall not be regarded as a precedent or waiver, and such prior practices shall not in any way prejudice the enforcement of these Specifications.

If the Engineer's Representative approves the workmanship or materials of any work, and the workmanship or materials are subsequently found to be not in compliance with the specified requirements, then the Contractor shall, at his own cost, remove and reinstate such work with work which complies with the specified requirements, if so ordered by the Engineer.

07 ACCESSES, USE OF LAND, AND TRESPASSING

The Contractor shall make arrangements with the owners or tenants in respect of access to the Site across their properties and shall pay all costs incurred in this regard.

Where existing roads are used, they shall be protected from damage by extraordinary traffic. The Contractor shall keep all gates closed and shall immediately repair any damage done by him to fences, gateways, drains or to any other structure in the execution of the Contract and shall leave everything in the same state as it was found by him.

The Contractor shall not harm or destroy any vegetation by fire or by any other means nor allow any practice which may have a detrimental effect on the environment. He shall be responsible for any damage whatsoever caused by his employees.

The Contractor shall as far as possible confine his operations to within the limits of the Site or the land provided by the Employer, but if this is inadequate for his purpose, he shall make all arrangements for any further land he may require and shall pay all costs and charges in this connection.

The Contractor shall not use the land constituting the Site of the Works or a construction camp for any purposes whatsoever other than for the proper execution of the Contract, and shall be debarred specifically from any form of trading or bartering. The Contractor shall not sell any spirituous liquors or allow them to be sold or brought within the limits of the Works, and shall in every way discourage their use and distribution.

He shall erect and maintain suitable temporary fencing wherever necessary, and he shall pay for all damage in respect of trespassing, and for all damage to the stock, crop or other property on the land, which may arise from the inefficiency or disrepair of such temporary fencing or from interference with existing fencing in the course of the work.

The Contractor's employees and those seeking employment shall be prohibited from trespassing on adjoining lands and from killing and disturbing any game, livestock or domestic animals.

08 CONTRACTOR ACTIVITIES ON PRIVATE PROPERTY

08.01 Action required prior to entering property

The Contractor shall not enter onto private property or property not belonging to the Employer for the purpose of carrying out any work in connection with the Contract without having completed the following formalities well ahead of his intended date for entering such property:

(a) The Contractor shall give notice, in writing, to the owner, lessee or occupier, on a form approved by the Engineer, of his intention of entering upon the property, together with full details of the work he intends to carry out on the property and the intended dates and duration of occupation.

(b) The Contractor shall arrange a meeting with the owner, lessee or occupier, to -

- confirm that the owner, lessee or occupier has permitted the Contractor to enter upon the property for the said purpose;
- obtain details from the owner, lessee or occupier, regarding any special precautions that should be taken by the Contractor during the execution of the Works;
- record details, with photographs if necessary, of the condition of the property at that stage, including any defects in buildings, swimming pools, outbuildings, fences, etc that may be affected by his activities;
- record in writing the details of the above; the form and substance of such records and agreements shall be subject to the Engineer's approval and a copy of the details as recorded shall be sent to the Engineer for his records and his approval.

(c) In the event of the Contractor failing to reach agreement with the owner, lessee or occupier of the property on any of the matters referred to above, the matter shall be referred to the Engineer for further action.

(d) Not less than three days before actually entering such property, the Contractor shall again give notice in writing to the owner, lessee or occupier of the exact date on which he intends to enter the property. If this date is not adhered to, he shall again give similar notice of his revised date.

08.02 Execution of the Works

The Contractor shall take all reasonable measures to limit as far as possible damage to gardens, fences, outbuildings, swimming pools and other property and disruption to the occupiers while he is working on private property. He shall particularly programme his activities so as to minimize his time of occupation.

Where normal access by way of driveways and footpaths is obstructed, he shall provide suitable temporary vehicle or pedestrian crossings. Grass and topsoil shall be carefully removed and stored separately for replacement upon completion of the work.

Upon completion of construction, the affected area shall be restored to its original condition within one week as far as this is reasonably possible, and all rubbish and debris shall be removed and all damage made good.

08.03 After completion of the work

As soon as the work on any property has been completed and the area restored as set out above, the Contractor shall obtain from the owner, lessee or occupier, on a form approved by the Engineer, a signed statement that the owner, lessee or occupier is satisfied with the condition to which the property has been restored and that he has no unsettled claims for damage. This statement shall be delivered to the Engineer.

In the event of the owner, lessee or occupier refusing to sign such statement, the matter shall be referred to the Engineer for further instructions.

08.04 Dumping on Private Property

In the case of the Contractor requesting permission to dump excavated material or any other material from the works on private property, the Contractor shall provide the Engineer with the following documentation before dumping commences:

(a) A signed indemnification by both parties, that is the Contractor and the Owner of the property on which dumping will occur. The indemnification shall exempt the City of Tshwane Metropolitan Municipality from any claims that may arise from the dumping of material on the specific property.

(b) The agreements or conditions under which dumping shall take place.

09 WORKMEN TO BE KEPT WITHIN BOUNDS

The Contractor will be responsible for keeping all persons under his control, including personnel employed by subcontractors, within bounds and will be liable for all damage to adjoining premises and property caused by workmen, by transportation, or by any other occurrence under his control.

10 EXTENT OF OCCUPATION OF SITE

The Contractor shall limit his occupation of the Site to such period and the number of working places to such number as would reasonably be necessary in the circumstances. Trenches shall not be allowed to remain open for longer than is necessary and access for the public shall be limited or restricted for as short a period as is reasonably possible.

11 TEMPORARY CLOSING OF ROADWAYS

The Contractor shall take every precaution to prevent a nuisance or an obstruction in public or private streets, roads, rights of way, footpaths and entrances and shall not interfere unnecessarily or improperly with the public convenience or the use or occupation of properties, buildings, etc.

Should the Engineer deem it advisable for any portion of a street, road, right of way, footpath or entrance to be temporarily closed, arrangements will be made by him to do so, in which case the Contractor shall comply with such orders and regulations as may be in force. The Employer will pay the cost of inserting advertisements in the public press to give notice of the intended closure and its probable duration. The Contractor shall notify the occupiers of premises along the route affected by any proposed closure of the intended closure and its probable duration and shall, as punctually as possible, reopen same at the set time or times. Should circumstances arise which could defer reopening at the appointed time, the Contractor shall inform the Engineer and notify the occupiers timeously.

Where a trench crosses or traverses the length of any public or private road, the Contractor shall exhibit road signs in advance of the barricades at such distances as to give sufficient warning to approaching traffic that work is in progress on the road. The type of sign to be used shall be approved by the Engineer, the General Manager: Roads and Stormwater and the Chief of Police, Tshwane Metropolitan Police Department.

During the hours between sunset and sunrise the road signs shall be clearly illuminated as specified in clause 26 of this section.

12 SERVICES REQUIRED BY CONTRACTOR

The Contractor is responsible for the provision of all the services he requires such as telephone, sewerage as well as water and electricity for domestic and/or construction purposes.

Should the Contractor wish to make use of the relevant authority for providing some or all of the above services, he will nevertheless remain fully responsible if the authority cannot fully meet his requirements regarding the type, capacity or quantity of the service.

Should the Contractor make use of local services, he shall make arrangements, where applicable, for connections to be made, complete with meters, from these services for use at the Site. All costs incurred in respect of these connections and the meters, pipes, cables, etc, from the connections to his facilities, the cost of the water and electricity consumed, the cost of the removal of sewage and the use of the telephone, and the cost for finally disconnecting and removing the services shall be paid by the Contractor, who shall include full compensation for such costs in his tendered rates for the various items of work requiring the use of one or more of the services. The Contractor shall furnish the Engineer with documentary proof that proper notice has been given to the relevant authority for termination of the services.

Sufficient back-up services shall be provided to ensure the uninterrupted execution of the Works such as storage tanks for water for use in the mixing of concrete, stand-by electrical power for work at night and for electrical plant and equipment used on Site.

The electrical wiring of all buildings shall be carried out by registered and licensed electricians in accordance with the requirements of SANS 10142-1 and the regulations of the local authority.

13 PROTECTION OF EXISTING SERVICES

13.01 General

Specific requirements relating to the location, protection and work in the vicinity of certain services such as electrical cables may be included in the Project Specifications.

13.02 Location of existing services

Before any underground or excavation work is carried out, the Contractor shall ascertain the presence and position of all services likely to be damaged or interfered with by his activities. For this purpose he shall obtain from the Engineer up-to-date plans showing the position of services in the area where he intends to work. As the location of services can often not be reliably determined from such plans, he shall further determine the exact position of such services by means of suitable detecting equipment and afterwards by careful hand excavation where necessary in order to expose the service at the positions of possible interference by his activities. The latter procedure shall also be followed in respect of any service not shown on plans but believed to be present.

All such services, the positions of which have been located at the critical points, shall be designated as "known" services and their positions shall be indicated on a separate set of drawings, a copy of which shall be furnished to the Engineer.

While he is in occupation of the Site, the Contractor shall be liable for all damage caused by him to known services as well as for consequential damage arising therefrom, whether caused directly by his operations or by lack of proper protection.

The locating of existing services and any hand excavations done to expose such services will be paid for separately under the measurement and payment clause of this section.

13.03 Protection during construction

The Contractor shall exercise all the necessary care to prevent damage to known services during construction operations. Major excavating equipment and other plant shall not be operated in dangerously close proximity of these services. Where necessary, excavation in close proximity of these services shall be carefully carried out by means of suitable hand tools, excluding picks wherever their use could cause damage to the services. No additional payment will apply to such more difficult work.

Services left exposed shall be suitably protected from damage.

13.04 Liability for damage and insurance

The Contractor's attention is drawn to the relevant clauses of the General Conditions of Contract and Special Conditions of Contract regarding liability for damage to the Works or property, or injury to persons arising from the construction of the Works and regarding insurance of the Works and public liability insurance to be effected.

13.05 Alterations and repairs to existing services

Unless the contrary is clearly specified or ordered, the Contractor shall not carry out any alterations to existing services. Where this may be necessary, the Contractor shall inform the Engineer, who will either make arrangements for such work to be executed by the owner of the service or instruct the Contractor to make such arrangements himself.

Where existing services are damaged by the Contractor, he shall immediately inform the Engineer and the relevant authority, and shall obtain instructions as to who should carry out repairs. In urgent cases the Contractor shall take all necessary steps to minimize damage to and the interruption of the service. No repairs shall be attempted to telecommunication cables or electric power lines and cables.

A list of the important telephone numbers to be used when services are damaged or need to be altered will be included in the Project Specifications.

No liability for damages arising from any delay in having such alterations or repairs effected will be accepted by the Employer. The Contractor shall provide all reasonable opportunity, access and assistance to persons doing alterations or repairs to existing services.

14 NOTICES, SIGNS AND ADVERTISEMENTS

The Contractor shall not erect any notices, signs or advertisements on or near the Site without the written approval of the Engineer.

As part of his general obligations, the Contractor shall supply and erect the official name-board(s), the details of which are shown on the Drawings. The name-board(s) shall be erected in the position(s) indicated by the Engineer.

All notices, signboards, the official name-board(s), and advertisements shall be removed by the Contractor on completion of the Work or by the end of the defects liability period, as may be decided by the Engineer.

15 TEMPORARY WORKS

Temporary Works will not be paid for under separate pay items, except where provision for this is specifically made elsewhere in the Specifications, and payment for temporary work not covered by specific pay items shall be included in the rates and prices tendered for the related items of permanent work which do or may require Temporary Works.

The Contractor shall be solely responsible for the safety and efficacy of all Temporary Works provided by him, but the Engineer may order such alterations or additions to be made to Temporary Works which he considers necessary for the safety of the Works or to comply with any other requirements under the Contract.

The Contractor is referred to clause 27 of this section regarding the Temporary Works required for dealing with water, and to clause 26 of this section and section 102 of these Specifications regarding temporary barricading, lighting, signposting and accommodation of traffic.

16 WORK IN RESTRICTED AREAS

In certain cases, particularly in road work, trenching, excavations for structures and in pipe jacking operations, work may have to be carried out in restricted areas or in narrow widths which would preclude the use of equipment suitable only for work in unrestricted areas or normal full-width construction.

The Contractor shall note that no reclassification of excavated material and no additional payment over and above the rates for normal construction will be made for such work, unless provision for this has specifically been made in a particular case.

17 SAFE WORKING CONDITIONS

17.01 General

The Contractor shall at all times observe adequate safety precautions on Site to ensure the safety of the public as well as of his own staff and other persons engaged in or about the Works. In this respect he shall observe all laws, ordinances and regulations pertaining to his work.

When work is carried out within a road reserve, the road surfaces not affected by the work and which remain open to traffic, shall be kept clean at all times so that gravel and debris will not be thrown up by passing vehicles, causing possible injury to persons and damage to property and other vehicles.

The contractor's attention is specifically drawn to the following Acts and Regulations, and particularly to the relevant regulations under each Act, copies of which shall at all times be kept by the contractor on the Site:

- The Occupational Health and Safety Act, 1993 (Act 85 of 1993) and its Regulations
- The Explosives Act 2003, (Act 15 of 2003)
- The Explosives Regulations, 2002
- The Mine Health and Safety Act, 1996 (Act 29 of 1966)

Should the work so require, the Contractor shall comply with the safety precautions set out in the following publications, copies of which shall also be kept by him on the Site:

- The latest edition of the Code of Practice relating to the safety of persons working in small diameter shafts and test pits for Civil Engineering purposes, obtainable from the Secretary, SA Institution of Civil Engineers.
- The latest edition of the Operation of Waste Water Treatment Works Handbook, Chapter 25, Safety, obtainable from WISA.

17.02 Occupational Health and Safety Act

The Contractor shall comply with the Occupational Health and Safety Act (Act 85 of 1993) and its Regulations.

In particular the Construction Regulations, 2003 (Government Gazette No 25207) shall be adhered to at all times.

The Employer or his Agent shall inspect the works from time to time to monitor the contractor’s compliance with the above legislation.

Where any such investigations reveal, or where it comes to the Engineer’s attention that the contractor is in any way in breach of the requirements of the above legislation, the engineer shall in accordance with the Conditions of contract, be entitled to suspend construction of the works, or any part thereof, until such time as the breach has been rectified to the satisfaction of the Engineer.

The Contractor shall have no grounds for a claim against the Employer for extension of time and/or additional costs if the construction of the works or any part thereof is suspended by the Engineer in terms of the conditions of contract.

The Contractor shall, in terms of the contract, remain fully liable for the payment of penalties for late completion should the Contractor fail to complete the works within the time for completion as a consequence of the suspension of construction for the above reason.

17.03 Health and safety plan

The health and safety plan required by the Act and supporting Regulations shall include, but not limited to, the following:

- Occupational health and safety policy
- Administrative requirements
- Risk identification and assessment including maintenance of all registers
- Training
- Incident and accident reporting
- Incident and accident investigation
- First aid
- Occupational heath and safety representatives
- Occupational heath and safety committees
- Permits
- Certificates of competence and compliance Permits
- Audits and inspections

17.04 Health and Safety file

Every Contractor shall ensure that a health and safety file, which shall include all documentation required in terms of the provisions of the Act and the relevant Regulations, is kept on site and made available to the client, agent or inspectors on request.

A Principal Contractor shall hand over a consolidated health and safety file to the client upon completion of the construction work and shall, in addition to the documentation referred to in the regulations , include a record of all drawings, designs, materials used and other similar information concerning the completed works.

A Principal Contractor shall ensure that in addition to the documentation required in the health and safety file as determined in the regulations, a comprehensive and updated list of all sub-contractors on site accountable to the principal contractor, the agreements between the parties and the type of work being done are included and available.

17.05 Safety Officer

The Contractor shall in accordance with the act and supporting regulations upon having considered the size of the project, the degree of dangers likely to be encountered or the accumulation of hazards or risks on the site, appoint a full-time or part-time construction safety officer with the necessary competencies and resources to assist him in the control of all safety related aspects on the site.

17.06 Health and safety training

The Contractor shall provide employees with the necessary information and training or supervision that is necessary to enable them to perform their work safely and without risk to health, and shall ensure that every employee becomes familiar with work-related hazards and risks and the measures that must be taken to eliminate, control and minimize those hazards and risks.

17.07 Personal protective clothing and equipment (PPE)

All employees employed on the construction site and visitors shall wear clothing and equipment as prescribed in the site hazard analysis.

The Contractor shall identify tasks requiring protective clothing and equipment and issue the necessary to employees on site.

Employees shall maintain all PPE in a safe, clean condition.

Personnel not wearing PPE where PPE is prescribed will be disciplined in accordance with the company's disciplinary code of conduct

17.08 Provision of safety fences, signs and barricades

The contractor shall in accordance with the act and supporting regulations erect fences and/or barricades to protect the public passing by or entering the construction area.

The Contractor shall, in accordance with the act and supporting regulations, erect Notices and Signs at entrances and along perimeters of the construction site indicating "No Unauthorized Entry" and "Visitors to report to Site Office". Notices and Signs at the construction site entrance instructing visitors and non-employees what to do, where to go, and where to report to on entering the site shall also be erected.

Where necessary, or as instructed by the Engineer, the Contractor shall employ security guards to safeguard safety fences, signs and barricades from theft or vandalism.

18 USE OF EXPLOSIVES

The Contractor will generally be permitted to use explosives for breaking up rock and hard material during excavations, for demolishing existing structures and for such other purposes where they may normally be required, subject to any provisions to the contrary in the Project Specifications and to the following conditions:

(a) The Engineer shall be authorized to prohibit the use of explosives in cases where, in his opinion, the risk of injury to persons or damage to property or adjoining structures is too high. Such action by the Engineer shall not entitle the Contractor to any additional payment for having to resort to other less economical methods of construction unless otherwise provided in the Project Specifications.

(b) The Engineer's prior approval shall be obtained in writing in respect of each and every blasting operation carried out. Such approval may be withheld in the event of the Contractor not acting responsibly and carefully in his use of explosives.

(c) The requirements of the Various Acts and Regulations referred to under clause 17.01 of this section and the requirements of the Inspector of Explosives shall be complied with.

(d) Where the excavation work involves the use of explosives, a method statement shall be developed in accordance with the applicable explosives legislation, by an appointed person who is competent in the use of explosives for excavation work and the contractor shall ensure that the procedures therein are followed.

(e) Where the demolition work involves the use of explosives, a method statement is to be developed in accordance with the applicable explosives legislation, by an appointed person who is competent in the use of explosives for demolition work and the contractor shall ensure that the procedures therein are followed.

(f) Before any blasting is undertaken, the Contractor shall satisfy the Engineer that he has established, in collaboration with the Employer's Manager, Insurance Operations, whether or not the insurers concerned require pre- and post-blasting inspections of buildings and structures within a certain perimeter of the proposed blasting to be carried out.

Should such inspections be required, the Contractor shall, together with the Engineer and the insurer, examine and measure up any buildings, houses or structures in the vicinity of the proposed blasting and establish and record, together with the owner, lessee or occupier thereof, the extent of any cracking or damage that may exist before the commencement of blasting operations. It shall be the responsibility of the Contractor to make good at his own expense any further damage to such houses, buildings or structures which is a result of the blasting.

(g) Where there is a reasonable possibility of damage to power and telephone lines or any other property, the Contractor shall suitably adapt his method of blasting and the size of charges and shall use adequate protective measures, such as cover blasting, to limit the risk of damage as far as possible. Specific requirements relating to certain services may be included in the Project Specifications.

(h) All accidents, injury to persons and damage to property shall be reported in detail and in writing to the Engineer as soon as is practicable.

(i) The Engineer shall be given 24 hours' notice by the Contractor before each blasting operation is carried out.

(j) Where blasting is to be performed in built-up areas or close to infrastructural components susceptible to vibration damage, the Contractor shall, before commencing blasting, employ the services of a specialist blasting consultant to prepare a method statement for approval by the Engineer, specifying in detail the requirements for all the activities related to blasting operations, to ensure that the vibration damage potential is controlled by keeping within the limiting criteria for vibration levels. These criteria shall be in accordance with acknowledged international standards, as approved by the Engineer, and shall relate to both peak particle velocity and wave frequency. The method statement shall be based on site-specific vibration characteristics determined by trial blasting as planned and monitored by the specialist-blasting consultant.

Vibrations caused by blasting operations shall be recorded by one or more blasting seismographs of a type as approved by the Engineer and in positions as described by the specialist blasting consultant.

19 WORK ON, OVER, UNDER OR ADJACENT TO A RAILWAY LINE

All work carried out on, over, under or adjacent to a railway line shall be carried out strictly in accordance with the requirements of the owner of such railway line. Specific requirements in this regard may be included in the Project Specifications.

20 SITE MEETINGS

The Contractor will be required to attend regular site meetings which will normally be held once a month to discuss general progress, quality of work, problems, claims, payments, etc, but not any matters concerning the day-to-day running of the Contract.

21 MATERIALS

The Contractor, when using materials that are required to comply with any standard specification, shall, if so ordered, furnish the Engineer with certificates showing that the materials do so comply. Where so specified, materials shall bear the official mark of the appropriate authority. Samples ordered or specified shall be delivered to the Engineer's office on the Site free of charge.

Unless otherwise specified, all proprietary materials shall be used and placed in strict accordance with the relevant manufacturer's current published instructions.

Where proprietary products have been specified, similar products may be used subject to the prior written approval of the Engineer.

Unless anything to the contrary is specified, or approved by the Engineer in writing, all manufactured articles or materials supplied by the Contractor shall be new and unused.

Earth, stone, gravel, sand, and all other materials excavated or present on the Site or in borrow areas provided by the Employer shall not become the property of the Contractor, but will be at his disposal only in so far as they are approved for use on the Contract. Existing structures on the Site shall remain the property of the Employer and, except as and to the extent required elsewhere in the Contract, shall not be interfered with by the Contractor in any way.

All materials to be included in the Works shall not be damaged in any way and, should they be damaged on delivery or by the Contractor during handling, transportation, storage, installation or testing, they shall be replaced by the Contractor at his own expense.

All places where materials are being manufactured or obtained for use in the Works, and all the processes connected therewith, shall be open to inspection by the Engineer (or other persons authorized by the Engineer) at all reasonable times, and the Engineer shall be at liberty to suspend any portion of work which is not being executed in conformity with these Specifications.

22 ORDERING OF MATERIALS

Immediately upon his Tender being accepted, the Contractor shall purchase all materials which are in short supply or for which the delivery period may be long.

The quantities set out in the Schedule of Quantities are estimated quantities. The Contractor shall therefore, before ordering materials of any kind, confirm with the Engineer the quantities required. No liability or responsibility whatsoever shall attach to the Employer for materials ordered by the Contractor except if they have been ordered in accordance with written confirmation issued by the Engineer.

23 MATERIALS SUPPLIED BY THE EMPLOYER

Materials designated in the Contract Documents to be supplied by the Employer shall not be obtained by the Contractor from any other source except from the Employer. All requisitions for materials which are to be supplied by the Employer shall be submitted in writing and shall be signed by the Contractor or his authorized representative and the Engineer.

The Contractor or his authorized representative shall sign a receipt upon delivery of all such materials which, having once been accepted by the Contractor, will be deemed to be in sound and satisfactory condition and will be his sole responsibility thenceforth.

24 REJECTION OF MATERIALS SUPPLIED BY THE EMPLOYER

The Contractor shall ensure that he accepts only sound materials from the Employer which are suitable for the purpose intended, and the Engineer shall be authorized to reject any materials on the Site of the Works, which are unsuitable, unsound or defective in any way. The Contractor shall immediately remove such rejected materials from the Site of the Works to a place designated by the Engineer and at the Employer's expense. However, should the Engineer be of the opinion that the Contractor should not have accepted the materials, such removal shall be carried out at the Contractor's expense.

25 TOLERANCES AND AUTHORIZED DIMENSIONS

The work specified in the various sections of these Specifications shall comply with the various dimensional and other tolerances specified in each case. Where no tolerances are specified, the standard of workmanship shall be in accordance with normal good practice. No guarantee is given that the full specified tolerances will be available independently of each other, and the Contractor is cautioned in regard to the fact that the liberal or full use of any one or more of the tolerances may deprive him of the full or any use of tolerances relating to other aspects of the work. The latter would apply particularly in respect of level tolerances on layer work and the related requirements regarding layer thicknesses.

In the description of certain pay items where it is stated that quantities will be determined from the "authorized" dimensions, this shall be taken to mean the dimensions as specified or shown on the Drawings or, if changed, as finally instructed by the Engineer, without any allowance for the tolerances specified. Save as hereinafter specified to the contrary, all measurements for determining quantities for purposes of payment will be based on the "authorized" dimensions.

If the work is therefore constructed in compliance with the authorized dimensions plus or minus any tolerances allowed, quantities will be based on the authorized dimensions regardless of the actual dimensions to which the work has been constructed.

Where the work is not constructed in accordance with the authorized dimensions plus or minus any tolerances allowed, the Engineer may nevertheless in his sole discretion accept the work for payment. In such cases no payment shall be made in respect of quantities of work or material in excess of those calculated from the authorized dimensions and, where the actual dimensions are less than the authorized dimensions minus any tolerance allowed, quantities for payment shall be based on the actual dimensions as constructed.

26 SIGNS AND LIGHTING

Without limiting the Engineer's right to request additional requirements in terms of the General and Special Conditions of Contract, the following shall be regarded as the minimum requirements for safety and security of the Works:

26.01 Watching

At least one watchman shall be employed after hours to patrol the Works and to ensure, inter alia, that all warning lights have been placed in position and are burning, and that road signs are illuminated.

The watchman shall have access to a telephone if available, and to a list of the relevant telephone numbers in case of an emergency.

26.02 Lighting

Open trenches shall be illuminated by red lights in the following manner:

- At least two red lights shall be placed across the ends of open trenches, at a maximum spacing of 2 m.
- Red lights shall be placed along open trenches at 10 m intervals on the road side and at 3 m intervals along the pedestrian side.
- At least one red lamp shall be placed at each of the four corners of each pedestrian crossing and at least two red lamps at each of the four corners of each vehicular crossing.
- All lamps shall be in position and burning between the hours of sunset and sunrise, and shall be provided with a chain and padlock and locked to suitable posts to prevent theft.

Open excavations (other than open trenches) which constitute a hazard to persons or traffic shall be provided with lighting as directed. The Contractor shall apply for directions from the Engineer in good time.

26.03 Fencing

Open excavations that may constitute a hazard to pedestrians and vehicular traffic, including all open trenches, shall be fenced off with stout temporary fencing in accordance with the details shown on the Drawings or as approved by the Engineer.

In addition, one line of red-and-white plastic warning tape of an approved design shall be securely fixed along the top of the fence for its full length.

27 DEALING WITH WATER

The Contractor shall deal with and dispose of all water so as to ensure that the Works are kept sufficiently dry at all times so that they can be properly executed, and he shall protect them against flood damage.

For this purpose the Contractor shall provide sufficient pumps, pipes and other equipment that may be necessary. Where necessary, the Contractor shall construct temporary berms, culverts and channels to drain away the water, but, in order to limit such work as far as possible, the permanent drainage provided in the Contract shall be constructed at the earliest opportunity as may be practicable.

Payment for dealing with water shall be included in the Contractor's rates for preliminary and general charges, except in so far as special provision for dealing with water may be made elsewhere in the Specifications.

28 VARIATIONS FROM SPECIFIED NOMINAL RATES OF APPLICATION OR NOMINAL MIX PROPORTIONS

The various sections of these Specifications prescribe nominal rates of application or nominal mix proportions for materials such as bituminous materials, aggregates, mineral fillers, stabilizing agents, paint and the like. Tenderers shall base their Tenders on these nominal rates of application and mix proportions.

Allowance is made, in the various sections of the Specifications where such rates of application and mix proportions are given, for variations arising from different rates of application or mix proportions ordered by the Engineer to suit the materials and conditions on Site in every particular case.

Where the actual rates of application or mix proportions used in the Works vary from the nominal specified rates or proportions, compensation will be adjusted as follows:

(a) As a payment to the Contractor in respect of any authorized increase in the quantities specified which has been ordered in writing by the Engineer;

or

(b) as a refund to the Employer in respect of any decrease in the quantities specified, whether such decrease results from an authorized decrease in the rates of application or mix proportions, or from unauthorized reductions made by the Contractor.

Payment for a varied rate shall be based on the actual rate of application used, provided that this does not exceed the rate of application ordered by the Engineer plus any tolerance in the rate of application allowed. If the actual rate of application exceeds the above, payment shall be based on the rate of application ordered. If the actual rate of application is below the rate of application ordered, payment shall be based on the actual rate of application regardless of any tolerance allowed. Notwithstanding the above, the Engineer shall have full authority to reject work that has been constructed at variance with the Specifications or the rates of application ordered by him.

The Employer shall be refunded for any decrease in the specified rates of application or mix proportions at the same price per unit of measurement as that tendered by the Contractor for additional materials required by an increase in the rates of application or mix proportions.

29 THE CONTRACTOR'S ESTABLISHMENT ON SITE

29.01 General

The Contractor shall establish his construction camp on a Site made available for this purpose by the Employer, or selected by him and approved by the Engineer.

The camp shall be fenced off and shall contain all offices, stores, workshops, testing laboratories, toilet facilities, etc. The camp shall always be kept in a neat and tidy condition and, upon completion of the Works, the camp shall be removed and the Site cleaned and restored to its original condition as far as is practicable, unless otherwise specified in the Project Specifications.

29.02 Housing

Unless the Contractor is specifically given permission in the Project Specifications to erect temporary housing for personnel on the Site, no personnel will be allowed to reside on the Site. Only night-watchmen may be on the Site after hours. Where permission is granted for personnel to reside on Site, provision for housing must be in accordance with the regulations of the relevant authority.

29.03 Workplace Facilities

Toilets, showers, change rooms and eating facilities shall be provided for the Contractor's personnel in accordance with Regulation 28 of the Construction Regulations, 2003 (Government Gazette No 25207) and the Facilities Regulations 1988, (Government Notice R1593 of 12 August 1988).

Such facilities shall at all times be maintained in a clean and hygienic condition and shall be sited so as not to be offensive.

The Contractor shall provide and maintain the facilities and move them to the required positions, and finally remove them, on completion of the Works, all to the satisfaction of the Health Care Division of the relevant authority. Toilets must be screened from public view and their use shall be enforced.

The Contractor shall make arrangements where necessary for the removal of night-soil.

29.04 Storage

The Contractor shall provide adequate storage accommodation for and/or protection to all perishable materials to the satisfaction of the Engineer.

All materials shall, in addition, be stored or stacked in such positions as will preclude any interference with traffic and any public rights or the progress of the Works.

Materials subject to deterioration with time shall be used in the order in which they have been received.

30 COMMUNITY LIAISON OFFICER

When scheduled, the Contractor shall appoint a Community Liaison Officer (CLO) from the local community after the person has been identified by the Ward Councillor and Ward Committee.

The Community Liaison Officer shall perform the following duties:

- Meet regularly with Ward Councillor, ward committee and the community;
- Attend and report at site meetings and PSC meetings;
- Coordinate community activities with construction works;
- Arrange special meetings;
- Interact with the Contractor daily
- Facilitate in resolving community disputes;
- Manage the labour desk
  - Coordinate local labour matters,
  - Give feedback to the community on local labour matters,
  - Recruit local labour and local entrepreneurs,
  - Keep record of the wages and labour force,
  - Facilitate in resolving labour disputes.

The contract with the CLO shall make provision for payment by the Contractor to the CLO of a maximum amount calculated as follows:

Wage per Month = CTMM's minimum B1-level monthly notch (prior to deductions)

The contractor shall also be responsible for the payment of contributions to all statutory charges

The City of Tshwane Metropolitan Municipality's (CTMM) current minimum B1-level monthly notch is specified in the Project Specifications

Only one CLO shall be appointed per project, however, the functions of CLO and labour desk may be split between persons with the understanding that the remuneration will also be split.

Should the Contractor experience any difficulty with community matters, these matters shall immediately be brought to the attention of the Engineer who shall arrange a meeting with the relevant Ward Councillor(s) and the CLO to resolve such matters.

31 MEASUREMENT AND PAYMENT

Note:

The Contractor's obligations under this section, the General Conditions of Contract and the Special Conditions of Contract will be collectively measured and paid for under pay item 001.01, except where separate pay items are provided as specified in clause 13,17 and 30 of this section or where pay items are provided under this section in the Project Specifications.

Item		Unit
001.01	**Preliminary and general charges**	
001.01.01	Fixed charges	lump sum
001.01.02	Time-related charges	lump sum

The lump sums tendered for subitems 001.01.01 and 001.01.02 shall collectively include full compensation for the following:

(a) All the Contractor's obligations in terms of the General Conditions of Contract, Special Conditions of Contract and this section of these Specifications, except the following:

- Work carried out for the purpose of locating and exposing existing services which will be paid for under pay items 001.02 and 001.03 respectively as well as work specified in the Project Specifications and for which separate pay items are provided.
- The cost of preparing alternative offers, which shall be included in the rates for items of work tendered for the alternative offers.
- Compensation for certain work of a general nature such as quality control shall be deemed to be included in the rates for the related items of work unless provision is made for separate payment.
- Compensation for risks, obligations and costs associated more specifically with a certain type of work which, at the Contractor's discretion, may be included in the rates for the related items of work.

(b) Site and head office overheads and profit.

(c) The Contractor's establishment on Site.

(d) All other obligations, costs and charges of a general nature for which no provision is made elsewhere in the Contract Documents, including but not limited to -

- moving personnel, equipment, materials and plant to the Site, setting up, maintaining and running the Contractor's establishment on Site and removing them from the Site on completion of the Works;
- controlling the quality of materials and workmanship, including the cost of performing such tests as may be necessary or required for this purpose except where the contrary is specified elsewhere;
- supplying, erecting and later removing any name-boards as specified in clause 14 of this section;
- all finishing and clearing of the Site not specified in other sections of these Specifications, and the clearing of all drainage structures and streams of debris, soil, silt and other material.

Subitem 001.01.01 "Fixed charges" shall be deemed to include full compensation for all charges that do not vary with variations in the final completion time and/or the final Contract Price.

Payment of the lump sum tendered under subitem 001.01.01 shall be made in three separate instalments as follows:

- The first instalment, which is 40% of the lump sum, will be paid when the Contractor has met all his obligations to date under this section, the General Conditions of Contract and the Special Conditions of Contract, and where the value of work certified for payment, excluding materials on Site and any payments under preliminary and general items is equal to not less than 5% of the total value of the work listed in the Schedule of Quantities.
- The second instalment, which is 40% of the lump sum, will be made when the amount certified for payment, including retention monies but excluding the second instalment referred to herein, exceeds 50% of the Tender Price.
- The final payment, which is 20% of the lump sum, will be made when the Works have been certified as completed and the Contractor has fulfilled all his obligations to date under this section, the General Conditions of Contract and the Special Conditions of Contract.

The lump sum tendered under subitem 001.01.02 above shall represent that part of the Contractor's preliminary and general charges which is related to the time required for the completion of the Contract.

Payment of the lump sum tendered under subitem 001.01.02 shall be made as follows:

- A pro rata payment of the lump sum will be made monthly in the proportion that the value of the Works completed up to the date of the certificate bears to the final value of the Works, estimated if not known, less the amount of all previous payments under this subitem.
- The amount of any additional or reduced time-related preliminary and general charges to be paid to the Contractor or to be subtracted from payments to the Contractor, shall be calculated in accordance with the following formula:

$$A = C \times \frac{t}{T}$$ wherein:

A = amount of time-related preliminary and general charges to be paid in addition to C to the Contractor or to be subtracted from C in payments to the Contractor

C = lump sum tendered under subitem 001.01.02

t = time determined in accordance with the General Conditions of Contract for which additional or reduced time-related preliminary and general charges apply

T = tendered completion period

T and t shall have the same units in the formula.

The amount calculated in accordance with this formula shall be taken to be the amount agreed upon for full compensation for additional or reduced time-related preliminary and general charges.

Item **Unit**

001.02 Locating existing services lump sum

The tendered lump sum shall include full compensation for the supply or hiring of specialized detecting equipment, for the use of such equipment and for drawing up plans of the located services as specified. Alternatively an approved specialist firm may be employed to carry out the work.

Item **Unit**

001.03 Excavate by hand to expose existing services, and backfill cubic metre (m^3)

The unit of measurement shall be the cubic metre of material excavated.

The tendered rate shall include full compensation for all hand excavation within the lengths and widths authorized by the Engineer and the depth required to expose the service (excavation in excess of the authorized dimensions shall not be measured for payment), for backfilling and compacting to a minimum of 90% of modified AASHTO density, for disposal of any excavated material not required for backfilling, for keeping excavations safe, for dealing with any surface or subsurface water, for taking special care to ensure that services are not damaged in any way, and for any other operation necessary to complete the work. The tendered rate shall also include the transporting of surplus excavated material within the defined free-haul boundaries as well as for supplying adequate supervision during both excavation and backfilling operations.

No distinction will be made between hard and soft material neither will distinction be made between the various types of services to be exposed or the depths to which excavations are taken.

Item **Unit**

001.04 Compliance with the Occupational Health and Safety Act and applicable regulations

001.04.01 Provision of a Health and Safety plan lump sum

The lump sum tendered shall include full compensation for the provision and maintenance of a health and safety plan, risk assessment, permit applications and notifications as called for in the act and regulations.

Eighty per cent (80%) of the amount will be paid when an approved health and safety plan has been received by the client. A further 10% will be paid when the value of all work done, excluding escalation, exceeds one-half of the Tender Price, and the remaining 10% will be payable when the completion certificate has been issued.

001.04.02 Provision of Health and Safety file lump sum

The lump sum tendered shall include full compensation for the provision and maintenance of a health and safety file on site containing all the documentation required in terms of the act and applicable regulations.

The payment will be made in four equal instalments when the value of all permanent work done, excluding escalation, reaches 25%, 50% and 75% of the Tender Price. The final payment will be made when a consolidated health and safety file is handed to the client on completion of the works.

001.04.03 Provision of construction supervisors lump sum

The lump sum tendered shall include full compensation for the provision of one or more competent and experienced construction supervisors as may be necessary for the duration of the construction work.

The payment will be made in four equal instalments when the value of all permanent work done, excluding escalation, reaches 25%, 50% and 75% of the Tender Price. The final payment will be payable when the completion certificate has been issued.

001.04.04 Provision of a safety officer (state full-time or part-time) lump sum

The lump sum tendered shall include full compensation for the provision of a competent and experienced safety officer, part-time or full-time as the case may be, for the duration of the construction work.

The payment will be made in four equal instalments when the value of all permanent work done, excluding escalation, reaches 25%, 50% and 75% of the Tender Price. The final payment will be payable when the completion certificate has been issued.

001.04.05 Health and Safety training lump sum

The lump sum tendered shall include full compensation for the provision of training programs for the contractor's employees and also, where applicable, for sub-contractors.

Eighty per cent (80%) of the amount will be paid when the contractor's personnel and sub-contractors, where relevant, have received health and safety training. A further 10% will be paid when the value of all work done, excluding escalation, exceeds one-half of the Tender Price, and the remaining 10% will be payable when the completion certificate has been issued.

001.04.06 Provision of personal protective clothing and equipment lump sum

The lump sum tendered shall include full compensation for the provision, maintenance, repair and/or replacement of damaged or unsuitable protective clothing and equipment for use by the contractor's employees, subcontractors and visitors on site.

Sixty per cent (60%) of the amount will be paid when the contractor's personnel and sub-contractors, where relevant, have received personal protective clothing and equipment. The payment of the remaining amount will be made in four equal instalments when the value of all permanent work done, excluding escalation, reaches 25%, 50% and 75% of the Tender Price. The final payment will be payable when the completion certificate has been issued.

001.04.07 Provision of safety fences, signs and barricades lump sum

The lump sum tendered shall include full compensation for the provision of safety fences, signs and barricades as well as maintenance, repair and/or replacement of damaged safety fences, signs and barricades and for all labour and costs required for the placement, removal or moving to fresh positions as and when necessary. The cost of safeguarding the above items against theft and vandalism shall also be included in the tendered sum.

The payment will be made in four equal instalments when the value of all permanent work done, excluding escalation, reaches 25%, 50% and 75% of the Tender Price. The final payment will be payable when the completion certificate has been issued.

01.04.08	Other obligations	
01.04.08.01	Short description of obligation	Lump sum
01.04.08.02	Etc for other obligations	Lump sum

The lump sum tendered shall include full compensation for the contractor's obligations in terms of the occupational health and safety act and supporting regulations not specifically covered in the items above.

The payment will be made in four equal instalments when the value of all permanent work done, excluding escalation, reaches 25%, 50% and 75% of the Tender Price. The final payment will be payable when the completion certificate has been issued.

001.05 Community liaison officer Lump sum

The lump sum tendered shall include full compensation for the appointment of a community liaison officer for the duration of the construction works.

Payment shall be made in equal monthly instalments, spread over the tendered completion period, upon proof of payment to the Community Liaison Officer.

In the event of the construction period exceeding the tendered completion period and no extension of time been granted, the Contractor shall still pay the Community Liaison Officer the specified remuneration, but shall not be reimbursed therefor.

Note:

The following item of work, when specified, shall be carried out, measured and paid for in accordance with the relevant sections of the Specifications, but shall be listed under this section in the Schedule of Quantities.

Item	**Applicable section**	
(a)	Overhaul on surplus excavated-material	103

SERIES 0 : GENERAL

SECTION 002 : ENGINEER'S ACCOMMODATION

CONTENTS

01 SCOPE

This section covers the provision of accommodation for the Engineer's resident staff. This accommodation includes the necessary office space, laboratory accommodation and houses, as well as the provision of all the services required.

02 OFFICE AND LABORATORY ACCOMMODATION

02.01 General requirements

The various units of accommodation and the fittings shall be constructed in accordance with the details shown on the Drawings, given in the Project Specifications or provided by the Engineer.

The siting and orientation of all offices, laboratories, housing or other accommodation shall be to the Engineer's satisfaction and shall be decided on in consultation with him and confirmed in writing before erection. All accommodation shall include the provision of 240 V electricity and, where required, fresh clean potable water and sewerage, including septic tanks if necessary, which will be considered to be part and parcel of the accommodation provided and will not be paid for separately, except in so far as their costs are covered under pay item 002.01.

Buildings for offices and laboratories shall be constructed of timber, fibre-cement or other approved materials. The huts shall have double walls filled with insulating material and lined on the inside with timber or other approved material. Ceilings shall be provided for both office and laboratory huts. Office huts shall have timber floors or concrete floors with vinyl floor tiles and laboratory huts shall have concrete floors.

The clear height of all offices between floor and ceiling shall be a minimum of 2,4 m. All windows shall be of the type of which the full window area can open.

After erection, the office and laboratory huts shall be painted with an approved paint and the paintwork shall be maintained during the Contract Period.

Each door shall be provided with a lock and two keys.

All accommodation shall meet with the approval of the Engineer.

02.02 Offices

The various types of offices required shall be as detailed in the Project Specifications or as shown on the Drawings. All offices shall be dustproof. All fittings, furniture and equipment detailed in the Project Specifications or as shown on the Drawings and schedules of fittings, equipment and furniture shall be provided and shall conform to the following requirements:

(a) Each office desk shall have a surface area of at least 1,5 m^2 and shall be provided with at least three drawers, one of which can be locked.

(b) General-purpose steel cabinets shall have at least 1,5 m^2 shelf area and a volume of 0,70 m^3 each. Each cabinet shall have a lock with two keys.

(c) Steel filing cabinets shall each be fitted with four drawers on runners. Each cabinet shall be fitted with a lock and shall be 1 300 mm high, 460 mm wide and 600 mm from front to back.

(d) Shelves shall be suitable for storing all the Contract Drawings or shall be as detailed on the Drawings.

(e) Each wash-hand basin shall be fitted with taps and a drain.

(f) Air-conditioning units and heaters shall be as specified in subclause 02.06 of this clause.

(g) Lights shall be of the fluorescent type, either double 80 W, single 80 W or double 55 W, or of the incandescent type, as may be required or specified.

(h) Each draughtsman's stool shall be fitted with a padded seat, the height of which shall be adjustable.

(i) Electric power plug points shall be provided. Each office shall have at least two 15 A plug points. Earth leakage shall be provided for the local authority's network.

(j) Each drawing table shall have either an inclined or a horizontal surface, as may be required, and a smooth top constructed to the dimensions shown on the Drawings.

(k) Chairs shall be sturdy and comfortable.

(l) Telephone extensions shall be provided as specified and tendered rates shall include the cost of all local calls and trunk calls in connection with the Works.

(m) Each conference table shall be large enough to seat the number of persons stipulated on the Drawings and schedules.

(n) Blinds shall be one of two types:

  (i) Venetian blinds shall be adjustable so as to permit light to enter the room but shall shut out direct sunlight.

  (ii) Opaque roller blinds.

02.03 Laboratories

All or any of four types of laboratories may be required: laboratories for soils, bituminous materials, chemistry and concrete testing.

The sizes, layout and other details of the laboratories shall be as shown on the Drawings and schedules of fittings, equipment and furniture.

The laboratories, fittings, furniture and equipment shall conform to the following:

(a) Conventional chairs, telephone extensions, electricity plug points, air-conditioners, heaters and lights shall be as specified for offices, including earth-leakage protection where necessary.

(b) Shelf space provided against walls shall be of heavy construction and shelving shall be of suitable timber or fibre-cement material as required. Shelving below work tables shall be 390 mm above floor level. Shelving above working areas shall be 1 980 mm above floor level.

(c) Work-bench areas shall be one of two types, as may be required:

(i) Of wooden construction: The tops shall be hard and smooth, free from warping or other defects.

(ii) With concrete tops: The tops shall be at least 75 mm thick concrete slabs with a smooth, hard steel-trowelled finish.

All work benches shall be solid and their upper surfaces shall be 920 mm above floor level.

(d) Gas installations shall consist of the necessary gas cylinders, regulators, tubing, taps and suitable approved burners. The number of burners shall be as specified in the schedules.

(e) High stools for use at work benches shall be solid and of a fixed height of 800 mm.

(f) Where required, a 415 V, 3-phase electric power supply shall be provided. Power points for ovens and a crusher shall be adequate. Power points in oven rooms shall be 1,2 m above floor level.

(g) Concrete working floors shall be at least 125 mm thick and shall have a hard, smooth finish. The working areas shall be either entirely open or under a lean-to roof, as required.

(h) Wash-hand basins shall be as ordered, either of stainless steel or of precast concrete, at least 0,3 m^2 in size and with a minimum depth of 0,3 m, and shall be provided with swan-neck type laboratory taps and drain pipes.

(i) A supply of fresh clean potable water at a constant head of not less than 3 m at the taps shall be provided. Storage capacity for the laboratory water supply shall be not less than 700 litre.

(j) Fire extinguishers shall be manufactured to SANS 1151 and suitable for types A, B and E fires. The extinguishers shall contain not less than 2,5 kg of extinguishing fluid and shall be fitted to the wall in suitable positions by means of quick-release brackets. They shall be kept freshly charged and their seals shall be unbroken. If necessary they shall be serviced and recharged every twelve months.

(k) Any extractor fans required shall be mounted so as to operate silently and they shall have a capacity of at least 0,15 kW each.

(l) Fume cupboards shall be constructed in accordance with the details shown on the Drawings.

(m) When required a jaw-type gravel crusher suitable for crushing gravel material to less than 13,2 mm shall be provided. It shall be fitted with a 100 mm x 150 mm jaw complete on a concrete foundation and with its own power connection and switchgear.

(n) Where required, concrete footings and pedestals for the installation of certain test equipment shall be constructed to the dimensions indicated by the Engineer.

(o) When required, temperature-controlled baths for the curing of concrete test cubes, beams and cylinders shall be provided. The baths shall be of the size as shown on the Drawings and shall be provided with automatic temperature control and suitable circulating pumps. The baths shall be made from heavy-gauge galvanized iron or other suitable approved material.

02.04 Carports

Carports shall be so constructed as to protect the vehicles parked under them at all times against the weather and sun. The car ports shall each be at least 20 m^2 in area and their floors shall consist of a layer of concrete or broken stone to minimize dusty and muddy conditions.

02.05 Areas surrounding offices and laboratories

The access and other roads and parking areas surrounding the offices and laboratories shall be treated and maintained to make them dust free, either by using crushed stone or bituminous surfacing, or by any other approved means. They shall be well drained and kept trafficable and free from mud at all times. Footpaths shall be similarly treated to provide convenient access to all buildings.

02.06 Air-conditioning units and heaters

The Contractor shall provide and install air-conditioning units and heaters as specified in the Project Specifications. The air-conditioning unit shall be an electrically operated compressor type with closed circuit, and not an evaporation type. The capacity of the air-conditioning units shall be at least 2,2 kW each.

Heaters shall be preferably of the space-heating type without exposed elements and shall have a capacity of not less than 1,5 kW each.

02.07 Ablution units

Ablution units shall be constructed in accordance with the requirements of the relevant authority and the details shown on the Drawings or given in the Project Specifications. They may be constructed from fibre-cement sheeting with steel frames or from other suitable approved materials, and the floors shall be of concrete with vinyl floor tiles. Latrines shall be provided with vitreous enamel WC pans with PVC seats, covers and flushing cisterns. Wash-hand basins shall be of vitreous enamel of the minimum size, complete with taps and drains.

Provision shall be made for sanitary arrangements, as specified in clause 04 of this section.

Where required, a separate shower and change-room section shall be provided, complete with shower, hot and cold running water and drains.

Each latrine or shower shall be provided with a door fitted with a latch. Each ablution unit shall be provided with an outside door with a lock. At least two keys shall be provided for each lock.

03 HOUSING

No housing for the Engineer's supervisory staff will be required.

04 SERVICES

04.01 Sanitary arrangements

The Contractor shall be responsible for providing all sanitary services necessary to keep latrines in a clean, neat and hygienic condition.

When no municipal sewage connection is available, the Contractor shall provide the necessary septic tanks for all latrines. Waste water and septic-tank effluent shall run off in properly designed French drains.

Where the construction of septic tanks or water-borne sewerage is not feasible, the Contractor shall construct conservancy tanks and shall make arrangements for sewage removal and disposal.

The Contractor shall make provision for the removal of all rubbish.

04.02 Water, electricity, gas and telephone

The Contractor shall provide a constant supply of clean potable water suitable for human consumption, as well as the necessary 240 V power supply to the offices and laboratories and a separate telephone service to the Engineer's office as soon as this service is available.

Where specified, the Contractor shall provide 415 V, 3-phase power to the laboratories. The specified 240 V power available shall be not less than 10 kVA for each 40 m^2 of laboratory space with a minimum of 10 kVA. If 415 V, 3-phase electricity is required for the laboratories, the power available shall be not less than 12 kVA per 50 m^2 of laboratory space with a minimum of 12 kVA.

Electric power shall be supplied to the laboratories 24 hours per day and shall be available between 06:00 and 22:00 for the offices.

The Contractor shall also provide a constant supply of liquid petroleum gas for the burners used in the laboratories.

04.03 Maintenance

The Contractor shall provide all labour, equipment and material which may be necessary to keep all accommodation in a neat and clean condition, and repairs shall be done immediately upon their being requested by the Engineer.

04.04 Cooking facilities

The Contractor shall make available suitable cooking facilities for the Engineer's Site staff and shall provide a regular supply of fuel for cooking. The cooking area shall be kept clean and tidy.

05 GENERAL

(a) The Contractor shall not order any buildings, materials, equipment or fittings on the basis of their having been specified or scheduled without the written confirmation of the Engineer having been obtained. No buildings shall be erected without the Engineer's written instructions as to the exact position and orientation of the buildings.

(b) Unless otherwise agreed upon, the offices and laboratories shall be erected in close proximity to the Contractor's offices and laboratories. Should the Contractor decide to move his own offices and/or laboratories to a new site, the offices, laboratories and other buildings erected for the use of the Engineer shall, if so required by the Engineer, be moved to the new site and re-erected at no additional charge.

(c) The Contractor may not proceed with the permanent Works before the required offices and laboratories have been erected by him.

(d) The ownership of all offices, laboratories, sanitary facilities, laboratory equipment and other items provided by the Contractor shall, when they are no longer required by the Engineer, revert to the Contractor on the written advice of the Engineer and shall be dismantled and removed from the Site.

(e) The Contractor shall take all reasonable precautions to prevent unauthorized entry to the offices and laboratories and to ensure the general security of the offices and laboratories.

(f) No accommodation shall be erected without the prior approval of the Drawings by all local or Government authorities requiring such prior approval.

06 SURVEY EQUIPMENT AND ASSISTANTS

Survey equipment shall be provided, maintained and insured by the Contractor for the duration of the Contract and shall consist of a theodolite and an automatic level each fitted with an optical plumb as well as the necessary tripods, metric staffs with built-in plumb bubbles, ranging rods and tapes.

The instruments and accessories shall be approved by the Engineer and shall be serviced and adjusted for accuracy prior to bringing them onto the Site. A certificate stating that this has been done shall be provided.

The equipment shall be for the exclusive use of the Engineer's supervisory staff and shall, when no longer required, be returned to the Contractor.

The Contractor shall also make available to the Engineer's supervisory staff at least two capable survey assistants as and when required.

07 MEASUREMENT AND PAYMENT

Item		Unit
002.01	**Services**	
	The provision of water, electricity, telephone, low-pressure gas, sewerage, septic tanks, sewage and rubbish removal, cleaning services, maintenance and repairs, all as specified in clause 04 of this section:	
002.01.01	Services for offices and laboratories	lump sum
002.01.02	Services for cooking and ablution facilities on Site for the Engineer's Site staff	lump sum

Payment of the lump sums tendered shall be in full compensation for the provision of the services specified. Payment will be made in four equal instalments. The first three instalments will be paid when the value of all permanent work done, excluding escalation, reaches 25%, 50% and 75% of the Tender Price. The final payment will be made when all the accommodation provided has been removed from the Site.

Item		Unit
002.02	**Treatment and maintenance of areas surrounding offices and laboratories**	
	The treatment and maintenance of access and other roads and parking areas surrounding the offices and laboratories and of footpaths providing access to all buildings, all as specified in subclause 02.05 of this section	lump sum

The tendered lump sum shall be in full compensation for the treatment and maintenance of the areas specified. The payment will be made in four equal instalments when the value of all permanent work done, excluding escalation, reaches 25%, 50% and 75% of the Tender Price.

The final payment will be made when all the accommodation provided has been removed from the Site.

Note:

Calculation of additional or reduced time-related amounts for items 002.01 and 002.02:

Any additional or reduced time-related amounts to be paid to the Contractor or to be subtracted from payments to the Contractor in respect of items 002.01 and 002.02, shall be determined in accordance with the following formula:

$A = C \times \frac{t}{T}$ wherein:

A = amount to be paid in addition to C to the Contractor or to be subtracted from C in payments to the Contractor

C = lump sum tendered under subitems 002.01.01 or 002.01.02 or item 002.02, as applicable

t = time determined in accordance with the General Conditions of Contract for which additional or reduced amounts in respect of C apply

T = tendered completion period.

T and t shall have the same units in the formula.

The amount calculated in accordance with this formula shall be taken to be the amount agreed upon in full compensation for additional or reduced costs under the relevant pay item.

Item	Unit
002.03 Office and laboratory accommodation	
Office and laboratory accommodation, including fittings, furniture and equipment and car ports, all as specified in the Project Specifications and/or as shown on the Drawings and schedules	lump sum

The tendered lump sum shall be in full compensation for the supplying and erecting of the accommodation, fittings, furniture and equipment as specified and as shown on the Drawings and schedules and for their proper maintenance and for their subsequent removal from the Site on completion of the Works.

Eighty per cent (80%) of the amount will be paid when the office and laboratory accommodation have been provided complete with all the fittings, furniture and equipment, all to the Engineer's satisfaction. A further 10% will be paid when the value of all work done, excluding escalation, exceeds one-half of the Tender Price, and the remaining 10% will be payable in the certificate which follows the removal of the items from the Site.

Item	Unit
002.04 Provision of survey equipment and assistants	lump sum

The tendered lump sum shall include full compensation for the provision and maintenance of survey equipment and for making available at least two survey assistants as specified.

Eighty per cent (80%) of the amount will be paid when all the survey equipment has been provided and approved by the Engineer. A further 10% will be paid when the value of all work done, excluding escalation, exceeds one-half of the Tender Price, and the remaining 10% will be payable when the Certificate of Completion is issued.

SERIES 1 : ANCILLARY WORK

SECTION 101 : SITE CLEARING AND GRUBBING

CONTENTS

01 SCOPE

This section covers the clearing of the Site and the grubbing necessary for the construction of the Works covered by the Contract.

Reference shall be made to clause 02 of section 202 regarding the payment of clearing and grubbing for trenching operations.

02 GENERAL

The taking down of fences and the sorting, coiling and stacking of the fencing material are specified in and shall be measured and paid for under section 105.

Pipelines, electricity transmission lines and cables, telephone lines and cables and other existing services shall be dealt with as specified in clause 13 of section 001.

03 AREAS TO BE CLEARED AND GRUBBED

Normally borrow areas and the portions of the Site on which excavations are to be made and embankments, fences and structures are to be constructed, shall be cleared or grubbed, or both, but the Contractor shall not commence clearing and/or for grubbing until the Engineer has designated, in writing and in detail, the exact areas or strips to be cleared and/or grubbed and the time when the work is to start. The Contractor shall ensure that the general shape, profile, and levels of the area are not materially altered during clearing and grubbing operations.

In order to avoid reclearing or to control dust or erosion the Contractor shall, if so ordered, clear and grub at the latest practicable stage of construction.

04 CLEARING

Clearing shall involve the following:

- The removal of all trees and bushes (complete with roots), other vegetation, rubbish and all other material that may interfere with the construction of the Works.
- The removal of all rocks and boulders of up to 0,15 m^3 in size, which are lying on the surface to be cleared or which are exposed during the clearing operations.
- The disposal of all material produced by the clearing.
- The removal and disposal of structures which encroach upon or may otherwise obstruct other work on the Site and which can be cleared by means of a bulldozer with a mass of approximately 20 t and a flywheel power of approximately 130 kW. (Structures that cannot be so cleared shall be dealt with as specified in Item 101.05, the Project Specifications or as directed by the Engineer.)

The moving of a certain amount of soil or gravel may be inherent in or unavoidable during the clearing process. No extra payment will be made for the removal of such soil or gravel.

Areas that are cleared in strips for the purpose of constructing fences shall be cleared over the full length of the fence to a width as specified in the Project Specifications and as scheduled. Surface irregularities shall, in the case of fencing, be so graded that the fence will follow the general ground contour.

05 GRUBBING

All stumps and roots exceeding 75 mm in diameter shall be removed to a depth of at least 100 mm below the original ground level. In the case of roads and parking areas, grubbing shall be done to a depth of at least 600 mm below the projected finished road level. Where a construction bed or any other area has to be compacted, all stumps and roots including matted roots shall be removed to a depth of at least 200 mm below the cleared surface.

All material produced by the grubbing shall be disposed of.

Except in borrow areas, cavities caused by grubbing shall be backfilled with approved material and compacted to a density equal to at least that of the surrounding ground.

06 THE CUTTING OF TREES

06.01 Protection of persons, animals and structures

The Contractor shall take the necessary precautions to prevent injury to persons and animals and damage to structures and other private and public property.

Where necessary, trees shall be cut in sections from the top downwards.

06.02 Branches overhanging boundaries

The branches of trees to be left standing shall be so trimmed as not to encroach upon the space (to a height of at least 7 m) vertically above any carriageway, railway formation, or other designated area.

06.03 Preservation of trees

No tree shall be cut down and no branches shall be trimmed off any of the trees to be preserved until the Engineer has given written authorization for such work to commence. Individual trees indicated and marked by the Engineer as trees to be preserved shall be left standing and undamaged. The amount stated in the Project Specifications shall be deducted from monies owing to the Contractor as a penalty in respect of every such tree that has been damaged or removed unnecessarily.

06.04 Indigenous forest

Before commencing the clearing of an indigenous forest or a part of such forest, the Contractor shall obtain from the Engineer a copy of the written confirmation of the Director-General of the Department of Environment Affairs, and Tourism to the effect that work may be proceeded with, and of the written instructions on which the Contractor is required to act.

07 THE RECLEARING OF VEGETATION

If during the currency of the Contract vegetation should again grow on any portion of the Site, borrow areas, or other areas or strips that have been cleared in accordance with the Specifications, the Engineer may, if it is deemed by him to be necessary, order that such area(s) be recleared.

Such reclearing shall include the removal and disposal of grass, shrubs, and other vegetation, grubbing, the backfilling of holes, and the removal, transport and disposal of material produced by these operations, as during the first clearing and grubbing operation.

08 THE CONSERVATION OF TOPSOIL

When suitable topsoil is found within the limits of the area to be cleared, the Contractor shall, if so ordered by the Engineer, remove and conserve the topsoil together with any grass or other acceptable vegetation in accordance with the requirements specified in section 201. If it is not used immediately, or if it is not stockpiled in windrows clear of the working areas, the topsoil shall be transported and deposited in stockpiles for later use. The Contractor will not be required to remove topsoil from any area in which the average depth of the topsoil is less than 150 mm.

The removal, stockpiling and placing of topsoil shall be measured and paid for under section 104 except in the case of trenching operations, in respect of which reference shall be made to clause 05 of section 202.

Where the topsoil can be removed without prior clearing and grubbing, no payment will be made for clearing and grubbing under this section.

09 THE CONSERVATION OF FLORA

When so required in terms of the Project Specifications, certain designated flora encountered in areas to be cleared, including borrow areas, shall be preserved by the Contractor. He shall carefully remove and plant the flora in a protected and fenced-off area, and on completion of the Works he shall replant the flora on the Site or in the borrow areas in accordance with the Engineer's instructions.

10 THE DISPOSAL OF MATERIAL

Any material obtained from clearing and grubbing, the demolition of structures, the reclearing of vegetation and the cutting of trees shall be disposed of in borrow pits or other suitable places indicated by the Engineer. Spoil areas shall be treated as specified for borrow areas in the third last paragraph of clause 05 section 201. Where no such place for the disposal of material is indicated by the Engineer, the Contractor shall make his own arrangements to provide a suitable place which complies with the requirements laid down by the Engineer. The disposal or burning if specially permitted of combustible material on the Site may be done only with the prior written approval of the Engineer. Care shall be taken to observe the provisions of the Atmospheric Pollution Prevention Act, 1965 (Act 45 of 1965), and any regulations published in terms of the Act.

All tree trunks and major branches shall be sawn into transportable lengths before removal from the Site.

No haulage will be payable to the Contractor for the disposal of material obtained from clearing and grubbing, the demolition of structures, the reclearing of vegetation, and from the cutting of trees.

11 MEASUREMENT AND PAYMENT

Item		Unit
101.01	**Clearing and grubbing**	
101.01.01	Areas	square metre (m^2)
101.01.02	Strips (width indicated)	metre (m)

The unit of measurement for clearing and grubbing is the square metre or metre.

Only those areas or strips designated by the Engineer under clause 03 of this section and cleared and grubbed in accordance with the requirements of this section shall be measured.

The tendered rates shall include full compensation for clearing the surface, removing boulders with a size of up to 0,15 m^3, cutting trees with single or multiple trunks each with a girth of 1 m or less, grubbing the stumps and roots of such trees, cutting trunks and branches into transportable lengths, backfilling cavities, demolishing structures, and removing, transporting and disposing of material thus cleared, grubbed, cut and demolished. Boulders exceeding 0,15 m^3 in size shall be dealt with as set out in series 2.

Item		Unit
101.02	**Cutting and removing large trees with a girth-**	
101.02.01	exceeding 1 m and up to and including 2 m	number (No)
101.02.02	exceeding 2 m and up to and including 3 m	number (No)
101.02.03	etc in steps of 1 m	

The unit of measurement shall be the number of tree trunks cut and removed in each size group. The girth of a tree trunk will be measured at the narrowest point of the trunk in the first metre of its height above ground level.

The tendered rates shall include full compensation for cutting the trees, for cutting the trunks and branches into transportable lengths, and for removing, transporting and disposing of all such trees, trunks, branches and associated material.

Item		Unit
101.03	**Grubbing and the removal of the stumps and roots of large trees with a girth-**	
101.03.01	exceeding 1 m and up to and including 2 m	number (No)
101.03.02	exceeding 2 m and up to and including 3 m	number (No)
101.03.03	etc in steps of 1 m	

The unit of measurement shall be the number of tree stumps and associated roots of which were grubbed and removed in each size group.

The tendered rates shall include full compensation for grubbing the stumps and roots, backfilling holes, cutting the stumps and roots into transportable pieces, and removing, transporting and disposing of all such stumps and roots and associated material.

The girth of a tree trunk shall be measured as specified in item 101.02.

Item		Unit
101.04	**Reclearing areas (only on the written instructions of the Engineer)**	
101.04.01	Strips (width indicated)	metre (m)
101.04.02	Areas not classified as strips	square metre (m^2)

The unit of measurement for reclearing areas which have been previously cleared shall be the metre for strips and the square metre for other areas.

The tendered rates shall include full compensation for reclearing the surface in accordance with the requirements of clause 07 of this section.

Item		Unit
101.05	**Removal and Disposal of specific elements**	
101.05.01	Concrete Kerbing/Kerbing combination	metre (m)
101.05.02	Concrete or brick elements (reinforced or unreinforced)	
101.05.02.01	(Description and type of material indicated)	cubic metre (m^3)
101.05.02.02	Etc for other elements and types of material	
101.05.03	Asphalt surfacing	square metre (m^2)

Note:

Separate items shall be scheduled for elements that are too large or cannot be safely and efficiently cleared as part of the clearing operations covered by clause 04 of section 101.

- 101.05.01

  The unit of measurement shall be per running metre of the existing kerb removed.

  The tendered rate shall include full compensation for uplifting, demolishing, removing, transporting and the disposal of material to a dump site.

- 101.05.02

  The unit of measurement shall be the actual cubic metres of existing concrete or brickwork broken out, removed and disposed of. Dimensions in determining volumes are to be confirmed on site by the Engineer or his representative before the work commences.

  The tendered rate shall include full compensation for demolishing, removing, uplifting, transporting, the disposal of material to a dump site and the backfilling and finishing off of the excavation to the satisfaction of the Engineer.

- 101.05.03

  The unit of measurement shall be the actual square metres of existing asphalt surfacing broken out, removed and disposed of. Dimensions in determining the areas are to be confirmed on site by the Engineer or his representative before the work commences.

  The tendered rate shall include full compensation for demolishing, removing, uplifting, transporting, the disposal of material to a dump site and the backfilling and finishing off of the excavation to the satisfaction of the Engineer.

Note:

The following items of work, when specified, shall be carried out, measured and paid for in accordance with the relevant sections of the Specifications, but shall be listed under this section of the Schedule of Quantities.

Item	Applicable section
(a) Saw cutting of asphalt	606

SERIES 1 : ANCILLARY WORK

SECTION 102 : ACCOMMODATION OF TRAFFIC

CONTENTS

01 SCOPE

This section covers the construction and maintenance of the necessary detours and bypasses, barricades and signs, and everything necessary for the safe and easy passage of all vehicular and pedestrian traffic during the construction and defects liability periods. It also covers the obliteration of bypasses as they become redundant and the reinstatement of existing roads and streets that were used as bypasses or detours.

02 GENERAL REQUIREMENTS

02.01 Safe and easy passage of traffic

During the construction and defects liability periods the Contractor shall be responsible for the safe and easy passage of vehicular and pedestrian traffic over, underneath, past or alongside the Works.

During all his operations and when using his machinery, plant and equipment, the Contractor shall at all times take the necessary care to protect the public and to facilitate the traffic flow.

02.02 Haul and construction roads

Before tendering, the Contractor shall ascertain the need for haul and construction roads as well as the extent of the work involved in connection therewith and he shall satisfy himself of the feasibility of providing the haul and construction roads that will be necessary for the execution of the Works in accordance with the construction programme.

The Contractor shall timeously submit detailed proposals for haul and construction roads to the Engineer so that the Engineer's written approval can be obtained before construction commences.

02.03 Bypasses and detours

Bypasses and detours shall be constructed in accordance with the Engineer's instructions and the details shown on the Drawings and the requirements of the relevant sections of these Specifications. The Contractor shall not commence with the construction of a bypass or a detour or any section thereof until he has obtained the Engineer's written permission to do so.

02.04 Consultation and arrangements

At least three weeks before construction work in a railway or road reserve is due to commence, the Contractor shall consult with the relevant authorities and make arrangements with them in connection with all traffic matters. The Contractor shall submit written confirmation of such arrangements to the Engineer, and construction shall not commence until the Engineer has approved the arrangements.

02.05 Failure to comply with the provisions

The failure or refusal of the Contractor to construct or to maintain or to construct and maintain bypasses and detours at the proper time, or to take the necessary precautionary measures for the safety and convenience of the traffic as required by the relevant statutory authorities or as ordered by the Engineer, shall be sufficient cause for ordering all the work under this Contract to be suspended until the Contractor has complied with all the specified requirements to the satisfaction of the Engineer.

02.06 Width and vertical clearance

The minimum usable width of bypasses and detours accommodating two-way vehicular traffic shall be 9 m. Where bypasses or detours consist of two separate one-way lanes, the minimum usable width of each lane shall be 5 m. The aforementioned widths may be reduced only with the written permission of the Engineer.

The minimum vertical clearance over any portion of a bypass or a detour for vehicular traffic shall be 4,9 m.

For pedestrian bypasses and detours the minimum usable width shall be 1,2 m and the minimum vertical clearance shall be 2,5 m.

02.07 Access to properties

In accordance with the requirements of the General Conditions of Contract, the Contractor shall at all times provide and allow pedestrian and vehicular access to properties that fall within or adjoin or are affected by the area in which he is working. The Contractor shall at all times, wherever possible, keep open and maintain all existing roads on or about the Site which may be affected by his operations in the execution of the Contract, and he shall construct and maintain to the satisfaction of the Engineer temporary access roads and steel or timber bridges over excavations in roads, pavements, entrances or accesses to properties. Temporary pedestrian access bridges shall be at least 1,2 m wide and temporary access bridges for vehicles shall be at least 3,6 m wide. All temporary access bridges shall be fitted with hand-rails as well as protective mesh fencing on both sides. On completion of the work, the Contractor shall dismantle and remove all such temporary structures and reinstate the areas so used and occupied to their former condition.

Full compensation for providing access to properties, excluding temporary access bridges, shall be included in the rate tendered for item 102.01. Temporary access bridges shall be measured and paid for under items 102.12 and 102.13.

02.08 Existing services

The Contractor shall comply with the requirements specified in clause 13 of section 001.

Where no moving of services is required, the Contractor shall clearly indicate where services cross the bypass or detour so that these points will be clearly visible to operating staff.

03 TRAFFIC CONTROL

03.01 General requirements

Wherever the Contractor's activities on Site affect or have the potential to affect the normal flow or safety of traffic during the construction and defects liability periods, he shall be responsible for all aspects of traffic control, including flagmen, warning devices, signs, channelization devices, layout of detours and bypasses, sign sequences and layouts, and all the requirements of the General Manager: Roads and Stormwater Division and the Chief of Police, Tshwane Metropolitan Police Department.

Full compensation for all aspects of traffic control as specified in this clause shall, in the case of detours and bypasses, be included in the rate tendered for item 102.01, but, where construction takes place alongside an existing road as well as where trenches in roadways obstruct the traffic flow, full compensation for all aspects of traffic control shall be included in the rates tendered for item 102.14 and where applicable, item 102.15.

03.02 Warning devices, signs, speed limits and channelization devices

The dimensions and other properties of all signs and devices and the sign and device sequences, layouts and spacings shall be in accordance with the provisions of the National Road Traffic Act, (Act 93 of 1996) and its Regulations. In addition, signs and devices shall be placed at the positions shown on the Drawings. In cases not covered by the Act, the signs, speed limits, devices, sequences, layouts and spacings shall comply with the requirements of The Southern African Development Community Road Traffic Signs Manual, the General Manager: Roads and Stormwater Division, the Chief of Police, Tshwane Metropolitan Police Department, and of the Engineer.

03.03 Language

Traffic signs shall be alternately in Afrikaans and English.

04 DRAINAGE WORKS FOR BYPASSES

The Contractor shall construct and maintain the necessary temporary drainage works, such as side drains, catchwater drains, mitre drains, culverts, catchpits, chutes, berms, channels, etc, to deal adequately with surface run-off.

Temporary culverts shall be installed on existing drainage channels wherever required by the Engineer and shall be of the sizes and types as ordered by him.

Suitable metal or precast concrete culverts salvaged from existing roads or abandoned bypasses may be re-used if they are in a good condition and approved by the Engineer.

Any damage caused to bypasses by the inability of temporary culverts, installed in accordance with the Engineer's instructions, to cope with floods, shall be repaired and the Contractor shall be paid for the cost of such work at applicable rates or, where no such rates exist, the work shall be carried out on a daywork basis in accordance with the provisions of the General Conditions of Contract.

Payment for the construction of temporary culverts will be made under the appropriate items provided in this section. Full compensation for the construction of the other temporary drainage works for bypasses and for the maintenance of all drainage works including temporary culverts shall be included in the rates tendered for item 102.01.

Where the construction of bypasses necessitates the construction of elements of the permanent drainage works, such work will be measured and paid for under the relevant sections of these Specifications.

05 EARTHWORKS FOR BYPASSES

The Contractor shall shape and grade the bypasses, making full use of all approved material that can be obtained from alongside the bypasses, or from the immediate vicinity. If sufficient material cannot be obtained in this manner, he shall import material from other sources. Where necessary, cuttings shall be made to obtain a satisfactory vertical alignment. Where the in situ material is not sufficiently dense in its natural condition, it shall be given a three-pass roller compaction as specified in section 203 prior to the construction of the earthworks.

The Contractor shall also do the necessary clearing and grubbing, including the removal of all trees and stumps, all as specified in section 101. Clearing and grubbing shall be measured and paid for in accordance with section 101.

All material shall be watered, mixed and compacted with suitable compaction equipment to give sufficient density to the material so that it will be capable of carrying traffic without undue wear or distress. In case of disagreement between the Engineer and the Contractor as to the adequacy of this compaction, a dry density of 90% of modified AASHTO density shall be taken as the required minimum density.

Any fills which may be necessary for any reason, e.g. for the construction of drifts, shall be constructed and compacted by the Contractor as described above. Wherever possible, drifts shall be constructed of rock fill or coarse material so as to limit flood water damage as far as possible.

06 GRAVEL WEARING COURSES FOR BYPASSES

When the earthworks for bypasses as described in clause 05 of this section have been completed, those portions of the bypasses and of existing gravel roads used as bypasses indicated by the Engineer shall be provided with a wearing course of suitable gravel approved by the Engineer.

The Contractor shall provide, spread, water, mix and compact such material to a density at which it can carry traffic without undue wear and tear. In case of disagreement between the Engineer and the Contractor as to the adequacy of the compaction, a dry density equal to 93% of modified AASHTO density shall be taken as the required minimum density.

07 PAVEMENT LAYERS, STABILIZATION AND ROAD MARKING FOR BITUMEN-SURFACED BYPASSES

Where shown on the Drawings or required by the Engineer, pavement layers such as gravel layers of subgrade or subbase quality, crushed-stone and asphalt base courses, the stabilization of pavement layers and road marking shall be constructed and measured and paid for in accordance with the requirements of the relevant sections of these Specifications.

08 BITUMEN-SURFACED BYPASSES

08.01 Standard bituminous surfacing

The following bituminous surface treatment shall be applied to the central 7,4 m width of the top compacted pavement layer for two-way traffic and 3,7 m for single-lane traffic, unless otherwise instructed or authorized by the Engineer:

(a) Prime

The prime coat shall be applied as specified in section 605. Road tar of grade RTH 3/12P shall be used.

(b) Tack coat

A coat of RTH 45/50 road tar shall be applied at a rate of 1,0 ℓ/m^2. This coat shall be applied only after the prime coat has dried and, in the opinion of the Engineer, will not pick up under traffic.

(c) Crushed-stone aggregate

- Immediately after the tack coat has been applied, it shall be covered by a 6,7 mm nominal size crushed-stone aggregate at a spread rate of 0,0050 m^3/m^2. No more than 10 minutes shall elapse between application of the tack coat and spreading of the chips at any particular point.
- Rolling shall be done as specified for the initial rolling in section 607.
- The grading of the 6,7 mm aggregate shall conform to that given in section 607 for 6,7 mm aggregate.

08.02 Other types of surfacing

Any other type of surfacing or surface course may be ordered in lieu of the surfacing specified above and payment will be at the appropriate rates tendered or agreed on, as the case may be.

09 TEMPORARY FENCING AND GATES

New fencing and gates shall be provided or existing fencing and gates shall be moved and subsequently reinstated in accordance with the Specifications and Drawings or, in the absence thereof, to standards acceptable to the property owners concerned.

New fencing and gates shall be removed when no longer required, and previously existing fencing and gates which have been temporarily moved shall be reinstated to their original position and condition.

Temporary grid gates shall be constructed in accordance with the Drawings and shall be demolished and removed when they are no longer required.

10 EXISTING ROADS USED AS BYPASSES

The Contractor shall carry out all repairs, alterations or additions, as required by the Engineer, to bring existing roads which are to be used as bypasses in a good and safe trafficable condition. When existing roads are no longer required as bypasses, they shall be reinstated to their original condition.

Gravel courses for bypasses shall be measured and paid for under item 102.03. All other work ordered by the Engineer in terms of this clause shall be measured and paid for under item 102.07.

11 MAINTENANCE OF GRAVEL BYPASSES AND EXISTING GRAVEL ROADS USED AS BYPASSES

The Contractor shall maintain all gravel bypasses and existing gravel roads used as bypasses in a good and safe trafficable condition for as long as they are used as bypasses. Whenever required by the Engineer, the roads and bypasses shall be bladed by means of self-propelled graders to provide a smooth riding surface free of corrugations. All potholes shall be promptly repaired. The Engineer may also instruct the Contractor to water the bypasses to keep down dust or to facilitate the proper blading of the surface.

Maintenance shall also include the clearing and repair of all drainage works, the repair and keeping in good condition of guard rails, guide posts, road signs and fences, and painting and other incidental work.
The blading of the surfaces of bypasses and the application of gravel and water shall be measured and paid for separately, but full compensation for all other maintenance shall be deemed to be included in the rate tendered for item 102.01.

12 MAINTENANCE OF BITUMEN-SURFACED BYPASSES AND EXISTING BITUMEN-SURFACED ROADS USED AS BYPASSES

All bitumen-surfaced bypasses and existing bitumen-surfaced roads used as bypasses shall be maintained in a good and safe trafficable condition for as long as they are used as bypasses. Maintenance shall include the patching and repair of the bitumen surfacing, the clearing of shoulders, the clearing of all drains, including culvert inlet and outlet drains, and other incidental work, and the care and maintenance of all road markings, guide posts, guard rails and fences.

The cost of repairs to the bituminous surfacing and to the pavement layers shall be measured and paid for separately under item 102.08. All the other maintenance of bitumen-surfaced bypasses shall be deemed to be included in the rate tendered for item 102.01.

13 THE CONTRACTOR'S USE OF BYPASSES

Where the Contractor constructs bypasses, haul or construction roads at his own initiative for accommodating construction traffic, he shall construct and maintain them at his own cost and in accordance with details previously agreed on with the Engineer, in writing. Such roads shall be obliterated and the surface properly reinstated when no longer required, also at the Contractor's own cost.

The Contractor has the right to use public roads, including bypasses open to the public, but where his own traffic causes excessive damage or wear to such roads or constitutes a traffic hazard, the Engineer shall have the right to regulate the Contractor's traffic over such bypasses and to require that the Contractor provide, at his own cost, such maintenance including wearing-course gravel and watering, as in the Engineer's opinion is necessary in addition to any requirements in respect of the proper maintenance of the bypasses when not used by the Contractor's construction traffic. Where regulation of the Contractor's traffic does not satisfactorily alleviate the traffic hazard, or the maintenance of the bypasses cannot be or is not properly executed, the Contractor shall, conditions permitting, divert his traffic over construction roads provided and maintained at his own cost.

14 OBLITERATION OF BYPASSES

On completion of construction, the bypasses which are no longer required and any sections of obsolete roads as may be instructed by the Engineer, shall be levelled off with the original ground. Bituminous and asphalt surfacing and crushed-stone layers shall be broken up and removed from the Site, after which the entire area occupied by the bypasses and obsolete roads shall be scarified and broken up to a depth of 150 mm in order to promote plant growth.

All work ordered by the Engineer in terms of this clause shall be measured and paid for under item 102.16.

15 TRAFFIC LIGHTS

Traffic lights shall be provided at the positions shown on the Drawings. The Contractor shall make all the arrangements for the provision and installation of the traffic lights and shall in each case co-operate with the relevant authority.

16 MEASUREMENT AND PAYMENT

Item **Unit**

102.01 Accommodation of traffic and maintenance of bypasses metre (m)

The unit of measurement shall be the metre measured along the centre line of the bypass constructed and along the centre line of existing roads used as bypasses and maintained by the Contractor. Sections where traffic is diverted onto existing roads which the Contractor is not required to maintain shall not be included. Where, on the Engineer's instructions, bypasses are provided as two one-way roads, the average length along the two roads shall be measured for payment.

The tendered rate for the accommodation of traffic and the maintenance of bypasses shall include full compensation for all general obligations and incidental items of cost necessary for the accommodation of traffic and the maintenance of bypasses and of existing roads used as bypasses, during the construction period and during the defects liability period where such items of cost are not specifically paid for under the pay items provided under this section in the Schedule of Quantities. It shall also include full compensation for traffic control, the provision of traffic signs and, where necessary, communications equipment required to regulate traffic, for the construction of temporary drainage works, excluding temporary culverts, and for the maintenance of all drainage works, arranging for the moving of services, attending to traffic problems, complying with the requirements of the Road Traffic Act and of the relevant local authorities, and for providing temporary access to properties, excluding temporary bridges.

Payment shall be made in two equal instalments in respect of each section. The first instalment shall be made when suitable bypasses have been approved for use. The second instalment shall become due when the traffic can again be accommodated on the permanent roads, all bypasses have been obliterated, all previously existing roads have been reinstated and all general obligations of the Contractor have been complied with, everything to the satisfaction of the Engineer.

Item **Unit**

102.02 Earthworks for bypasses

102.02.01 Shaping of bypasses metre (m)

The unit of measurement shall be the metre bypasses shaped, compacted and constructed in accordance with the provisions of clause 05 of this section. Where the Contractor has to provide access roads to private property, the length of such access roads shall be included in the quantity measured for payment.

The tendered rate shall include full compensation for shaping, compacting and constructing the bypasses, all as specified in clause 05 of this section, but shall include only those portions of the fills which do not exceed 0,5 m in height and of which the fill material is imported from a location not more than 100 m from the point of use.

102.02.02 Cut and borrow to fill cubic metre (m^3)

The unit of measurement shall be the cubic metre of fill measured in situ from levelled cross-sections taken before and after construction where such material is either imported from a point further than 100 m from the point of use or is utilized in a portion of fill which is more than 0,5 m above the original ground level.

Where measurement by cross-sections is considered by the Engineer to be impracticable, the in situ volume shall be measured in a manner mutually agreed upon by the Engineer and the Contractor.

The tendered rate shall include full compensation for procuring and furnishing and the placing of all classes of material, including transport. Where overhaul is applicable, the requirements of section 103 shall apply.

102.02.03 Cut to spoil cubic metre (m^3)

The unit of measurement shall be the cubic metre of authorized excavation taken from cut in bypasses or removed from fill in redundant bypasses and carted to spoil on the instructions of the Engineer, all measured in situ before excavation by means of levelled cross-sections.

The tendered rate shall include full compensation for excavating in all classes of material, loading, transporting, off-loading, including the shaping and levelling of spoil material and transport. Where overhaul is applicable, the requirements of section 103 shall apply.

Item **Unit**

102.03 Gravel wearing courses for bypasses cubic metre (m^3)

The unit of measurement shall be the cubic metre of gravel measured in the final position after compaction and computed from the dimensions authorized by the Engineer.

Where measurement by the above method is considered by the Engineer to be impracticable, the volume may be computed in a manner mutually agreed upon by the Engineer and the Contractor.

The tendered rate shall include full compensation for procuring and furnishing all materials and for the construction of the gravel wearing course as specified, including transport. Where overhaul is applicable, the requirements of section 103 shall apply.

Item **Unit**

102.04 Watering of bypasses kilolitre (kℓ)

The unit of measurement shall be the kilolitre of water applied to the bypasses on the written instructions of the Engineer. Water required for the construction of bypasses shall not be measured for payment.

The tendered rate shall include full compensation for the supply, transportation and application of the water. Overhaul shall not apply to the transportation of water used for the watering of bypasses.

Item		Unit
102.05	**Blading of bypasses by motor grader**	kilometre pass (km pass)

The unit of measurement for using a motor grader to blade the surface of bypasses shall be the kilometre pass, i.e. each kilometre of a full-width bypass the whole surface of which has been bladed by one pass of the motor grader. Where bypasses are constructed as two separate one-way roads, the average length along the two roads shall be considered to be one full-width bypass for purposes of measurement.

Only the number of kilometre passes actually authorized by the Engineer, in writing, shall be measured.

Where the blading of bypasses has been carried out as a single pass and the surface has not been improved as much as can reasonably be expected from such operation, the Contractor shall, at his own cost, carry out further grader work until a satisfactory result is obtained.

The tendered rate shall include full compensation for the provision of the motor graders and operators, flagmen, guards, barriers, signs, and all other costs incidental thereto and for the blading of the bypasses to a smooth surface free of corrugations.

Item		Unit
102.06	**Standard bituminous surfacing of bypasses**	square metre (m^2)

The unit of measurement shall be the square metre of completed standard bituminous surfacing constructed as specified in sub clause 08.01 of this section. Where any type other than the standard surfacing specified is used, payment shall be as provided for in the relevant section of series 6 of the Specifications or as provided for in the Project Specifications.

The tendered rate shall include full compensation for procuring and furnishing all materials and for the construction of the bituminous surface as specified.

Item		Unit
102.07	**Existing roads used as bypasses**	provisional sum

The provisional sum allowed for covering the cost of work ordered by the Engineer in terms of clause 10 of this section shall be expended in accordance with the provisions of the General Conditions of Contract.

Item		Unit
102.08	**Maintenance of surfacing and pavement layers of bitumen-surfaced bypasses and existing bitumen-surfaced roads used as bypasses**	provisional sum

The provisional sum allowed for covering the cost of work ordered by the Engineer in terms of clause 12 of this section for repairing and maintaining the bituminous surfacing and pavement layers of bitumen-surfaced bypasses and existing bitumen-surfaced roads used as bypasses shall be expended in accordance with the provisions of the General Conditions of Contract.

Item		Unit
102.09	**Traffic lights**	provisional sum

The provisional sum allowed for covering the cost of providing traffic lights shall be expended in accordance with the provisions of the General Conditions of Contract.

Item		Unit
102.10	**Temporary fencing and gates**	
102.10.01	Temporary fencing	metre (m)

The unit of measurement shall be the metre of temporary fencing erected by the Contractor.

The tendered rate shall include full compensation for the construction of fencing by supplying and using new or approved second-hand material and its subsequent removal, or for the moving and re-erection of existing fencing when permitted by the Engineer and subsequently the reinstating of such fencing to its original condition, in its original position.

102.10.02	Temporary gates	number (No)

The unit of measurement shall be the number of temporary gates provided by the Contractor.

The tendered rate shall include full compensation for the supply and erection of new or approved second-hand gates and their subsequent removal and the reinstating of the fencing, or for moving existing gates where permitted and their subsequent removal, the reinstating of the fencing where it had been installed, and reinstating of the gates in their original positions.

Item		Unit
102.11	**Temporary culverts**	
102.11.01	Supplying and laying temporary prefabricated culverts complete (state type, size and type of bedding)	metre (m)

The unit of measurement shall be the metre of culvert provided and installed by the Contractor.

The tendered rate shall include full compensation for procuring and providing new culverts, all excavations, bedding, laying and backfilling and the eventual removal of the culverts, including excavation, loading, transporting off Site, and the reinstating of surfaces.

102.11.02	Re-using of pre-fabricated culverts complete (state type, size and type of bedding)	metre (m)

The unit of measurement shall be the metre of culvert installed.

The tendered rate shall include full compensation for taking up the culverts from their positions where they have been originally installed in bypasses and installing them in new positions, including all excavation, backfilling and bedding, the loading, transporting and off-loading of the culverts, the eventual removal of the culverts, including excavation, loading, transporting, off-loading and stacking them at a suitable site, and the reinstatement of surfaces.

Item		Unit
102.12	**Provision of temporary bridges for maintaining access to properties**	
102.12.01	Temporary pedestrian bridges	number (No)
102.12.02	Temporary vehicular bridges	number (No)

The unit of measurement shall be the number of temporary pedestrian and vehicular bridges actually provided in accordance with the Specifications and to the Engineer's satisfaction.

The tendered rates shall include full compensation for the supply, first installation, maintenance and final dismantling and removal of the temporary access bridges when no longer required, all as specified in subclause 02.07 of this section. A distinction shall be made between temporary pedestrian and vehicular access bridges for purposes of payment.

Item		Unit
102.13	**Moving of temporary bridges to and their re-erection in entirely new positions**	
102.13.01	Temporary pedestrian bridges	number (No)
102.13.02	Temporary vehicular bridges	number (No)

The unit of measurement shall be the number of times each temporary bridge is moved to and re-erected in an entirely new position, excluding its first erection in the position where it was originally installed.

No payment shall be made unless the Engineer has furnished prior approval for the moving and re-erection of a temporary bridge.

The tendered rates shall include full compensation for the taking down, transporting, handling, re-erection and maintenance of the temporary bridges in the new positions.

Item		Unit
102.14	**Temporary traffic-control facilities**	
102.14.01	Flagmen	lump sum
102.14.02	Portable STOP and GO-RY signs	number (No)
102.14.03	Amber flicker lights	number (No)
102.14.04	Road signs, TR-series, 1 200 mm in diameter or 900 mm x 675mm if rectangular	number (No)
102.14.05	Road signs, TW-series, 1 524 mm sides	number (No)
102.14.06	Road signs, TG-series	square metre (m^2)
102.14.07	Danger plates and delineators	number (No)
102.14.08	Movable barricades (chevron and ROAD CLOSED types)	number (No)
102.14.09	Traffic cones	lump sum
102.14.10	Plastic New Jersey Barrier	number (No)

- 102.14.01

  The lump sum tendered for this item shall include full compensation for all flagmen who may be required to control traffic by way of flags or portable STOP and GO-RY signs and shall include the provision of flags.

- 102.14.02 to 102.14.05 and 102.14.07

  The unit of measurement shall be the number of each sign or light provided, and, as may be applicable, completely erected. In the case of subitem 102.14.02, the tendered rate shall include full compensation for moving the sign as may be necessary.

- 102.14.06

  The unit of measurement shall be the square metre of sign face, measured on the face of each item provided. The tendered rate shall include full compensation for providing and erecting each sign, complete with posts.

- 102.14.08

  The unit of measurement shall be the number of movable barricades provided, complete with road signs. The tendered rate shall also include full compensation for moving the barricades to fresh positions as and when necessary.

- 102.14.09

  The lump sum for traffic cones shall include full compensation for providing as many cones as may be necessary, irrespective of their number, and for all labour and costs required for their placement, removal or moving as may be necessary.

- 102.14.10

  The unit of measurement shall be the number of Plastic New Jersey barrier sections provided and erected in positions instructed by the Engineer.

  The tendered rate shall include full compensation for supply, first erection, maintenance and final dismantling and removal of the barricades when no longer required.

General:

The tendered rates for the respective traffic-control facilities shall also include full compensation for their maintenance and the replacement of items which have become unserviceable, and their removal when no longer necessary.

Seventy five per cent (75%) of the tendered amount will be payable when the items have been provided and erected, and 25% when finally removed from the Site.

Item		Unit
102.15	**Re-use or removal of traffic-control facilities**	
102.15.01	Amber flicker lights	number (No)
102.15.02	Road signs, TR and TW-series	number (No)
102.15.03	Road signs, TG-series	number (No)
102.15.04	Danger plates and delineators	number (No)
102.15.05	Plastic New Jersey Barrier	number (No)

The unit of measurement shall be the number of each unit removed once and re-erected.

The tendered rates shall include full compensation for the dismantling, storing if necessary, transporting and re-erecting in a fresh position of the various items specified above.

Note:

The tendered rates for item 102.14 and where applicable, item 102.15 shall collectively include full compensation for all other aspects of traffic control for which no pay items have been provided. (See subclause 03.01 of this section.)

Item		Unit
102.16	**Obliteration of bypasses**	metre (m)

The unit of measurement shall be the metre of bypass obliterated.

The tendered rate shall include full compensation for the obliteration of bypasses as specified in clause 14 of this section.

Note:

The following items of work, when specified, shall be carried out, measured and paid for in accordance with the relevant sections of the Specifications, but shall be listed under this section in the Schedule of Quantities.

Item		Applicable section
(a)	Clearing and grubbing	101
(b)	Overhaul	103
(c)	Removal of excess overburden	201
(d)	Three-pass roller compaction	203
(e)	Gravel pavement layers	601
(f)	Crushed-stone layers	602
(g)	In situ stabilization of materials	604
(h)	Asphalt paving and bituminous surfacing (other than the standard type specified in this section)	607 and 608
(i)	Road marking	613

SERIES 1 : ANCILLARY WORK

SECTION 103 : OVERHAUL

CONTENTS

01 SCOPE

This section covers the hauling of overhaul material, as defined herein, from the place of excavation or stockpile to the position where finally placed or disposed of, to the extent that such haul is carried out outside the free-haul boundaries.

02 DEFINITIONS

02.01 Overhaul material

Overhaul shall apply only to materials obtained from approved borrow pits and from mass excavations, trench and open drain excavations and excavations for structures.

Overhaul material shall include only the following materials:

- Gravel, soil or rock used in the construction of fills, and in the subgrade, subbase, base and shoulders of roads, streets, and parking areas.
- Gravel, soil or rock used in the construction of banks and dykes.
- Gravel ordered by the Engineer as wearing course for bypasses.
- Selected material used for backfilling trenches, but excluding permeable material used in subsurface drains.
- Spoil material resulting from authorized excavations in road prisms and trenches and for structures and from fills in redundant bypasses.
- Crushed stone used in the construction of subbase and base courses of roads, streets and parking areas and in the construction of certain types of pipe bedding.

Overhaul shall not apply in the case of -

- material to be obtained from commercial sources or sources to be supplied by the Contractor;
- material to be disposed of to sites to be provided by the Contractor; or
- any material transported within the free-haul boundaries as defined below.

02.02 Overhaul

Overhaul, when applicable, shall be the product of the volume of overhaul material hauled, multiplied by the overhaul distance as defined below.

02.03 Free-haul boundaries and free-haul areas

The free-haul boundaries are the boundaries shown on the Drawings for the purpose of indicating the areas within which the cost of hauling material shall be included in the tendered rates for the operation or item of work for which such material is used.

Free-haul areas are the areas contained within the free-haul boundaries, and overhaul shall apply only to haul outside the free-haul boundaries.

02.04 Overhaul distance

The overhaul distance for the materials listed in subclause 02.01 shall be the distance between the free-haul boundary as defined on the Drawings for the purposes of overhaul and the borrow, stockpile or spoil area outside these free-haul boundaries measured to the nearest 0,1 km along the shortest practicable route as designated by the Engineer between the centres of volume of the material at the points of loading and off-loading.

If the Contractor chooses to haul material over some other longer route, computations for payment shall nevertheless be based on the haul distance measured along the shortest practicable route designated by the Engineer.

03 QUANTITY OF MATERIAL

The volume of the overhaul material shall be measured either in excavation or in fill or backfill as determined by the pay item according to which the material being hauled is paid for.

04 PAYMENT OF OVERHAUL

Overhaul will be paid only where so specified in the Project Specifications.

05 MEASUREMENT AND PAYMENT

Item		Unit
103.01	**Overhaul on material hauled outside the defined free-haul boundaries**	cubic metre-kilometre (m^3 - km)

The unit of measurement shall be the cubic metre of overhaul material hauled multiplied by the overhaul distance.

The rate tendered for overhaul shall include full compensation for hauling overhaul material outside the defined free-haul boundaries.

Overhaul of material in excess of that required for the completion of the Works, unless authorized by the Engineer, will not be measured for payment purposes.

Notes:

In the special cases detailed below, overhaul shall be measured as follows:

(a) Crushed and/or screened gravel and stone.

In the case of crushed and/or screened gravel as described in section 601 and crushed-stone base or subbase material as specified in section 602, overhaul, if applicable, shall be measured along the shortest practicable route as determined by the Engineer from the point of excavation or borrow to the crushing or screening plant and from these to the point of final use.

Overhaul shall be measured only along the part or parts of this route falling outside the free-haul boundaries.

(b) Stockpiled material

When material is stockpiled as set out in clause 07 of section 201, or when material is stockpiled outside the free-haul area and provided always that the Engineer's written permission for such stockpiling has been obtained, overhaul may be applicable.

Overhaul, when applicable, shall be calculated on the basis of two operations, the first being excavation to stockpile and the second stockpile to point of final use.

The route along which overhaul shall be measured shall be the shortest practicable route as determined by the Engineer from the point of excavation to the stockpile and from there to the point of use.

Overhaul shall be measured as specified for (a) above.

SERIES 1 : ANCILLARY WORKS

SECTION 104 : LANDSCAPING AND GRASSING

CONTENTS

01 SCOPE

This section covers the landscaping and/or the establishing of vegetation in such areas as indicated on the Drawings or ordered by the Engineer, in writing.

02 MATERIALS

02.01 Fertilizer

The type of fertilizer to be used shall be as specified in the Project Specifications, ordered by the Engineer or scheduled.

02.02 Grass cuttings

Grass cuttings shall be fresh and in a good condition for planting, with sufficient root material to ensure good growth. Species to be planted shall be local couch-grass ("kweek") or other species as specified in the Project Specifications.

02.03 Grass seed

Only good-quality fresh seed shall be used. The types of seed in the mixture and the pure live-seed content shall be as specified in the Project Specifications.

02.04 Trees, shrubs and ground covers

Plants shall be of the variety and size shown on the Drawings or indicated in the Project Specifications.

When trees, shrubs and ground covers are supplied and delivered to the Site by the Employer, the Contractor shall give the Engineer at least six weeks advance notice of his requirements. Upon receipt of the plants, the Contractor shall ensure that the plants are in good condition and free from obvious diseases and shall accept full responsibility to maintain the plants in good condition throughout the Contract, including the defects liability period. The plants shall be fully maintained and watered during this period, and any losses of plants due to lack of maintenance or diseases developing during the Contract period and the defects liability period shall be replaced at the Contractor's expense.

Plants shall be handled and packed in the approved manner for the particular species or variety, and all necessary precautions shall be taken to ensure that plants will arrive at the point of use in proper condition for successful growth. Trucks used for transporting plants shall be equipped with covers to protect plants from windburn. Containers shall be in a good condition.

Plants supplied by the Contractor shall be healthy, shapely and well-rooted. Roots shall not show any evidence of having been restricted or deformed at any time. Plants shall be well-grown and free from insect pests and diseases.

02.05 Grass sods

Grass sods shall be nursery-grown and shall be harvested, delivered and planted within 36 hours, unless otherwise authorized by the Engineer. Grass sods shall be free from noxious weeds and diseases and shall contain a minimum of 30 mm of soil.

Sods shall be of the variety of grass specified in the Project Specifications, unless otherwise approved by the Engineer. The grass shall have been grown specifically for sod purposes, mown regularly and maintained to provide an approved quality of uniformity. It shall be harvested by special machines manufactured for this purpose to ensure an even depth of cut with sufficient root material and soil.

02.06 Revegetation cylinders

Revegetation cylinders shall consist of cylindrical capsules with a diameter of approximately 125 mm and a length of 1 500 mm. They shall be manufactured from extruded plastic netting or similar approved biodegradable material. The plastic material shall be specially formulated to provide protection against ultra-violet rays from the sun, and shall be sufficiently robust to last for a period of not less than three years without disintegration under normal service conditions.

The revegetation cylinders shall be filled with shredded or partially compressed organic matter, such as wood chippings. Where wood chippings are used, only material passing a 31 mm sieve with round holes and having been retained on a 5 mm sieve with square holes shall be used. The wood chippings shall be treated with Tanalith C or a similar approved wood preservative.

The Contractor's attention is drawn to the fact that the use of revegetation cylinders is subject to patent rights and that all royalties shall be payable by the Contractor.

The Contractor shall, at the start of the Contract, ascertain what delivery period applies in respect of the cylinders so that orders can be placed in good time.

02.07 Anti-erosion compounds

Anti-erosion compounds shall consist of a plastic material in dispersion, such as Verdyol or a similar approved compound, which can be sprayed onto the soil to bind and protect it against erosion.

02.08 Topsoil

Topsoil shall consist of fertile loamy soil selected from areas showing a good coverage of natural vegetation, preferably grasses. It shall be free from deleterious matter such as large roots, any stones, refuse, stiff or heavy clays and noxious weeds, which would adversely affect its suitability for the planting of grass.

Topsoil shall be obtained wherever suitable material occurs, either from the Site or from borrow areas to be cleared, as described in clauses 03 and 05 respectively of section 201. The Engineer shall indicate his requirements to the Contractor regarding the quantity of topsoil required and the areas at which it shall be selected and whence it shall be removed. Unless otherwise specified or instructed by the Engineer, topsoil shall not be taken from more than 400 mm below the original undisturbed surface. If the Contractor fails to conserve topsoil as instructed, he shall obtain suitable substitute material from other sources at no extra cost to the Employer.

Where so specified, the Contractor shall procure and supply topsoil from his own sources outside the Site. Such sources shall be subject to the approval of the Engineer.

In respect of borrow material obtained from sources provided by the Contractor, the provisions of clause 05(f) of section 201 are applicable.

Topsoil shall be stockpiled in separate loose heaps as tipped from the trucks and shall not be stockpiled higher than 2,0 m unless otherwise authorized.

02.09 Manure

Manure shall, unless another type is approved by the Engineer, be pure "kraal" manure, free from soil, weed seed or other objectionable material. It shall not contain any particles that will not pass through a 50 mm screen. Only manure which has been approved by the Engineer shall be delivered to the Site.

02.10 Compost

Compost shall be well-decayed, friable and free from weed seed, dust and other objectionable materials.

03 LANDSCAPING OF AREAS

03.01 Shaping

Areas that require shaping which involves bulk earthworks, such as contoured areas, shall be excavated, filled, compacted when required, and shaped to the correct contours to within a tolerance of plus or minus 150 mm. Such work shall be considered as earthworks and measurement and payment shall be made under series 2 of these Specifications, except that quantities may be measured by means of a grid of levels taken at 10 m intervals before and after shaping, or by means of levelled cross-sections.

03.02 Trimming

Trimming shall consist of bringing the existing or previously shaped ground to an even surface with the final levels generally following the original surface. Trimming shall normally be done by grader, or, in more confined or steep areas, by bulldozer. Where machine operations are not practicable because of confined spaces or steep slopes, trimming shall be done using hand tools.

All trimming alongside roads and streets shall be completed before construction of the subbase layer commences. Such trimming shall be carried out on both sides of the road or street up to the boundaries of the road reserve unless otherwise specified or instructed by the Engineer.

Where applicable, trimmed surfaces shall be left slightly rough to facilitate binding with topsoil or the natural establishing of vegetation.

When subsequent grassing is required or when instructed by the Engineer, areas previously shaped shall be trimmed as described above to within a tolerance of plus or minus 25 mm, with all undulations following a smooth curve. The above tolerance shall apply only to areas where the final contours are given in the Drawings.

During trimming, all stones in excess of 50 mm in size and all excess material shall be removed. The trimming of any areas requiring grass shall be done in such a way that, after cultivation and application of any topsoil, the finished surface of the area shall be approximately 25 mm below the top of adjacent kerbing, channelling or pavement.

03.03 Plant rates

The Engineer shall be entitled to pay for shaping and trimming as described above on the basis of the hourly rates for motor graders and bulldozers. The motor grader and bulldozer to be provided shall each have a fly-wheel power of not less than 93 kW. Any labour or other plant ordered shall be paid for as "extra work" as specified in the General Conditions of Contract.

04 PREPARATION OF AREAS FOR GRASSING

The various areas to be grassed shall be prepared as follows:

04.01 Areas not requiring topsoil

Where the areas to be grassed consist of organically suitable material, they shall be scarified to a minimum depth of 150 mm. All loose stones larger than 30 mm on areas to be mowed by machine shall be removed. Areas to be mowed by machine will be as shown on the drawings.

04.02 Areas requiring topsoil

Where areas to be grassed consist of organically unsuitable material, the surface shall be roughened to ensure a proper bonding between the topsoil and the subsoil. If required, the area shall be scarified as described in subclause 04.01 above.

Topsoil shall be placed on the prepared surfaces and trimmed to the uniform thickness required. The topsoil shall be prepared by means of hand-rakes or light rotavators to obtain a smooth surface. All stones shall be removed as specified for areas not requiring topsoil in subclause 04.01 above.

04.03 Fertilizing

The Contractor shall, without any additional compensation, have the top 150 mm of the prepared surfaces tested to determine the amount and type of fertilizer required for establishing proper growing conditions for the grass. The fertilizer shall be evenly applied at the recommended rate of application over all surfaces where grass is to be planted and shall then be thoroughly mixed with the soil, either mechanically or manually, to a depth of 150 mm. Where hydroseeding is to be performed, the fertilizer may be mixed with the cellulose pulp and water used in hydroseeding.

05 GRASSING

The method of establishing grass shall depend on the circumstances relating to each case. The method to be used in each case shall be as specified or as agreed on by the Engineer and the Contractor.

05.01 Planting of grass cuttings

The areas to be planted shall, unless they are wet, be thoroughly watered before planting to ensure that soil will be uniformly wet over a depth of at least 150 mm during planting.

The Contractor shall plant an approved variety of couch-grass ("kweek") cuttings, using his own method, in such a way as to obtain a sufficient number of live and actively growing plants per square metre to provide an acceptable cover as defined in subclause 06.02 of this section. At least 70 grain bags of cuttings shall be planted per hectare. Only fresh cuttings shall be used; grass cuttings that have been allowed to dry out shall not be used. Immediately after planting, the grass cuttings shall be given a copious watering and when sufficiently dry shall be rolled with a light agricultural roller.

05.02 Sodding

Areas to be grassed by sodding shall be given a layer of topsoil at least 75 mm thick unless the Engineer instructs that the topsoil be omitted where suitable subsoil is present. The areas to be sodded shall be thoroughly watered beforehand so that they will be wet to a depth of at least 150 mm after sodding. The surface shall be slightly roughened to ensure a good penetration of roots into the soil. Sods shall be protected against drying out and shall be kept moist from the time of harvesting until finally placed.

Wherever possible, the first row of sods shall be laid in a straight line and, if on a slope, laying shall be started at the bottom of the slope. The sods shall be butted tightly against each other and care shall be taken not to stretch or overlap the sods. Where a good fit cannot be obtained, the intervening space shall be filled with topsoil. The next row shall similarly be placed tightly against the bottom row with the joints staggered, and so on, until the entire area is covered with sods. On the instructions of the Engineer, sods shall be held in position on steep slopes by a sufficient number of robust wooden stakes approximately 300 mm in length by 20 mm in diameter.

Each section of completed sodding shall be lightly rolled and thoroughly watered.

05.03 Hydroseeding

The types and mixtures of seeds to be used shall be as specified in the Project Specifications or, if not so specified, shall be agreed on by the Engineer and the Contractor before any seed is ordered for use by the Contractor. The Contractor shall be solely responsible for establishing an acceptable grass cover, and any approval by the Engineer of seed or seed mixtures proposed for use shall not relieve him of this responsibility.

Cellulose pulp shall be added to the hydroseeding mix at a rate of 25 kg of pulp per kilolitre of water used, except where otherwise instructed for flat slopes.

Hydroseeding shall then be carried out with the use of an approved hydroseeding machine at a rate of application of not less than 38 kg of seed mixture per hectare, unless otherwise specified in the Project Specifications.

When the use of an approved anti-erosion compound such as an organic adhesive or biodegradable covering material is required and the compound is to be applied simultaneously with the hydroseeding, it shall be mixed with the hydroseeding mixture before application. In this case the amount of cellulose pulp shall be decreased by one-third to a half, depending on the amount of compound added.

05.04 Revegetation cylinders

Revegetation cylinders shall be placed end to end in rows along the contour lines of the slope, as directed by the Engineer. The spacing of rows shall be as shown on the Drawings and the cylinder ends shall be staggered in alternate rows to prevent runnels from forming. Revegetation cylinders shall be secured at their ends and in the middle to barbed-wire stays running down the slope; special wire ties supplied by the manufacturer and a suitable wire-tying tool shall be used.

The stay wires shall be secured to the slope by means of steel stakes and shall be pulled taut. The slope face shall preferably be not smooth but kept slightly rough in order to facilitate the retention of topsoil.

After the revegetation cylinders have been placed and secured in position, the space between rows shall be filled with an approved topsoil and the upper surface of the topsoil shall be finished flush with the top of the revegetation cylinders. The use of rake-shaped wooden tools is recommended for this purpose. Care shall be taken during construction not to compact the topsoil excessively or to damage the cylinders when topsoil is moved down the slope. On slope lengths exceeding 10 m, special measures shall be taken to protect finished work, such as the use of metal chutes or plastic sheeting to move topsoil down the slope. All topsoiling shall start from the top of the slope.

The Contractor's attention is directed to the more comprehensive details of construction which may be given on the Drawings and in the manufacturer's instructions.

05.05 Grassing of borrow pits, temporary bypasses, camp sites, access roads and stockpile sites

Prior to any grassing that may be required on borrow areas, the finishing-off of borrow pits as described in clause 05 of section 201, the obliteration of bypasses and access roads as described in clause 14 of section 102 and the clearing of camp sites as described in section 001 shall have been carried out as specified in the relevant sections.

06 ESTABLISHING AND MAINTENANCE OF GRASS

06.01 Watering, weeding, cutting and replanting

All sodded and planted areas shall be adequately watered at frequent and regular intervals in order to ensure proper seed germination and the growth of grass until the grass has established an acceptable cover and thereafter until the beginning of the defects liability period of the grass. The amount and frequency of watering shall be subject to the Engineer's approval. Where hydroseeding is carried out, the commencement of watering may be postponed until a favourable time of the year, but watering shall in any case commence and continue as soon as the seeds have germinated and growth begins.

The Contractor shall mow the grass on all areas that have been grassed, whenever so instructed by the Engineer, until the end of the defects liability period.

All grass cuttings shall be collected and disposed of if so directed by the Engineer. Weeds shall be controlled by means of pulling or cutting or by any other approved means. Any bare patches where the grass has not taken, or where it has been damaged or has dried out shall be recultivated, planted, sodded or hydroseeded at the Contractor's expense.

All grassed areas shall have acceptable cover as defined below at both the beginning and end of the defects liability period.

06.02 Acceptable cover

An acceptable grass cover shall mean that not less than 75% of the area planted or hydroseeded shall be covered with grass and that there shall be no bare patches the maximum dimension of which shall not exceed 500 mm. In the case of sodding, acceptable cover shall mean that the full area shall be covered with live grass at the end of a period of not more than three months after sodding.

06.03 Defects liability period

The defects liability period of grass shall commence when an acceptable cover as defined in subclause 06.02 above has been established and shall be one year. This means that the defects liability period for grass can commence earlier or later than the defects liability period for other portions of the Contract.

The defects liability period for grassing by revegetation cylinders shall start whenever an acceptable grass cover is obtained or when the section of the Works where grassing is done is handed over for maintenance, whichever is the earlier date, and shall be one year.

If the defects liability period for the grass expires before the end of the defects liability period for the Contract, the Contractor shall further mow the grass on such areas as instructed by the Engineer up to the end of the defects liability period for the Contract.

07 TREES, SHRUBS AND GROUND COVERS

07.01 Positions of plants

The positions in which trees, shrubs and ground covers are to be planted shall be as indicated on the Drawings or as determined by the Engineer, and care shall be taken that the taller plants will not obscure traffic signs.

07.02 Preparation of plant holes

Unless otherwise directed by the Engineer, holes for trees and shrubs shall be placed and prepared as follows:

- All holes shall be square in plan.
- For shrubs the holes shall be at least 500 mm square by 600 mm deep.
- For trees the holes shall be at least 600 mm square by 700 mm deep.
- The planting holes shall be refilled with selected and approved topsoil, thoroughly mixed with manure or compost (one heaped spadeful added to every plant hole), and, depending on soil-test reports, the required amount and type of fertilizer.
- The holes shall be thoroughly watered before planting. Where the local soil has poor drainage, 150 mm of broken rock shall be placed at the bottom of the planting hole before filling it with soil.

07.03 Planting

Before planting, the plants shall be well watered before they are removed from their containers.

Ground-cover plants shall be carefully lifted from their containers and transferred to holes in the prepared soil, which holes shall be just large enough to accommodate the plant and the adhering soil.

Care shall be taken to avoid exposure of the roots during planting. Soil for ground covers shall be prepared as for grassing, as specified in clause 04.

Directly after the planting, plants shall be well watered to establish them firmly in the soil. After the soil has set, additional soil shall, in the case of trees and shrubs, be added where necessary to bring the backfill material to within 150 mm of the ground surface to ensure the retention of sufficient water. All trees shall be tied to a suitable creosote-treated timber stake planted firmly in the ground. The stake shall have a minimum diameter of 35 mm and shall be 300 mm longer than the planted tree, with a maximum length of 3 m above the ground. After planting, the ground surface around the plants shall be covered with straw or grass or any other type of mulch to minimize evaporation.

07.04 Maintenance

During the defects liability period, which shall end twelve months after completion of the actual planting of trees, shrubs and ground covers, the Contractor shall be responsible for watering the plants and for keeping them free from weeds and pests.

Every plant that is not healthy or shows unsatisfactory growth shall be replaced by the Contractor at his own expense before the end of this period.

08 GENERAL

08.01 Time of planting

The planting of grass, trees, shrubs and ground covers shall be carried out as far as is practicable during periods most likely to produce beneficial results. The Contractor shall make every effort to programme his operations to make this possible.

08.02 Traffic on grassed areas

The Contractor shall not plant grass until all operations that may require construction equipment to be moved over the grassed areas have been completed. No equipment, trucks or water carts shall be allowed on areas that have been grassed and only equipment required for the preparation of areas, the application of fertilizer and the spreading of topsoil will be allowed to operate on areas ready for grassing.

08.03 Erosion control

During construction, the Contractor shall protect all areas susceptible to erosion by installing all necessary temporary and permanent drainage works as soon as possible and by taking such other measures as may be necessary to prevent the concentration of surface water and the scouring of slopes, banks and other areas.

Runnels or erosion channels developing during the construction period or during the defects liability period shall be backfilled and consolidated and the affected areas shall be restored to their former proper condition. The Contractor shall not allow large-scale erosion to develop before effecting repairs and all erosion damage shall be repaired as soon as possible and in any case not later than three months before the end of the defects liability period. Topsoil washed away shall be replaced.

08.04 Proprietary brand materials used for erosion control

Proprietary brands of materials that may be required for erosion protection to enable natural grass to become established shall comply with the requirements specified in the Project Specifications.

08.05 Responsibility for establishing an acceptable cover

Notwithstanding the fact that the method of grassing and the type of seed or grass used and the rate of seed application may be specified or agreed to by the Engineer, and that the frequency of mowing will be as instructed by him, the Contractor shall be solely responsible for establishing an acceptable grass cover and for the cost of replanting or rehydroseeding where an acceptable cover has not been obtained. Where, however, in the opinion of the Contractor, it is doubtful from the outset whether an acceptable cover can be established, he may inform the Engineer of his reasons for this, and the Engineer shall, if he agrees, either adopt another grassing method or agree to accept whatever cover can be obtained, provided that all reasonable efforts are made to establish a good cover by the method proposed. Such agreement shall only be valid if given in writing by the Engineer.

09 MEASUREMENT AND PAYMENT

Item		Unit
104.01	**Trimming**	
104.01.01	Machine trimming	square metre (m^2)
104.01.02	Hand trimming	square metre (m^2)

Note:

All bulk earth-moving operations as described in sub clause 03.01 shall be measured and paid for under section 203.

The unit of measurement for trimming shall be the square metre of area trimmed on the Engineer's instructions, including areas trimmed after shaping.

The tendered rates shall include full compensation for trimming areas to the specified finish, including the moving of small quantities of material which would be inherent in this process, and the removal of surplus material and stones. For payment purposes a distinction shall be made between machine trimming that can reasonably be carried out by bulldozer or motor grader, and hand trimming that cannot be done by machine owing to confined space, steep slopes or difficult shapes.

Item		Unit
104.02	**Use of machines for trimming or shaping** (alternative to subitem 104.01.01)	
104.02.01	Bulldozer	hour (h)
104.02.02	Motor grader	hour (h)

The unit of measurement shall be the hour actually worked by each machine in trimming or shaping areas. Standing time shall not be measured.

The tendered rates shall include full compensation for the supply and use of the machines, including the cost of fuel, operators, maintenance, transporting the machine to and from the point of use, and for all other incidentals necessary to carry out the work.

Item		Unit
104.03	**Preparing areas for grassing and ground covers**	
104.03.01	Scarifying	hectare (ha)
104.03.02	Topsoiling on the Site with -	
104.03.02.01	Topsoil obtained from the Site or borrow areas provided by the Employer	cubic metre (m^3)
104.03.02.02	Topsoil provided by the Contractor from other sources (including all haul)	cubic metre (m^3)
104.03.03	Topsoiling of borrow pits with topsoil obtained from borrow areas or from the Site	cubic metre (m^3)
104.03.04	Supplying and applying chemical fertilizers:	
104.03.04.01	Lime	ton (t)
104.03.04.02	Superphosphate	ton (t)
104.03.04.03	Limestone ammonium nitrate	ton (t)
104.03.04.04	2:3:2(22)	ton (t)
104.03.04.05	Other fertilizers if required (type stated)	ton (t)
104.03.05	Stockpiling of topsoil	cubic metre (m^3)

- 104.03.01 Scarifying

  The unit of measurement for scarifying shall be the hectare of ground scarified and prepared as specified. Only areas scarified on the written instructions of the Engineer shall be measured.

  The tendered rate shall include full compensation for scarifying, removing stones and smoothing the surface.

- 104.03.02 and 104.03.03 Topsoiling

  The unit of measurement shall be the cubic metre of topsoil applied to the specified thickness or as directed by the Engineer, measured in situ after the topsoil has been placed. The quantity shall be calculated from the net area of the surface topsoil multiplied by the average thickness of the topsoil before the application of grass sods. Any topsoil placed in excess of the average thickness specified or ordered shall not be measured.

  For payment purposes a distinction shall be made between topsoil obtained from designated areas on the Site or borrow areas and topsoil obtained by the Contractor from outside sources found by himself when sufficient topsoil is not available from the said designated areas. For payment purposes a further distinction shall be made between topsoil applied to areas on the Site and topsoil applied to borrow areas.

  The tendered rates shall include full compensation for excavating and loading the topsoil, for constructing the topsoil as specified, any royalties or compensation that may be payable in the case of topsoil under subitem 104.03.02.02, transport, off-loading, placing, spreading, for removing any stones and for roughening the surface to be topsoiled.

  Where overhaul is applicable, the requirements of section 103 shall apply.

- 104.03.04 Furnishing and applying fertilizers

  The unit of measurement of fertilizer shall be the ton of each type of fertilizer ordered and applied.

  The tendered rates shall include full compensation for supplying the fertilizers, and for fertilizing the designated surfaces, all as specified.

- 104.03.05 Stockpiling of topsoil

  The unit of measurement shall be the cubic metre of topsoil stockpiled, on the written instructions of the Engineer, where this operation is unavoidable despite proper advance planning. Only material actually loaded, transported to and stockpiled on sites designated for stockpiling shall be measured, and not any material merely pushed or bladed into heaps adjacent to the area from which it was taken.

  The tendered rate shall include full compensation for removal and loading the topsoil, transporting it, placing it in stockpile, and for any payments to private owners for the use of stockpile areas.

  Where overhaul is applicable, the requirements of section 103 shall apply.

Item		Unit
104.04	**Grassing**	
104.04.01	Planting of grass cuttings	hectare (ha)
104.04.02	Sodding	square metre (m^2)
104.04.03	Revegetation cylinders	metre (m)
104.04.04	Hydroseeding	
104.04.04.01	Providing approved seed mixture for hydroseeding	kilogram (kg)
104.04.04.02	Hydroseeding	hectare (ha)

- 104.04.01 Planting of grass cuttings

  The unit of measurement for the planting of grass cuttings shall be the hectare of established grass with an acceptable grass cover.

  The tendered rate shall include full compensation for furnishing and planting of grass cuttings, the establishing of an acceptable cover, the replanting of dead areas and the maintenance of the grass, all as specified, but excluding the mowing of grass.

- 104.04.02 Sodding

  The unit of measurement for sodding shall be the square metre covered with sods and having an acceptable cover.

  The tendered rate shall include full compensation for procuring, furnishing, loading, transporting, off-loading, placing and watering the sods, for the establishing of an acceptable cover, the replanting of dead areas, and the maintenance of the grass, all as specified, but excluding the mowing of the grass.

- 104.04.03 Revegetation cylinders

  The unit of measurement for revegetation cylinders shall be the metre of revegetation cylinders furnished and placed as specified, measured along the rows in which they are placed end to end.

  The tendered rates shall include full compensation for all labour, materials, plant and transport necessary to construct and maintain the revegetation cylinders, as specified. Topsoiling shall be paid for separately under item 104.03, and due allowance shall be made for excluding the volume occupied by the revegetation cylinders from the volume of topsoil measured for payment. Hydroseeding shall be paid for separately.

- 104.04.04 Hydroseeding

  104.04.04.01 The unit of measurement for providing seed shall be the kilogram of seed of the specified mixture, excluding the mass of any pulp added thereto.

  104.04.04.02 The unit of measurement for hydroseeding shall be the hectare of grass established by hydroseeding and having an acceptable cover.

  The tendered rates shall include full compensation for furnishing and mixing the materials hydroseeding, for the establishing of an acceptable cover, rehydroseeding bare patches, and the maintenance of the grass, all as specified, but excluding the mowing of the grass.

General

Half the payments under item 104.04 shall become due when the grassing or hydroseeding has been carried out, and the remainder shall become due when a satisfactory cover has been established, except in the case of subitem 104.04.03 where the full amount will become due upon the satisfactory execution of the work.

Item		Unit
104.05	**Mowing of grass**	hectare (ha)

The unit of measurement shall be the hectare, measured each time when the grass has been cut on the instructions of the Engineer.

The tendered rate shall include full compensation for all plant, equipment and labour required for each grass cutting and the disposal of grass cuttings, i.e. payment shall be made every time the grass has been cut on the instructions of the Engineer.

Item		Unit
104.06	**Anti-erosion compounds such as organic adhesives or bio-degradable covering material (type indicated)**	kilogram (kg)

The unit of measurement shall be the kilogram net mass of anti-erosion compound used as approved by the Engineer.

The tendered rate shall include full compensation for supplying the material and mixing and applying it with the hydroseeding or by itself.

Item		Unit
104.07	**Trees, shrubs and ground covers**	
104.07.01	Provision of trees and shrubs (types indicated)	number (No)
104.07.02	Provision of ground covers	number (No)

The unit of measurement shall be the number of each variety of tree, shrub or ground cover supplied and established.

The tendered rate shall include full compensation for supplying the plants at the point of final use, including substitutes for plants that may become diseased or may die.

104.07.03	Planting and establishing of -	
104.07.03.01	Trees	number (No)
104.07.03.02	Shrubs	number (No)
104.07.03.03	Ground covers	number (No)

The unit of measurement shall be the number of each type planted and established.

The tendered rates shall include, in the case of trees and shrubs, full compensation for excavating the holes to the specified dimensions, for supplying topsoil, wooden stakes, broken rock, manure and compost, and mixing them with any fertilizer required for planting, for refilling each hole with the topsoil mixture and other soil, for watering the plants until the end of the defects liability period, and in the case of ground covers, for planting in the soil prepared as specified in clause 04, for supplying and replanting substitutes for plants that have died, and for maintaining the plants as specified until the end of the defects liability period, including any other incidentals that may be necessary for the proper execution of the work.

Where the Employer supplies the plants, the above rates shall also include full compensation for taking delivery of the plants, maintaining them until required, transporting them to the point of final use, and for providing substitutes for plants that die or become diseased during storage.

Any chemical fertilizer required will be measured and paid for under subitem 104.03.04. Preparation of soil for the planting of ground covers will be measured and paid for under item 104.03.

Item		Unit
104.08	**Extra work for landscaping**	provisional sum

The provisional sum allowed shall be expended at the discretion of the Engineer to cover the cost of work in addition to the scheduled items that may be required in respect of landscaping when plant is used at hourly rates, e.g. the cost of loading and transporting surplus material, in respect of establishing the grass by topsoiling only, repairing erosion damage after topsoil has been applied, or in respect of any other items of work required for which no pay items have been provided.

Payment shall be made as specified in the General Conditions of Contract.

Note:

The following item of work, when specified, shall be carried out, measured and paid for in accordance with the relevant sections of the Specifications, but shall be listed under this section in the Schedule of Quantities.

Item	Applicable section
(a) Overhaul on topsoil	103

SERIES 1 : ANCILLARY WORK

SECTION 105 : FENCING

CONTENTS

01 SCOPE

This section covers the erection of new fences, the moving of existing fences, the erection and later removal of temporary fences, the dismantling of existing fences, and finally the stacking of the fencing material.

02 TYPES OF FENCES

The following types of fences shall be erected in accordance with the dimensions shown on the Drawings:

(a) Ordinary fences with diamond mesh, or tension fencing to the full height of the fence.

(b) Security fences, either the verandah type with diamond mesh or tension fencing on the vertical portion and barbed wire on the overhang, or the vertical type with full height diamond mesh, barbed wire or tension fencing, with or without rolls of barbed-tape concertinas fitted as shown on the Drawings. Verandah-type fences can also be fitted with barbed-tape concertinas.

03 MATERIALS

03.01 Posts, stays, standards and droppers

Posts, stays, standards and droppers shall be of the type and size indicated on the Drawings. Posts shall include gate posts, straining posts and corner posts.

Metal posts, stays, standards and droppers shall comply with the requirements of CKS 82 and SANS 280. "Acceptable" in CKS 82 means "acceptable to the Engineer".

Tubular posts shall be sealed at the top with caps and shall be fitted with base plates as shown on the Drawings.

Tubular posts, standards and stays shall be galvanised in accordance with SANS 32 quality B1 or SANS 121 Table 2 or 3, as applicable. All rail sections, Y-sections and metal droppers shall be provided with a protective coating of tar or other approved material.

Timber posts, stays, standards and droppers shall comply with the requirements of SANS 457 part 2 or part 3 as applicable and shall be creosote-impregnated in accordance with SANS 10005, with creosote complying with SANS 538 or SANS 539. All timber shall be straight and free from unsightly knots, splits and other imperfections.

Corner, gate and straining posts shall be suitably drilled for stay bolts or gate fittings as indicated on the Drawings.

03.02 Bolts for stays

Bolts shall be of mild steel and galvanized in accordance with SANS 121 Table 2 or 3, as applicable. The length and diameter of the bolts shall be as shown on the Drawings. All the necessary bolts, together with nuts and washers, shall be supplied with each post.

03.03 Wire

All wire shall conform to the requirements of SANS 675 and shall be zinc coated as set out in Table 3 of this specification.

(a) Barbed wire

Barbed wire shall be one or both of the following types:

(i) High-tensile grade, oval shaped, single-strand wire, 2,60 mm x 2,00 mm.

(ii) Mild-steel grade, double strand, uni-directional twist wire, each strand 2,50 mm in diameter.

Barbs shall be spaced at not more than 150 mm intervals.

(b) Smooth wire

Smooth wire shall be of the types specified below:

(i) Straining wire shall be mild-steel wire, 4,00 mm in diameter.

(ii) Fencing wire shall be high-tensile strength-grade 2,24 mm diameter wire.

(iii) Tying wire or binding wire shall be 2,50 mm diameter, mild-steel for tying fencing wire to standards and droppers, and 1,60 mm diameter, mild-steel for tying wire mesh to fencing wire.

(c) Barbed-tape security barriers

Barbed-tape security barriers shall comply with the requirements of SANS 1620 for type A and shall consist of close-coiled high-tensile strength wire with a continuous strip of flat steel barbs (barbed tape) crimped to the wire along the entire length of the wire. The coils shall further be attached together by clips to give a concertina configuration when pulled apart. The coils shall be of the diameter as shown on the Drawings. Each concertina shall have a minimum of 55 coils, and the maximum effective length of open concertina, when pulled apart, shall depend on the diameter of the roll but shall be at least 12 m.

The high-tensile wire shall be Class B galvanized as per SANS 935.

The barbed tape shall be made of cold-rolled carbon steel galvanized to Class Z600 as per SANS 934.

The concertina clips shall be manufactured from steel strip galvanized to Class Z600 as per SANS 934.

03.04 Diamond mesh

Diamond mesh (chain-link fencing) shall comply with the requirements of SANS 1373. The width shall be as shown on the Drawings, and both edges shall be clinched.

The diameter of the wire shall be 2,5 mm and the mesh size shall be as shown on the Drawings.

The wire shall be Class B galvanized as per SANS 935.

03.05 Tension fencing

Pre-assembled tension fencing shall be manufactured from wires complying with the requirements of SANS 675. The height shall be as shown on the Drawings with the edge wires and intermediate wires having a minimum diameter of 2,24 mm. Edge wires and intermediate wires shall be of a high-tensile strength grade, and all wires shall be galvanized as per SANS 935.

03.06 Gates

Gates shall comply with the requirements of CKS 146 and shall be manufactured to the dimensions shown on the Drawings.

Gates shall be complete in every respect, and shall include hinges, washers, bolts and locking mechanism.

03.07 Materials for temporary fences

All new material for temporary fences shall be of the same quality as the material for new fences. Second-hand material, whether available on Site or purchased, shall be thoroughly inspected for defects before use. The protective galvanized coating on all second-hand fencing wires shall be intact, but barbs, diamond mesh, posts, standards, droppers and gates may have a rusty appearance provided that the rust is superficial and does not impair the structural strength of the items.

03.08 Concrete

Concrete used for fencing shall comply with the requirements of section 704.

04 CLEARING OF FENCE LINE

Strip clearing for the fence shall be carried out and paid for in accordance with section 101 of these Specifications.

05 INSTALLING POSTS AND STANDARDS

Straining posts shall be erected at all ends, corners and bends in the line of fencing and at all junctions with other fences. Straining posts shall not be spaced further apart than shown on the Drawings. The height of the posts above the ground shall be such that the correct clearance between the lowest wire and the ground can be obtained.

Posts shall be accurately set in holes and, where indicated, shall be provided with concrete bases to the dimensions shown on the Drawings.

Holes shall be dug to the full specified depth. Where, owing to the presence of rock, the holes cannot be excavated by hand or by pneumatic tools and the Contractor has to resort to the use of explosives, he will be paid separately for the drilling and blasting operations required.

Corner, gate, end and straining posts shall be braced by means of stays or anchors, as shown on the Drawings. Pipe stays shall be bolted to the posts. Gate posts shall not be used as straining posts, but at each gate post a straining post shall be placed as shown on the Drawings and stayed by means of an anchor consisting of six strands of wire.

Standards shall be firmly planted in the ground at the spacing shown on the Drawings or as directed by the Engineer. The spacing of standards between any two straining posts shall be uniform. In rock or hard material non-tubular standards shall either be driven or set in holes drilled into the rock.

The size of drilled holes shall be such that a tight fit is obtained. Care shall be taken not to buckle or damage the standards when driven. Where indicated, standards shall be provided with concrete bases to the dimensions shown on the Drawings.

All posts and standards shall be accurately aligned and set plumb. Where verandah-type security fencing is used, the posts and standards shall be planted with the overhang as shown on the Drawings and at right angles to the direction of the fence. After posts and standards have been firmly set in accordance with the foregoing requirements, the fencing wire shall be attached thereto as described below.

06 INSTALLING WIRE AND TENSION FENCING

All fencing wire shall be carefully stretched and hung without sag and with true alignment, and care shall be taken not to stretch the wire so tightly as to cause breaking, to pull up straining posts, or to be easily damaged during veld fires.

Each strand of fencing wire shall be securely fastened in the correct position to each standard with galvanized binding wire. The binding wire for each horizontal fence wire shall pass through a hole or notch in the standard, and the ends of the wire shall be wound at least four times around the fencing wire.

At the end, corner, straining and gate posts the fencing wire shall be securely wrapped twice around the post and secured against slipping by tying the end tightly around the wire by means of at least six snug, tight twists. In the case of high-tensile wire, two long windings must first be made before the six tight twists to prevent the wire from breaking at the first twist. Where smooth wire is used, the loose end shall be bent back and hooked into the opening between the fencing wire and the first winding.

Splices in the fencing wire will be permitted if made in the following manner with the use of a splice tool. The end of each wire at the splice shall be carried at least 75 mm past the splice tool and wrapped snugly around the other wire for not less than six complete turns, after which the two separate wire ends shall be wound in opposite directions. After the splice tool has been removed, the space left by it in the splice wire shall be closed by pulling together the wire ends. The unused ends of wire shall be cut close so as to leave a neat splice.

The gaps between gate posts and the adjacent straining posts shall be fenced off with short fencing wires.

Tension fencing shall be installed according to the methods and with the special tools recommended by the manufacturer.

07 INSTALLING DROPPERS

Droppers shall be tied to each fence wire with binding wire in the required position to prevent vertical slipping. The spacing of droppers between any two standards shall be uniform. Droppers shall be suspended clear of the ground at a distance as shown on the Drawings.

08 INSTALLING DIAMOND MESH

Where indicated on the Drawings, diamond mesh shall be stretched against the fence and properly tied to the fencing wire. The diamond mesh shall be secured by means of binding wire at 1,2 m centres along the top and bottom wires and at 3 m centres along each of the other fencing wires, unless shown otherwise on the Drawings.

09 INSTALLING BARBED-TAPE CONCERTINAS

Barbed-tape concertinas shall be positioned on the fence as shown on the Drawings. The concertinas shall be fastened to the appropriate fencing wires at each standard as well as at 1,0 m maximum intervals between standards.

Rolls of barbed-tape concertinas shall be joined with binding wire at four points, spaced at equidistant intervals around the circumference of the loop. Joints shall be made to coincide with the positions of standards.

10 CLOSING OPENINGS UNDER FENCES

At ditches, streams, drainage channels or other hollows where the fence cannot follow the general ground contour, the Contractor shall close the opening under the fence by means of horizontal barbed wires 150 mm apart and stretched between additional straining posts as shown on the Drawings. The opening shall be covered with strips of diamond mesh, 1 000 mm wide, fixed to the barbed wires.

In the case of larger streams the opening below the lower fencing wire shall be closed by means of loose-hanging wire nets as shown on the Drawings. These mats shall be erected at streams only on the instructions of the Engineer.

11 EXISTING FENCES

Where a new fence joins an existing fence, whether in line or at an angle, the new fence shall be erected with a new straining post positioned at the junction with the existing fence.

Existing fences that are required to be taken down or moved to a new location shall be dismantled and shall either be re-erected to the same design as originally constructed, with such modifications as the Engineer may require, or shall be erected to one of the standards specified in clause 02 if so scheduled.

Material not required for re-erection or declared to be unsuitable for re-use shall be neatly stacked at approved locations in accordance with the Engineer's instructions. Fencing wire, mesh or netting shall be stacked clear of the ground.

In the case of existing fences that require moving, the Contractor shall, where possible, re-use all material found to be suitable for this purpose, and shall supply any such new material as may be required for re-erecting the fence to the standards specified for new fences.

The Contractor shall take extreme care when straining used wire to avoid unnecessary breakage.

12 TEMPORARY FENCES

At any time during the currency of the Contract, the Engineer may direct the Contractor to erect temporary fencing where necessary in order to prevent unauthorised access to the Works. Such fencing shall be of one of the types mentioned in clause 02 and the type to be used shall be as scheduled.

Should material be available from fences that have been dismantled elsewhere on the Site, it shall be utilized, where possible, before additional new or second-hand material is acquired for completing the fence.

The fencing shall be maintained in good order during construction operations, and on completion of the Works it shall be removed from the Site. Wherever practicable, the Engineer may instruct that permanent and not temporary fencing be erected before construction operations commence.

Payment for temporary fencing around the Contractor's camp shall be included in the amount tendered for the Contractor's establishment on Site as specified in section 001.

13 INSTALLING GATES

Gates shall be installed at the positions indicated on the Drawings.

The gates shall be hung on gate fittings in accordance with the details shown on the Drawings. Gates shall be so erected that they swing in a horizontal plane at right angles to the gate posts and clear of the ground in all positions. Double swing gates shall close to have a gap of not more than 25 mm between them, and other gates shall close to be not further than 25 mm from the gate post.

14 GENERAL REQUIREMENTS AND TOLERANCES

The completed fences shall be plumb, taut, true to line and to the ground contour, and with all posts, standards and stays firmly set.

The height of the lower fencing wire above the ground at posts and standards shall not vary by more than 25 mm from that shown on the Drawings. Other fencing wires shall not vary by more than 10 mm from their prescribed relative vertical positions.

Anchoring of a fence to structures shall be done as shown on the Drawings.

The Contractor shall, on completion of each section of fence, remove all cut-offs and other loose wire or mesh so as to leave the fence with a neat and finished appearance.

15 MEASUREMENT AND PAYMENT

Item		Unit
105.01	**Supply and erection of new fencing material**	
105.01.01	Barbed wire (grade, size and type of wire indicated)	metre (m)
105.01.02	Smooth wire (grade and size indicated)	metre (m)
105.01.03	Barbed tape security barriers (type and where applicable coil diameter indicated)	metre (m)

The unit of measurement shall be the metre of each type of fencing wire and security barriers measured between end posts. Binding wire and wire used for the bracing and anchoring of posts shall not be measured for payment.

105.01.04	Diamond mesh (mesh size indicated)	square metre (m^2)
105.01.05	Tension fencing	square metre (m^2)

The unit of measurement shall be the square metre of diamond mesh or tension fencing and the quantity shall be calculated on the prescribed height and the length between straining posts or gate posts, or the length of strips for covering openings under fences, or the length used for the covering of gates.

105.01.06	Corner, end, straining and gate posts, including anchors (type, size and length indicated)	number (No)

The unit of measurement shall be the number of posts erected in accordance with the maximum specified spacing or such lesser spacing as authorized by the Engineer. New gate posts that may be required when existing gates are moved will be paid for under this item. However, gate posts for new gates shall not be measured for payment.

105.01.07	Standards (length and type indicated)	number (No)
105.01.08	Droppers (length and type indicated)	number (No)

The unit of measurement shall be the number of standards and droppers erected in accordance with the maximum specified spacing or such lesser spacing as authorized by the Engineer.

The tendered rates shall include full compensation for all excavations, for providing all materials including concrete, binding wire, straining wire, bolts, washers and nuts, for the drilling of holes for standards, and for the complete erection of the fence as specified and as shown on the Drawings. The tendered rate for posts shall make provision for the construction of the stays of the types shown on the Drawings.

The quantity of material used shall be determined by measuring the quantities of individual items of material installed in the completed fence. No linear measure of completed fence shall be applicable.

Item		Unit
105.02	**New gates**	
105.02.01	Single leaf (size and type indicated)	number (No)
105.02.02	Double leaf (size and type indicated)	number (No)

The unit of measurement shall be the number of new gates erected. A pair of gates shall be measured as one.

The tendered rates shall include full compensation for providing all materials including gate posts, hinges, bolts, concrete and straining wire, and for the erection of the gates as specified and as shown on the Drawings. It shall not include compensation for any fencing wire or mesh used on the gate.

Item		Unit
105.03	**Moving of existing fences and gates**	
105.03.01	Fences:	
105.03.01.01	Ordinary fences	metre (m)
105.03.01.02	Security fences	metre (m)
105.03.02	Gates	number (No)

The unit of measurement for moving existing fences shall be the metre of fence moved and the quantity shall be taken as the length of fence which is permanently re-erected where material available from fences that have been dismantled elsewhere is used. Additional new material used during the re-erection of existing fences shall be measured as set out under item 105.01. The unit of measurement for the moving of gates shall be the number of gates moved. A double-leaf gate shall be measured as two.

The tendered rate for each metre of existing fence moved, or for each existing gate moved, shall include full compensation for dismantling the old fence, coiling and stacking the material not suitable for re-use, moving all material, including posts and wire, re-erecting the fence or gate in the new position, and providing new binding, tying and straining wire. Additional new material used during the re-erection of the old fence shall be paid for under item 105.01. For payment a distinction shall be made between the moving of ordinary and security fences.

The tendered rate for each gate moved shall include full compensation for taking down the gate and re-erecting it where required, including all new bolts, nuts and other accessories required, but excluding new gate posts, which will be measured and paid for under subitem 105.01.06.

Item		Unit
105.04	**Dismantling of existing fences**	metre (m)

The unit of measurement shall be the metre of existing fencing, including gates taken down and dismantled on the instruction of the Engineer.

The tendered rate shall include full compensation for taking down existing fences and gates, the coiling of wires, rolling netting into rolls, transporting the material to designated sites, and stacking the material.

Item		Unit
105.05	**The drilling and blasting of holes for posts and anchors**	number (No)

The unit of measurement shall be the number of holes for posts and anchors made by drilling and blasting where excavation by hand tools or pneumatic tools cannot be done economically.

The tendered rate shall include full compensation for drilling and blasting the holes and for all other expenses in connection with the provision, storage, transportation and use of explosives.

Item		Unit
105.06	**Provision of temporary fencing**	
105.06.01	Ordinary	metre (m)
105.06.02	Security	metre (m)

The unit of measurement shall be the metre of each type of temporary fence erected as instructed by the Engineer.

The tendered rates shall include full compensation for the provision of all labour, and new or suitable second-hand material, including gates, for the erection of the temporary fence and, when no longer required, the dismantling and removal of such material from the Site or to any new position where required. For payment a distinction shall be made between the erection of ordinary and security fences.

When second-hand material is obtained from existing fences for the erection of temporary fences, the material shall be transported to designated sites and stacked when the fence has been dismantled and the material is no longer required.

Item		Unit
105.07	**Ring bolts for anchoring fencing to structures**	number (No)

The unit of measurement shall be the number of ring bolts supplied and fixed to the structure.

The tendered rate shall include full compensation for the supplying and fixing of ring bolts, of the type shown on the Drawings, to the structure, including, where necessary, drilling holes, the grouting-in of ring bolts with epoxy resin, and for all incidentals.

Note:

The following item of work, when specified, shall be carried out, measured and paid for in accordance with the relevant sections of the Specifications, but shall be listed under this section of the Schedule of Quantities.

Item	Applicable section
(a) Clearing and grubbing	101

SERIES 1 : ANCILLARY WORK

SECTION 106 : SERVICE DUCTS

CONTENTS

01 SCOPE

This section covers the construction of service ducts to make provision for the easy installation, maintenance and protection of existing, new and future cables and other services at road crossings.

02 MATERIALS

Service ducts shall normally be constructed from one or more of the following materials:

(a) Normal-duty PVC pipes conforming to SANS 791

(b) Pitch-fibre pipes conforming to SANS 921 Class 1

(c) Fibre-cement pressure pipes conforming to SANS 1223 Class C for COD pipes

(d) Vitrified clay pipes conforming to SANS 559

(e) Precast concrete pipes conforming to SANS 677 Type SI.

Joints for ducts shall be of the rubber-ring type or the sleeve-type couplings as scheduled, and shall be watertight. Material for telecommunication cable ducts will normally be supplied by Telkom.

Split pipes shall only be used to provide ducts for existing services which cannot be severed and threaded through the ducts. The pipes shall be accurately cut in the middle and opposite halves shall be matched as sawn. Split pipes shall be placed around the service, firmly bound by steel straps, and finally encased in concrete if required.

Draw wires shall be mild-steel Class B galvanized wire, 3,05 mm in diameter for all ducts.

Concrete used for bedding, encasing and duct markers shall comply with the requirements of section 704. The class of concrete to be used shall be as shown on the Drawings or specified in the Project Specifications.

03 EXCAVATION

The excavation of trenches and the preparation of trench bottoms for the installation of ducts shall be carried out as specified in section 202 and shall extend beyond the kerb line for a distance as shown on the Drawings.

The minimum trench widths for single ducts shall be determined as specified in subclause 04.01 of section 202 and the widths for multiple ducts as well as the depth of the duct trenches shall be as shown on the Drawings.

Where single or multiple ducts are to be encased in concrete or soilcrete, the width of the trench shall be determined either by the width of the encasing as shown on the Drawings or by the Engineer on Site.

04 BEDDING

No bedding shall be placed until the trench bottom has been inspected and approved by the Engineer or the controlling authority.

The bedding on which the ducts are to be laid will be one of the following:

04.01 Concrete bedding

The thickness of the concrete below the pipe, the height to which it extends upwards on either side of the pipe as well as the class of concrete to be used shall be as indicated on the Drawings. During concreting, pipes shall be supported on suitably shaped temporary pedestals and strapped down to prevent uplift.

04.02 Gravel bedding

The pipe shall be bedded on a layer of selected gravel with a PI not exceeding 6, which is free from stones exceeding 20 mm, organic matter and lumps of clay.

In the case of telecommunication-cable ducts, the bedding shall be of an approved, selected, granular, non-cohesive material graded from 13,2 mm to dust with not more than 60% passing the 0,6 mm sieve or crusher stone graded from 13,2 mm to dust. No extra payment will however be made for the use of crusher stone unless its use is prescribed by the Engineer.

Gravel bedding material shall be compacted to 90% of modified AASHTO density and the thickness of the bedding material below the pipes shall be as shown on the Drawings.

05 LAYING OF DUCTS

Ducts shall be laid and jointed true to line and shall be evenly supported for their full length on the bedding. If lengths of ducting are jointed alongside the trench, care shall be taken to avoid straining of the joints when the ducting is lowered into the trench. The insides of the ducts shall be kept clean as they are laid.

Jointing of all pipes shall be carried out strictly according to the manufacturer's instructions.

06 BACKFILLING

After the ducts have been laid and approval has been obtained, one of the following methods will be specified to fill in the space surrounding the pipes.

06.01 Gravel backfilling

To ensure adequate compaction between pipes, an approved tamping tool shall be used. For the backfilling of telecommunication-cable ducts, a T-shaped tamping tool must be used which shall consist of a 300 mm long mild steel rod, 32 mm in diameter, welded to a 20 mm diameter mild-steel handle approximately 1,35 m in length.

The gravel used for backfilling shall be similar to the gravel used for bedding and must be placed and compacted to 90% of modified AASHTO density alongside and over the pipes to a height of 300 mm or such lesser height as shown on the Drawings. When specified, the gravel must be stabilised by the addition of a quantity of cement equal to 5% of the dry weight of the gravel. Vibratory equipment shall only be used when compacting material more than 100 mm above the pipes.

06.02 Concrete encasing

Where shown on the Drawings or required by the Engineer, pipes shall be fully encased in concrete of the strength and to the dimensions as shown on the Drawings or as instructed by the Engineer. During concreting, pipes shall be supported on suitably shaped pedestals and strapped down so as to prevent uplift. Poker vibrators shall be used to ensure that all spaces under and around the pipes are properly filled with concrete. Concrete encasing shall be cast in one continuous operation until completed.

06.03 Soilcrete encasing

Where shown on the Drawings or required by the Engineer, soilcrete shall be used to encase the pipes completely. Soilcrete shall be prepared as described in clause 12 of section 202 and shall be placed in a manner identical to the encasing with concrete, with the pipes supported and strapped as described above.

Notes:

- Where multiple layers of ducts are to be encased in concrete or soilcrete, the operation shall be carried out in stages, each stage being taken to the underside of the next layer of pipes. Irrespective of the backfilling specified, the vertical distance between layers of ducts shall be 75 mm.
- When backfilling or encasing to the prescribed height above the pipes has been completed and approved, the balance of the trench shall be backfilled as specified in clause 13 of section 202.

07 PROVING

After the laying of ducts and the backfilling have been completed, the interior of the ducts shall be thoroughly cleaned by drawing a cylindrical cleaning brush through each duct twice, once in each direction. The ducts shall then be proved by drawing a polished hardwood or aluminium mandrel, with spherical ends through the ducts. The diameter of the mandrel shall be less than the internal diameter of the duct by -

(a) 3 mm in the case of ducts with diameters up to and including 75 mm (mandrel 300 mm long);

and

(b) 5 mm in the case of ducts with diameters exceeding 75 mm (mandrel 400 mm long).

08 DRAW WIRE

Duct ends shall be provided with suitable stoppers to prevent dirt from entering. One strand of draw wire shall be threaded through each unit. The strand shall extend 2 m outside each end and shall be wedged firmly into position with the stoppers.

These projections shall be neatly coiled into 300 mm diameter coils except where duct markers are to be installed, in which case the projecting wires must be attached to the markers.

09 DUCT MARKERS

Temporary and permanent markers for ducts shall be constructed to details as shown on the Drawings or as specified in the Project Specifications.

10 SCREENING

All telecommunication cable ducts shall be screened with copper wires. The screen shall consist of two strands of 2,5 mm diameter wires bound together by two turns of similar copper wire at 5 m intervals. The screen shall be placed approximately 200 mm above the pipe or top layer of pipes. All joints in the screening wires shall be soldered.

11 TOLERANCES

Permissible tolerance limits shall be as follows:

Grade:	Maximum deviation from the specified grade, expressed as a percentage of the specified grade	10%
Plan:	Maximum deviation	25 mm
Invert level:		±10 mm.

12 MEASUREMENT AND PAYMENT

Note:

Reference shall be made to the last paragraph of clause 02 of section 202 regarding payment for work carried out under this section.

Item		Unit
106.01	**Bedding and backfilling up to 300 mm above pipes**	
106.01.01	Using selected excavated material	cubic metre (m^3)
106.01.02	Using imported selected material	cubic metre (m^3)
106.01.03	Using imported non-cohesive material	cubic metre (m^3)
106.01.04	Using crushed stone	cubic metre (m^3)
106.01.05	Using stabilized material	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material in place after compaction and the quantity shall be calculated from the leading dimensions of the bedding and backfilling as specified or authorized by the Engineer. The volume occupied by the ducts shall be subtracted for calculating the volume of backfilling.

The tendered rates shall include full compensation for furnishing the material bedding under and backfilling alongside and over conduits, for watering and compacting the backfill material, for mixing the material with 5% cement where applicable, and for supplying the cement. In addition, the rates tendered for subitems 106.01.01 and 106.01.05 shall include transport within the free-haul boundaries. Where overhaul is applicable, the requirements of section 103 shall apply only when the material has been imported from borrow pits furnished by the Employer.

No overhaul shall be paid on crushed stone or cement.

Item		Unit
106.02	**The casting of in situ concrete in bedding and the encasing of pipes** (class of concrete indicated)	cubic metre (m^3)

The unit of measurement shall be the cubic metre, and the quantity shall be calculated from the dimensions of the excavation as shown on the Drawings or as specified or authorized by the Engineer, irrespective of whether the actual excavation exceeds the specified or authorized dimensions, minus the volume occupied by the pipes.

The tendered rate shall include full compensation for all materials, formwork, pedestals, labours, plant and equipment necessary to complete the work as specified in section 704 and this section.

Item		Unit
106.03	**Soilcrete**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of soilcrete backfilling or encasing constructed, calculated from the authorized dimensions of the excavations and the height of the encasing or backfilling in soilcrete. The volume occupied by conduits shall not be included in the quantities measured.

The tendered rate shall include full compensation for the supply of all material, plant labour and equipment for constructing soilcrete encasing and backfilling complete and in accordance with clause 12 of section 202, including full compensation for cement, used at the rate of 5% of the dry mass of the soil used, and stone-packing or temporary formwork at duct ends to support wet soilcrete.

Overhaul shall apply when gravel material used for soilcrete is imported from sources not furnished by the Contractor, which are situated outside the free-haul boundaries.

Item		Unit
106.04	**Service duct pipes**	
106.04.01	Ordinary pipes:	
106.04.01.01	(type and diameter indicated)	metre (m)
106.04.02	Split pipes:	
106.04.02.01	(type and diameter indicated)	metre (m)

The unit of measurement shall be the metre of service duct laid.

The tendered rates shall include full compensation for procuring, providing and laying the pipes including end plugs and draw wires as well as for proving the duct as specified, but excluding excavation, backfilling and encasing which shall be measured and paid for under the relevant pay items of this section. The tendered rate for telecommunication-cable ducts shall not include procurement but it shall include their screening.

The tendered rates shall include the marking of the duct position on the kerbs as shown on the Drawings.

Item		Unit
106.05	**Duct markers (type indicated)**	number (No)

The unit of measurement shall be the number of markers installed.

The tendered rate shall include full compensation for the manufacture, delivery and installation of the markers complete as shown on the Drawings or as specified in the Project Specifications.

Item		Unit
106.06	**Extra over items 106.01 and 106.03 for using material obtained from sources provided by the Contractor**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material provided and placed.

The tendered rate shall be in full compensation for the additional cost of paying any royalties or charges for procuring the material from sources provided by the Contractor as well as for transporting the material from where obtained to where used on the Site.

Note:

The following items of work, when specified, shall be carried out, measured and paid for in accordance with the relevant sections of the Specifications, but shall be listed under this section of the Schedule of Quantities.

Item		Applicable section
(a)	Overhaul on selected backfill and soilcrete material	103
(b)	Excess overburden at borrow pits provided by the Employer	201

SERIES 2 : EARTHWORKS

SECTION 201 : GENERAL

CONTENTS

01 SCOPE

This section covers provisions of a general nature relating to all earthworks and trenching operations.

02 DEFINITIONS

For the purposes of this section in particular and these Specifications in general, the following words and expressions shall, unless inconsistent with the context, have the meanings hereby assigned to them.

(a) Borrow area

An area within designated boundaries, which has been approved by the Engineer for the purpose of obtaining borrow material. A borrow pit is the excavated pit in a borrow area.

(b) Borrow material

Any gravel, sand, soil, rock or ash used in the construction of the Works and obtained from borrow areas, stockpiles or sources other than excavations which form part of the Works, but excluding crushed stone and sand obtained from commercial sources.

(c) Excavations

(i) Hand excavations

Excavations which, on account of their size, shape or location, or of the need to avoid damage to existing services or structures, cannot be made by means of trenching or by large excavating equipment and have to be made by hand tools, but shall exclude the trimming by hand of excavations to their final shape.

No excavations shall be classified as hand excavations unless designated as such in the Project Specifications or ordered by the Engineer to be a hand excavation.

(ii) Mass excavations

Excavations which by virtue of their size, will permit their construction by large equipment such as bulldozers, motor graders, scrapers, mechanical shovels, etc.

(iii) Structure excavations

Excavations intended purely for accommodating structures such as reservoirs, retaining walls, culverts and bridges or elements of such structures, such as foundations or wing walls. Structure excavations which could also qualify as trenches or mass excavations by virtue of their shape or size will nevertheless be classified as structure excavations. Structure excavations are covered under section 701.

(iv) Trench excavations

Long narrow excavations, specified to have vertical sides, which can be excavated, ground conditions permitting, with equipment specifically designed for trench excavation. Trenches which qualify as mass excavations will be classified as mass excavations.

(d) Excess overburden

Overburden within a borrow area, which is neither required nor suitable for use in construction.

(e) Mass earthworks

Earthworks, which include mass excavations as defined above, and fills that can be constructed with equipment normally used for fills and layer work in road construction.

(f) Overbreak

An inevitable excess excavation caused by the use of explosives or heavy construction equipment during excavation operations.

(g) Selected material

Material obtained and selected from excavations, borrow pits or other sources to be used as bedding material for pipes and services, backfilling around and over pipes and services, the construction of certain pavement layers, and for the making of soilcrete.

(h) Spoil

Material originating from construction operations, and which is not utilized for construction purposes.

03 GENERAL REQUIREMENTS

Prior to starting any excavations, construction-bed preparations, or embankment and fill construction, the Contractor shall obtain instructions from the Engineer regarding any stripping of topsoil or any clearing and grubbing that may be required.

Excavations shall be made within the applicable tolerances to the dimensions specified or shown on the Drawings. In the case of excavations made in hard material, a certain amount of overbreak is inevitable but the Contractor shall include in his rates tendered for excavation, the costs in respect of the backfilling of over-excavated sections as a result of overbreak or excavation outside the specified limits.

The Contractor shall not import, remove from the Site, or waste any material without the Engineer's approval, and he shall arrange the construction of fills and the backfilling of trenches so as to make the best possible use of excavated materials. The necessary safety precautions as set out in clause 17 of section 001 shall be observed at all times.

04 SELECTION OF MATERIALS

The Engineer may instruct that particular materials from excavations or borrow areas be selected for a specific purpose. Where such selection is instructed, the method of excavation and the sequence of carrying out the work shall be so arranged as to avoid the contamination or waste or the double handling of selected materials.

If selected materials are contaminated or used incorrectly or if they become unavailable through the injudicious planning of excavation operations, the Contractor shall be required to replace the shortfall with material of at least equal quality, imported at his own expense.

05 BORROW MATERIAL

Where sufficient quantities of suitable material cannot be obtained from the excavations or trenches to complete certain work, additional material shall be imported from borrow areas or other sources designated in the Project Specifications or by the Engineer.

Should borrow areas not be provided by the Employer for this Contract, the Contractor shall supply the necessary material from sources obtained by him. The following provisions shall apply in respect of borrow material obtained from sources provided by the Contractor, including material obtained from commercial sources:

(a) Samples of all such material shall be submitted to the Engineer for approval before the material is brought onto the Site.

(b) No haulage will be payable to the Contractor and the cost of transporting such material from its source to its final point of use shall be deemed to be included in the rates tendered for imported material.

(c) The material will not be classified for purposes of excavation and breaking down, and no extra over-payment will apply in respect of material excavated in intermediate, hard or boulder formations.

(d) Tendered rates shall include for all royalties and other charges whether in cash or in kind to be paid by the Contractor to the owner of such borrow material.

(e) No payment will be made for removing overburden, bringing it back after completion of borrow operations, for stockpiling such material unless so ordered by the Engineer, for providing haul roads and for restoring the borrow area to the condition required by the owner.

(f) The Contractor shall comply with the Mineral and Petroleum Resources Development Act, 2002 (Act No 28 of 2002) and its supporting Regulations, in respect of borrow material obtained from sources provided by him.

Compliance with the provisions of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) and its Regulations does not necessarily guarantee that the Contractor is in compliance with other Regulations and legislation. Other legislation that may be immediately applicable includes, but are not limited to:

- National Monuments Act, 1969 (Act 28 of 1969)
- National Parks Act, 1976 (Act 57 of 1976)
- Environmental Conservation Act, 1989 (Act 73 of 1989)
- National Environmental Management Act, 1998 (Act No 107 of 1998)
- Atmospheric Pollution Prevention Act, 1965 (Act 45 of 1965)
- The National Water Act, 1998 (Act 36 of 1998)
- Mine Safety and Health Act, 1996 (Act 29 of 1996)
- The Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983).

Tendered rates shall also include full compensation for any costs or charges in complying with the above legislation by the Contractor.

Where borrow areas are provided by the Employer, the plans of borrow pits will be included in the Documents. The information shown on these plans reflects the results of Site investigations and laboratory tests and is furnished in good faith as to the material being of sufficient quantity and adequate quality. Should it therefore appear at any time during construction that the quantity of material in such borrow area is insufficient or its quality inadequate and should the Employer have no other borrow areas available, the Contractor shall make use of approved sources found by himself.

Prior to opening a borrow pit or extending an existing borrow pit belonging to the Employer, the Contractor shall obtain from the Engineer written instructions regarding the removal of topsoil and excess overburden, and any clearing and grubbing that may be required. The measurement of excess overburden shall be made only after the removal of topsoil and any clearing and grubbing if required. Clearing and grubbing and the removal of topsoil shall be measured and paid for in accordance with the provisions of sections 101 and 104 respectively.

No contaminated material may be brought onto the Site. The Contractor shall exercise the necessary control in this respect during the loading of material from borrow pits.

On completion of his operations in the borrow areas provided by the Employer, the Contractor shall reinstate the entire area to blend with the surrounding area and so as to be suitable for the re-establishment of vegetation. For this purpose the borrow area shall be shaped to even contours with no slopes steeper than 1 in 2. Material which is incapable of supporting vegetation shall be buried and used for shaping the borrow area and shall be subsequently covered with material capable of supporting vegetation if available.

All haul roads shall be obliterated and their surfaces scarified, earth banks constructed to prevent erosion, and damaged fences reinstated.

The rates tendered for the various items of work for which borrow materials are used shall include full compensation for procuring and supplying borrow material and also, in the case of borrow areas provided by the Employer, for the final shaping and finishing off of the borrow areas, the reinstatement of fences, the prevention of erosion, and the obliterations of haul roads.

06 SURPLUS MATERIAL

Any surplus material produced by excavations, including waste or oversize material, shall be disposed of as directed by the Engineer, who may require that the material be somehow utilized in the Works or that the material be removed from the Site.

If the Employer does not provide spoil sites, this will be specified in the Project Specifications and it shall then be the responsibility of the Contractor to find the necessary spoil sites for material removed from the Site. All such spoil sites are to be approved by the Engineer in writing and the written consent of the owner shall be submitted to the Engineer. The rates tendered under the relevant sections for the removal of such material to spoil shall include full compensation for all haulage and for reinstating the spoil area.

Surplus material produced by trench excavations and carted to spoil shall be measured and paid for as follows:

(a) Trenches for pipes with a diameter of 300 mm and less:

The volume of spoil shall be taken as being equal to the authorized volume of soil or gravel backfill material imported from outside sources.

(b) Trenches for pipes with a diameter exceeding 300 mm and for culverts:

The volume of spoil shall be determined as in (a) above, plus the volume occupied by the pipe or culvert.

The volumes occupied by beddings, encasings, manholes, junction boxes, etc, shall not be used for determining the amount of material carted to spoil.

The carting to spoil of surplus material produced by additional excavations, the excavation of tunnels, and excavations for subsurface drains in trench bottoms shall be deemed to be included in the rates tendered for such excavations in section 202.

When material for earthworks and layerwork is either oversize or otherwise unsuitable for use -

- because it has not been properly excavated to ensure adequate breaking down in the borrow pit or in excavation; or
- because it has not been properly selected or has been contaminated; or
- because careless excavation has spoilt the material for its intended final use;

it shall be removed from the Works and carted to spoil and, except as provided below, no payment shall be made in respect of the removal of such material to spoil.

Where there is a local surplus of material from excavations other than trenches and material is also present which is unsuitable or oversize for the reasons set out above, the material removed shall be paid for as excavation to spoil under item 203.03 to the extent of such local surplus of material.

Other oversize material removed from the Site shall, subject to the provisions of this clause, be paid for as specified in sub clause 06.09 of section 203.

Any soft material which the Engineer requires to be tipped over the sides of rock fills without further shaping or finishing shall be classified as excavation to spoil, but if shaping and finishing is required, material shall be classified as excavation to fill, and all such material shall be measured and paid for in addition to fill measured according to the net specified dimensions of the road, parking area or embankment.

07 STOCKPILING OF MATERIALS

Where materials from excavations cannot be placed directly in their required positions, or cannot be temporarily stockpiled alongside the excavation such as in built-up areas, the Engineer may authorize their removal to temporary stockpiles. Stockpile sites shall be approved by the Engineer and shall be cleared prior to being used. The temporary stockpiling of all materials within or outside the free-haul boundaries shall be at the Contractor's own cost unless otherwise specified in the Project Specifications.

Overhaul will be paid on materials transported to and from authorized stockpiles, provided that the stockpiles are situated outside the free-haul boundaries.

The material shall be stockpiled in successive layers over the full stockpile area to the approximate dimensions required by the Engineer and shall subsequently be reloaded and placed.

Topsoil shall be stockpiled in separate loose heaps as tipped from the trucks and shall not be stockpiled higher than 2,0 m unless otherwise ordered.

Stockpiling, when specified or authorized in writing, shall be paid for under section 104 in the case of topsoil, and in accordance with this section in the case of other material.

Where selected material and topsoil are stockpiled temporarily within a borrow-pit area, this operation shall not be paid for separately as temporary stockpiling but shall be deemed to be part of the obligations described in clause 05 of this section.

Selected material from trenching operations shall preferably be placed alongside the trench, separate from the other excavated material. Should sufficient space not be available alongside the trench, the selected material shall be removed to stockpile sites when authorized by the Engineer.

08 PLANT

Plant and equipment used in the various construction activities shall be suitable for achieving the required end result under the condition applicable to the Site.

09 MEASUREMENT AND PAYMENT

Note:

Save as provided hereunder, payment in respect of the general obligations and requirements described in this section shall be deemed to be covered elsewhere by the rates tendered for the various items of work to which these general obligations and requirements apply.

The rates for the various items of work for which borrow materials are used shall specifically include compensation for the provision of haul roads, the selecting of suitable material in the borrow area, the final shaping and finishing-off of the borrow areas, the reinstatement of fences, erosion protection and the obliteration of haul roads.

In the case of borrow or spoil areas provided by the Contractor, they shall also include any royalties payable.

Item		Unit
201.01	**Excess overburden at borrow pits provided by the Employer**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of excess overburden measured in place before stripping, which measurement shall be based on the depth of overburden measured in the trial pits excavated by the Contractor in a square pattern at intervals of 10 m over the whole area in question.

The tendered rate shall include full compensation for digging the trial pits, stripping, removing and stockpiling the excess overburden prior to the excavating of borrow material, replacing the excess overburden in the borrow pit after completing the excavating of borrow material, and for levelling off the excess overburden in the borrow area.

Where the stockpiled excess overburden has to be moved beyond the limits originally indicated by the Engineer, it shall be measured once more for payment under this item. This item shall only apply to borrow areas provided by the Employer. Where borrow material is obtained from sources provided by the Contractor, the price of the material shall include the costs of dealing with any excess overburden.

Item	Unit
201.02 Temporary stockpiling of material	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material stockpiled on the written instructions of the Engineer, measured in its final position after placing and compaction. Only material actually loaded and transported to a stockpile as instructed shall be measured for payment. Material dumped or stockpiled next to where excavated, whether in a trench, cutting, or borrow area, or anywhere within the free-haul boundaries shall, unless authorized in writing by the Engineer, not be measured as stockpiled material.

The tendered rate shall include full compensation for preparing stockpile areas, the constructing of haul roads, placing the material in stockpile, loading it when required, and transporting it within the free-haul boundaries, as well as for cleaning up and reinstating the stockpile areas and the obliterating of haul roads and, in the case of stockpile areas provided by the Contractor, for any charges made for the use of stockpile areas.

The stockpiling of topsoil shall be measured and paid for under section 104 of these Specifications.

SERIES 2 : EARTHWORKS

SECTION 202 : TRENCHING

CONTENTS

01 SCOPE

This section covers all work in connection with trenching for pipelines, ducts, culverts, cables and subsurface drains.

Where the dimensions of a trench allow bulldozers and motor graders to be used effectively for doing the excavations, the operation will be classified as mass earthworks as specified in section 203 whether or not trenching equipment is used.

02 GENERAL

The Contractor shall examine the route of the proposed trench well in advance of construction to determine whether the route is clear. Should he encounter unforeseen permanent obstacles such as buildings, swimming pools, etc, he shall immediately inform the Engineer thereof with a view to solving the problem without causing undue delay to construction activities. Where such investigations are made on private property, the Contractor shall adhere strictly to the requirements laid down in clause 08 of section 001.

Clearing and grubbing shall be carried out as specified in section 101, and the width of the strip to be cleared will be indicated in the Project Specifications or by the Engineer on Site. Where fences, precast walling, paving and other improvements to properties are to be temporarily removed from the line of the trench, they shall be carefully dismantled or lifted and stored, and later re-erected at or repositioned in the same place and in the same condition as before their removal. Material damaged by the Contractor shall be replaced at his own cost.

Except for trees with a girth exceeding 1,0 m, no separate payment will be made for such clearing and grubbing or temporary removal of improvements unless otherwise specified in the Project Specifications, and the cost thereof shall be included in the rates tendered for excavation.

The removal of trees with a girth exceeding 1,0 m will be paid for under items 101.02 and 101.03 of section 101 and the girth shall be measured as specified under section 101.

Where trenches are to be made in servitudes or designated areas of specified width, the Contractor shall confine all his construction activities to within the limits of such servitudes unless permission to encroach on his property has been obtained, in writing, from the owner, lessee or occupier.

The owner, lessee or occupier shall be afforded a reasonable time to remove any small trees, shrubs or other plants as well as improvements from the servitude should he wish to do so. Trees with a girth exceeding 300 mm shall not be removed by the Contractor without the written permission of the Engineer.

Before excavation may be started, the Contractor shall notify the Engineer, that the strip has been cleared, to enable the latter to obtain the necessary ground levels for measurement purposes.

The Contractor shall be responsible for maintaining accesses over trenches where applicable, in which regard he shall comply with the relevant requirements of section 102.

The Engineer reserves the right to limit the length of excavation of trenches in advance of pipe-laying and backfilling operations.

Where trenching, pipe-laying operations and culvert construction are carried out in built-up areas, the work shall be completed as quickly as possible so as not to unduly inconvenience the public. Payment for work carried out under this section as well as under sections 106, 302, 402 and 502 regarding such trenching, pipe-laying operations and culvert construction will only be made once the work has been completed and the surface has been reinstated as specified. The sections of trench affected by this requirement will be indicated in the Project Specifications.

03 CLASSIFICATION OF MATERIALS EXCAVATED

The materials excavated shall be classified as follows for payment purposes:

- Soft material:

  Material that can be efficiently removed by a back-acting excavator of flywheel power approximately 0,10 kW per millimetre of tined-bucket width, without the use of pneumatic tools such as paving breakers.

- Intermediate material:

  Material that requires a back-acting excavator of flywheel power exceeding 0,10 kW per millimetre of tined-bucket width or the use of pneumatic tools before removal by equipment equivalent to that specified above for soft material and shall include boulders of up to 0,15 m^3.

- Hard material:

  Material that cannot be efficiently removed without blasting or without wedging and splitting as well as boulders exceeding 0,15 m^3.

Notwithstanding the above classification, all material excavated from previously constructed fills, embankments, pavement layers and from above existing services shall be classified as soft material.

The expression "efficiently removed" shall be taken to mean removed in a manner that can reasonably be expected from the equipment in question, having regard to the production achieved.

In the first instance the classification shall be based on inspection of the material to be excavated and the method of excavation proposed by the Contractor. In the event of disagreement between the Contractor and the Engineer, the Contractor shall, if required, make available such mechanical equipment as specified above in order to test the reasonable removability or otherwise of the material. The decision of the Engineer as to the classification shall thereafter be final and binding.

The Contractor shall immediately inform the Engineer as and when the nature of the material which is being excavated changes to the extent that a new classification for further excavation is warranted. Failure on the part of the Contractor to advise the Engineer in good time shall entitle the Engineer to classify, at his sole discretion, any material of a different nature which may have been excavated.

04 EXCAVATION

The type of excavation shall be classified in accordance with the definitions given in section 201 based on the methods and equipment normally used irrespective of whether or not such methods and equipment have actually been used.

04.01 Trench excavations

Unless otherwise specified or shown on the Drawings, the width of trenches for single pipes and precast culverts shall be the authorized trench widths as determined below and will be used to calculate the quantities of material excavated. Excavations in excess of these predetermined widths will not be measured for payment and excavations narrower than these widths will only be allowed with the written approval of the Engineer.

The authorized trench widths shall, irrespective of the type of pipe or precast culvert and the type of bedding and floor slab, be determined by the following formula:

W = B + 2S where

W = the authorized width

B = the outside diameter of the pipe or the external width of the culvert

S = the working space on each side of the pipe or culvert measured between the external surface of the conduit and the side of the trench.

For the purpose of these Specifications, S shall be allotted the following values:

S = 200 mm for values of B equal to or less than 620 mm and will apply to all pipes and culverts

S = 250 mm for values of B in excess of 620 mm and will apply only to water pipes

S = 450 mm for values of B in excess of 620 mm and will apply to all culverts and pipes with the exception of water pipes.

The above formula and values of S will only apply to portal and rectangular culverts if the subsequent backfilling is done using natural gravel and reference shall be made to sub clause 05.02 of section 502 for trench widths applicable when backfilling with concrete or soilcrete.

The width of trenches for pipes encased in concrete or soilcrete or for multiple pipes or culverts shall be as specified in the relevant sections of these Specifications or as shown on the Drawings.

The Contractor may side-slope or bench the trench from a point above the top of the pipe at his own expense in compliance with the Construction Regulations 2003.

The depth of excavations shall be as specified or shown on the Drawings or as indicated by the Engineer on Site. Trenches for water pipes shall, unless otherwise specified, be excavated at a constant depth to follow the general surface contours wherever possible.

The cost of trimming excavations by hand or machine shall not be paid for separately but shall be included in the rates tendered for excavation.

The Contractor shall maintain the correct line and grade throughout the work. The trench shall be straight along the centre line and between pegs, where applicable. Between pegs the bottom shall be carefully graded and tested by sight rails and boning rods or other approved means. Trenches shall, except where otherwise indicated or permitted, or in the case of a statutory requirement, be excavated with vertical sides without any undercutting of the sides.

All excavated material shall be kept within defined limits and shall, wherever possible, be deposited alongside the trench. The material shall be deposited so as to leave a clear strip of at least one metre between the edge of the trench and the excavated material and shall not cause undue inconvenience to traffic and property owners. The material shall be placed and kept well clear of all manhole covers, culvert in- and outlets, fire hydrants, bench marks, stand pegs, fences, etc.

To prevent vertical trench walls from collapsing, excavated material shall, wherever possible, not be stacked on the side where underlying strata slope down towards the trench and in this regard, attention is specifically drawn to the shales sloping south to north in the Pretoria area.

04.02 Hand excavations

Where the use of conventional excavating equipment is either unpractical or likely to cause damage to services, trees or property, the Contractor shall advise the Engineer thereof, who may then instruct, in writing, that the excavations be made by means of hand labour and paid for as hand excavation.

04.03 Excavations outside the normal trench profile

Excavations outside the normal trench profile, which are necessary for the removal of unsuitable material at founding levels, for accommodating structures such as manholes, valve chambers, junction boxes, thrust blocks, draw pits, catchpits, wing walls, and that portion of the sewer-house connections between the junction with the main sewer and its point of connection with the sewer from the property, will be measured and paid for separately from trench excavations. These excavations may be made by means of excavating plant wherever practicable, or otherwise by hand, in which case it shall not be classed as hand excavation. Excavations for handholes to accommodate pipe joints will not be included in payment for excavations outside the normal trench profile. See clause 10 of this section.

04.04 Mass earthworks

Where pipes are to be installed at a level lower than the level of any mass earthworks that have to be carried out for the purpose of constructing a structure or a road, the trenching and pipework shall, if so specified in the Project Specifications, be carried out after the mass earthworks have been completed.

05 TOPSOIL

The topsoil shall be removed from over the full width of the trench to a depth of 300 mm or to the actual depth of topsoil where subsoil or rock occurs closer than 300 mm to the existing natural surface. On completion of backfilling, the topsoil shall be replaced in its original position.

Topsoil is the property of the land owner and shall be kept separate from the subsoil. No separate payment shall be made for the removal and returning of topsoil, allowance for which shall be made in the rates tendered for excavation.

06 TIMBERING AND SHORING

The Contractor shall provide all the timbering, strutting and shoring required in terms of the Construction Regulations 2003 for the safety of the excavations and structures adjacent to the trenches, and shall be solely and wholly responsible for ensuring the adequacy of these measures for this purpose.

Without in any way affecting or detracting from the Contractor's responsibility, the Engineer shall have the right to instruct the Contractor to provide additional or improved timbering, shoring or strutting where he considers this to be necessary. The Contractor shall have no claim for additional payment on this account.

The shoring method adopted shall be compatible with the soil type and the excavating, backfilling and pipe-laying methods adopted and shall not place any undue restrictions on the laying of the pipes.

Timbering and shoring shall be left in position until the Engineer has authorized their removal.

Unless otherwise indicated in the Project Specifications, no separate payment shall be made for timbering and shoring, except where they are left in the excavations in accordance with instructions. The specified trench width shall be the clear width between the timbering and shoring. Any extra excavations required for the timbering and shoring shall be included in the rates tendered for excavations.

As an alternative to timbering and shoring, the Contractor may, where sufficient space is available and where the safety of nearby services and structures is not jeopardized, elect to slope the sides of the trench from a point above the pipe as mentioned in clause 04, and he shall also make allowance for such additional work in the tendered rates for excavation and backfilling.

07 TUNNELS AND BOLSTERS

The Contractor shall be permitted to tunnel underneath obstructions such as trees, walls, etc, provided that he has obtained the Engineer's written approval, the trench is of sufficient depth, and the in situ material is suitable for tunnelling. No blasting will be allowed for the excavation of tunnels and bolsters. Tunnelling will not be paid for as hand excavation.

The tunnel or bolster shall have the same width as the trench and shall have a minimum vertical height of 1 200 mm above the pipe. Tunnels and bolsters shall be properly timbered and shored where necessary.

Where a pipeline passes through a tunnel or bolster, the pipe shall, after having been tested, be encased in concrete or soilcrete as may be instructed by the Engineer, after which the tunnel or bolster shall be filled with hand-packed stones having a maximum dimension of 300 mm. The stones shall be so packed as to provide a minimum of voids. Voids remaining in the stone packing shall be filled with dry sand, as the packing proceeds. Payment will be made under the applicable pay items of this section.

A tunnel with a length of 4,5 metres or less shall be designated as a bolster and shall be paid for as an open trench, and a tunnel with a length in excess of 4,5 metres shall be paid for as a tunnel.

The minimum distance between two consecutive tunnels or bolsters shall be 3,0 metres.

08 EXCESS EXCAVATIONS

Should the Contractor for any reason whatsoever excavate beyond the limits of the authorized dimensions, he shall, at his own cost, carry out the additional backfilling that will be required as a result of such excess excavation, and shall use the same material that has been used for the rest of the trench at the level in question. Where the trench has been excavated deeper than the required depth, the bottom shall be reinstated to the correct level as described in clause 09.

09 PREPARATION OF TRENCH BOTTOMS

Trench bottoms in hard material shall be cleared of all rock projections and of all rock fragments and particles of hard material. Poor founding material shall be removed to depths determined by the Engineer.

The trench bottom shall then be reinstated to the required level with selected gravel material compacted to 90% of modified AASHTO density, with concrete aggregate having a maximum size of 38 mm, with class 1:3:6/19 concrete, or with soilcrete as may be instructed by the Engineer in each case. Such reinstatement will not be paid for in the case of overbreak or where poor founding conditions have been caused by the Contractor's negligence.

Where selected gravel material is used to replace poor founding material, the gravel shall be compacted in layers not exceeding 100 mm of compacted thickness.

The minimum selected gravel bedding thickness for trenches in hard material is 150 mm.

Where trench bottoms consist of loose in situ gravel material, they shall be thoroughly compacted to the Engineer's approval to provide a firm floor. Trench bottoms shall be hand-trimmed to final levels and grades immediately before pipe beddings are placed or pipes are laid.

No separate payment will be made for the preparation of trench bottoms, except where material is imported to fill excess excavations authorized by the Engineer.

10 EXCAVATIONS FOR PIPE JOINTS

If necessary, accurately located recesses shall be cut into trench bottoms to accommodate pipe joints. Such recesses shall be properly shaped and sized to facilitate jointing. Recesses for pipes to be welded together in the trench shall provide a clear space of not less than 0,5 m below the pipes. Payment for making such recesses shall be included in the tendered rates for the supply, installation, joining and testing of the various types of pipes and fittings.

11 DEALING WITH WATER

Water that may be encountered during the trenching operations shall be dealt with as set out in clause 27 of section 001. The Engineer may instruct the Contractor to provide a layer of 38 mm maximum size concrete aggregate below the bedding to serve as a drain to dispose of excess water. The thickness of the layer shall be determined on Site by the Engineer.

In the case of trenches for sewer pipes, the Engineer may instruct the Contractor to install a subsurface drain below the bottom of the trench, which shall consist of 150 mm diameter vitrified clay pipes of commercial quality (known as irrigation or rejected pipes), surrounded by 19 mm crushed stone in a 300 mm x 300 mm trench. The position of the drain in the trench shall be as shown on the Drawings or as determined by the Engineer.

If required by the Engineer, the Contractor shall leave portions of the trench unexcavated to prevent the flow of water down the trench. These bulkheads shall be at least one metre thick and shall be spaced as directed by the Engineer. No additional payment over and above normal excavation rates will be made for leaving these bulkheads temporarily unexcavated.

12 SOILCRETE

Soilcrete shall consist of an approved soil or gravel mixed with 5% cement of the type as specified in section 704 and only sufficient water to give it a consistency that will permit the soilcrete to be so placed, with the use of vibrators, as to properly fill all voids between the pipes and the sides of excavations.

The aggregate used for soilcrete shall preferably be a sandy material but may contain larger particles up to 38 mm and its plasticity index shall not exceed 10. Harmful percentages of silt or clay shall be avoided and the aggregate shall be obtained from an approved source.

The soilcrete shall be mixed on Site by means of suitable concrete mixers. The water and cement contents shall be carefully controlled during mixing. The material shall be placed and then thoroughly compacted by means of concrete vibrators so as to fill all voids as described above.

13 BACKFILLING

The backfilling of trenches to a point 300 mm above the tops of pipe barrels (200 mm in the case of water pipes) shall be carried out as specified in the relevant sections of these Specifications.

Further backfilling shall be done with approved excavated material, which shall not contain any stones larger than 150 mm. Backfilling shall, in the case of pipes on a class A concrete bedding, not be commenced before the concrete has attained a compressive strength of at least 15 Mpa. For other concrete beddings, further backfilling may commence 3 days after the backfilling over the pipes has been completed. All backfill material shall be compacted to 90% of modified AASHTO density in layers not exceeding 150 mm in compacted thickness and with the use of vibratory equipment.

Topsoil previously set aside shall be replaced as a final layer on top of the backfilling leaving the material 100 mm proud of the original ground surface to allow for settlement.

During the contract period and also during the defects liability period, the Contractor shall make good promptly and at his cost any settlement that may occur in the surfaces of roads, sidewalks, private or public property, etc, caused by his trenches. He shall be liable for any accidents caused by it and shall repair, at his cost, any damage to property.

The backfilling of culverts shall be carried out as specified in section 502.

14 TRENCHES WITHIN ROAD RESERVES

In this clause the word side-way denotes the area between the edge of a road and the boundary of the road reserve.

Where trenching operations are carried out in a roadway, at least half the roadway shall remain open to traffic at all times and where trenching is carried out on side-ways, safe, uncluttered thoroughfares shall be provided for pedestrians.

Where the temporary closing of any road to vehicular traffic is required in exceptional circumstances, the requirements set out in clause 11 of section 001 shall be adhered to.

Before construction equipment is allowed onto surfaced roadways or paved side-ways, the Contractor shall obtain approval from the Engineer for his proposals of how he intends operating his equipment without causing damage to the road and side-way surfaces. Such proposals shall include the following:

- the use of gravel, wood, tyres, etc as ramps where kerbs have to be negotiated;
- the use of tyres and rubber mats where crawler-tracked equipment is used;
- the placing of wooden blocks under the hydraulic stabilizing arms of excavators, cranes, etc;
- the tined buckets of excavating equipment shall be placed on wooden blocks when fully lowered; and
- loading equipment shall be fitted with buckets without tines and shall be used to remove dumped material to a minimum of 200 mm above a paved surface. The remaining 200 mm of material shall be removed by means of hand labour.

The Contractor shall at his own cost adhere to the approved proposals and will be held liable for repairing the damage caused by his equipment to surfaced roads, paved side-ways, kerbing, etc and restoring them to their original condition.

Before excavations are made in a surfaced roadway or paved side-way, the width of the trench or such other width as may be agreed on by the Engineer, shall be marked on the surface and the surfacing material or in situ concrete paving shall be neatly cut along the markings, to avoid any overbreak of the surfacing or paving beyond the limits agreed on. Paving units shall however not be cut but shall be lifted as near as possible along the markings and stored for re-use. The cost of removing surfacing and paving material shall be deemed to be included in the rates tendered for trenching.

Where services and culverts are to be installed across or along new roads that are under construction, such work shall be completed before the subbase layer is constructed, provided the requirements for mass earthworks as set out in subclause 04.04 are not applicable.

The excavating and backfilling of trenches in road reserves shall be carried out as specified in clauses 04 and 13 except that the material shall be compacted during backfilling to the density specified hereafter.

Where excavated material cannot be temporarily placed alongside the excavation, the material shall be stockpiled as specified in clause 07 of section 201.

The backfilling in respect of gravel roads shall be compacted to 93% of modified AASHTO density and shall be taken to the level of the existing road surface or, in the case of new roads under construction, to the top of the subgrade.

The backfilling in respect of surfaced roads shall also be compacted to 93% of modified AASHTO density and shall be taken up to a level 500 mm below the existing road surface. Selected material, stabilized by the addition of a quantity of cement of the type as specified in section 704 equal to 3% of the dry mass of the gravel and compacted in three 150 mm thick layers to 95% of modified AASHTO density shall be used to backfill the balance of the trench to a level 50 mm below the existing road surface.

The remaining 50 mm shall be filled with asphalt after the stabilized surface and the cut sides of the existing surfacing have been primed with a 60% anionic bituminous emulsion.

The asphalt shall be supplied by the Contractor and shall conform to the requirements for medium grade, continuously graded asphalt as specified in section 606. The asphalt shall be placed and thoroughly compacted by means of vibratory equipment and shall be finished off flush with the existing road surface.

If for some reason the remaining 50 mm cannot be filled immediately with asphalt, approved excavated material shall be used as a temporary measure, enabling the road to be opened to traffic as soon as possible. This temporary backfill shall be well compacted and maintained until the asphalt can be placed. Before priming is done and the asphalt placed, all traces of the temporary material shall be removed.

The backfilling of trenches in paved side-ways shall be carried out as specified for trenches in roadways and the compaction to 93% of modified AASHTO density shall be taken to below the paving material with due allowance, where applicable, for the thickness of the sand bedding layer.

The paving blocks or slabs shall be replaced as specified in section 609 and in situ concrete paving as specified in section 610. Payment will be made under item 609.05 for replacing blocks or slabs and under items 610.01 and 610.02 for in situ concrete paving.

After completion of the work in road reserves, the Contractor shall repaint in the manner specified in section 613, any traffic markings that have been damaged or obliterated. Payment for repainting traffic markings will be made under the applicable items of section 613.

15 TOLERANCES

A tolerance of plus or minus 25 mm in respect of the required level of the trench bottom shall be the maximum deviation allowed. The maximum permissible deviation in plan shall be 25 mm, whereas the grade of the trench shall be within the same tolerance limits as the service for which it is excavated.

Where trenches are deepened or widened to accommodate structures, etc, as mentioned in clause 04, the tolerance limits of the excavations shall be the same as those of the structures, etc, in so far as invert level and plan are concerned.

16 MEASUREMENT AND PAYMENT

Note:

Reference shall be made to the last paragraph of clause 02 of this section regarding payment for work carried out under this section.

Item		Unit
202.01	**Trench excavations**	
202.01.01	Up to 1,0 m wide	
202.01.01.01	Up to 1,0 m deep	cubic metre (m^3)
202.01.01.02	Over 1,0 m and up to 1,5 m deep	cubic metre (m^3)
202.01.01.03	Etc, increased by additional 0,5 m depths	
202.01.02	Over 1,0 m and up to 2,0 m wide	
202.01.03	Etc, increased by additional 1,0 m widths	

The unit of measurement shall be the cubic metre of material excavated as if in soft material, classified according to the various depth and widths ranges listed. The depth classification shall be in accordance with the total depth of the trench and not with the depth range in which the material is situated before excavation. For measurement purposes the width of a trench shall be determined from the authorized dimensions and not from the width range listed and the depth of excavation shall be measured to the underside of the bedding, except where no bedding is required, in which case it shall be measured to the underside of the conduit.

The tendered rates shall include full compensation for clearing and grubbing the trench areas except for trees with a girth larger than 1,0 m, the temporary removal of improvements from the line of the trench, the removal of surfacing and paving material, for excavating the trench, preparing the bottom of the trench, separating material unsuitable for backfill, keeping the excavations safe, which includes the provision, installation and later removal of shoring and strutting, dealing with any surface or subsurface water, for separating topsoil and selected backfill material where necessary and for temporary stockpiling of material unless otherwise specified in the Project Specifications. Excavations in bolsters less than 4,5 m in length will be measured and paid for as for trench excavations.

Item		Unit
202.02	**Extra over items 202.01, 202.03, 202.04 and 202.09 for excavating in -**	
202.02.01	Intermediate material	cubic metre (m^3)
202.02.02	Hard material	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material excavated and classified as intermediate or hard, in accordance with the classification set out in clause 03.

The tendered rates shall be paid over and above the rate tendered for excavation in respect of items 202.01, 202.03, 202.04 and 202.09 in full compensation for the additional cost of excavating in material other than soft material. The tendered rates shall include full compensation for any overbreak as well as the additional backfilling required, reinstating the trench bottom, and for any other incidentals resulting from overbreak.

Item		Unit
202.03	**Excavations outside the normal trench profile**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material excavated, if necessary by hand, outside the normal trench profile for manholes, catchpits, valve chambers, thrust blocks, etc, and for removing unsuitable material from trench floors, all as specified in sub clause 04.03 of this section.

The tendered rate shall include full compensation for excavating outside the normal trench profile, trimming the excavations, separating any material unsuitable for backfill, keeping excavations safe, dealing with water, separating selected backfill material, for carting all surplus or unsuitable material to spoil sites indicated by the Engineer or provided by the Contractor, as may be specified in the Project Specifications and for temporary stockpiling of material unless otherwise specified in the Project Specifications.

Item		Unit
202.04	**Hand excavation (extra over item 202.01)**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of trench material excavated by means of hand tools as instructed or authorized in writing by the Engineer in accordance with the provisions of subclause 04.02 of this section.

The tendered rate shall be paid extra over the rates tendered for item 202.01 in full compensation for the additional expense of excavating by means of hand labour instead of conventional trenching equipment.

Item		Unit
202.05	**Excavation in tunnels exceeding 4,5 m in length in -**	
202.05.01	Soft material	cubic metre (m^3)
202.05.02	Intermediate material	cubic metre (m^3)
202.05.03	Hard material	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material excavated in tunnels exceeding 4,5 m in length in accordance with the authorized dimension.

The tendered rates shall be in full compensation for excavating by hand or machine in tunnels through soft, intermediate and hard material, for separating material unsuitable for backfill, for supporting the roof if necessary, for compacting the floor of the tunnel if necessary, for carting all surplus or unsuitable material to spoil sites indicated by the Engineer or provided by the Contractor, as may be specified in the Project Specifications and for temporary stockpiling of material unless otherwise specified in the Project Specifications.

This item shall apply only to tunnels exceeding 4,5 m and up to 10,0 m in length.

Item		Unit
202.06	**The backfilling of trenches (excluding backfill around the pipe barrel) with material obtained from excavations**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of backfill placed in ordinary trench excavations from 300 mm above the pipe barrel (200 mm in the case of water pipes), from above concrete encasement, and in excavations outside the normal trench profile, as specified in clause 13 of this section.

The tendered rate shall be in full compensation for the backfilling of trenches, compacting the backfill to 90% of modified AASHTO density, replacing topsoil previously set aside, and for transporting previously excavated material, from where dumped to where used, as backfill, regardless of the distance transported.

Item		Unit
202.07	**Extra over items 202.06 and 202.13 for using backfill material obtained -**	
202.07.01	From borrow areas	cubic metre (m^3)
202.07.02	From sources provided by the Contractor	cubic metre (m^3)

The unit of measurement shall be the cubic metre of imported backfill material.

The tendered rates paid extra over items 202.06 and 202.13 shall be in full compensation for the additional cost of excavating and loading borrow material, and in the case of the following:

- Subitem 202.07.01 for all operations at borrow areas not subject to separate payment as specified in clauses 05 and 09 of section 201 and for hauling material within the free-haul boundaries, and
- Subitem 202.07.02 for payment of any royalties or charges for procuring the material from sources provided by the Contractor as well as for transporting the material from where obtained to where used on Site.

Item		Unit
202.08	**Backfilling additional excavations in trench floor, using -**	
202.08.01	Class 1:3:6/19 concrete	cubic metre (m^3)
202.08.02	Concrete aggregate, max size 38 mm	cubic metre (m^3)

The unit of measurement shall be the cubic metre of backfill placed and compacted as specified.

The tendered rates shall include full compensation for mixing, furnishing and placing the concrete.

Where gravel is used as backfill, it shall be paid for under items 202.06 and 202.07, and where soilcrete backfill is used, it shall be paid for under item 202.13.

Item		Unit
202.09	**Subsurface drains in trench bottoms**	
	(Drawing number indicated)	metre (m)

The unit of measurement shall be the metre of subsoil drain constructed complete as specified and shown on the Drawings.

The tendered rate shall include full compensation for constructing the subsoil drain complete, including excavation by hand in soft material, the supply and installation of reject pipes, and the supply and placing of concrete aggregate. The rate shall be subject to an extra over-payment under item 202.02 for excavation in intermediate or hard material, and shall also include full compensation for the removal of all surplus or unsuitable excavated material to spoil sites indicated by the Engineer or provided by the Contractor, as may be specified in the Project Specifications.

Item		Unit
202.10	**Removal of spoil material -**	
202.10.01	To positions indicated on the Drawings or by the Engineer	cubic metre (m^3)
202.10.02	To dumping areas to be provided by the Contractor	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material removed to spoil measured as specified in clause 06 of section 201.

The tendered rates shall include full compensation for loading the material and transporting it in the case of -

- Subitem 202.10.01 within the free-haul boundaries, and
- Subitem 202.10.02 for the full distance and for providing the dumping area, and shall include any payments to the landowners.

The rates shall also include the provision of haul roads and the clearing up of haul roads and dumping areas on completion of the work. Spoil areas shall be finished-off as specified for borrow areas in the third last paragraph of clause 05 of section 201.

Item		Unit
202.11	**Timbering and shoring left in excavation**	square metre (m^2)

The unit of measurement shall be the square metre of tunnel wall or roof or trench wall against which timbering and shoring is required to be left in position permanently on the Engineer's instructions. Each side of the trench or tunnel shall be measured.

The tendered rate shall include full compensation for leaving the timbering and shoring permanently in position, for ensuring that the timbering and shoring will not be disturbed during backfilling, and that the backfilling is compacted fully around the shoring.

Item		Unit
202.12	**Extra over item 202.06 for additional compaction of backfill to 93% of modified AASHTO density in road reserves**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material subjected to additional compaction, as specified.

The tendered rate shall be paid as an extra over the rate for item 202.06 in full compensation for the additional cost resulting from the higher compaction requirement.

Item		Unit
202.13	**Backfilling trenches with soilcrete**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of soilcrete. The volume shall be determined from the authorized dimensions of the trench minus the volume occupied by a conduit or casing.

The tendered rate shall be in full compensation for providing suitable gravel from excavations, providing and mixing in the cement, and placing the material. It shall also include all haulage. Where gravel for soilcrete is obtained from borrow areas or from sources provided by the Contractor, the extra over item 202.07 shall apply.

Item		Unit
202.14	**Stone packing**	
202.14.01	In bolsters	cubic metre (m^3)
202.14.02	In tunnels	cubic metre (m^3)

The unit of measurement shall be the cubic metre of stone packing constructed as specified in clause 07, determined from the authorized dimensions.

The tendered rates shall include full compensation for furnishing the stones and sand and for all labour required to hand-pack the stones as specified.

Item		Unit
202.15	**Reinstatement of bitumen surfaced roads**	square metre (m^2)

The unit of measurement shall be the square metre of road surface reinstated, measured in accordance with the authorized dimensions.

The tendered rate shall include full compensation for procuring and furnishing selected material, stabilizing the material with cement, compacting the material in three 150 mm layers to 95% of modified AASHTO density, for temporarily filling the top 50 mm if necessary with excavated material and for compacting, maintaining and later removal of the material, for priming and for furnishing, placing and compacting the asphalt, all as specified in clause 14.

The backfill of the trench up to 500 mm from the road surface will be paid for under items 202.06 and 202.12.

Note:

The following items of work, when specified, shall be carried out, measured and paid for in accordance with the appropriate sections of the Specifications, but shall be listed under this section in the Schedule of Quantities.

Item		Applicable section
(a)	Removal of trees	101
(b)	Overhaul	103
(c)	Excess overburden at borrow areas	201
(d)	Temporary stockpiling of excavated material	201
(e)	Replacing segmented paving over trenches	609
(f)	Replacing in situ concrete paving over trenches	610
(g)	Repainting traffic markings	613

SERIES 2 : EARTHWORKS

SECTION 203 : MASS EARTHWORKS

CONTENTS

01 SCOPE

This section covers the construction of mass earthworks as defined in clause 02 of section 201. It mainly covers the construction of cuttings and embankments for road and railway construction up to the underside of the pavement or the subballast layers, and the construction of large excavations and embankments for other works such as sports fields.

02 DEFINITIONS

For the purposes of this section in particular and these Specifications in general, the following words and expressions shall, unless inconsistent with the context, have the meanings hereby assigned to them.

(a) Construction bed

The natural material on which fills or, in the absence of fills, pavement layers are constructed.

(b) Cut or Cutting

A large excavation, in mass earthworks, usually for the purpose of accommodating a road or railway line.

(c) Embankment

A structure consisting of imported material, usually rock, soil or gravel, and built above the natural ground level.

(d) Fill

That portion of an embankment below the pavement, subballast or topsoil layers.

(e) Fill material

Material used in the construction of an embankment up to the underside of the pavement, subballast or topsoil layers.

(f) Grade line

The grade line is a reference line shown on the Drawings of the longitudinal sections of the road or railway line which at regular intervals indicates the elevations according to which the road or railway line is to be constructed. The grade line may refer to the surface level of the completed road or railway line, the base, fill or subballast and may indicate the elevations either along the carriageway or railway centre line or along any designated position on the cross-section.

(g) Pavement layers

The upper layers of a road or parking area comprising the subgrade, subbase, basecourse and surfacing.

(h) Pioneer layer

An initial layer constructed over a weak construction bed where selected material is used to provide a stable surface for the construction of subsequent layers.

(i) Roller-pass or pass

One pass of a roller comprising a single coverage of the drum of a roller with only sufficient overlap to ensure that no area is left uncompacted.

(j) Side drain

An open longitudinal drain situated adjacent to and at the bottom of cut or fill slopes.

(k) Slope

Unless otherwise stated, slope is expressed in terms of the ratio of the vertical difference in elevation between any two points and the horizontal distance between them. This ratio may also be expressed as a percentage.

03 MATERIALS

03.01 In situ materials

In situ materials in construction beds and excavations have been tested, and the results of the tests are shown on the Drawings. The test results, read in conjunction with these Specifications, give a preliminary indication as to the purposes for which excavated material may be used and the treatment, if any, to be given to the construction bed. During construction the Engineer shall give final instructions regarding the use of excavated material and the treatment of the construction bed.

03.02 Fill

Fill material shall conform to the requirements specified below.

(a) The material shall contain no rock fragments with a maximum dimension exceeding 750 mm, unless otherwise authorized by the Engineer.

(b) The minimum CBR at a specified in situ density shall be as follows:

Depth below final fill level	Minimum CBR
0 m to 9 m	3
9 m to 12 m	5

By way of a written instruction the Engineer may allow or order the use of material not meeting these requirements, provided that he has satisfied himself regarding the stability of the fills to be constructed from such material, and provided further that the minimum CBR of the material at 100% AASHTO density exceeds 3.

The requirements in respect of material in the lower layers of fills which exceed 12 m in height shall be set out in the Project Specifications.

(c) Compaction requirements, minimum in situ dry density.

- When compacted to a percentage of modified AASHTO density 90%
- When compacted by proof rolling 98% of proof density

- Rockfill — no density specified

Sands which for the purposes of this requirement are specified as being non-plastic and, of which not less than 95% passes through a 4,75 mm sieve, shall be compacted to 100% of modified AASHTO density.

04 CLASSIFICATION OF EXCAVATED MATERIAL

04.01 Classes of material

The material from excavations and borrow shall be classified as follows for purposes of measurement and payment.

(a) Soft material

Material which can be efficiently removed or loaded, without prior ripping, by any of the following plant:

- A bulldozer having a mass, including the mass of a ripper if fitted, of 22 t and flywheel power of approximately 145 kW;

  or

- a tractor-scraper unit having a mass of approximately 28 t and flywheel power of approximately 245 kW, pushed during loading by a bulldozer equivalent to that specified in subclause 04.01(b);

  or

- a track-type front-end loader having a mass of approximately 22 t and flywheel power of approximately 140 kW.

(b) Intermediate material

Material which can be efficiently ripped by a bulldozer of approximately 35 t mass when fitted with a single-tine ripper, and having a flywheel power of approximately 220 kW.

(c) Hard material

Material which cannot be efficiently ripped by a bulldozer equivalent to that described in subclause 04.01 (b).

This material generally includes formations of unweathered rock, which can only be removed after blasting.

(d) Boulder material Class A

Material containing more than 40% by volume of boulders between 0,03 m^3 and 20 m^3 in size in a matrix of softer material or smaller boulders.

Dolomite formations other than solid dolomite shall also be classed as Class A material if the formation contains more than 40% by volume of lumps of hard dolomite between 0,03 m^3 and 20 m^3 in size in a matrix of soft material or smaller lumps of hard dolomite.

Solid boulders or lumps of hard dolomite in excess of 20 m^3 in size shall be classed as hard material. Fissured or fractured rock shall not be classed as boulder material but as hard or intermediate material according to the nature of the material.

(e) Boulder material Class B

Where a material contains 40% or less by volume of boulders or lumps of hard dolomite ranging between 0,03 m^3 and 20 m^3 in size, in a matrix of soft material or smaller boulders or lumps of hard dolomite, then those boulders or lumps of hard dolomite between 0,03 m^3 and 20 m^3 in size shall be classed in Class B boulder material.

The rest of the material shall be classed as soft or intermediate material according to the nature of the material.

All the equipment specified in subclauses (a), (b) and (c) above shall be in a good mechanical condition. The expressions "efficiently ripped", "efficiently removed" or "efficiently loaded" as used in this subclause shall in this context be taken to mean ripped, removed or loaded (as the case may be) in a manner than can reasonably be expected of the equipment in question having regard to the production achieved.

04.02 Method of classifying

The Contractor shall be at liberty to use any method he wishes to excavate any class of material, but the method of excavation shall not dictate the classification of the material.

The Engineer shall decide under which one of the classes excavated material shall be classified and paid for.

In the first instance the classification shall be based on inspection of the material to be excavated and the method of excavation proposed by the Contractor. In the event of disagreement between the Contractor and the Engineer, the Contractor shall, if required, make available at his own cost, such mechanical equipment as specified in subclauses 04.01 (a) and (b) in order to test the reasonable removability or otherwise of the material. The decision of the Engineer as to the classification shall thereafter be final and binding.

The Contractor shall immediately inform the Engineer as and when the nature of the material which is being excavated changes to the extent that a new classification for further excavation is warranted. Failure on the part of the Contractor to advise the Engineer in good time shall entitle the Engineer to classify, at his sole discretion, any material of a different nature which may have been excavated.

05 CLASSIFICATION OF COMPACTION

For purposes of measurement and payment, the method of processing and the compaction of material shall be classified as described below. The Engineer shall, except in the case of compaction to a minimum percentage of proof density, decide in advance on the classification of compaction to be employed, and the classification of material for purposes of excavation shall have no bearing on the classification of the compaction of material.

Compaction to a minimum percentage of proof density shall be carried out only after a written request by the Contractor to use this type of classification has been received and approved by the Engineer.

05.01 Compaction to a minimum percentage of modified AASHTO density

Wherever a density requirement for a soil or gravel layer is specified in terms of a percentage of modified AASHTO density in these Specifications or on the Drawings or in the Project Specifications or when directed by the Engineer, the Contractor shall be at liberty to employ any type of compaction equipment he may prefer in order to achieve the required density over the full specified depth of the layer, always provided that he complies in all respects with the general requirements of these Specifications, and that the equipment employed is adequate and suitable for the purpose and is in no way detrimental to any part of the Works.

05.02 Compaction to a minimum percentage of proof density

Where serious difficulties are encountered in regard to obtaining the densities specified in terms of a percentage of modified AASHTO density, the Engineer may, as a concession to the Contractor, specify compaction to 98% of proof density as described below.

(a) Materials

The requirements of subclause 05.01 shall apply in respect of material compacted to a percentage of proof density, save that the required density shall be expressed as a percentage of a proof density as described below, instead of as a percentage of modified AASHTO density.

For each type of material encountered, a trial section shall be constructed from material which is representative of the type of material for which a proof density is to be determined. The material shall be placed and compacted as described in clause 06. The compaction shall consist of a total of twelve passes or coverages per 150 mm of compacted layer thickness over every section of the area to be compacted, by various items of compaction equipment to give the most efficient combination for the material in question. The Contractor shall use a combination of all or any of the following equipment: heavy grid rollers, sheepsfoot rollers, tamping rollers, flatwheel rollers and vibratory rollers, or any other item of equipment agreed on by the Engineer as being suitable. The Contractor shall include four passes by a vibratory roller for each 12-pass-roller combination. On completion of the compaction of the trial section, at least ten dry-density measurements shall be made in the top 150 mm of the layer, or, in the case of non-plastic sand in the layer 100 mm to 250 mm below the surface, the proof density of which shall be the average of these dry densities.

The specified dry density to which the material shall be compacted shall be 98% of the proof density and shall be measured in the top 150 mm of the layer in the case of soils and gravels and in the layer 100 mm to 250 mm below the surface in the case of non-plastic sands.

(b) Equipment

The equipment shall be of any size and type deemed to be suitable by the Engineer, except that the following items of equipment shall comply with the requirements set out below:

- Vibratory roller

  The vibratory roller shall be capable of exerting a combined static and dynamic load of not less than 120 kN/m at an operating frequency not exceeding 25 Hz.

- Grid roller

  The mass of the grid roller shall be not less than 13 t when ballasted, and it shall be loaded to this mass.

(c) Payment

Compaction to 98% of proof density shall be paid for at the rate tendered for compaction to the percentage of AASHTO density replaced by it at the Contractor's request.

05.03 Rock-fill processing and compaction

Rock-fill processing and compaction shall apply to material which contains more than 25% of rock particles the greater dimension of which exceeds 150 mm, and which, on account of the mechanical interlocking of the rock, cannot be effectively compacted by the construction methods normally used for soils and gravels.

Where the layer thickness after compaction is 200 mm or less, as has been directed by the Engineer, the processing and compaction of such material shall not necessarily be classed as rock-fill processing and compaction, in which case the Engineer may direct that the material be compacted as described in subclause 05.04.

The maximum-size rock used in a rock-fill shall be 750 mm, and the layer thickness before compaction shall not exceed one and a half times the maximum actual size of the rock. The Engineer may direct that, after the material has been dumped in the fill, up to 5% of the oversize material be bladed off and disposed of as described in subclause 06.09 in order that the layer thickness need not be dictated by the presence of isolated large rocks.

The compacted layer shall not contain any rock with a maximum dimension which exceeds the compacted layer thickness.

The material to be compacted shall be off-loaded by progressive end tipping and so spread, pushed and levelled by means of bulldozers or other suitable equipment as to cause the fine material to be well mixed with the rock. Hauling, spreading and compacting equipment shall be routed uniformly over the full width of the layer to be compacted.

During the spreading and compaction process the material shall be compacted and broken down by grid or other suitable roller and shall finally be compacted by vibratory roller in accordance with the formula given below, so as to achieve a good mechanical interlock of the rock and a maximum compaction of the finer material in the interstices between the rock.

The type of vibratory roller used, the operating speed, the number of passes and the layer thickness shall be governed by the following formula:

$$\frac{Pe \times n}{h \times v} = 1\,500 \text{ (minimum)}$$

Where

Pe = total static and dynamic force per metre width, exerted by the vibratory roller at the operating frequency given by the manufacturer (kN/m)

n = number of passes required

h = compacted layer thickness in metres

v = roller speed in metres per second

Operating frequencies shall be between 18 Hz and 30 Hz and Pe shall be not less than 120 kN/m in width x (the loose-layer thickness in metres).

05.04 Twelve-pass roller compaction

When, on account of the nature of the material used, the degree of compaction cannot be satisfactorily controlled by way of testing the in situ densities, the Engineer may instruct that the material be placed and compacted as described in subclause 05.02 by way of twelve passes or coverages (per 150 mm of compacted layer thickness) by a combination of various items of compacting equipment. The Engineer may also instruct that the number of passes required be increased or reduced, in which case adjustment in the compensation to be paid to the Contractor shall be made either as a payment to the Contractor in respect of the increased number of passes required by the Engineer, or as a refund to the Employer in respect of the reduced number of passes required by the Engineer.

The provisions of subclause 05.02 shall apply mutatis mutandis to this method of compaction, with the proviso that compaction to a specified density will not be required, but that the full number of roller passes required and paid for shall be done.

06 PLACING AND COMPACTION

06.01 General

This clause covers the placing, breaking down, watering, mixing and compaction of natural gravel materials by conventional construction techniques.

06.02 Spreading of materials

All materials which are deposited in place prior to compaction shall be evenly spread over the entire area designated for the layer concerned and in a quantity that will give the thickness of any one layer which, when measured after compaction, shall comply with the specified requirements.

A new layer of less than 75 mm of compacted thickness shall be bonded to the previous layer by the previous layer being scarified to a depth of not less than 25 mm, or to such greater depth as to give a total compacted thickness of the new layer plus the scarified portion of the previous layer, of not less than 100 mm.

06.03 Breaking down and preparation of the material

All material used in the construction of the fill shall be reduced to a maximum size of 750 mm in the excavation or the borrow pit by cross ripping, secondary blasting or other suitable means if necessary, before any breaking down on the fill is attempted.

Once reduced to this size, the material shall be either processed and broken down as described below and in subclause 06.06, or it shall be utilized directly in rock-fill construction as described in subclause 05.03, all as instructed by the Engineer.

No separate payment shall be made for any breaking-down as described above, and the cost of such breaking-down, which shall include any secondary blasting, shall be included in the rates tendered for the construction of fill layers.

Excavated material not required for the construction of the Works, need only be broken down sufficiently to facilitate handling and so as not to be unsightly where it is finally deposited in spoil.

The material shall be broken down to a size not exceeding the compacted thickness of the fill layers. The thickness of the fill layers will depend on the size to which the material can be broken down by the specified techniques and will be decided on the Site by the Engineer.

To prevent the fill-layer thicknesses from being governed by the presence of isolated larger rocks, the Engineer may direct that any material, which cannot be broken down to the size which can generally be obtained for the rest of the material in the layer, be bladed off the fill and removed and that payment therefore be made as described in sub clause 06.09.

The material placed on the fill shall be thoroughly broken down through the entire layer by equipment suited for this purpose. The Contractor shall be at liberty to use any equipment considered by him to be the most suitable, but in the event of disagreement between the Engineer and the Contractor as to the adequacy of the equipment used or the process employed, the material shall be given a normal grid rolling as described in subclause 06.07, and the Engineer may at any time require that all material be given a normal grid rolling or any equivalent alternative treatment approved by him.

During such processing the material shall be frequently bladed to bring oversize material to the surface to facilitate breaking-down.

When normal grid rolling cannot effectively break down the material to the required size, the Engineer may negotiate with the Contractor in regard to the use of specialized equipment such as heavy vibrating grid rollers and self-propelled tamping rollers to break down the material. Where the extensive use of such equipment is contemplated in advance, its use and payment for such use will be specified in the Project Specifications.

Where the coarse and fine fractions of the material are not uniformly distributed or have been allowed to become segregated, the material shall be thoroughly mixed on the road by blading with a motor grader being done in successive cuts over the full depth of the layer after the required amount of water has been added as described in subclause 06.04. Mixing shall continue until a uniform mixture of the variously sized fractions of the material has been obtained.

06.04 Watering and mixing

Any water that is required before the material is compacted shall be added to the material in successive applications by means of water sprinklers fitted with sprinkler bars or by means of pressure distributors, all capable of applying the water evenly and uniformly over the area concerned.

The water shall be thoroughly mixed with the material to be compacted by means of motor graders or other suitable equipment. Mixing shall continue until the required amount of water has been added and a uniform mixture is obtained, after which compaction may be proceeded with.

The amount of water to be added shall be sufficient to bring the material up to the optimum moisture content required for the compaction equipment used and to the required density, provided always that compaction shall not be attempted with and will not be approved in respect of materials the moisture content of which exceeds the optimum moisture content by 2%. Should the material be too wet on account of rain or for any other reason, it shall be harrowed and allowed to dry to attain a moisture content which conforms to the above requirement before compaction is proceeded with.

06.05 Compaction

Compaction shall be done in a series of continuous operations which cover the full width of the layer concerned. The length of any section of a layer to be compacted shall, wherever possible, neither be less than 150 m nor more than can be properly compacted with the available equipment.

The Engineer is authorized to instruct the Contractor to reduce the area of any layer which is compacted in any single operation if such layer is not being properly compacted.

The types of compaction equipment to be used and the amount of rolling to be done shall be of such a nature as to ensure that specified densities are obtained without damage being done to lower layers or structures. During compaction the layer shall be maintained to the required shape and cross-section, and all holes, ruts and laminations shall be eliminated.

06.06 Construction of thick layers

Where the blading and mixing of fill layers by motor grader becomes very difficult on account of the thickness of the layer to be constructed, the Engineer may allow this operation to be curtailed or entirely omitted during any breaking-down, mixing or watering process in which blading and mixing has been specified. In such cases the Contractor shall take all reasonable measures to ensure that the material is nevertheless thoroughly broken down and brought as near as is practicable to the moisture content required for proper compaction.

During breaking-down on the fill, the loose-layer thickness shall be adapted to the size of the material being handled and shall not be so excessive as to reduce the efficacy of the breaking-down process.

06.07 Normal grid rolling

For the purposes of this Specification, normal grid rolling shall be taken to mean the following:

(a) The material to be grid-rolled shall be evenly spread over the entire width of the layer being prepared.

(b) The grid roller, which shall have a minimum mass of 13,5 t, shall make two complete passes over the material, where each pass shall consist of rolling with the grid roller in a longitudinal direction over the entire width of the layer so that each roll laps over half of the previous roll.

(c) The material shall then be bladed to a windrow on one side of the road, respread and subjected to two more grid-roller passes.

The above procedure shall apply to a compacted layer thickness of up to 150 mm. Where the actual layer thickness exceeds 150 mm, the number of passes of the grid roller shall be increased proportionately.

06.08 Drainage and protection

The compacted layers shall be adequately drained and shaped to prevent water from standing on or scouring the finished work. Windrows shall be removed to facilitate the drainage of water from the surface.

No material for a succeeding layer shall be placed if the underlying layer has been softened by excessive moisture.

06.09 Disposal of oversize material

The Engineer will direct that oversize material be disposed of or utilized elsewhere in the construction of the Works and that it be paid for in one of the following ways:

(a) Where the oversize material is bladed off the fill and utilized in the uniform widening of fills beyond the specified dimensions, the material shall be paid for as "excavation to spoil" material.

(b) Where the material is bladed off the fill, loaded, transported and taken to spoil, the material shall be paid for under the item "removal of oversize material".

(c) Where the material is bladed off the fill, loaded, transported to the point of use and utilized in any other item of construction, it shall be paid for under the item "removal of oversize material" as well as under the item of construction for which it is utilized.

Notwithstanding the methods of payment described above, tender rates for the construction of all the fill layers from excavated or borrow material shall include full compensation for the removal of oversize material of up to 5% by volume at no additional payment to the Contractor.

Only that volume of oversize material removed in excess of 5% of the compacted volume of any fill layers constructed from excavated and borrow material will therefore be measured for payment under the items "removal of oversize material" in the case of (b) or (c) above, or as "excavation to spoil" material in the case of (a) above.

The Contractor shall take all reasonable care not to bring onto the fill any material which cannot be broken down to the required size by processing on the fill. This can be avoided by proper selection in excavation or in borrow. In excavation any material thus selected shall be taken direct to spoil or shall be utilized as directed by the Engineer.

07 EXCAVATION

07.01 Dimensions of excavations

The dimensions of excavations shall be generally in accordance with the details as shown on the Drawings and shall further be defined or amended during the course of construction as may be instructed by the Engineer. The Contractor shall obtain instructions beforehand from the Engineer regarding the slope of the sides of cuttings and other excavations and the depth to which excavations are to be taken, also regarding the dimensions of excavations during any in situ treatment that may be required below the pavement layers, where applicable.

In rock cuttings for road construction the rock shall be removed to such a depth as will permit the construction of the subbase layer, unless otherwise instructed.

All excavations carried below the specified depths shall be backfilled with suitable material and shall be compacted, all at the Contractor's own expense, as directed by the Engineer.

If deemed necessary by him, the Engineer may instruct the Contractor to widen any existing cuttings which have been completed or partially completed either uniformly or by altering the slopes of the sides of cuttings, cutting benches, or in any other way.

Those portions of cut slopes situated more than a vertical height of 2,5 m above the cutting floor and widened horizontally by less than 4 m, either by flattening the slope or by relocating the sloping side uniformly in an outward position, as well as by benches cut less than 4 m wide and situated at any height above the cutting floor, shall be measured and paid for under item 203.06.

Those portions of cutting slopes widened horizontally by more than 4 m by any of the above-mentioned methods and irrespective of the height above the cutting floor, as well as those portions of cutting slopes less than 2,5 m above the cutting floor and irrespective of width, shall, except in the case of benching as described above, be measured and paid for as excavation to fill or excavation to spoil, as the case may be.

07.02 Use of excavated material

All suitable and approved materials excavated shall, in so far as it is practicable, be used in the construction of fill, shoulders, pavement layers, mitre banks and for such other purposes as shown on the Drawings or as directed by the Engineer.

Coarse rock encountered in excavations shall be utilized for the construction of the lower layers of fills to a sufficient height to accommodate thick layers or, where so required, shall be conserved and used as directed for constructing the sides of embankments or to serve as protection against embankment or channel erosion.

The Engineer shall have full control of the use of all material produced by excavations, but the Contractor shall so plan his operations, and in particular his excavation to fill operations, that all excavated material can be used to the best economical advantage to the Employer. This would mean that no material shall be unnecessarily spoiled, borrowed or hauled.

The Contractor shall neither borrow nor spoil any material without the Engineer's approval and without satisfying the Engineer that it is necessary and the most economical method of constructing the Works.

08 FINISHING OF SLOPES

08.01 Slopes of excavations

The slopes of cuttings and other excavations shall be trimmed to neat lines and to a standard that is generally attainable with proper care and workmanship in the type of material concerned. All loose rocks, stones and nests of loose material shall be removed, especially in solid-rock cuts, which must be completely free of such material. The final surface of batters must not be absolutely smooth, but shall have a slightly rough surface which will be suitable for subsequent grassing or for the establishing of natural vegetation on the surface and, in the case of the slopes of open drains, the surface shall be trimmed as specified in section 504.

08.02 Fill slopes

Fill slopes shall be finished to neat lines with all loose rocks and uncompacted material removed. The degree of finish required shall depend on the nature of the material used for the slopes, but the finish shall be as smooth as is consistent with the material involved and good workmanship.

No boulders exceeding 750 mm in size may be present, and isolated large boulders in otherwise smaller-size material shall not be allowed to project from the surface.

In the case of rock fill, the Engineer may order the dumping of soft material over the side and that it be worked into the interstices between the rock on the slope surface. It is recommended that the Contractor establish beforehand whether this will be required and that he follow this procedure as the fill is being built up. Payment for soft material thus worked into fill slopes shall be made under subitem 203.01.01 and the volume of such material shall be taken to be equal to 70% of the loose volume measured in the trucks.

08.03 General

Except in solid rock, the tops and bottoms of all slopes, including the slopes of drainage ditches, shall be rounded as indicated on the Drawings or as instructed by the Engineer. Slopes at the junctions of excavations and fills shall be adjusted and warped to flow into one another or into the natural ground surfaces without any noticeable break.

When directed by the Engineer, slopes shall be adjusted to avoid harm being done to existing trees, and also to harmonize with existing landscape features. The transition to such adjusted slopes shall be gradual.

Slopes of excavations and fills shall be finished to give a uniform appearance without any noticeable breaks. The degree of finish required for all fill slopes and for slopes of excavations flatter than 1 in 4 shall be that normally obtainable by motor-grader or hand-shovel operations.

The slopes of excavations and fills which are designated for grassing shall, after having been finished, be prepared for grass planting with or without topsoil as specified in section 104 of these Specifications.

All trimming of the side slopes of cuttings shall be completed before any work on the subbase is commenced inside such cuttings.

09 CONSTRUCTION BED TREATMENT

09.01 Removal of unsuitable material

All construction bed material which is considered by the Engineer to be of a quality that would prejudice the performance of the completed road, railway line or parking area, shall be removed to such widths and depths as instructed by the Engineer and shall be disposed of as directed. The excavated spaces shall then be backfilled with approved imported material compacted to the required density. This excavation shall be measured and paid for under item 203.03.

The Engineer may also instruct that material which is too wet to provide a stable platform for the construction of the fill be removed and replaced with suitable dry material. The Contractor shall be paid for this work, provided that the Engineer is satisfied that, despite any adequate temporary drainage installed by the Contractor and any permanent drainage that the Contractor may have installed on the Engineer's instructions, the wet conditions are not likely to be remedied within a reasonable period and could not have been reasonably foreseen and avoided by proper advance planning, e.g. by carrying out the construction during a dry period. This excavation shall also be measured and paid for under item 203.03.

09.02 Three-pass roller compaction

Any portion of the construction bed which, by reason of its inadequate natural density, is shown on the Drawings or is specified or directed by the Engineer to be given three-pass roller compaction, shall be prepared by shaping where necessary and by compacting with a vibratory roller complying with the requirements specified in subclause 05.02(b), or with an impact roller.

The impact roller shall be a multi-faced roller with a maximum of five flat or practically flat faces and a roller mass of between 8 t and 10 t. The roller and towing mechanism shall be designed in such a manner that all the energy applied in lifting the roller, when the roller is supported on the ridge between consecutive faces, will be available for dissipation on impact when the roller drops down again. The roller shall be towed at a speed of between 8 km/h and 24 km/h.

Except where otherwise authorized by the Engineer, compaction shall comprise not less than three complete coverages by the wheels of the roller specified or ordered over every portion of the area being compacted.

While the Contractor is not meant to apply water to the construction bed under this class of compaction and while no rigid moisture control will be exercised during compaction, the Contractor shall nevertheless satisfy the Engineer that every endeavour is being made to take full advantage of favourable soil-moisture conditions during the rainy season, and, as far as possible, to carry out such compaction when the construction bed is neither excessively dry nor excessively wet.

The Engineer is authorized to decide as to when conditions are favourable for compaction and where such compaction shall be done at any particular time, and he shall have the right to instruct the Contractor to water the construction bed at the Contractor's expense where, in the opinion of the Engineer, the Contractor has failed, neglected or refused to comply with these requirements.

09.03 Preparation and compaction of construction bed

A construction bed which is classified as suitable for in situ use, save that it fails to meet density requirements, shall be scarified, watered and compacted to 90% of modified AASHTO density. The depth of compaction shall be as directed by the Engineer. If necessary, construction-bed material may have to be temporarily bladed off to windrow to attain the necessary depth of compaction.

Where additional material has to be imported to obtain the required levels and layer thicknesses, and where the thickness of the imported material, measured after compaction, is less than the specified layer thickness, the construction-bed material shall be scarified and the required imported material placed, and the combined material thus obtained shall be mixed and compacted to the full specified depth of the layer. The imported material shall be measured and paid for under "Excavation and borrow to fill" and the construction-bed material shall be measured and paid for under "Preparation and compaction of construction bed material".

09.04 Draining of construction bed

A drainable, water-logged construction bed where saturated material overlies less pervious strata shall first be drained by all permanent surface or subsoil drainage shown on the Drawings or as directed by the Engineer being installed before any other construction is started on these sections.

Such drains shall be constructed, measured and paid for in accordance with the requirements of sections 501 and 502 of these Specifications.

09.05 In situ treatment of construction bed

Wherever shown on the Drawings or directed by the Engineer, the construction bed shall be treated in situ by the breaking-up of undesirable formations of hard or rocky materials to attain a uniform standard of compaction or to improve drainage.

In situ treatment shall consist of ripping or blasting to depths below subgrade level. Unless otherwise indicated on the Drawings or directed by the Engineer, the depth of ripping shall be not less than 300 mm. Similarly the depth of drilling and blasting shall be not less than 700 mm.

After ripping or blasting, the material shall be processed as follows:

- Where the Engineer instructs the Contractor to rip the in situ material, all the material shall be sized by rolling or knapping until the maximum dimension of any clod or spall does not exceed two-thirds of the thickness of the layer after compaction.

  The material shall then be compacted as described in clause 06 and in subclause 05.04 by twelve passes being made by an approved combination of various rollers.

- Where the Engineer instructs the Contractor to blast the in situ material, all the material shall be processed and compacted as described in subclause 05.03.

In both cases surplus material produced by bulking after in situ treatment shall be removed and disposed of or utilized elsewhere, as directed by the Engineer.

10 FILL CONSTRUCTION

10.01 General

The dimensions of fills shall be in accordance with the typical cross-sections and with the details shown on the Drawings, and as may be further defined or amended by the Engineer during the course of construction. Before construction, the Contractor shall obtain instructions regarding any matter that may affect the construction of the fill or sequence of operations.

All material used in the construction of fills shall be broken down during excavation and during the placement and compaction of the material.

The thickness of individual layers shall depend on the type of material encountered and on the maximum size of the particles in such material. Where the material can generally be broken down to a maximum size of 200 mm or less, the layer thickness shall not exceed 200 mm after compaction, except in the case of cohesionless sands where layers may be up to 400 mm thick, subject to specified densities over the full depth of compaction being attained.

In the case of material that cannot be reduced to a maximum size of 200 mm or less after removal of the oversize material, thicker layers shall be constructed, but the thickness of the loose layer shall not be more than is necessary to ensure that the maximum particle size generally does not exceed the completed layer thickness. The Engineer may, at his sole discretion, allow thicker layers than those specified above to be constructed, provided that he is satisfied that the specified densities can be obtained throughout the full depth of each layer and that the layers will be uniformly compacted with the use of equipment specifically suited to this purpose.

Wherever practicable, the successive layers of material shall be placed parallel to the final surface. The construction of tapered layers shall be restricted to the bottom layers where it may be unavoidable on account of the crossfall, tapering out of fills or super elevation of the final surface.

10.02 Placing of rock

Rock material containing rock particles exceeding 300 mm in size shall not be used at a depth of less than 150 mm below the top of the fill level, unless otherwise authorized by the Engineer.

The Contractor shall, by judiciously planning the layer thicknesses and selecting the smaller-sized material to be placed in the thinner fill layers, avoid the unnecessary spoiling of the larger-sized rock material and ensure, wherever practicable, its full utilization.

10.03 Placing on unstable ground

Where fill is to be constructed across water-logged or soft clayey soil that displays excessive movement under normal compaction equipment and haulage trucks so as to preclude the effective compaction of the bottom layers, the Engineer may direct the construction of a pioneer layer on the unstable ground. This layer shall be constructed by the dumping and spreading of successive loads of suitable coarse material in a uniform layer of a thickness just sufficient to provide a stable working platform for the construction of further layers which are to be compacted to a controlled density.

Light hauling equipment and, where necessary, end tipping shall be used to place the material, and the layer shall be compacted with such light compaction equipment as will give the most effective compaction without overstressing the construction bed. Pioneer layers need not be compacted to a controlled density.

The compacted volume of material used may be determined on the basis of 70% of the loose volume in trucks as an alternative to the taking of cross-sections before and after construction.

10.04 Benching

Where the crossfall of the construction bed exceeds 1 in 4, the construction bed shall be cut away, as shown on the Drawings, to form benches with each bench being cut as the material is compacted and built up. The benches shall be of sufficient dimensions to allow placing and compaction equipment to operate on the benches.

Where solid rock occurs, the dimensions of the benches may be smaller than those required for the operation of equipment. Those benches may be made by stepping or serrating the slope, with the steps sloping inwards to ensure a satisfactory bond between the slope and fill. The fill in such cases shall preferably consist of rock.

The material shall be placed in a single layer at the toe of the fill to the minimum elevation that will allow the placing and compacting equipment to operate on such layer.

Material excavated from benches, if suitable, shall be incorporated in the fill. Bench-making shall be measured and paid for as "Excavation to fill" or "Excavate and spoil", unless otherwise provided in the Project Specifications.

10.05 Construction of fills near structures

At all fills adjoining uncompleted structures such as bridges and large culverts, where the construction of the fill and the backfilling behind the structure cannot be done simultaneously, the fill shall be so constructed that the longitudinal slope of the surface of the fill will at any stage form a continuous plane sloping towards the structure with a gradient not exceeding 10%. When the structure is completed, the remaining portion of the fill shall be similarly completed and shall coincide with the backfilling of the structure, with the backfill behind the structure being maintained at the same elevation as the adjoining fill. No additional payment shall be made for similarly constructing the fill outside the restricted area.

See subclause 08.04 of section 701 regarding the construction of the fill in restricted areas.

11 PROTECTION OF FILLS

During construction the fills shall be kept well-drained and protected at all times. All windrows shall be cut away after construction to prevent flow being concentrated on completed layers, but, where necessary, flat berms shall be constructed to prevent an undue erosion of the slopes. All permanent drains shall be constructed as soon as possible, together with a sufficient number of additional temporary drains as may be necessary to protect the fill, and they shall be maintained in a good working order. Ruts and potholes which develop in the fill after completion shall be repaired and damaged sections shall be reshaped and recompacted at the Contractor's own cost.

All slopes shall be maintained by the Contractor until the final acceptance of the Works. All erosion and flood damage to slopes shall be promptly repaired.

Side drains and all other drains shall be so constructed as to avoid any erosion damage.

12 CONSTRUCTION TOLERANCES

The work described in this section shall be constructed to the dimensional tolerances given below.

12.01 Level

The level tolerances referred to in subclause 05.01 of section 902 shall be as follows for fill:

H_{90} = ±25 mm

H_{max} = ±33 mm

12.02 Width

(a) Common fill

The transverse width of a fill at any level, measured horizontally, shall not at any place be more than 125 mm less or 250 mm more than the design width at that level.

(b) Rock fill

The transverse width of rock fill at any level, measured horizontally, shall not at any place be more than 250 mm less or 500 mm more than the design width at that level.

(c) Slopes of excavations

No specific tolerances are given, but the excavation slopes shall be finished to a standard generally attainable with proper care and workmanship, bearing in mind the nature of the material excavated. Care shall be taken not to undercut any slopes to give sections a slope steeper than specified. All loose material shall be removed.

13 TESTING

13.01 Process control

The minimum testing frequency required from the Contractor in terms of clause 05 of section 901 for purposes of process control is shown in table 203/1.

13.02 Routine Inspection and testing

Routine inspection and testing will be carried out by the Engineer in accordance with the provisions of clause 06 of section 901 for testing the quality of materials and workmanship with a view to compliance with the requirements of this section.

The requirements specified in subclause 03.02 for the compaction of fill material to a percentage of modified AASHTO density or proof density shall be deemed to have been complied with if at least 75% of in situ density tests on any lot are equal to or above the values specified and no single density is more than 5 percentage points of relative compaction below the value specified.

Any materials which do not comply with the specified requirements shall be removed and replaced with materials which comply with the specified requirements or, if the Engineer so permits, be repaired as specified in section 901 so that it will comply with the specified requirements after having been repaired. Similarly any workmanship which does not comply with such requirements shall be made good so as to comply therewith.

Table 203/1

Test	Position or layer	Testing frequency	
		One test every -	Minimum number of tests per lot or road section
Materials			
Field density and OMC*	(i) Ordinary fill	2 000 m^3	4 per fill
	(ii) Top 300 mm of fill and construction bed	5 000 m^2	4
Tolerances			
Surface levels	Top of fill	20 m (1 test = 3 pts per cross-section)**	
Width (for roads and railways)	Cut and fill slopes	500 m	

* The determination of field density expressed as a percentage of modified AASHTO density implies a modified AASHTO density determination for each field density. Where material is homogeneous, this ratio can be decreased to one determination of the modified AASHTO-density, for up to four field densities

** For large areas such as parking areas, 1 test equals a series of points 5 m apart, in a straight line across the full width of the fill at every 20 m cross-section.

14 MEASUREMENT AND PAYMENT

Note:

The Contractor may, at his own expense, take the levels and prepare the cross-sections necessary for the measurement and computation of fill quantities should he wish to check the Engineer's quantities. The Engineer will, however, conduct check tests on any such cross-sections as he may consider necessary to confirm their accuracy and adequacy. Failure on the part of the Contractor to submit his own cross-sections to the Engineer before commencing with construction will indicate his preparedness to accept the cross-sections provided by the Engineer, and no subsequent claims in this regard will be considered.

Cross-sections for fill quantities shall be taken after any clearing and grubbing, removal of topsoil and preparation of the construction bed has been completed.

Item		Unit
203.01	**Excavation and borrow to fill**	
203.01.01	Compaction to 90% of modified AASHTO density	cubic metre (m^3)
203.01.02	Rock-fill processing and compaction	cubic metre (m^3)
203.01.03	Twelve-pass roller compaction	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material measured in the compacted fill. The quantity measured shall be computed after clearing and grubbing, the removal of topsoil and the completion of any preparatory construction-bed treatment which may have been instructed by the Engineer. For measurement, a distinction shall be made between the three alternative methods of processing and compacting.

Material excavated for the construction of open drains, subsurface drains, culverts, bridge foundations and other structures shall, if it is of a suitable quality and if so directed by the Engineer, be used for the construction of the fill. Payment shall be made under this item notwithstanding any payment previously made for the excavation of such material. All such material shall be classified as soft material.

The tendered rates shall include full compensation for excavating the material as if it were soft material, for the temporary stockpiling of material unless otherwise specified in the Project Specifications, for transporting, mixing, watering, placing and compacting the material, and for the removal and disposal of up to 5% oversize material. Overhaul shall apply in accordance with the provisions of section 103 and will not apply to material obtained from borrow areas provided by the Contractor.

For payment purposes, a distinction shall be made between the three methods of processing and compacting specified, as itemized above. Compaction to 98% of proof density shall be paid at the rate tendered for subitem 203.01.01.

Item		Unit
203.02	**Extra over item 203.01 for excavating in**	
203.02.01	Intermediate material	cubic metre (m^3)
203.02.02	Hard material	cubic metre (m^3)
203.02.03	Boulder material class A	cubic metre (m^3)
203.02.04	Boulder material class B	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material removed as specified and measured as specified under item 203.01.

No extra over shall apply to material obtained from sources provided by the Contractor and all such material shall be classified as soft material regardless of the methods employed to excavate such material.

The tendered rates shall be paid as extra over the rates tendered for item 203.01 and shall include full compensation for excavating the various classes of material over and above the rates tendered for soft material, also the cost of all additional work, plant, tools, materials, labour and supervision required for the excavating and breaking down of the material as specified.

The tendered rates shall include full compensation for any overbreak as well as the additional backfilling required and for all other incidentals resulting from overbreak and over-excavation resulting from excavation carried out below the specified depths.

Item		Unit
203.03	**Excavate and spoil of -**	
203.03.01	Soft material	cubic metre (m^3)
203.03.02	Intermediate material	cubic metre (m^3)
203.03.03	Hard material	cubic metre (m^3)
203.03.04	Boulder material class A	cubic metre (m^3)
203.03.05	Boulder material class B	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material measured in its original position in the excavation.

Where this is not considered by the Engineer to be practicable, excavation to spoil may be measured in a manner mutually agreed upon by the Engineer and the Contractor.

No excavation in excess of the authorized cross-sections shall be paid for, notwithstanding any tolerances in workmanship allowed.

The tendered rates shall include full compensation for excavating the various classes of material, for the temporary stockpiling of material unless otherwise specified in the Project Specifications, for loading and transporting the material and for off-loading and disposing of the material as specified, including the shaping and levelling-off of spoil sites in the manner specified for borrow areas in the third last paragraph of clause 05 of section 201.

Overhaul shall apply in accordance with the provisions of section 103 to material hauled outside the free-haul boundaries but not when spoiled in dumping areas to be provided by the Contractor.

Any construction-bed material below the bottom of the subgrade level, which is removed as described in sub clause 09.01 because it is of poor quality or because it is too wet, shall be measured for payment under this payment item.

Item		Unit
203.03	**Removal of oversize material**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of oversize material from excavations or borrow which cannot be broken down, as specified, and is removed. The volume shall be determined by taking 70% of the measured volume in stockpiles or, where this is impracticable, in a manner mutually agreed upon by the Engineer and the Contractor. Only that volume of oversize material in excess of 5% of the compacted volume of any fill layers will be measured for payment, all as specified in subclause 06.09.

The tendered rate shall include full compensation for excavating all classes of material, loading and transporting, placing, any break-down treatment given or attempted, blading all oversize material off the fill, loading, transporting it to the point of disposal or subsequent use, and for off-loading and spreading of the material. Overhaul shall apply in accordance with the provisions of section 103 to material hauled outside the free-haul boundaries but not when spoiled in dumping areas to be provided by the Contractor.

Item		Unit
203.05	**Variations in compactive effort (applicable to subitem 203.01.03 and item 203.07)**	
203.05.01	Vibratory rollers	square-metre-pass (m^2 pass)
203.05.02	Impact roller	square-metre pass (m^2 pass)
203.05.03	All other rollers	square-metre pass (m^2 pass)

The unit of measurement for the increased or decreased number of roller passes used for construction-bed compaction or for twelve-pass roller compaction shall be the square-metre pass, which shall be computed by multiplying the area in square metres, to which the variation applies, by the increased or decreased number of roller passes by which the specified effort has been increased or decreased.

The tendered rate for each additional square-metre pass required by the Engineer over and above the specified number of passes shall include full compensation for all supervision, labour, plant, equipment, fuel, materials, work and incidentals necessary to complete and test the work as specified.

The Employer shall be refunded for any lesser number of square-metre passes at the same tendered rate as is paid to the Contractor for any increased number of such passes under this item.

Item		Unit
203.06	**Widening of cuttings (extra over items 203.01 and 203.03)**	
203.06.01	In hard material	cubic metre (m^3)
203.06.02	In intermediate and soft material	cubic metre (m^3)
203.06.03	In boulder material class A or class B	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material excavated in those portions of cutting slopes as specified in subclause 07.01 of this section.

Measurement shall be in the original position in the cutting.

Material excavated in excess of the authorized cross-section shall not be paid for, irrespective of any tolerances in workmanship allowed under the Contract.

The tendered rates shall be paid as extra over the rates tendered for items 203.01 and 203.03 and shall include full compensation for the additional costs involved, over and above those involved in the excavating of new cuttings, for excavating material by widening the cuts as specified.

Item		Unit
203.07	**Three-pass roller compaction**	
203.07.01	Vibratory roller	square metre (m^2)
203.07.02	Impact roller	square metre (m^2)

The unit of measurement shall be the square metre of material compacted, as specified, in the area designated by the Engineer.

The tendered rates shall include full compensation for shaping, providing and keeping the rollers ready for use when soil-moisture conditions are favourable as specified, and for compacting the construction bed by three roller passes. Extra-over payments shall apply in respect of providing the impact rollers and keeping them available. (See items 203.12 and 203.13).

Item		Unit
203.08	**Preparation and compaction of construction bed material to 90% of modified AASHTO density**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of construction bed material prepared and compacted as specified.

The tendered rate shall include full compensation for shaping, scarifying and the mixing of in situ and imported material if required, and for preparing and compacting the material as specified.

Compaction to 98% of proof density shall be paid at the rate tendered for this item.

Item		Unit
203.09	**Material bladed to windrow**	cubic metre (m^3)

The unit of measurement for material temporarily bladed to windrow shall be the cubic metre of material required to be bladed off, measured in its original position before blading-off.

The tendered rate shall include full compensation for temporarily removing and subsequently replacing the material, as well as for all tidying-up that may be required after completion of the replacement.

Only material bladed to windrow on instructions of the Engineer in terms of subclause 09.03 for the purpose of exposing underlying construction-bed material to be treated shall be measured and paid for as described here.

Item		Unit
203.10	**In situ treatment of the construction bed**	
203.10.01	In situ treatment by ripping	cubic metre (m^3)
203.10.02	In situ treatment by blasting	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material treated in situ, as specified. The quantity shall be calculated from the authorized dimensions of the in situ material treated.

The tendered rates shall include full compensation for ripping or blasting, shaping, scarifying, sizing, knapping, rolling, and the mixing of in situ and imported material if required, and for preparing and compacting the material as specified. For payment purposes a distinction shall be made between in situ treatment by ripping and in situ treatment by blasting. Surplus material shall be measured and paid for as in item 203.01 if placed in fill and as in subitem 203.03.01 if placed to spoil, and no payment under item 203.02 shall apply.

Item		Unit
203.11	**Finishing off slopes**	
203.11.01	Excavation slopes	square metre (m^2)
203.11.02	Fill slopes	square metre (m^2)

The unit of measurement shall be the square metre of slopes finished off as specified. The areas shall be the area between the shoulder breakpoint and the toe of the fill in the case of fill slopes, and the area between the top of the excavation slope and the toe in the case of excavation slopes. The areas occupied by side drains or any other drains shall not be included.

The tendered rates shall include full compensation for finishing off the slopes as specified and for loading, transporting and disposal of any material brought down during finishing operations. For payment purposes a distinction shall be made between excavation and fill slopes.

Item		Unit
203.12	**Provision of impact roller (extra over item 203.07)**	number (No)

Where the use of an impact roller is required and the Contractor is instructed to provide this item of equipment, he shall be paid separately for providing it on Site.

No payment shall be made for returning an impact roller that has been removed from the Site or for providing a replacement.

The unit of measurement shall be the number of impact rollers provided on the instructions of the Engineer.

The tendered rate shall be extra over item 203.07 and shall include full compensation for the provision of the impact roller, including its transport to and from the Site. No payment shall be made for the providing of substitute rollers for rollers that have broken down.

Item		Unit
203.13	**Keeping impact rollers available on the Site (extra over item 203.07)**	roller-day

The unit of measurement shall be the number of days for which each impact roller is held available on the Site in a good working order in accordance with the instructions of the Engineer. No payment shall be made in respect of the time when rollers are under repair or not in a good working order.

The tendered rate shall be extra over item 203.07 and shall include full compensation for keeping the impact rollers available for use and maintaining them in a good working order.

Item		Unit
203.14	**Extra over item 203.01 for borrow material from sources to be supplied by the Contractor**	cubic metre (m^3)

The extra over rate shall be in full compensation for obtaining the material and transporting it to the point of use including for all activities at the borrow areas such as removal and replacement of overburden, finishing off borrow areas and for the payment of royalties and other charges.

Item		Unit
203.15	**Extra over items 203.03 and 203.04 for disposing of spoil material to sites to be provided by the Contractor**	cubic metre (m^3)

The extra over rate shall be in full compensation for disposing of the material to sites to be provided by the Contractor, for transporting the material from the point of excavation to the point of disposal and for all charges to the Contractor for accepting spoil material.

Note:

The following items of work, when specified, shall be carried out, measured and paid for in accordance with the relevant sections of the Specifications, but will be listed under this section of the Schedule of Quantities.

Item		Applicable section
(a)	Overhaul	103
(b)	Excess overburden at borrow areas	201
(c)	Temporary stockpiling of excavated material	201

SERIES 3 : SEWERS

SECTION 301 : MATERIALS

CONTENTS

01 SCOPE

This section covers the materials used in connection with the construction of sewerage systems which utilize prefabricated pipes.

02 PIPES AND FITTINGS

02.01 General

All pipes and fittings shall be marked with the manufacturer's name, its grade, type or class, the SANS standardization mark where applicable, and any other markings that may be required in terms of this section.

Should different manufacturers supply the same type of pipe for a Contract, the products of only one manufacturer shall be used in any section of pipeline between two manholes.

Record of where the different products have been installed shall be handed to the Engineer for inclusion in the as-built drawings.

Pipes shall be supplied in standard lengths. The cutting of pipes on Site will only be permitted if the Contractor can satisfy the Engineer that he can finish off the ends of cut pipes to the same standard and within the same tolerances as the ends of uncut pipes. Standard shorter lengths of concrete pipes shall be factory-made and the cutting of concrete pipes on Site will only be allowed at manholes where the cut ends are cast into the manhole foundation.

The relevant requirements for materials under section 401 shall apply where a rising main forms part of the sewerage system.

02.02 Unplasticized poly (vinyl chloride) structured wall pipes and fittings (PVC-U)

PVC pipes shall comply with the relevant requirements of SANS 1601 for stiffness Class 400 pipes and shall be fitted with approved spigot and socket joints with rubber seal rings. PVC products shall be stored out of the sun and must be backfilled as soon as practical after been laid.

02.03 Vitrified clay pipes and fittings

Vitrified clay pipes and fittings shall comply with the requirements of SANS 559.

All pipes with a diameter of 200 mm and smaller shall be plain-ended and joined with polypropylene couplings such as Vitro Hepsleve or an approved equivalent. Pipes exceeding 200 mm in diameter shall have spigot-and-socket ends with factory applied polyurethane joints, or shall be plain-ended with an approved fibreglass-type of coupling.

Notwithstanding the requirement for crushing strength given in SANS 559, all 375 mm diameter pipes shall have a crushing strength of at least 50 kN per metre of bearing surface and shall be marked accordingly.

02.04 Reinforced concrete pipes

Reinforced concrete pipes shall comply with the relevant requirements of SANS 677 for SI type spigot-and-socket D-load pipes and shall have been manufactured from dolomitic aggregate.

During the manufacturing process, each pipe shall be provided with a sacrificial layer of concrete to increase the minimum cover to the reinforcement as specified in SANS 677, with the following additional thicknesses:

(a) Pipes with a nominal diameter up to and including 1 500 mm - at least 15 mm;

(b) Pipes with a nominal diameter of 1 800 mm and over - at least 20 mm.

The sacrificial layer of concrete shall be ignored for the purpose of determining the strength of the pipe and the position of the reinforcement.

Pipes with elliptically placed reinforcement shall not be used.

Only rubber-ring joints as specified in subclause 02.09 below shall be used.

Additional to the marking requirements specified in SANS 677, the contract number shall be indelibly marked on each pipe at the factory.

The minimum wall thickness, including the additional cover stipulated above, shall be as follows for the different pipe diameters:

Nominal pipe diameter thickness (mm)	Minimum wall thickness (mm)
300	46
375	48
450	51
525	54
600	57
675	64
750	67
825	67
900	77
1050	83
1200	92
1350	95
1500	112
1800	133

Where required in terms of the Project Specifications, concrete pipes shall be factory-coated externally with an approved bitumen or epoxy.

02.05 Fibre-cement (FC) pipes and fittings

FC sewer pipes shall comply with the relevant requirements of SANS 819 and shall have suitable approved flexible joints. FC fittings shall have a crushing strength equal to or better than that of the pipes to which they are coupled and shall otherwise comply with the relevant requirements of SANS 819.

Fibre-cement pipes and fittings shall be factory-coated internally and externally with an approved bitumen or epoxy.

02.06 Cast-iron (Cl) pipes and fittings

Cast-iron pipes and fittings shall comply with the requirements of BS 78 and BS 2035 respectively. Pipes and fittings shall be class A and shall be factory-coated internally and externally with an approved bitumen or epoxy.

02.07 Steel pipes and fittings

Steel pipes and fittings shall be both lined and coated with a protective layer as specified in clause 05 of section 401.

Steel pipes shall comply with the requirements of SANS 719 for grade A or B pipes, as scheduled, whereas steel fittings shall comply with BS EN 10224.

Steel pipes shall be joined by using flanges, by welding or by using flexible couplings, all as specified in subclause 05.03 of section 402. Gaskets for flanges shall be of the full-face type, with the appropriate diameter, provided with bolt holes, and shall be made of virgin rubber and shall comply with the requirements of BS EN 681 Class WC.

02.08 Polyethylene (PE) pipes and fittings

PE pipes shall comply with the relevant requirements of SANS 4427 and shall be one of the following: PE80 PN16 SDR9, or PE63 PN12,5 SDR9. Pipes shall be joined together and to fittings by means of thermofusion carried out in accordance with the requirements of SANS 10268-1. The type of fittings and thermofusion to be used shall be specified on the Drawings or in the Project Specifications.

02.09 Rubber joint rings

Rubber joint rings shall comply with the relevant requirements of Part I of SANS 974-1 and shall not have more than one joint, which joint shall be positioned at the soffit of the pipeline.

03 MANHOLES

03.01 General

There are six types of standard manholes, the details and specifications of which are shown on the Drawings:

(a) Types I, MA and MB

These manholes are used in conjunction with sewer pipes with a diameter of 300 mm and smaller.

(b) Type III

This manhole is similar to types I, MA and MB but shall be constructed of precast concrete sections.

(c) Type Z

This manhole is used in conjunction with pipe diameters from 375 mm up to and including 600 mm and is constructed from cast in situ class 20/19 concrete. The roof slab is provided with a 225 mm diameter hole for the fitting of a ventilation pipe.

(d) Type Y

This manhole is similar to type Z, except that it is used on pipelines exceeding a diameter of 600 mm.

Manholes shall be provided with access shafts and/or step irons as shown on the Drawings or specified in the Project Specifications. Roof slabs and spacer slabs for cast in situ manholes may be precast on Site if the Contractor can satisfy the Engineer that he is capable of carrying out such work satisfactorily.

As types Y and Z manholes are not used at pipeline junctions, special manholes at such junctions will be specified in the Project Specifications and shown on the Drawings when necessary.

Non-standard structures such as manholes for in situ sewers, metering structures and inlet and outlet structures shall be constructed in accordance with the details shown on the Drawings and shall be measured and paid for under the applicable items of sections 202, 302, 702, 703, 704, 706 and 805.

03.02 In situ concrete

In situ concrete used in the construction of manholes and related structures shall conform to the relevant requirements of section 704. Only dolomitic aggregates shall be used. The dolomitic sand, however, may be blended with up to a maximum of 40% by mass of an approved pit sand.

In situ concrete used for the construction of pipe beddings and the concrete encasing of pipes shall also conform to the relevant requirements of section 704, except that dolomitic aggregates need not be used.

03.03 Precast concrete manhole sections and slabs

Precast concrete manhole sections and slabs shall comply with the relevant requirements of SANS 1294 and shall have been manufactured from dolomitic aggregate. Spun concrete chamber and shaft sections shall also comply with the requirements of SANS 677 for SI type pipes. Joints between cylindrical sections shall be of the interlocking self-centering type. The joints shall be sealed so as to be watertight in accordance with the Drawings.

The dimensions of the various sections and slabs shall be as shown on the Drawings.

03.04 Granolithic concrete

Granolithic concrete shall consist of 1 part CEM I strength class 32,5N Cement complying with SANS 50197-1, 1 part blended dolomitic sand and 2 parts of coarse dolomitic aggregate with a nominal size of 4,75 mm.

03.05 Mortar

Mortar for the bedding of prefabricated roof slabs and spacer slabs shall consist of 1 part of cement and 6 parts of blended dolomitic sand.

All mortar shall be prepared using CEM I strength class 32,5N Cement complying with SANS 50197-1, unless otherwise specified, and shall be used within 30 minutes of being prepared.

03.06 Soilcrete

Soilcrete, where specified, shall be prepared as described in clause 12 of section 202.

04 ACCESSORIES

04.01 Manhole covers and frames

Manhole covers and frames shall be of the type as scheduled or as shown on the Drawings.

Cast-iron manhole covers and frames shall comply with the relevant requirements of SANS 558, and all surfaces not embedded in concrete shall receive two coats of epoxy-tar paint. The types of covers and frames shall be type 2A or type 4 as scheduled or as shown on the Drawings.

Precast concrete manhole covers will be scheduled for use either with precast concrete frames or with types 2 A and 4 cast-iron manhole cover frames. Concrete manhole covers and frames shall be of approved manufacture and capable of carrying the same load as their cast-iron counterparts.

04.02 Step irons

Step irons, shall comply with the requirements for malleable cast-iron step irons of BS EN 13101, or shall be of the type as shown on the Drawings or specified in the Project Specifications.

04.03 Ventilation pipes

Ventilation pipes shall be manufactured of steel pipes complying with the requirements of SANS 719 for grade A pipes in accordance with the details shown on the Drawings. The flange, welded onto the lower end, shall be drilled in accordance with SANS 1123, Table 1600.

The upper end of the pipe shall be closed by means of a rodent-proof cap in accordance with the details shown on the Drawings.

The pipe shall be fixed to the roof slab by means of eight 16 mm diameter, grade 304, stainless-steel bolts cast into the roof slab.

Where no ventilation pipe is fitted over the manhole, the hole in the roof slab shall be covered by a 10 mm thick, 368 mm square plate of Grade A steel, conforming to the requirements of SANS 719, bedded on 1:6 mortar and firmly bolted down. The steel plate shall be painted all over with two coats of epoxy tar.

04.04 Lamp holes

Lamp holes shall be constructed to details as shown on the Drawings and shall be fitted with a cast-iron lamphole cover and frame and an access bend connector (ABC).

Cast-iron covers and frames shall comply with the relevant requirements of SANS 558, and all surfaces not embedded in concrete shall receive two coats of expoxy-tar paint.

Precast concrete covers will be scheduled for use either with precast concrete frames or with cast-iron cover frames. Concrete covers and frames shall be of approved manufacture and capable of carrying the same load as their cast-iron counterparts.

04.05 Marker blocks

Marker blocks indicating the positions of house connections shall be constructed in accordance with the details shown on the Drawings.

04.06 Epoxy-tar paint

Epoxy-tar paint used for protecting metal surfaces, where specified, shall conform to the requirements of SANS 801 type III and shall be applied in two coats with a total dry thickness of 0,460 mm.

05 HANDLING AND STORAGE

The method of handling pipes and other items will depend on the material from which the item is made or with which the item is coated. Light-sensitive items as well as items prone to weathering shall be stored under cover. The manufacturer's instructions regarding the handling and storage of their products shall, where applicable, be strictly adhered to and copies of such instructions shall be supplied to the Engineer before any such item is despatched to the Site.

Concrete pipes however shall, irrespective of the manufacturer, be handled and stored as set out in the latest issue of the Concrete Pipe Handbook issued by the Concrete Manufacturers Association, unless otherwise directed by the Engineer.

Should the Engineer consider that any pipes or components are being handled, stacked, stored or transported in such a way that damage, deterioration or contamination is liable to occur, he may instruct the Contractor to adapt the method used, or to take specific precautions without the Contractor being entitled to any additional payment.

Unless otherwise specified, no separate payment shall be made for taking delivery of, or for handling, storing, stacking, transporting, protecting, etc, pipes and components or materials, and allowance must be made (in the rates tendered for pipe-laying) for all labour, plant and equipment required for such work during the validity of the Contract.

06 MEASUREMENT AND PAYMENT

Except where pay items are provided for certain materials, no separate measurement and payment shall be made for materials, the cost of which shall be included in the appropriate tendered rates of section 302.

SERIES 3 : SEWERS

SECTION 302 : CONSTRUCTION

CONTENTS

01 SCOPE

This section covers the construction of sewers, house connections, manholes, etc, (excluding sewer rising mains) to the details shown on the Drawings and with the use of materials conforming to the appropriate requirements as set out in section 301. Sewer rising mains shall be constructed in accordance with the requirements of section 402.

02 EXCAVATION

The excavation of trenches and the preparation of trench bottoms as well as the excavation for manholes, house connections, etc, shall be carried out as specified in section 202 and shall be approved by the Engineer before any pipe-bedding and pipe laying is carried out or house connections, and manholes are constructed.

The minimum trench widths, shall be as specified in section 202, and any variations to specified widths may only be effected with the written approval of the Engineer before excavation commences.

Where pipes are to be encased in concrete or soilcrete, the trench width shall be determined either by the width of encasing as shown on the Drawings, or by the Engineer on Site.

The Engineer will have the power to limit the length of excavation preceding the pipe-laying activities as well as the length of pipeline laid ahead of the backfilling.

Excavations for manholes shall be 1 200 mm wider than the outer diameter of the manhole barrel to provide a working space of 600 mm around the circumference of the manhole.

03 PIPE BEDDING

Pipe beddings shall be properly designed for the specific application in accordance with SANS 10102 parts 1 and 2.

The various types and applications of beddings are as shown and specified on the Drawings.

03.01 Types I and II beddings

These beddings consist of zero slump 1:3:6/19 concrete which is placed and consolidated by hand. Aggregates smaller than 19 mm may be used with the written approval of the Engineer.

03.02 Class A bedding

This class of bedding shall be of cast in situ concrete in accordance with SANS 10102-2. The dimensions of the bedding are shown on the Drawings.

Vertical joints, details of which are shown on the Drawings, shall be provided in the concrete bedding to coincide with the flexible joints in the pipeline. Concreting between joints shall be carried out in one continuous operation using class 20/19 concrete.

03.03 Class B bedding

This class of bedding shall be of an approved selected gravel material with a PI not exceeding 6, which is free from stones exceeding 20 mm, organic matter and lumps of clay.

The bedding material shall be compacted to 90% of modified AASHTO density.

04 LAYING OF PIPES

Each pipe and fitting shall be thoroughly cleaned out and carefully examined for damage and defects immediately before laying. The onus for detecting damaged and defective pipes and fittings before installation shall be on the Contractor. Should any damaged or defective pipe or fitting be found in the sewer after it has been laid, it shall be removed and replaced at the Contractor's expense.

Pipes shall be laid on the specified bedding according to approved methods to ensure trueness to line and level and in such a manner that the barrels of pipes bear evenly on the bedding over their full length.

Unless otherwise indicated in the Project Specifications or on the Drawings, sewers shall be laid straight between adjacent manholes and also along the centre line of the trench.

Unless otherwise ordered or authorized by the Engineer, pipe-laying shall commence at the lower end of each section of pipeline. Spigot-and-socket pipes shall be placed with the socket facing upstream. Pipes shall be laid and jointed strictly in accordance with the manufacturer's instructions and a badger or other suitable device shall be drawn through all pipes smaller than 600 mm in diameter as the laying proceeds. Pipes of 600 mm in diameter and larger shall be kept clean on the inside by the pipes being swept by hand as laying progresses. The open ends of the pipelines shall be closed by means of approved plugs at all times when laying is not in progress.

Except in the case of class A beddings, the pipes and fittings shall be placed on the bedding material, and the bedding shall be completed by the placing and tamping of additional concrete or gravel, as the case may be, into place to the shape and dimensions as shown on the Drawings. Care shall be taken to ensure that the haunches of the pipes are fully supported.

For class A beddings, the pipes shall first be placed in position by using suitable approved precast concrete spacers or cradles and also timber wedges. The pipes shall then be tested and the concrete placed, and care shall be taken to fill all voids, and to prevent any movement or flotation of the line.

Vertical joints, the details of which are shown on the Drawings, shall be provided in the concrete of type II and class A beddings to coincide with the flexible joints in the pipeline.

During all pipe-laying and bedding operations care shall be taken to prevent the entry of any dirt or concrete into the flexible pipe joints by sealing the joint with clay or by other approved means.

05 ENCASING OF PIPES

Where shown on the Drawings or where ordered by the Engineer, pipes shall be fully encased in class 20/19 concrete to the dimensions as shown on the Drawings or as ordered by the Engineer. During concreting, pipes shall be supported near their ends on suitable pedestals and strapped down where necessary to prevent uplifting. All spaces under and around the pipes shall be properly filled with concrete.

Vertical joints shall be provided in the concrete to coincide with the flexible joints in the pipeline. Concreting between joints shall be carried out in one continuous operation.

Care must be taken to seal the flexible joint with clay to prevent concrete from entering the joint.

The encasing of pipes shall be carried out only after the pipeline has been tested and approved.

06 HOUSE CONNECTIONS

House connections shall be constructed as shown and specified on the Drawings.

The requirements specified herein for the construction of sewers shall apply mutatis mutandis in respect of the construction of house connections.

07 MANHOLES

Manholes shall be constructed to details shown on the Drawings. All cast in situ concrete shall be class 20/19.

After the manhole foundation slab has been cast, the semi-circular channels and fittings suitable for the type of pipe laid shall be placed in position and embedded in the concrete benching. The sockets of channels and the space between two abutting channels shall be filled with a 1:1 cement:sand mortar well worked in, and all joints shall be neatly finished off. Where standard channels and fittings cannot be used and where they are not available for the size or type of pipe used, the Contractor shall form the channels in class 20/19 concrete.

The cast in situ channelling and benching in manholes and adjoining culverts shall, where applicable, be rendered in 25 mm thick granolithic concrete and finished smooth and true with a steel trowel and rounded at corners and edges. The benching shall be taken to 25 mm above the highest pipe soffit.

Pipes entering manholes shall be cast into position in the benching in order to ensure a watertight joint between the pipe and the manhole. Caulking will only be allowed where a pipe is built into an existing manhole. Short lengths of concrete pipe that have been cut on Site shall only be used for casting into position in the benching.

The walls of cast in situ manholes shall be constructed in lifts not exceeding 1,5 m and the first construction joint shall be 50 mm above the highest pipe soffit. The starting ring of precast concrete manholes shall be placed on the concrete foundation and the joint shall be made watertight with granolithic rendering as shown on the Drawings.

All joints between factory units shall be keyed and shall be made watertight as described in subclause 03.03 of section 301.

The pipes built into manholes or into the culverts adjoining large manholes, shall be encased in concrete after the walls have been completed, and the sewer shall be so jointed to the pipes as to produce a flexible joint on each side of each manhole or culvert, as shown on the Drawings.

Roof slabs and spacer slabs may be precast slabs of class 20/19 concrete and shall be bedded on a 1:6 cement: sand mortar.

Manhole frames shall be bedded in a 1:3 cement:sand mortar and finished off with a reinforced concrete surround in accordance with the Drawings.

08 MARKERS

The marker blocks shall be placed after completion of the pipework and trimming of the area where the marker block is to be installed. Marker blocks shall be constructed in accordance with the details shown on the Drawings.

09 CLEANING EYES

Cleaning eyes shall be constructed in the positions and to the details shown and specified on the Drawings.

10 RAMPS

Ramps shall only be allowed under special circumstances with the written permission of the General Manager: Water and Sanitation.

11 BACKFILLING

No backfilling shall be carried out until authorized by the Engineer.

After a pipeline has been laid, tested and approved, the trench shall be partly backfilled (with hand implements), to a height of 300 mm above the top of the pipe barrel, with suitable selected backfill material free from stones exceeding 20 mm, organic matter and lumps of clay exceeding 75 mm, but which contains sufficient fine material to ensure a densely graded, well-compacted backfill. Backfilling around and over the pipeline shall be in layers not exceeding 100 mm compacted thickness.

Backfilling shall be carried out simultaneously and equally on both sides of the sewer to avoid unequal forces from being exerted.

Should suitable material be not available from the excavation of the trench which is being backfilled, the Contractor shall obtain suitable material from other excavations on the Site. In the event of suitable material being not available on the Site, the Contractor shall screen excavated material using a sieve with 20 mm clear openings but, if the latter method is impracticable, the Engineer may order the Contractor to import suitable material. Separate pay items are provided in the Schedule of Quantities for the screening of excavated material and for obtaining suitable material from other sources.

In respect of backfill material obtained from sources provided by the Contractor, the provisions of clause 05(f) of section 201 are applicable.

Selected backfill material shall be compacted at an optimum moisture content to at least 90% of modified AASHTO density.

Where pipes are encased in concrete, backfilling with selected material can proceed as soon as the concrete has, in the opinion of the Engineer, attained sufficient strength and the thickness of backfilling shall be reduced by the thickness of the encasement.

When backfilling to the prescribed height above the pipes or encasing has been completed and approved, the balance of the trench shall be backfilled as specified in clause 13 of section 202.

The material and method of compaction used for backfilling around manholes, cleaning eyes and vertical house connections shall be subject to the same requirements as specified in respect of pipe trenches, except that the entire backfilling process shall be carried out using selected material. Backfilling in layers shall proceed simultaneously around the whole circumference of the manhole, cleaning eye or house connection and payment for such backfilling shall be included in the rates tendered for the pay items for the construction of manholes, cleaning eyes and house connections.

12 CONNECTION TO EXISTING NETWORK

Wherever a new sewerage system joins up with an existing network, the Contractor shall timeously notify the Engineer as to when he intends to construct the connection and he may carry out this work only with the written permission of the Engineer and only under the supervision of the Employer.

Where connecting to an existing network is done at an existing manhole, payment for the connection will be made under item 302.16. However, where the connection is to be made at a point along the pipe between two manholes, a new manhole shall be constructed and payment will be made as follows:

- excavation, under items 202.01, 202.02 and 202.03 of section 202;
- breaking into the existing pipeline, accommodating existing flow and other preliminary work, under item 302.20 of this section; and
- building the manhole, under items 302.09, 302.10 and 302.11 of this section.

13 TOLERANCES

Permissible tolerance limits shall be as follows for pipelines and manholes:

Plan : maximum deviation	25 mm
Invert level:	± 5 mm

14 MEASUREMENT AND PAYMENT

Note:

Reference shall be made to the last paragraph of clause 02 of section 202 regarding payment for work carried out under this section.

Item		Unit
302.01	**Supplying, laying and jointing of sewer pipes irrespective of depth or width of trench:**	
302.01.01	For type and class of pipe (state diameter, and type of coupling)	metre (m)
302.01.02	Etc for different diameters, types and classes of pipes and types of couplings	

The unit of measurement shall be the metre of each size and type of pipe supplied, laid, jointed and approved, measured in the case of sewers with a diameter equal to or less than 600 mm, from centre to centre of adjacent manholes, or from the ends of ramps, cleaning eyes and stop ends, and, in the case of sewers exceeding 600 mm in diameter, between the internal faces of the walls of manholes or the internal ends of the culverts. No deductions will be made for any fittings laid in the lines as these will be paid for as extra over to the pipes.

The testing of pipes will be paid for under section 303.

The tendered rates shall also include full compensation for the cutting of pipes, the provision of short sections of pipes at manholes, the provision and installation of jointing material and for all work and incidentals required to complete the work as specified and as shown on the Drawings.

This pay item shall also apply to the construction of 100 mm diameter straight pipes used in the construction of sloping house connections (types 2 and 3), house connections from manholes (type 5), and for the straight pipework from all house connections to the erf boundaries.

Item		Unit
302.02	**Constructing of pipe beddings**	
302.02.01	(State type or class of bedding)	
302.02.01.01	(Diameter of pipe stated)	metre (m)
302.02.01.02	Etc for other pipe diameters	
302.02.02	Etc for other types and classes of bedding	

The unit of measurement shall be the metre of bedding provided for the different pipe diameters as specified and in accordance with the Drawings.

The tendered rates shall also include full compensation for formwork and for constructing the joints in the concrete bedding where they apply, to the details as shown on the Drawings.

Item		Unit
302.03	**Concrete encasing of pipes**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of encasement provided to dimensions shown on the Drawings when ordered by the Engineer in writing or when specified.

The tendered rate shall also include full compensation for formwork and for constructing the joints in the concrete encasement to the details as shown on the Drawings.

The concrete encasement of vertical house connections and cleaning eyes shall be measured and paid for under items 302.06 and 302.07 and the concrete encasement of the short pipes cast into manhole or adjoining culvert foundations shall be included in the rates tendered for manholes and culverts.

Item		Unit
302.04	**Extra over Item 302.01 for supplying, installing and jointing with an approved method of coupling the following pipe fittings in the main sewer lines** (type specified)	
302.04.01	Branch junctions:	
302.04.01.01	100 mm dia off 150 mm dia	number (No)

302.04.01.02	Etc for other sizes of junctions	
302.04.02	Reducers:	
302.04.02.01	150 mm dia x 100 mm dia	number (No)
302.04.02.02	Etc for other sizes of reducers	
302.04.03	Stoppers:	
302.04.03.01	100 mm dia (type)	number (No)
302.04.03.02	Etc for other sizes and types of stoppers	
302.04.04	Etc for other fittings	

The unit of measurement for supplying, installing and jointing fittings shall be the number of each type of fitting installed, and approved in accordance with the Drawings and Specifications.

The tendered rates shall be extra over the rates for item 302.01 and shall include full compensation for all extra costs involved in carrying out the work as specified. Distinction shall be made between different sizes of fittings.

This payment item shall also apply to fittings laid in the main sewer lines for house connections, stop ends and cleaning eyes.

Item		Unit
302.05	**Supplying, laying and jointing with an approved method of coupling, 100 mm dia vitrified clay bends for house connections**	
302.05.01	22,5° bends	number (No)
302.05.02	45° bends	number (No)

The unit of measurement shall be the number of 22,5° and 45° bends installed for sloping house connections in accordance with the Drawings, as well as the number of each type of bend installed additional to those shown on the Drawings for any type of house connection.

The tendered rates shall include full compensation for all work and incidentals required for supplying and installing bends in positions as shown on the Drawings or as determined by the Engineer on Site.

Item		Unit
302.06	**Construction of vertical house connections**	
302.06.01	Type 1 house connections:	
302.06.01.01	Up to but not exceeding 1,5 m in depth	number (No)
302.06.01.02	Exceeding 1,5 m but not exceeding 2,0 m in depth	number (No)
302.06.01.03	Etc for various depths in depth increments of 0,5 m	
302.06.02	Type 4 house connections:	
302.06.02.01	Etc for depth increments as for 302.06.01 above	

The unit of measurement shall be the number of vertical house connections constructed to various depths. For payment purposes the depths shall be measured from the socket of the junction in the main sewer to the top of the lamphole cover in the case of type 4 house connections, and to the stopper in the case of type 1 house connections.

The tendered rates shall include full compensation for the supply and installation of vertical 100 mm dia pipes, two 100 mm dia 45° bends, one 100 mm dia x 100 mm dia junction, a stopper or an access bend connector (ABC) with lamphole cover and frame, as well as for concrete bedding and encasing, including formwork, and backfilling with selected material and for all labour and equipment necessary to complete the work as specified on the Drawings.

Excavation shall be paid for under item 202.04 of section 202.

Item		Unit
302.07	**Construction of cleaning eyes**	
302.07.01	Up to but not exceeding 1,5 m in depth	number (No)
302.07.02	Exceeding 1,5 m but not exceeding 2,0 m in depth	number (No)
302.07.03	Etc for various depths in depth increments of 0,5 m	

The unit of measurement shall be the number of cleaning eyes constructed to various depths complete, in accordance with the Drawings. For payment purposes, the depths shall be measured from the socket of the bend to the top of the lamphole cover.

The tendered rates shall include full compensation for the supply and installation of the vertical 150 mm dia pipes, the access bend connector (ABC) with lamphole cover and frame, as well as for encasing the bend in concrete, including formwork, and for backfilling the cleaning eye with selected material.

Excavation shall be paid for under item 202.01 of section 202.

Item		Unit
302.08	**Marker blocks**	number (No)

The unit of measurement shall be the number of marker blocks installed.

The tendered rate shall include full compensation for all labour, equipment and material necessary for installing the marker blocks in accordance with the Drawings.

Item		Unit
302.09	**Construction of manholes, up to 1,0 m deep**	
302.09.01	For sewers 300 mm in diameter and smaller	
302.09.01.01	(Type of manhole stated)	number (No)
302.09.01.02	Etc for other types of manholes	
302.09.02	For sewers with diameters exceeding 300 mm	
302.09.02.01	(Type of manhole stated)	number (No)
302.09.02.02	Etc for other types of manholes	

The unit of measurement for the construction of manholes shall be the number of each type of manhole constructed (irrespective the angles of deflection, where these apply) for different pipe diameter ranges and up to 1,0 m deep, complete, as shown on the Drawings and as specified. The depth of manhole shall be measured from the top of the manhole cover to the invert of the channel in the centre of the manhole.

The tendered rates for the construction of manholes shall also include full compensation for encasing in concrete the sections of the pipes cast into the manhole and for backfilling around the manhole with selected material.

Item		Unit
302.10	**Extra over item 302.09 for the construction of manholes in excess of 1,0 m deep**	
302.10.01	For sewers 300 mm in diameter and smaller	
302.10.01.01	(Type of manhole stated)	metre (m)
302.10.01.02	Etc for other types of manholes	
302.10.02	For sewers with diameters exceeding 300 mm	
302.10.02.01	(Type of manhole stated)	metre (m)
302.10.02.02	Etc for other types of manholes	

The unit of measurement shall be the metre of each type of manhole constructed in excess of 1,0 m deep, measured to the nearest 0,1 m.

The tendered rates shall be paid as an extra over the rates tendered for item 302.09 and shall include full compensation for the cost of labour, plant and materials required to construct and backfill with selected material, each additional metre depth of manhole.

Item		Unit
302.11	**Construction of culverts adjoining manholes**	
302.11.01	(Pipe diameter stated)	meter (m)
302.11.02	Etc for other diameters	

The unit of measurement shall be the metre length of culvert constructed on each side of the manhole, measured along the centre line of the culvert from the outside face of the manhole wall to the internal end of the culvert for the different pipe diameters, irrespective of the depth of the adjoining manhole and of whether the culvert is straight or curved.

The tendered rates shall include full compensation for the building-in of pipe ends into the culvert, for the encasing of the short sections of pipe, but excluding their provision, for construction of the channelling, including the granolithic concrete finish, for all reinforcement, for permanent and temporary formwork, for backfilling with selected materials, and for all labour, equipment and incidentals necessary for completing the work as specified and in accordance with the Drawings.

Short pipes built into culverts shall be paid for under item 302.01 and excavations outside normal trench widths shall be paid for under item 202.03 of section 202.

Item		Unit
302.12	**Supplying and installing manhole covers and frames**	
302.12.01	SANS 558 Type 4 circular	number (No)
302.12.02	SANS 558 Type 2A circular	number (No)
302.12.03	Precast concrete cover with type 2A CI frame	number (No)
302.12.04	Precast concrete cover with type 4 CI frame	number (No)
302.12.05	Precast concrete cover with precast concrete frame:	
302.12.05.01	(Type stated)	number (No)
302.12.05.02	Etc for other types	

The unit of measurement shall be the number of each type of manhole cover and frame installed.

The tendered rates shall include full compensation for supplying and installing the covers and frames and for the cost of all labour, equipment and appurtenant materials required to carry out the work.

Item		Unit
302.13	**Extra over item 302.09 for the construction of house connections from manholes**	
302.13.01	One-house connections	number (No)
302.13.02	Two-house connections	number (No)

The unit of measurement shall be the number of single or double house connections installed from manholes in accordance with the Drawings.

The tendered rates shall be extra over the rates tendered for item 302.09 and shall include full compensation for additional excavations, for the supply and installation of additional channels, for the modification of the standard benching to suit the additional channels, for additional concrete encasing, for additional backfilling, and for all extra costs involved for carrying out the work as specified and in accordance with the Drawings.

Item		Unit
302.14	**Supplying and placing selected backfill material around and up to 300 mm above pipe barrels using**	
302.14.01	Excavated material	cubic metre (m^3)
302.14.02	Imported material	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material placed around and up to 300 mm above pipe barrels. Where pipes are encased, the thickness of the backfill material shall be reduced by the thickness of the encasement. The quantity shall be calculated from the authorized dimensions of the backfill. The volume of the pipe and encasing shall be subtracted when calculating the volume of the backfill.

The tendered rates shall include full compensation for excavating and loading the material from approved borrow areas, or alternatively for loading approved material previously excavated from trenches and other excavations, transporting it to where required, and for off-loading, placing and compacting the material.

Material shall be imported only on the instructions of the Engineer, and overhaul shall apply when imported material is obtained from sources not provided by the Contractor and which lie outside the free-haul boundaries.

Item		Unit
302.15	**Extra over subitem 302.14.01 for screening material**	cubic metre (m^3)

The extra over rate shall include full compensation for the additional handling and transport necessary, for screening excavated material and for disposing of the material screened out.

Screening of material will only be paid for if ordered by the Engineer in writing.

Item		Unit
302.16	**Connecting to existing manholes**	
302.16.01	(Pipe size, type, grade or class indicated)	number (No)
302.16.02	Etc for other pipes	

The unit of measurement shall be the number of each size of pipe built into existing manholes.

The tendered rates shall include full compensation for the supply of all labour, plant and materials, for carrying out the necessary excavations, for breaking into existing manholes for new connections, for fitting new pipes into the newly formed access, for sealing around the pipes and making them watertight, for breaking out the existing benching and channelling where required and the reconstruction thereof complete with granolithic concrete rendering to suit the new pipe arrangement, for disposal of all debris to a dumping site and for backfilling around the manhole with selected material.

The tendered rate shall also include for dealing with the sewage flow in the existing manholes during construction and for any additional costs should the work have to be carried out at night or during non-working days.

Item		Unit
302.17	**Construction of anchor blocks on steep grades**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of concrete used.

The tendered rate shall include full compensation for excavations, shuttering, concrete, backfilling, the disposal of surplus excavated material as well as all labour, plant and other materials necessary to complete the blocks to the dimensions and in positions shown on the Drawings.

Item		Unit
302.18	**Raising or lowering of existing manholes:**	
302.18.01	(Type of manhole stated)	
302.18.01.01	Raised/lowered up to 0,5 m	number (No)
302.18.01.02	Raised/lowered exceeding 0,5 m but not exceeding 1,0 m	number (No)
302.18.01.03	Etc in increments of 0,5 m	
302.18.02	Etc for other types of manholes	

The unit of measurement shall be the number of manholes raised or lowered.

The tendered rates shall include full compensation for removing the cover and frame, demolishing the top of the manhole if required, providing materials and labour for rebuilding the manhole to the designated new level, setting and grouting the cover and frame to the correct level, and disposing of debris and surplus material.

Item		Unit
302.19	**Supplying and installing ventilation pipes**	number (No)

The unit of measurement shall be the number of ventilation pipes installed where specified and in accordance with the Drawings.

The tendered rate shall also include full compensation for carrying out all work as specified in subclause 04.03 of section 301.

Item		Unit
302.20	**Preliminary work prior to the construction of a manhole on an existing pipeline**	
302.20.01	(Diameter and description of existing pipe)	number (No)
302.20.02	Etc for other pipes	

The unit of measurement shall be the number of manhole positions where preliminary work has been carried out. A distinction shall be made between the different sizes and types of existing pipelines.

The tendered rates shall include full compensation for the supply of all labour, equipment and materials, for neatly cutting through the existing pipe and concrete encasing or bedding, for removal of the necessary length of pipe together with its concrete encasing or bedding, for accommodating the existing sewage flow, for disposal of all debris to a dumping site, for any additional costs should the work have to be carried out at night or during non-working days and for the cost of any appurtenant work not provided for under items 302.09, 302.10 and 302.11.

Item		Unit
302.21	**Extra over subitem 302.14.02 for using material obtained from sources provided by the Contractor**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material provided and placed.

The tendered rate shall be in full compensation for the additional cost of paying any royalties or charges for procuring the material from sources provided by the Contractor as well as for transporting the material from where obtained to where used on the Site.

Item		Unit
302.22	**Building pipes into concrete work**	
302.22.01	Pipes supplied and installed by the Contractor (irrespective of type)	
302.22.01.01	(State diameter of pipe)	number (No)
302.22.01.02	(Etc. for other diameters)	number (No)

The unit of measurement shall be the number of pipes built into the concrete work as shown on the Drawings.

The tendered rate shall include full compensation for supplying all materials (wet to dry epoxy in the case of casting new concrete against the faces of old concrete) concreting in the pipes, cutting and placing formwork to fit around pipes and neatly finished to conform to a class F2 surface finish.

Where necessary the rate shall also include for holding the pipe in position and aligning the pipes to the correct levels as indicated on the Drawings or as ordered by the Engineer.

Note:

The following items of work, when specified, shall be carried out, measured and paid for in accordance with the relevant sections of the Specifications, but shall be listed under this section of the Schedule of Quantities.

Item		**Applicable section**
(a)	Overhaul on selected material	103
(b)	Excess overburden at borrow pits provided by the Employer	201

SERIES 3 : SEWERS

SECTION 303 : TESTING

CONTENTS

01 SCOPE

This section covers the various tests to which sewerage systems shall be subjected as the work progresses.

02 GENERAL

When the Contractor considers any section of the sewerage system to be ready for testing, he shall timeously advise the Engineer of his intention to carry out the appropriate test and arrange a time therefore with the Engineer.

All tests shall be carried out in the presence of the Engineer, and the Contractor shall provide all labour, equipment and material (including water) that may be required for carrying out the tests.

Should any portion of the work fail to pass a test, the fault or faults shall be made good by the Contractor at his own expense according to methods approved by the Engineer. After repairs have been completed, the work shall be tested again at the Contractor's own expense until finally approved.

Where a manhole or pipeline passes a test but visual or other defects are still apparent, these defects shall be repaired before the section of work will be accepted.

03 TESTING OF MANHOLES

Manholes shall, on completion and before backfilling, be tested by the Contractor for watertightness by completely filling the manhole with water up to the underside of the manhole cover frame after pipes leading from manholes have been closed off for the test.

The manhole shall be allowed to stand for one hour to allow initial absorption to take place, after which the water shall be topped up if necessary. After topping up, the water level shall not drop by more than 20 mm in one hour.

The Contractor shall be responsible for the disposal of the water used in the test by pumping or other approved means.

The Engineer reserves the right to determine whether or not each and every manhole shall be tested. Should it be decided not to test all manholes, the Engineer will determine which of the manholes shall be tested.

04 TESTING OF SEWERS

Sewers with a 375 mm diameter and less shall be visually inspected by means of handheld mirrors before the pipes are backfilled, and again on completion of the backfilling. Sewers shall be tested in sections between manholes after the section being tested has been isolated from other sections by means of suitable plugs or stoppers that have been adequately braced.

Should house connections, cleaning eyes and stop ends form part of the section being tested, they shall be tested together with the section.

All sections of pipeline of 900 mm diameter and smaller shall be tested twice: the first time after the pipes have been laid and visually inspected (with the use of mirrors where appropriate), and before the bedding or encasement is completed, and the second time, in the case of bedded pipes, after the bedding has been completed and the trenches have been backfilled to 300 mm above the tops of the pipes, and, in the case of encased pipes, after the encasement has been completed.

All pipelines of 900 mm diameter and smaller shall be tested by conducting the air test. Should a section of the pipeline fail the air test, the Contractor may, if he so wishes, apply the water test entirely at his own expense whether such water test is successful or not.

04.01 Air test

The air test consists of pumping air into the pipeline or portion thereof until a specified pressure is reached, and then measuring the time it takes for the pressure to drop from one pressure level to a lower level.

Under no circumstances shall the Eclipse or equivalent air-test apparatus be used.

The apparatus to be used for the air test, (see the CSIR's NBRI publication X/BOU 2-34 for a diagram of the apparatus) should be shielded from the direct rays of the sun when in use, is commercially available and consists of the following:

(a) An air compressor or blower of adequate capacity.

(b) A flexible 50 mm diameter pipe, approximately 10 m in length, with a standard sewer-testing plug with an appropriate diameter at one end, which is connected to the compressor or blower outlet at the other end. A suitable stop valve must be inserted on the 50 mm dia pipe between the blower or compressor and the plug.

(c) A Bourdon tube type pressure gauge connected by a 6 mm OD rubber or plastic tube to a copper pipe which passes through the sewer-plug connection into the pipeline under test.

(d) A stopwatch.

The testing procedure shall consist of the following sequence of operations:

- The sewer-testing plug attached to the testing apparatus shall be inserted in one end of the sewer and the other end and any other openings shall be plugged off.
- The stop valve in the blower tube shall be opened and the blower set in operation, the throttle being adjusted until the pressure in the sewer is kept constant at about 380 mm water gauge (3,80 kPa).
- After two minutes at this pressure, the stop valve shall be shut off sharply. At the same time the stopwatch must be kept in readiness and the pressure gauge carefully watched in case of a rapid pressure drop. The time taken for the pressure to drop from 250 mm to 125 mm water gauge (2,5 to 1,25 kPa) shall not be less than the value of T (in seconds) determined as follows:

For pipelines of which the internal surface area is less than or equal to 58 m^2, the value of T shall be determined by the formula:

$$T = 1\,181{,}0\ D$$

and where the internal surface area exceeds 58 m^2, by the formula:

$$T = 63{,}973\ D^2L$$

Where D = internal pipe diameter, in metres

L = length of pipe tested, in metres

T = time in seconds.

04.02 Watertest

The test shall be conducted by closing the pipe at the lower manhole and by slowly filling the pipeline and the upper manhole with water until the depth of water in the manhole is 1,5 m.

Should the upper manhole be less than 1,5 m deep, the Contractor may use an approved apparatus to raise the water pressure in the pipeline, measured at the highest point, to 15 kPa. Should the difference in invert levels between the lower and the higher manholes of the section to be tested exceed 3,5 m, the water test shall not be conducted.

After a period of at least 10 minutes to allow initial absorption to take place, the loss of water over the next 30 minutes shall be noted. The amount of water lost shall not exceed 0,34 litres per 10 mm internal pipe diameter per 100 metres of pipeline per hour.

04.03 Camera Inspection

Sewers shall be inspected by means of a Closed Circuit Television (CCTV) Camera on completion of the backfill and manhole construction.

The inspection shall be conducted by inspecting the pipe with a CCTV Camera equipped with inclinometers so that a pipeline profile can be produced.

The Contractor shall provide the Engineer with a written report, a pipeline profile as well as an electronic report of the pipeline in .pdb format.

Any sewer pipeline not meeting the tolerances specified in clause 13 of section 302 shall be made good by the Contractor, at his own expense, with methods approved by the Engineer.

05 MEASUREMENT AND PAYMENT

Item		Unit
303.01	**Testing of manholes**	number (No)

The unit of measurement shall be the number of manholes tested and passed, irrespective of the depth and type of manhole.

The tendered rate shall include full compensation for all labour, plant and materials necessary, including the supply and disposal of water, for carrying out the tests as specified in clause 03 of this section.

Item		Unit
303.02	**Air testing of sewers**	
303.02.01	(Pipe diameter stated)	metre (m)
303.02.02	Etc. for other diameters	

The unit of measurement shall be the metre of each diameter of sewer tested and which has passed the air test.

The tendered rates shall include full compensation for the provision of all labour and materials required for the provision, installation, calibration and operation of the equipment used for testing, for testing the pipelines twice, as well as for visual inspections, all as specified in clause 04 of this section.

Item		Unit
303.03	**CCTV Camera Inspection**	
303.03.01	(Pipe diameter stated)	metre (m)
303.03.02	Etc. for other diameters	

The unit of measurement shall be the metre of each diameter of sewer inspected by CCTV Camera and which has met the tolerances specified in clause 13 of section 302.

The tendered rates shall include full compensation for the provision of all labour and materials required for the provision, installation, calibration and operation of the equipment used for inspecting the pipeline, the provision of a written report, pipeline profile and an electronic report of the pipeline in .pdb format.

SERIES 4 : WATER RETICULATION AND WATER MAINS

SECTION 401: MATERIALS

CONTENTS

01 SCOPE

This section covers the materials to be used in connection with the construction of water reticulation networks, pipelines and service connections operating under pressure.

The requirements for materials as set out in this section shall also apply to pumping mains forming part of sewerage systems.

02 DEFINITIONS

For the purpose of this series, the following definitions shall apply:

(a) Fittings

Standard accessories available ex stock, such as bends, crosses, tees, plugs, flanges, sockets, adaptors, reducers, couplings, elbows, saddles, etc.

(b) Specials

Any of the accessories mentioned in (a) above which are purpose-made for a specific project or for use in conjunction with large-diameter pipes.

03 ABBREVIATIONS

For the purpose of this series, the following abbreviations shall apply:

CI	Cast iron
CID	Constant inner diameter
COD	Constant outer diameter
GMS	Galvanized mild steel
PE	Polyethylene
PVC	Poly (vinyl chloride)

04 PIPES, FITTINGS AND SPECIALS

04.01 General

All pipes and fittings shall be marked with the manufacturer's name, the grade, type or class, the SANS standardization mark where applicable, and any other markings that may be required in terms of this section.

Pipes shall be supplied in standard lengths unless otherwise shown on the Drawings.

Specials shall be fabricated to the details shown on the Drawings, using, where applicable, the same materials, welding procedures and protective linings and coatings as are specified for the corresponding straight pipes.

Satisfactory temporary end covers shall be provided for the protection of threads, flanges and the prepared ends of pipes, fittings and specials, and for the prevention of damage to internal linings during transportation and during handling on Site.

Pipe diameters other than those specified in this section shall only be used if prior written approval is obtained from the General Manager Water and Sanitation.

Galvanized steel pipes or fittings may be used for underground water pipelines provided that prior written approval is obtained from the General Manager Water and Sanitation. GMS pipes and fittings below ground shall be protected against corrosion as specified in the Project Specifications.

All pipelines shall be positioned in accordance with the Project Specifications or as shown on the Drawings.

A minimum cover of 1,0 m over pipelines shall be maintained under roads and sidewalks, and a maximum cover of 1,5 m where other services are encountered or where gradients of roads require this.

Main supply pipelines for proposed adjacent township extensions shall be laid right up to the boundary of the adjoining township.

Communication pipes shall only be of polyethylene (PE) with a minimum diameter of 40 mm and shall be installed in accordance with the Drawings. In the case of erven smaller than 400 square metres, a diameter of 25 mm may be used to supply not more than two residential properties.

House connections shall be installed as shown on the Drawings. No holes larger than 25 mm in diameter shall be drilled into PVC pipes for house connection saddles.

04.02 Polyethylene (PE) pipes and fittings

PE pipes shall comply with the relevant requirements of SANS 4427 and shall be one of the following:

PE80 PN16 SDR9, or
PE63 PN12,5 SDR9.

Pipe fittings and couplings for PE pipes shall be Plasson or approved equivalent compression fittings and shall be manufactured for a working pressure of 1 600 kPa. Only fittings that the General Manager Water and Sanitation has approved shall be used with PE pressure pipes.

Acceptable nominal pipe diameters for PE high pressure pipes are 25 mm, 40 mm, 50 mm, 63 mm, 75 mm and 90 mm.

Under no circumstances may saddles be used with PE pipes. Welded adaptors may also not be used with PE pressure pipes.

04.03 PVC pipes and fittings

PVC pipes shall comply with the requirements of SANS 966-1 (PVC-U) or SANS 966-2 (PVC-M) for class 12 pressure pipes and shall be fitted with spigot and socket joints with rubber sealing rings.

Except for bends, which shall be of PVC with a factory-made socket joint at one end in accordance with the above specifications, all fittings for use with PVC pipes shall be of cast iron, with wall thicknesses in accordance with SANS 546 and socket dimensions in accordance with SANS 966. Only fittings that the General Manager: Water and Sanitation has approved shall be used with PVC pressure pipes. Welded adaptors may also not be used with PVC pressure pipes.

Acceptable nominal pipe diameters for PVC pressure pipes are 75 mm, 90 mm, 110 mm, 160 mm, 200 mm, 250 mm, 315 mm and 400 mm; 75 mm diameters shall only be allowed when a network analyses shows that the water demand for fire fighting is satisfied.

All PVC pipes and fittings shall, prior to delivery, be factory-tested to 4,2 times the specified working pressure, and a certificate to this effect shall accompany all deliveries. PVC products shall be stored away from sunlight and shall be backfilled as soon as practicable after having been laid.

04.04 GMS pipes and fittings

GMS pipes shall be solid-drawn, seamless, medium-duty, screwed-and-socketed pipes which comply with the requirements of SANS 62-1. Screwed pieces shall comply with the requirements of SANS 62-2. Welding will not be permitted on GMS piping.

Pipe fittings shall be of malleable cast iron and shall comply with the requirements of SANS 514.

Pipes and fittings shall be galvanized inside and outside in accordance with SANS 532 and SANS 121.

GMS pipes and fittings below ground shall be protected against corrosion as specified in the Project Specifications.

04.05 Steel pipes, fittings and specials

(a) General

All steel pipes with a diameter exceeding 150 mm shall conform to the requirements of SANS 719 and specials shall be manufactured from straight pipes in accordance with the relevant requirements of BS EN 10224. All welding in pipes and specials shall be electric fusion welding in accordance with SANS 719.

The grade of the steel plate or strip to be used in the manufacturing process, the wall thickness and diameter of the pipes, and whether flanges, welding or couplings will be used for jointing the pipes and specials, shall be as specified in the Project Specifications or as shown on the Drawings.

The Contractor shall furnish the Engineer with the manufacturer's certificates which cover the chemical analysis and physical properties of the steel used in the manufacture of pipes and specials, and shall provide written confirmation that welding has been carried out by coded welders.

All production welding of pipes and specials shall be done by welders who are competent in terms of the procedure approval tests set out in SANS 10044-4 or an acceptable equivalent standard, and all welding, whether by hand or otherwise, shall be so carried out that the height of inner-weld reinforcement and of upset metal on the inner surface shall not exceed 1 mm. Field welding shall comply with the relevant requirements of ANSI / API 1104.

All bends used shall be long radius bends with minimum outer leg lengths of 1,5 m.

The ends of pipes and specials shall be bevelled for the field welding of butt-welded joints and shall be plain-ended for use with slip-on couplings, all in accordance with the relevant requirements of BS EN 10224.

Acceptable nominal mild steel pipe diameters are 200 mm to 1 200 mm, with 50 mm intervals up to and including 500 mm, and after that with 100 mm intervals up to 1 200 mm.

(b) Flexible couplings

All flexible couplings for plain-ended steel pipes and fittings shall be of the slip-on type without centre register, such as Viking Johnson or an approved similar, and shall comply with the relevant requirements of BS EN 10224. Flexible couplings shall be thoroughly cleaned and painted as specified in the Project Specifications.

(c) Electrical continuity bonds

Steel pipes other than those with welded joints shall be double bonded by two separate copper connecting wires of 16 mm^2 copper strand black PVC-covered wire being installed across all flanged joints and flexible couplings to provide electrical continuity over the entire pipeline.

Connections on the pipe on either side of the coupling and on the coupling barrel shall be made by Thermite welds and shall be done only when the pipeline is full of water, (i.e. during pressure tests, etc) to prevent possible damage to the internal lining of the pipe.

The costs of repairing the external coating at the welds shall be included in the price of the pipes.

(d) Pipe record

The Contractor shall maintain a record, in an approved form, showing the pipe serial and delivery numbers, the steel cast number for the plate used in each pipe section, the date of fabrication and hydrostatic testing, together with the actual test pressure and details of defects and subsequent repairs. Each record shall be signed by the Contractor, and copies shall be handed over to the Engineer before the commencement of the defects liability period.

05 COATING AND LINING OF STEEL PIPES

The material used for protecting steel pipes against corrosion shall be as specified in the Drawings or Project Specification. Coatings and linings shall be tested as specified in clause 04 of section 403.

05.01 Surface preparation

Surfaces to be treated shall have all projections, sharp edges, laminations and tool marks removed to provide a smooth surface and shall be cleaned in accordance with sections 2, 3 and 4 of SANS Code of Practice 10064 to meet the following requirements:

(a) A cleanliness of not less than Sa 2½ when they are tested according to SANS test method 5767.

(b) A surface profile not exceeding 0,09 mm when they are tested according to SANS test method 5772.

(c) Freedom from dust and debris not more than 0,2% when they are tested according to SANS test method 5769.

Tenderers shall, with their Tenders, submit information regarding the cleaning methods to be employed to meet the above requirements, and the Contractor shall furnish the Engineer with the manufacturer's guarantee that the requirements have been met.

05.02 Materials to be used

(a) Internal linings

(i) Epoxy lining : A solvent-free liquid epoxy such as Copon Solvent Free Hot-cote DW (Plascon code JHCI) or an approved similar product, hot applied in one operation.

(ii) Cement Mortar lining: Shall be done according to specification: AWWA C 205-00 (for Cement-mortar protective lining and coating for steel water pipe - 4 in. and larger - shop-applied).

(b) External coatings

Fusion-bonded medium-density polyethylene such as Sintakote or an approved similar product.

05.03 Epoxy linings

Epoxy coatings and linings shall have a total dry-film thickness of at least 250 micron, shall be applied strictly in accordance with the epoxy manufacture's instructions and shall comply with the requirements of SANS 1217.

The Contractor shall furnish the Engineer with a certificate which confirms that the coatings and/or linings have been applied to the manufacturer's satisfaction. Such certificate shall be signed by the manufacturer.

05.04 Fusion-bonded, medium-density, polyethylene coatings (MDPE)

A uniform MDPE coating shall be obtained by dipping the already prepared and heated pipe into a fluidified bed of MDPE powder which then fuses directly on to the heated surface.

A coating thickness of between 1,8 mm and 2,5 mm depending on the diameter of the pipe and the service for which it is required shall be obtained with the coating extending around the ends of the pipe to under-lap the concrete lining for Sinta Joint pipes.

Fusion bonded MDPE coatings and concrete linings shall meet the applicable SANS requirements for this type of pipe protection.

05.05 Cutting back of linings and coatings

The extent to which linings and coatings shall be cut back will depend on the type of jointing specified, and the linings and coatings shall be cut back cleanly from the ends of the pipes and specials.

Linings and coatings shall be taken to the ends of pipes for welded and Viking Johnson type couplings and according to the manufacturer's instructions for Sinta Joint pipes. Coatings shall also be applied according to the manufacturer's instructions for Sinta Joint pipes and 50 mm from the end of pipes for Sintakote pipes.

The uncoated portions of the pipe shall be protected with a primer conforming to SANS 926 and applied to a maximum dry thickness of 0,25 mm.

06 VALVES AND HYDRANTS

Valves shall be of the types, sizes and ratings as specified in the Schedule of Quantities or Project Specifications or as shown on the Drawings. Hydrants shall be constructed to details shown on the Drawings.

All valves shall be at least Class 16 valves which are suitable for dealing with a maximum working pressure of 1 600 kPa. Where higher working pressures are experienced, depending on circumstances, Class 25 or Class 40 valves shall be used. Valves shall be able to open and close under an unbalanced pressure equal to the specified maximum working pressure.

Valves shall be installed on street corners, directly opposite the splay corner of the erf. Line valves on supply pipelines shall be installed every 500 m or as instructed by the General Manager: Water and Sanitation. High pressure pipelines shall be equipped with a suitable bypass and scour pipes provided with valves as specified in the Project specifications or on the drawings.

Where practically possible, a strategically placed fire hydrant may replace a scour valve.

Where a valve is abnormally deep under the finally finished off ground level, an extension shall be fitted to the valve stem to ensure that the normal valve key will open the valve stem.

A list of approved Valve Suppliers is included in the Project Specifications and is also available from the General Manager: Water and Sanitation.

06.01 Resilient seal gate valves

Anticlockwise closing gate valves for water works, with compression-type seals and non-rising spindles shall be used. The valve shall conform to the requirements of the latest edition of SANS 664, subject to the following additional requirements:

The valve shall have socketed ends to fit PVC pipes. (Where double flanged valves are specified the flange dimensions and drilling shall be to SANS 1123:1977 Table 1600 (or 2500 when specified.) The face to face dimensions for double flanged valves shall conform to either SANS 664 or DIN 3202 part 4.

The body and bonnet shall be epoxy-coated internally and externally. The spindle seal shall consist of at least two O-rings located in a corrosion resistant housing. A wiper ring to prevent ingress of dirt shall be provided. The spindle nut may be loose or fixed in the gate.

The valves shall be provided with a straight, unobstructed body passage without any pocket and the gate shall be completely clear of the waterway in the fully open position. The sealing and gate-guide areas shall be designed to eliminate deposits in the valve body. The gate guides shall be of substantial design so as to support the gate until the point of closure.

All components shall be interchangeable between valves of one size.

Materials of construction:

Valve gate:	Cast Iron covered with nitrile, EPDM or similar rubber.
Spindle:	Stainless steel.
Valve body and bonnet:	Spheroidal graphite, grey cast or ductile iron.

The rated working pressure shall be 16 bar (or 25 bar when specified). The valves are required to seal drop-tight from zero to a test pressure of 1,5 times the rated working pressure under test and field conditions.

The valve shall be capable of being opened and closed under an unbalanced pressure equal to the rated working pressure.

The valve shall operate via a cap top (or hand wheel when specified).

06.02 Butterfly valves

Butterfly valves shall comply with the requirements of BS EN 593 and be of double-flanged, lugged or wafer types, as specified. They shall be designed to fit between flanges in which holes are drilled in accordance with SANS 1123. It shall be possible to install the valve in any position and for the valve to function in any open position, without the disc adjusting its position or causing any flutter.

Butterfly valves shall be controlled by weather-proof actuators fitted with hand wheels. Arrows shall indicate open and closed directions. Valves shall open or close without any difficulty under an unbalanced pressure equal to the specified working pressure. Valves shall close by anticlockwise movement of the hand wheel or ratchet handle. It shall be possible to positively stop in positions which are completely open and completely closed. When specified, valves with diameters of 200 mm and less may be controlled by direct-mounted ratchet handles.

Actuators shall be equipped with position indicators and adjustable travel stops. Safety measures such as shear pins shall be built into actuators to prevent damage to valves when excessive force is applied to the hand wheel in a fully open or closed position. Valve bodies should preferably be equipped with integral disc stops to limit the movement of the disc. This is to prevent damage when actuators are incorrectly adjusted and also damage to seals and seats.

Valve discs shall be cast in one continuous process, and they shall have a streamlined shape and a smooth surface. Seat profiles shall be smooth and continuous. During closure of the disc, adequate "lead in" for the resilient seal shall be provided to prevent the development of excessive seating torque. Resilient seals shall lock in completely, and be removable and replaceable, and it should be possible to readily remove and replace the seats on site.

Resilient seals shall have durable non-weathering, non-sticking and long-life properties. Securing elements of seals and seal seats shall be manufactured of stainless steel or nickel-plated mild steel. Butterfly valves of Class 16 and higher or with a diameter of 350 mm and more shall be fitted with self-lubricating, two-way, adjustable thrust bearings to permit precise disc-to-seat positioning at all times.

Valve shafts should preferably be continuous, but if stub shafts are provided, each of these shall extend into the disc hub for a distance of at least 1,5 times the diameter of the shaft.

The composition of stuffing box assemblies shall be such that the packing can be adjusted or replaced under pressure without removing the valve from the pipeline. O-rings may be used for valves with working pressures up to 2 500 kPa.

Materials for construction:

Valve body: Spheroidal graphite, grey cast or ductile iron.

Disc: Spheroidal graphite, grey cast, ductile iron or stainless steel.

Valves shall be coated inside and out with an epoxy paint of the highest quality.

All butterfly valves shall be tested hydrostatically to be drip-free so as to determine whether the valve seats and actuators are correctly adjusted. The seat shall be tested to be drop tight to 1,1 times the rated working pressure and, in the case of a valve designed for unidirectional flow, the seat shall be tested to the rated pressure in the opposite direction of flow. Valve bodies and discs shall be designed to withstand 1,5 times the specified working pressure. The bodies and discs of all valves with diameters of 300 mm and greater shall be hydrostatically tested at 1,5 times of their rated working pressure.

06.03 Air valves

Air valves shall be double-acting as specified and shall be manufactured, when applicable, to the same standards of quality and finish as laid down in SANS 664 for gate valves. Sizes less than 80 mm diameter shall, in accordance with SANS 62-2, have screwed inlets, and larger sizes shall be flanged in accordance with SANS 1123. Built-in isolating valves are not required. All air valves shall however be fitted with a separate isolating valve which shall be approved by the Engineer.

All material shall resist corrosion or be coated with a protective layer which is highly resistant to corrosion, such as an epoxy coating of excellent quality. Floats shall not lose their shape or leak and they shall resist wear so as to ensure long life.

Air valves shall withstand twice the maximum rated working pressure and ensure a positive drop-tight seal from a minimum pressure of 50 kPa to the maximum rated working pressure.

The large orifice diameter shall be the same as the nominal diameter of the valve. The small opening valve shall function through the whole range of pressures up to the rated pressure.

Tenderers shall, with their tenders, furnish the minimum working pressure at which the specified air valves are watertight.

06.04 Hydrant valves

The 65 mm diameter hydrant valves shall be tamper-resistant and shall be fitted with a single or a double-lugged, 65 mm diameter, aluminium alloy instantaneous coupling complying with SANS 1128 Parts I and II and shall be equipped with a square stainless steel spindle on which the keys of the local fire brigade fit.

After installation, fire hydrants shall be painted with one undercoat of zinc chromate conforming to SANS 679 followed by two coats of bright red high-gloss enamel paint which conforms to SANS 630.

06.05 Hydrants

The requirements of SANS 10400 part T, Fire Protection and of the Chief Fire Officer shall be adhered to.

Fire hydrants shall be placed in accordance with SANS 10090, Community Protection against Fire, 450 mm from the erf boundary directly opposite the corner peg of the erf as shown on the Drawings.

Proposed positions shall be submitted to the General Manager: Tshwane Electricity for approval to ensure that the positions of fire hydrants and electricity meter boxes do not clash.

Fire hydrants shall be jointed to the water main by a flanged hydrant tee of which the flange is drilled in accordance with SANS 1123 Table 1600. Where the water main exceeds 150 mm, an isolating gate valve shall be fitted to the tee. From the gate valve or hydrant tee, a length of horizontal diameter GMS pipe and a 90° GMS bend shall link up with the hydrant as shown on the Drawings.

On completion, the portion of the GMS pipe housing which protrudes above the ground, shall be cleaned and painted with one coat of zinc chromate primer conforming to SANS 679, followed by two coats of medium yellow high-gloss enamel paint such as Plascon code G6 or an approved similar which conforms to SANS 630.

GMS pipes and fittings below ground shall be protected against corrosion with Denso tape or as specified in the Project Specifications.

07 ACCESSORIES AND APPURTENANT MATERIALS

07.01 Flanges

Unless otherwise specified, the flanges of flanged pipes and fittings shall be drilled in accordance with SANS 1123, Table 1600, for pipes and fittings with a diameter of 150 mm and smaller, and in accordance with Table 1000 for diameters exceeding 150 mm. Where a pressure is specified, the flanges shall be drilled in accordance with the required pressure class. In the case of flanges of air-valve matching tees, the drilling shall conform to the drilling of the valve supplied.

Loose flanges for galvanized steel pipes shall be threaded to fit the threaded pipe, and loose flanges for welding onto steel pipes shall be manufactured from the same steel as is specified for the pipes and shall be either flat faced or raised in accordance with SANS 1123.

Any item that is found to have flanges that are incorrectly drilled will be rejected, and the reaming of bolt holes to oversize dimensions to make a particular piece fit will not be permitted.

All flanged items shall be supplied with one set of bolts and nuts and one suitable gasket with the appropriate diameter and the gasket shall be made of a material that is suitable for the maximum test pressure.

07.02 Bolts and nuts

Bolts and nuts shall be of mild steel unless otherwise specified in the Project Specifications or shown on the Drawings and shall comply with the relevant requirements of the appropriate section of SANS 1700 for coarse thread, medium fit bolts. The length of each bolt shall be such that, after the nut has been tightened, the end of the bolt shall be flush with the outside of the nut or project above the nut by not more than two full threads.

All nuts, bolts, screws and threaded articles shall be hot-dip galvanized in accordance with the requirements of SANS 121 Table 2 or 3, as applicable, or coated with a material used to protect steel against corrosion as specified in the Project Specifications.

07.03 Step irons

Step irons shall be of stainless steel and shall comply with the appropriate requirements of BS EN 13101. The length of step irons shall be suitable for being fixed in brick or in situ concrete.

07.04 Surface boxes and valve chamber covers and frames

All surfaces which will not be in contact with concrete shall be painted with two coats of epoxy-tar paint prior to installation. Following installation all exposed upper surfaces of manhole and valve box covers shall be painted with two layers of white road-marking paint as specified in section 613.

A 400 mm x 400 mm white mark shall be painted directly opposite the cover on the kerb of the road and parallel to the pipeline.

The types of boxes, covers and frames shall be as follows:

(a) Valve chambers

(i) In roadways:

A rectangular cast-iron (CI) box of 175 mm x 115 mm, with a hinged lid in accordance with the Drawings shall be placed on the surface with the longest side in the direction of the water pipeline which the valve controls. The box shall be supported by a pipe shaft as indicated on the drawings.

The covers and frames of valve chambers shall be of CI and shall comply with the requirements of SANS 558.

The Contractor shall be at liberty to precast the surface box into its concrete surround by using a mould made of 2 mm steel plate. The concrete shall be class 1:2:4/19, and light reinforcing shall be used as shown on the Drawings.

(ii) On sidewalks:

Reinforced manhole rings with an internal diameter of 750 mm shall be used to form the chamber as shown on the drawings. A type 11A CI surface box for access to the valve cap top shall be cast into the reinforced concrete lid as shown on the drawings.

The CI surface box shall comply with the requirements of SANS 558 and the manhole rings with SANS 1294.

(b) Manhole covers

On sidewalks, for medium service, a prefabricated, welded, mild steel lid with hinges and a frame as shown on the Drawings. In the case of manhole covers to be placed in streets, the design of the cover shall be approved in writing by the General Manager: Water and Sanitation.

(c) Meters

Under normal circumstances, meters are placed above ground just outside the boundary of the erf.

(d) Air valve chamber lids

Welded mild steel lids as specified on the Drawings shall be used.

(e) Control valve chambers

The design of control valve chambers shall be approved in writing by the General Manager: Water and Sanitation.

07.05 Appurtenant materials

(a) Bricks

Bricks shall be obtained from an approved manufacturer, shall be of the class shown on the Drawings and shall comply with the appropriate requirements of SANS 227. The Contractor shall furnish the Engineer for his approval with samples of the bricks which he intends to use.

(b) Mortar

Mortar for brickwork shall consist of 1 part cement and 4 parts of building sand.

All mortar shall be prepared using ordinary masonry cement complying with SANS 50413 Parts 1 and 2.

(c) Concrete

Concrete shall conform to the requirements of section 704.

(d) Soilcrete

Soilcrete shall be prepared as described in clause 12 of section 202.

(e) Marker blocks and markers

Where specified, concrete marker blocks indicating the position of pipelines shall be constructed in accordance with the Drawings.

Markers indicating the position of all reticulation pipelines and erf connection pipelines shall be constructed and positioned in accordance with the Drawings. Markers shall consist of the letter W, 75 mm high, recessed into the concrete during road kerb construction. Where kerbing is already in place, the letter shall be cut clearly and legibly into the concrete or sandblasted with a template.

Markers indicating the position of valves shall be constructed and positioned in accordance with the drawings. These markers shall consist of a 400 mm x 400 mm block painted onto the concrete kerb with white road marking paint as specified in section 613.

No separate payment will be made for such markers and the cost thereof shall be included in the rates tendered for kerbing under section 503, or, where no kerbing is to be constructed, in the rate tendered for pipe laying or valve installation as may be applicable.

(f) Epoxy-tar paint

Epoxy-tar paint used for protecting metal surfaces where specified, shall conform to the requirements of SANS 801 Type III and shall be applied in two coats with a dry film thickness of 0,230 mm each.

(g) Welding electrodes

Welding electrodes shall comply with SANS 455, and the type of electrode shall be compatible with the welding operation to be performed.

08 HANDLING, STORAGE AND TRANSPORT

The handling, storing and transporting of pipes and other items shall be carried out as specified in clause 05 of section 301.

09 MEASUREMENT AND PAYMENT

Except where pay items are provided for certain materials, no separate measurement and payment shall be made for materials and the cost thereof shall be included in the appropriate tendered rates of section 402.

SERIES 4 : WATER RETICULATION AND WATER MAINS

SECTION 402 : CONSTRUCTION

CONTENTS

01 SCOPE

This section covers the construction of water reticulations, pipelines and service connections to the details shown on the Drawings using materials conforming to the requirements of section 401.

02 EXCAVATION

The excavation of trenches, the preparation of trench bottoms, and the additional excavation for valve chambers and joint holes shall be carried out as specified in section 202 and shall be approved by the Engineer before any pipe bedding and pipe laying is carried out.

The minimum trench widths shall be as specified in section 202 but, where the Contract requires the laying of more than one pipe in the same trench, the trench width in such cases will be as given in the Project Specifications or as determined by the Engineer on the Site.

Where pipes are to be encased in concrete or soilcrete, the trench width shall be determined either by the width of encasing as shown on the Drawings, or by the Engineer on Site.

Variations in the authorized widths may only be effected with the written approval of the Engineer.

The Engineer reserves the right to limit the length of excavation preceding the pipe-laying activities.

Excavations for valve chambers and other brickwork structures shall be 200 mm wider than the outer dimensions of the structures, i.e. 100 mm measured from each outer face.

Excavations for reinforced-concrete chambers which require the use of formwork shall be such that a working space of 600 mm will be available around the outer perimeter of the structure.

03 SELECTED BACKFILL

Selected backfill material shall be free from stones exceeding 10 mm in size and from organic matter and clayey material, and shall contain sufficient fine material to ensure a densely graded, well-compacted backfill.

04 LAYING OF PIPES

All pipes, fittings, specials and valves shall be thoroughly cleaned and carefully examined for damage and defects before they are laid. The onus for detecting damage and defects before installation shall be on the Contractor. Should any damaged or defective pipe, fitting, special or valve be found after laying or installation, it shall be removed and replaced at the Contractor's expense.

After the bottom of the trench has been approved by the Engineer, a 100 mm thick layer of uncompacted selected backfill material shall be placed thereon.

Pipes shall be laid in the centre of the trench and, except where it is specified that they should be supported on precast pedestals (subclause 05.05(a) and clause 06), they shall be laid in such a manner that the full length of their barrels will bear uniformly on the uncompacted material. After the pipes have been placed in position the loose material shall be well-compacted on both sides of the pipes by using hand implements. Valves shall be placed in the upright position unless otherwise specified or shown on the Drawings. All valves, specials and fittings shall be set, supported and placed in their correct positions as the work proceeds and their positions shall not be governed by the standard lengths of pipe.

Pipes shall be laid with the identification marks (subclause 04.01 of section 401) visible from the top of the trench. Where markings are no longer visible once the pipes have been laid, the Contractor shall at his expense, re-mark the pipes in a manner approved by the Engineer. Control of laying shall be by means of boning rods and sight rails or by other approved methods.

Precautions shall be taken to prevent the entry of foreign matter and unwanted water into the pipes, and to prevent the flotation of the pipes caused by water and mud in the trenches. At the close of each day's work, or at any time when work is suspended for a significant period, the last laid section of each pipe shall be plugged, capped or otherwise tightly closed until laying is recommenced.

An approved badger shall be drawn through all pipes smaller than 600 mm in diameter as they are being laid and jointed. Pipes with a 600 mm diameter and larger shall be kept clean internally by the pipes being carefully swept by hand as laying progresses.

05 JOINING OF PIPES

Subject to approval of the methods to be used and the observance of the necessary precautions, only steel pipelines with welded joints and PE pipes may be jointed outside their trenches prior to being laid. In all other cases pipes shall be jointed in their final positions in trenches.

05.01 PE pipes

PE pipes and their fittings shall be jointed in accordance with the manufacturer's instructions, and special care shall be taken not to over-tighten the couplings.

05.02 PVC pipes

PVC pipes and their fittings shall be jointed strictly in accordance with the manufacturer's instructions and, except for the joint, shall be backfilled as soon as possible after laying.

05.03 GMS pipes

Before connections are made, all external and internal threads of GMS pipes and fittings shall be thoroughly cleaned, and external threads shall be covered with a small quantity of yarn and a thin layer of approved jointing compound. The external threads of pipes and fittings smaller than 25 mm may be wrapped with an approved tape in lieu of the yarn and compound.

Care shall be taken to avoid tool damage to the surfaces of pipes and fittings during installation. All joints shall be screwed up tightly.

05.04 Steel pipes

(a) Flanged joints

In the jointing of steel pipes with flanges, special care shall be taken to align and level the pipes, specials, fittings and valves to avoid straining of the flanges. To facilitate the alignment process, all flanged pipes and larger fittings, specials and valves shall be supported on precast pre-positioned concrete pedestals, all in accordance with the Drawings.

The mating face of each flange shall be thoroughly cleaned immediately before jointing. Gaskets shall be placed so that no portion of the gasket will project inside the bore of the pipe.

Nuts shall be tightened up evenly in opposite pairs to ensure a uniform bearing on the gasket but shall not be fully tightened until all bolts have been inserted and the flanges accurately aligned relative to each other.

Wherever loose flanges are welded onto pipes, the Contractor shall make sure that the linings and coatings are repaired and are soundly jointed to existing linings and coatings.

(b) Slip-on type couplings

Slip-on type couplings shall be installed in strict accordance with the manufacturer's recommendations, and the angular deflection allowed by the couplings shall on no account be exceeded.

(c) Welded joints

All field welding of butt-welded joints shall be carried out by welders who are competent in terms of the procedure- approval tests of SANS 044 Part III. Pipes shall be well ventilated in an approved manner when welding is done inside the pipes.

06 ENCASING OF PIPES

Where specified or ordered by the Engineer, pipes shall be fully encased in accordance with the Drawings. During concreting pipes shall be adequately supported and anchored to prevent movement and uplift. All spaces under and around the pipes shall be properly filled with concrete.

No part of the concrete casing shall be closer than 150 mm to any flexible joint, and concreting between joints shall be carried out in one continuous operation. The concrete shall be raised equally on both sides of the pipe.

Where shown on the Drawings or ordered by the Engineer, soilcrete shall be used to encase the pipes fully and shall be placed in the same manner as concrete casing.

Care shall be taken to prevent concrete or soilcrete from entering the flexible joint.

The encasing of pipes shall be carried out only after the pipeline has been tested and passed and when the pipeline is still full of water. Formwork shall be used where necessary to ensure that flexible joints remain uncased, and payment for such formwork shall be deemed to be included in the rates tendered for the encasing of the pipe.

07 THRUST BLOCKS

Thrust blocks shall be constructed in accordance with the Drawings at tees, bends, terminal valves and end caps and where otherwise directed by the Engineer.

The sides and bottoms of excavations against which thrust blocks are cast shall be sound and undisturbed, and all loose material shall be removed. Excess excavations shall be filled with concrete simultaneously with the concreting of the thrust block and shall not be paid for unless the excess excavations have been authorized.

Care shall be taken to leave all joints accessible and no pipeline shall be tested unless the concrete has attained its full strength. Formwork shall be used to ensure the accessibility of joints.

No thrust blocks shall be constructed where steel pipes with flanged or welded joints are used, unless otherwise directed.

08 VALVE CHAMBERS

Valve chambers shall be constructed to details as shown on the Drawings.

Chambers for flanged gate valves with a nominal bore not exceeding 200 mm and for air valves shall, unless otherwise specified, be constructed after the selected backfill material has been thoroughly compacted around the valve and above the pipe to serve as a firm base for the chamber.

Where pipes with diameters exceeding 200 mm pass through the brick or concrete walls of chambers, relieving arches shall be built neatly over the upper halves of the pipes. In all other cases the bricks shall be carefully cut to fit closely and neatly against the pipes.

CI valve chamber covers and frames, surface boxes and surface boxes precast into their surrounds shall be fitted on top of the chambers as shown on the Drawings.

09 BACKFILLING

No backfilling shall be carried out unless authorized by the Engineer.

Before pipelines are hydraulically tested, the selected backfill shall be completed, also at joints, valves, specials and fittings to a height of 200 mm above the top of the pipe barrels, as shown on the Drawings, with the use of the material described in clause 03 of this section and with great care being taken not to damage protective materials with which pipes, specials, etc, may be coated. All joint holes shall be carefully backfilled with the same material.

All backfilling with selected material shall be carried out in 100 mm layers and shall be compacted using hand implements. The compaction shall be approved by the Engineer.

Should suitable material for selected backfill not be available from the excavation of the trench which is backfilled, the Contractor shall obtain suitable material from his other excavations on the Site. In the event of suitable material not being available on the Site, the Contractor shall screen the excavated material using a sieve with 10 mm clear openings but, if the latter method is impracticable, the Engineer may order the Contractor to import suitable material. Separate pay items are provided in the Schedule of Quantities for the screening of excavated material and for obtaining suitable material from sources outside the Site of the Works.

In respect of backfill material obtained from sources provided by the contractor, the provisions of clause 05(f) of section 201 are applicable.

After the selected backfill has been completed and approved, the balance of the trench shall be backfilled as described in clause 13 of section 202, except above the joints, valves, specials and fittings.

Testing of the pipeline shall now be carried out as specified in section 403.

When the tests have been successfully completed and the pipeline approved, the balance of the trench shall be backfilled at joints and at all other positions where no chambers have to be constructed.

At valves the selected backfill shall be completed to a height as shown on the Drawings, or, as may be applicable, a concrete slab shall be constructed followed by the construction of the valve chambers. Backfilling around valve chambers shall be carried out with selected backfill material compacted by hand in 100 mm layers or with soilcrete where insufficient space is available and the cost of backfilling shall be included in the rates tendered for valve chambers.

No separate payment shall be made for the backfilling of joint holes and for backfilling over joints, specials, etc, after testing has been completed, the cost of which shall be included in the rates tendered for backfilling.

Backfilling of the authorized excavations in excess of the specified trench width shall be paid for under pay item 202.06 of section 202.

10 SERVICE CONNECTIONS

Service connections shall be constructed to details shown on the Drawings.

Payment for the installation of the connecting pipes and fittings will be made under items 402.01 and 402.02 respectively.

11 MARKERS

The marker blocks shall be installed, after the trimming of the surrounding area has been completed, to mark the sealed ends of connecting pipes temporarily until such time as the distribution pipes are installed by the Employer.

12 CONNECTION TO EXISTING NETWORK OR PIPELINE

Wherever a new reticulation system or pipeline joins up with an existing network or pipeline, the Contractor shall timeously notify the Engineer as to when the connection will be required. The work will be carried out by the Employer unless otherwise specified in the Project Specifications.

13 STERILIZATION OF PIPELINES

After each pipeline has been successfully tested, it shall be thoroughly flushed out with clean water until all sediment and other foreign matter have been removed.

The pipeline shall then be filled with water containing 0,015 grams per litre of chloride of lime. The solution shall be allowed to flow slowly into the pipeline until it fills it completely, and shall be left there for at least 24 hours. All valves shall be opened and closed during sterilization to ensure that all surfaces are sterilized.

The pipeline shall then be thoroughly and repeatedly flushed with clean water until the water which is flushed from the pipeline complies with the requirements of the Employer.

Where work, which has to be carried out on a section of pipeline which has been sterilized, causes internal contamination of the pipeline, the entire section of the pipeline shall again be sterilized. Water for the first sterilization will be provided free of charge by the Employer.

14 TOLERANCES

The permissible tolerance limits shall be as follows:

(a) Valves, fittings and specials

- Lateral deviation:
- Plus or minus 100 mm except where pipelines are to be laid at a designated distance from a fence, kerb or boundary, in which case the permissible deviation shall be plus or minus 25 mm.
- Vertical deviation: Plus or minus 100 mm.

(b) Pipelines

Permissible horizontal deviation from a straight line joining valves, fittings and specials shall be plus or minus 100 mm with a permissible deviation per pipe length of plus or minus 20 mm. The permissible vertical deviation from a straight line joining valves, fittings and specials shall be plus or minus 50 mm.

(c) Valve chambers

- Lateral deviation:

  As for valves, provided that access to bolts, nuts, etc, is maintained.
- Vertical deviation:

  To suit the valve.

15 CATHODIC PROTECTION

Cathodic protection where specified, shall be as set out in the Project Specifications. No separate payment shall be made for cathodic protection, the cost of which shall be included in the rates tendered for the laying and jointing of pipes.

16. MEASUREMENT AND PAYMENT

Note:

Reference shall be made to the last paragraph of clause 02 of section 202 regarding payment for work carried out under this section.

Item		Unit
402.01	**Supplying, laying and jointing of water pipes irrespective of depth:**	
402.01.01	(Type, grade or class of pipe indicated)	
402.01.01.01	(Diameter indicated)	metre (m)
402.01.01.02	Etc for other diameters	
402.01.02	Etc for other types, grades or classes of pipes	

The unit of measurement shall be the metre of each type, grade, class and size of pipe measured in place, including couplings. No deductions shall be made for fittings, valves or specials as these, except couplings, will be paid for as an extra over to the pipes.

The tendered rates shall include full compensation for supplying and laying the pipes, for the protective linings and coatings and supplying electrical continuity bonds, and cathodic protection for keeping the pipes clean, for all accessories and appurtenant materials such as flanges, welding electrodes, gaskets, bolts, nuts and washers, as well as precast concrete pedestals, where applicable, and for excavating and backfilling the joint holes.

Item		Unit
402.02	**Extra over item 402.01 for providing and installing fittings, valves and specials:**	
402.02.01	(Type of fitting, valve or special indicating class or grade):	
402.02.01.01	(Diameter indicated)	number (No)
402.02.01.02	Etc for other diameters	
402.02.02	Etc for other types of fittings, valves or specials	

The unit of measurement shall be the number of each item installed in positions as shown on the Drawings.

The tendered rates for each item shall be paid as an extra over the rate tendered for item 402.01 and shall include full compensation for any additional costs, work or materials required to provide and install each item, all as specified and approved by the Engineer, as well as for refilling joint holes with the appropriate material, as specified.

Item		Unit
402.03	**Encasement of pipes with :**	
402.03.01	Class 15/19 concrete	cubic metre (m^3)
402.03.02	Soilcrete	cubic metre (m^3)

The unit of measurement shall be the cubic metre of encasement provided, to dimensions shown on the Drawings, when specified or when ordered by the Engineer, in writing. At flexible joints, a gap shall be left in the encasement as specified.

The tendered rates shall include full compensation for providing the necessary concrete pedestals and the strapping down of the pipe, where applicable, to prevent uplift, and for providing and removing the necessary formwork.

Overhaul shall apply when gravel material used for soilcrete is imported from sources not furnished by the Contractor, which are situated outside the free-haul boundaries.

Item		Unit
402.04	**Providing thrust blocks using class 15/19 concrete**	cubic metre (m^3)

The unit of measurement for thrust blocks shall be the cubic metre of concrete in place. Quantities shall be calculated from the dimensions shown on the Drawings or as authorized by the Engineer.

The tendered rate shall include full compensation for trimming the contact faces, procuring and furnishing all materials, including formwork, and for all concrete work.

Item		Unit
402.05	**Supplying and placing unscreened selected backfill material under, alongside and up to 200 mm above pipe barrels using:**	
402.05.01	Excavated material	cubic metre (m^3)
402.05.02	Imported material from sources provided by the Employer	cubic metre (m^3)
402.05.03	Imported material from sources provided by the Contractor	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material placed under, around and up to 200 mm above pipe barrels. The quantity shall be calculated from the dimensions of the bedding as specified or authorized by the Engineer. The volume of the pipe will be subtracted when the volume of the material is calculated.

The tendered rates shall include full compensation for excavating and loading the material or alternatively for loading approved material previously excavated from trenches and other excavations, transporting it to where required and for offloading, placing and compacting the material as specified.

Material shall only be imported on instructions from the Engineer, and overhaul shall apply when the imported material is obtained from sources not provided by the Contractor, which are situated outside the free-haul boundaries.

Item		Unit
402.06	**Extra over item 402.05 for screening excavated material for selected backfill**	cubic metre (m^3)

The extra over rate shall include full compensation for the additional handling and transport necessary, for screening the material and for disposing of the material screened out.

Screening of material will only be paid for if ordered by the Engineer in writing.

Item		Unit
402.07	**Valve chambers complete for -**	
402.07.01	Flanged gate valves not exceeding 200 mm in dia:	
402.07.01.01	(Diameter indicated)	number (No)
402.07.01.02	Etc for other diameters	
402.07.02	Flanged gate valves exceeding 200 mm in dia:	
402.07.02.01	(Diameter indicated)	number (No)
402.07.02.02	Etc for other diameters	
402.07.03	Single air valve	number (No)
402.07.04	Double air valve	number (No)

The unit of measurement shall be the number of chambers constructed complete as shown on the Drawings and as specified.

The tendered rates shall include full compensation for all labour and materials necessary to construct and backfill the chambers complete with surface boxes, covers and frames and step irons.

Item		Unit
402.08	**Installation of marker blocks**	number (No)

The unit of measurement shall be the number of marker blocks manufactured and installed in accordance with the Drawings.

The tendered rate shall include full compensation for all labour, equipment and materials required to provide and install the marker blocks.

Item		Unit
402.09	**Installation of hydrants**	number (No)

The unit of measurement shall be the number of hydrants installed complete.

The tendered rate shall include full compensation for compliance with the requirements of subclause 06.05 of section 401.

The horizontal 80 mm diameter piping will be measured and paid for under item 402.01.

Item		Unit
402.10	**Sterilizing of pipelines**	
402.10.01	(Pipe diameter stated)	metre (m)
402.10.02	Etc for other diameters	

The unit of measurement shall be the metre of each diameter of pipeline sterilized.

The tendered rates shall include full compensation for the provision of all labour, chemicals and equipment and for sterilizing the pipeline.

Where pipelines have to be sterilized again due to some fault of the Contractor, the cost of the water shall be for the Contractor's account.

Item		Unit
402.11	**Extra over subitem 402.03.02 for using material obtained from sources provided by the Contractor**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material provided and placed.

The tendered rate shall be in full compensation for the additional cost of paying any royalties or charges for procuring the material from sources provided by the Contractor as well as for transporting the material from where obtained to where used on the Site.

Note:

The following items of work, when specified, shall be carried out, measured and paid for in accordance with the relevant sections of the Specifications, but shall be listed under this section of the Schedule of Quantities.

Item		Applicable section
(a)	Overhaul on selected material	103
(b)	Excess overburden at borrow pits provided by the Employer	201

SERIES 4 : WATER RETICULATION AND WATER MAINS

SECTION 403 : TESTING

CONTENTS

01 SCOPE

Although this section covers some of the tests to be conducted at various stages during the manufacture of pipes, fittings and specials and on completion of sections of water reticulations and pipelines, the Contractor will remain responsible for carrying out any other test that may be required to ensure that his work complies with the Specifications.

02 GENERAL

All tests shall be conducted in the presence of the Engineer (or his representative) as well as an Inspector of the Water Supply Division who will verify that the test results are to the satisfaction of the client. The Contractor shall, except for field testing as specified in clause 06, be responsible for the cost of all tests incurred in this connection, and shall submit all test results to the Engineer. All testing equipment and testing methods to be used by the Contractor shall be submitted to the Engineer for approval.

Should any portion of the work fail to pass a test, the fault or faults shall be made good by the Contractor at his own expense according to methods approved by the Engineer. After repairs have been completed, the work shall again be tested by the Contractor or by others engaged by the Employer at the Contractor's expense.

03 TESTING OF WELDS

03.01 Shop welds

To prove the procedures, radiographic examination shall be carried out on 100% of the welded seams of the first pipe of each type. If unsatisfactory results are obtained, the successive pipes shall be radiographically examined until the procedures are acceptable. Thereafter one pipe from each lot of 50 pipes shall be radiographically examined.

Irrespective of the above, each and every coil-joining butt weld for helically formed pipes, a 400 mm length from each end of every longitudinal weld seam of every pipe, and all welded seams of all specials shall be tested radiographically.

03.02 Field welds

The Contractor shall supply all equipment and materials on the Site and also personnel to conduct the radiographic examination in accordance with the requirements of API 1104 of the full length of 10% of the circumferential welds made by hand welding and 2,5% of the circumferential welds made according to an approved automatic process during the installation of pipes and specials.

03.03 Defects

Cracks, a lack of complete penetration or a lack of complete fusion shall be considered as being injurious defects, and defective field welds shall be repaired in accordance with API 1104. The full length of all repairs shall be radiographically tested.

04 TESTING OF LININGS AND COATINGS

04.01 Epoxy linings and coatings

A low-voltage pinhole detector with a wet-sponge probe, which is operated at a voltage between 80 V and 100 V, shall be used for the detection of pinholes in linings and coatings with a thickness of less than 0,50 mm. A high-voltage holiday detector operated at a voltage between 12 kV and 15 kV shall be used to detect pinholes and holidays in linings and coatings exceeding 0,50 mm in thickness.

This test shall be carried out both in the factory and on Site.

04.02 Repairs

Repairs to and the making good of damaged areas and areas that have failed shall be carried out strictly in accordance with the manufacturer's instructions unless otherwise specified.

Where linings and coatings have been cut back to facilitate the jointing of pipes, the uncoated section shall be recoated in an approved manner to a standard and quality not inferior to the original protection. Protective linings and coatings shall be reinstated strictly in accordance with the manufacturer's instructions.

05 HYDROSTATIC TESTING OF STEEL PIPES

Prior to the application of protective coatings and linings, each pipe shall be subjected to an approved hydrostatic test at a test pressure determined as follows:

$$P = \frac{2\,000\ tf}{D}$$

where P = the test pressure in kPa

t = the wall thickness in mm

f = 85% of the guaranteed minimum yield stress in MPa for the steel plate

and

D = the outer diameter of the pipe in mm.

Hydrostatic testing shall not be done until all aspects of fabrication have been completed.

The pressure shall be applied steadily by an approved method and shall be maintained, without variation, for a sufficient period of time to allow proving and inspection.

Should water ooze from any part, or any defect of any other nature be detected, the pipe shall be emptied and the defect made good. The pipe shall then be retested. Should a pipe, after repair, fail to pass the second hydraulic test, the Engineer may order its rejection.

06 HYDRAULIC FIELD-TESTING OF PRESSURE PIPES

06.01 General

Hydraulic testing shall be commenced only after permanent thrust blocks have attained their specified strength. The Contractor shall provide all the necessary testing equipment, including pressure-testing domes, blank flanges, the pump, meters, temporary valves etc, to carry out the tests on the various pipes. Water for testing purposes will be provided free of charge by the Employer from the nearest supply point.

After the trench has been partially backfilled and before the trench is filled in at the pipe joints and the fittings, the pipelines shall be tested in sections between isolating valves, end caps, blank flanges or other isolating devices at a pressure of 1,5 times the design maximum working pressure of the pipe, unless otherwise specified.

In the case of fibre cement pipelines, each section shall be filled with water 24 hours before the pressure is applied.

Care shall be taken to ensure that all air is expelled from the line to be tested after it has been filled and before the test commences.

06.02 Visible leaks

The test pressure shall be maintained for a period of at least 3 hours (or such longer period as is necessary for the inspection of the pipeline) by means of a suitable pump, during which period all pipes, specials, joints and fittings shall be carefully inspected for leaks. All visible leaks shall be made good and any pipe, special or fitting found to be defective shall be removed and replaced at the expense of the Contractor, and such replacement material shall, after installation, be tested at the expense of the Contractor.

06.03 Permissible leakage rates

The test pressure shall be maintained for a further period of 1 hour after the completion of the visible leaks test during which time the volume of water required to be pumped into the pipeline for maintaining the pressure shall be measured. No additional water shall be required in the case of continuously welded steel pipes, and in other cases the volume shall not exceed the value, in litres, calculated from the appropriate formula below:

Fibre-cement pipes:

0,075 x diameter of pipe in millimetres
x length of test section in kilometres
x square root of the test pressure in megapascal.

Jointed pipes in steel, PVC and PE:

0,01 x diameter of pipe in millimetres
x length of test section in kilometres
x square root of the test pressure in megapascal.

07 MEASUREMENT AND PAYMENT

Note:

Except for the hydraulic field test, no separate payment will be made for conducting any of the abovementioned tests, the cost of which shall be deemed to be included in the rates tendered under section 402 for items requiring testing.

Item		Unit
403.01	**Hydraulic field-testing of pipelines**	
403.01.01	(Pipe diameter stated)	metre (m)
403.01.02	Etc for diameters	

The unit of measurement shall be the metre of each diameter of pipeline tested and which has passed the test.

The tendered rate shall include full compensation for the provision of all labour and materials required, for the provision, installation, calibration and operation of the equipment used for testing and for visually inspecting the pipe for leaks, all as specified in clause 05 of this section.

SERIES 5 : DRAINAGE AND EROSION PROTECTION

SECTION 501 : SUBSURFACE DRAINS AND DRAINAGE BLANKETS

CONTENTS

01 SCOPE

This section covers all the work in connection with the construction of subsurface drains and drainage blankets at the locations and to the sizes, shapes, grades and dimensions as shown on the Drawings or as directed by the Engineer.

02 MATERIALS

02.01 Pipes

Pipes for subsurface drains shall be one of the following types as specified:

(a) Perforated pitch-fibre pipes which comply with the requirements of SANS 921.

(b) Perforated or slotted unplasticized PVC pipes which comply with the requirements of SANS 791.

(c) Porous concrete pipes which comply with the requirements of BS 5911-1144.

(d) Vitrified clay pipes which comply with the requirements of SANS 559 (excepting the requirement regarding nominal diameter) and which have special joints intended for subsoil drains may be specified or used if the Engineer's approval is obtained in advance, provided that, where the gaps at the joint do not conform to the requirement for the slots specified below, the grading of the permeable material shall be suitably adapted to meet the design requirements for preventing permeable material from entering the pipe.

The size of perforations in perforated pipes shall in all cases be 8 mm in diameter plus or minus 1,5 mm, and the number of perforations per metre shall not be fewer than 26 for 100 mm pipes and 52 for 150 mm pipes. Perforations shall be spaced in two rows for 100 mm pipes and in four rows for 150 mm pipes, as shown on the Drawings.

Slotted pipes shall have a slot width of 8 mm with a tolerance of 1,5 mm in width. The arrangement of slots shall be subject to the Engineer's approval, but the total slot area shall not be less than that specified for perforations.

Pipes without slots or perforations required for transporting subsoil water from the subsoil drain proper to the point of discharge shall be unperforated pitch-fibre or PVC pipes of the types specified above, or concrete pipes which comply with the requirements of SANS 677 Class 25D.

02.02 Permeable material

Sand, crushed stone and geotextiles used as permeable filter materials for subsurface drains and drainage blankets shall conform to the following requirements.

(a) Sand

Sand shall be clean, hard sand obtained from approved sources. The grading of the sand shall be subject to the Engineer's approval. The requirements in respect of each type and the comparative prices of sand from the available sources will determine which source is to be used. The Contractor shall submit samples and prices from available sources when so instructed by the Engineer.

(b) Crushed stone

Crushed stone shall be clean, hard, durable crushed stone from approved sources. The aggregate crushing value of the stone shall not exceed 30 when tested in accordance with method B1 of TMH1.

(i) Crushed stone for graded filters

Crushed stone for graded filters shall conform to the grading requirements set out in table 501/1.

Table 501/1

Grade	Sieve size (mm)	Percentage passing by mass
Fine grade	26,5	100
	13,2	60 - 85
	3.35	15 min
	1,18	15 max
Coarse grade	26.5	100
	13,2	60 - 85
	6,70	15 min
	2,36	15 max

The aggregate shall be evenly graded between the coarse and fine fractions with no excessive discontinuities. The Engineer shall indicate the grade of stone required.

(ii) Crushed stone for filters which incorporate geotextiles

Crushed stone for filters which incorporate geotextiles shall be nominally sized stone which conforms to the grading requirements of SANS 1083, or crushed stone which complies with the grading requirements for graded filters. The Engineer shall indicate the type of stone to be used in each particular case.

(c) Geotextiles

Geotextiles shall be a non-woven, spun or thermic-bonded continuous filament fabric consisting of at least 85% by mass of polypropylene, polyester or other approved material and manufactured for civil-engineering applications by a recognized manufacturer. The brand and type of geotextile to be used shall be as specified in the Project Specifications or on the Drawings or as directed by the Engineer.

02.03 Polyethylene sheeting

Polyethylene sheeting shall be black in colour with a minimum thickness of 0,15 mm and manufactured by a recognized manufacturer.

03 CONSTRUCTION

03.01 Excavation

The excavation of the trenches for subsurface drains shall comply with the requirements specified in and shall be measured and paid for under section 202: Trenching. The trenches shall have a width as determined by the formula in clause 04 of section 202 unless a different width is specified on the Drawings or has been authorized by the Engineer. No payment will be made for excavations outside the specified width or for additional permeable and impermeable material required because of excess trench widths.

03.02 Graded filter drains

After the completion of the excavations, the bottom portion of the trench shall be lined with polyethylene sheeting as shown on the Drawings. The top edges of the vertical portions of the sheeting shall be tacked to the sides of the excavation with nails or by any other suitable approved means. The sheeting shall be heat-welded at the laps. Sheeting damaged during installation or construction shall be replaced at the Contractor's cost.

A layer of permeable material of the class and thickness as shown on the Drawings shall be placed on the polyethylene sheeting on the bottom of the trench and shall be lightly tamped and finished to the required gradient to serve as a bedding for the pipes.

Pipes of the type and size required shall then be firmly bedded in the permeable material, true to level and grade, and shall be coupled where required. Where spigot-and-socket pipes are used, the socket ends shall be laid upgrade with the spigot fully entered into the adjacent socket. Where plain butt-ended pipes are used, they shall be laid firmly together to prevent the infiltration of backfill material. Perforated and slotted pipes shall be joined by couplers. Perforated pipes shall be laid with the perforations at the top unless otherwise shown on the Drawings or instructed by the Engineer, in writing. The higher end of a subsurface drain pipe shall be sealed off with a loose concrete cap, and at the lower end the pipe shall be built into a concrete headwall to provide a positive outlet, or it shall be connected to stormwater pipes or culverts, all as shown on the Drawings or as directed by the Engineer.

Successive layers of permeable material, shall be placed after the pipes have been laid. Permeable material shall be placed in layers not exceeding 300 mm at a time, and shall be lightly compacted. The total thickness of each type of permeable material shall be carefully controlled by means of spacers. When successive layers are placed, the lower layer shall not be walked on and shall, as far as is possible, not be disturbed. Care shall be taken to prevent the contamination of permeable material during construction of the subsurface drains, and all permeable material contaminated by soil or silt shall be removed and replaced by the Contractor at his expense. Care shall also be taken at all stages not to perforate or otherwise damage the polyethylene lining.

The remainder of the trench shall be immediately backfilled with approved impermeable material preferably obtained from the excavations, in layers not exceeding 100 mm and compacted to 90% of modified AASHTO density, unless otherwise ordered by the Engineer. The trench must be specially protected against the ingress of water, soil and silt until the backfilling with impermeable material has been completed.

Permeable material in subsoil drains shall not be taken to the surface but shall be discontinued at such heights as will be determined by the Engineer.

Any section of a subsurface drain constructed from pipes without perforations or slots shall be backfilled with impermeable backfill material as described above. Where suitable, the excavated material may be used for backfilling. Impermeable material will be paid for under section 202.

03.03 Filter drains which incorporate geotextiles

After the completion of the excavations, the bottom portion of the trench shall be lined with geotextile sheeting as shown on the Drawings. The top edges of the vertical portions of the geotextile sheeting shall be tacked to the sides of the excavation with nails or by another suitable approved means. An overlap of at least 200 mm shall be provided at each joint. Geotextile sheeting damaged during the installation or construction shall be replaced at the Contractor's cost.

The specifications set out in subclause 03.02 above for the construction of the pipe bedding, the pipe laying, and the placing of the crushed stone filter material for graded filter drains shall apply mutatis mutandis to filter drains which incorporate geotextiles.

After the pipes have been laid and the specified layer of crushed stone filter material has been completed, the protruding vertical sections of the geotextile sheeting shall be folded back across the filter material so that the filter material will be completely enwrapped in the geotextile sheeting. An overlap of at least 200 mm shall be provided between the portions folded back.

The specifications set out in subclause 03.02 above shall apply mutatis mutandis to the placing of the remaining layers of permeable material and the top layer of impermeable material, all as shown on the Drawings or ordered by the Engineer.

03.04 Drainage blankets

Drainage blankets shall be constructed in accordance with the details shown on the Drawings. Firstly geotextile sheeting shall be laid on top of the layer on which the drainage blanket is constructed. Then permeable material of the type specified shall be spread on the geotextile sheeting to the specified depth. The Contractor shall take care not to damage the geotextiles. The permeable material shall be lightly compacted and finished to the required level. To complete the drainage blanket, geotextile sheeting shall be laid on the layer of permeable material.

The layers on top of the drainage blanket shall be constructed in such a manner that the permeable material or the geotextile sheeting will not be displaced or damaged. Normally material which is to be compacted on top of the drainage blanket shall be watered and mixed before it is placed on the blanket. It shall then only be necessary to level and compact the material on the blanket.

04 TOLERANCES

Permissible tolerance limits shall be as follows:

Grade :	maximum deviation from the specified specified grade expressed as a percentage of the specified grade	10%
Plan :	maximum deviation	25 mm
Invert level :		±10 mm

05 MEASUREMENT AND PAYMENT

05.02 Pay items

Item **Unit**

501.01 Crushed stone

501.01.01 Graded crushed stone cubic metre (m^3)

501.01.02 Single-sized crushed stone (specify nominal aggregate size) cubic metre (m^3)

The unit of measurement for graded or single-sized crushed stone shall be the cubic metre of crushed stone in place, calculated according to the authorized dimensions.

The tendered rates shall include full compensation for the supply of the material and construction of the crushed stone layers as specified. No overhaul shall be paid on crushed stone for subsurface drains and drainage blankets. For payment purposes a distinction shall be made between the different grades and sizes of crushed stone.

Impermeable material will be paid for under section 202.

Item **Unit**

501.02 Procuring of filter sand provisional sum

The provisional sum allowed to cover the cost of authorized expenditure incurred in procuring, transporting and furnishing approved filter sand including the cost of transporting the material to the Site, shall be expended in accordance with the provisions of the General Conditions of Contract.

Item **Unit**

501.03 Placing of filter sand cubic metre (m^3)

The unit of measurement shall be the cubic metre of filter sand measured in place and calculated from the authorized dimensions.

The tendered rate shall include full compensation for the construction of the filter sand layers as specified.

Item **Unit**

501.04 Geotextiles (specify type, grade, brand, etc) square metre (m^2)

The unit of measurement shall be the square metre of geotextiles installed, calculated from the authorized dimensions, including the specified overlap on the top surface of filter drains but not at the joints.

The tendered rate shall include full compensation for the supply and installation of the geotextiles, as specified, including wastage and overlap.

Item **Unit**

501.05 Pipes in subsurface drains

501.05.01 (Type of pipe indicated) complete with couplings:

501.05.01.01 (Diameter and whether perforated or not, indicated) metre (m)

501.05.01.02 Etc for other diameters

501.05.02 (Type of fitting indicated)

501.05.02.01 (Diameter indicated) number (No)

501.05.02.02 Etc for other diameters

501.05.03 Etc for other types of pipes.

501.05.04 Etc for other types of fittings.

The unit of measurement for pipes shall be the metre of pipe, measured in place along its centre line, including the length of fittings. The unit of measurement for fittings shall be the number of fittings, irrespective of the type.

The tendered rates shall include full compensation for procuring, furnishing, laying and jointing the pipes and fittings as specified.

Item **Unit**

501.06 Polyethylene sheeting 0,15 mm thick, or an equivalent approved material, for lining subsurface drains square metre (m^2)

The unit of measurement shall be the square metre of polyethylene sheeting installed, measured net from the specified dimensions.

The tendered rate shall include full compensation for the supply, installation and bonding of the sheeting as specified, including overlap and wastage.

Item **Unit**

501.07 Concrete outlet structures for subsurface drains, including formwork (specify class of concrete) cubic metre (m^3)

The unit of measurement shall be the cubic metre of the specified class of concrete provided for outlet structures for subsurface drains.

The tendered rate shall include full compensation for the construction of the outlet structures as specified, including formwork, excavation and backfilling.

Item **Unit**

501.08 Concrete caps for subsurface drain pipes number (No)

The unit of measurement shall be the number of caps supplied.

The tendered rate shall include full compensation for supplying and installing the caps as specified.

SERIES 5 : DRAINAGE AND EROSION PROTECTION

SECTION 502 : PREFABRICATED CULVERTS AND STORMWATER SEWERS

CONTENTS

01 SCOPE

This section covers the work in connection with the construction, using prefabricated units, of culverts and stormwater sewers together with inlet and outlet structures, manholes and other appurtenant structures.

The specifications in respect of culverts, which are set out in this section, and which include the method of measurement and payment, shall apply mutatis mutandis to the construction of stormwater sewers which are constructed from the prefabricated units described in clause 03 of this section.

In the Schedule of Quantities no distinction will be made between the construction of culverts and the construction of stormwater sewers, which are both classed as culverts.

02 TYPES OF CULVERTS

For the purposes of these specifications, the term "prefabricated culverts" shall mean culverts constructed from

(a) circular prefabricated concrete pipes, hereinafter referred to as "concrete pipe culverts";

(b) prefabricated concrete culverts other than pipe culverts, hereinafter referred to as "portal culverts" or "rectangular culverts"; and

(c) prefabricated corrugated-metal pipes and pipe arches, hereinafter referred to as "metal culverts".

Other types of prefabricated culverts not mentioned above, if required, shall comply with the requirements specified in the Project Specifications or in the Schedule of Quantities or on the Drawings.

03 MATERIALS

The prefabricated culvert units shall be factory produced by a reputable manufacturer of these articles and shall comply with the following requirements:

03.01 Precast-concrete pipe-culvert units

Precast-concrete pipe-culvert units shall comply with the requirements of SANS 677 for SC type pipes of the class or D-load specified in the Project Specifications, in the Schedule of Quantities or on the Drawings.

Ogee joints or spigot-and-socket joints with rubber rings shall be used as indicated on the Drawings. Rubber rings shall comply with the requirements of SANS 974-1.

03.02 Portal and rectangular precast-concrete culvert units

Portal and rectangular precast-concrete culvert units shall comply with the requirements of SANS 986.

03.03 Corrugated-metal culvert units

Corrugated-metal culvert units shall comply with the requirements of CKS 176 for riveted and nestable pipes and pipe arches, and of CKS 437 for multiplate pipes and pipe arches.

Culvert units the gauge of which is below that specified, or the spelter coating of which has been bruised or broken, or which show defective workmanship shall be rejected.

The following defects are specified as constituting poor workmanship, and the presence of any or all of these or other defects in any individual unit or in general shall be sufficient cause for rejection:

Uneven laps, distorted shapes, variations from a straight centre line, ragged or diagonally sheared edges, loose rivets, unevenly aligned or spaced rivets, poorly finished rivet heads, illegible trade marks, lack of rigidity, dents or bends in the metal.

Nestable culvert units shall be stored on the Site in a manner that will prevent any moisture from accumulating between the contact faces of the nested units, as this could adversely affect the spelter coating and render the units liable to rejection. Any units damaged by corrosion shall, if not rejected, be repaired by all affected areas being cleaned and at least two coats of an approved zinc-rich epoxy primer which complies with SANS 926 being applied in accordance with the manufacturer's instructions or as directed by the Engineer.

03.04 Fine granular material

Wherever the use of fine granular material is specified in this section for the bedding of culverts, it shall mean sand or other cohesionless material, all of which shall pass a 6,70 mm square mesh sieve, and not more than 10% of which shall pass a 0,150 mm square mesh sieve.

03.05 Protective coating for metal culverts

Where corrosive soil or water conditions are likely to cause excessive corrosion of metal culverts, or where culverts are to be backfilled with soilcrete as specified in clause 12 of section 202, the Engineer may order the protection of prefabricated units by the application of a mastic asphalt protective coating before installation. The coating shall be applied to the inside or the outside or to both sides of the metal culvert units, as may be directed by the Engineer.

The material to be used shall be a proprietary brand of mastic asphalt which contains asbestos fibres and mineral filler, such as Bituseal or an equivalent approved material, and shall be supplied in a spray or brush grade, as may be directed by the Engineer.

The surfaces to be protected shall be cleaned to remove all moisture, dirt, oil, paint, grease, alkalies, rust, millscale or other deleterious matter.

The coating material shall be mixed so as to effect the uniform distribution of all asbestos fibres and mineral filler.

Spray-grade mastic shall be applied by means of an airless gun, and it shall be of a suitable consistency without excessive amounts of thinner being added.

Brush-grade mastic shall be applied with an ordinary roofing brush, and the second coat shall be applied at right angles to the first coat.

The final dry-film thickness shall be a minimum of 1,30 mm or such other thickness as may be specified, measured on the crest of corrugations.

Care shall be taken not to damage the protective coating, which must be allowed to harden before handling or assembly. All damage to the coating shall be repaired before assembly.

03.06 Skewed ends

Where culverts are to be constructed at a skew angle exceeding 20°, the culvert units at the inlet and outlet of the culvert shall be supplied with skew ends, if required.

Skewed units shall be supplied by the manufacturer and the cutting of skew ends on the Site shall be allowed only if authorized by the Engineer, in writing.

Metal culverts shall be supplied with inlet and outlet ends that have been finished as set out below, whichever is shown on the Drawings or directed by the Engineer:

(a) Where no concrete inlet and outlet structures are required, inlet and outlet units shall be bevelled to suit the skew angle of the culverts and the slope. Bevelling of the units shall be done in the factory and not on the Site.

(b) Where concrete inlet and outlet structures are required, the ends of the culvert units shall be cut to the required plan skew angle (if any) and shall be provided with anchor bolts which project radially around the edge, as shown on the Drawings, for securing the metal culvert to the concrete inlet and outlet structures.

Portal and rectangular units shall not be provided with skewed ends unless specified in the Project Specifications. These culvert units shall be supplied square, and the portion that would otherwise be cut off shall project outside the culvert head walls.

03.07 Defects

All broken, bent, chipped, cracked, dented, corroded or otherwise damaged units shall be repaired to the Engineer's satisfaction or, where this cannot be done, they shall be removed and replaced with undamaged units.

04 CONSTRUCTION METHODS

Prefabricated culverts shall be constructed under either

(a) "trenched conditions", where the units are laid in a trench excavated below the existing ground level, or in a trench excavated in previously constructed fills, subgrade and, if necessary, subbase layers; or

(b) "embankment conditions", where the units are laid more or less on the existing ground surface and the fill or embankment is then constructed on either side and over the culvert.

As a rule all prefabricated culverts and all stormwater sewers shall be constructed under trenched conditions. The only exceptions to this rule are normally the larger sizes of metal culverts and in some cases the larger portal or rectangular culverts, or cases where the Engineer considers it advisable, under certain local or climatic conditions, that prefabricated culverts be constructed before the fills. Culverts shall be constructed under embankment conditions only where shown on the Drawings or on the written authority of the Engineer.

Surface drainage shall be controlled by the construction of temporary earth berms and drainage channels to prevent stormwater from entering the trench.

05 EXCAVATION

All excavations for prefabricated culverts shall be carried out as specified in section 202. However, the Contractor's attention is drawn to the contents of the second paragraph of clause 01 of section 202 regarding wide trenches.

05.01 Depth of excavation

In the case of culverts to be constructed under trenched conditions, the Contractor shall first construct the fill, and, if necessary, the pavement layers to a level which will provide the minimum cover above the proposed level of the top of the culvert, as described hereinafter for the various types of culverts. Thereafter the Contractor may commence excavation of the trench for the culvert.

The amount by which the excavation is to exceed the proposed level of the invert of the culvert shall be sufficient to allow for the type and thickness of bedding material or invert slab to be placed as specified or as shown on the Drawings.

Where the bottom of the trench as excavated does not provide a suitably firm foundation for the culvert, the unsuitable material shall be replaced by approved material to provide a firm earth cushion as specified in section 202. When ordered by the Engineer, the Contractor shall construct a blinding layer of concrete to provide a suitable working floor for casting the invert slabs of rectangular culverts.

The minimum cover above the top of the culvert and the minimum depth of excavation below the underside of the culvert shall be as follows:

(a) Concrete pipe culverts

The minimum height of embankment construction over the top of the proposed pipe culvert before excavation may commence is the minimum cover specified on the Drawings for the type of pipe and bedding condition used.

(b) Portal and rectangular culverts

The minimum height of embankment construction over the top of the proposed culvert before excavation may commence is 100 mm or such greater height as may be shown on the Drawings.

(c) Metal culverts

The minimum height of embankment construction over the top of the proposed metal culvert before excavation may commence is the minimum cover specified on the Drawings for the type of metal culvert, or 0,25 times the diameter of the pipes, or 0,25 times the span of the pipe arches, whichever is the greater.

05.02 Width of excavation

The widths of trenches shall be determined by the formula given in clause 04 of section 202. The widths of trenches may vary only with the written approval of the Engineer.

If the width of any trench is increased by the slipping or collapsing of the side of the trench, the Contractor shall inform the Engineer immediately and shall not proceed with any further pipe-laying or backfilling in the relevant section until the Engineer has reviewed the circumstances and has given instructions as to the need for altering the class of pipe or bedding conditions.

Where pipe culverts consist of two or more pipes next to each other, the minimum spacing between adjacent pipes shall be 300 mm or half the outer diameter of the pipe, whichever is the greater, up to a maximum of 900 mm. Where the backfilling between multiple pipe culverts is done with soilcrete as specified in clause 12 of section 202, the spacing between adjacent pipes shall be 225 mm or one-third of the outer diameter of the pipe, whichever is the greater, up to a maximum of 500 mm.

Where pipes are to be encased in concrete or soilcrete, the trench width shall be determined either by the width of encasing as shown on the Drawings, or by the Engineer on Site.

Where portal and rectangular culverts are to be backfilled with concrete or soilcrete as described hereinafter, the width of excavation shall be equal to the total outside width of the culvert portal, plus 0,5 m for both single and multiple openings. In the case of rectangular culverts with a span of up to 1 200 mm, which are so located that the tops of the culverts are in or just below the subbase layer, the Engineer may require that the excavation width shall be the net width of the cast in situ invert slabs or the net width of precast invert slabs, plus 100 mm.

The width of excavation for metal culverts shall be equal to the inner diameter or the span of the metal pipe or pipe arch plus 0,8 m on each side of the culvert. Where metal culverts consist of two or more units next to each other, the minimum clearance between adjacent culverts shall be 0,8 m.

06 CONSTRUCTION UNDER EMBANKMENT CONDITIONS

Where culverts are to be constructed under embankment conditions as defined in clause 04 of this section, the Contractor shall level the existing ground by excavating and filling and compacting as required, so that the foundation for the culvert will be true to grade and of a uniform density over the entire length of the culvert and over a width determined as specified in subclause 04.01 of section 202.

The finished level of the ground on which the culvert is to be bedded shall be in accordance with the Drawings.

07 BEDDING AND LAYING OF PREFABRICATED CULVERTS

07.01 Concrete pipe culverts

Ogee-type pipes and spigot-and-socket pipes shall be laid with the spigot ends pointing downstream. The inside of the culverts shall be smooth with no displaced joints. All pipes shall be laid true to line and level.

(a) Bedding

The pipes shall be laid on a class A or class B bedding as specified for sewers in clause 03 of section 302, and to the dimensions as indicated on the Drawings.

(b) Rock foundation

Where rock, shale or other hard material is encountered on the bottom of an excavation, the bottom shall be prepared as specified in clause 09 of section 202.

(c) Concrete casing

Where shown on the Drawings or ordered by the Engineer, pipes shall be fully encased in class 20/19 concrete in accordance with clause 05 of section 302.

07.02 Portal and rectangular culverts

(a) Cast in situ invert slabs

Cast in situ invert slabs shall be constructed to the dimensions and at the locations as shown on the Drawings or as directed by the Engineer. They shall be reinforced with steel reinforcement as detailed on the Drawings.

(b) Precast invert slabs

A layer of fine granular material with a thickness of at least 75 mm shall be placed on the bottom of the excavation, and shall be levelled, compacted and trimmed to grade and line to form a bed suitable for receiving the precast invert slabs.

The slabs shall be carefully placed on the prepared bed, true to line and grade, and shall be bedded in such a manner that they will be uniformly supported over their entire area on the bedding.

(c) Placing of upper portion of culverts

The upper portion of portal and rectangular culverts shall be placed true to line and grade on the invert slabs, with a thin layer of 1:3 cement: sand mortar between the contact surfaces to ensure a firm and uniform support.

The units shall be butted end to end and the joints shall be covered on the outside with two layers of 340 g/m^2 hessian which has been presoaked in bituminous emulsion. The hessian shall be at least 150 mm wide, and the culverts shall first be primed with a coat of 60% bituminous emulsion before they are covered with the hessian. The hessian strips shall be placed symmetrically over the joints.

Where two or more culverts are placed side by side to form a multi-barrel culvert, the space between the culverts shall be filled with class 20/19 concrete up to the level of the top of the culvert.

07.03 Metal culverts

The excavation shall be trimmed to the contour of the invert of the culvert, and a bed of fine granular material with a thickness of not less than 75 mm shall be placed, compacted and shaped to enable the culverts to be bedded as shown on the Drawings. The culverts shall be installed in accordance with the manufacturer's recommendations and as approved by the Engineer. In case of a discrepancy between these Specifications and the manufacturer's recommendations, these Specifications shall apply. Anchor bolts shall be installed at the ends of metal pipe culverts in accordance with the manufacturer's instructions and as approved by the Engineer, for tying them to inlet and outlet head walls.

No concrete bedding or casing shall be used in the installation of metal culverts.

Where metal culverts with diameters or spans exceeding 1 500 mm are to be laid on steep grades, the Engineer may direct that the invert be protected with a layer of concrete with dimensions and of a class as shown on the Drawings.

07.04 General

Construction of culverts shall begin at the one end, the position of which shall be fixed as shown on the Drawings or as directed by the Engineer. The position of the other end of the culvert shall normally be determined by the end of the last complete unit, the top of which breaks through the fill slope. However, in the case of skew culverts, culverts with a cover of less than 0,5 m at the shoulder, or metal culverts, the Engineer may order that the end unit be cut to the length and skew required.

Any deformed or cracked units, or units which are not constructed to the required lines, levels and grades, or which become displaced in the process of the work or during the maintenance period, shall be removed and replaced by the Contractor at his own expense.

Precast units shall be lifted and handled by means of approved lifting devices only. Lifting eyes shall be caulked with a suitable mortar after the units have been installed.

The Contractor shall exercise due care not to damage, overstress or displace any prefabricated culverts with his own traffic or compaction equipment and he shall provide additional cover over the culverts or take other approved measures so as to ensure that the design stresses of the culverts are not exceeded.

All concrete work shall be carried out in accordance with the provisions of series 7 of these Specifications.

08 BACKFILLING OF PREFABRICATED CULVERTS

After the culverts have been firmly laid on the required bedding, backfilling shall be carried out as follows:

The material used for the backfilling of those portions of culverts subject to traffic loads shall be selected material as specified in clause 11 of section 302. Where the quality of the excavated material is poor, selected material shall be imported for this purpose. The Contractor shall ascertain in advance from the Engineer what portions will require selected material for backfilling.

In the case of concrete pipe culverts on class B bedding and metal culverts, the backfilling material shall be thoroughly tamped in under the flanks of the culverts to provide a uniform bedding, all to the Engineer's satisfaction. Metal culverts shall be temporarily ballasted during backfilling to prevent them from lifting.

Backfilling alongside and over all culverts shall be watered, mixed, placed and compacted, in layers not exceeding 150 mm after compaction, to a density of at least the density required for the material in adjoining layers of fill, subgrade and subbase. The density of backfilling in excavations made in natural ground shall be at least 90% of modified AASHTO density.

Backfilling shall be carried out simultaneously and equally on both sides of a culvert to avoid any unequal lateral forces from being exerted.

Where culverts have been constructed under embankment conditions as defined in clause 04 of this section, the backfilling shall be carried out to the same standard as described above, simultaneously and equally on both sides of the culvert and over the culvert, until the minimum specified cover is obtained. After completion, the width of backfill on each side of the culvert shall be at least equal to the diameter (or span) of one of the openings of the culvert.

Metal culverts shall be backfilled symmetrically to prevent distortion of the units, and the Contractor shall also make sure as to whether the required cover as specified in subclause 05.01(c) has been provided over the culvert before his construction equipment may be routed across the culvert.

Where the width of excavation for rectangular culverts has been limited by the Engineer, as described in subclause 05.02 of this section, the backfilling shall consist of class 1:4:8/38 concrete placed between the side of the culvert and the excavation up to the top of the culvert.

When specified or ordered by the Engineer, culverts shall be backfilled with a soilcrete in lieu of a compacted gravel or lean concrete.

The soilcrete shall be placed by vibrators so as to properly fill all voids between the culverts and the sides of excavations, and between culverts in the case of multi-barrel culverts. The height to which the soilcrete backfill is taken shall be as determined by the Engineer or as shown on the Drawings, and any remaining backfilling shall be carried out as described above with a granular material.

Soilcreting shall be carried out in accordance with the requirements of section 202.

Where soilcrete is used for the backfilling of corrugated metal culverts, they shall be provided with a protective coating as specified in subclause 03.05 of this section.

The backfilling of stormwater sewers with selected material to 300 mm above the barrel of the pipes shall be carried out as specified in clause 11 of section 302, and the balance of the trench as specified in clause 13 of section 202.

Backfilling carried out without selected material shall be measured and paid for under section 202.

09 INLET AND OUTLET STRUCTURES, CATCHPITS, MANHOLES AND JUNCTION BOXES

Inlet and outlet structures for prefabricated culverts and stormwater sewers and catchpits, manholes and junction boxes shall be constructed in accordance with the details shown on the Drawings.

09.01 Excavation

Excavation shall be carried out in accordance with the requirements of section 202.

09.02 Backfilling

The material and method of compaction used for backfilling around manholes, cathpits, precast inlet and outlet structures and junction boxes shall be subject to the same requirements as specified in respect of prefabricated culverts, except that the entire backfilling process shall be carried out using selected material. Backfilling in layers shall proceed simultaneously around the whole circumference of the structure and payment for such backfilling shall be included in the rates tendered for the pay items for the construction of manholes, catchpits, precast inlet and outlet structures and junction boxes.

09.03 Concrete work

Concrete work shall be carried out in accordance with the provisions of series 7 of these Specifications. Unless otherwise specified, concrete for blinding shall be class 15/19 concrete, and class 25/19 for other purposes.

09.04 Brickwork

Bricks shall be engineering grade burnt clay masonry units complying with SANS 227 and shall be of the class NFX E14 unless otherwise specified in Project Specifications or Drawings.

Brickwork shall be built in accordance with the requirements of section 805.

Where pipes enter brickwork, they shall be thoroughly caulked into the wall and rendered with mortar.

09.05 Plaster and mortar

Plaster and mortar work shall be carried out in accordance with the requirements of section 805.

09.06 Manhole covers, grid inlets, etc

Manhole covers and frames, grid inlets and other metal accessories such as step irons, etc, shall be supplied and/or manufactured in accordance with the details shown on the Drawings.

After having been fixed, all exposed metal surfaces of covers, frames and gratings shall, after having been cleaned, be painted with two coats of epoxy tar paint conforming to the requirements of SANS 801 type III. Manhole frames shall be set firmly in cement mortar so that the covers will be flush with the final surface with allowance as may be required for any future paving.

09.07 Benching

All benching shall be rendered in granolithic concrete with a minimum thickness of 20 mm and shall be finished smooth and true with a steel trowel, and all corners shall be rounded.

09.08 Precast inlet and outlet structures

Where the use of precast inlet and outlet structures for culverts is specified, they shall be manufactured in accordance with the dimensions shown on the Drawings. These units shall be laid and jointed generally as specified for precast concrete pipe culverts.

Kerb inlets shall be installed in positions shown on the Drawings and shall be parallel to the road centre line and at the same grade as the road, but the specified positions of kerb inlets shall be modified if necessary to ensure that they are located at the lowest points of the vertical curves of the roads they serve.

10 ROAD CROSSINGS

Where stormwater drains cross existing roads, the work shall be carried out as specified in clause 14 of section 202.

11 TOLERANCES

Permissible tolerance limits shall be as follows:

(a) Catchpits, kerb inlets, junction boxes and grid inlets:

- Plan : maximum deviation (with the proviso that catchpits, kerb inlets and grid inlets shall be placed at the exact lowest point of the road) 25 mm or to suit the kerbing where applicable
- Invert level: ± 25 mm

(b) Pipelines and culverts:

- Plan : maximum deviation 25 mm
- Grade : maximum deviation from the specified grade expressed as a percentage of the specified grade 10%

(c) Culvert in- and outlets: to suit the pipes

12 MEASUREMENT AND PAYMENT

Note:

Reference shall be made to the last paragraph of clause 02 of section 202 regarding payment for work carried out under this section.

Item		Unit
502.01	**Backfilling with selected excavated material compacted to -**	
502.01.01	90% of modified AASHTO density	cubic metre (m^3)
502.01.02	93% of modified AASHTO density	cubic metre (m^3)
502.01.03	95% of modified AASHTO density	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material in place after compaction and the quantity shall be calculated from the authorized dimensions of the backfilling as specified or as authorized by the Engineer. The volume occupied by the culvert shall be subtracted when the volume of backfilling is calculated.

The tendered rates shall include full compensation for selecting the material, for backfilling alongside and over culverts, for watering and compacting the backfill material to the specified densities and for transporting the material from where excavated to where used, regardless of the distance transported.

Item		Unit
502.02	**Supplying and laying of concrete pipe culverts (type SC-pipes)**	
502.02.01	(Bedding, class or D-load indicated)	
502.02.01.01	(Diameter indicated) dia pipes	metre (m)
502.02.01.02	Etc for other diameters	
502.02.02	Etc for other beddings, classes or D-loads	

Item		Unit
502.03	**Supplying and laying of metal culverts**	
502.03.01	(Type and wall thickness indicated)	
502.03.01.01	(Diameter indicated)	metre (m)
502.03.01.02	Etc for other diameters	
502.03.02	Etc for other types and wall thicknesses	

Item		Unit
502.04	**Supplying and laying bevelled ends for metal culverts**	
502.04.01	(Type and wall thickness indicated)	
502.04.01.01	(Diameter indicated)	number (No)

502.04.01.02 Etc for other diameters

502.04.02 Etc for other types and wall thicknesses

Item		Unit
502.05	**Supplying and installing anchor bolts for metal culverts**	
502.05.01	(Size indicated)	number (No)
502.05.02	Etc for other sizes	

Item		Unit
502.06	**Supplying and laying portal and rectangular culverts**	
502.06.01	Complete with precast invert slab (type indicated)	
502.06.01.01	(Size of culvert indicated)	metre (m)
502.06.01.02	Etc for other sizes	
502.06.02	Without precast invert slab (type indicated)	
502.06.02.01	(Size of culvert indicated)	metre (m)
502.06.02.02	Etc for other sizes	

The unit of measurement for prefabricated culverts (concrete pipes, metal culverts and portal or rectangular culverts) shall be the metre of culvert laid as shown on the Drawings or as directed by the Engineer.

The length shall be measured along the soffit of the culvert. In the case of metal culverts with bevelled ends, the bevelled portions which extend beyond the soffit shall be measured separately per unit for each size of culvert.

The tendered rates shall also include full compensation for the testing, loading, transporting and off-loading of the culverts, and for the provision and placing of the fine granular material where it is required for the bedding of culverts.

For payment purposes a distinction shall be made between the different sizes and types of culverts and, in the case of concrete pipe culverts, between pipes laid on class A or B bedding.

Bevelled ends of metal culverts shall be paid for separately per end.

Item		Unit
502.07	**Extra over item 502.02 for end units for concrete pipe culverts with a skew of more than 20°**	
502.07.01	(Type indicated)	
502.07.01.01	450mm	number (No)
502.07.01.02	Etc for other diameters	
502.07.02	Etc for other types	

Item		Unit
502.08	**Extra over item 502.03 for end units for metal culverts with a skew of more than 20°**	
502.08.01	(Type indicated)	
502.08.01.01	(Size indicated)	number (No)
502.08.01.02	Etc for other sizes	
502.08.02	Etc for other types	

Item		Unit
502.09	**Extra over item 502.06 for end units for portal and rectangular culverts with a skew of more than 20°**	
502.09.01	Complete with precast invert slab (type indicated)	
502.09.01.01	(Size indicated)	number (No)
502.09.01.02	Etc for other sizes.	
502.09.02	Without precast invert slab (type indicated)	
502.09.02.01	Size indicated	number (No)
502.09.02.02	Etc for other sizes	

The unit of measurement for providing manufactured end units for skew culverts shall be the number of such skew end units supplied for each type and size of prefabricated culvert, irrespective of the angle of skew.

The tendered rates shall be extra over the rates for items 502.02, 502.03 and 502.06 and shall include full compensation for all additional costs involved in manufacturing, supplying and laying the skew end units.

Item		Unit
502.10	**Cast in situ concrete**	
502.10.01	In class A bedding, blinding layers and encasing of pipes, including any form-work required	
502.10.01.01	(Class of concrete indicated)	cubic metre (m^3)
502.10.01.02	Etc for each class of concrete required	
502.10.02	In invert slabs for portal or rectangular culverts, including formwork to provide class F1 surface finish and class U2 surface finish for unformed surfaces	
502.10.02.01	(Class of concrete indicated)	cubic metre (m^3)
502.10.02.02	Etc for each class of concrete required.	
502.10.03	In inlet and outlet structures, catchpits, manholes and junction boxes excluding form-work, but including class U2 surface finish	
502.10.03.01	(Class of concrete indicated)	cubic metre (m^3)
502.10.03.02	Etc for each class of concrete required.	
502.10.04	Formwork for concrete under item 502.10.03 above	
502.10.04.01	(Type of finish indicated)	square metre (m^2)
502.10.04.02	Etc for each type of finish	

502.10.05	In concrete lining for invert of metal culverts, including formwork and class U2 surface finish	
502.10.05.01	(Class of concrete indicated)	cubic metre (m^3)
502.10.05.02	Etc for each class of concrete.	

Measurement of and payment for formwork and concrete (where paid for separately) shall be as specified in series 7 of these Specifications.

Item		Unit
502.11	**Class 1:4:8/38 concrete backfill for culverts**	cubic metre (m^3)

The unit of measurement shall be the cubic metre and the quantity shall be calculated from the dimensions of the excavation as specified or authorized by the Engineer, minus the volume occupied by the culverts.

Payment for concrete shall be made as specified in section 704.

Item		Unit
502.12	**Supplying and laying precast concrete inlets and outlets for culverts**	
502.12.01	(Type indicated)	
502.12.01.01	(Size indicated)	number (No)
502.12.01.02	Etc for each size required	
502.12.02	Etc for other types	

Precast concrete inlets and outlets to concrete pipe culverts shall be measured per inlet or outlet complete in position.

The tendered rates shall include full compensation for providing, loading, transporting off-loading and installing the inlets or outlets as specified.

Item		Unit
502.13	**Welded-steel fabric**	
502.13.01	(Nominal longitudinal and cross pitch and nominal diameter of longitudinal and cross wires indicated)	kilogram (kg)
502.13.02	Etc for other pitches and diameters	

Measurement of and payment for welded-steel fabric shall be made as specified in section 703.

Item		Unit
502.14	**Reinforcement**	
502.14.01	Mild steel	
502.14.01.01	Bars with an 8 mm dia	ton (t)
502.14.01.02	Etc. for other diameters	
502.14.02	High-yield-stress steel	
502.14.02.01	Bars with an 8 mm dia	ton (t)
502.14.02.02	Etc for other diameters	
502.14.03	Etc for other types of steel	

Measurement of and payment for steel reinforcement shall be made as specified in section 703.

Item		Unit
502.15	**Protective mastic-asphalt coating for corrugated-metal culvert units** (state whether applied by brush or spray gun)	square metre (m^2)

The unit of measurement shall be the square metre of protective coating applied as specified and directed by the Engineer. When both inner and outer surfaces have been treated, both surfaces shall be measured.

The tendered rate shall include full compensation for procuring and furnishing the mastic-asphalt and for the treatment of the surface with the protective coating as specified.

Item		Unit
502.16	**Manholes, catchpits, precast inlet and outlet structures and junction boxes complete**	
502.16.01	Manholes (type and standard depth indicated)	number (No)
502.16.02	Catchpits (type indicated)	number (No)
502.16.03	Precast inlet and outlet structures (type indicated)	number (No)
502.16.04	Transitions before and after catchpits (length and type indicated)	number (No)
502.16.05	Junction boxes (size indicated)	number (No)
502.16.06	Extra over or under item 502.16.01 for variation in depth of manholes from the standard depth designated for purposes of tendering (manhole type indicated)	metre (m)

The unit of measurement shall, in the case of subitems 502.16.01, 502.16.02, 502.16.03, 502.16.04 and 502.16.05 be the complete unit as shown on the Drawings, including all concrete, brickwork, covers, frames, grids and other accessories.

The tendered rates shall include full compensation for procuring, furnishing and installing the complete units and for backfilling around the unit with selected material. The tendered rates shall also include full compensation for connecting up and building any conduits into the walls of the various structures.

The unit of measurement in the case of subitem 502.16.06 shall be the metre of increased or decreased depth of the manhole measured in relation to the standard depth designated for tendering purposes. The tendered rate per metre shall be an adjustment of compensation for the standard item, payable to the Contractor either as an increased compensation in the case of an increase in depth, or as a decrease in compensation in the case of a decrease in depth measured in relation to the standard depth.

Where the above items of work cannot be conveniently standardized according to complete units for payment purposes, the various types of work and items of material provided shall be measured separately in accordance with items 502.17 to 502.20 and such other items as may be necessary.

Excavation shall be measured and paid for under section 202.

Item		Unit
502.17	**Brickwork**	
502.17.01	115 mm thick	square metre (m^2)
502.17.02	230 mm thick	square metre (m^2)
502.17.03	345 mm thick	square metre (m^2)

The unit of measurement shall be the square metre of brickwork built, calculated from the leading dimensions of the brickwork. Areas in walls occupied by conduits shall not be included in the areas measured, and corners and intersections common to more than one brick wall shall be measured only once.

The tendered rates per square metre shall include full compensation for the brickwork complete as specified, including pointing and building in conduits.

Item		Unit
502.18	**Plaster**	square metre (m^2)

The unit of measurement shall be the square metre of plasterwork provided.

The tendered rate shall include full compensation for raking out joints in the brickwork and applying a 1:3 plaster as specified to all surfaces required.

Item		Unit
502.19	**Benching**	square metre (m^2)

The unit of measurement shall be the square metre of benching, measured in plan, constructed in class 20/19 concrete with granolithic rendering.

The tendered rate shall include full compensation for procuring and furnishing all materials and placing the benching complete as specified with granolithic rendering.

Item		Unit
502.20	**Accessories**	
502.20.01	Manhole covers including frames (description)	number (No)
502.20.02	Inlet grids including frames (description)	number (No)
502.20.03	Step irons (description)	number (No)
502.20.04	Etc for other accessories	

The unit of measurement shall be the number of each type of accessory delivered and installed.

The tendered rates shall include full compensation for procuring, furnishing and installing the accessories.

Item		Unit
502.21	**Soilcrete**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of soilcrete backfilling constructed, calculated from the authorized dimensions of the excavations and the height of the backfilling in soilcrete. The volume occupied by conduits or other structures shall not be included in the quantities measured.

The tendered rate shall include full compensation for constructing soilcrete backfilling complete and in accordance with clause 12 of section 202 of the specifications, including full compensation for ordinary cement, used at the rate of 5% of the dry mass of the soil used, and stone-packing at culvert ends to support wet soilcrete.

Where gravel material for soilcrete is imported, the extra over item 502.22 shall apply.

Item		Unit
502.22	**Extra over items 502.01 and 502.21 for using backfill material obtained -**	
502.22.01	from borrow areas provided by Employer	cubic metre (m^3)
502.22.02	from sources provided by Contractor	cubic metre (m^3)

The unit of measurement shall be the cubic metre of imported backfill material.

The tendered rates paid extra over items 502.01 and 502.21 shall be in full compensation for the additional cost of excavating and loading the material, and in the case of -

- subitem 502.22.01, for all operations at borrow areas not subject to separate payment as specified in clauses 05 and 09 of section 201 and for hauling material within the free-haul boundaries, and
- subitem 502.22.02, for payment of any royalties or charges for procuring the material from sources provided by the Contractor as well as for transporting the material from where obtained to where used on Site.

Item		Unit
502.23	**Cleaning of existing culverts**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material/ debris removed from the existing culvert.

The tendered rate shall include full compensation for the provision of all labour and plant necessary to clean the culvert and the removing, transporting and disposing of all material to sites to be provided by the contractor.

Note:

The following items of work, when specified, shall be carried out, measured and paid for in accordance with the relevant sections of the Specifications, but shall be listed under this section of the Schedule of Quantities.

Item		Applicable section
(a)	Overhaul on selected backfill material	103
(b)	Excess overburden at borrow pits provided by the Employer	201

SERIES 5 : DRAINAGE AND EROSION PROTECTION

SECTION 503 : KERBING AND CHANNELLING

CONTENTS

01 SCOPE

This section covers the work in connection with the construction of precast and cast in situ concrete kerbing and channelling.

02 MATERIALS

02.01 Concrete

All concrete work shall be carried out in accordance with the requirements of sections 702 and 704 of these Specifications.

02.02 Kerbing and channelling

Precast kerbing shall be of the dimensions shown on the Drawings, shall comply with the requirements of SANS 927 and shall, unless otherwise directed, be supplied in 1,0 m long sections, except around curves at road intersections where they shall be 0,3 m in length. Kerbing and channelling cast in situ shall be of the class of concrete indicated on the Drawings.

02.03 Bedding material

The material on which precast concrete kerbs are to be bedded shall consist of crushed stone, cinders, slag, sand or other approved porous material with a maximum particle size of 13,2 mm.

02.04 Mortar

Mortar shall be mixed in the ratios of sand and cement specified.

Only ordinary cement shall be used.

03 TYPES OF KERBS

Kerbing shall be one or more of the following types:

(i) Precast barrier kerbs (fig 3 in SANS 927) with cast in situ-channels

(ii) Precast semi-mountable kerbs (fig 7 in SANS 927) with cast in situ channels

(iii) Cast in situ sloping kerbs as indicated on the Drawings.

Sloping kerbs may also be constructed with slip forms in a continuous operation with an approved machine.

04 CONSTRUCTION

04.01 General

Kerbing and channelling shall be constructed after the subbase, which extends below and beyond the kerbing and channelling, has been completed.

No excavation into the completed subbase is necessary to accommodate kerbing and channelling and in most cases, depending on the thickness of the base and wearing course, a difference in level exists between the top of the subbase and the bottom of the kerbing as is shown on the Drawing.

This difference in level will vary depending on how accurately the subbase layer has been constructed.

04.02 Precast concrete kerbing

Precast kerbing shall be constructed on a bedding layer of the type of material specified in subclause 02.03, and approved by the Engineer.

Precast concrete kerbing shall be laid with close joints of 3:1 sand : cement mortar at the ends. The joints may not exceed 10 mm in width and must be neatly pointed with a pointing trowel. Guide-lines and straight-edges shall be used to ensure that the exposed faces of kerbs are set true to line and elevation. Kerbing around curves shall be laid along the full curve length before the joints are made, unless otherwise allowed by the Engineer.

After the precast kerbing has been constructed, the cast in situ channelling shall be constructed as specified in subclause 04.03 below.

Precast kerbs shall be supported with a concrete backing of the dimensions and class of concrete as shown on the Drawings.

04.03 Cast in situ kerbs and channels

Where there is a difference in level between the top of the subbase and the bottom of the cast in situ kerbs or channels, such difference shall be made up with the same concrete as specified for the kerb or channel. This additional concrete shall be cast in one operation with the kerb or channel. Alternatively, if the difference in level exceeds 75 mm, it can be made up with a layer of subbase material compacted to at least 90% of modified AASHTO density, the surface of which shall be finished off true to line and level.

Kerbs and channels cast in situ shall be cast in alternate sections. The lengths of sections shall be 2 m except where shorter sections are necessary for closures or where otherwise shown on the Drawings or required by the Engineer. Cast in situ channels used with precast kerbs shall be of the same length as the kerbs.

Forms shall be accurately set to line and elevation and shall be firmly fixed in position during the placing of the concrete. Stops at the ends of sections shall be placed accurately so as to ensure that the joints between adjacent sections are truly perpendicular to the surface of the concrete and at right angles to the edge of the road. After the concrete has been placed in the forms, it shall be tamped and spaded until the exposed surfaces are entirely covered with mortar. Exposed faces shall then be finished to smooth and even surfaces and edges shall be rounded to the radii shown on the Drawings.

The forms of concrete surfaces that will be exposed shall be removed within a period of 24 hours after the concrete has been placed. Minor defects shall be repaired with a 2:1 sand : cement mortar. Plastering shall not be permitted on exposed faces and all rejected portions shall be removed and replaced at the Contractor's expense. Exposed surfaces shall be finished while the concrete is still green, by wetting a soft brick or a wooden block and rubbing the surfaces until they are smooth. When the concrete has been smoothed by using water, it shall be rubbed with a thin paste of 1:1 sand : cement mortar to obtain a uniform colour and texture.

When completed, the sections shall be cured in accordance with the requirements specified in section 704.

After the concrete in alternate sections has set, the intermediate sections shall be cast and finished off in accordance with all the requirements specified above for alternate sections. The exposed end surfaces of the alternate sections cast first shall be coated with an approved bituminous emulsion containing 60% net bitumen by mass, and the emulsion must be allowed to set and dry before the intermediate sections are cast.

Guide-lines and straight-edges shall be used to ensure that the exposed faces of kerbs and channels are formed true to line and elevation.

The Contractor may use an approved machine which is capable of placing cast in situ kerbs and channels in one continuous operation by means of slip forms. He must, however, be able to obtain at least the same standard of finish, in respect of both appearance and line, as can be obtained by the methods described above. The concrete strip shall also be provided with neat joints at the intervals described above.

04.04 Backfilling

After completion of concrete work, the excavated spaces at the back of kerbs shall be refilled with approved material to shoulder or sidewalk level. Such backfill shall be placed in layers not exceeding 150 mm in thickness and each layer shall be watered and thoroughly compacted before the succeeding layer is placed thereon. The construction of medians, sidewalks, traffic islands and other unsurfaced areas behind kerbs shall be carried out in accordance with the relevant clauses of section 104 : Landscaping and grassing, and shall be measured and paid for under that section.

Where the basecourse is to be constructed after the kerbing has been laid, the concrete backing to the kerbs and backfill behind the kerbs shall be completed prior to the construction of the basecourse in order that the kerbing shall not be displaced during construction of the basecourse.

Where kerbs and channels are laid after the basecourse has been constructed, the spaces between the concrete and adjoining base shall be backfilled with premixed bituminous material.

04.05 Protection

Care shall be taken to protect all precast units against chipping or breakage during transportation and laying. Broken or badly chipped sections may not be used and shall be removed and replaced with undamaged units.

Concrete kerbing and channelling as well as any other structures adjacent to the road shall be protected from discolouration by bitumen being sprayed or premix being placed. Where bitumen is to be sprayed, all such work shall be completely covered with polyethylene sheeting at least 0,25 mm thick and weighted down by packed stones and sand to prevent the sheeting from lifting during windy conditions. Any work discoloured by bitumen shall be broken down and replaced, unless all such bitumen is completely removed so that no discolouration is visible at all. Painting over discoloured sections will not be allowed.

05 TRANSITION SECTIONS

Transition sections for kerbing and kerbing-channelling combinations shall be constructed to the same standards and by the same methods as described for the uniform sections, but with the required modifications as detailed on the Drawings. Sections may be either precast or cast in situ units. Transition sections which form part of inlet structures shall be measured and paid for under section 502.

06 TOLERANCES

Concrete kerbing and channelling shall be constructed to within the following dimensional and alignment tolerances:

(a) Horizontal alignment:

The maximum deviation of edges, the centre line or vertical surfaces from the specified position shall be 25 mm.

The maximum deviation of edges, the centre line or vertical surfaces from the specified horizontal alignment shall be 1:500 when taken over any section exceeding 10 m in length.

(b) Vertical alignment and level:

The inside edge of channelling shall nowhere be less than 20 mm and not more than 30 mm below the finished road surface. The invert level of channels and the top of kerbing shall nowhere deviate more than 10 mm from the required level, and nowhere shall channels have any adverse grade.

(c) Trueness of exposed surfaces:

When tested with a 3 m straight-edge, no surface irregularities shall exceed 6 mm.

(d) Cross-sectional dimensions:

All cross-sectional dimensions shall be within 6 mm of the specified dimensions, except that the underside of channelling may extend up to 25 mm below the level at which it would have the required thickness.

07 SURFACE FINISH

All unformed exposed concrete surfaces shall have a class U2 surface finish, and all formed exposed concrete surfaces shall have a class F2 surface finish.

08 MEASUREMENT AND PAYMENT

Item		Unit
503.01	**Concrete kerbing** (Class of concrete indicated for in situ concrete)	
503.01.01	(Description of type with reference to Drawing)	metre (m)
503.01.02	Etc for other types	

Item		Unit
503.02	**Concrete kerbing-channelling combination** (Class of concrete indicated for in situ concrete)	
503.02.01	(Description of type with reference to Drawing)	metre (m)
503.02.02	Etc for other types	

The unit of measurement shall be the metre of concrete kerbing or kerbing-channelling combination complete as constructed, measured along the front face of the kerb.

The tendered rate for each metre of concrete kerbing and kerbing-channelling combination shall include full compensation for constructing the complete item, including the necessary excavation, bedding, additional concrete or subbase material as specified in subclause 04.03, backfilling, formwork, concrete, curing and finishing, for recessing the specified letters into the concrete where necessary to indicate the positions of service ducts or house connections for water and for the installation of the concrete backing.

Item		Unit
503.03	**Transition sections** (Type designs)	
503.03.01	(Description of type, etc with reference to Drawing and class of concrete)	number (No)
503.03.02	Etc for other types	

The unit of measurement and payment shall be the number of completed units of each type of transition section constructed, and payment shall include full compensation for all formwork, concrete, curing, excavation, trimming and backfilling.

SERIES 5 : DRAINAGE AND EROSION PROTECTION

SECTION 504 : OPEN DRAINS

CONTENTS

01 SCOPE

This section covers the construction of open drains as defined in clause 02, either as unlined excavations and banks, lined excavations, or as concrete drains.

02 DEFINITIONS

For the purpose of this section in particular and these Specifications in general, the following words shall have the meanings hereby assigned to them.

(a) Catchwater drain

An open drain constructed at the top of a cutting to prevent water from running down the face of the cutting.

(b) Channel

Any open drain other than a chute, mitre drain, catch-water drain or side drain.

(c) Chute

A drain, usually in precast concrete, running down the slope of an excavation or embankment. Chutes are called down-lets in railway work.

(d) Mitre drain

An open drain consisting of an excavation and bank, normally at an angle to the road or rail centre-line, for the purpose of conveying water away from the road or rail reserve.

(e) Open drain

A chute, mitre drain, catchwater drain, side drain or channel constructed for the purpose of conveying stormwater.

(f) Side drain

A longitudinal open drain situated adjacent to and at the bottom of a cutting or embankment slope or adjacent to the shoulder of a road.

03 EXCAVATIONS

03.01 Classification of excavations according to the type of material excavated

Excavations shall be classified as either soft excavations or hard excavations in accordance with the provisions of clause 03 of section 202.

03.02 Mass excavations

All mass excavations for road and railway cuttings shall be completed, measured and paid for under section 203. Only the remainder of such excavations which is required solely for the purpose of constructing open drains will be measured and paid for in accordance with the provisions of this section. (See diagram 504/01.)

In the case of large open drains, the excavation thereof or part thereof shall be treated as mass excavations (and earthworks) under section 203, or be measured and paid for under that section wherever so specified in the Project Specifications, otherwise they shall be constructed, measured and paid for in accordance with the provisions of this section.

03.03 Hand excavation

In the case of open drains paid for as type designs, and in the case of mitre drains, catchwater drains and concrete chutes, no extra over payment will apply in respect of hand excavations, and the Contractor shall, as may be necessary, make allowance in his rates for all hand excavations.

For side drains and channels paid for by components, the Engineer shall classify as hand excavation such excavations or parts thereof as he may consider can be excavated only by hand tools, and the Contractor shall be paid accordingly. Notwithstanding the above, any hand excavation required solely for the purpose of accurately trimming the excavations to the final shape specified, shall not be classified or paid for as hand excavation.

03.04 General

Open drains shall be excavated true to line, grade, level and cross section, and unlined drains shall be maintained to this shape until completion of the Works has been certified. Care shall be taken not to excavate beyond the limits of the required cross section, and any over-excavation or overbreak shall be backfilled to the required cross section and at the Contractor's own cost, either with class 1:3:6/19 concrete, soilcrete or with compacted gravel, as may be directed by the Engineer.

Where open drains are to be lined, the final trimming of excavations shall be done by hand and shall be guided by the use of accurately installed profile guides or other approved means. Trimming shall include the removal by hand of not less than the final 75 mm of material or such additional thickness as may be necessary under the circumstances to ensure accurate excavation.

04 CONSTRUCTION

04.01 Mitre drains and banks

Mitre drains and banks shall be constructed to the dimensions shown on the Drawings and as instructed by the Engineer. The mitre banks shall be constructed with the material excavated from the drains or with imported material, which shall be thoroughly compacted to 90% of modified AASHTO density.

Payment will only be made for material in the mitre banks and not for the excavation of the material used in the mitre banks.

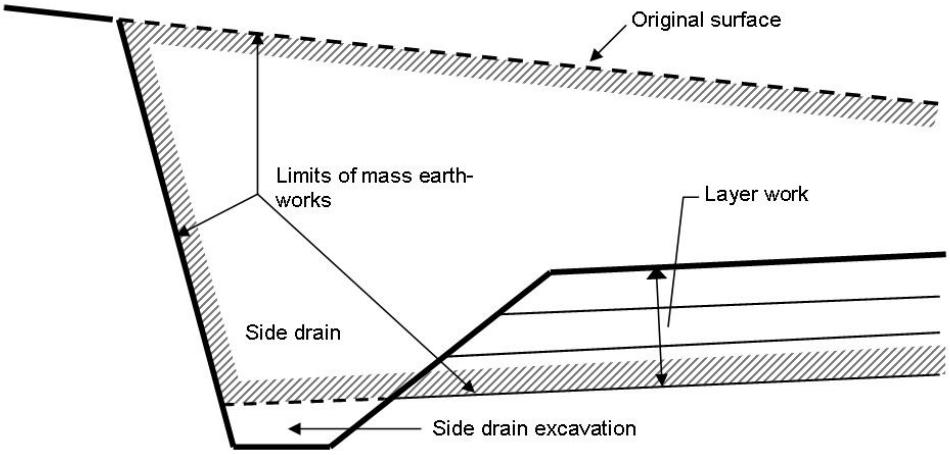
04.02 Catchwater drains

Catchwater drains shall be constructed in accordance with the details shown on the Drawings and as instructed by the Engineer. Material excavated from catchwater drains shall be placed on the lower side of the drain and thoroughly compacted. Where a sufficient quantity of suitable material cannot be obtained from the excavations, imported material shall be used. The larger-sized stones shall be placed on the inside faces of catchwater drains to afford protection against erosion. As is the case with mitre drains, payment will only be made for the material in the banks and not for excavations.

04.03 Side drains

After completion of any mass earthworks (see diagram 504/01), such further excavations as may be necessary shall be done by hand to complete the excavations for the side drains to the dimensions shown on the Drawings.

DIAGRAM 504/01



Where the shape of side drains is of such a nature that mass excavation methods can produce the final shape of the side drains, no further payment will be made for side drains except if they have to be lined for erosion protection.

The final surface of the side drains shall be neatly cut and trimmed to shape. Where required, the side drains may be lined for erosion protection, or they may be constructed entirely from concrete. Side drains that are paved with or constructed from concrete shall be protected against disfigurement by bitumen being split onto the concrete during surfacing operations. This shall be done by covering the side drains completely in plastic sheeting which has been properly weighted down by stones or by other means. All bitumen spilt on the paving or concrete of the side drains shall be removed entirely, and no overpainting will be allowed.

04.04 Channels

Channels shall be excavated with any suitable excavating or earth-moving equipment and, where the size and shape of the channel precludes the use of excavating equipment, with hand tools.

Surplus excavated material shall be utilized, as far as possible, in the construction of fills, banks and other structures and, where this is not feasible, the material shall be removed to spoil as instructed by the Engineer. Where specified or instructed by the Engineer, channels shall be protected against erosion by means of gabions, grassing or concrete lining, or they may be constructed entirely from concrete in accordance with the provisions of sections 702, 703 and 704, in which case formwork shall also be used for the outer faces of the channel sides.

The final surfaces of all channel excavations shall be neatly cut and trimmed to shape.

04.05 Chutes

Chutes shall be constructed, as may be required, either in precast units or from cast in situ concrete to the details shown on the Drawings.

The excavations for chutes shall be thoroughly compacted and accurately trimmed to shape, and graded so as to be ready to receive the cast in situ concrete or precast units.

Outlet structures shall be constructed before the chutes are constructed so as to provide the necessary support for the chute.

Precast units shall be laid from the bottom upwards and firmly bedded, and the space between the side walls and the excavation shall be backfilled and thoroughly compacted.

Inlet sections shall be provided as shown on the Drawings.

04.06 Protective linings

Where open drains are required to be provided with protective linings which consist of gabions, stone pitching, riprap, masonry walls, concrete-block pitching or cast in situ concrete, these shall be constructed in accordance with the provisions of section 505 and this section.

04.07 Concrete construction

Where open drains are required to be constructed in concrete either from precast units or from cast in situ concrete, they shall be constructed as specified in sections 702, 703 and 704 of these Specifications. Where the drains are lined with concrete, they shall also comply with the requirements of section 505. Similarly inlet, outlet and transition sections shall be constructed in accordance with the provisions of sections 702, 703 and 704, as may be applicable.

The excavations shall be compacted and accurately trimmed to receive the concrete. Where side walls are not cast against the excavation, the excavation shall be widened just sufficiently to accommodate the formwork and, on completion of the concreting, the excavation shall be backfilled against the side walls and thoroughly compacted.

04.08 Casting against the side of the excavation

Where soil conditions are suitable, the concrete side walls or paving of open drains shall be cast against the prepared excavations, in which case inside formwork shall be used where the slope of the side walls exceeds one vertical to two horizontal.

Where prices are based on type designs, the Contractor shall be at liberty to choose whatever method of construction he may prefer, either by casting against the prepared surface, or by doing additional excavation and using inside and outside formwork for the side walls.

Where payment is based on components, the Engineer shall decide whether casting side walls against the excavation is practicable or whether outside formwork is necessary, and payment will be based on his ruling irrespective of the method of construction ultimately employed by the Contractor.

04.09 Excess excavation and overbreak

The Contractor shall take due care not to excavate outside the authorized dimensions and any over-excavation shall be backfilled at the Contractor's own expense, with a stiff soilcrete, well compacted, in the case of unlined drains and with class 1:3:6/19 concrete or a stiff soilcrete, as the Engineer may require, in the case of lined open drains cast against the excavations.

The Contractor shall make allowance in his unit rates for the construction of the drains for the risk of overbreak as no specific payment will apply in respect of overbreak.

05 MISCELLANEOUS DETAILS

05.01 Joints

Watertight joints in concrete shall be constructed in accordance with the details shown on the Drawings and the provisions of section 706. During the construction of butt joints, the exposed joint surfaces of alternate panels cast first shall be coated with two coats of an approved bituminous emulsion which contains 60% bitumen by mass, and the emulsion shall be allowed to set and dry before the intermediate panels are cast.

05.02 Surface finish

All unformed concrete surfaces shall be finished to a class U2 surface finish, and all formed surfaces to a class F2 surface finish, all as specified in section 702.

05.03 Polyethylene sheeting

Unless otherwise specified, the surfaces on which concrete lining is to be cast shall, after having been trimmed, be covered with polyethylene sheeting, 0,150 mm thick, and all joints in the sheeting shall overlap by at least 150 mm. Care shall be taken not to damage this sheeting during concreting or the placing of reinforcement.

05.04 Transition sections

Transition sections for concrete-lined open drains shall be constructed to the same standards and according to the same methods as described in respect of uniform sections, but with the necessary modifications.

05.05 Inlet and outlet structures

Inlet and outlet structures for channels, side drains and chutes shall be constructed using the same methods as described in respect of the uniform sections, but with the necessary modifications.

05.06 Tolerances

No specific constructional tolerances shall apply in respect of unlined open drains, but the following tolerances shall apply in respect of lined open drains and open drains constructed in precast concrete:

(a) Horizontal alignment:

The maximum deviation from the true position of the centre line shall be 25 mm.

(b) Vertical alignment:

The invert level shall not at any place deviate more than 25 mm from the required level and the inverts shall not at any place have an adverse grade.

(c) Trueness of exposed surfaces:

When tested with a 3 m straight-edge, no exposed surface shall show surface irregularities exceeding 10 mm.

(d) Cross-sectional dimensions:

Cross-sectional dimensions shall be within 10 mm of the specified dimensions.

(e) Thickness of concrete lining:

The thickness of the concrete lining shall not at any place be less than the specified thickness, nor shall it be thicker by more than 10 mm or 10% of the specified thickness, whichever is the greater.

06 MEASUREMENT AND PAYMENT

Item		Unit
504.01	**Mitre drains and catchwater drains:**	
504.01.01	Mitre drains	cubic metre (m^3)
504.01.02	Catchwater drains	cubic metre (m^3)

The unit of measurement for mitre drains and catchwater drains shall be the cubic metre of material placed in the mitre bank or in the bank of the catchwater drain in accordance with the authorized dimensions.

The tendered rates shall include full compensation for excavating the drains by machine or, where necessary, by hand, for importing additional material where required, placing and compacting the material to the required dimensions in the mitre bank or catchwater bank, and for all other incidentals necessary for constructing the drains complete as specified and detailed on the Drawings.

Where excavations are done in hard material, an extra over payment shall apply for excavating in hard material, but no payment shall apply in respect of overbreak, the cost of which shall be included in the rates for item 504.01.

Item		Unit
504.02	**Concrete chutes** (type designs):	
504.02.01	(Description of the type with reference to the Drawings. State whether it will be precast or cast in situ and state the class of concrete)	metre (m)
504.02.02	Etc in respect of other types	

The unit of measurement shall be the metre of concrete chute measured along the slope, but shall exclude inlet and outlet structures.

The tendered rates shall include full compensation for procuring, furnishing and installing the concrete chutes complete as specified and shown on the Drawings, including excavation by hand where necessary, the trimming of excavations, backfilling, and the disposal of excavated material.

Where excavations are made in hard material, an extra over payment shall apply in respect of excavating in hard material, but no payment shall apply in respect of overbreak, the cost of which shall be deemed to be included in the rates for item 504.02.

Item		Unit
504.03	**Side drains (type designs):**	
504.03.01	(Description of the type with reference to the Drawings. State the class of concrete)	metre (m)
504.03.02	Etc in respect of other types	

The unit of measurement shall be the metre of side drain with a standard cross section, but shall exclude the inlet, outlet and transition sections.

The tendered rates shall include full compensation for procuring, furnishing and installing the concrete side drains complete as specified and shown on the Drawings, including, where necessary, excavation by hand outside the limits of mass excavation (see diagram 504/01), disposing of excavated material as directed by the Engineer, and trimming the excavations. Where excavations are in hard material, extra over rates shall apply in respect of excavating in hard material but not in respect of overbreak, the cost of which shall be included in the rates for item 504.03.

Item		Unit
504.04	**Channels (type design):**	
504.04.01	(Description of the channel with reference to the Drawings. State the class of concrete)	metre (m)
504.04.02	Etc in respect of other types.	

The unit of measurement shall be the metre of channel which shall exclude the inlet, outlet and transition sections.

The tendered rates shall include full compensation for procuring, furnishing and installing the channel complete in all respects, including excavation where necessary by hand, trimming the excavations, and disposing of excavated material as directed by the Engineer. Where excavations are made in hard material, extra over rates shall apply in respect of excavating in hard material, but not in respect of overbreak, the cost of which shall be included in the rates for item 504.04.

Item		Unit
504.05	**Construction of chutes, side drains channels, inlet and outlet structures, transition sections and auxiliary structures** (Measured by components):	
504.05.01	Excavation	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material excavated in accordance with the authorized dimensions of the open drain, plus, where applicable, an allowance for formwork to the outside of side walls.

The tendered rate shall be in full compensation for excavating the open drains, compacting and trimming the excavations, for disposing of excavated material as directed by the Engineer and, where applicable, for backfilling behind side walls. Where excavation is made in hard material, extra over payment shall apply in respect of hard material but not in respect of overbreak, the cost of which shall be included in the rates for item 504.05.

For side drains for road or railway work, the mass excavations shall be measured and paid for under mass earthworks, and only the remainder of the excavations required for the side drains shall be measured and paid for under item 504.05.01.

Item 504.05.01 shall also apply in respect of the excavations for inlet and outlet structures, transition sections and any other structures or non-standard cross sections required for the open drains.

504.05.02	Preparation of excavations for concrete-lined open drains	square metre (m^2)

The unit of measurement shall be the square metre of open drain excavation prepared to receive concrete.

The tendered rate shall include full compensation for trimming, compacting and preparing excavations to the standard required for receiving concrete.

504.05.03	Cast in situ concrete for the lining of open drains, or open drains constructed in concrete (concrete class and type of drain stated. Class U2 surface finish)	cubic metre (m^3)

Measurement and payment shall be as specified in section 704, but payment shall include compensation for painting the open joint surfaces as specified.

504.05.04	Formwork for cast in situ concrete (class F2 surface finish):	
504.05.04.01	To vertical sides of open drains (formwork on internal face only)	square metre (m^2)
504.05.04.02	To sloping sides of open drains (formwork on internal face only)	square metre (m^2)
504.05.04.03	To both internal and external faces of open drain sides (both sides measured)	square metre (m^2)
504.05.04.04	To ends of slabs	square metre (m^2)
504.05.04.05	To inlet and outlet structures and non-standard sections, etc	square metre (m^2)

Measurement and payment shall be in accordance with the provisions of section 702. Formwork under item 504.05.04.02 shall be measured and paid for only when the slope of the side exceeds one vertical to two horizontal, and the tendered rate shall include the weighing down or anchoring of formwork to prevent uplift.

504.05.05	Joints in the concrete lining of open drains	
504.05.05.01	(Description of type with reference to the Drawings)	metre (m)

The unit of measurement shall be the metre of completed joint of each size and type measured along the upper surface of the joint.

Measurement and payment shall be as specified under the appropriate pay items of section 706.

504.05.06	Welded steel fabric	
504.05.06.01	(Nominal longitudinal and cros pitch and nominal diameter of longitudinal and cross wires indicated)	kilogram (kg)

Item		Unit
504.05.06.02	Etc for other pitches and diameters	

Measurement and payment for welded steel fabric shall be made as specified in section 703.

504.05.07	Mild steel	
504.05.07.01	Bars with an 8 mm dia	ton (t)
504.05.07.02	Etc for other diameters	
504.05.08	High yield-stress steel	
504.05.08.01	Bars with an 8 mm dia	ton (t)
504.05.08.02	Etc for other diameters	
504.05.09	Etc for other types of steel.	

Measurement and payment for steel reinforcement shall be in accordance with the provisions of section 703.

Item		Unit
504.06	**Polyethylene sheeting (0,150 mm thick) for concrete-lined open drains**	square metre (m^2)

The unit of measurement shall be the square metre of area covered with polyethylene sheeting.

The tendered rate shall include full compensation for supplying and installing the sheeting and for wastage and overlap.

Item		Unit
504.07	**Excavation in hard material (Extra over items 504.01, 504.02, 504.03, 504.04 and 504.05)**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of hard material excavated in accordance with the authorized dimensions.

The tendered rate shall include full compensation for the additional costs of excavating in hard material.

Item		Unit
504.08	**Hand excavations (Extra over subitem 504.05.01)**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material excavated in side drains or channels by means of hand tools and classified as hand excavation by the Engineer in accordance with the provisions of subclause 03.03 of this section.

The tendered rate shall include full compensation for the additional costs of excavating by hand tools, as against conventional excavating equipment.

Note:

The following items of work, when specified, shall be carried out, measured and paid for in accordance with the relevant sections of the Specifications, but shall be listed under this section of the Schedule of Quantities.

Item		Applicable section
(a)	Overhaul on selected material	103
(b)	Excess overburden at borrow pits provided by the Employer	201
(c)	Temporary stockpiling of excavated material	201
(d)	Erosion protection (other than the concrete lining of open drains for which provision has been made for payment in this section	505

SERIES 5 : DRAINAGE AND EROSION PROTECTION

SECTION 505 : EROSION PROTECTION

CONTENTS

01 SCOPE

This section covers the construction of gabions, masonry walls and various protective coverings for the protection of earthworks and open drains against erosion by stormwater.

02 DEFINITIONS

For the purpose of this section in particular and these Specifications in general, the following words shall have the meanings hereby assigned to them.

(a) Gabion

A flexible, wire-mesh cage packed with rock and in the form of a box or a mattress, depending on its dimensions.

(b) Pitching

A covering of stone, concrete or concrete blocks placed on a prepared surface to protect it against erosion. The surface may be horizontal or sloping.

(c) Riprap

One or more layers of large rock dumped or packed on embankment slopes and toes, river and stream beds and other localities where such protection is required.

(d) Masonry walls

Walls constructed of natural stone with or without cement mortar having been used.

03 MATERIALS

03.01 Stone

(a) Stone for gabions

Stone used as filling for cages shall be clean, hard, unweathered boulders or rock fragments. No rock particles shall exceed the maximum size given below, and at least 85% of the stones shall have a size equal to or exceeding the minimum size given in table 505/1.

(b) Stone for pitching

Stone for pitching shall be sound, tough and durable, with no stones with a minimum dimension of less than 200 mm, apart from smaller pieces or spalls which may be used for filling the spaces between the larger stones. Rocks or stones shall be of a shape which will form a stable protection structure of the required thickness. Rounded boulders or cobbles shall not be used on slopes steeper than 2:1 unless grouted.

All stone intended for use on any particular pitching job shall be subject to the prior approval of the Engineer.

Table 505/1

	Stone size according to largest dimension of the stone	
Depth of cage (m)	**Minimum (mm)**	**Maximum (mm)**
0,2	75*	125
	95**	
0,3	100	200
0,5	100	250
1.0	100	250

* With a 60 x 80 mm mesh

** With an 80 x 100 mm mesh

(c) Stone for riprap

Stone for riprap shall be hard field or quarry stone not susceptible to disintegration or excessive weathering upon being exposed to the atmosphere or water. It shall be free from soft material such as sand, clay, shale or organic material and shall not contain an excessive number of elongated stones.

The required size of the stones will be determined by the "critical mass" specified. At least 50% by mass of the material comprising the riprap shall consist of stones with a mass exceeding the critical mass, and not more than 10% by mass of the material shall consist of stone with a mass of less than 10% of the critical mass or more than 5 times the critical mass.

(d) Stone for masonry walls

The minimum mass of each stone shall be 10 kg and the minimum dimension 75 mm.

03.02 Cement

Cement shall be ordinary cement which complies with the requirements of SANS 50197-1.

03.03 Sand

Sand for the cement mortar shall comply with the requirements of SANS 1083.

Sand for concrete block pitching shall comply with the requirements of concrete sand and shall not contain more than 3% silt and clay by mass.

03.04 Precast concrete blocks

Interlocking concrete blocks shall be factory-produced precast concrete blocks manufactured from concrete with a 28-day compressive strength of not less than 30 MPa. The design shall be subject to the Engineer's approval and shall ensure a sound interlock between adjacent blocks. The thickness shall be as indicated on the Drawings and the blocks shall be manufactured to a tolerance of plus or minus 3 mm in any dimension.

Square precast concrete blocks shall, unless otherwise specified, be of size 450 mm x 450 mm x 50 mm and shall be manufactured from class 30/19 concrete. The appearance requirements shall be as specified in clause 3.3 of SANS 927.

Concrete grass-blocks shall consist of concrete slabs with the dimensions shown on the Drawings, with openings through the slab totaling at least 20% of the surface area.

Other types of concrete blocks as well as prefabricated concrete block mats may be specified in the Project Specifications.

03.05 Concrete

Concrete work shall be carried out in accordance with the provisions of sections 702, 703 and 704.

03.06 Permeable material for filter backing

Permeable material for filter backing shall comply with the requirements specified in subclause 02.02 of section 501 for permeable material for subsurface drains.

03.07 Synthetic-fibre filter fabric (geotextiles)

Synthetic-fibre filter fabric shall be of the grade and type specified in the Schedule of Quantities or the Project Specifications.

03.08 Wire

All wire used shall be mild steel wire, complying with SANS 675 and shall be Class A zinc coated in accordance with SANS 935.

(a) Wire for wired pitching

Wire for wired pitching shall be 4,0 mm in diameter.

(b) Wire for gabions

The wire used in the fabrication of the gabions shall have a minimum mass of zinc coating in accordance with table 505/2 below:

Table 505/2

Nominal diameter of coated wire (mm)	Mass of coating (g/m^2 surface area)
below 2,2	245
2,2 -2,9	260
3,0 -3,6	275
3,7 -4,0	290

The wire mesh shall be hexagonally woven mesh the joints of which are formed by each pair of wires being twisted through three half-turns. The twisted joints shall be of a tightness to require a force of not less than 1,7 kN for pulling one wire to separate it from the other wire, provided that each wire is prevented from being turned and the applied forces and the wire are all kept in the same plane.

The diameter of the wire and the size of mesh used shall be in accordance with table 505/3 below:

Table 505/3

Depth of gabion	Mesh size (mm)	Wire diameter (mm)
0,2 m - 0,3 m	60 x 80	2,0
	80 x 100	2,2
	80 x 100	2,6
0,5 m and over	100 x 100	2,7

The shorter dimensions of the mesh shall be taken from centre to centre of the twisted joints and the larger dimensions shall lie between the inside ends of the twisted joints.

Other combinations of mesh size and wire diameter may be used when so specified in the Project Specifications.

Binding and connecting wire for the construction of the gabion cages shall be 2,0 mm in diameter.

(c) Gabions made with PVC-coated wire

When gabions made from PVC-coated wire are specified, the wire used for the gabion mesh and for wiring the gabions during construction shall be a galvanized wire as specified in (b) above onto which a polyvinyl-chloride (PVC) coating has been extruded. The average thickness of the PVC coating shall be, as specified, either 0,30 mm for use in mildly corrosive conditions, or 0,55 mm for use in severely corrosive or abrasive conditions. The minimum thicknesses of the coatings shall be 0,25 mm and 0,4 mm respectively.

The PVC-coated gabions shall be subject to the approval of the Engineer.

03.09 Ant poison and vegetation destroyer

Where the use of an ant poison and/or a vegetation destroyer is called for, full details of such products, including the type, the rate of application, the method of application, etc, will be specified in the Project Specifications. The work may only be carried out by a firm experienced in such work (and duly licensed, if so required by law) and approved by the Engineer.

04 CONSTRUCTION OF GABION CAGES

04.01 General

Gabion cages shall be fabricated from wire mesh with the size and selvedge and of the type as specified below. The cages shall be subdivided into cells by wire-mesh diaphragms and shall be of two types:

(i) Boxes which are generally used for the construction of gabion walls. They are subdivided into cells by diaphragms spaced at 1,0 m intervals.

(ii) Mattresses which are generally only used as single- layer aprons in revetments, channel linings, etc, the maximum width of which shall be 2,0 m and the maximum depth 0,5 m. Mattresses shall be subdivided by diaphragms into cells with a width of 600 mm or 1,0 m, as specified in the Project Specifications.

The standard sizes of boxes and mattresses shall be as follows:

- Boxes
  - Length: 1 m, 2 m, 3 m and 4 m
  - Width: 1 m
  - Depth: 0,3 m, 0,5 m and 1,0 m
  - Diaphragm spacing: 1,0 m.
- Mattresses
  - Length: 6m
  - Width: 2m
  - Depth: 0,2 m, 0,3 m and 0,5 m
  - Diaphragm spacing: 600 mm or 1,0 m, as specified.

Other gabions may be supplied, provided that the prior permission of the Engineer has been obtained.

04.02 Selvedges

The cut edges of all mesh used in the construction of gabions, except the bottom edges of diaphragms and end panels, shall be selvedged with wire with a diameter of at least 0,5 mm greater than that of the mesh wire.

Where the selvedge has not been woven integrally with the mesh but has to be fastened to the cut ends of the mesh, it shall be attached by the cut ends of the mesh being bound to the selvedge so as to require a force of not less than 8, kN, applied in the same plane as the mesh at a point on the selvedge of a mesh sample 1 m long, to separate it from the mesh.

04.03 Diaphragms and end panels

The diaphragms and end panels shall be selvedged at the top and on the vertical sides only.

The end panels shall be attached by the cut ends of the mesh wires being twisted to the selvedge at the bottom of the panel at the base of the gabions. Similarly, the diaphragms shall be attached by the cut ends of the mesh being twisted to the twisted joints of the mesh at the base of the gabion. In each case the force required to separate the panels from the base should be not less than that required to break the mesh over the same length.

05 CONSTRUCTION OF GABIONS

05.01 Preparation of the foundation and surface

The surface on which the gabion cages are to be laid prior to filling shall be levelled to a depth as shown on the Drawings or as directed by the Engineer so as to present an even surface. If necessary, cavities between rock protrusions shall be filled with material similar to that specified in subclause 03.01 (a) of this section. Where required, a foundation trench along the toe of the revetment or wall shall be excavated to the dimensions shown on the Drawings or as indicated by the Engineer.

05.02 Assembly

The methods of erection, stretching, aligning, wiring and filling the gabions shall generally be in accordance with the manufacturer's instructions as approved by the Engineer, but nevertheless a sufficient number of connecting wire braces shall be provided and tensioned between the vertical sides of each of the outer visible cells to prevent the deformation of the boxes as they are being filled with stone.

It is essential for the corners of gabion cages to be securely wired together to provide a uniform surface and to make sure that the structure will not appear as a series of blocks or panels. Consecutive courses of boxes should preferably be "bonded" as in brickwork in order to avoid vertical joints coinciding.

05.03 Rockfilling

(a) Boxes in retaining walls

Particular care shall be exercised during the filling of the visible faces of gabion boxes, for which only selected stone of adequate size shall be used, which shall be so prepacked as to obtain a fair-faced finish. Boxes shall be filled in stages to prevent deformation and bulging. Boxes shall be filled to just below the level of the wire braces, after which the braces shall be twisted to provide tension. Care shall be taken to ensure that consecutive layers of cages which are filled, are filled evenly to a level surface ready to receive the next course.

(b) Mattresses used for revetments and aprons
The filling of the 0,3 m and 0,5 m gabions for the forming of aprons and revetments shall be carried out by random stones being spread on the first layer and selected stones being used for the top layer so as to present a dry-stone-pitched surface.

06 STONE PITCHING

06.01 Plain stone pitching

The area shall be prepared by excavating, shaping and trimming to accommodate the stonework and shall be thoroughly compacted by hand-ramming to minimize subsequent settlement. A trench shall be excavated, as directed by the Engineer, along the toe of a slope to be pitched or along the unprotected edge of the pitching in the beds of streams. Two methods for the laying of stone are set out below, and the method to be adopted shall be decided on by the Engineer.

Method 1

The laying of the stones shall be commenced at the bottom of the trench, where they shall be firmly bedded into the slope and against adjoining stones. They shall be laid with their longitudinal axes at right angles to the slope and with their surfaces in contact with each other so as to stagger the joints. The stones shall be rammed well into the bank or surface to be protected and the spaces between the larger stones shall be filled with fragments of approved pitching stone securely rammed into place. Placing of rock by dumping will not be allowed.

Method 2

The technique and requirements laid down in method 1 shall apply to method 2, except for the following aspects:

(i) No small stones or spalls shall be used to fill in spaces between larger stones.

(ii) Simultaneously with the placing of stones, topsoil shall be introduced between individual stones, which shall be adequately rammed so as to provide a firm bonded construction. The topsoil shall be applied to the full depth of the stone pitching at any point.

(iii) Rooted grass, grass tufts or ground covers of the types specified in the Project Specifications shall then be planted in the topsoil between the stones and be given copious initial watering. Watering shall then be carried out at regular intervals until the plants have been established. The planting and maintenance of grass and ground covers and establishing an acceptable cover shall be carried out in accordance with section 104.

Whichever of the above two methods is adopted, the finished surface of the pitching shall present an even, tight and neat appearance. The thickness of the pitching, measured at right angles to the surface, shall not be less than 200 mm.

06.02 Grouted stone pitching

This work shall be done in accordance with all the requirements specified for plain pitching in subclause 06.01 above, except that the spaces between the stones shall be filled with cement mortar composed of one part of cement to three parts of sand. Before the mortar is applied, the surfaces of the stones shall be thoroughly cleaned of adhering dirt and clay and then moistened. The mortar shall be placed in a continuous operation for any one day's run at any one location.

The mortar shall be worked into the pitching so as to ensure that all spaces or voids between the stones are completely filled with mortar to the depth of the stone pitching.

After the grout has been placed, the stones shall be thoroughly brushed so as to expose their top surfaces. The grouted pitching shall be cured with wet sacking or some other approved wet cover for a period of not less than four days after grouting and shall not be subjected to loading until adequate strength has developed. Where required, weep holes shall be formed in the pitching.

06.03 Wired and grouted stone pitching

The pitching shall be held in position below and above with wire nets with a 150 mm square mesh. The lower net, with wire ties fastened to it at 600 mm centres which project outwards, shall first be placed over the surface to be pitched. The stone shall then be laid onto this net in accordance with the requirements specified for plain stone pitching in subclause 06.01 above. After the stone has been laid, the upper wire net shall be drawn tightly over the stone course and securely tied down by the wire ties being passed from the lower net through the pitching. After tying, these ties shall be turned down into the pitching. The whole area of wired pitching shall then be grouted and finished off with cement mortar in accordance with all the requirements specified for grouted pitching in subclause 06.02 above. Where required, weep holes shall be formed in the pitching.

07 RIPRAP

07.01 General

Two types of riprap are specified, one type where the rocks are individually packed, which is designated as packed riprap, and another type where the stone is dumped and then spread by machines, which is designated as dumped riprap.

The surfaces of the areas to receive riprap shall be neatly trimmed to line and level and all loose material shall be compacted. The perimeters of riprap shall be protected by the construction of either rock-filled trenches, walls or other structures, as may be required. Perimeter trenches shall normally be backfilled with rock of the same size and quality as that which has been used in the construction of the adjoining riprap, but any cavities shall be filled with smaller material, and the entire backfill shall be well consolidated.

07.02 Filter backing

Filter backing shall consist of a layer or layers of permeable material placed on the prepared surface to the required thickness and finished to an even surface and thickness after the placement of each layer. Compaction of pervious material will not be required. Care shall be taken not to mix various grades of filter material nor to disturb material already placed when subsequent layers or riprap are constructed.

When the use of synthetic-fibre filter fabric is required, the material shall be placed on the prepared surface or on the filter backing, as may be required. The overlap between adjacent sheets shall be 150 mm, unless otherwise specified. Care shall be taken not to damage the filter fabric when subsequent layers are placed, nor to expose the filter fabric to the sun for periods in excess of one day before it is covered up.

07.03 Packed riprap

Packed riprap shall be constructed from rocks individually placed with staggered joints, and shall be firmly bedded on the prepared surface. The spaces between larger stones shall be filled with spalls, and smaller stones shall be securely rammed into place. On inclined surfaces the rock shall be laid in long horizontal lengths starting from the bottom, and not in strips up the slope.

The completed riprap shall present an even, tight surface.

07.04 Dumped riprap

Dumped riprap shall be constructed by stone being dumped onto the prepared surfaces and spread by bulldozers or other suitable earth-moving equipment and trimmed to the required lines and levels. The material shall be placed so as to prevent the segregation of the smaller and larger stone, and the final layer shall be tight with a minimum of voids.

08 MASONRY WALLS

08.01 General

Masonry walls may be plain with dry joints or may be constructed with stones set in cement mortar, as indicated on the Drawings or as ordered.

08.02 Plain masonry walls

A foundation trench shall be excavated down to the rock or to material with an adequate bearing capacity, and the minimum depth shall be 300 mm below ground level. Selected large stones shall be used in the foundation layer. Flat and stratified stones shall be laid with their flat surfaces in the horizontal plane. Stones shall be individually placed with staggered joints and to leave a minimum of voids, and shall be firmly bedded against adjoining stones. The spaces between the larger stones shall be filled with spalls securely rammed into place. The larger stones shall not bear on the spalls used for filling the voids. The top and ends of the wall shall be neatly finished with selected coping stones.

The wall surface shall present an even, tight appearance.

08.03 Cement-mortared masonry walls

The walling shall be constructed as specified in subclause 08.02 above, except that the stones shall be wetted and set in a 3:1 sand: cement mortar. Exposed stones on the wall faces shall be cleaned of mortar by washing or wire-brushing. The mortar shall be flush pointed to the approval of the Engineer, who may require a capping and end treatment in the same mortar.

Weep holes shall be provided as ordered and shall be cleaned of mortar and any other clogging material that may have entered during construction.

The walling shall be protected from the elements and shall be kept moist for a minimum period of four days after completion.

09 CONCRETE BLOCK PITCHING

09.01 General

All loose material on areas where concrete block pitching is to be constructed shall be compacted by hand or by mechanical means to at least 90% of modified AASHTO density, and the surface shall be trimmed to ensure that the surface of the pitching will conform to the required lines, levels and grades.

For the purpose of this section, concrete block pitching shall not be regarded as paving for pedestrian and vehicular traffic as specified in section 609.

09.02 Interlocklng-type of concrete blocks

A layer of sand of 25 mm compacted thickness shall first be spread and levelled, where necessary, on the surfaces to be paved. When required, the prepared surfaces shall be treated with a vegetation destroyer and/or an ant poison of the type specified in the Project Specifications. The concrete blocks shall then be laid hard up against each other with each block interlocking with the previously laid blocks. Joints shall be filled with sand which is brushed in.

At edges special edge blocks shall be placed, or the edges shall be finished by means of concrete edge beams to the dimensions shown on the Drawings. Concrete shall be class 1:3:6/19 concrete. Earth cuts, if suitable, may be used as forms for the vertical surfaces of edge beams. Where formed vertical faces are used, they shall be of a class F2 finish. The upper surface shall be of a class U2 surface finish.

The finished surface of the pitching shall present an even and neat appearance with no concrete blocks projecting above the surface.

09.03 Concrete grass-blocks

Concrete grass-blocks of the size specified or shown on the Drawings shall be placed on areas prepared for grassing as specified in section 104. The holes in the blocks shall be filled with topsoil and be grassed by grass cuttings or hydroseeding, as specified in section 104.

09.04 Precast concrete blocks

The areas shall be prepared as specified for the interlocking type of concrete blocks, and shall include a sand bed of 25 mm compacted thickness.

The concrete blocks shall then be placed on the prepared areas. Where required, the joints shall be grouted with a 3:1 sand: cement mortar.

10 CAST IN SITU CONCRETE PITCHING

The areas where cast in situ concrete pitching is to be constructed shall be compacted, trimmed and prepared as described in clause 09 for concrete block pitching. The areas shall also be treated with vegetation destroyer and/or ant poison if required.

Prior to the placing of the concrete, the surface shall be covered with polythene sheeting, or it shall be watered and kept damp until the concrete is placed. The type of concrete used shall, unless otherwise specified, be class 20/19 and it shall be accurately laid in alternate panels to the lines and levels indicated. Accurate guides shall be set to achieve the required line and slope. The concrete shall be thoroughly compacted and finished to a class U2 surface finish.

Where indicated, the concrete pitching shall be contained by concrete edge beams being constructed as described in subclause 09.02 for the interlocking type of concrete blocks.

The concrete pitching shall be cured for at least seven days.

If specified, joints shall be sealed in accordance with section 706.

11 TOLERANCES

The permissible tolerance limits shall be as follows:

(a) Wire : diameter ± 2,5%

(b) Gabion cages assembled on the Site:

- Length ± 3,0%
- Width ± 3,0% with a maximum of 25mm
- Depth ± 3,0%

(c) Gabions in position:

- Finished level ± 50 mm
- Permissible vertical and horizontal deviation from a line joining two points 30 metres apart ± 100 mm
- Deviation from a specified position in the plan ±150 mm

(d) Stone pitching:

No stones shall vary by more than 25 mm from the specified surface grades or lines.

(e) Masonry walls:

As for gabions in position (see above).

(f) Concrete block pitching:

The finished surface shall not vary by more than 15 mm from the specified surface lines and grades.

(g) Cast in situ concrete pitching:

When tested with a 3,0 metre straight-edge no surface irregularities of more than 10 mm shall be revealed.

12 MEASUREMENT AND PAYMENT

Item		Unit
505.01	**Foundation trench excavation and backfilling**	
505.01.01	In solid rock (material which requires blasting)	cubic metre (m^3)
505.01.02	In all other classes of material	cubic metre (m^3)

The unit of measurement shall be the cubic metre of each class of excavation made in accordance with the authorized dimensions for gabions, edge beams and foundation trenches.

The tendered rates shall include full compensation for excavating in each class of material, including full compensation for unavoidable overbreak, for trimming trenches and compacting trench inverts, for backfilling and consolidating backfill, and for the disposal of surplus excavated material. Overhaul will be paid for where dumping sites have been provided by the Employer and where they are situated outside the free-haul boundaries.

Item		Unit
505.02	**Surface preparation for the bedding of gabions**	square metre (m^2)

The unit of measurement for the levelling and preparation of areas to receive gabions shall be the square metre to the neat dimensions of wall foundations, revetments or aprons.

The tendered rate shall include full compensation for excavating and filling cavities with rock, and for levelling and compacting the ground surface so as to be ready for receiving the gabion cages for retaining walls, aprons and revetments.

Item		Unit
505.03	**Gabions**	
505.03.01	Gabion boxes (Size of box and mesh indicated)	cubic metre (m^3)

The unit of measurement shall be the cubic metre of the rock-filled cages, and the quantity shall be calculated from the dimensions of the gabions indicated on the Drawings or ordered by the Engineer, irrespective of any deformation or bulging of gabions as constructed.

The tendered rates shall include full compensation for the supply of all materials, including rock fill, wire mesh cages, tying and connecting wire, for loading, transporting and off-loading, for the assembly and filling of the cages and for any other work necessary for the construction of the gabions.

Item		Unit
505.04	**Extra over item 505.03 for supplying gabions with PVC-coated wire** (Thickness of PVC coating stated)	cubic metre (m^3)

The tendered rate shall be in full compensation for the additional costs over and above the rate tendered for the relevant item, for supplying PVC-coated gabions and tying wire.

Item		Unit
505.05	**Filter fabric for gabions and riprap** (Type, class and grade stated)	square metre (m^2)

The unit of measurement shall be the square metre area covered with filter fabric placed in position, including overlaps.

The tendered rate shall include full compensation for the supply of the filter fabric, for cutting, waste, placing, joining, overlapping and fastening the material in position.

Item		Unit
505.06	**Stone pitching**	
505.06.01	Plain pitching:	
505.06.01.01	Method 1	square metre (m^2)
505.06.01.02	Method 2	square metre (m^2)
505.06.02	Grouted pitching	square metre (m^2)
505.06.03	Wired-and-grouted pitching	square metre (m^2)

The unit of measurement for pitching shall be the square metre of each type of pitching in place.

The tendered rates for each type of stone pitching shall include full compensation for the supplying of all materials, excavations, excluding trench and bulk excavations, the compaction and trimming of excavated areas, the forming and cleaning of weep holes, the placing of stones, grouting or wiring and grouting where applicable, grassing and watering (in respect of method 2) and for all other work necessary for completing the pitching as specified.

Excavations for foundation trenches and edge beams and the construction of edge beams shall be paid for separately.

Item		Unit
505.07	**Riprap**	
505.07.01	Packed riprap (Critical mass of stone indicated)	cubic metre (m^3)
505.07.02	Dumped riprap (Critical mass of stone indicated)	cubic metre (m^3)
505.07.03	Filter backing (sub-clauses 02.02 of section 501 and 07.02 of this section) which consists of -	
505.07.03.01	Crushed stone	cubic metre (m^3)
505.07.03.02	Filter sand obtained from borrow sources	cubic metre (m^3)

The unit of measurement for riprap and filter backing shall be the cubic metre of riprap or filter backing in place, including rock in trench backfill.

Filter fabric will be measured and paid for under item 505.05.

The tendered rates for subitems 505.07.01, 505.07.02 and 505.07.03 shall include full compensation for the preparation of surfaces, including excavation but excluding excavation for trenches and bulk excavations, and for furnishing, transporting, handling and placing the riprap or filter backing. Collectively the rates shall also include full compensation for all other incidentals which are necessary for completing the work as specified.

Item		Unit
505.08	**Masonry walls**	
505.08.01	Plain	cubic metre (m^3)
505.08.02	Cement-mortared	cubic metre (m^3)

The unit of measurement for masonry walls shall be the cubic metre of actual walling constructed and accepted.

The tendered rate for each type shall include full compensation for the supplying of all materials, the trimming of areas, the placing of stones, cement-mortared where necessary, and for all other work necessary for completing the walls as specified. The excavation of foundation trenches shall be paid for separately.

Item		Unit
505.09	**Concrete pitching**	
505.09.01	Cast in situ concrete pitching (Class of concrete and thickness of pitching indicated)	square metre (m^2)
505.09.02	Interlocking precast concrete block pitching (Type and thickness indicated)	square metre (m^2)
505.09.03	Precast concrete grass blocks	square metre (m^2)
505.09.04	Precast concrete blocks (Thickness indicated)	square metre (m^2)

The unit of measurement shall be the square metre of each type constructed.

The tendered rates shall include full compensation for the supplying of all materials and for excavation, but shall exclude bulk excavation, and for excavation for foundation trenches and edge beams, the compaction and trimming of all excavated areas, the provision of a sand bedding (subitems 505.09.02 and 505.09.04), topsoiling and grassing (subitem 505.09.03), the construction of concrete pitching, including minor formwork and the forming of surfaces (subitem 505.09.01), the forming and cleaning of weep holes (subitem 505.09.01), and for all other work necessary for completing the work as specified.

Item		Unit
505.10	**Concrete in edge beams and foundation trenches** (Class of concrete indicated)	cubic metre (m^3)

The unit of measurement shall be the cubic metre of concrete in edge beams and foundation trenches constructed as instructed.

The tendered rate shall include full compensation for supplying all materials and labour, including formwork as necessary, for placing concrete, and for forming all surfaces.

Item		Unit
505.11	**Provision and application of -**	
505.11.01	Ant poison (State type and rate of application)	P C sum
505.11.02	Add the Contractor's charges onto the P C sum	per cent (%)
505.11.03	Vegetation destroyer (State type and rate of application)	P C sum
505.11.04	Add the Contractor's charges onto the P C sum	per cent (%)

Payment under the prime cost sum for the provision and application of ant poison and/or vegetation destroyer by an approved subcontractor, who shall be licensed to carry out such work (if so required by law), as well as the Contractor's charges thereon, shall be made in accordance with the provisions of the General Conditions of Contract.

Note:

The following item of work, when specified, shall be carried out, measured and paid for in accordance with the relevant sections of the Specifications, but shall be listed under this section of the Schedule of Quantities.

Item		Applicable section
(a)	Overhaul on surplus excavated material	103

SERIES 6 : ROADS AND PARKING AREAS

SECTION 601 : GRAVEL PAVEMENT LAYERS

CONTENTS

01 SCOPE

This section covers the construction of subgrade and subbase layers using unstabilized or stabilized selected gravel material and the construction of base layers using only unstabilized material.

This section does not, however, include the construction of shoulders and gravel wearing courses, which are dealt with under section 603.

02 DEFINITIONS

For the purpose of this section in particular and these Specifications in general, the following words and expressions shall have the meanings hereby assigned to them, except where the context otherwise requires:

(a) Subgrade

The layer or layers of gravel material of specified dimensions on top of the fill or embankment and below the subbase. The material may include construction-bed material compacted in situ. (Construction bed is defined in section 203.)

(b) Subbase

The layer of material of specified dimensions on top of the subgrade and below the base and, where applicable, below the shoulders.

(c) Base

A layer of material of specified dimensions constructed on top of the subbase or, in the absence thereof, on top of the subgrade.

03 MATERIALS

03.01 General

Gravel material to be used in subgrade, subbase and base layers shall be obtained from borrow pits provided by the Employer, from excavations, cuttings or from sources provided by the Contractor.

In respect of borrow material obtained from sources provided by the Contractor, the provisions of clause 05(f) of section 201 are applicable.

The Engineer must approve all sources of supply and shall have the authority to direct from which sources all materials are to be obtained. The approval of a specific source of supply will not imply that all material from such a source is suitable for use, but it means that suitable material is available for selection from that source.

The gravel material for pavement layers shall, unless otherwise specified in the Project Specifications, conform to the requirements of TRH 14.

The subgrade layer as defined in clause 02 above is referred to in TRH 14 as the selected layer.

03.02 Compaction requirements

An indication of the minimum in situ dry density of gravel material is given below for the respective layers and is expressed as a percentage of modified AASHTO density.

•	Subgrade:	G9 material	90%
		G8 material	90%
		G7 material	93%
		G6 material	93%
•	Subbase:	G6 material	95%
		G5 material	95%
•	Base:	G4 material	98%

The G classification used above is that of TRH 14.

The materials to be used in the various layers and its/their compaction, will be specified in the Project Specifications.

03.03 Soluble salinity

When specified in the Project Specifications, the soluble salinity of base material shall be subject to the requirements of subclause 02.02 of section 602.

04 CONSTRUCTION

04.01 Removal of in situ material

In situ material falling within the specified levels of the subbase and base layers shall, whether or not the material is suitable for the construction of the subbase and base layers, be removed unless otherwise instructed by the Engineer. Such material removed shall be measured and paid for under the relevant pay items of section 203.

Should the material thus exposed not conform to the requirements for the subgrade, it shall be excavated and replaced with suitable material or be stabilized as ordered by the Engineer. However, if the material is classified as suitable for use in situ, save that it fails to meet the requirements for density, it shall be scarified to the full depth of the subgrade layer and watered and recompacted to the specified percentage of modified AASHTO density.

Material in the construction bed below the subgrade level shall be dealt with as specified in clause 09 of section 203.

04.02 Placing and compaction

The various pavement layers shall only be constructed on condition that the underlying layers conform to the requirements specified for the layer concerned. Immediately before placement of the material, the underlying surface shall be checked by the Contractor for any damage or deficiencies, which shall be made good as directed by the Engineer.

The material shall be placed, spread, broken down and compacted all in accordance with the requirements of clause 06 of section 203 except that wherever the word "fill" is used, it shall be taken to read as "pavement" or "pavement layer", as may be required by the context.

Coarse gravel containing non-plastic or slightly plastic soil fines and used in the construction of the gravel base will usually require slushing and rolling in addition to the compaction specified in clause 06 of section 203 in order to obtain a firm, well-knit surface.

If so directed by the Engineer, the base shall, after having been processed and compacted as specified above, be watered well, in short sections at a time, slushed and rolled with compactors and/or heavy flat-wheel rollers with a mass of not less than 10 t each. Watering and rolling shall continue over a section until all excess fines have been brought to the surface of the layer.

Such excess fines shall be uniformly distributed over the surface of the layer by means of stiff brooms, and watering, rolling and brooming shall continue until all areas deficient in fines have been suitably corrected. All excess fines shall be finally removed from the surface of the layer.

04.03 Crushing and screening

Where the material intended for use in the pavement layers cannot be suitably broken down by the methods described in subclause 06.03 of section 203, or requires modification by screening out certain fractions, the Engineer may direct that the material be crushed or screened, or crushed and screened.

For single-stage crushing the material shall be passed through a single-stage crusher capable of breaking down oversize material to the maximum size specified for the layer concerned.

For crushing and screening the material shall be passed through a multiple-stage crusher and shall be screened so that, after the crushing and screening, the material will conform to the grading specified for the layer concerned.

For screening only the material shall be screened through one or more screens, the smallest of which shall be the 6,7 mm screen, so that the material shall be separated at this size, and any specified proportion of the minus 6,7 mm material shall be added back if required.

04.04 Stabilization

When specified on the Drawings or in the Project Specifications or ordered by the Engineer, the material shall be stabilized by chemical stabilization or by mechanical modification as specified in section 604.

Where the addition of a natural binder is necessary in order to reduce the plasticity index or to improve the grading of gravel base material, the Engineer may direct that the material be stabilized by mechanical modification using a suitable binder, all as specified in section 604.

04.05 Protection and maintenance

The Contractor shall protect and maintain the completed layers at his own expense until the next layer or, in the case of the base, the bituminous surface has been constructed. Maintenance shall include the immediate repair of any damage or defects that may occur to a layer and shall be repeated as often as is necessary to keep the layer continuously intact. Repairs shall be done in a manner that will ensure restoration to an even and uniform surface. Traffic shall not be allowed on any completed layer unless authorized by the Engineer.

05 CONSTRUCTION TOLERANCES

The work described in this section shall conform to the tolerances given below.

05.01 Level

The level tolerances referred to in subclause 05.01 of section 902 shall be as follows:

	Subgrade	Subbase	Base
H_{90}	±25 mm	±25 mm	±10 mm
H_{max}	±33 mm	±33 mm	±25 mm

05.02 Width

The average width of the layer shall be at least equal to that shown on the Drawings and the outer edge of the layer shall not at any place be less than the lines shown on the Drawings. (Where kerbing has been installed, the base shall be contained within the kerbs.)

05.03 Thickness

The thickness tolerances referred to in subclause 05.02 of section 902 shall be as follows:

	Subgrade	Subbase	Base
D_{90}	30 mm	27 mm	27 mm
D_{max}	40 mm	35 mm	35 mm
$D_{average}$	10 mm	5 mm	5 mm

05.04 Cross-section (for roads)

At any transverse section of the subbase and base layers, the difference in level between any two points shall not vary by more than 20 mm from their difference in level as computed from the cross-sections shown on the Drawings.

When the base layer is tested with a 3 m straight-edge laid at right angles to the road centre line, the surface shall not deviate from the bottom of the straight-edge by more than 10 mm.

05.05 Grade (for roads)

For the base layer, the deviation from the specified longitudinal grade as a result of deviations from level shall not exceed the following:

Length of grade measured (m)	Maximum variation from specified grade (%)
2	0,34
5	0,27
10	0,21
20	0,13
30	0,08

05.06 Surface regularity (for roads)

When tested with a rolling straight-edge as described in clause 09 of section 903, the number of surface irregularities in the base layer shall not exceed the following:

(a) The average number of irregularities per 100 m equal to or exceeding 6 mm when taken over 300 m - 600 m lengths shall not exceed 4

(b) The number of irregularities equal to or exceeding 6 mm when taken over 100 m sections shall not exceed 6

(c) The maximum value of any individual irregularity measured with the rolling straight-edge or a 3 m straight-edge laid parallel to the road centre line shall not exceed 10 mm

06 TESTING

06.01 Process control

The minimum testing frequency that will be required from the Contractor in terms of clause 05 of section 901 for the purpose of process control is shown in table 601/1.

Table 601/1

Test	Position of layer	Testing frequency	
		One test every	Minimum number of tests per lot or section of road
Materials			
Field density and OMC*	All layers	1 500 m^2	4
Indicator tests	All layers	2 500 m^2	4
Tolerances			
Surface levels	All layers	20 m (1 test = 3 pts per cross-section)**	
Thickness	All layers		30
Width (for roads)	All layers	100 m	1
Cross-sections (for roads)	Subbase and base	20 m	-
Smoothness (for roads)	Base	40 m^2	

* The determination of field dry density expressed as a percentage of modified AASHTO density implies a modified AASHTO density determination for each field density. Where material is homogeneous, this ratio can be decreased to one modified AASHTO density determination for up to four field densities.

** For parking areas, 1 test equals a series of points, 5 m apart, in a straight line across the full width of the parking area, at every 20 m cross-section.

06.02 Routine Inspection and testing

Routine inspection and testing will be carried out by the Engineer in accordance with the provisions of clause 09 of section 902, to test the quality of materials and workmanship for compliance with the requirements of this section.

Compliance with the density requirements specified in clause 03 of this section, shall be controlled in accordance with the statistical judgment scheme specified in section 902.

Any materials or workmanship which do not comply with the specified requirements shall be removed and replaced with materials and workmanship which comply with the specified requirements or, if the Engineer permits, shall be repaired as specified in section 901 so that they will comply with the specified requirements after having been repaired.

07 MEASUREMENT AND PAYMENT

Item		Unit
601.01	**Preparation and compaction of in situ subgrade material to -**	
601.01.01	90% of modified AASHTO density	cubic metre (m^3)
601.01.02	93% of modified AASHTO density	cubic metre (m^3)

The unit of measurement shall be the cubic metre of in situ subgrade material prepared and compacted as specified.

The tendered rates shall include full compensation for scarifying, watering, mixing, shaping and compacting the material as specified.

Item		Unit
601.02	**Gravel layers constructed from material obtained from borrow pits:**	
601.02.01	Subgrade	
601.02.01.01	Compacted to 90% of modified AASHTO density	cubic metre (m^3)
601.02.01.02	Compacted to 93% of modified AASHTO density	cubic metre (m^3)
601.02.01.03	Compacted to 95% of modified AASHTO density	cubic metre (m^3)
601.02.02	Subbase	
601.02.02.01	Compacted to 95% of modified AASHTO density	cubic metre (m^3)
601.02.02.02	Compacted to 97% of modified AASHTO density	cubic metre (m^3)
601.02.03	Base	
601.02.03.01	Compacted to 98% of modified AASHTO density	cubic metre (m^3)

The unit of measurement shall be the cubic metre of compacted gravel material, and the quantity shall be calculated from the authorized dimensions of the various layers.

The tendered rates shall include full compensation for procuring, breaking down, placing and compacting the material for the addition of up to 20% of soil binder if necessary in the case of the base layer, for transporting the material, and for the removal and transportation of up to 5% by volume of oversize material.

The tendered rates shall apply irrespective of the hardness or other properties of the material.

Overhaul will apply only if the material is transported from the Employer's borrow pits or to his dumping sites and which are situated outside the free-haul boundaries.

Item		Unit
601.03	**Gravel layers constructed from material obtained from excavations:**	
601.03.01	Subgrade	
601.03.01.01	Compacted to 90% of Modified AASHTO density	cubic metre (m^3)
601.03.01.02	Compacted to 93% of Modified AASHTO density	cubic metre (m^3)
601.03.01.03	Compacted to 95% of Modified AASHTO density	cubic metre (m^3)

601.03.02	Subbase	
601.03.02.01	Compacted to 95% of Modified AASHTO density	cubic metre (m^3)
601.03.02.02	Compacted to 97% of Modified AASHTO density	cubic metre (m^3)
601.03.03	Base	
601.03.03.01	Compacted to 98% of Modified AASHTO density	cubic metre (m^3)

Measurement and payment shall be as described in the first and second paragraphs for item 601.02 above.

Item		Unit
601.04	**Extra over item 601.03 for obtaining material from**	
601.04.01	Intermediate excavations	cubic metre (m^3)
601.04.02	Hard excavations	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material obtained from intermediate or hard excavations as specified in section 203 and measured in the final position after compaction.

The tendered rates shall be paid as extra over the rates tendered for item 601.03, including the cost of additional work, plant, tools, material, labour and supervision required for excavation of and breaking down the material as specified in section 203.

Item		Unit
601.05	**Crushing and screening**	
601.05.01	Single-stage crushing	cubic metre (m^3)
601.05.02	Screening	cubic metre (m^3)
601.05.03	Crushing and screening	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material crushed or screened, or crushed and screened and finally used in construction, measured in place after compaction. No allowance shall be made for wastage except in the case of screening only, where the quantity measured as above for payment shall be increased by including 70% of the loose volume, measured in stockpile, of the material screened out and discarded.

The tendered rates shall include full compensation for crushing or screening or crushing and screening the material as applicable, including all labour, plant, fuel, handling, processing, stockpiling if necessary, loading for transportation to the point of final use, and for disposing of any material screened out and discarded.

Item		Unit
601.06	**Extra over Item 601.02 for borrow material from sources to be supplied by the Contractor**	
614.02.01	(Layer and type of material indicated)	cubic metre (m^3)
614.02.02	Etc for other layers and type of material	cubic metre (m^3)

The extra over rate shall be in full compensation for obtaining the material and transporting it to the point of use including for all activities at the borrow areas such as removal and replacement of overburden, finishing off borrow areas and for the payment of royalties and other charges.

Note:

The following items of work, when specified, shall be carried out, measured and paid for in accordance with the appropriate sections of the Specifications, but shall be listed under this section in the Schedule of Quantities.

Item		Applicable section
(a)	Overhaul	103
(b)	Excess overburden at borrow areas	201
(c)	Removal of oversize material	203
(d)	Stockpiling	201
(e)	Stabilization	604

Items (a), (b) and (c) shall not apply to material obtained from sources provided by the Contractor.

SERIES 6 : ROADS AND PARKING AREAS

SECTION 602 : CRUSHED-STONE PAVEMENT LAYERS

CONTENTS

01 SCOPE

This section covers the procurement, furnishing and placing of approved crushed stone on top of the completed subgrade or subbase and the construction of a crushed-stone base or subbase, as the case may be, in accordance with the requirements of these Specifications.

02 MATERIALS

02.01 General

The aggregate used for crushed-stone base or subbase shall comply with the requirements for G1, G2 and G3 material as specified in TRH 14 and in this clause.

In respect of borrow material obtained from sources provided by the contractor, the provisions of clause 05(f) of section 201 are applicable.

02.02 Soluble salts

(a) The percentage of soluble salts in the material shall be subject to the following provisions:

(i) Untreated material (6,7 mm fraction)

- Witwatersrand quartzite : Crushed stone and mine sand.
- Where the pH < 6,0, it shall be treated with lime until pH ≥ 10, and then used. (The aggregate is normally treated at the crusher, and if the pH exceeds 10 at that stage, the decrease which will occur later on, shall be ignored.)
- Where the pH ≥ 6,0, the material is used as it is.

(ii) Other materials such as natural gravel and other crushed stone

- Where the electrical conductivity (EC) ≤ 0,15 Sm-1, the material may be used.
- Where the EC > 0,15 Sm-1, the pH shall be determined.
- Where the pH < 6,0, the material shall be treated with lime until the pH ≥ 10. The material may then be used. (Any later decrease of the pH shall be ignored should it remain ≥ 6,0.)
- Where the pH ≥ 6,0, it may be used, but special attention should be given to design and construction measures.

(iii) Material being stabilized (for example with lime or cement)

Where the pH ≥ 6,0 and the EC < 0,02 Sm^{-1} and the qualitative test shows that sulphates do not pose a problem, the material may be used. If not, the material shall be further analysed by the Engineer. In accordance with the Employer's instructions, and the proposals for its use shall be submitted to the Employer for approval.

(b) The tests conducted for determining the above judgment parameters shall be the following:

Electrical conductivity (EC)	method A21T of TMH1 (< 6,7 mm fraction)
pH	CSIR Transportek method CA 21 (< 6,7 mm fraction)
Acid-soluble sulphate content	BS 1377, part 3, test No 9
Water-soluble sulphate content	BS 1377, part 3, test No 5

(c) Where the salinity of the water used for compaction purposes is so high as to cause a considerable increase in the salinity of the material, the Engineer shall be entitled to determine the soluble salinity from samples taken from the compacted layer within 24 hours, and before the prime coat is applied.

02.03 Grading requirements

The grading of the crushed aggregate shall conform to the grading limits set out in TRH 14.

Where, on account of factors beyond the control of the Contractor, the material available from commercial sources or obtainable by normal crushing methods is consistently above or below the average of the grading limits given in TRH 14, the Engineer may fix a target grading to suit the average grading of the available material, provided that the target grading shall be within the grading limits, shall follow a smooth curve without any marked gaps or excessive quantities at a particular size, and shall preferably not approach the finer limits of the grading envelope. The material shall then conform to the target grading within the tolerances set out in table 602/1 below.

Tests to determine whether the crushed-stone material complies with the specified grading requirements shall be conducted after the material has been mixed and spread on the road or parking area.

The aggregate shall be produced entirely by the crushing of rock. Single-stage crushing will not be allowed and the crusher installation shall be capable of producing material which complies with the specified requirements. If, however, the parent rock is of such a nature that, despite every effort made, the material remains deficient in regard to the finer fractions, the Engineer may allow the addition of approved soil fines, crusher fines or sand in controlled quantities. Fines shall be introduced at the crushing plant.

Table 602/1

TOLERANCES FOR TARGET GRADING

Sieve (mm)	Tolerances for target grading
26,500	±5,0
19,000	±6,0
9,5 – 2,0	±8,0
0,425	±6,0
0,075	±4,0

02.04 Compaction requirements

The minimum dry density to which G1 material shall be compacted when used as base or as subbase is either 86% or 88% of the apparent density as may be specified or ordered by the Engineer. The apparent density shall be determined as specified in subclause 08.02(e) of section 903.

The minimum dry density to which G2 material shall be compacted when used as base or as subbase, is either 100% or 102% of modified AASHTO density as may either be specified or instructed. Field dry densities for G1 and G2 materials shall be determined by test method C (Direct radiation) of method A10(b)T as described in TMH 1.

Where the higher density is ordered and the Contractor cannot achieve the required compaction, the Engineer may, in his sole discretion, accept such sections at the rate tendered for compaction to the lower density, provided that at least this density is obtained.

G3 material shall be compacted to 98% of modified AASHTO density when used as base and to 95% of modified AASHTO density when used as subbase.

03 REQUIREMENTS BEFORE CONSTRUCTING THE CRUSHED-STONE LAYER

Before any crushed-stone layer is constructed, the following requirements shall be met:

The underlying layer shall comply with the requirements for the layer concerned.

The crushed-stone base shall, in the case of roads without kerbing, be supported during construction along the outer edge by placing, compacting and trimming the adjacent shoulder before the base is constructed. Excess material resulting from the trimming of shoulders shall be removed from the area of the base to the outside of the shoulders.

A crushed-stone layer shall not be rolled if, on account of either rain or any other cause, the underlying layer is so wet that the underlying layers could be damaged.

04 CONSTRUCTION

04.01 Spreading and mixing

Crushed-stone material which complies with any of the requirements specified above shall be dumped in sufficient quantities to ensure that, after construction, the completed layer will comply with all requirements in regard to layer thickness, levels, cross-section and density.

The maximum compacted thickness of any layer of crushed-stone base or subbase compacted in one process shall be 150 mm, unless otherwise specified or permitted by the Engineer.

The dumps of material shall be spread out to a flat-surfaced layer with a thickness suitable for mixing, after which the required amount of water shall be added and the material mixed until a homogeneous mixture is obtained.

04.02 Compaction

After mixing, the crushed-stone material shall be placed to the correct thickness and levels and shall be thoroughly compacted by means of suitable equipment so that the specified density is obtained throughout the entire layer after slushing.

The finally compacted layer shall be free from surface laminations, portions exhibiting segregation of the fine and coarse aggregates, corrugations or other defects that may detrimentally affect layer performance.

04.03 Watering and slushing

After completion of the compaction described above, short sections of the surface shall be thoroughly watered and rolled and slushed by three-wheeled flat-wheeled rollers with a mass of not less than 12 t each or by suitable vibratory rollers approved by the Engineer.

The process shall continue until all excess fines have been brought to the surface. The grout or mulch thus formed shall then be uniformly broomed over the surface by means of stiff brooms in order to correct any areas still deficient in fines, whereupon the excess fines shall be broomed off the surface of the layer. This operation shall continue until all the excess fines in the mixture have been brought to the surface of the layer and the specified density of the layer has been reached. Excess fines and loose aggregate shall then be swept from the surface while the surface is still damp, and the layer shall be allowed to dry out.

Care shall be taken during slushing operations not to roll the surface out of shape.

The slushing process shall be carried out on each section in one continuous operation, and each section shall be completed before proceeding with the next.

The completed layer shall be firm and stable with a closely knit surface of aggregate exposed in mosaic and free from nests of segregated materials, laminations or corrugations.

If the underlying layer is not a stabilized layer, care shall be taken not to saturate it during the slushing operation.

The Engineer may permit the slushing process in the lower layer of a two-layer crushed-stone base to be omitted, provided that the specified densities are obtained in each of the layers.

04.04 General

(a) Kerbs and channelling

Care shall be taken during rolling not to displace any concrete edging, kerbs and channelling which have already been laid. Any concrete edging, kerbs or channelling damaged during construction shall immediately be replaced or repaired by the Contractor at his own expense.

(b) Excess crushed-stone material

Any excess crushed-stone material shall be loaded and removed from the road or parking area. It shall not be re-used unless it has been rescreened, retested and again approved for use. It shall not be mixed with approved material unless screened, tested and approved for use on its own.

(c) Junctions with existing bituminous surfaces

At junctions with existing bituminous surfaces the new base shall not be feathered off to obtain a continuity of grade, but the existing work in the vicinity of the joint shall be cut back so as to ensure an overall compacted thickness of a new base and surfacing of not less than 100 mm.

05 PROTECTION AND MAINTENANCE

The Contractor shall protect and maintain the completed crushed-stone layer at his own expense until the next layer or the surfacing has been applied. Maintenance shall include the immediate repair of any damage that may be done to or defects that may occur in the layer, which shall be repeated as often as is necessary to keep the layer continuously intact and in good condition.

Repairs shall be done in a manner to ensure restoration to an even and uniform surface. No traffic shall be allowed to move direct on any unprimed crushed-stone layer.

The crushed-stone base shall be primed as soon as possible and, where ordered by the Engineer, traffic may have to be routed across primed layers, as specified in section 605.

06 CONSTRUCTION TOLERANCES

The completed crushed-stone layer shall comply with construction tolerances specified in section 601 for subbase and base layers.

Where a base is to be constructed in two layers, the requirements in regard to grade, thickness, cross section and smoothness shall not apply to the lower layer, but the lower layer shall be constructed with sufficient accuracy to enable the combined layer to be constructed to the tolerances specified.

07 TESTING

07.01 Process control

The minimum testing frequency the Contractor will be required to do in terms of clause 05 of section 901 for the purpose of process control shall be as given in table 602/2.

07.02 Routine inspection and testing

Routine inspection and testing will be carried out by the Engineer in accordance with the provisions of clause 09 of section 902 to test the quality of materials and workmanship in regard to compliance with the requirements of this section.

Compliance with the density requirements specified in clause 02 of this section shall be controlled in accordance with the statistical judgment scheme specified in section 902.

Any materials or workmanship which do not comply with the specified requirements shall be removed and replaced with materials and workmanship which do comply with the specified requirements or, if the Engineer permits, be repaired as specified in section 901 so that it will comply with the specified requirements after having been repaired.

Table 602/2

Test	Testing frequency	
	One test every	**Minimum number of tests per lot or section of road**
Materials		
Field density*	1 500 m^2	4
Indicator tests	2 500 m^2 (in road) 2 500 m^3 (when stockpiling)	2
ACV	5 000 m^3	-
Flakiness	5 000 m^3	-
Construction tolerances		-
The provisions of section 601 shall apply		

***** The determination of field dry density expressed as a percentage of apparent density implies an apparent density determination for each field density.

Where the material is homogeneous, this ratio may be reduced to one apparent density determination for every four field densities.

08 MEASUREMENT AND PAYMENT

Item		Unit
602.01	**Crushed-stone base constructed with material obtained from**	
602.01.01	Commercial sources	
602.01.01.01	G1 material compacted to 86% of apparent density	cubic metre (m^3)
602.01.01.02	G2 material compacted to 100% of modified AASHTO density	cubic metre (m^3)
602.01.01.03	G3 material compacted to 98% of modified AASHTO density	cubic metre (m^3)
602.01.02	Approved borrow pits and crushed by the Contractor	
602.01.02.01	G1 material compacted to 86%of apparent density	cubic metre (m^3)
602.01.02.02	G2 material compacted to 100% of modified AASHTO density	cubic metre (m^3)
602.01.02.03	G3 material compacted to 98% of modified AASHTO density	cubic metre (m^3)

Item		Unit
602.02	**Crushed-stone subbase constructed with material from**	
602.02.01	Commercial sources	
602.02.01.01	G1 material compacted to 86% of apparent density	cubic metre (m^3)
602.02.01.02	G2 material compacted to 100% of apparent density	cubic metre (m^3)
602.02.01.03	G3 material compacted to 95% of modified AASHTO density	cubic metre (m^3)
602.02.02	Approved borrow pits and crushed by the Contractor	
602.02.02.01	G1 material compacted to 86% of apparent density	cubic metre (m^3)
602.02.02.02	G2 material compacted to 100% of modified AASHTO density	cubic metre (m^3)
602.02.02.03	G3 material compacted to 95% of modified AASHTO density	cubic metre (m^3)

The unit of measurement shall be the cubic metre of completed crushed-stone base or subbase, as the case may be, compacted to the specified density, and the quantity shall be calculated from the authorized dimensions of the layer as specified or as directed by the Engineer.

The tendered rates shall include full compensation for procuring, furnishing and placing all materials including the crusher fines or sand necessary for correcting the grading of the crushed stone or lime for correcting the conductivity where necessary, for rolling, slushing and correcting the layers, and for testing, protecting and maintaining the work as specified.

Where overhaul applies, payment therefore will be made in terms of section 103.

Item		Unit
602.03	**The establishment of a crushing plant and opening of borrow pits where stone is obtained from approved borrow pits and is crushed by the Contractor**	number (No)

Where the Contractor obtains the material for crushed-stone base or subbase from approved borrow pits, whether indicated on the borrow-pit plans or approved after construction commences, the Contractor shall be entitled to the compensation provided under this item, provided that prior instructions were obtained from the Engineer in regard to the crushing of such material.

No payment shall be made under this item if the crushed-stone material is supplied from commercial sources or from a crusher that was erected or was in operation prior to the award of the Contract, or from a crusher that is not completely or directly under the control of the Contractor. In such cases payment under item 602.01.01 or 602.02.01 shall be in full compensation for the work performed in accordance with this section.

The unit of measurement for the establishment of the crushing plant and opening of borrow pits shall be the number of times the plant is set up and dismantled for the purpose of supplying crushed-stone material for base and subbase at the sources of supply, all as agreed to in writing by the Engineer.

The tendered rate shall include full compensation for the provision and erection of the crusher ready for crushing, the later dismantling and removal after completion of the crushing operations, and the work involved in opening the borrow pits, including clearing, the removal of overburden and establishing a working face and finishing-off the borrow pits upon completion of the operations.

Payment for crushed-stone material stockpiled on Site shall be made only if the Engineer is satisfied that the material in stockpile meets the specified requirements. Where the Contractor produces his own crushed-stone, the value of the crushed material per cubic metre, measured loose in stockpile, shall not be taken to be more than 45% of the rate tendered per cubic metre of compacted material.

Item		Unit
602.04	**Additional compaction**	
602.04.01	Extra over subitems 602.01.01.01,602.01.02.01, 602.02.01.01and 602.02.02.01 for compaction to 88% of apparent density	cubic metre (m^3)
602.04.02	Extra over subitems 602.01.01.02, 602.01.02.02, 602.02.01.02 and 602.02.02.02 for compaction to 102% of modified AASHTO density	cubic metre (m^3)

The extra over rates tendered for the listed subitems shall include full compensation for all additional costs for compacting the material to the higher density.

Note:

The following items of work, when specified, shall be carried out, measured and paid for in accordance with the appropriate sections of the Specifications, but shall be listed under this section in the Schedule of Quantities.

Item		Applicable section
(a)	Overhaul	103
(b)	Excess overburden at borrow pits	201
(c)	Temporary stockpiling of material	201
(d)	Stabilization	604

SERIES 6 : ROADS AND PARKING AREAS

SECTION 603 : UNPAVED AREAS

CONTENTS

01 SCOPE

This section covers the construction of gravel wearing courses for unsurfaced roads and parking areas and gravel shoulders for surfaced roads.

This section does not apply to medians, sidewalks, traffic islands and other unsurfaced areas, which shall be constructed in accordance with the relevant clauses of section 104.

02 MATERIALS

Material for gravel shoulders and wearing courses shall be obtained from borrow pits provided by the Employer, from excavations, cuttings or from sources provided by the Contractor.

In respect of borrow material obtained from sources provided by the contractor, the provisions of clause 05(f) of section 201 are applicable.

The Engineer shall approve all sources of supply and shall have the authority to direct from which sources all materials are to be obtained. The approval of a specific source of supply will not imply that all material from such a source is suitable for use, but it means that suitable material is available for selection from that source.

After compaction, the coarse aggregate in the gravel shall have a maximum dimension not exceeding 40 mm, unless otherwise ordered by the Engineer. Oversized aggregate in the gravel shall be broken down on the road or parking area and any remaining oversized material shall be bladed off and disposed of, all as specified in clause 06 of section 203. Alternatively, the material shall be crushed as specified in section 601.

Gravel finally placed in the shoulders or wearing course shall conform to the quality of the material suitable for the construction of subbase, with the proviso, however, that the plasticity index shall not exceed 10 +3 (GM) unless otherwise authorized by the Engineer. The plasticity index shall not be less than 6.

03 CONSTRUCTION

03.01 General

Construction shall be carried out in such a manner that adequate drainage will take place at all times and, in the case of shoulder construction, temporary drains shall be opened through the shoulder material and properly maintained until the base has been completed.

The Contractor shall not commence with bituminous work on any particular section of the road until the shoulders on that section of road have been completed and have been approved by the Engineer.

03.02 Placing and compaction

Gravel wearing courses shall be constructed to the dimensions specified on top of the final fill layer.

Where shoulders are to be constructed from the same material as the base, the shoulders shall be constructed at the same time as the base.

Where a crushed-stone base must be constructed, the shoulders shall be constructed first and shall be cut true to line to provide lateral support for the crushed-stone material. Care shall be taken to prevent shoulder material from contaminating the base material. In the case of asphalt bases, the gravel shoulders may be constructed after the base has been compacted.

Shoulder and wearing-course material shall be spread, broken down, watered, processed and compacted in accordance with the provisions of clause 06 of section 203. The material shall be compacted to a density of not less than 93% of modified AASHTO density.

04 PROTECTION AND MAINTENANCE

The Contractor shall protect and maintain the completed shoulders and wearing course. Maintenance shall include the immediate repair of any damage or defects which may occur and shall be repeated as often as is necessary to keep the work continuously intact until the end of the prescribed maintenance period, excluding normal wear and tear after the road has been opened to the public.

05 CONSTRUCTION TOLERANCES

The completed shoulders or wearing course shall comply with the construction tolerances set out below:

(a) Grade

The finished surface shall nowhere be more than 25 mm above or below the specified grade.

(b) Width

The outer edge of the shoulder or wearing course shall nowhere be more than 150 mm outside the lines shown on the Drawings. The tolerances for the position of the inner edge of the shoulder shall be as dictated by the tolerances for the width of the base.

(c) Thickness

The average thickness of the shoulder or wearing course as determined by way of test holes or accurate levels taken at the same position before and after construction, shall not be less than the specified thickness nor shall the thickness at any point be more than 30 mm less than the specified thickness.

06 TESTING

(a) Process control

The minimum frequency of testing the Contractor will be required to do in terms of clause 05 of section 901 for the purpose of process control shall be as shown in table 603/1.

(b) Routine inspection and testing

Routine inspection and testing will be carried out by the Engineer in accordance with the provisions of clause 09 of section 902 to test the completed work for compliance with the dimensional tolerances, quality of material, density of compaction and any further requirements stated in this section.

Compliance with the density requirements specified in clause 03 of this section shall be controlled in accordance with the judgment scheme specified in section 902.

Any materials or workmanship which do not comply with the specified requirements shall be removed and replaced with materials and workmanship which do comply with the specified requirements or, if the Engineer permits, be repaired as specified in section 901 so that it will comply with the specified requirements after having been repaired.

Table 603/1

	Testing frequency	
Test	**One test every**	**Minimum No of tests per lot or section of road**
Materials		
Field density and OMC*	1 500 m^2	4
Indicator tests	2 500 m^2	2
Tolerances		
Surface levels	40 m (3 pts per cross section)**	
Width	200 m	-
Thickness	-	30

***** The determination of field dry density expressed as a percentage of modified AASHTO density implies a modified AASHTO density determination for each field density. Where material is homogeneous, this ratio can be decreased to one modified AASHTO density determination for up to four field densities.

****** For parking areas, 1 test equals a series of points, 5 m apart, in a straight line across the full width of the parking area, at every 40 m cross section.

07 MEASUREMENT AND PAYMENT

Item **Unit**

603.01 Compacted gravel shoulder or gravel wearing course (compaction requirements indicated)

603.01.01 Shoulder — cubic metre (m^3)

603.01.02 Wearing course — cubic metre (m^3)

The unit of measurement shall be the cubic metre of shoulder or wearing-course material measured in final position after compaction and the quantity shall be calculated from the authorized dimensions of the layer as specified or as directed by the Engineer.

The tendered rates shall include full compensation for procuring, furnishing and placing all materials, for testing, protecting and maintaining the work as specified, for transporting the material and for removing and transporting up to 5% by volume of oversized material.

The tendered rates shall apply irrespective of the hardness or other properties of the material.

Overhaul will apply only if the material is transported from borrow pits or other sources provided by the Employer, and situated outside the free-haul boundaries.

Item **Unit**

603.02 Extra over item 603.01 for borrow material from sources to be supplied by the Contractor cubic metre (m^3)

The extra over rate tendered for item 603.02 shall be in full compensation for obtaining the material and transporting it to the point of use including for all activities at the borrow areas such as removal and replacement of overburden, finishing off borrow areas and for the payment of royalties and other charges.

Note:

The following items of work, when specified, shall be carried out, measured and paid for in accordance with the appropriate sections of the Specifications, but shall be listed under this section in the Schedule of Quantities.

Item	**Applicable section**
(a) Overhaul	103
(b) Excess overburden at borrow areas	201
(c) Removal of oversized material	203
(d) Single-stage crushing	601

SERIES 6 : ROADS AND PARKING AREAS

SECTION 604 : STABILIZATION

CONTENTS

01 SCOPE

This section covers the stabilization of materials used in the construction of the construction bed, fill or pavement layers by the addition of a chemical stabilizing agent or by the mechanical modification of the material by the addition of a soil binder.

02 MATERIALS

02.01 Chemical stabilizing agents

For the purposes of this Contract the stabilizing agent shall be either one or more of the following agents, whichever is specified on the Drawings, in the Schedule of Quantities, the Project Specifications or ordered by the Engineer:

(a) Road lime

Road lime shall comply with the requirements of SANS 824, but the use of unslaked lime will not be permitted. Lime shall bear the SANS mark.

(b) Cement

Cement shall comply with the requirements of SANS 50197-1. The use of rapid-hardening cement will not be permitted.

(c) Blast-furnace cement (CEM III)

Blast-furnace cement shall comply with the requirements of SANS 50197-1.

(d) Milled blast-furnace slag

Milled blast-furnace slag shall have a specific surface of not less than 3 500 cm^2/g and the residue on a sieve with 0,075 mm openings shall not exceed 10% by mass.

Milled blast-furnace slag shall not be used on its own as a stabilizing agent, but shall be mixed either with cement to form a cement-slag mixture or with lime to form a lime-slag mixture. The ratio by mass of the ingredients of each mixture shall be indicated by the Engineer.

Cement-slag and lime-slag mixtures shall be thoroughly mixed by means of approved mixers and/or spreaders prior their being applied to any layers to be stabilized, or, provided that the Engineer is satisfied that the Contractor can do it satisfactorily and the Engineer agrees thereto, they may be mixed on the road.

(e) Other chemical stabilizing agents

Other chemical stabilizing agents may be used if specified in the Project Specifications.

02.02 Soil binder

Soil binder for mechanical modification shall be taken from within the limits of an approved source and shall be subject to such requirements regarding grading, plasticity index or other properties as may be indicated on the borrow pit plans or in the Project Specifications or ordered by the Engineer.

02.03 General

From the time of purchase to the time of use, all stabilizing agents shall be kept under proper cover and protected from moisture.

Consignments of these materials shall be used in the same sequence as that in which they are delivered at the Works. Stocks which may have been stored on the Site for periods exceeding three months shall not be used in the work, unless otherwise authorized by the Engineer.

03 CHEMICAL STABILIZATION

03.01 Preparation of layer

The material to be stabilized shall be prepared and placed as specified in clause 06 of section 203, and shall be given at least one pass with a flat-wheel roller. The material must be damp.

03.02 Application of stabilizing agent

After the layer of soil or gravel has been prepared, the stabilizing agent shall be spread uniformly over the full width of the layer at the prescribed rate of application and in a continuous operation by an approved type of mechanical spreader or by hand.

When spreading is done by hand, pockets or bags of stabilizing agent shall be accurately spaced at equal intervals along the section to be stabilized to provide the specified rate of application. The pockets or bags shall be opened and the stabilizing agent spread in transverse rows across the full specified width to be stabilized. Such spreading shall be done as evenly as possible, and uniform distribution of the stabilizing agent over the entire surface to be treated shall then be obtained by levelling off the rows of stabilizing agent by hand rakes and/or screeds.

The Engineer may permit the spreading of the hand-spotted stabilizing agent by motor grader, provided that the stabilizing agent is spread evenly to his satisfaction.

03.03 Mixing in of stabilizing agent

Immediately after the stabilizing agent has been spread, it shall be mixed with the loose gravel to the full depth to be treated. Care shall be taken not to disturb the compacted layer underneath, nor to mix the agent below the desired depth. Mixing shall be continued for as long a period of time and be repeated as often as may be required to ensure a thorough, uniform and proper mix of the soil or gravel and stabilizing agent over the full width and depth of the material to be treated and until the resulting mixture is homogeneous and of a uniform appearance throughout.

Mixing shall be done by grader, disc harrow, rotary mixer or by similar equipment which shall make successive passes over the full width and depth of the layer to be stabilized.

Mixing may also be done in central batch-mixing plants, but the Contractor will not be entitled to payment for additional overhaul resulting from such procedure.

03.04 Watering

Immediately after the stabilizing agent has been properly mixed with the soil or gravel, the moisture content of the mixture shall be determined and the required amount of water specified in clause 06 of section 203 shall be added.

All water applied or added shall be well mixed with the gravel or soil to avoid the concentration of water near the surface or a flow of water over the surface of the layer.

Particular care shall be taken to ensure a satisfactory moisture distribution over the full depth, width and length of the section being stabilized and to prevent any portion of the work from becoming excessively wet after the stabilizing agent has been added. Any portion of the work that becomes too wet after the stabilizing agent has been added and before the mixture has been compacted will be rejected, and such portion shall be allowed to dry out to the required moisture content and shall be scarified, restabilized, recompacted and again finished off in accordance with the requirements specified herein, all at the expense of the Contractor. The water supply and watering equipment shall be adequate to ensure that all the necessary water is added and mixed with the material being treated within a sufficiently short period to enable compaction and finishing to be completed within the period specified in subclause 03.08 below.

03.05 Compaction

The provisions of clause 06 of section 203 shall apply. During compaction the layer shall be continuously bladed by a motor grader, and loss of moisture by evaporation shall be corrected by further light applications of water.

During compaction of base layers the Contractor shall harrow or scarify the surface lightly before final rolling, if so required by the Engineer, to prevent the formation of compaction planes near the surface of the base. Final rolling shall be done with equipment that will give a smooth surface which conforms to the surface tolerances specified.

The minimum compaction requirements shall be as specified for the particular layer in the various sections of these Specifications.

A sufficient number of compacting units shall be employed on the work to ensure that, from the time when the stabilizing agent is first applied to the layer, the process of mixing, applying water, compaction, shaping and final finishing is completed within the periods specified in subclause 03.08 below.

03.06 Finishing at junctions

Any finished portion of the stabilized layer adjacent to new work, that is used as a turn-around area by equipment while the adjoining section is being constructed, shall be provided with a protective cover of soil or gravel at least 100 mm thick over a sufficient length to prevent damage to work already completed. At the time of final finishing of the adjoining section, the cover shall be removed to permit the making of a smooth joint at the junction of the two sections. Material to be used in the vicinity of the joint, which cannot be processed satisfactorily with normal construction equipment, shall be mixed and compacted by hand or with suitable hand-operated machines.

03.07 Curing of stabilized work

The stabilized layer shall be protected against rapid drying out for at least seven days following the completion of the layer.

The methods of protection may be any one or more of the following:

(a) The stabilized layer shall be kept continuously damp by water being sprayed at frequent intervals. This method will be permitted for up to a maximum period of 48 hours, after which time one of methods (b), (c) or (d) must be applied. The Contractor is warned that work which is not kept continuously damp but is subjected to wet-dry cycles may be rejected by the Engineer in his sole discretion.

(b) The stabilized layer shall be covered with the material required for the next layer whilst the stabilized layer is still in a damp condition. The material that forms the protective layer shall be watered at such intervals as may be required to keep the stabilized layer continuously damp, and these intervals shall not exceed 24 hours in dry weather.

(c) The layer shall be covered with a curing membrane which consists of a spray grade emulsion or cut-back bitumen, applied at the rate directed by the Engineer. The provisions of section 605 shall apply mutatis mutandis to the application of a curing membrane.

(d) Where prime coat is specified on top of the stabilized subbase, the prime coat may be utilized as a curing membrane and shall be applied as specified in section 605.

No additional payment shall be made for curing as described above, except that the application of a curing membrane when ordered by the Engineer shall be paid for separately and the application of a prime coat shall be paid for under section 605.

03.08 Construction limitations

The stabilizing agent shall be applied only to an area of such size that all processing, watering, compacting and finishing can be completed within the period stated below:

Table 604/1

Stabilizing agent	Maximum time for completion after stabilizing agent comes into contact with the material to be stabilized
CEM I, CEM II, CEM III or cement-slag/lime-slag	10 hours
Lime	24 hours

No stabilizing agent shall be applied when the moisture content of the material to be stabilized exceeds the optimum moisture for the compaction equipment proposed by more than 2% of the dry mass of the material. No stabilization shall be done during wet weather or when, in the opinion of the Engineer, windy conditions may adversely affect the stabilizing operations. Any rain falling on the working area during the process of stabilization may be sufficient cause for the Engineer to order that areas affected be reconstructed at the Contractor's cost.

No traffic nor any equipment not actually used in the processing of the layer shall be allowed to pass over the freshly spread stabilizing agent. Only equipment required for curing or priming shall be allowed to pass over the treated layers during the specified curing period. Where specified in the Project Specifications, watering shall be done by side spraying by tankers travelling off the stabilized layer.

04 MECHANICAL MODIFICATION

The modification of soils and gravels by the addition of a soil binder, hereinafter referred to as "mechanical modification," shall involve the addition of an approved soil binder to the material to improve the load-bearing capacity, plasticity index, grading and other properties of the material.

The material to be treated shall be prepared, broken down and spread to the required loose thickness, all as specified in clause 06 of section 203. An approved binder material shall then be spread over the prepared material at the required rate, and the materials shall be mixed dry by motor grader, plough or other suitable equipment until the binder material is uniformly and thoroughly mixed with the material being treated, after which the mixed materials shall be watered, mixed and compacted as described in clause 06 of section 203.

05 TOLERANCES

05.01 Rate of application

The average rate of application of chemical stabilizing agents when applied by chemical bulk-spreading equipment and measured by the canvas patch or tray method shall be equal to the specified rate of application of plus or minus 5% measured over any section not exceeding 1,0 km in length, and no single measurement shall show a value exceeding 20% below the specified rate.

When hand spotted, stabilizing agents shall be spread exactly at the specified rate of application.

05.02 Uniformity of mix

The cementitious binder content of the mixed material, as determined from 10 samples per lot, when sampled and tested as specified in subclause 08.04(a) of section 903, shall be within the following limits:

(a) The average cementitious binder content of all 10 samples shall be not less than 91% of the specified binder content.

(b) Not more than 2 of the 10 samples shall show a cementitious binder content of less than 70% of the specified binder content.

As described in subclause 08.04(a) of section 903, test results shall be adjusted to allow for the presence, in the material to be stabilized, of minerals which affect the test results. The above requirements in respect of the uniformity of mix shall be applied only on condition that the variation in these adjustments is within the limits specified in subclause 08.04(a) of section 903.

06 QUALITY CONTROL

06.01 Process control

(a) Application rate of stabilizing agent

The Contractor shall keep detailed records of the quantities of stabilizing agent applied to the road and of the volume of material stabilized, and shall make these records available to the Engineer.

He shall also monitor the rate of application when bulk-spreading equipment is used by taking a canvas patch or tray test every 100 m, with at least one test per section of road, unless the Engineer has permitted the number of tests to be reduced.

When a bulk spreader is used on the Site for the first time, or after it has been adjusted or repaired, the spread rate shall be checked by at least five tests over as short a distance as is practicable, with the equipment running at normal speed without stops. Spreading shall not continue on a large scale until the spread rate is within the permissible tolerances.

(b) Compaction

The requirements for process control in respect of compaction shall be the same as those stated for the unstabilized layers in each section. Modified AASHTO densities shall be determined as described in subclause 08.02 of section 903.

06.02 Routine inspection and testing

Routine inspections will be carried out by the Engineer in accordance with the provisions of clause 09 of section 902 to test the quality of materials and workmanship for compliance with the requirements of this section.

Compliance with the requirements for the compaction of stabilized materials shall be as specified in the relevant section for each layer.

The requirements for uniformity of mix and rate of application shall be deemed to have been complied with if the mixture meets the requirements of clause 05 of this section.

When the tests for uniformity of mix are not applicable as stated in subclause 05.02, the material shall be visually appraised for uniformity of mix.

06.03 Defective work or materials

Any material or work which does not comply with the specified requirements shall be removed and replaced with new materials or work which complies with the specified requirements or, if the Engineer permits, be repaired as specified in section 901 so that it will comply with the specified requirements after having been repaired.

07 MEASUREMENT AND PAYMENT

Item		Unit
604.01	**Chemical stabilization, extra over unstabilized compacted layers** (indicate layer to be stabilized)	cubic metre (m^3)

The unit of measurement shall be the cubic metre of chemically stabilized material measured in place after compaction in the manner specified for the particular layer under the various sections of these Specifications. The quantity shall be determined according to the authorized dimensions.

Chemical stabilization shall be paid for as extra over the rates tendered for constructing unstabilized layers. The tendered rates for chemical stabilization shall therefore include full compensation for completing the prescribed work, but shall exclude the cost of providing the stabilizing agent.

No distinction shall be made in respect of the type of stabilizing agent used, the time for completion, and the specific layer which is being stabilized, and the extra-over rate tendered shall apply to any combination of these. The Engineer shall have the right to vary the thickness of the layer to be stabilized without varying the Contractor's rate for this work. The Contractor will not, however, be called upon to stabilize any layer of less than 100 mm or more than 200 mm thick.

Item		Unit
604.02	**Chemical stabilizing agent**	
604.02.01	Cement	ton (t)
604.02.02	Blast-furnace cement (CEM III)	ton (t)
604.02.03	Road lime	ton (t)
604.02.04	Milled blast-furnace slag	ton (t)
604.02.05	Other stabilizing agents (specify type)	ton (t)

The unit of measurement shall be the ton of stabilizing agent. When mixtures of slag and cement or lime are used, the quantity of each constituent agent shall be measured separately and not the mixture as a whole. The tendered rates shall include full compensation for the provision of the stabilizing agent within the works, irrespective of the rate of application specified or ordered by the Engineer, but shall allow for the variations in mixing and compaction times for the various stabilizing agents. The rate for milled blast-furnace slag shall include full compensation for premixing with other stabilizing agents in the required proportions.

Item		Unit
604.03	**Mechanical modification, extra over untreated layer**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of compacted material that has been mechanically modified by the addition of a soil binder.

The tendered rate for mechanical modification shall be paid for as extra over the rate for the construction of an untreated layer irrespective of the binder content specified or eventually used.

The addition of material during a crushing and screening process, whether it is specially imported material which is not the product of crushing or whether it is crushed material screened out and then added back in part or in full, shall not be measured or paid for as treatment with soil binder, but shall be considered as part of the process of producing crushed stone for subbase, base or other construction work, the cost of which shall be included in the rates tendered for those items of work.

Item		Unit
604.04	**Application of a curing membrane which consists of**	
604.04.01	Bituminous emulsion 55% net bitumen	litre (ℓ)
604.04.02	MC-70 grade cut-back bitumen	litre (ℓ)

The unit of measurement shall be the litre of bituminous curing membrane applied in accordance with the Engineer's instructions.

The tendered rates shall include full compensation for procuring, furnishing and applying the membrane and for the maintenance of the curing membrane for a period of at least fourteen days of its being applied.

SERIES 6 : ROADS AND PARKING AREAS

SECTION 605 : PRIME COAT

CONTENTS

01 SCOPE

This section covers the application of a tar or bituminous prime coat to a prepared pavement layer.

02 MATERIALS

02.01 Prime material

The prime material shall be one of the following, as specified or directed by the Engineer:

- MC-30 cut-back bitumen which complies with SANS 308;
- MC-70 cut-back bitumen which complies with SANS 308;
- RTH 3/12P tar prime which complies with SANS 748;
- RTL 3/12P tar prime which complies with SANS 749;
- RTH 1/4P quick-drying tar prime which complies with SANS 748; or
- Invert bitumen emulsion which complies with SANS 1260.

If ordinary grade tar prime does not penetrate adequately into the layer to be primed, or if curing is inadequate, between 10% and 30% by volume of high-temperature creosote which complies with SANS 538 shall be added to and mixed with the priming material by introducing the creosote direct into the distributor and using the circulating system to mix it with the prime material.

02.02 Mineral aggregate for blinding

The aggregate used for blinding the primed surface shall consist of crushed rock or river sand, 100% of which passes through the 6,7 mm sieve and not more than 10% of which passes through the 2,36 mm sieve. The aggregate shall be clean, hard and free from excessive dust. It shall not contain any clay, loam or other deleterious matter.

03 EQUIPMENT

The following equipment shall be available and in good working order:

(a) Binder distributor

The binder distributor used for distributing the bituminous binders shall -

- comply with TMH2 and shall be covered by a valid certificate of compliance with TMH2 issued by one of the centres for testing binder distributors mentioned in TMH2;
- not have any fuel or binder leaks;
- have a straight and clean spraybar, all the spray heads of which shall be of the same type which open simultaneously and shall not leak when closed;
- have its spray heads all spraying at the same angle to the spraybar and adjusted to the correct level so as to obtain the required overlapping;
- have its fans not interfering with one another;
- have its sieve undamaged and clean;
- be under the direct control of an operator approved by the engineer on the grounds of a reference, in writing, or a certificate of competence signed by a representative of a road authority.

(b) Water sprinkler

The water sprinkler shall have efficient spray equipment capable of spraying a uniform film of water over the entire area to be primed.

(c) Rotary broom

The rotary broom shall be power-operated and shall be supplied together with a suitable pneumatic-tyred towing vehicle.

(d) Other equipment

Other equipment shall include hand brooms, reinforced paper for joints, string, nails and all other ancillary equipment required to carry out the operation efficiently and neatly.

04 WEATHER LIMITATIONS

No prime shall be applied under the following adverse weather conditions:

- During foggy or wet conditions
- When rain is imminent
- When wind is blowing sufficiently hard to cause uneven spraying
- When the layer is visibly wet, thus more than damp
- When, immediately prior to commencing with the application of the prime, the temperature of the road surface is below or, in the opinion of the Engineer, likely to fall below 10°C.

The Engineer's decision as to whether or not to apply the prime coat under specific weather conditions shall be final.

05 PREPARATION OF THE LAYER TO BE PRIMED

Not longer than 24 hours before spraying, the layer to be primed shall be broomed and cleaned of all loose and deleterious material by means of a rotary broom and hand brooms. A light spray of water, sufficient to dampen the surface, shall be uniformly applied to the layer immediately before the application of the prime. If the water is over-applied, the layer shall be allowed to dry until a uniformly damp surface is obtained.

Before any prime material is sprayed, the layer to be primed shall be checked for compliance with the specified surface and other requirements. Any sections which do not comply with the specified requirements shall be corrected as specified in section 901.

06 APPLICATION OF THE PRIME COAT

(a) Twine-reinforced paper or other suitable approved material shall be used at all joints at the beginning and end of all sprays in order to obtain a neat start and cut off.

(b) The temperatures for storage and spraying shall be in accordance with table 605/1 below.

Table 605/1

Type of prime	Maximum storage temperature °C		Spraying temperature °C
	Up to 24 hrs	Over 24 hrs	
Cut-back bitumen			
MC-30	65	30	45 - 65
MC-70	80	50	60 - 80
Tar prime			
RTH3/12P	70	50	55 - 70
RTL3/12P	65	40	50 - 65
Tar + 10% creosote	60	50	45 - 55
Tar + 20% creosote	55	45	40 - 50
Tar + 30% creosote	50	40	35 - 45

All prime materials stored in a heated condition shall be stored in a container with a properly functioning circulation system and with a securely fitting lid. No heat shall be added to materials delivered above the storage temperature until the temperatures are below those specified above, unless the materials are intended for immediate use.

(c) The rate of application shall be as specified in the Project Specifications or as directed by the Engineer after trial applications have been made to short sections if necessary.

Should the prime material be sprayed in excess of the tolerances specified in clause 08 of this section, the Engineer may require remedial measures to be taken by the Contractor at his own expense, as specified in clause 08 of section 901.

(d) Wherever feasible, the prime shall be applied evenly over the full width of the surface in one or more lanes and be allowed to penetrate and cure until traffic can pass over the surface without the prime being picked up by the tyres. All traffic shall be kept off the surface until this condition has been reached.

Where no kerbing is installed, the total width of the primed surface shall be 300 mm wider than the specified width of the final surfacing, and the edges of the prime in the case of roads, shall be parallel to the centre line.

(e) Where it is not feasible for traffic to use bypasses, the prime shall be applied and allowed to penetrate for so long as is practicable before a blinding layer of mineral aggregate is applied at a rate of 0,0035 m^3/m^2. Care shall be taken to ensure that the mineral aggregate is not applied too soon after spraying of the prime.

Where practicable, two to four hours shall elapse, as may be directed by the Engineer. Any "caking" of aggregate which may take place and cause problems during the surfacing process shall be removed before the final surfacing is commenced.

(f) If the prime is applied in more than one lane, allowance shall be made for the overlapping of lanes by 100 mm.

(g) Care shall be taken to protect any kerbing, guardrails and channelling from the prime by covering them with a suitable protective material when spraying.

07 MAINTENANCE AND OPENING TO TRAFFIC

As soon as the primed surface has dried sufficiently to allow the traffic to pass without the primed surface being picked up or otherwise damaged by the tyres, the road or parking area shall, where practicable, be opened to public traffic for a period of 14 days if the primed layer is constructed of crushed-stone, and one week in the case of natural gravel layers. During this period the primed area under traffic shall be maintained and all damage caused by traffic shall be repaired as directed by the Engineer, all at no additional payment.

The Engineer may negotiate with the Contractor that sections be opened to traffic for longer periods than those stated above, but during such extended periods the cost of maintaining the primed surface and of repairing any further damage to the primed layer caused by traffic shall be paid for as "extra work" in accordance with the provisions of the General Conditions of Contract.

08 TOLERANCES

The actual spray rates shall not deviate by more than 0,05 litre/m^2 from the required spray rate as specified or ordered by the Engineer. Any material sprayed in excess of 0,05 litre/m^2 more than the required spray rate shall not be paid for.

09 TESTING

The Contractor shall give the Engineer at least 24 hours notice of his intention to spray prime material so that the actual spray rates can be controlled by the Engineer. Unless otherwise agreed beforehand, the Contractor shall spray only when the Engineer or his representative is present.

10 MEASUREMENT AND PAYMENT

Item		Unit
605.01	**Prime coat**	
605.01.01	RTH 3/12P or RTL3/12P tar prime	litre (ℓ)
605.01.02	MC-30 cut-back bitumen	litre (ℓ)
605.01.03	MC-70 cut-back bitumen	litre (ℓ)
605.01.04	Invert bituminous emulsion	litre (ℓ)
605.01.05	Tar + 10% creosote	litre (ℓ)
605.01.06	Tar + 20% creosote	litre (ℓ)
605.01.07	Tar + 30% creosote	litre (ℓ)
605.01.08	Quick-drying RTH1/4P tar prime	litre (ℓ)

The unit of measurement shall be the litre of priming material measured at spraying temperature and sprayed as required.

The tendered rates shall include full compensation for supplying the priming material, including the supplying of high-temperature creosote and mixing the components in the case of tar-and-creosote mixes, cleaning and watering the layer to be primed, applying the priming material and maintaining the primed surface as specified.

Item		Unit
605.02	**Aggregate for blinding**	square metre (m^2)

The unit of measurement shall be the square metre of prime coat blinded with aggregate on the instructions of the Engineer.

The tendered rate shall include full compensation for procuring, furnishing and applying the aggregate for blinding where directed by the Engineer, and for maintenance of the blinding layer as specified.

SERIES 6 : ROADS AND PARKING AREAS

SECTION 606 : ASPHALT BASE AND SURFACING

CONTENTS

01 SCOPE

This section covers all the work in connection with the construction of asphalt bases and surfacing. It includes the procurement and supply of aggregate and bituminous binder, mixing at a central mixing plant, spreading and compaction of the mixture, all as specified for the construction of -

- a continuously graded asphalt base;
- a semi-gap-graded asphalt base;
- continuously graded asphalt surfacing;
- gap-graded asphalt surfacing with or without rolled-in precoated chips;
- semi-gap-graded asphalt surfacing with or without rolled-in precoated chips;
- open-graded asphalt surfacing;

This section also covers the construction of asphalt surfacing on bridge decks.

02 MATERIALS

02.01 Bituminous binders

The various bituminous binders specified shall comply with the relevant SANS specifications mentioned below:

Penetration grade bitumens	SANS 307
Bitumen emulsions	SANS 309 (anionic) SANS 548 (cationic)

The type and grade of bituminous binder to be used in each case shall be as specified hereinafter or in the Project Specifications.

When bitumen rubber is specified for use as a bituminous binder, the relevant specification will be incorporated in the Project Specifications.

02.02 Aggregates

Coarse and fine aggregates shall be clean and free from decomposed materials, vegetable matter and other deleterious substances and shall comply with the requirements of SANS 1083 unless otherwise specified in this section.

(a) Resistance to crushing

The crushing value (ACV) of the coarse aggregate, when determined in accordance with TMH1 Method B1, shall not exceed the following values for aggregate used for-

open-graded surfacing	21
other surfacing	25
base	29
rolled-in chips	21

(b) Shape of the aggregate

The weighted average value of the flakiness index of the coarse aggregate, when determined in accordance with TMH1 Method B3T, shall not exceed the following values for aggregate used for -

Surfacing 30

Based on the following separate sifted-out fractions of the combined aggregate:

- fraction passing through the 19,0 mm sieve and retained on the 13,2 mm sieve;
- fraction passing through the 13,2 mm sieve and retained on the 9,5 mm sieve; and
- fraction passing through the 9,5 mm sieve and retained on the 6,7 mm sieve.

Base 35

Based on the following separate sifted-out fractions of the combined aggregate:

- fraction passing through the 26,5 mm sieve and retained on the 19,0 mm sieve; and
- fraction passing through the 19,0 mm sieve and retained on the 13,2 mm sieve.

Rolled-in chips (all nominal sizes) 20

Based on the following separate sifted-out fractions:

- fraction passing through the 26,5 mm sieve and retained on the 19,0 mm sieve;
- fraction passing through the 19,0 mm sieve and retained on the 13,2 mm sieve;
- fraction passing through the 13,2 mm sieve and retained on the 9,5 mm sieve; and
- fraction passing through the 9,5 mm sieve and retained on the 6,7 mm sieve.

(c) Polishing

The polished-stone value of aggregate, when determined in accordance with SANS Method 5848, shall not be less than the following values for aggregate used for-

continuously and open-graded surfacing	50
gap-graded surfacing	45
rolled-in chips	55

Aggregate with polishing values below those stated above may be approved for use by the Engineer.

(d) Adhesion

When tested in accordance with TMH1 Method C5, the immersion index of a mixture of the binder and aggregate proposed for use shall not be less than 75%. The aggregate used for the test mixture shall have a grading that is within the limits for the mix concerned.

(e) Absorption

When tested in accordance with TMH1 Methods B14 and B15, the water absorption of the coarse aggregate shall not exceed 1% by mass, and that of the fine aggregate shall not exceed 1,5%, unless otherwise permitted.

(f) Sand

The total fine aggregate used in all asphalt mixes shall have a sand equivalent of at least 35 when tested in accordance with TMH1 Method B19 and the sand to be mixed with the aggregate shall have a sand equivalent of at least 30.

(g) Design requirements

By conducting the necessary tests, the Contractor shall satisfy himself that he will be able to produce a mixture which will meet the design requirements specified hereinafter using the aggregate he proposes to supply within the grading limits specified.

(h) Grading

The grading of the combined aggregate, including any mineral filler that may be added in an approved quantity as described in subclause 02.03, shall be within the limits stated in tables 606/1 and 606/2 for the various mixes. The approved grading shall be designated as the target grading and the composition of the working mix shall subsequently be maintained within the limits specified in subclause 13.03.

(i) Rolled-in chips

Rolled-in chips for gap-graded asphalt surfacing mixes shall comply with the grading requirements given in table 606/3.

02.03 Fillers

If the combined aggregate for asphalt surfacing mixes shows a deficiency in fines, an approved filler may be used to improve the grading. Filler may consist of "active" filler as defined herein or inert material such as rock dust with the required grading which is used to improve the grading of the combined aggregate. Under no circumstances shall more than 2% by mass of active filler be used in asphalt mixes. Inert filler such as rock dust used to improve the grading will not be subject to this limitation.

Table 606/3

GRADING LIMITS FOR ROLLED-IN CHIPS

Sieve size (mm)	Percentage passing by mass	
	19,0 mm chips	13,2 mm chips
26,5	100	-
19,0	85 - 100	100
13,2	0 - 30	85-100
9,5	0 - 5	0 - 30
6,7		0 - 5

The Engineer may order the use of any active filler to improve the adhesion properties of the aggregate. Active filler shall consist of milled blast-furnace slag, hydrated lime, cement, blast-furnace cement, fly-ash or a mixture of any of these materials. Individual materials shall comply with the requirements of the relevant SANS or other specifications for such material.

Active filler shall have a bulk density in toluene between 0,5 g/mℓ and 0,9 g/mℓ with at least 70% by mass passing through the 0,075 mm sieve. The voids in dry compacted filler shall be between 0,3% and 0,5%, when tested in accordance with BS 812.

Only active filler added on the instructions of the Engineer for improving adhesion will be paid for. No payment will be made for filler added to improve the grading.

02.04 General

All materials shall be handled and stockpiled in a manner that will prevent contamination, segregation or damage. Cement and lime shall be used in the order in which it has been received.

The Contractor shall, as often as is necessary, test and control the materials produced by himself or received by him from suppliers to ensure that the materials always comply with the specified requirements.

03 COMPOSITION OF ASPHALT BASE AND SURFACING

The rates of application and mix proportions of bituminous binder, aggregates and fillers set out hereafter are nominal rates and proportions and shall be used for tendering purposes only. The rates and proportions actually used shall be determined to suit the materials used and the conditions which prevail during construction, and any approved variation of a nominal mix in the bitumen content or active-filler content shall be the subject to an adjustment in payment for binder or active-filler variations, as described in clause 16.

At least eight weeks before production or delivery of the materials, the Contractor shall submit to the Engineer samples of the aggregates, filler materials and bituminous binders he proposes to use in the mix, together with his proposed mix design, so that the Engineer may test the materials and confirm the use of the proposed mix, if he is satisfied that it meets the specified requirements.

As soon as the materials become available, the Contractor shall produce a working mix in accordance with the design mix, which working mix must again be tested by him for compliance with the design requirements. Samples of the working mix shall also be made available to the Engineer, who will authorize the use of the working mix proportions as finally approved for use.

The composition of the approved working mix shall be maintained within the tolerances given in subclause 14.03.

The nominal mix proportions (by mass) of the various asphalt mixes are set out in tables 606/1 and 606/2.

The design of the asphalt mixes shall be in accordance with the design-guidelines of TRH8 for the class of traffic specified in the Project Specifications.

Precoated chips shall comply with the requirements of clause 10 of this section.

04 PLANT AND EQUIPMENT

04.01 General

All plant shall be designed and operated to produce a mixture which complies with the requirements of this Specification. The plant and equipment used shall be of an adequate rated capacity, in good working order and subject to the approval of the Engineer. Obsolete or worn-out plant will not be allowed on the Site.

Any alteration which has been or is being effected to any construction plant, and which does not comply with the Specifications of the manufacturer, shall be brought to the attention of the Engineer.

TABLE 606/1

GRADING LIMITS FOR COMBINED AGGREGATE AND MIX PROPORTIONS FOR ASPHALT BASE

Sieve size (mm)	Percentage passing through sieve by mass			
	Semi-gap-graded		Continuously graded	
	37,5 mm max	26,5 mm max	27,5 mm max	26,5 mm max
53,000	-	-	-	-
37,500	100	-	100	-
26,500	85 - 100	100	84 - 94	100
19,000	75 - 95	92 - 100	71 - 84	85 - 95
13,200	-	82 - 93	-	71 - 86
9,500	60 - 80	72 - 87	50 - 67	62 - 78
6,700	-	60 - 75	-	-
4,750	45 - 60	50 - 64	36 - 53	42 - 60
2,360	40 - 52	40 - 52	25 - 42	30 - 48
1,180	36 - 47	36 - 47	17 - 34	22 - 38
0,600	32 - 42	32 - 42	-	16 - 28
0,300	22 - 35	22 - 35	10 - 22	12 - 20
0,150	10 - 20	10 - 20	-	8 - 15
0,075	4 - 10	4 - 10	5 - 12	5 - 10
Aggregate	Nominal mix proportions by mass when bitumen is used			
	93%		94,5%	
Bitumen (grade according to Project Specifications)	6%		5%	
Active filler	1%		0,5%	

TABLE 606/2

GRADING LIMITS FOR COMBINED AGGREGATE AND MIX PROPORTIONS FOR ASPHALT SURFACING

Sieve size (mm)	Percentage passing through sieve by mass									
	Gap graded*			Semi-gap graded		Continuously graded			Open-graded	
	High stone-content	Intermediate stone content	Low stone-content	26,5 mm max	19 mm max	Coarse	Medium	Fine	Coarse	Fine
26,500	-	-	-	100	-	100	-	-	-	-
19,000	100	100	100	92 - 100	100	85 - 100	-	-	100	-
13,200	75 - 100	75 - 100	75 - 100	82 - 93	82 - 100	71 - 84	100	-	90 - 100	100
9,500	65 - 85	70 - 90	70 - 90	72 - 87	73 - 86	62 - 76	82 - 100	100	35 - 65	74 - 100
4,750	50 - 60	60 - 70	65 - 75	50 - 64	45 - 60	42 - 60	54 - 75	64 - 88	6 - 16	12 - 26
2,360	45 - 55	53 - 63	60 - 70	40 - 52	40 - 52	30 - 48	-	-	4 - 14	5 - 15
1,180	45 - 55	53 - 63	60 - 70	36 - 47	36 - 47	22 - 38	27 - 42	35 - 54	-	-
0,600	36 - 52	45 -63	55 - 70	32 - 42	32 - 42	16 - 28	18 - 32	24 - 40	-	-
0,300	25 - 45	35 - 55	45 - 65	22 - 35	22 - 35	12 - 20	11 - 32	16 - 28	3 - 8	3 - 8
0,150	12 - 32	15 - 35	20 - 40	10 - 20	10 - 20	8 - 15	7 - 16	10 - 20	-	-
0,075	5 - 12	5 - 12	5 - 12	4 - 10	4 - 10	4 - 10	4 - 10	4 - 12	2 - 5	2 - 5
Normal mix proportions by mass										
Aggregate	92%	92%	92%	92,5%	92,5%	93,5%	93,0%	93,0%	93,0%	93,0%
Bitumen (grade according to Project Specifications)	7,0%	7,0%	7,0%	6,5%	6,5%	5,5%	6,0%	6,0%	6,0%	6,0%
Active filler	1,0%	1,0%	1,0%	1,0%	1,0%	1,0%	1,0%	1,0%	1,0%	1,0%

***** The percentage passing through the 4,750 mm sieve and retained on the 0,600 mm sieve shall not exceed 15%

04.02 Mixing plant

Asphalt shall be mixed in a mixer of an approved type and of proven suitability for producing a mixture complying with all the requirements of the Specifications.

The mixing plant may be controlled either automatically or manually, but in the latter case two control operators shall be provided.

Tanks for the storage of binder shall be capable of heating the material to the specified temperature requirements and shall be under effective and positive control at all times. The heating system must be so designed that the binder will not be degraded during heating. A circulating system for the binder shall be provided, which shall be of adequate size to ensure the proper and continuous circulation of the binder between the storage tanks and mixer during the entire operating period.

Satisfactory means shall be provided for obtaining the proper amount of binder in the mix within the tolerances specified, either by weighing or by volumetric measurements. Suitable means shall be provided for maintaining the specified temperatures of the binder in the pipelines, weigh buckets, spraybars and in any other containers and flowlines.

In the case of a drum type mixer, the system shall control the cold feeding of each aggregate fraction and of the filler by mass, by means of a load cell or another device regulating the feed automatically, and by immediately correcting any variation in mass which results from moisture or from any other cause. The cold feed shall be regulated automatically with regard to the binder feed, to maintain the required mix proportion.

Suitable dust-collecting equipment shall be fitted to prevent pollution of the atmosphere in terms of Act 45 of 1965.

The type of oil used and the control of the burner to dry the aggregates will be such as to ensure full combustion of the fuel in order to prevent contamination of the aggregates and pollution of the atmosphere.

04.03 Spreading equipment

(a) Paver

The mixture shall be laid by an approved type of self-propelled mechanical spreader and finisher capable of laying to the required widths, thicknesses, profile, camber or crossfall without causing segregation, dragging or other surface defects.

All pavers shall be fitted with automatic electronic screed controls for maintaining the required levels, cambers and crossfalls. Where skids are used, they shall be at least 9 m long or as specified by the Engineer.

(b) Chip spreader for gap-graded surfacing

Wherever feasible, a machine straddling the full paved width shall be used to spread the precoated chips. Such a mechanical spreader must be self-propelled and able to follow immediately behind the paver.

When precoated chips are spread by hand, special care shall be taken to prevent bunching of the chips.

04.04 Rollers

Compaction shall be done by means of approved flat steel-wheeled vibratory or pneumatic-tyred rollers. These rollers shall be self-propelled and in good working order, free from backlash, faulty steering mechanism and worn parts. The frequency as well as the amplitude of vibratory rollers shall be adjustable. Rollers shall be equipped with adjustable scrapers to keep the tyres and drums clean and with efficient means of keeping the wheels wet to prevent the mixes from sticking to the drums and tyres.

The mass and/or tyre pressure shall be of such a nature to ensure proper compaction which complies with the Specifications in regard to surface finish and density.

04.05 Binder distributors

Where bituminous materials are to be sprayed onto areas before the laying of asphalt is commenced, binder distributors complying with the requirements of clause 03 of section 605 shall be used.

04.06 Transporting vehicles

The asphalt shall be transported from the mixing plant to the spreader in trucks having tight, clean, smooth beds and sides, which have been treated to prevent adhesion of the mixture to the truck bodies. A thin film of soapy water or vegetable oil may be used to prevent adhesion, but no petroleum products.

04.07 Mass-measuring device for asphalt mixes

Where payment per ton is specified, the Contractor shall keep available at the mixing plant or on the Site, a suitable gauged mass-measuring device for measuring the asphalt mixes. The device shall be provided with a printer to print the type of mix, the mass, the time and the date. The printed data shall be submitted to the Engineer.

05 LIMITATIONS REGARDING THE WEATHER, AND THE STORAGE OF MIXED MATERIAL

The mixing and placing of asphalt shall be carried out only under favourable weather conditions. The mixing and placing of asphalt shall not be allowed if the moisture content of the aggregate affects the uniformity of temperature, or if free water is present on the working surface. Mixing shall not be allowed to take place more than two hours before paving begins, unless provision has been made for storage. The method of storage of mixed material shall be approved by the Engineer and shall be such that the temperature of the mix shall remain uniform throughout. Storage shall in any case not be permitted for a period exceeding 12 hours after mixing, unless otherwise approved by the Engineer. Open-graded mixes shall not be stored or mixed ahead of paving operations, but shall be laid directly after mixing. The following wind and temperature conditions are regarded as suitable for paving work:

(a) While the air temperature is rising, work may be performed at temperatures of -
- 6°C and higher, with an allowable wind velocity of less than 25 km/h.
- 10°C and higher, with an allowable wind velocity of less than 55 km/h.

(b) When the air temperature drops, work must be stopped when the temperature reaches 6°C, regardless of wind velocity, and may not be resumed before the temperature is definitely rising.

06 PREPARATION OF SURFACE

06.01 Correction of base, subbase (in the case of asphalt base) and bridge decks

The base, subbase or bridge deck, as the case may be, shall be checked for smoothness and accuracy of grade, elevation and cross-section.

Any portion of the base, subbase or bridge deck, as the case may be, that does not comply with the specified requirements may, with the permission of the Engineer, be corrected with premixed asphalt material at the Contractor's own expense, until the specified requirements are met.

The Engineer may, in his sole discretion, allow minor surface irregularities to remain, provided that they can be taken up in the following asphalt layer without adversely affecting that layer.

The asphalt material used for the correction of the base, subbase or bridge deck shall be the same mixture as specified for the surfacing or as directed by the Engineer, and the maximum size of the aggregate used shall be dictated by the required thickness of the correction in each case.

06.02 Cleaning of surface

Immediately before the tack coat is applied or, where there is no tack coat, before the asphalt is applied, the surface shall be broomed and cleaned of all loose or deleterious material.

Where the prime coat (if any) has been damaged, it shall be repaired by priming material being hand-brushed or sprayed over the damaged portions.

Concrete bridge decks shall be thoroughly cleaned by washing and brushing to remove all loose material. After the surface has dried, it shall be painted with a tack coat.

06.03 Tack coat

Where required in these Specifications or the Project Specifications or where indicated by the Engineer, a tack coat shall be applied to the surface to be paved.

The tack coat shall consist of an anionic, stable grade bituminous emulsion containing 30% bitumen and shall be applied at a rate of 0,55 litre/m^2 or as directed by the Engineer.

Portions of kerbing, channelling, bridge kerbs and railings which will be exposed shall be suitably protected while the tack coat is being applied.

The tack coat shall not be applied more than 24 hours before the paving is done.

07 PRODUCING AND TRANSPORTING THE MIXTURE

07.01 Mixing and storage temperatures of binder

Bituminous binders shall be stored at temperatures which do not exceed those given in table 606/4, and the aggregate and bituminous binders shall be heated at the mixing plant to such temperatures that the mixed product shall have a temperature within the range given in table 606/4 when placed.

Table 606/4

Type of bituminous binder in mix	Max storage temp of asphalt (°C)		Temp range of asphalt at mixer (°C)	
	Over 24 h	Under 24 h	Cont. and gap-graded mixes	Open-graded mixes
40/50 pen	145	195	140-165	110-140
60/70 pen	135	185	135-160	105-135
80/100 pen	125	175	130-155	100-130
150/200 pen	115	165	125-150	

Bituminous materials delivered to the Site at temperatures which are higher than the storage temperatures shall not be heated until such temperatures are below those specified above, unless the materials are intended for immediate use.

07.02 Production of the mixture

(a) Using batching plants

(i) Heating of the aggregate

The aggregate shall be so dried and heated that, when delivered to the mixer, its temperature will be between 0°C and 20 °C lower than the maximum temperature indicated in table 606/4 for the mixture. The maximum moisture content of the mixture shall not exceed 0,5%.

(ii) Batching

The aggregate and binder shall be measured separately and accurately by mass in the proportions in which they are to be mixed. If mineral filler is used, it shall be measured separately on a scale with a suitable capacity and sensitivity. The error in the measuring apparatus used shall not exceed 2% for any batch.

(iii) Mixing

The aggregate, filler and binder shall be mixed until a homogeneous mixture is obtained in which all the particles are uniformly coated. Care shall be taken to avoid excessively long mixing times, which may cause hardening of the binder.

(b) Using drum-type mixing plants

The aggregate and filler shall be accurately proportioned and conveyed into the drum mixing unit. The correct amount of binder shall be sprayed onto the aggregate in such a manner that no hardening of the binder shall take place. A homogeneous mixture and uniform coating of binder must be achieved and the moisture content of the asphalt mixture shall not exceed 1,5%. Once the final mix temperature has been agreed on, it may not be altered without the prior consent of the Engineer.

The moisture content of the asphalt mixture shall be tested according to Method C11 of TMH1.

07.03 Transporting the mixture

The mixture shall be transported from the mixing plant to the Works in trucks which comply with the requirements of subclause 04.06. Loads shall be covered with waterproof canvas or metal sheets when the haul exceeds 10 km or during rainy weather. Deliveries shall be so made that spreading and rolling of all the mixtures prepared for a day's run can be completed by the end of a normal working day. Any asphalt which has become wet on account of rain or by any other means will be rejected. Hauling over freshly laid material will not be permitted.

08 SPREADING THE MIXTURE

The mixture shall be delivered to the paver in such a manner that the paver will never be forced to stop for lack of asphalt. The temperature of the mixture shall be controlled by measuring at random in the truck immediately before emptying, and it shall not exceed 10°C below the minimum temperature specified for mixing in table 606/4. The adjustment of the screed tamping bars, feed screws, hopper feed, etc, shall be checked frequently to ensure a uniform spreading of the mix.

If segregation occurs, the spreading operations shall be suspended immediately until the cause has been established and corrected.

The addition and removal of material behind the paver shall normally not be allowed and the paver shall be capable of spreading the mixture in the correct amounts, which will provide the required compacted thickness without resorting to spotting, picking-up or otherwise shifting or disturbing the mixture.

Paving shall, if possible, commence at the bottom of the grades and the lower edges of super elevated curves or sloping parking areas. On slopes steeper than 5% paving shall be done uphill.

Spreading shall be so arranged that longitudinal joints will not coincide with joints in lower layers of the asphalt base or surfacing.

Unless otherwise specified in the Project Specifications, the paver shall be equipped to provide automatic control of levels and cross-section. In the case of asphalt base construction, automatic control shall be run off reference wires and, in the case of surfacing, skids shall be used.

On restricted areas inaccessible to the spreading equipment used, the mixture may be placed by hand or by other means to obtain the specified results. Spreading shall be carried out in a manner that will prevent segregation and allow positive control of levels.

The mixer capacity and the operating speed of the paver shall be so adjusted that continuous laying is ensured and intermittent stopping of the paver is avoided.

Paving shall cease when rain is imminent or when the surfaces to be paved are visibly wet.

09 JOINTS

All joints between adjacent sections of the work shall be made by cutting back the layer against which the material is to be placed. All loose and incompletely compacted material shall be removed. A cutting wheel shall be used for cutting longitudinal joints.

In the case of open-graded surfacing, the joints of adjacent lanes shall not be cut.

Joints shall be either at right angles or parallel to the direction of paving, and in the case of roads, any joints in the final layer of the surfacing shall, wherever possible, correspond with the lane markings. Joints in lower layers shall be offset by not less than 150 mm from joints in subsequent layers.

Before a new layer is placed next to an existing layer, except in the case of open-graded mixes, the cut edge of the existing layer shall be painted with a thin coat of bituminous emulsion of the same type used for the tack coat, if so directed by the Engineer.

Joints shall be neat and shall have the same texture and density as the remainder of the asphalt course. All joints shall be marked out with chalk lines prior to cutting.

The outside edge of the completed asphalt course shall be trimmed along the shoulder and shall be parallel to the centre line to give a finished width within the tolerances specified, as shown on the Drawings.

Any fresh mixture accidentally spread onto existing work at a joint shall be carefully removed by brooming it back onto the uncompacted work with stiff brooms, to avoid the formation of irregularities at the joint. Whenever the paving operation is stopped due to a lack of mixture, the Contractor shall form a proper joint as specified above, if so directed by the Engineer.

10 PRECOATED CHIPS FOR GAP-GRADED ASPHALT SURFACING

Aggregate for precoated chips shall be coated with 1,5% plus or minus 0,3% by mass of the same bitumen used in the asphalt, provided the bitumen shall not be softer than a 60/70 penetration grade. One per cent by mass of active filler which conforms to the requirements of subclause 02.03 shall be added to the mixture.

The type of active filler to be used will be specified in the Project Specifications or by the Engineer, and shall comply with the requirements of subclause 02.03.

The aggregate shall be dried and fed into the mixer at a temperature of between 130°C and 185°C, followed by the bitumen at a temperature not exceeding 175°C, and the filler. Immediately after the aggregate has been coated and discharged from the mixer, it shall be rapidly cooled to ambient air temperature by hosing it down with water.

Precoated chips shall be stockpiled in heaps not exceeding 1,0 m in height and shall be protected if necessary to prevent its temperature from exceeding 60°C during storage.

The precoated chips shall be spread on the asphalt at the rate of 9 kg/m^2 when 13,2 mm nominal sized chips are used and 11 kg/m^2 when 19,0 mm nominal sized chips are used, or as directed by the Engineer. The chips shall be laid by a mechanical spreader which straddles the paved width and follows immediately behind the paver. The chips shall be spread to give a uniform texture free from clusters and open patches and shall be rolled in as described in clause 11 below.

11 COMPACTION

The mix shall be rolled with steel-wheeled and pneumatic-tyred rollers, in an approved sequence, immediately after it has been laid, and such rolling shall be continued for only as long as it is effective and does not have any detrimental effect. Only steel-wheeled rollers will be permitted for compacting open-graded mixtures, although rubber-tyred rollers shall be on standby if required.

As many rollers as may be necessary to provide the specified pavement density and the required surface texture shall be used. While only the surfacing is being rolled, the roller wheels shall be kept moist with just sufficient water to prevent the material from being picked up. After longitudinal joints and edges have been compacted, the rolling shall start longitudinally at the sides and gradually progress towards the centre of the pavement, except on super elevated curves or where the road or parking area has a straight cross-fall, in which case the rolling shall begin on the low side and progress to the higher side, uniformly lapping each preceding track, to cover the entire surface. During initial rolling of the mix (break-down rolling) the rollers shall move at a slow but uniform speed (not exceeding 5 km/h) with the drive wheel of the roller nearest to the paver.

The sequence of rollers used in compaction shall be at the discretion of the Contractor, provided the completed pavement shall have a density equal to or exceeding 97 percent, minus the percentage voids in the design mix, of the theoretical maximum density determined as described in TMH1 Method C4.

During the construction of an asphalt surfacing with rolled-in chips, the asphalt shall be paver-compacted, whereupon precoated chips shall be spread at the specified rate.

When the asphalt has reached the correct temperature, the chips shall be rolled in so that they are firmly bedded in the asphalt. Care shall be taken not to roll the chips flush with the asphalt but to leave them slightly proud.

The procedure for compacting the asphalt and rolling in the chips to produce the desired surface texture and specified degree of compaction, shall be determined on a trial section as described in clause 12.

The following requirements shall apply to rolling and compacting generally:

(a) The material shall not be displaced excessively in a longitudinal or transverse direction, especially when gears are changed or the rollers are stopped or started.

(b) No cracks or hair cracks shall be formed and the bond with the underlying layer shall not be broken.

(c) The density shall be uniform over the entire area of the layer.

(d) The tyre pressure of the pneumatic rollers shall be adjusted to the maximum that can be carried by the mixture without excessive displacement.

(e) In restricted areas where the specified rollers cannot be used, compaction shall be carried out with hand- operated mechanical compaction equipment or approved miniature vibratory rollers.

12 LAYING OF TRIAL SECTIONS

Before the Contractor commences with the construction of any asphalt base or surfacing, he shall demonstrate, by laying a trial section 200 m^2 in area, that the equipment and processes he proposes to use will enable him to construct the particular asphalt course in accordance with the specified requirements. Only when such a trial section has been satisfactorily laid and finished, and complies with the specified requirements, will the Contractor be allowed to commence with construction of the permanent work.

The Engineer will determine the position where the trial section is to be placed so that, if the trial section is approved, it will form part of the permanent work.

13 PROTECTION AND MAINTENANCE

The Contractor shall protect the asphalt base and asphalt surfacing from all damage until the work is finally accepted by the Employer and shall maintain the surfacing work until the end of the maintenance period. Any damage occurring to the completed base or surfacing, except fair wear and tear on surfacing during the maintenance period, or any defects which may develop on account of faulty workmanship, shall be made good by the Contractor at his own expense and to the satisfaction of the Engineer.

14 CONSTRUCTION TOLERANCES AND FINISH REQUIREMENTS

14.01 Construction tolerances

The completed sections of the asphalt base and surfacing shall comply with the requirements for grade, width, thickness, cross-section and smoothness which are as follows:

(a) Level

The level tolerances referred to in subclause 05.01 of section 902 shall be as follows:

H_{90}	±15 mm
H_{max}	±20 mm

(b) Grade (for roads)

Deviation from the specified longitudinal grade on account of deviations from the specified levels shall not exceed the values given in subclause 05.05 of section 601.

(c) Width

The average width of both asphalt base and surfacing, where no kerbing has been installed shall be at least equal to that shown on the Drawings and nowhere shall the outer edge of the layer be inside the lines shown on the Drawings.

(d) Thickness

The thickness tolerances referred to in subclause 05.02 of section 902 shall be as follows:

D_{90}	base = 15 mm	surfacing = 5 mm
D_{max}	base = 20 mm	surfacing = 8 mm
D_{ave}	base = 5 mm	surfacing = 2 mm

The thickness shall be determined from carefully controlled levels taken in exactly the same position before and after construction and/or from cores drilled from the completed layer.

(e) Cross-section (for roads)

When tested with a 3 m straight-edge laid at right angles to the road centre line, the surface shall not deviate from the bottom of the straight-edge by more than 10 mm.

At any transverse sections the difference in level between any two points shall not vary by more than 20 mm from their difference in level computed from the cross-sections shown on the Drawings.

(f) Surface regularity (for roads)

When tested with a rolling straight-edge as described in clause 09 of section 903, the number of surface irregularities shall not exceed those given below:

(i) The average number of irregularities per 100 m equal to or exceeding 6 mm, when taken over a 300 m - 600 m length, shall not, in respect of -

a gap-graded asphalt with rolled-in chips, exceed	4
other asphalt, exceed	2

(ii) The number of irregularities equal to or exceeding 6 mm, when taken over 100 m sections, shall not, in respect of -

a gap-graded asphalt with rolled-in chips, exceed	6
other asphalt, exceed	3

(iii) The maximum value of any individual irregularity when measured with the rolling straight-edge or a 3 m straight-edge laid parallel to the road centre line, shall not exceed 10 mm.

(g) Multiple-layer base

Where the base consists of more than one layer, the requirements specified in respect of width and thickness shall apply to the combined layers. The requirements for cross- section, smoothness and grade shall apply to the final layer only, but the lower layers shall be so constructed that these requirements can be met in the final layer.

14.02 Spread rate of rolled-in chips

The tolerance in the spread rate of rolled-in chips shall be 0,9 kg/m^2 for 13,2 mm chips and 1,1 kg/m^2 for 19 mm chips.

14.03 Grading

The combined aggregate and filler grading shall not deviate from the approved target grading for the working mix by more than the following:

Aggregate size: Material passing through the following sieves (mm)	Allowable deviation from approved target grading (%)
37,500	± 0
26,500	± 4,0
19,000	± 4,0
13,200	± 5,0
9,500	± 5,0
6,700	± 5,0
4,750	± 5,0
2,360	± 4,0
1,180	± 4,0
0,600	± 4,0
0,300	± 4,0
0,150	± 3,0
0,075	± 1,5

14.04 Binder content

The binder content in asphalt mixes shall not deviate from the specified binder content by more than the following:

Sample size (No)	Maximum deviation of sample mean from the specified binder content (% binder)	
	Gap and semi-gap-graded mixes	Cont. and open-graded mixes
2	0,51	0,37
3	0,44	0,33
4	0,41	0,30
5	0,38	0,28
6	0,36	0,27
7	0,35	0,26
8	0,33	0,25

Sample size (No)	Maximum deviation of any single test value from the specified binder content (% binder)	
	Gap and semi-gap-graded mixes	Cont. and open-graded mixes
2	0,76	0,54
3	0,81	0,58
4	0,84	0,60
5	0,87	0,62
6	0,89	0,64
7	0,91	0,65
8	0,92	0,66

15 TESTING

15.01 Sampling

Sampling of asphalt mixes shall normally be carried out at the mixing plant, but the Engineer may direct that sampling be also carried out at the paver if there is any danger of segregation of the mix during transportation and spreading.

15.02 Special tests

(a) The test for air permeability of asphalt, when required in the Project Specifications, shall be conducted as described in document TRH8 (Appendix C), published by the Department of Transport.

(b) The creep test on gap-graded asphalt shall be carried out in accordance with method C6T of TMH1. The appropriate minimum creep modulus will be given in the Project Specifications.

15.03 Process control

The minimum frequency of testing that will be required from the Contractor in terms of clause 05 of section 901 for the purpose of process control shall be as set out in table 606/5.

Table 606/5

Test	Testing frequency One test per -
Aggregate	
ACV	5 000 m³
Flakiness index	2 500 m³
Polishing index Immersion index Absorption	Every change in aggregate
Sand equivalent	200 m³
Grading (when stockpiling)	300 m³
Mixtures	
Grading and bitumen content	200 t (2/day min.)
Marshall stability, flow and voids	1 per day
Marshall mix design Air permeability	Every time the aggregate or design changes
Creep test	1 per day
Constructed layers	
Compaction	800 m² with a minimum of 2 tests per section of road
Spread rate of rolled-in chips	1 000 m² + continuous check on bulk rate of spread
Construction tolerances	
Width (for roads)	200 m with a minimum of 2 tests per section of road
Surface levels	20 m (1 test = 3 pts per cross-section)*
Layer thickness	20 m (1 test = 3 pts per cross-section)*
Cross-section (for roads)	20 m
Smoothness (for roads)	40 m²

* For parking areas one test shall equal a series of points, 5 m apart, in a straight line across the full width of the parking area, at every 20 m cross-section.

15.04 Routine inspection and testing

Routine inspection and testing will be carried out by the Engineer in accordance with the provisions of clause 09 of section 902 to test the completed work for compliance with the dimensional tolerances, quality of material, density of compaction and any further requirements stated in this section.

Compliance with the requirements specified in respect of certain properties will be controlled by the judgment scheme as specified in section 902.

Any materials or workmanship which does not comply with the specified requirements shall be removed and replaced with materials and workmanship which do comply with the Specifications, or, if the Engineer so permits, shall be repaired as specified in section 901 to comply with the specified requirements after they have been repaired.

15.05 The coring of asphalt layers

The Contractor shall provide suitable coring machines capable of cutting 100 mm diameter cores from the completed asphalt layers. The Contractor shall be paid in accordance with the relevant pay item for cutting any cores ordered by the Engineer. No payment will be made for cores that do not pass the test.

The cost of extracting cores for process control shall be included in the Contractor's rates for the construction of asphalt pavement layers and shall not be paid for separately.

All core holes shall be neatly repaired with asphalt and compacted to the specified density. Wherever possible, the cores shall be filled with the same mix as that used for the layer tested.

16 MEASUREMENT AND PAYMENT

Item		Unit
606.01	**Asphalt base** (specified thickness indicated)	
606.01.01	Using bitumen (state type):	
606.01.01.01	Continuously graded	square metre (m^2) or ton (t)
606.01.01.02	Semi-gap-graded (maximum size indicated)	square metre (m^2) or ton (t)
606.01.02	Etc for other binders.	

The unit of measurement shall be the square metre of asphalt base constructed to the specified thickness. When specified in the Project Specifications and/or indicated in the Schedule of Quantities, the unit of measurement shall be the ton of asphalt constructed as specified and measured according to the certified mass-measuring bridge tickets issued in respect of the mixture used. No payment will be made for wasted material.

The tendered rates shall include full compensation for procuring, furnishing, heating, mixing, placing and compaction of all materials as well as process control testing, protecting and maintaining the work as specified.

When the unit of measurement is a ton of asphalt, the tendered rate shall also include full compensation for supplying and installing a weighbridge, and for weighing the material.

Item		Unit
606.02	**Asphalt surfacing** (specified thickness indicated)	
606.02.01	Continuously graded (grade stated)	square metre (m^2) or ton (t)
606.02.02	Gap-graded (stone content indicated)	square metre (m^2) or ton (t)
606.02.03	Open-graded (grade stated)	square metre (m^2) or ton (t)
606.02.04	Semi-gap-graded	square metre (m^2) or ton (t)

The unit of measurement shall be the square metre of asphalt surfacing constructed to the specified thickness. When specified in the Project Specifications and/or indicated in the Schedule of Quantities, the unit of measurement shall be the ton of asphalt constructed as specified and measured according to the certified mass-measuring bridge tickets issued in respect of the mixture used. No payment will be made for wasted material.

The tendered rates shall include full compensation for procuring, furnishing, heating, mixing, placing and compaction of all materials as specified, as well as process control testing, protecting and maintaining the work as specified.

When the unit of measurement is a ton of asphalt, the tendered rate shall also include full compensation for supplying and installing a weighbridge, and for weighing the material.

The tendered rate for subitems 606.02.02 and 606.02.04 shall not include compensation for rolled-in chips.

Item		Unit
606.03	**Asphalt surfacing on bridge deck** (type and thickness indicated)	square metre (m^2)

The unit of measurement shall be the square metre of surfacing completed to the nominal thickness indicated. Where the bituminous surfacing is tapered in thickness, the nominal thickness shall be taken as the average thickness of the layer.

Payment shall be made as described for item 606.02, except that the tendered rate shall also include compensation for any variation in thickness within the specified tolerance for bridge-deck levels.

Where gap-graded asphalt is specified, the tendered rate shall not include compensation for rolled-in chips.

Item		Unit
606.04	**Rolled-in chips** (nominal size indicated) **in surfacing**	ton (t)

The unit of measurement shall be the ton of rolled-in chips applied at the specified rate and measured loose in the hauling vehicles.

The tendered rate shall include full compensation for the procuring, furnishing, precoating, spreading, and rolling in of the precoated chips, and for any additional costs resulting from more difficult construction of the asphalt surfacing with rolled-in chips.

Item		Unit
606.05	**Tack coat of 30% stable grade emulsion**	litre (ℓ)

The unit of measurement shall be the litre of 30% stable grade emulsion applied as specified.

The tendered rate shall include full compensation for procuring, furnishing and application of the material as specified.

Item		Unit
606.06	**Binder variations**	
606.06.01	Penetration grade bitumens	ton (t)
606.06.02	Etc for other binders	

The unit of measurement in respect of increases or decreases in the bituminous binder from that specified in the nominal mix shall be the ton.

Payment for variations shall be made as specified in clause 28 of section 001.

Item		Unit
606.07	**Variations in active filler content**	
606.07.01	Cement	ton (t)
606.07.02	Lime	ton (t)
606.07.03	Milled granulated blast furnace slag	ton (t)
606.07.04	Fly-ash	ton (t)

The unit of measurement in respect of increases or decreases in the active filler content for base and surfacing mixtures from the content specified in the nominal mix shall be the ton. No payment shall be made for inert filler added by the Contractor for the purpose of achieving the specified gradings.

Payment for variations shall be made as specified in clause 28 of section 001.

Item		Unit
606.08	**Trial sections** (nominal thickness indicated)	square metre (m^2)

The unit of measurement shall be the square metre of asphalt trial section constructed as ordered.

The tendered rate shall include full compensation for the construction of the trial section of asphalt base or surfacing complete as specified, and for the application of rolled-in precoated chips, if specified.

The prime coat will be paid for under item 605.01 provided the trial section is approved.

Item		Unit
606.09	**100 mm cores in asphalt paving**	number (No)

The unit of measurement shall be the number of 100 mm cores drilled and recovered as instructed by the Engineer, to be tested by him. No separate payment shall be made for cores drilled as part of the Contractor's obligations under process control, the cost of which shall be included in the rates tendered for the various items of asphalt paving. No payment will be made for cores that fail the test.

The tendered rate shall include full compensation for drilling the cores as directed, for all plant, fuel, labour and other incidentals necessary and for repairing the drilled holes.

Item		Unit
606.10	**Saw-cutting of asphalt, asphalt base or paving (depth of cut indicated)**	metre (m)

The unit of measurement shall be the saw-cut length in the original position, measured after the excavation and removal of the material.

A cutting wheel shall be used and the saw-cut, unless otherwise specified, shall be either at right angles or parallel to the centreline of the road.

The tendered rate shall include full compensation for the provision of all plant, tools, consumables and materials and labour for the cutting of a neat joint as well as the removal of any loose or incompletely compacted material. No distinction will be made for the depth of the cut or the number of cuts that may be required to achieve the specified depth or to cut through the thickness of the surfacing.

SERIES 6 : ROADS AND PARKING AREAS

SECTION 607 : BITUMINOUS SURFACE TREATMENTS

CONTENTS

01 SCOPE

This section covers the materials, methods of construction and requirements for a double-seal surface treatment as well as a surface treatment with aggregate and slurry seal.

02 MATERIALS

02.01 Aggregate for surface treatments

The aggregate shall consist of approved crushed stone which complies with the requirements of SANS 1083, and the grading, flakiness index and hardness shall be as follows for each nominal size of stone:

(a) Grading

The grading shall comply with the requirements set out in table 607/1.

(b) Hardness

When tested in accordance with TMH1 Method B1, the aggregate crushing value shall not exceed 21.

(c) Flakiness

The maximum flakiness index, when tested in accordance with TMH1 Method B3, shall be as follows:

Nominal size of aggregate (mm)	Maximum flakiness index (%)
19,0	25
13,2	25
9,5	30

02.02 Stockpiling

Sites for the stockpiling of aggregate shall be prepared in such a manner that no grass, mud, dirt or other deleterious material will be included when the aggregate is loaded for use.

Access roads to stockpile sites shall be prepared and maintained in such a way that, whilst aggregate is being transported to or from the stockpiles, no dirt is conveyed by any vehicle wheels onto the areas to be surfaced or resurfaced.

Stockpiles shall be so sited that they will not be exposed to excessive contamination by dust caused by construction traffic. Aggregate contaminated to the extent that it contains more than the allowable percentage of material which will pass through the 0,425 mm sieve, shall not be used for surfacing.

02.03 Aggregate for slurry seal

The aggregate for slurry seal shall be an approved crusher sand obtained from a parent rock with an ACV which does not exceed 30, or a mixture of crusher sand and clean natural sand. The mixture shall not contain more than 25% of natural sand. The aggregate shall be clean, tough, durable and angular in shape and shall conform to the grading requirements as set out in table 607/2.

The sand equivalent according to TMH1 Method B19 shall be a minimum of 35.

In order to ensure proper adhesion, the immersion index of briquettes made from slurry-seal aggregate and 80/100 penetration-grade bitumen shall not be less than 75 when tested in accordance with TMH1 Method C5.

Table 607/1

Sieve size (mm)	Percentage passing by mass				
	19,0 mm nominal size	13,2 mm nominal size	9,5 mm nominal size	6,7 mm nominal size	4,75 mm nominal size
26,50	100	-	-	-	-
19,00	85 – 100	100	-	-	-
13,20	0 – 30	85 – 100	100	-	-
9,50	0 – 5	0 – 30	85 – 100	100	-
6,70	-	0 – 5	0 – 30	85 – 100	100
4,75	-	-	0 – 5	0 – 30	85 – 100
3,35	-	-	-	0 – 5	0 – 30
2,36	-	-	-	-	0 – 5
Fine aggregate passing a 0,425 mm sieve (maximum)	0,5	0,5	0,5	0,5	1,0

Table 607/2

Sieve size (mm)	Percentage passing by mass		
	Fine Grade	Medium Grade	Coarse Grade
6,700		100	100
4,750	100	82 – 100	70 – 90
2,360	90 – 100	56 – 95	45 – 70
1,180	65 – 95	37 – 75	28 – 50
0,600	42 – 72	22 – 50	19 – 34
0,300	23 – 48	15 – 37	12 – 25
0,150	10 – 27	7 – 20	7 – 18
0,075	4 – 12	4 – 12	2 - 8

02.04 Cement filler for slurry seal

Cement and blast-furnace cement (CEM III) shall comply with the requirements of SANS 50197-1.

Only one of the above materials shall be used throughout, as alternative usage will produce undesirable colour differences in the surface.

02.05 Bituminous binders

Bituminous binders shall comply with the following specifications:

(a) Road tars

(i) High-temperature coke-oven tars SANS 748

(ii) Low-temperature tars and tars manufactured from gas-works crude SANS 749

(iii) PVC tars which shall be prepared by mixing 1,5% by mass of Corvic D60/11 polyvinyl-chloride with Grade 45/50 or 50/55 tars which comply with SANS 748.

(b) Bitumens

(i) Penetration-grade bitumens SANS 307

(ii) Cut-back bitumens SANS 308

(c) Bitumen emulsions

(i) Anionic emulsions SANS 309

(ii) Cationic emulsions SANS 548

The type and grade of bituminous binder to be used for each type of bituminous surface treatment shall be as specified below or in the Project Specifications.

When bitumen rubber is specified for use as a bituminous binder, the necessary specification will be incorporated in the Project Specifications.

03 PLANT AND EQUIPMENT

03.01 General

All plant and equipment used for the Works shall be of an adequately rated capacity and in good working order.

All plant and equipment which will be operated during construction of the surface treatment shall be free of any binder, fuel or oil leaks and no refuelling or servicing of any equipment will be allowed to take place while such equipment is on the surface under treatment.

03.02 Bitumen distributor

The bitumen distributor shall comply with the requirements of subclause 03(a) of section 605.

03.03 Chip spreaders

The chip spreaders shall be capable of uniformly spreading the stone over widths which vary between 2,4 m and 4,0 m and shall be adjustable to permit variations in the rate of application.

At least two chip spreaders shall be provided, and any spreaders which are not self-propelled shall be of a type that can be quickly attached to the rear of trucks and can operate while they are backing over the stone chips which are being spread.

03.04 Rollers

Sufficient rollers of each of the following types shall be available at the Works in order to maintain the required work tempo:

(a) Pneumatic-tyred rollers

Pneumatic-tyred rollers shall be of a self-propelled type equipped with smooth pneumatic tyres of uniform size and diameter. The mass of the roller shall not be less than 15 t.

The rollers shall be equipped with suitable devices to keep the wheels wet and clean during operation.

The wheels of the roller shall be so spaced that one pass of the roller will provide one complete coverage equal to the rolling width of the machine. The total operating mass and tyre pressure may be varied by the Engineer, at his discretion. Individual tyre pressures shall not differ from one another by more than 35 kPa.

(b) Steel flat-wheeled rollers

Steel flat-wheeled rollers shall be self-propelled, three-wheeled or tandem rollers with a mass of between 6 t and 8 t and shall be equipped with suitable devices for cleaning and moistening the wheels.

03.05 Brooms

(a) Dragbroom

The dragbroom shall be of a size, type and mass that will enable the chips to be distributed evenly over the surface without dislodging stone chips from the binder.

(b) Rotary broom

An approved rotary broom, complete with towing vehicle fitted with smooth pneumatic tyres, shall be available at all times.

03.06 Mixer for slurry seal

A mixer of a type approved by the Engineer shall be provided. It may be either a batch mixer or a continuous-type mixer. The paddles of the mixer shall be so designed to ensure a complete blending of the slurry constituents.

03.07 Spreader box for slurry seal

A spreader box of a type approved by the Engineer shall be used to spread the slurry.

The spreader box shall be so constructed that the weight is distributed on metal skids, in such a way that no damage is done to the surface when the box is in operation.

Soft rubber belting shall be so attached to the framework that no slurry will spill over the sides of the spreader box when the box is in operation.

The spreader box shall be capable of spreading a uniform application of slurry seal in adjustable widths from 2,4 m to 4,0 m at specified rates, and it shall have efficient mechanical means of adjusting the rates and widths of application as specified.

03.08 Precoating plant

Chips may be precoated in any suitable plant which is capable of coating the chips uniformly.

03.09 Miscellaneous equipment

Sufficient equipment for handling and hauling aggregate and binder shall be provided in order to ensure the prompt and continuous covering by bituminous materials as specified. The Contractor shall have available all the necessary ancillary equipment and hand tools for carrying out the work efficiently.

03.10 Front-end loader

A front-end loader with a sufficient capacity to ensure a continuous supply of aggregate from the stockpiles into the trucks shall be available for this work. The Engineer shall have the right to call for a stand-by loader if there is any doubt as to the efficiency or capacity of the front-end loader provided.

04 WEATHER LIMITATIONS

The minimum road-surface temperatures at which the spraying of the different types and grades of binder can be done are -

40/45 EVT tar	10°C
45/50 EVT tar	16°C
50/55 EVT tar	21°C
150/200 penetration-grade bitumen	21°C
80/100 penetration-grade bitumen	25°C
MC-800 cut-back bitumen	10°C
MC-3000 cut-back bitumen	10°C
Bitumen emulsion	10°C

No bituminous work shall be done during foggy or rainy weather, and when a cold wind is blowing, the temperatures mentioned above shall be increased by 3°C to 6°C as may be directed by the Engineer.

Slurry seal shall not be applied at an air temperature of less than 7°C when temperatures are rising, or at less than 13°C when temperatures are dropping.

During hot weather slurry operations shall be suspended as soon as the aggregate becomes displaced by the spreader box or squeegees.

When strong winds are blowing which are likely to interfere with the proper execution of the work, no surfacing, especially the spraying of binder, shall be done.

05 HEATING OF BITUMINOUS BINDERS

The temperature ranges between which bituminous binders are to be heated shall be as given in table 607/3.

Binders stored in a heated condition shall be kept in a container with a properly functioning circulation system and a securely fitting lid.

Binders that have been heated above the maximum temperatures indicated in this table shall not be used and shall be removed from the Site. Every effort shall be made to maintain the spraying temperature of the binder to within 50 °C of the recommended temperature.

06 PRECOATING OF AGGREGATES

Where hydrophillic or any other aggregate is encountered which is difficult to use, the Engineer may order that the stone chips be precoated, as described below.

06.01 The precoating of aggregate

The following method may be used for aggregate intended for immediate use or for stockpiling.

The untreated stockpile of the aggregate shall be sprayed thoroughly with water, which shall be allowed to drain off. The damp aggregate shall then be loaded into a front-end loader (1 m^3 bucket), and 10 litre to 12 litre of an approved precoating fluid shall be sprayed evenly over the aggregate by means of a watering can.

Duomene T or any other similar wetting agent approved by the Engineer shall be added to the precoating fluid at a rate of 0,5% of the volume of the precoating fluid.

The mixture of aggregate and precoating fluid shall then be dumped on a site prepared as specified in subclause 02.02. This process shall be repeated until a stockpile of approximately 15 m^3 to 20 m^3 has been built up.

This stockpile shall then be turned over with the front-end loader until the aggregate has been uniformly coated with the binder. Three complete turnings of the stockpile will probably be required.

Table 607/3

Materials	Maximum storage temperature in °C		Heating and spraying temperature in °C		
	Over 24 hours	Up to 24 hours	Minimum	Maximum	Recommended
Road tars					
40/45 EVT	80	90	100	115	110
45/50 EVT	90	100	105	120	115
50/55 EVT	100	105	110	125	120
Penetration-grade bitumens					
150/200	115	165	150	175	165
80/100	125	175	165	190	175
Cut-back bitumens					
RC-250	60	90	90	115	100
MC-800	75	125	11	135	125
MC-3000	100	155	0	155	145
Bituminous emulsions			Air		
60%	Air temp	60	temp	60	60
65%	Air temp	60	Air	60	60

06.02 Precautions

Areas used for stockpiling the precoated aggregate shall be so sited that the minimum amount of dust will be deposited on the chips. Where necessary, bypasses and access roads in the immediate proximity shall be watered or surfaced.

During the wet season, when there is danger of the precoating fluid being washed from the aggregate, the stockpiles must be covered with tarpaulins or similar protective coverings.

07 PREPARATION OF AREAS TO BE SURFACED

The primed surface shall be cleaned of all dust, dirt, dung, oil or any other foreign materials that may be deleterious to the surfacing. Where the prime coat has been damaged, it shall be repaired by hand-brushing or spraying the priming material over the damaged portions.

08 GRADES OF BINDER TO BE USED

08.01 Tack coat

The tack coat for both surface treatments shall consist of one of the following binders, whichever is specified in the Project Specifications or the Schedule of Quantities or ordered by the Engineer:

(a) RTH 45/50 or RTL 45/50 road tar

(b) 150/200 penetration-grade bitumen

(c) PVC tar

(d) MC-3000 or MC-800 cutback bitumen

(e) 60%, 65% or 70% spray-grade emulsion.

08.02 Second application of binder

The second application of binder for double seal shall consist of one of the binders, specified in subclause 08.01 and for an aggregate with slurry seal, of 30% or 60% bitumen emulsion, whichever is specified in the Project Specifications or the Schedule of Quantities or ordered by the Engineer.

Where thinning by water of a bitumen emulsion is applied, the requirements of TRH3 shall be complied with.

08.03 Slurry seal

The binder used for slurry seal shall be an anionic stable-grade emulsion (60% bitumen).

09 CONSTRUCTION OF SURFACE TREATMENTS

09.01 General

The double-seal surface treatment shall be constructed using either 19,0 mm and 9,5 mm aggregate or 13,2 mm and 6,7 mm aggregate and the surface treatment with aggregate and slurry seal shall be constructed using either a 19,0 mm or 13,2 mm aggregate and the application of a slurry seal in one or two coats.

The size of aggregate to be used in each type of surface treatment will be specified in the Project Specifications or the Schedule of Quantities.

09.02 Rates of application

All binders, aggregates and slurry used in the various types of bituminous surface treatment shall be applied at the rates of application as determined by the Engineer after tests have been made on the materials proposed for use.

No payment shall be made for bituminous binder material if it is applied in excess of the rate ordered, plus the tolerance allowed, unless such overspray in the case of a first application, in the opinion of the Engineer, can be satisfactorily corrected by the adjustment of the application rate of the second spray.

The nominal rates of application of bituminous binders and the variations in application rate, shall, unless otherwise specified, be measured at spraying temperature.

The nominal rates of application shall be for tendering purposes only and will not necessarily be used during construction. The actual rates of application to be used on the Site shall in all cases be as instructed by the Engineer.

Where the expressions "net bitumen" or "net bitumen quantity" are used elsewhere in these Specifications to specify the application rates for the binder, they shall be taken to mean penetration-grade bitumen, plus the volatiles it normally contains, but shall exclude any water, emulsifier or volatile oils added to manufacture bitumen emulsions or cutback bitumens. The nominal rates of application of the tack coat and aggregate for a double-seal surface treatment are given in table 607/4, and for a surface treatment with aggregate and slurry seal in table 607/5. The nominal application rates of the second application of bituminous binder and aggregate for a double-seal surface treatment are given in table 607/6.

Table 607/4

DOUBLE-SEAL SURFACE TREATMENT : FIRST APPLICATION

Nominal size of aggregate (mm)	Nominal rates of application	
	Tack coat (litres of tar or net bitumen per m^2)	Aggregate (m^3 per m^2)
19,0	1,2	0,014
13,2	1,0	0,009

Table 607/5

AGGREGATE WITH SLURRY SEAL

Nominal size of aggregate (mm)	Nominal rates of application	
	Tack coat (litres of tar or net bitumen per m^2)	Aggregate (m^3 per m^2)
19,0	1,2	0,013
13,2	0,6	0,009

Table 607/6

DOUBLE-SEAL SURFACE TREATMENT : SECOND APPLICATION

Nominal size of aggregate (mm)	Nominal rates of application	
	Tack coat (litres of tar or net bitumen per m^2)	Aggregate (m^3 per m^2)
9,5	0,8	0,006
6,7	0,8	0,005

09.03 Application of tack coat and aggregate

A bituminous tack coat which consists of the type and grade of specified binder shall, for both surface treatments, be sprayed onto the primed surface over the full specified width of the surfacing.

Immediately after the binder has been sprayed, it shall be covered with aggregate of the specified size and applied by means of chip spreaders.

Chip spreaders shall commence to spread the aggregate as closely as possible behind the distributor. The chip spreader shall be operated in such a manner that the tack coat shall be covered with aggregate before the wheels of the chip spreader, or truck pass over the uncovered tack coat. All chips shall be spread within 30 minutes of the binder having been sprayed.

The quantity of bitumen sprayed in any single spray operation shall be governed by the quantity of aggregate and the number of trucks available, which shall be sufficient to ensure the continuous application of stone behind the distributor.

09.04 Initial rolling of aggregate

As soon as the aggregate has been applied, rolling shall commence with a self-propelled 10 t pneumatic-tyred roller which is operated parallel to the direction of surfacing, until the entire surface has been covered at least three times by the wheels of the roller. In the case of roads, rolling shall commence at the shoulders and shall move towards the crown of the road.

09.05 Broom dragging and the final rolling of aggregate

After the bituminous binder has set sufficiently to prevent any aggregate from being dislodged, the surface shall be slowly dragged with a dragbroom to ensure an even distribution of the aggregate. If there are areas which are deficient in stone chips, additional material shall be added by hand to obtain a carpet with one layer of stone shoulder to shoulder.

If there are areas with an excess of stone chips, such excess shall be removed by hand. The importance of applying only a single layer of stone is stressed. Every care shall be taken to avoid over-application of stone.

When the spreading of aggregate has been completed, the surface shall be rolled with a 10 t pneumatic-tyred roller for two to four coverages. Final rolling shall then be done with a steel flat-wheeled roller with a 6 t to 8 t mass, in the manner as specified for initial rolling until every portion of the area concerned has been covered by at least two to four passes of the roller, provided that only a limited amount of crushing of the aggregate takes place, but if, in the opinion of the Engineer, general crushing occurs under the rollers, such rolling shall be stopped regardless of the number of passes completed by the roller.

The surface shall be well-knit and shall have a uniform appearance without any roller-tyre marks; all aggregate contaminated by fuel, oil or grease shall be removed and replaced with clean stone.

09.06 The second application of bituminous binder for a surface treatment with aggregate and slurry seal

The required binder shall be sprayed at a nominal rate of 0,50 ℓ/m^2 (net bitumen) in respect of 13,2 mm sized aggregate and at 0,70 ℓ/m^2 (net bitumen) in respect of 19,0 mm sized aggregate. This must be done not less than 2 days after the application of the tack coat and aggregate when bitumen is used in the tack coat, and when tar is used in the tack coat, it must be done not less than 14 days in summer and not less than 21 days in winter after the tack coat and aggregate have been applied.

09.07 The second application of bituminous binder and aggregate for a double-seal surface treatment

The bituminous binder specified shall be applied and shall be followed by the second layer of aggregate of the size specified.

This second application of binder shall take place within 48 hours after the application of the tack coat when bitumen is used for the tack coat, and not less than 10 days after the application of the tack coat when tar or cutback bitumen is used in the tack coat.

Initial rolling of the aggregate followed by broom dragging and final rolling shall be carried out as specified above in subclauses 09.04 and 09.05 respectively.

The aggregate for the second layer shall be precoated with precoating fluid as specified in clause 06, when so required in the Project Specifications, or if so directed by the Engineer.

09.08 Fog or mist spray for a double-seal surface treatment

When required in the Project Specifications or if so directed by the Engineer, in writing, a fog or mist spray of 30% or 60% spray-grade emulsion shall be applied to the surface of the second layer of stone by means of a pressure distributor at the rate of application specified by the Engineer.

09.09 Slurry seal

Slurry seal shall comply with the requirements of and shall be applied as specified in clause 10 below.

09.10 Transverse joints between binder sprays

In order to prevent overlapping at the junctions of separate binder applications, the first application at a transverse joint shall be covered with twine-reinforced building paper for a sufficient distance back from the joint to ensure that the distributor is operating at the required rate before the untreated surface is reached, and also to prevent additional binder application onto the previously treated section. The same method shall be used to ensure a neat joint at the end of the run.

09.11 Protection of kerbs, channels, etc

Kerbs, channels, manholes, guardrails, bridge railings and any other structures that may be soiled by bituminous binders during spraying operations shall be covered with suitable plastic sheeting during spraying operations. The sheeting shall be kept firmly in position by soil, stones or adhesive tape in such a manner that it will not be lifted or be blown away during windy conditions but will keep the areas to be protected fully covered.

The use of paper bags, sand or other materials will not be permitted in lieu of plastic sheeting and the Contractor shall replace at his own cost any items that have been soiled and cannot be cleaned entirely. The painting of soiled surfaces will not be accepted as a suitable remedy.

10 SLURRY SEAL

10.01 Condition of surface

The surface shall be rolled once with a light flat-wheeled roller early in the morning on the day of sealing in order to depress any loose stones that may have been displaced.

The surface shall be cleaned to remove all dust, mud, leaves, etc, and shall have a uniform closely knit appearance, with edges trimmed correctly to the specified width.

10.02 Time for slurry application

After the second application of bituminous material has cured or dried out, a slurry seal shall be applied as specified.

10.03 Composition of slurry seal

The slurry seal shall consist of a mix of the grade of slurry seal aggregate ordered by the Engineer and specified in subclause 02.03 together with a 60% stable grade emulsion, and filler and water in the proportions as directed by the Engineer. The following proportions shall apply in respect of tendering purposes only:

Slurry seal aggregate (saturated volume)	1 m^3
Stable-grade emulsion	260 litre
Cement, slagment or lime	0,01m^3
Water (as directed by the Engineer)	approx 235 litre

The saturated volume of slurry seal shall be determined by a correction being made in respect of bulking of moist aggregate, as described in pay item 607.07.

10.04 Mixing of slurry

A mixer of a type approved by the Engineer shall be provided, which shall be in a good working order and capable of producing uniform slurry from the constituent materials. It may be either a batch mixer or a continuous-type mixer.

(a) Batch mixer

The slurry shall be mixed in an approved type of mixer as specified in subclause 03.06.

The hopper of the mixer shall be filled with aggregate and struck off with a straight-edge to ensure that uniformly measured volumes of aggregate are obtained for each mix.

The required quantity of water shall be placed in the mixer, followed by the batch of aggregate to which the cement, lime or slagment has been added. When the water has been thoroughly mixed with the aggregate, the emulsion shall be added and mixed for at least 2 minutes.

All the components of the slurry seal shall be accurately proportioned, and due care shall be taken and attention given to the sequence in which the ingredients are introduced into the mixer, and to the period of mixing. Mixing shall be continued until the materials in each batch are thoroughly blended.

(b) Continuous mixer

Aggregate and mineral filler contained in separate bins shall be fed into the mixer at controlled rates by way of metering devices. Water and asphalt emulsion contained in separate tanks shall similarly be pumped in to the mixer at controlled rates by way of metering devices. The mixing of the slurry shall be at a suitable rate, adjusted to ensure a complete blending of the ingredients and uniformity of mix.

10.05 Application of slurry seal

Material which, in the opinion of the Engineer, is not properly mixed or in which the emulsion shows signs of having broken during mixing shall not be applied.

Before the slurry is applied, the surface shall be thoroughly cleaned and lightly sprinkled with water, but no free water shall be present on the surface when the slurry is applied.

The slurry shall be applied in two layers in the case of 19,0 mm chips and in one layer in the case of 13,2 mm chips, unless otherwise specified in the Project Specifications or ordered by the Engineer.

For the first of two layers and also in the areas inaccessible to the spreader box, hand spreading of the slurry will be allowed. For the final layer the slurry shall be spread by means of a spreader box as specified in subclause 03.07.

The nominal rate of application of slurry seal shall be as follows for a seal where the following is used:

13,2 mm aggregate	0,006 m^3/m^2 for one layer
19,0 mm aggregate	0,008 m^3/m^2 total for two layers

The rate of application of slurry shall be measured in cubic metres of fine aggregate (saturated volume) contained in the slurry applied, per square metre of surfacing.

The nominal rates of application given above are intended for tendering purposes only and the actual rates of application on the Site shall be as directed by the Engineer. The slurry shall be placed in accordance with the requirements of TRH3, unless otherwise specified.

When the slurry is applied in two layers, the first layer of slurry shall be struck off level with the tops of the stones in the aggregate layer so that the tops of the stones will be just visible after the slurry has been applied.

The second layer of slurry shall not be applied until the first layer has dried. Before the second layer of slurry is applied, the surface shall, wherever possible, be opened to traffic for as long as possible and as directed by the Engineer. On sections where this cannot be done, the surface shall be well rolled with a pneumatic-tyred roller and the second layer applied after sufficient time has been allowed for the first layer to cure. The Engineer shall decide on the time necessary for proper curing, which, in any case, shall be not less than 24 hours.

The surface shall be thoroughly cleaned of all dust, dirt and foreign materials before the second layer of slurry is applied.

The tops of the stone chips shall not be exposed after the second layer of slurry has been applied and the emulsion has cured and set.

For seals where 13,2 mm nominal-sized chips are used, the slurry shall be applied in one layer only. The slurry shall also be struck off so that the tops of the stone chips will not be visible after the emulsion has set and cured.

Where hand-spreading of slurry is allowed, the squeegees used for spreading shall be at least 1,2 m wide. The squeegee squad shall be allowed to complete the spreading of each discharged batch before the next batch may be discharged.

Where spreading is carried out by means of the spreader box, the slurry shall be discharged into the spreader box by means of a chute, which shall be so directed that an even supply of slurry is maintained against the full width of the strike-off blade of the spreader box.

Areas where an excess of slurry has been applied by the spreader box shall be corrected with hand squeegees immediately after the passage of the spreader box.

Should breaking of the emulsion, segregation of the mix or formation of lumps occur during the application of the slurry, the slurry operations shall be discontinued at once and any defective material shall be removed.

The slurry seal shall be applied in widths of between 2,5 m and 3,8 m, as the Engineer may direct. Successive strips of slurry seal shall overlap transversely by not less than 25 mm or more than 150 mm.

There shall be no overlapping on the longitudinal joint. Each application of slurry seal shall be laid accurately next to the adjacent lane and any areas omitted shall be rectified with squeegees immediately after the passage of the spreader box.

The Contractor shall make sure that both edges of the surface are finished to the specified widths and lines. All stones dislodged in the process of applying the slurry shall be removed on the same day as that on which the slurry seal has been applied. All spillage of slurry or excess slurry shall be neatly removed and buried.

A moist burlap drag shall be drawn behind the spreader box to ensure an even textured finish, unless otherwise permitted by the Engineer.

The work must be so programmed that, in the case of roads, the half road widths of slurry seal shall be applied on successive days in order to complete a full road width section within two days.

Any damage to the slurry seal by rain or traffic before the slurry has cured shall be rectified by the Contractor at his own expense.

11 AREAS INACCESSIBLE TO MECHANICAL EQUIPMENT

Areas inaccessible to mechanical equipment shall be constructed as follows:

11.01 Prime

Prime shall be applied to the base by hand spraying under the supervision of an experienced person. The total application shall be controlled to determine whether the specified application rate is being obtained.

11.02 Bituminous mixture

A premixed bituminous mixture shall be prepared, which shall consist of 9,5 mm nominal-sized aggregate, 6,7 mm nominal-sized aggregate and crusher sand which comply with the requirements of subclause 02.03, together with a 60% stable-grade emulsion prepared from 80/100 penetration-grade bitumen, in the following proportions:

9,5 mm nominal-sized aggregate	1 part
6,7 mm nominal-sized aggregate	1 part
Crusher sand (fine grade)	1 part

Net bitumen between 75 and 90 litre/m^3 of dry aggregate mix.

The ingredients shall be mixed in a suitable concrete or other type of mixer. Provision shall be made to heat the aggregate in the mixer by a gas flame or by other means while the mixer is rotating.

The aggregate shall be placed in the mixer and heated to 100°C during mixing, after which the bituminous emulsion shall be added. Mixing shall continue until the aggregate is uniformly coated with bitumen.

Before spreading the mixture, the surface shall be prepared by painting it with one layer of bituminous emulsion, which must be allowed to dry.

The mixture shall then be placed on the areas to be surfaced and shall be screeded off to form a layer of uniform thickness.

After the emulsion has broken and the layer has attained sufficient stability, it shall be rolled with an approved flat-wheeled roller to obtain compaction.

The surface shall comply with the requirements specified in clause 16 of this section. The thickness of the layer shall be the same as that of the adjacent surface treatment.

11.03 Slurry

Where the bituminous surfacing consists of an application of aggregate with slurry seal, a slurry seal shall be applied to the surface of the layer constructed as described above, at a rate of between 0,003 and 0,004 m^3/m^2 or as the Engineer may direct. This shall be done simultaneously with the application of the final slurry on the other sections of the work so as to obtain a uniform appearance.

12 DUST CONTROL

Bypasses and construction roads shall be kept watered and damp during all surfacing operations and all dust shall be removed from surfaces before any binder, aggregate or slurry may be applied.

The supply and application of water on bypasses shall be paid for separately as specified in section 102, but payment for the watering of haul and construction roads shall be included in the unit rates tendered for the various types of surfacing used.

13 OPENING TO TRAFFIC

The surfaced areas shall not be opened to traffic until the binder has set sufficiently to retain the aggregate, or, in the case of slurry seals, until the slurry has set sufficiently so that it cannot be picked up by the wheels of passing traffic.

The Contractor shall not allow any construction equipment, which is likely to cause damage, to pass over the completed surface treatment. The Engineer shall be responsible for determining when any surfacing is to be opened to public traffic.

14 BLEEDING

Should any bleeding occur during the currency of the Contract or during the defects liability period and, in the opinion of the Engineer, it can be attributed to the failure of the Contractor to observe any of the requirements of the Specifications or to use the correct rates of application, or to any other omission or fault on the part of the Contractor, any corrective work ordered by the Engineer shall be at the Contractor's cost, including the supply, precoating, stockpiling at selected sites and the later removal, if not used, of any aggregate reserved for corrective work during the maintenance period or thereafter.

Where the reason for bleeding, in the opinion of the Engineer, cannot be attributed to any fault or neglect on the part of the Contractor, the Employer shall pay at the tendered rates for the cost of any remedial measures taken on the instructions of the Engineer.

Bleeding shall be corrected by one or more of the methods described below, as ordered by the Engineer:

- **Method 1 : Single seal with slurry - Light bleeding**

Nominal 6,7 mm stone which conforms to the requirements of clause 02 shall be used. The aggregate shall be coated with creosote (Sacrosote 70 or a similar material) at the ratio of 12 ℓ/m^3, as described in clause 06 of this section.

If the binder of the existing surface has an oxidized film or if the surfacing has been used by traffic for some time, it shall be treated either by power paraffin being brushed in to soften the surface of the binder, or the surface shall be softened with gas burners. This work shall be done only on hot days.

The aggregate shall immediately be applied to the surface at the rate of 0,004 m^3/m^2 and rolled with a heavy pneumatic-tyred roller until the aggregate is firmly embedded. All loose stone not embedded shall be broomed off before the road is opened to traffic. When it is opened to traffic, any affected areas shall be demarcated with traffic cones and speed-limit signs for the first two days, and care shall be taken to remove all loose stone daily.

Areas where whip-off is excessive after the above treatment has been carried out shall be retreated in accordance with the Engineer's instructions.

- **Method 2 : Single seal with slurry - Severe bleeding**

The method to be used shall be the same as for Method 1, except that the aggregate shall be nominal-sized 9,5 mm or 13,2 mm and that it should be spread at the rate of 0,007 m^3/m^2 and 0,010 m^3/m^2 respectively.

- **Method 3 : Bleeding of double seals**

If the surface is non-uniform, i.e. partly bleeding and partly coarse textured, the surface shall be rectified by pretreating the coarse areas in accordance with subclause 03.03(b) of section 608 (type 2 pretreatment) to obtain a uniform surface, which shall then be covered with a single seal in accordance with section 608. The type of aggregate to be used shall be determined by the Engineer. The pretreated surface shall be inspected and the size of aggregate and the rates of application of the tack coat and aggregate which the surface can accommodate shall be established.

General

- All operations to correct bleeding shall be carried out on warm or hot days only.
- This work shall be done as soon as possible after bleeding occurs.
- Before any rectified work is opened to traffic, all loose aggregate shall be swept from the surface.
- It is essential that a heavy pneumatic-tyred roller be used for all this work. Rolling shall continue until the Engineer is satisfied that the aggregate has been properly embedded. No rolling may be done in wet weather, cold weather or early in the morning when the surface is cold.
- Notwithstanding the above methods of treatment, the Engineer may order that any seal which has not been properly constructed be removed and replaced. The seal shall be removed in such a way that no damage is caused to the existing base. All aggregate and binder shall be removed either by grader or by hand tools and any damage done to the surface shall be repaired to the satisfaction of the Engineer.

15 MAINTENANCE

The Contractor shall maintain the bituminous surface until the work is finally accepted by the Employer. Any damage caused to the surface or any defects that may develop during the defects liability period, fair wear and tear excepted, shall be corrected by the Contractor at his own expense and in a manner approved by the Engineer.

16 TOLERANCES AND FINISH REQUIREMENTS

The completed bituminous work shall comply with the following requirements regarding surface tolerances and finish:

(a) Level and grade

The requirements relating to the base on which the surfacing is constructed shall apply.

(b) Width

The edges of the surfacing not bounded by kerbing, shall nowhere be inside the specified edge line, with a maximum deviation of 15 mm outside the specified edge line.

(c) Cross-section

The requirements relating to the base on which the surfacing is constructed shall apply.

(d) Surface regularity

The requirements relating to the base on which the surfacing is constructed shall apply.

(e) Rate of application

The maximum permissible variation from the rates of application of bituminous binders, aggregates or slurry, as ordered by the Engineer, shall be plus or minus 5% of the rate of application required.

Table 607/7

Test	Minimum testing frequency
Materials	
Aggregate for chips:	
Grading	One test every 250 m^3
ACV	One test every 1 000 m^3
Flakiness	One test every 250 m^3
Aggregate for slurry seal:	
Grading	One test every 250 m^3
Sand equivalent	One test for every type of sand
Bituminous binders	No testing is required, but the Contractor shall produce certificates from all suppliers to the effect that all materials supplied comply with the relevant specifications.
Application rates	Complete records shall be kept of actual measurements made of quantities of materials applied and rates of application.
Construction tolerances	
Width	One test at each end of every spray run
Cross-section Smoothness	All rough areas shall be checked
Binder content of slurry	One extraction test in respect of every 100 m^3 of aggregate used
Bulking of aggregate for slurry	One test in respect of every 50 m^3 of aggregate used

(f) Binder content

The binder content of slurry seal shall be controlled to within the limits specified in subclause 13.04 of section 606 for gap and semi-gap-graded mixes.

(g) General

Any areas that show signs of bleeding after the section has been opened to traffic shall be corrected as specified in clause 14 above. Corrective work shall be so carried out that it will blend in colour, texture and finish with adjacent work.

The completed bituminous surfacing shall be free from corrugations or any other wave effect where depressions are preceded and followed by humps or ridges, irrespective of how small the distance is between the top of the hump and the bottom of the preceding or following depression.

17 TESTING

17.01 Process control

The minimum testing frequency that will be required from the Contractor in terms of clause 05 of section 901 for the purpose of process control shall be as given in table 607/7.

17.02 Routine inspection and testing

Routine inspection and testing will be carried out by the Engineer in accordance with the provisions of clause 09 of section 902 to test the materials and workmanship provided for compliance with the requirements specified in this section.

Where specified in the Project Specifications conformance in respect of certain designated properties will be controlled in accordance with the judgment scheme described in section 902. Where conformance is not controlled in accordance with this judgment scheme, full compliance with the specified properties will be required.

Any materials or workmanship which do not comply with the specified requirements shall be removed and replaced with materials and workmanship which comply with the Specifications or, if the Engineer permits, be repaired as specified in section 901 so that they will comply with the specified requirements after they have been repaired.

18 MEASUREMENT AND PAYMENT

Item		Unit
607.01	**Double-seal surface treatment using -**	
607.01.01	19,0 mm and 9,5 mm aggregate (state types of binder to be used)	square metre (m^2)
607.01.02	13,2 mm and 6,7 mm aggregate (state types of binder to be used)	square metre (m^2)

The unit of measurement shall be the square metre of completed and accepted surface treatment.

The tendered rates shall include full compensation for furnishing all materials, marking the centre line or reference lines, removing any dust or deleterious material, supplying water and spraying haul roads and construction roads, spraying of the binder, spreading of aggregate, rolling, trimming the edges of the completed surface and for all other incidentals necessary to complete the work as specified, except the application of a fog spray and precoating of aggregate, which shall be paid for separately.

Item		Unit
607.02	**Bituminous surface treatment with 19,0 mm aggregate and slurry seal using -**	
607.02.01	RTH 45/50 or RTL 45/50 road tar as a tack coat and 150/200 penetration-grade bitumen in the penetration spray	square metre (m^2)
607.02.02	150/200 penetration-grade bitumen in both applications	square metre (m^2)
607.02.03	150/200 penetration-grade bitumen in the tack coat and 60% or 65% spray-grade emulsion in the penetration spray	square metre (m^2)
607.02.04	Etc for other combinations of binders	

Item		Unit
607.03	**Bituminous surface treatment with 13,2 mm aggregate and slurry-seal using -**	
607.03.01	RTH 45/50 or RTL 45/50 road tar as a tack coat and 60% or 65% emulsion in the penetration spray	square metre (m^2)
607.03.02	150/200 penetration-grade bitumen in the tack coat and 60% or 65% emulsion in the penetration spray	square metre (m^2)
607.03.03	Etc for other combinations of binder, if required	

The unit of measurement for the complete surface treatment process shall be the square metre.

The tendered rates shall include full compensation for furnishing all materials, demarcating the working area, spraying the binders, spreading the aggregates, rolling, mixing and applying the slurry and for all other incidentals necessary to complete the work as specified, including the watering of haul and construction roads in and about the Site.

Item		Unit
607.04	**Bituminous binder variations**	
607.04.01	Road tar RTH 45/50 or RTL 45/50	litre (ℓ)
607.04.02	150/200 penetration-grade bitumen	litre (ℓ)
607.04.03	65% spray-grade emulsion	litre (ℓ)
607.04.04	60% spray-grade emulsion	litre (ℓ)
607.04.05	30% anionic spray-grade emulsion	litre (ℓ)
607.04.06	Anionic slurry-seal emulsion (60% bitumen)	litre (ℓ)
606.04.07	Precoating fluid	litre (ℓ
606.04.08	PVC tar	litre (ℓ)
606.04.09	MC-3000 cut-back bitumen	litre (ℓ)

The unit of measurement of bituminous binder in respect of variations in the specified rates of application shall be the litre, measured at spraying (or mixing) temperature.

Payment for variations shall be made as specified in clause 28 of section 001.

Item		Unit
607.05	**Aggregate variations**	
607.05.01	19,0 mm aggregate	cubic metre (m^3)
607.05.02	13,2 mm aggregate	cubic metre (m^3)
607.05.03	9,5 mm aggregate	cubic metre (m^3)
607.05.04	6,7 mm aggregate	cubic metre (m^3)

The unit of measurement in respect of variations in the application of aggregate shall be the cubic metre of aggregate measured in the truck.

Payment for variations shall be made as specified in clause 28 of section 001.

Item		Unit
607.06	**Application of fog spray consisting of**	
607.06.01	60% spray-grade emulsion	litre (ℓ)
607.06.02	30% spray-grade emulsion	litre (ℓ)

The unit of measurement shall be the litre of emulsion sprayed as specified and measured at application temperature.

The tendered rates per litre of emulsion shall include full compensation for procuring and providing the binder and applying the fog spray as specified.

Item		Unit
607.07	**Variation in the rate of application of slurry seal**	cubic metre (m^3)

The unit of measurement for slurry seal variations shall be the cubic metre of saturated fine aggregate.

Payment for variations shall be made as specified in clause 28 of section 001.

Every load of slurry sand used shall be struck off with a straight-edge at the stockpile. The volume of the load shall then be measured and corrected for bulking. The following method shall be used to calculate the corrected volume of fine aggregate when determining the application rate of slurry:

- The struck capacity of the truck used for batching aggregate shall be carefully measured in cubic metres (say A cubic metres).
- A representative sample of aggregate shall be obtained from the conveyor belt feeding the mixer. One thousand millilitres (1 000 mℓ) of the sample shall be placed in a plastic measuring cylinder and dropped ten times onto a wooden table from a height of 50 mm. The volume of aggregate in the cylinder shall then be measured in mℓ (say B mℓ).
- The sample in the cylinder shall then be saturated with water and water shall be added until it covers the aggregate by 50 mm. The mixture shall be well shaken and the cylinder which contains the aggregate and water shall then be placed on a horizontal surface to allow the aggregate to settle until the liquid above the aggregate has cleared sufficiently to take the reading of the volume of the saturated aggregate in mℓ (say C mℓ).
- The saturated volume of the aggregate in the hopper of the truck shall be calculated by the following formula and payment for the slurry application variations shall be made in accordance with this formula:
- True (saturated) volume carried by the truck hopper:

$$A\left[1 - 0{,}72\,\frac{(B - C)}{C}\right]$$

Item		Unit
607.08	**Precoating of aggregate for second application** (indicate precoating fluid)	cubic metre (m^3)

The unit of measurement for the precoating of aggregate shall be the cubic metre of aggregate so treated, measured in hauling vehicles or in stockpile.

The tendered rate shall include full compensation for providing the equipment and materials and precoating the aggregate as specified, including the handling, stockpiling and protection of the stockpiles against inclement weather. The rate shall also include full compensation for providing and adding an anti-stripping agent as specified.

Item		Unit
607.09	**Treating areas inaccessible to mechanical equipment with premixed bituminous material**	
607.09.01	19,0 mm thick	square metre (m^2)
607.09.02	13,2 mm thick	square metre (m^2)

The unit of measurement shall be the square metre of completed surfacing.

The tendered rates per square metre of surfacing shall include full compensation for the application of a tack coat and a slurry seal.

Item		Unit
607.10	**Correction for bleeding**	
607.10.01	Aggregate:	
607.10.01.01	13,2 mm	cubic metre (m^3)
607.10.01.02	9,5 mm	cubic metre (m^3)
607.10.01.03	4,75 mm	cubic metre (m^3)

The unit of measurement for aggregate shall be the cubic metre of aggregate supplied.

The tendered rates shall include full compensation for stockpiling the material, if required, at selected sites indicated by the Engineer.

607.10.02	Precoating of aggregate	cubic metre (m^3)

The unit of measurement for the precoating of aggregate shall be the cubic metre of material precoated.

The tendered rate shall include full compensation for precoating the material as specified, regardless of the type of precoating material used.

607.10.03	Treatment of surface for bleeding	square metre (m^2)

The unit of measurement for treatment of the surface shall be the square metre of surface treated for bleeding.

The tendered rate shall include full compensation for treating the surfaces as specified. This item shall apply only to Method 1 or 2 as described in clause 14. Treatment according to Method 3 shall be paid for in accordance with the provisions of section 608.

SERIES 6 : ROADS AND PARKING AREAS

SECTION 608 : ROAD AND SURFACING REHABILITATION AND OVERLAY CONSTRUCTION

CONTENTS

01 SCOPE

This section covers the work in connection with the replacement of failed layers, the repair of defective surfaces of existing roads and parking areas and the application of a single seal treatment or asphalt surfacing overlay.

02 ROAD REHABILITATION

02.01 Replacing of failed layers

The replacement of failed layers involves excavating the existing failed sections and reconstructing the excavated fills and pavement layers using gravel, crushed stone, or asphalt as specified or as may be determined by the Engineer.

Where, in terms of clause 16 of section 001, this work can be classified as work in restricted areas, no additional payment will be made.

The Engineer will demarcate any failed areas to be replaced, and shall instruct the Contractor with regard to the repair work to be done.

The various provisions of sections 203, 601, 602, 604, 605 and 606 shall apply mutatis mutandis, together with the following:

(a) Excavating pavement material

Where no overlay has to be applied to the road surface, and unless otherwise instructed by the Engineer, the excavated area shall have a neat rectangular shape. Asphalt layers shall be cut with approved sawing equipment.

Excavated material shall be discarded unless the Engineer instructs its re-use.

After completion of the excavation, the Engineer shall be afforded the opportunity to examine it. Where required, the floor of the excavation shall be compacted to the specified density for the layer concerned.

(b) Backfilling excavations

Excavations shall be backfilled with the material and in layer thicknesses as ordered by the Engineer, and the backfilling shall be compacted and finished to the required levels. The requirements for material quality, density and finish specified in other appropriate sections shall remain applicable.

Stabilized materials shall be mixed in concrete mixers or by other approved equipment. Unless otherwise instructed by the Engineer, gravel subbase and base shall be stabilized with cement at a rate of application of 80 kg cement for each cubic metre of material. Gravel base surfaces shall be primed with 30% of anionic emulsion at a rate of application of 0.4 litre/m^2 immediately after completion and approval.

Crushed stone for layer work shall be treated with 60% anionic bitumen emulsion at a nominal rate of 35 litres of emulsion for each cubic metre of compacted crushed stone. The Engineer may change the emulsion content at his discretion. Before it is added to the crushed stone, the emulsion shall be so diluted with water that the moisture content of the mix shall be the optimum moisture content for compaction.

(c) Restrictions

Unless the contrary is authorized in writing by the Engineer, all excavations shall be backfilled on the same day. Special attention shall be given to controlling and protecting traffic.

02.02 Repairing potholes and local pavement layer failures

Potholes are local failures covering an area of less than 1 m^2.

Unless otherwise ordered by the Engineer, the existing material shall be removed to the full depth in a rectangular pattern. The floor of the excavation shall be cleaned and a tack coat of 30% anionic stable-grade emulsion shall be applied at a rate of 0,4 litre/m^2.

The excavation shall be backfilled with a fine-grade continuously graded asphalt surfacing mix proportioned in accordance with table 606/2 of section 606 using 6,5% 80/100 penetration-grade bitumen and 1,0% active filler. The asphalt shall be placed in accordance with the requirements of section 606 and compacted with suitable vibratory rollers or other compacting equipment.

03 SURFACING REHABILITATION

03.01 Defects

A defect which requires treatment can be any of the following:

(a) The existing surface is deficient in binder;

(b) marked differences in texture occur over the surface;

(c) the existing surface is open-textured;

(d) unevenness of the surface due to bumps, slacks, etc;

(e) edges require trimming and/or repairs;

(f) the existing surface exhibits cracking.

03.02 Materials

The following grades of binder may be used. The actual type or grade used shall be as specified in the Project Specifications or the Schedule of Quantities or as ordered by the Engineer.

(a) Binder for fog or mist spray (treatment type 1)

30%- or 60%-cationic or -anionic spray-grade emulsion.

(b) Tack-coat binder

60%-anionic or -cationic spray-grade emulsion (treatment type 2).

30% stable-grade emulsion (treatment types 3 and 4).

(c) Slurry-seal binder (treatment type 3)

60% anionic slurry-grade emulsion.

(d) Binder for asphalt skim coat (treatment type 4)

80/100 penetration-grade bitumen (6,5%).

(e) Binder for asphalt used in reconstructing pavement edges (treatment type 5)

60% stable-grade bituminous emulsion for tack coat and 80/100 penetration-grade bitumen in asphalt.

Note: When bitumen rubber is specified for use as a bituminous binder or, when a surface treatment which requires the use of bitumen rubber is specified, the necessary specification will be incorporated in the Project Specifications.

03.03 Construction

Before any treatment is carried out, the area to be treated shall be cleaned of all dust, dirt, dung, oil or any other foreign materials that may be deleterious to the surfacing and any failures shall be repaired as specified in clause 02 above.

(a) Treatment type 1

This treatment shall be applied where the existing surface is deficient in binder.

The treatment shall consist of the application of a fog spray of the specified grade of emulsion to the existing surface by a pressure distributor, at the rates of application as directed by the Engineer and in widths that may vary from 0,5 m to 4,0 m.

(b) Treatment type 2

This treatment is intended for application where marked differences in texture occur in the existing surfacing, in order to obtain a uniform texture before resealing.

A tack coat of the specified type and grade of emulsion shall be applied to the surface as specified in subclause 09.03 of section 607, followed by an application of doubly washed crusher sand. The crusher sand shall be the medium-grade specified for slurry seal in clause 02 of section 607, but shall be on the coarse side of the grading envelope. The nominal rates of application shall be as follows:

Emulsion	0,70 litre net bitumen/m^2
Aggregate	0,0035 m^3/m^2

The actual rates of application shall be as instructed by the Engineer.

It can be anticipated that spraying and spreading will have to be carried out in narrow bands varying in width from 0,5 m to 2,0 m. The emulsion shall be allowed to break before the aggregate is applied.

As soon as the aggregate has been applied, its distribution shall be corrected by light hand-brooming or by means of a dragbroom.

Rolling shall be carried out as specified in subclause 09.04 of section 607. Any excess aggregate which remains after the road has been opened to traffic for two days or longer shall be removed.

(c) Treatment type 3

Treatment type 3 shall be used when it is necessary to treat an existing surface treatment, which is open-textured or exhibits cracking, with an application of bituminous slurry.

Prior to treatment with a slurry, the surface shall, if so instructed by the Engineer, be sprayed with a tack coat of 30% stable-grade emulsion at rates directed by the Engineer.

For payment purposes, a distinction shall be made between two methods of construction:

(i) Where the slurry can only be applied by hand methods, or where the Engineer directs or where it is specified that the slurry shall be applied by hand methods.

(ii) Where the slurry can be applied mechanically with a spreader box.

The slurry shall be prepared, mixed and applied as specified in subclauses 10.03, 10.04 and 10.05 of section 607, with the following exceptions:

(i) Slurry to be applied by hand may be mixed in a suitable concrete mixer.

(ii) Where it is to be applied by spreader box, the slurry shall be applied in a single layer at a nominal rate of 0,004 m^3/m^2 for tendering purposes. When it is to be applied by hand with brooms or rubber squeegees, the slurry shall be worked into cracks and any other open areas until a sound, uniform surface is obtained.

(d) Treatment type 4

This treatment is intended for use where the road surface is uneven and contains slacks, bumps or minor rutting on account of the deformation of the pavement layers, but not on account of the failure of these layers.

The surface to be treated shall, after having been cleaned and prepared, be given a tack coat of 30% anionic stable-grade emulsion at rates directed in the field by the Engineer.

Asphalt used shall consist of a medium or fine-grade continuously-graded asphalt surfacing mix, as specified in table 606/2 of section 606, and with 6,5% of 80/100 penetration-grade bitumen and 1,0% active filler. The actual grades of the mix used shall be as directed by the Engineer or as dictated by the required thickness of the asphalt layer.

The asphalt shall be applied, as specified in section 606, in thicknesses varying between 6 mm and 25 mm, depending on the nature of the irregularities that occur, so that the final surface will conform to the surface tolerances for cross-section and smoothness as specified in clause 14 of section 606. Where the thickness of the required asphalt exceeds 25 mm, it shall be laid in separate layers each not exceeding 25 mm in thickness.

Any skim coat which exhibits ravelling of the surface shall be given treatment type 3 or shall be removed and replaced, all at the Contractor's cost.

(e) Treatment type 5

This treatment is intended for use where trimming and/or repairing of the edges of the surfaced area is required, including the restoring of the edge lines to the true edge line of the original road or to such other edge line as may be required.

Where the existing edge of the surfacing is sound but exceeds the required width by more than 150 mm, the excess surfacing shall be cut back to the required width.

Where the edges of the surfacing have broken away or are narrower than the required width, they shall be cut back to a line or lines along which a sound edge can be obtained and where the edge of the surfacing, as cut back, requires building-up to bring it to the required width, all material between the edge of the surfacing and the line to which the edge has to be built up shall be removed to a depth of 60 mm below the final surface, and the surface so exposed shall be cleaned and compacted, if necessary, with a suitably sized vibratory roller to ensure a sound surface. The exposed surface shall then be watered and primed at a rate of 0,60 ℓ/m^2 with a 60% stable-grade emulsion diluted with three parts of water to each part of emulsion.

The edges shall then be built up with the asphalt specified for treatment type 4 and shall be well compacted with a suitable vibratory roller or compactor.

The built-up edges shall be finished neatly to the required line and levels.

(f) Treatment type 6 (crack-sealing)

This treatment is intended for use where the Engineer decides that treatment type 3 will not be effective and where the cracks are not in excess of 5 mm wide.

Where cracks wider than 5 mm are to be sealed, the treatment will be specified in the Project Specifications.

(i) Equipment for crack-sealing

Over and above the equipment normally used for surface treatments, the following additional equipment will be necessary for the sealing of cracks:

- A vibratory roller having a mass approximately equal to that of a Bomag 905 or similar, with an adjustable amplitude and frequency of vibration.
- A mobile pneumatic pump capable of producing at least 3 m^3/min at 750 kPa for blowing out cracks.
- Special spraying equipment with 2 mm nozzle openings and provided with reserve nozzles.

(ii) Preparation

The cracks shall be blown clean with compressed air, and all foreign and loose matter shall be removed from the cracks.

The cracks shall then be penetrated with an invert bitumen emulsion manufactured from 80/100 penetration-grade bitumen such as MSP/1 or similar suitable primer.

(iii) Sealing

After the primer has been applied, anionic stable-grade emulsion shall be mixed with synthetic modifiers, as specified in the Project Specifications, and applied with hot bitumen rubber or similar agent by means of pneumatic spray cans or other approved equipment at the rate specified in the Project Specifications.

Where the cracks are to be rolled, the Contractor, in accordance with the provisions of the Project Specifications or the prescriptions of the Engineer, shall treat the cracks in one of the following two manners before rolling:

(1) The surface shall be heated in an approved manner along the full length of the crack and over a width of 250 mm on each side of the crack and then rolled with approved rollers until an even surface has been obtained.

(2) A solution of 1 part of SV250 and 2 parts of diesel oil shall be applied by paint roller over the crack at a rate determined by the Engineer. The adjacent surfaces or the crack itself may not be overfilled with the material. Twenty-four hours after treatment of the crack, it shall be rolled with approved rollers until an even surface is obtained.

(iv) Restrictions

Cracks may be sealed only where the temperature of the road surface exceeds 10°C. Crack sealing may not be done within 3 days after rain has fallen on the Site, unless otherwise instructed by the Engineer.

03.04 Opening to traffic

Irrespective of which type of treatment is specified, the surface shall be left open to traffic for at least five weeks or for such longer period as the Engineer may direct before further surface treatment work is carried out.

03.05 Joints and the protection of kerbs

The requirements of subclauses 09.10 and 09.11 of section 607 regarding joints between sprays and the protection of kerbs, channels, etc, shall be complied with.

04 OVERLAY CONSTRUCTION

04.01 General

Overlay construction shall consist of the application of a single-seal surface treatment as specified hereafter or of asphalt surfacing as specified in section 606. Asphalt overlays shall be measured and paid for under section 606, whereas overlays which consist of a single-seal surface treatment shall be measured and paid for under this section.

04.02 Single-seal bituminous surface treatment

(a) Bituminous binders

The following bituminous binders shall be used:

(i) Tack coat

80/100 penetration-grade bitumen or, if specified in the Project Specifications, a cut-back bitumen, a PVC tar manufactured from RTH 45/50 road tar, a spray-grade emulsion, or bitumen rubber.

(ii) Fog spray

30% or 60% spray-grade emulsion of the anionic or cationic type as may be specified or ordered by the Engineer.

(b) Aggregate

The aggregate shall consist of approved crushed stone of the size specified in the Project Specifications or the Schedule of Quantities, which complies with the requirements of clause 02 of section 607. When required in the Project Specifications or if so directed by the Engineer, the aggregate shall be precoated as specified in clause 06 of section 607.

(c) Plant and equipment

In all respects plant and equipment used in the works shall comply with the relevant provisions of clause 03 of section 607, except that both chips spreaders shall be self-propelled.

(d) Preparation of areas to be surfaced

The areas to be surfaced shall be cleaned of all dust, dirt, oil or any other foreign materials that may be deleterious to the surfacing.

(e) Construction

(i) Application of tack coat and aggregate

The tack coat and aggregate shall be applied as specified in subclause 09.03 of section 607.

The nominal rates of application in Table 608/1 shall be used for tendering purposes only.

The actual rates of application shall be as determined by the Engineer.

Not more than 15 minutes shall elapse between the application of the bituminous binder and the spreading of the aggregate at any particular position on the road.

Table 608/1

	Nominal rates of application	
Nominal size (mm)	**Tack coat (litres of tar or net bitumen per m^2)**	**Aggregate (m^3 per m^2)**
13,2	1,90	0,010
9,5	1,60	0,009
6,7	1,20	0,006

Where a bitumen rubber seal is used on an existing surfacing, a layer of diluted anionic stable-grade bituminous emulsion (30% of bitumen) shall first be applied at a rate of 0,55 litre/m^2 or as instructed by the Engineer.

After the emulsion tack coat has broken and when, in the opinion of the Engineer, it has dried out sufficiently, a bitumen rubber tack coat shall be applied at a rate as instructed by the Engineer. For tender purposes, the Contractor shall base his rate on a nominal rate of application of 2,1 litre/m^2.

The total application of bitumen rubber shall be applied in a single spray.

All the aggregate shall be 13,2 mm and shall be applied within 5 minutes of the application of the bitumen rubber tack coat.

(ii) Initial rolling

Initial rolling shall be carried out as specified in subclause 09.04 of section 607.

(iii) Final rolling

Any areas deficient in aggregate shall have additional material added so as to obtain a carpet with a single layer of stone where the stones lie shoulder to shoulder. It is essential to ensure that only one layer of stone is applied and every care shall be taken to avoid over-application of the aggregate.

The final rolling shall be done with a 15 t to 20 t pneumatic-tyred roller doing a minimum number of four coverages.

The finished surface shall be well-knit and shall have a uniform appearance free from any roller-tyre marks. All aggregate contaminated by oil, fuel or grease shall be removed and replaced by clean aggregate.

All loose stones shall be broomed from the surface with a rotary broom or hand brooms, as may be directed by the Engineer.

(iv) Fog or mist spray

When required in the Project Specifications or if so directed by the Engineer, in writing, a fog spray of 60%- or 30%- anionic or -cationic emulsion shall be applied to the surface of the stone at the required rate by a pressure distributor.

(f) Tolerances and finish requirements

The completed bituminous work shall comply with the requirements in respect of tolerance and finish as specified in clause 16 of section 607.

05 MEASUREMENT AND PAYMENT

Item		Unit
608.01	**Replacing of failed layers**	
608.01.01	Excavating in existing pavements	cubic metre (m^3)
608.01.02	Compacting the floor of excavations	square metre (m^2)
608.01.03	Backfilling of excavations with:	
608.01.03.01	Chemically-stabilized gravel	cubic metre (m^3)
608.01.03.02	Emulsion-treated crushed stone	cubic metre (m^3)
608.01.03.03	Asphalt base	ton (t)
608.01.03.04	Asphalt surfacing	ton (t)

- 608.01.01 Excavating in existing pavements

The unit of measurement shall be the cubic metre of material excavated from the existing pavement, irrespective of the type of material. The quantity shall be computed in accordance with the authorized dimensions of the excavation.

The tendered rate shall include full compensation for demarcating the excavation and excavating and disposing of the material, including all transport.

Payment will not distinguish between the different types of pavement material excavated.

- 608.01.02 Compacting the floor of excavations

The unit of measurement shall be the square metre of excavation floor compacted on the instruction of the Engineer, which quantity shall be computed in accordance with the authorized dimensions of the excavation floor.

Payment will not distinguish between the various methods of compaction or various density requirements.

- 608.01.03 Backfilling of excavations

The unit of measurement shall be the cubic metre of chemically-stabilized gravel or emulsion-treated crushed stone or a ton of asphalt placed in accordance with the specified requirements. The quantity will be computed in accordance with the authorized dimensions of the layer in the case of gravel or crushed stone and in accordance with the certified weighbridge tickets issued in the case of asphalt. Payment will not be made for wasted material.

The tendered rates shall include full compensation for providing all the material, irrespective of its origin, for all mixing, placing, compacting and finishing as specified in this section and other appropriate sections, for all transport, work in restricted areas, and also for all machinery, equipment, labour, supervision and other incidentals for executing the work as specified.

Item		Unit
608.02	**Repairing potholes and local pavement layer failures with asphalt**	ton (t)

The unit of measurement shall be the ton of continuously graded asphalt placed in accordance with the specifications, which quantity will be calculated in accordance with the certified weighbridge tickets issued with regard to the mix used.

The tendered rate shall include full compensation for cleaning the floor of the excavation, for procuring, providing and mixing all the material and for compacting and finishing the asphalt in accordance with the required lines and levels. The tendered rate shall also include full compensation for excavating existing surfacing material and disposing thereof as specified, and for supplying and applying an emulsion tack coat to the surface to be treated.

The tendered rates shall include full compensation for all transport, handling, labour, material, and all incidentals necessary for completing all the work in accordance with the specifications, and also for work in restricted area.

No extra payment will be made with regard to this item for producing small quantities of asphalt.

Item		Unit
608.03	**Treatment type 1** (fog or mist spray)	
608.03.01	30% spray-grade emulsion	litre (ℓ)
608.03.02	60% spray-grade emulsion	litre (ℓ)

The unit of measurement for treatment type 1 (fog or mist spray) shall be the litre of bituminous emulsion sprayed, measured at spraying temperature.

The tendered rates shall include full compensation for cleaning and preparing the existing surface, for providing the material and applying the fog spray, and for all other incidentals necessary for completing the work as specified.

Item		Unit
608.04	**Treatment type 2** (crusher-sand seal) using :	
608.04.01	60% spray-grade emulsion	litre (ℓ)
608.04.02	An application of doubly washed slurry-seal aggregate	cubic metre (m^3)

The unit of measurement for binder application shall be the litre, measured at spraying temperature. The unit of measurement for the doubly washed slurry-seal aggregate shall be the cubic metre of aggregate applied, measured loose in the truck and corrected for bulking as described in pay item 607.07 of section 607.

The tendered rates shall include full compensation for providing all materials, demarcating the areas to be sprayed, spraying the binder and applying the aggregate, rolling and sweeping, and for all other incidentals necessary for completing the work as specified.

Item		Unit
608.05	**Treatment type 3** (slurry seal)	
608.05.01	Tack coat of 30% stable-grade emulsion	litre (ℓ)
608.05.02	Slurry seal applied by hand	cubic metre (m^3)
608.05.03	Slurry seal applied by spreader box	square metre (m^2)

The unit of measurement for tack coat shall be the litre of emulsion, measured at spraying temperature and applied as specified. The unit of measurement for slurry seal applied by hand shall be the cubic metre of saturated fine aggregate used, measured as described in pay item 607.07 of section 607.

The unit of measurement for slurry seal applied by spreader box shall be the square metre of area to which the slurry is applied as specified.

The tendered rates shall include full compensation for procuring and furnishing all the materials, for mixing and applying the slurry seal and demarcating all areas to be treated.

Item		Unit
608.06	**Variation in rate of application of slurry seal (applicable to item 608.05.03 only)**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of additional or reduced slurry seal applied, measured as specified for pay item 607.07 of section 607.

Payment for variations shall be made as specified in clause 28 of section 001.

Item		Unit
608.07	**Treatment type 4**	
608.07.01	Tack coat of 30%-stable-grade emulsion	litre (ℓ)
608.07.02	Continuously-graded asphalt	ton (t)

The unit of measurement for the tack coat shall be the litre of emulsion applied, measured at spraying temperature. The unit of measurement for asphalt shall be the ton of asphalt laid according to the Specifications.

The tendered rate for tack coat shall include full compensation for procuring, furnishing and applying the tack coat and demarcating the areas to be sprayed, and for all incidentals necessary to complete the work as specified.

The tendered rate for asphalt shall include full compensation for procuring, furnishing and mixing all the materials required for applying the asphalt and for all transport and other incidentals necessary to complete the work as specified.

Item		Unit
608.08	**Treatment type 5**	
608.08.01	Trimming the edges of existing surfacing	metre (m)
608.08.02	Reconstructing edges using continuously-graded asphalt	ton (t)

The unit of measurement for trimming the edges shall be the metre of edge cut back and trimmed as specified. The unit of measurement for reconstructing pavement edges shall be the ton of continuously graded asphalt provided and compacted as specified.

The tendered rate for trimming the edges shall include full compensation for cutting back the edges as directed and removing all excavated and loose material. The tendered rate for reconstructing pavement edges shall include full compensation for compacting the surface on which the new edge is to be constructed, for procuring, furnishing and mixing all the materials, and for compacting and trimming the asphalt to the lines and levels required. It shall also include full compensation for applying a tack coat of emulsion to the area to be treated.

Item		Unit
608.09	**Treatment type 6 (crack sealing)**	
608.09.01	Cleaning the cracks with compressed air	square metre (m^2) or metre (m)
608.09.02	Applying bituminous binders for sealing cracks	
608.09.02.01	MSP/1 or similar prime	litre (ℓ)
608.09.02.02	Anionic stable-grade emulsion mixed with synthetic modifiers	litre (ℓ)
608.09.02.03	Hot bitumen rubber	litre (ℓ)
608.09.02.04	SV250 plus 2 parts of diesel oil	litre (ℓ)
608.09.03	Rolling the cracks	square metre (m^2) or metre (m)

The unit of measurement for subitems 608.09.01 and 608.09.03 shall be the square metre of road surface within which the cracks have been blown clean and rolled or, in the case of long cracks, the metre length of crack cleaned and rolled. The unit of measurement for subitem 608.09.02 shall be the litre of material applied as specified or instructed by the Engineer.

The tendered rates shall include full compensation for providing as applicable, all equipment, materials, labour, supervision and incidentals for sealing the cracks as specified and where instructed by the Engineer.

Item		Unit
608.10	**Single-seal surface treatment where 80/100 penetration grade bitumen is used -**	
608.10.01	with 6,7 mm aggregate	square metre (m^2)
608.10.02	with 9,5 mm aggregate	square metre (m^2)
608.10.03	with 13,2 mm aggregate	square metre (m^2)

Item		Unit
608.11	**Single-seal surface treatment with bitumen rubber binder and 13,2 mm aggregate**	square metre (m^2)

The unit of measurement for items 608.10 and 608.11 shall be the square metre of completed and accepted surface treatment.

The tendered rates shall include full compensation for cleaning the existing surfacing, for furnishing all materials, marking of centre and edge lines, spraying the binder, spreading the aggregate and rolling, and for all other incidentals necessary to complete the work as specified.

Item		Unit
608.12	**Bituminous binder variations**	
608.12.01	80/100 penetration-grade bitumen	litre (ℓ)
608.12.02	65% spray-grade emulsion	litre (ℓ)
608.12.03	60% spray-grade emulsion	litre (ℓ)
608.12.04	PVC tar	litre (ℓ)
608.12.05	Precoating fluid	litre (ℓ)
608.12.06	Bitumen rubber	litre (ℓ)

The unit of measurement for bituminous binder in respect of an increase or a decrease in the specified rates of application shall be the litre, measured at spraying temperature. Payment for variations shall be made as specified in clause 28 of section 001.

Item		Unit
608.13	**Aggregate variations**	
608.13.01	6,7 mm aggregate	cubic metre (m^3)
608.13.02	9,5 mm aggregate	cubic metre (m^3)
608.13.03	13,2 mm aggregate	cubic metre (m^3)

The unit of measurement shall be the cubic metre of increased or decreased aggregate applied, as compared with the amounts required at the specified nominal rate of application.

Payment for variations shall be made as specified in clause 28 of section 001.

Item		Unit
608.14	**Application of fog spray**	
608.14.01	60%-spray-grade emulsion	litre (ℓ)
608.14.02	30%-spray-grade emulsion	litre (ℓ)

The unit of measurement shall be the litre, measured at spraying temperature.

The tendered rates shall include full compensation for furnishing the material and applying the fog spray as specified.

Item		Unit
608.15	**Precoating of aggregate** (indicate precoating fluid)	cubic metre (m^3)

The unit of measurement for the precoating of aggregate shall be the cubic metre of aggregate so treated, measured in hauling vehicles or in stockpile.

The tendered rate shall include full compensation for providing the equipment and materials and precoating the aggregate as specified, including the handling, stockpiling and protection of the stockpiles against inclement weather. The rate shall also include the providing of and adding an anti-stripping agent as specified.

SERIES 6 : ROADS AND PARKING AREAS

SECTION 609 : SEGMENTED PAVING

CONTENTS

01 SCOPE

This section covers the paving of roads, parking areas, sidewalks, etc, with individual paving units laid closely together to form a segmented pavement. Paving units can be precast concrete segmental blocks and precast concrete paving slabs. The latter are used for pedestrian and cycle traffic only.

02 DEFINITIONS

For the purposes of this section in particular, the following words and expressions shall have the meanings hereby assigned to them unless inconsistent with the context:

(a) Bedding

The operation of placing a paving unit on top of a sand layer, including the compaction of the sand layer.

(b) Lock-up

A phenomenon that occurs with regard to segmented paving when the sealing of the joints between the paving units is improved by the action of compaction equipment, traffic and weathering. Lock-up can also be defined as the initial settling-in improvement of the paving.

(c) Interlock

The interaction between adjoining paving units which prevents random movement.

03 MATERIALS

03.01 Precast concrete segmental blocks

Precast concrete segmental blocks shall be of the thickness, colour, class of concrete, shape and type (S-A, S-B or S-C) as specified in the Project Specifications, shall comply with the relevant requirements of SANS 1058, and shall be obtained from a manufacturer approved by the Engineer, in writing.

The colour of coloured blocks shall penetrate to a depth of at least 5 mm below the wearing surface of each unit and the coloured layer shall be integrally bound to the body of the unit.

03.02 Precast concrete paving slabs

Precast concrete paving slabs shall be square and, unless otherwise specified, shall measure 450 mm x 450 mm x 50 mm at the base with the sides sloping slightly inward towards the top.

The slabs shall be manufactured from class 30/19 concrete and their appearance shall be as specified in clause 3.3 of SANS 927 for precast concrete kerbs and channels. When specified in the Project Specifications, the upper surface of the paving slabs shall have an approved skid-resistant pattern.

03.03 Sand for bedding

(a) Sand for bedding the segmental blocks

Sand for bedding shall be free from deleterious substances or substances that could cause the discolouring of paving units. The sand shall not contain more than 3% silt and clay by mass and shall conform to the following grading:

Nominal sieve size (mm)	Percentage passing by mass
9,52	100
4,75	95 - 100
2,36	80 - 100
1,18	50 - 85
0,600	25 - 60
0,300	10 - 30
0,150	5 - 15
0,075	0 - 10

(b) Sand for bedding the paving slabs

Sand for bedding the paving slabs shall comply with the requirements for concrete sand and shall not contain more than 3% silt and clay by mass.

(c) Sand for jointing

Jointing sand shall pass through a 1,18 mm sieve and shall contain between 10% and 15% of material that passes through a 0,075 mm sieve. The sand shall not contain substances which may cause the staining of the units.

04 CONSTRUCTION

04.01 Construction of paving with segmental blocks

(a) General

Prior to constructing the paving on roads and parking areas, the subgrade or subbase shall be checked for conformance with the requirements specified in the relevant sections of this series. The earthworks on sidewalks, traffic islands, etc, to be paved shall be trimmed to within plus or minus 10 mm of the specified level.

Local high spots shall be removed and local depressions shall be filled with approved gravel mixed with 5% CEM I cement by mass. Alternatively, the levelling course may consist of lean concrete with a minimum of 7-day cube strength of 5 MPa.

Under no circumstances shall depressions be levelled with bedding sand.

(b) Edge restraints

Edge restraints such as kerbs, channelling, concrete strips or other forms of edge restraints shall be constructed and approved well in advance of the paving.

(c) Grass and weed control

When specified in the Project Specifications, the surface of the layer below the bedding sand shall be treated with a suitable herbicide to control the growth of grass and weed. The herbicide shall be applied strictly in accordance with requirements of subclause 03.09 of section 505.

(d) Placing of sand for bedding

To ensure an even paved surface, sand from a single source shall be used. The sand shall have a moisture content of between 4% and 8%, unless otherwise permitted by the Engineer.

The sand shall be evenly spread over the area to be paved, and the kerbs and other restraints shall be used as screeding guides. For wide pavements, temporary screeding guides shall be set up in intermediate positions.

The uncompacted thickness of the sand shall be such that, after compaction, the sand layer will be 20 mm plus or minus 10 mm thick. The sand bed shall be laid slightly in advance of the placement of the paving units. Where the sand is accidentally compacted before the units are laid, it shall be raked and evenly re`screeded.

(e) Laying of paving blocks

The units shall be laid in a herringbone pattern if the block shape so permits, and, where the units cannot be so laid, they shall be laid with their long axes at right angles to the line of traffic. Except where curved patterns are required, the lines of the pattern shall be straight and parallel to kerbs or buildings or other approved structures which adjoin the paved areas.

Full units shall be laid first, care being taken to ensure that the joint lines are straight and square. To control alignment, string lines set up in two directions shall be used.

The disturbance of laid units prior to compaction by foot or light construction traffic shall be prevented by placing boards on the paving.

Areas against kerbs, manholes, etc, that require infilling shall be filled with units cut to size with appropriate cutting tools.

Areas of less than 25 per cent of the area of a full block unit or with a 25 mm minimum dimension shall be filled in with 30 MPa concrete with 10 mm coarse aggregate. Smaller areas shall be filled with a 1:3 cement:sand mortar.

After compaction, joints between the blocks shall not be wider than 3 mm.

(f) Compaction

The surface shall be compacted as soon as possible after the blocks are laid, but no compaction shall be attempted within 1 m of the laying face. At the completion of each day's work, the surface shall be left fully compacted to within 1 m of the working face.

Units damaged during compaction shall be removed and replaced. Compaction shall be done with a vibrating-plate compactor which produces a centrifugal force of approximately 16 to 20 kN at a frequency of approximately 75 to 100 Hz, and which has a plate area of between 0,35 and 0,5 m². For blocks of less than 80 mm thick, a vibrating-plate compactor with a centrifugal force of 7 to 16 kN, a plate area of 0,2 to 0,4 m^2 and a frequency of 75 to 100 Hz shall be used. Sufficient passes shall be made to compact the bedding course fully to produce an even surface.

(g) Joint filling

Immediately after the initial compaction made by two passes of the compactor, a layer of jointing sand shall be uniformly distributed over the surface of the pavement and lightly broomed into the joints. Further passes of the plate vibrator shall then be made to fill the joints, and more sand shall be spread over the surface if required. Finally, the excess sand shall be removed. The sand and the area treated shall be perfectly dry.

After the joints have been filled, the construction traffic shall be encouraged to use the pavement to achieve maximum lock-up. Where the use of the construction traffic is unfeasible, lock-up shall be achieved, especially in the case of heavy-duty paving, by at least five passes of a heavy pneumatic-tyred roller.

04.02 Construction of paving with paving slabs

Subclauses 04.01 (a) up to and including 04.01 (d) above apply to the construction of paving with paving slabs, except that the sand shall comply with the requirements of subclause 03.03(b).

Where specified in the Project Specifications, the sand shall be mixed with 5% CEM I cement by mass, and sufficient water shall be added to form a fairly dry and crumbly mixture. This mixture shall then be spread and screeded as specified for sand, and the slabs shall be laid thereon before the initial set has taken place.

When slabs are laid in sand or on a sand-cement mixture, a rubber hammer shall be used to bed the slabs firmly. The use of string lines is compulsory.

The slabs shall be laid with their bases butting, and the joint formed by the inward sloping sides shall be filled with a 1:3 cement:sand mortar. Paving slabs shall not be cut for infilling but the filling-in of areas shall be carried out with a class 30/13 concrete which shall be finished off smoothly with a steel trowel.

No pedestrian traffic will be allowed on the paving until 24 hours after the joints and infills have been completed.

05 TRIAL SECTION

Full-scale paving shall not commence until a trial section which has been laid as part of the permanent paving for the purpose of assessing the Contractor's ability to produce a paving that complies with the requirements of the Specifications, has been approved by the Engineer.

A trial section in the case of roads or narrow strips of up to 5 m wide shall be a 20 m long section over the full width of the road or strip. A trial section in the case of parking areas shall be an area 20 m long and at least 5 m wide with one of the long sides butting on a permanent edge restraint.

06 TOLERANCES

Three months after it has been opened to traffic, the finished paving shall be accurate to within the following limits:

06.01 Line of pattern

(a)	Deviation from any 3 m straight line	10 mm maximum
(b)	Deviation from any 20 m straight line	20 mm maximum

06.02 Vertical deviation from a 3 m straight edge

(a)	At the edge restraints	plus 3, minus 0 mm
(b)	Elsewhere, except at vertical curves	plus 10 minus 15 mm

06.03 Surface levels of adjacent units -

Shall not differ by more than 3 mm

07 MEASUREMENT AND PAYMENT

Item		Unit
609.01	**Construction of segmental block paving made from -**	
609.01.01	(Thickness, type, class, etc, indicated) precast blocks	square metre (m^2)
609.01.02	Etc.	

The unit of measurement shall be the square metre of completed paving.

The tendered rates shall include full compensation for the supply and laying of the blocks, the levelling of underlying layers, the removal and replacement of damaged blocks, cutting the blocks where required, the provision and placing of a layer of bedding sand, jointing sand, the infilling of small areas with cut blocks or concrete and the laying of a trial section, all as specified.

Item		Unit
609.02	**Construction of paving with precast concrete paving slabs, 450 mm x 450 mm x 50 mm -**	
609.02.01	Bedded on sand	square metre (m^2)
609.02.02	Bedded on a sand-cement mixture	square metre (m^2)

The unit of measurement shall be the square metre of paving completed.

The tendered rates shall include full compensation for the supply and laying of the slabs, for the levelling of underlying layers, the removal and replacement of damaged slabs, the provision and placing of the bedding, jointing, the filling in of small areas with concrete and the laying of a trial section.

Item		Unit
609.03	**The construction of edge restraints with**	
609.03.01	Precast concrete according to Drawing No (number stated)	metre (m)
609.03.02	In situ concrete according to Drawing No (number stated)	metre (m)

The unit of measurement shall be the metre of edge restraint constructed to the details shown on the Drawings. Kerbing, channelling and structures will not be classified as edge restraints for the purposes of this pay item.

The tendered rates shall include full compensation for excavation and backfill, bedding, formwork, concrete, joints, and the disposal of excavated surplus material.

Item		Unit
609.04	**The lifting of existing segmental paving, loading and transporting it to the stockpile site specified in the Project Specifications**	
609.04.01	Segmental blocks	square metre (m^2)
609.04.02	Paving slabs	square metre (m^2)

The unit of measurement shall be the square metre of paving material lifted.

The tendered rates shall include full compensation for the cleaning and selecting of paving material, the carting to spoil of damaged units, and all labour, plant and equipment necessary for carefully lifting, loading, transporting, off-loading and stacking the units in a manner approved by the Engineer.

Item		Unit
609.05	**Construction of segmented paving with material supplied by the Employer or from the stockpile**	
609.05.01	Segmental-block paving	square metre (m^2)
609.05.02	Concrete-slab paving	
609.05.02.01	Bedded on sand	square metre (m^2)
609.05.02.02	Bedded on a sand-cement mixture	square metre (m^2)

The unit of measurement shall be the square metre of paving completed.

The tendered rates shall include compensation for the work covered by pay items 609.01 and 609.02 as well as the loading and transporting of the material from the stockpiles.

Item		Unit
609.06	**Construction of pedestrian ramps for the disabled**	number (No)

The unit of measurement shall be the number of pedestrian ramps constructed complete as specified on the Drawings.

The tendered rate shall include full compensation for the procuring, furnishing and installation of all the items required for a complete pedestrian ramp, excavation, backfilling, bedding, formwork, concrete, joints and the disposal of excavated surplus material.

Note:

The following item of work, when specified, shall be carried out, measured and paid for in accordance with the appropriate sections of the Specifications, but shall be listed under this section in the Schedule of Quantities.

Item	Applicable section
The control of grass and weed growth	505

SERIES 6 : ROADS AND PARKING AREAS

SECTION 610 : CONCRETE PAVEMENTS

CONTENTS

01 SCOPE

This section covers all the work in connection with the construction of cast in-situ concrete pavements where concrete is placed by hand with the use of side forms.

Should the Contractor elect to use a paving machine for placing the concrete, he shall, in good time, submit full details of such equipment, his method of obtaining the specified pavement requirements, and any possible modifications to the requirements for concrete, to the Engineer for approval. When the Employer specifies the use of paver-laid concrete, the necessary modifications and additions to this section will be included in the Project Specifications.

02 MATERIALS

02.01 Cement

The cement shall be normal cement or blast-furnace cement which complies with SANS 50197-1, a mixture which contains milled, ground, blast-furnace slag and at least 50% CEM 1 cement, or such other cement as may be specified in the Project Specifications.

02.02 Water

The requirements of subclause 02.03 of section 704 shall apply.

02.03 Aggregates for concrete

The aggregates shall comply with SANS 1083, but shall be subject to the following:

(a) The shrinkage of both fine and coarse aggregate shall each not exceed 130% of the reference aggregate referred to in the SANS standard.

(b) Coarse aggregate shall comply with the 10% FACT values specified in the SANS standard for stone to be used in concrete which is subject to abrasion.

In addition, the aggregates shall comply with the following requirements:

(i) The fine aggregate shall be either a natural or crusher-produced sand, or a blend of natural and crusher sands.

(ii) Wherever feasible, the grading of the fine aggregate shall be such that not less than 8% is retained between the 4,75 mm and 2,36 mm sieves and not less than 12% between the 2,36 mm and 1,18 mm sieves.

(iii) Aggregates shall not contain any deleterious amounts of organic materials such as grass, timber or other foreign materials.

(iv) The nominal maximum size of coarse aggregate shall be 37,5 mm.

(v) The coarse aggregate shall be supplied in two separate nominal sizes, the larger of which shall be 37,5 mm and the smaller size either 19,0 mm or 13,2 mm. The relative proportions of larger and smaller aggregate shall be determined by laboratory testing.

(vi) Coarse aggregate produced from limestone, felsite, dolomite or other calcareous rocks will not be permitted, unless authorized by the Engineer.

(vii) The flakiness index of the fraction of the coarse aggregate smaller than 37,5 and larger than 26,5 mm, determined in accordance with SANS Method 847, shall not exceed 35.

02.04 Admixtures to concrete

No admixtures shall be used without the written permission of the Engineer, or unless specified in the Project Specifications. Admixtures, if allowed, shall comply with the requirements of subclause 02.04 of section 704.

02.05 Steel reinforcement

Reinforcement shall comply with the relevant requirements of section 703.

02.06 Curing compound

The curing compound used shall be a white-pigmented, resin-based curing compound which complies with the requirements of AASHTO M-148, except that the water loss as determined by the water-retention test shall not exceed 0,040 g/cm^2 within 72 hours.

A valid certificate from an approved testing laboratory shall be submitted, to certify that the curing compound complies with the Specifications and that further testing shall be carried out at regular intervals.

The curing compound shall be capable of being sprayed onto a wet surface without loss of stability or performance. This characteristic shall also be certified by the approved testing laboratory.

02.07 Joint sealers

(a) Neoprene compression seals

Neoprene compression seals for the sealing of sawn joints shall comply with the requirements of SANS 1023. The seals shall be manufactured by the extrusion of an elastomeric material which consists wholly of polychloroprene, which has subsequently been vulcanized.

(b) Joint filler

The joint filler for the expansion joints shall be manufactured from a closed-cell polyethylene, and the filler strips shall be provided with a tear-off cover strip. The joint filler shall be of an approved brand, such as Sondor or an equivalent material, and the type used shall be subject to the Engineer's approval.

(c) Liquid sealant in joints between concrete and asphalt pavements

The liquid sealant used in joints between concrete and asphalt pavements shall be a hotpoured type joint-sealing compound which complies with the requirements of US Federal Specification SS-S-1401 C(1).

(d) Lubricant adhesive for compression seals

The lubricant adhesive used for inserting neoprene compression seals shall comply with ASTM D-2835.

(e) Polysulphide sealant

Two-component polysulphide sealant shall comply with the requirements of SANS 110.

02.08 Tie bars and dowels

(a) Tie bars

Tie bars shall consist of hot-rolled mild steel or hot-rolled, deformed high-yield-stress steel which comply with the requirements of SANS 920, except that any tie bars to be bent and later re-straightened shall be of mild steel.

Tie bars of the required dimensions and spacing shall be placed at right angles to the joints. The tie bars shall be free of paint, grease or other coatings that may affect bonding with the concrete.

At the construction joints, one half of the tie bar shall be supported by suitable stools placed on the subbase, while the other half shall project into the adjacent panel. Alternatively tie bars at longitudinal joints may be bent parallel to the edge of the first panel constructed and shall be straightened into their final positions before the concrete of the adjacent panel is placed, provided the method of fixing and support is approved by the Engineer.

At weakened-plane hinge joints the bars shall be firmly supported on steel supporting devices fixed to the subbase.

(b) Dowels

Dowel bars shall consist of plain, round mild-steel bars which comply with the requirements of SANS 920. The dimensions and spacing of dowel bars shall be as shown on the Drawings.

Dowel bars shall be straight, free from burred edges or other irregularities and with bevelled sliding ends. The free or unbonded end of the dowel shall be coated with a bond-breaking compound which consists of 200 penetration-grade bitumen blended hot with 14% light creosote oil and later, when cold, brought to the consistency of paint by the addition of 20% solvent naphtha.

Dowels shall be held rigidly in horizontal and vertical alignment by an approved dowel-supporting frame. The dowel shall not be tack-welded to the supporting frame but shall be held in position by soft binding wire.

A tolerance of not more than 2 mm in 300 mm (1 in 150) from the correct alignment, either vertical or horizontal, will be permitted prior to concreting. After concreting, the tolerance for dowels shall remain within 4 mm in 300 mm.

03 PREPARATION OF UNDERLYING LAYERS

03.01 General

The underlying layers shall be constructed in accordance with these Specifications up to the level of the underside of the concrete pavement.

The Contractor shall note that the specified construction tolerances for any underlying layers shall not relieve him of his responsibility to construct the concrete pavement to the requirements for thickness, grade, cross- section and smoothness specified in clause 11 of this section.

As the Contractor has to work to stricter tolerances on the concrete pavement than those obtained or specified for the underlying layers, the costs of any additional work involved with a view to complying with the requirements specified for the concrete pavement shall be included in the tendered rates for the concrete pavement.

Similarly, the costs of any additional thickness of concrete which may be required to provide the thickness of pavement slab within the specified tolerances shall be borne by the Contractor, irrespective of any tolerances specified for the construction of the subbase.

03.02 Application of the prime coat

When so specified in the Project Specifications, a bituminous prime coat shall be applied to the completed and accepted subbase as specified in section 605, at a rate of application as specified in the Project Specifications or as directed by the Engineer. Before the pavement concrete is placed, the prime coat shall be checked and any areas deficient in prime, or where the prime coat has been damaged, shall be repaired as directed by the Engineer. The primed surface shall then be cleaned thoroughly. The prime coat shall be dry before any reinforcing steel, tie bars, dowels or concrete is placed.

03.03 Wetting of the subbase

The surface of the subbase shall be kept continuously wet for a period of at least one hour before the concrete is placed. Immediately before the concrete is placed, the excess water shall be broomed off to ensure that the subbase is still damp but without puddles of water or pockets of mud when the concrete is placed. The wetting is of particular importance during hot, dry weather, and no concrete shall be placed on a subbase that has not been wetted or that has dried out.

04 SIDE FORMS

04.01 General

Side forms shall be of steel. The thickness of the steel used shall not be less than 5 mm. Forms 250 mm or more in height shall be at least 250 mm wide at the base; forms less than 250 mm in height shall have a base width at least as wide as the height. Flange braces shall extend outwards on the base for at least two thirds of the height of the form. The forms shall be free from warps, bends or kinks. The top face of the form shall not vary from a true plane by more than 3 mm in 3 m. The inside face of the upstanding leg shall not vary from a true plane by more than 6 mm in 3 m.

Side forms shall be of sufficient rigidity, both in the form and in the interlocking connection with the adjoining forms, so that deflection and springing will not occur under the weight of the wet concrete which is placed in the pavement.

04.02 Setting of forms

The forms shall be supported over their entire length. They shall be set to the correct height by means of steel shims and wedges or by other approved methods, and over the full length of the forms the space between the forms and the supporting layer shall be caulked with a 1:3 cement:sand mortar. The mortar bed shall be trimmed flush with the inside face of the forms.

The side forms shall be set to line and secured with not less than three pins over each 3 m of length, and one pin shall be fixed at each side of a joint. The top surfaces of the forms shall be flush at all joints.

The side forms shall be so set and supported that the finished slab surface will comply with the requirements specified in clause 11; the slab edge shall nowhere deviate more than 3 mm from the vertical alignment.

The forms shall be cleaned and oiled immediately before each use.

The forms shall be fixed in position within a reasonable time for the Engineer to inspect them prior to paving.

04.03 Removal of forms

The side forms shall be removed before any sawing of transverse joints can be commenced.

The concrete and projecting tie bars shall not be damaged in any way during the removal of the forms.

05 CONCRETE WORK

05.01 Requirements of concrete

(a) General

The specifications for materials to be used for the concrete shall not limit the Contractor's responsibility to manufacture concrete which complies with the requirements of these Specifications.

(b) Minimum cement:water ratio

The cement:water ratio of the mix shall not be less than 1,9.

(c) Minimum cement content

The cement content of the mix shall not be less than 320 kg/m^3.

(d) Specified strength

The specified strength shall be the higher of the following values:

(i) 33 MPa.

(ii) A 28-day compressive strength which corresponds to a 28-day flexural strength of 3,8 MPa.

(e) The workability of concrete

The mix proportions and consistency shall be such that, with the equipment in use the concrete can be fully compacted without the materials segregating or the occurrence of excessive bleeding. Testing shall be carried out in accordance with clause 07 of section 903.

05.02 Determining mix proportions

(a) General

The preliminary proportions of cement and aggregate required to produce concrete which complies with the requirements of these Specifications shall be determined by way of laboratory tests on concrete which is manufactured from the cement, coarse and fine aggregates, air-entraining agent (if any) and water as proposed for use in the Works.

(b) Preliminary tests

At least 30 days prior to the construction of the trial pavement, as specified in clause 09, the Contractor shall submit to the Engineer for approval samples of the materials he proposes to use and a report from an approved testing laboratory which shows the proportions proposed for the paving concrete.

The report shall also indicate the relationship between the 28-day compressive and flexural strengths for at least three cement:water ratios.

The tests to determine the relationship between the compressive and flexural strength shall be based on not less than six compressive strength specimens and not less than twelve flexural strength specimens for each cement:water ratio. All strength tests shall be made in accordance with SANS Methods 5863 and 5864.

(c) Changes in proportions or materials

(i) If, during the progress of the work, the requirements set out in subclause 05.01 are not being met by the concrete being manufactured, the Contractor shall immediately stop the production of such concrete and shall make such changes as may be necessary in the mix proportions and/or the materials to meet these requirements.

(ii) Any changes made shall be at the Contractor's expense and no extra payment will be allowed on grounds of such change.

(d) Changes in requirements

The Engineer shall have the right, at any time during the progress of the work, to amend the requirements set out in subclause 05.01. In such case the Contractor shall be compensated in accordance with the terms of the Contract for the additional costs of materials or additional handling and placing or for other costs, if any, entailed by such changes.

05.03 Batching, mixing and transporting of concrete

Concrete shall be batched, mixed and transported as specified in the relevant clauses of section 704.

05.04 Placing and compaction

(a) Time for placing and compaction

The placing, compacting and finishing of the concrete shall be carried out as rapidly as possible and the operations shall be so arranged that, in any transverse vertical section of the slab, the concrete shall be fully compacted and finished within two and a half hours of mixing. This time shall be reduced by half an hour for every 5°C by which the concrete temperature is above 20°C at the time of placing, unless otherwise permitted by the Engineer.

Unless adequate lighting facilities approved by the Engineer are provided by the Contractor, the placing of concrete pavement shall cease at a time when the finishing operations can still be completed during daylight hours.

(b) Adverse weather conditions

(i) Protection against rain and hail

No concrete shall be placed during rainy weather. For the concrete to be properly protected against the effects of rain and hail until it has hardened sufficiently, the Contractor shall at all times have frame-mounted waterproof covers available for the protection of the surface of the unhardened concrete. When rain appears to be imminent, all paving operations shall cease and all personnel shall take the necessary steps to ensure complete protection of the unhardened concrete.

(ii) Paving in cold weather

All reasonable precautions shall be taken to ensure that the temperature of the pavement concrete will not fall below 5°C during the first 48 hours after casting. When prevailing temperatures are low or when cold weather is forecast and there is danger of the temperature of the freshly cast pavement concrete falling below the prescribed limits, the Contractor shall either cease concreting operations or he may be permitted to carry on, provided the Engineer is satisfied that adequate protective measures are available and will be taken.

(iii) Paving in hot weather

Hot weather is defined as any combination of high air temperature, low relative humidity and a wind velocity which is liable to cause cracking in the pavement and/or the impairment of the quality of fresh or hardened concrete, or which will otherwise result in abnormal properties.

When paving during hot weather and when the temperature of the fresh concrete can be expected to exceed 24°C, the Contractor shall implement appropriate precautionary measures to maintain the concrete at the coolest temperature as may be practicable.

Paving shall cease when the concrete temperature, while being discharged from the mixer, exceeds 32°C.

(c) Responsibility for protection

The Contractor shall be responsible for the quality and strength of the concrete placed and for its protection, and any concrete damaged by adverse weather conditions shall be removed and replaced at the Contractor's expense.

(d) Maintaining the continuity of placing

The Contractor shall make adequate advance arrangements to prevent a delay in the delivery and placing of the concrete. An interval of more than 30 minutes between the placing of any two consecutive batches or loads of concrete shall constitute a cause for stopping any paving operations, and the Contractor shall, at his own expense make a construction joint in the concrete already placed, at the location and of the type as may be directed by the Engineer. Paving shall be continuous, and the rate of paving shall be adjusted to suit the rate of delivery of the concrete.

(e) Width of placing

The width of concrete pavement to be placed in a single operation shall be as shown on the Drawings or as specified in the Project Specifications.

(f) Placing and spreading

The concrete shall be placed and spread to a surcharge of about one-fifth of the pavement thickness and shall thereafter be compacted, struck off and finished to the level of the side forms.

(g) Compaction and finishing

The concrete shall be compacted with poker vibrators which are followed by a steel-shod hardwood compacting beam not less than 75 mm wide and 225 mm deep.

The beams shall be provided with mounted vibrators with an energy input of not less than 0,25 kW per metre length of beam. Alternatively, a vibrating twin-beam compactor of an equivalent power may be used.

The beam shall be lifted and moved forward by increments which do not exceed the beam width. After every 2 m the beam shall be taken back 2 m and then slowly drawn forward whilst vibrating over the compacted surface to provide a smooth finish.

The surface shall then be regulated by at least two passes of a scraping straight-edge with a blade length of not less than 2 m. If the surface is torn by the straight-edge on account of irregularities in the surface, a further pass of the vibratory beam shall be made, followed by a further pass of the straight-edge.

Poker vibrators shall not be permitted to come in contact with joint assemblies, the underlying layer or side forms.

A final surface finish of the concrete shall be obtained by means of hand-operated floats. If necessary, more than one set of equipment consisting of a vibratory beam, a straight-edge and floats, shall be used to keep up with the concrete produced by the mixer.

06 REINFORCED PAVEMENT

06.01 General

In this context the term "reinforced pavement" shall mean isolated reinforced slabs incorporated within pavement which is generally unreinforced.

06.02 Reinforcement

Reinforcement shall comply with section 703. The type, size, spacing and position of reinforcement in the slab shall be as shown on the Drawings or as directed by the Engineer.

Reinforcement shall be supported on prefabricated metal stools or supports, or in any other manner approved by the Engineer. The method of support for reinforcement shall maintain the reinforcement in the position and at the depth shown on the Drawings.

07 TEXTURING, CURING AND PROTECTION

07.01 General

After placing, compaction and finishing and before the curing membrane is applied, the surface of the concrete shall be provided with a transverse surface texture.

Texturing on the downgrade shall be at 80° to the longitudinal axis of the pavement. The surface texturing shall be made and completed before the concrete has set to such an extent that the surface will be torn and the coarse aggregate will be unduly loosened during texturing.

07.02 Texturing

The texturing shall be made with a wire brush. The wire brush shall have 100 mm long tufts which consist of tape wire approximately 0,25 mm thick. The brush shall contain two rows of tufts at 20 mm centres, which two rows of tufts shall be offset 10 mm so that the tufts in one row will be exactly halfway between the tufts in the other row. The tufts shall average fourteen wires each. Brushes shall be replaced when the shortest tufts wear down to 85 mm.

Each succeeding sweep of the texturing brush shall overlap the previous sweep by not more than 15 mm and the average depth of texturing shall be not less than 0,80 mm. In order to ensure straight brush marks, the brush shall be operated against a straight-edge laid downgrade at 80° to the pavement centre line.

07.03 Curing

The exposed surfaces of the concrete pavement, including the sides of the slab, shall be treated immediately after the texturing of the surface and after removal of the side forms with a white-pigmented curing compound, as specified in subclause 02.06 above.

The curing compound shall be sprayed onto the surface at a rate of 0,30 litre/m^2, or as directed by the Engineer, by hand-spraying equipment which produces a fine fog-type of spray which will not damage the surface of the concrete. The curing compound shall be applied in two applications and coverage shall be uniform on all surfaces.

Care must be taken to control the spray rate of the curing compound, as a too thick application may cause difficulties when the compound has to be removed from areas which have to be painted with road-marking paint.

During spraying operations, the curing compound shall be continuously agitated or stirred to keep the pigmentation in suspension.

The curing membrane shall be maintained intact for seven days after the concrete has been placed. Any damage to the curing membrane on account of the Contractor's activities on the pavement shall be made good by respraying the affected areas.

07.04 Protection of pavement

No vehicles with an axle load exceeding 20 kN shall be run on the finished surface of a concrete pavement within a period of twenty-one days of its completion, unless the Engineer permits a reduction of this period to fourteen days when the pavement has been constructed during generally warm weather conditions. Rubber-tyred vehicles with an axle load of less than 20 kN which travel at a speed not exceeding 25 km/h, may be permitted after a period of seven days from the completion of the concrete pavement.

No vehicle with an axle load in excess of 80 kN shall be run on the completed surface during any stage of the Contract.

08 JOINTS

08.01 General

Joints in concrete pavement shall be provided at the positions and spacings indicated on the Drawings or ordered by the Engineer.

The faces of all joints shall be at right angles to the surface of the pavement.

If the joints do not comply with the requirements of the Specifications in all respects, it shall be sufficient reason for the Engineer to stop the concreting operations until the Contractor can satisfy the Engineer that he will be able to perform the work in accordance with the Specifications.

08.02 Construction joints

Construction joints are made by placing fresh concrete against hardened concrete at predetermined locations. The edges of all construction joints shall be rounded to a 5 mm radius.

Construction joints shall be constructed in accordance with the requirements of clause 08 of section 704 of these specifications.

(a) Longitudinal construction joints

Where the pavement is constructed in partial widths, the construction joint or joints shall be provided where shown on the Drawings.

Tie bars shall comply with subclause 02.08 and shall have the dimensions and spacings indicated on the Drawings.

When longitudinal construction joints are to be sealed, the top portion of these joints shall be sawn to a nominal width of 6 mm and to the depth shown on the Drawings, but not before seven days after construction of the pavement. If so indicated on the Drawings, the top arises of these joints shall be bevelled 5 mm at 45 degrees at the time of the sawing of the joint, or directly after completion.

(b) Transverse construction joints

Transverse construction joints are made at the end of the day's work or where concreting has to be suspended on account of breakdowns or for other reasons.

These joints may be formed at the position of a planned contraction joint (in which case a dowelled butt joint shall be provided), or midway between contraction joints (in which case the joint shall be a keyed and tied construction joint), or at an expansion joint (in which case capped dowel bars shall be used).

When transverse construction joints are to be sealed, the top portion of these joints shall be sawn to a nominal width of 6 mm and to the depth shown on the Drawings, but not before seven days after construction of the pavement. If so indicated on the Drawings, the top arises of these joints shall be bevelled 5 mm at 45 degrees at the time of the sawing of the joint or directly after completion.

08.03 Weakened plane joints

Weakened plane joints shall be formed by reducing the concrete thickness at the joint by sawing a groove in the hardened concrete.

(a) Longitudinal hinge joints

Where the pavement is constructed in widths of two or more panels at a time, a hinge joint shall be formed by sawing.

Sawing shall be carried out as specified in subclause 08.05 and not later than 48 hours after the concrete has been placed. If, however, longitudinal cracking of the concrete takes place before this time, sawing shall be completed at an earlier time to prevent any future longitudinal cracking.

The nominal width of the groove shall be 6 mm for joints sealed with preformed neoprene seals and 3 mm for unsealed joints. A width tolerance of plus or minus 0,5 mm shall be applicable to all joints.

The depth of the groove shall be one quarter of the nominal pavement thickness, plus 13 mm.

Deformed steel tie bars shall be installed where specified or indicated on the drawings.

(b) Transverse contraction joints

Transverse contraction joints shall consist of planes of weakness created by the sawing of grooves in the surface of the pavement at the spacings shown on the Drawings.

(i) General requirements

Sawing shall be carried out as specified in subclause 08.05. Transverse contraction joints shall be sawn to a depth of one quarter of the nominal pavement thickness within 24 hours of the placing of the concrete. The exact time shall be determined by the Contractor, who must bear in mind the risk of cracking of the pavement and the risk of spalling when green concrete is sawn.

When the pavement is constructed in partial widths, the transverse joints opposite those which have opened in the adjacent pavement shall be sawn within 24 hours of the concrete having been placed, for which the exact time will be determined by the Contractor, as above, but in all cases not more than two consecutive planned contraction joints shall be omitted.

The remaining contraction joints may be sawn at such time as the Contractor may elect within 48 hours of the placement of the concrete, but before uncontrolled cracking takes place.

Where required, dowels shall be installed as specified in subclause 02.08. Dowelled joints shall be at right angles to the longitudinal axis of the pavement.

(ii) Contraction joints left unsealed

Unsealed joints shall be sawn to a nominal width of 3 mm and to a tolerance of plus or minus 0,5 mm.

(iii) Contraction joints to be sealed

All joints shall initially be sawn not more than 3 mm wide. In sealed joints the top portion of the groove shall subsequently be reamed to the specified final width and depth not before four days after the initial sawing. Notwithstanding these requirements, the Engineer may direct that all or some joints be sawn to the required final dimensions in a single operation if the Contractor demonstrates that the quality of the completed joints is comparable with that of joints sawn in two separate operations.

The nominal reamed width of sawn contraction joints which do not exhibit shrinkage cracking along the side of the pavement shall be as shown on the Drawings, with a tolerance of plus or minus 0,5 mm.

In respect of the nominal reamed width of contraction joints which exhibit shrinkage cracking along the side of the pavement account shall be taken of the width of cracking, and such reamed width shall be as shown on the Drawings when the width of the contraction crack is 1,5 mm or less, and as directed by the Engineer when the width of a contraction crack exceeds 1,5 mm.

Joints shall be sealed by a preformed neoprene compression seal as specified in subclause 02.07(a).

08.04 Expansion joints

Expansion joints shall be constructed with vertical preformed joint filler, dowel bars and supporting cradles or assemblies.

The joint filler shall comply with the requirements of subclause 02.07(b) and shall be accurately punched out or drilled to admit dowels where called for on the Drawings. The filler for each joint shall be furnished in a single piece over the full depth and width required for the joint, unless otherwise authorized by the Engineer. When the use of more than one piece is authorized for a joint, the abutting ends shall be fastened securely and held accurately to shape by stapling or by any other suitable means of fastening which the Engineer regards as being satisfactory.

The joint filler, together with the sealing groove, shall completely separate adjacent slabs, and any loose-fitting dowel bars and spaces between the subbase and the filler shall be packed with joint filler material after assembly of the joint.

If the expansion joints incorporate dowels, the dowels shall be of the required dimensions, material and spacing and shall be provided with a close-fitting cap at one end. The cap shall be placed on the free half of each dowel, which shall be coated, as late as possible before concreting, with a bond-breaking compound which complies with subclause 02.08 (b).

The sealing groove in the upper portion of expansion joints shall be sealed with a preformed neoprene compression seal.

The edges of the expansion joints shall be rounded to a radius of 5 mm. If so indicated on the Drawings, the top arrises of these joints shall be bevelled 5 mm at 45 degrees not before seven days after construction of the pavement.

08.05 Sawing of joints

The joints in the pavement slab shall be sawn by experienced personnel only.

Except in portions of pavement which incorporate dowelled contraction joints, no transverse contraction joint shall be constructed within 1,5 m of a transverse volunteer crack. If the planned spacing of transverse contraction joints in portions of pavement which do not incorporate dowels in transverse joints would result in locating a transverse contraction joint within 1,5 m of a transverse volunteer crack, the transverse contraction joint shall be relocated so that it is not within 1,5 m of the said transverse volunteer crack.

The transverse contraction joints shall be sawn in such a manner that transverse volunteer cracks will not occur.

Excessive spalling of the arrases will not be allowed and the Contractor shall use the type of blade and equipment best suited to the hardness of the concrete being sawn.

Sufficient standby power saws shall be kept available on the Site by the Contractor ready for use at all times when concrete is being placed in the pavement.

Where spalling exceeds 5 mm in depth at any point measured from the top surface of the pavement, joints shall be repaired with an epoxy-resin mortar as specified in clause 10.

Immediately after sawing, the joint grooves shall be washed out with a jet of clean water to remove all fine material and the joints shall be sealed temporarily with an approved paper rope.

No traffic of any kind shall be allowed on the pavement until all joints have been temporarily sealed.

08.06 Joint sealing

(a) Neoprene compression seals

(i) Material

Neoprene seals shall be as specified in subclause 02.07(a). The actual configuration of the seal shall be as shown on the Drawings, as specified in the Project Specifications, or as approved by the Engineer.

(ii) Installation

The joint grooves into which the seals are to be inserted shall be cleaned with a power-driven rotary wire brush. The grooves shall be dry and shall be finally cleaned with compressed air immediately before the seals are installed.

The sides of the neoprene seal shall be coated with an approved lubricant-adhesive compound, as specified in subclause 02.07 (d). The seal shall be inserted into the joint with suitable equipment which will not damage the seal during its insertion. The seal shall not be stretched to fit into the groove, but a maximum increase of 10% in the length of the seal after installation will be allowed.

The top of the seal shall not be less than 5 mm or more than 7 mm below the pavement surface.

No traffic of any kind shall be allowed on the pavement before the joints have been sealed either permanently or temporarily.

The size of the sealing strip to be used will depend on the width of the groove to be sealed.

The Contractor shall not order large quantities of preformed seals before the quantities required in the various sizes have been discussed with and approved by the Engineer.

(b) Liquid sealant in joints between concrete and asphalt pavement

These joints shall be sealed with a hot-pour-type joint-sealing compound as specified in subclause 02.07 (c). Prior to application, the joints shall be clean without any free water being present. Curing compound on joint walls shall be removed by sand-blasting or with an abrasive wheel. Dirt, dust and laitance shall be blown out of the joint with oil-free compressed air at a pressure of approximately 600 kPa immediately before the sealing operation. The sealant shall be applied in accordance with the manufacturer's recommendations, particularly with regard to temperature, which shall be carefully controlled.

(c) Polysulphide sealant

Polysulphide sealant of the grade scheduled or shown on the Drawings shall comply with the requirements of subclause 02.07 (e) and shall be mixed and applied in strict accordance with the manufacturer's instructions after the joints have been thoroughly cleaned as specified in subclause 08.06 (b) above.

09 TRIAL PAVEMENT

09.01 General

Prior to the commencement of full-scale paving, the Contractor shall construct a section of trial pavement, which is laid as part of the permanent pavement, to demonstrate his capability of constructing the pavement in accordance with the Specifications.

The Contractor shall also demonstrate the methods he proposes to use for the application of the required surface texture, the construction of joints and for the placement of tie bars, dowels, etc.

The size of the trial section of pavement for roads and parking areas shall in each case depend on the dimensions of the panels and shall be determined by the Engineer on the Site.

09.02 Proceeding with full-scale paving and further trial pavements

Unless he has been advised of any deficiencies in the trial pavement, the Contractor may proceed with full-scale paving ten days after the completion of the trial pavement or at such earlier time as the Engineer may allow. In the event of deficiencies occurring in the trial pavement, the Engineer may order the Contractor to break up and reconstruct the trial pavement after repairing any damage to the underlying layers, or he may allow the Contractor to effect repairs, all as set out in clause 10 and at his own expense.

10 REMEDIAL WORK

10.01 Removal of concrete

Where any section of the pavement which does not comply with the specified requirements is to be removed and reconstructed, the entire portion of the slab between the longitudinal and transverse joints shall be removed and reconstructed.

10.02 Removal of high spots

Wherever the Engineer so permits, high spots may be removed with approved power cutters or surface planers. Generally this shall apply to spots not exceeding 10 mm in height. No hand-operated grinding wheels or chisels shall be used. After individual high spots have been removed, the Contractor shall, if required, grind the surface to the nearest longitudinal and transverse joint so that all the ground areas are neat rectangular areas with a uniform texture.

On all portions of the pavement where the surface texture has been destroyed or reduced by grinding, surface texture shall be restored by grooves being cut into the concrete surface. The grooves shall be approximately 3 mm deep and 10 mm apart.

10.03 Repairing of joints

Joints along which spalls occur that exceed 5 mm in depth at any point measured from the top surface of the pavement, or any other joints which in the opinion of the Engineer are not acceptable, shall be repaired with an approved epoxy-resin mortar. Some epoxy binder shall be used to prime the surface being repaired prior to placement of the mortar mix. The mix shall be shaped to the original proper joint configuration.

10.04 Repairing of cracks

The Contractor shall be responsible for constructing a pavement that will not show any cracks.

Where cracks occur in the pavement which, in the opinion of the Engineer, do not warrant the removal and reconstruction of the pavement, the Contractor shall repair such cracks as specified hereafter.

The cost of repairing cracks or of breaking up, removing and replacing existing slabs shall be borne by the Contractor if the first cracks in any slab section between joints occur within 30 days of the casting.

If the first cracks in any slab section between joints occur more than 30 days after casting, the Contractor will be paid for repairing the cracks or replacing the slab section.

All cracks, except as otherwise provided, shall be repaired by epoxy being injected over the entire length of the cracks under pressure. Cracks which do not require injection with epoxy shall be limited to single continuous cracks without branch or connecting cracks that -

(a) either begin or end at a longitudinal joint or an edge of the pavement and, at any point along the length of crack, are not within 1,5 m of a transverse joint or other crack that has not been injected with epoxy; or

(b) do not begin or end at a longitudinal joint or edge of pavement and, at any point along the length of crack and

- are not within 1,5 m of any transverse joint,

  and

- are not within 300 mm of any longitudinal joint, edge of pavement or other crack that has not been injected with epoxy.

Where cracks cross or partly coincide with sawn joints, adequate protective measures shall be taken to prevent the entry of epoxy into saw cuts which will reduce the groove depth, or, at the option of the Contractor, accumulations of epoxy in saw cuts shall be removed by resawing to the specified depth prior to opening the pavement to any traffic, but not later than 72 hours after the epoxy has been injected.

Epoxy injection shall be completed within 90 working days after the pavement has been placed.

When making epoxy-injection repairs, a surface seal shall be applied to prevent the loss of epoxy, and entry ports shall be placed at sufficiently close intervals to allow the entire length of the crack to be filled. Surface seal materials and injection procedures shall be such that damage to the texture and appearance of the pavement surface will be prevented after the pavement has been opened to public traffic. Epoxy shall be injected with in-line mixing equipment. Pressure pots shall not be used. The epoxy shall conform to California State Specification 8040-03, but other epoxy adhesives and injection methods will be considered if their use can be supported by conclusive proof of satisfactory performance in concrete roads.

The Contractor shall provide cores of epoxied cracks at the rate of five relatively evenly spaced cores for each 50 m of epoxied crack. If the total length of cracks to be epoxied exceeds 50 m, the rate of coring may be reduced to one core for each additional 30 m of epoxied crack, provided that the Contractor's methods and equipment are producing satisfactory results. Cores shall extend through the entire depth of pavement and shall include the full depth of crack. The locations of cores will be determined by the Engineer. Cracks where epoxy has penetrated to less than 80% of the crack depth shall have additional epoxy injected until a minimum of 80% of the crack depth has been filled. Such cracks may require additional cores for verification as determined by the Engineer.

All holes which result from coring shall be completely filled with concrete of the same quality as that used for constructing the pavement, but with a maximum coarse aggregate size of 13,2 mm.

Volunteer cracks which do not require epoxy injection shall be routed out and sealed with an approved two-component, cold-applied polysulphide sealant which complies with SANS 110, or a polyurethane liquid sealant which complies with ASTM C-920.

The sealant shape factor shall be taken into account for the dimensions of the sealant groove which dimensions shall be approved by the Engineer. Prior to sealing, the surfaces of the joint shall be cleaned of all traces of dust, laitance and other foreign material by wire brushing, followed by a blowing out with clean, dry compressed air. The joint faces shall be primed with primer recommended by the sealant manufacturer. The sealant shall be supported by an approved bond-breaking tape to prevent the underside of the sealant from adhering to the concrete.

11 CONSTRUCTION TOLERANCES

The work described in this section shall be constructed to the dimensional tolerances given below.

11.01 Level and grade

The level tolerances referred to in subclause 05.01 of section 902 shall be as follows:

H_{90}	± 15 mm
H_{max}	± 20 mm

Deviations from the specified longitudinal grade for roads on account of deviations from the specified levels shall not exceed those given in subclause 05.05 of section 601.

11.02 Width of pavements and the alignment of pavement edges

The width of each pavement shall be at least the specified width.

The edge of the pavement shall not deviate by more than 10 mm from the edge of a 3 m long straight-edge placed to touch the edge of the pavement for straight sections, or by more than 3 mm from the designated offset per 3 m length of curve for curved sections.

11.03 Joints

Joints shall not deviate by more than 10 mm from their designated positions in the pavement or by more than 10 mm from the edge of a 3 m long straight-edge placed to touch the line of the joint. There shall be no discontinuities in the line of joints.

11.04 Thickness

The thickness tolerances referred to in subclause 05.02 of section 902 shall be as follows:

D_{90}	21 mm
D_{max}	27 mm
D_{ave}	5 mm

The thickness of the slab shall be determined by accurate levelling in the same position at predetermined random points before and after construction of the slab, and also by measuring cores drilled from the slab (an average of three measurements per core).

11.05 Cross-section (for roads)

When tested with a 3 m straight-edge laid at right angles to the road centre line, the surface shall not deviate by more than 6 mm from the bottom of the straight edge.

11.06 Surface regularity (for roads)

When tested with a rolling straight-edge as described in subclause 09.03 of section 903, the number of surface irregularities in excess of 4 mm shall not exceed the following:

(a) Average number of surface irregularities per 100 m taken over 300 m - 600 m lengths 5

(b) Number of surface irregularities taken over 100 m at a time 8

The maximum value of any individual irregularity when measured with the rolling straight-edge or with a 3 m straight edge laid parallel to the road centre line shall not exceed 7 mm.

12 TESTING

12.01 Process control

The tests and testing frequencies shown in table 610/1 shall be the minimum that will be required from the Contractor in terms of clause 05 of section 901 for the purpose of process control.

Note:

The Contractor is advised to carry out regular accelerated 18-hour compressive-strength tests in order to predict the 28-day compressive strength of the concrete. The methods of testing and predicting the 28-day strengths shall be as determined in consultation with the Engineer. Whenever 18-hour tests indicate that the required 28-day strengths will not be obtained, the Contractor shall immediately bring about such changes in materials and mix proportions as may be necessary to ensure future compliance.

The Engineer may carry out 28-day compressive-strength tests and the Contractor will be permitted to avail himself of these test results instead of carrying out his own testing.

However, if he elects to do so, it will be entirely at his own risk, and neither the Engineer nor the Employer will be liable for damages or costs to the Contractor which may arise from any reliance placed on such tests.

12.02 Routine Inspection and testing

Routine inspection and testing will be carried out by the Engineer in accordance with the provisions of clause 09 of section 902 to test the quality of materials and workmanship for compliance with the requirements of this section. In addition, the following shall apply:

(a) Compressive-strength control

(i) Test for compliance

Compressive-strength control shall be carried out on the basis of the acceptance-control plan as described in section 902.

Table 610/1

Test	Testing frequency (one test)
Materials	
Aggregates:	
Shrinkage10% FACT Flakiness index Organic impurities	For every type of aggregate used or apparent changes in properties
Moisture content	At the beginning and halfway through each shift and after rain showers
Grading	For every 100 m^3 of coarse aggregate
	For every 50 m^3 of fine aggregate
Bulking	As for moisture content but in respect of volume batching only
Concrete	
28-day cube compressive strength	For every 100 m^3 of concrete (min 9/day)
Constructional tolerances	
Surface levels	Every 20 m (5 points per test)*
Width and edge alignment	Every 100 m
Joint alignment	Every 100 m
Thickness (level measurements)	Every 20 m (2 points per test)*

* For parking areas, 1 test equals a series of points, 5 m apart, in a straight line across the full width of the parking area, at every 20 m interval.

(ii) Procedure in the event of failure

Should, on the basis of the acceptance control plan, the 28-day compressive strengths of concrete cubes fail to meet the requirements, the lot represented by these tests shall be rejected, but the Contractor shall nevertheless have the right to resubmit the lot on the basis of concrete cores drilled from the pavement in a random pattern.

Each lot shall be represented by 12 cores, and the required average equivalent cube strength, ignoring outliers, shall not be less than the following:

$$L_a = L_s + 1{,}435\ S_n$$

where

L_a = the required average equivalent cube strength

L_s = the specified 28-day cube compressive strength as specified in subclause 05.01 (d) of this section

S_n = Standard deviation of the equivalent cube strengths.

The method of coring and testing shall be in accordance with SANS method 5865, and the interpretation of test results shall generally be in accordance with the recommendations of Technical Report No 11 : Concrete core testing for strength, published by the Concrete Society London.

The equivalent cube strength shall be the "potential strength" referred to in the above publication. The Engineer's decision regarding the interpretation of the above publication, together with such adaptations as, in his opinion, are necessary to make allowance for circumstances which differ from those contemplated in this publication, shall be final. When the resubmitted lot fails to meet the requirements stated above, it shall be rejected, but the Engineer may, in his sole discretion, permit the Contractor to resubmit such sections of the lot as, in the Engineer's opinion, appear to have, in substance, the required strength judging by the cores already taken.

Such sections of the lot shall be resubmitted by way of 12 fresh cores being taken for each section, and the required average equivalent cube strength of each sublot of 12 cores shall not be less than that stated above with regard to the first resubmission.

The costs of drilling and testing the cores shall be for the Contractor's account irrespective of the outcome of such tests.

All sections which do not meet the above requirements shall be rejected. In the case of rejected work, the Engineer shall have the option of requiring the Contractor to remove such defective work and to replace it with work which meets the specified requirements, or of accepting substandard work at a reduced payment, as described in subclause 12.02 (d) below.

(b) Relationship between the compressive and flexural strength of concrete

During paving, the relationship between the 28-day compressive and flexural strengths established by the preliminary tests shall be monitored by continuing tests being made at the discretion of the Engineer.

For this purpose sets of six beams and three cubes shall be manufactured from the same batch of concrete and tested for flexural and compressive strength respectively.

If the test results vary from those established by the preliminary tests, the specified compressive strength, as defined in subclause 05.01 (d), will be adjusted accordingly.

(c) Defective work or materials

Any materials or work which does not comply with the specified requirements shall be removed and replaced with materials or work which complies with the specified requirements or, if the Engineer permits, shall be repaired as specified in clause 10 of this section so that it will comply with the specified requirements after having been repaired.

(d) Acceptance of substandard work at reduced payment

In lieu of requiring the removal of work that has been rejected on account of insufficient strength or thickness, the Engineer shall have the right to accept such work at a reduced payment for the pavement concrete in accordance with the conditions set out below:

(i) Work which does not comply with the strength requirements

The acceptance of substandard work at reduced payment shall only apply to work which, on the basis of the tests on which it was finally rejected, exhibited not less than 80% of the required strength. Acceptance of work that is substandard in strength shall be subject to reduced payment at the percentage of full payment set out in table 610/2 below:

Table 610/2

Average strength as percentage of required average (% to nearest 0,1%)	Percentage of full payment (%)
100	100
95 - 99,9	90
90 - 94,9	81
85 - 89,9	72
80 - 84,9	64

(ii) Work which does not comply with the requirements for average thickness

Where the average thickness of a pavement lot fails to meet the specified requirements, the acceptance of substandard work shall be subject to reduced payment at the percentage of full payment set out in table 610/3 below:

Table 610/3

Average thickness deficiency of concrete pavement (mm to nearest 0,1 mm)	Percentage of full payment (%)
0,0 - 5,0	100
5,1 - 7,5	80
7,6 - 10,0	72
10,1 - 12,5	68

(iii) Work which does not comply with the requirements for both strength and average thickness.

Work which does not comply with the requirements for both strength and average thickness may be accepted by the Engineer at a reduced payment, which is calculated by applying the product of the above reduction factors, provided that the quality of the work is such that the combined reduction factor is not less than 0,64.

12.03 Tests and testing equipment

(a) Tests

Reference shall be made to section 903 for details concerning the following tests which will have to be made:

- Tests on coarse and fine aggregate for concrete
- Flexural-strength test (modulus of rupture)

- Compressive-strength test for concrete cubes
- Testing of concrete cores
- Slump tests

(b) The provision of testing equipment

Where provision is made for testing equipment in the Schedule of Quantities, the following items of testing equipment shall be supplied by the Contractor, on the instructions of the Engineer:

- Concrete cube testing press (compressive-strength test)
- Concrete cube moulds (150 mm)
- Concrete beam moulds (150 mm x 150 mm x 700 mm)

(c) Certification, calibration and maintenance of equipment

Immediately before it is brought onto the Site, the press shall be tested and calibrated by an officially recognized and approved agency and shall carry a certificate to that effect, together with all calibration curves or tables. Thereafter the Engineer may require the Contractor to have the apparatus retested once a year at no additional costs to the Employer.

13 MEASUREMENT AND PAYMENT

Item		Unit
610.01	**Concrete pavement** (Class, thickness and nominal cement content indicated) excluding texturing and curing	square metre (m^2)

The unit of measurement shall be the square metre of pavement placed and finished in accordance with the Specifications and Project Specifications. No additional payment over the tendered rate shall be made for any pavement with an average thickness in excess of that shown on the Drawings. The quantity shall be calculated from the authorized dimensions of the completed pavement surface, except when the Drawings show or the Engineer requires local deviations from the specified thickness. The volume of the concrete, in such cases, shall be converted into an equivalent area in square metres based on the specified thickness of the slab.

The tendered rate shall include full compensation for procuring and furnishing all materials, the storage of materials, provision of all plant, determining mix proportions, for mixing, transporting, placing and finishing of the concrete, including formwork, repairs to defective surfaces, grinding and retexturing if required, repairing joints and cracks, protecting the pavement against damage, construction joints and for process control.

Item		Unit
610.02	**Texturing and curing of concrete pavement**	
610.02.01	Wire-brush texturing	square metre (m^2)
610.02.02	Curing	square metre (m^2)

The unit of measurement for texturing and for curing shall be the square metre of exposed completed pavement textured or cured as specified. The quantity shall be calculated from the authorized horizontal dimensions of the completed pavement surface in the case of texturing or curing, plus the surface area of slab sides in the case of curing. The Engineer shall determine which portions of the pavement will require texturing.

The tendered rate for texturing shall include full compensation for providing the required equipment and for applying the texturing as specified.

The tendered rate for curing shall include full compensation for providing the curing compound and for applying it at the specified nominal rate with an approved hand-operated sprayer, as specified. The tendered price shall also include full compensation for the spraying of curing compound in unsealed joints.

Item		Unit
610.03	**Variation in the rate of application of the curing compound**	litre (ℓ)

The unit of measurement in respect of increases or decreases in the rate of application of the curing compound shall be the litre.

Payment for variations shall be made as specified for variations of other materials in clause 28 of section 001.

Item		Unit
610.04	**Joints**	
610.04.01	Expansion joints complete (excluding dowels)	metre (m)
610.04.02	Longitudinal hinge joints	
610.04.02.01	Sawn hinge joints (unsealed)	metre (m)
610.04.02.02	Sawn hinge joints (sealed)	metre (m)
610.04.03	Transverse contraction joints	
610.04.03.01	Sawn contraction joints (sealed) completed in a single operation (width as shown on Drawings)	metre (m)
610.04.03.02	Sawn contraction joints (sealed) completed in two separate operations (width as shown on Drawings)	metre (m)
610.04.03.03	Sawn contraction joints (unsealed)	metre (m)
610.04.04	Dowel bars (mild steel) (diameter and length indicated)	number (No)
610.04.05	Tie bars (diameter and length indicated)	number (No)
610.04.06	End caps for dowels at expansion joints	number (No)
610.04.07	Forming and sealing of joints between asphalt and concrete pavement	metre (m)

The unit of measurement for joints in the pavement shall be the metre of completed joint, except that dowel bars and tie bars across joints shall be measured separately by the number of each type installed.

Construction joints as such shall not be measured for payment, and the cost thereof shall be deemed to be included in the tendered rate for concrete pavement. However, if the position of a longitudinal construction joint coincides with that of an unsealed hinge joint, the Contractor shall be paid at the rate tendered for the type of unsealed hinge joint it replaces, provided that the requisite number and sizes of tie bars detailed for the hinge joints are installed.

Where the hinge joint replaced by the construction joint is a sealed hinged joint, the construction joint shall be sawn and sealed and the correct number of tie bars inserted, in which case payment shall be at the tendered rate for sawn and sealed hinge joints.

The tendered rates for expansion joints shall include full compensation for forming the joint complete with joint filler, the rounding off of corners and chamfering (if required) and inserting of a compression seal or a sealant.

The tendered rates for longitudinal hinge joints shall include full compensation for sawing the joint, or for supplying and inserting the preformed compression seal or a sealant (if sealing is specified) in the case of sawn joints.

The tendered rate for transverse contraction joints shall include full compensation for sawing the joint, supplying and inserting the preformed compression seal or a sealant (if sealing is specified), and temporary sealing with paper rope.

The tendered rate for dowel bars and tie bars shall include full compensation for the supply, cutting, placing, the holding in position - which includes supporting framework where required - and the coating of dowels.

The tendered rate for end caps shall include full compensation for the supply of the end caps and for fixing the caps to dowels at expansions joints.

The tendered rate for the forming and sealing of joints between asphalt and concrete pavement shall include full compensation for the supply of all plant and materials necessary for the forming of a joint of required dimensions in the bituminous surfacing, cleaning the joint, and for priming and sealing as specified in subclause 08.06 (b).

Item		Unit
610.05	**Coring and testing of cores**	
610.05.01	100 mm cores drilled from pavement	number (No)
610.05.02	150 mm cores drilled from pavement and tested for compressive strength	number (No)

The unit of measurement shall be the number of cores drilled or drilled and tested on the instructions of the Engineer. Cores drilled by the Contractor at his own initiative as part of his process control or for the resubmission of pavement sections which have been rejected, or for testing cracks sealed at the Contractor's own cost, shall not be measured for payment.

The tendered rates shall include full compensation for drilling the test cores and, where applicable, having them tested at an approved laboratory, and for all labour, transport, drilling and testing charges and other incidentals.

Item		Unit
610.06	**Repairing cracks**	
610.06.01	By the injection of epoxy resin	metre (m)
610.06.02	By routing and sealing with cold-applied liquid sealant	metre (m)

The unit of measurement shall be the linear metre of crack repaired as specified. Only cracks in slab sections which have not shown any cracks for 30 days after casting shall be measured for payment.

The tendered rates shall include full compensation for repairing the cracks as specified, including all materials, labour and equipment, but excluding the cost of drilling cores and having them tested, which shall be paid for under item 610.05.02 above. No cores showing defective injection shall be measured for payment.

Item		Unit
610.07	**Breaking up, removing and replacing defective slabs**	square metre (m^2)

The unit of measurement shall be the square metre of pavement slab broken up, removed and replaced on account of the presence of cracks. The quantity shall be calculated from the horizontal dimensions of the slab replaced. Only slabs that showed no cracks within the first 30 days after casting shall be measured for payment.

The tendered rate shall include full compensation for breaking up the cracked slab section, removing the concrete, repairing the subbase if necessary, casting a new concrete slab, including all joints, dowels, tie bars, curing and texturing the concrete, and for furnishing all the necessary materials, labour, plant, transport and other incidentals.

Note:

The following item of work, when specified, shall be carried out, measured and paid for in accordance with the appropriate sections of the Specifications, but shall be listed under this section in the Schedule of Quantities.

Item	Applicable section
Steel reinforcement for concrete pavements	703

SERIES 6 : ROADS AND PARKING AREAS

SECTION 611 : GUARDRAILS

CONTENTS

01 SCOPE

This section covers the supply, installation and maintenance of metal-plate beam guardrails at locations and in conformity with the details, dimensions and design shown on the Drawings or as directed by the Engineer.

02 MATERIALS

02.01 Guardrails

Guardrails shall comply with the requirements of SANS 1350.

Dimensions of guardrails and terminal sections shall be as shown on the Drawings.

Guardrails shall be supplied together with all bolts, nuts, washers and fixing materials required other than bolts for fixing to posts.

(a) Galvanizing

When galvanized guardrails are called for on the Drawings or in the Schedule of Quantities, a hot-dip (galvanized) zinc coating that complies with the requirements of SANS 32 or SANS 5121 as applicable for coatings on Type A2 articles shall be applied. Galvanized guardrails shall not be nested when stacked for storage.

All bolts, nuts and washers shall have a hot-dip (galvanized) zinc coating that complies with the requirements of SANS 32 or SANS 5121 for coatings on Type C1 articles in the case of bolts and nuts and Type A2 in the case of washers and reinforcing plates.

(b) Painting

When painted guardrails are called for, two coats of zinc-chromate primer as specified in section 806 shall be applied after manufacture and surface preparation.

02.02 Guardrail posts

(a) Timber posts

Timber posts shall be supplied in lengths as shown on the Drawings and shall comply with the requirements of SANS 457 parts 2 or 3 and carry the SANS mark.

Posts shall have a top diameter of at least 150 mm. Posts with a top diameter of up to 230 mm will be acceptable, provided posts with widely varying diameters are not used together in the same length of guardrail. Posts shall be drilled and shaped as shown on the Drawings and shall be provided with the necessary bolts, nuts, washers and spacer blocks for fixing.

Timber posts and spacer blocks shall be treated in accordance with SANS 10005, using a copper-chrome-arsenic compound for timber preservation, which complies with SANS 673, or using creosote which complies with the requirements of SANS 538 or 539. No cutting, drilling or shaping will be permitted after creosoting.

However, where the cutting of posts is unavoidable, the Engineer may permit the required length to be cut off from the bottom of a post, provided the exposed area is subsequently treated with creosote.

Timber posts shall not exhibit excessive cracking at the ends, and particularly no cracks aligned at an angle of more than 45° to the guardrail. Posts which, in the opinion of the Engineer, exhibit a degree of cracking that would seriously impair their life or strength shall not be used.

(b) Steel posts

Normally only timber posts shall be used to support the guardrails, but under certain conditions, e.g. where the guardrails are placed on concrete retaining walls, steel posts shall be used. The steel posts shall be of the type and size shown on the Drawings or described in the Project Specifications.

02.03 Reflector plates

V-shaped reflector plates shall be manufactured from 1,5 mm thick mild-steel plate to the dimensions shown on the Drawings. When supplied with galvanized guardrails, they shall be galvanized, and when supplied with painted guardrails, they shall be finished in white baked enamel. The outer surfaces shall be coated with engineering grade retro-reflective material which complies with the provisions of subclause 02.08 of section 612, in the colours shown on the Drawings. Holes for fixing shall be drilled before galvanizing or painting.

03 CONSTRUCTION

03.01 Erection

The holes for the timber posts shall be of a sufficient size to permit the proper setting of the posts and to allow sufficient room for backfilling and tamping. At least 1 m of the posts shall be embedded in the ground.

The holes for the timber posts shall be spaced to suit the standard length of guardrail supplied. Where shown on the Drawings or as directed by the Engineer, posts shall be set at half spacings. The hole for the concrete block at the end of a length of guardrail shall be neatly excavated and the top 120 mm shall be cast using formwork.

The posts, spacer blocks (if applicable) and guardrails shall be completely erected and set true to line and level, so that the rail is at the required height above the level of the completed road shoulder. The guardrail shall be suitably braced to prevent any movement, and all the bolts shall be tightened prior to any backfilling of holes.

After the Engineer has signified his approval of the guardrails thus erected, the holes shall be backfilled with a 12:1 soil:cement mixture. The material may be mixed either by hand or mechanically, and the correct quantity of water shall be added to ensure that the mixture is placed at or near the optimum moisture content.

The mixture shall then be placed and thoroughly rammed in layers not exceeding 100 mm in compacted thickness. The approach ends, where the guardrail has to be bent down and anchored, shall be constructed as shown on the Drawings.

When the backfilling is complete and the bracing removed, the posts must be rigid and vertical and the guardrail true to line and level and firmly fastened to the posts. Excess excavated material shall be disposed of as directed by the Engineer.

Steel posts shall be erected and fixed as shown on the Drawings.

All guardrails shall be erected in such a way that there will be no projecting ends that might interfere with or endanger traffic. The edges and the centre of the rail element shall make contact with the spacer block, or with the post where no spacer blocks are used. Where guardrail elements lap, the end which points in the direction of the traffic shall be on the side of the rail away from the traffic and, if specified, the guardrails shall be provided with terminal sections. All splices of rail elements shall be at a post, and plate ends shall make contact over the entire area of the splice.

Reflector plates shall be fixed in accordance with the details shown on the Drawings. The reflective surfaces shall be arranged with the colours as shown on the Drawings.

03.02 Painting

Before installation, the rail elements shall be cleaned, primed and painted as specified in section 806. After installation, all abraded or damaged surfaces shall be repainted with the finishing coat specified in subclause 08.03 (a) of section 806. Galvanized rail elements shall not be painted, and damaged galvanized surfaces shall be repaired in accordance with clause 02 of section 806.

When existing guardrails must be repainted, they shall be thoroughly cleaned with wire brushes and descaled with suitable tools to remove all rust and loose and oxidized paint. Thereafter they shall be washed down, and all exposed steel surfaces shall be given two coats of zinc-chromate primer followed by two finishing coats, as specified in subclause 08.03 (a) of section 806.

04 REQUIREMENTS

The completed guardrail shall be neat, and there shall be no visible deviations from line and grade. The posts shall be straight and vertical. The rail beam shall not be warped but shall be in a vertical plane and, in the case of roads, parallel to the road centre line except at flared sections. The painted or galvanized surface of the rail shall be smooth and continuous and free from abrasions and scratches. Any damage to the painted surface shall be made good at the Contractor's expense.

Guardrails which do not comply with the specified requirements shall be replaced or otherwise made good.

05 REMOVAL OF EXISTING GUARDRAILS

Where ordered by the Engineer, the Contractor shall dismantle and remove existing guardrails and posts. The guardrails shall be carefully removed, the posts dug out, and the excavations made for removing the posts backfilled and compacted. Guardrails and accessories shall be removed, transported to the point of re-use or storage and stacked in the positions indicated by the Engineer.

06 MEASUREMENT AND PAYMENT

Item		Unit
611.01	**Guardrails on timber posts**	
611.01.01	Galvanized	metre (m)
611.01.02	Painted	metre (m)

The unit of measurement shall be the metre of guardrail as erected, excluding end units.

The tendered rates shall include full compensation for furnishing all plant, materials and labour, for erecting the guardrails complete with posts, spacer blocks, bolts, nuts, washers and reinforcing plates, for excavating and backfilling post holes, for providing and mixing cement with the backfill material and for removing surplus excavated material.

Item		Unit
611.02	**Guardrails on steel posts**	
611.02.01	Galvanized	metre (m)
611.02.02	Painted	metre (m)

The unit of measurement shall be the metre of guardrail erected, excluding the end units.

The tendered rates shall include full compensation for furnishing all plant, materials and labour, and for erecting the guardrail, complete with posts, spacer blocks, bolts, nuts, washers and reinforcing plates, for excavating and backfilling post holes, including concrete backfill, and for removing surplus excavated material.

Item		Unit
611.03	**Extra over items 611.01 and 611.02 for horizontally curved guardrails, factory bent to a radius of less than 150 m**	metre (m)

The unit of measurement shall be the metre of curved guardrail erected, measured in place.

The tendered rate extra over the rates tendered for items 611.01 and 611.02 shall be in full compensation for the additional costs of supplying and erecting curved sections.

Item		Unit
611.04	**End units**	
611.04.01	End wings	number (No)
611.04.02	Terminal sections in accordance with the Drawing, where single guardrail sections are used	number (No)
611.04.03	Terminal sections in accordance with the Drawing, where double guardrail sections are used	number (No)

The unit of measurement shall be the number of end units of each type erected.

The tendered rates shall include full compensation for all labour, plant and materials required to install the end units as shown on the Drawings, including posts, fittings, the bending of turned-down sections, for excavations, formwork, concrete, backfilling and the removal of surplus backfilling.

Item		Unit
611.05	**Additional guardrail posts**	
611.05.01	Timber	number (No)
611.05.02	Steel	number (No)

The unit of measurement for guardrail posts erected over and above the normal spacing shown on the Drawings shall be the number completed in place.

The tendered rates shall include full compensation for supplying, excavating, backfilling and erecting additional posts.

Item		Unit
611.06	**Reflector plates**	number (No)

The unit of measurement shall be the number of reflector plates installed.

The tendered rate shall include full compensation for supplying all materials and labour required to manufacture, paint, galvanize and fix the reflector plates as specified and as shown on the Drawings.

Item		Unit
611.07	**Dismantling existing guardrails and posts**	
611.07.01	Dismantling guardrails	metre (m)
611.07.02	Removing posts	number (No)

The unit of measurement shall be the metre of existing guardrail dismantled and the number of existing posts removed.

The tendered rates shall include full compensation, as applicable, for dismantling existing guardrails, removing all posts, transporting material to the point of re-use or storage, for stacking and for excavating, importing additional backfill material if required, backfilling and compacting post holes.

Item		Unit
611.08	**Repainting existing guardrails**	metre (m)

The unit of measurement shall be the metre of single guardrail repainted.

The tendered rate shall include full compensation for cleaning the existing guardrails, supplying all the materials, and repainting the guardrails as specified.

Item		Unit
611.09	**Re-erection of dismantled guardrails with new treated timber posts**	metre (m)

The unit of measurement shall be the metre of guardrail as erected, including the end units.

The tendered rate shall include full compensation for supplying new treated timber posts and spacer blocks, for the replacement of lost or damaged guardrail fittings, for cleaning and painting the used guardrails, for excavating and backfilling post holes, for the re-erection of the dismantled guardrails complete with all fittings, and for the removal of surplus guardrail material and excavated material, all as specified and as shown on the Drawings.

SERIES 6 : ROADS AND PARKING AREAS

SECTION 612 : TRAFFIC SIGNS

CONTENTS

01 SCOPE

This section covers the supply and erection of permanent traffic signs at the locations indicated on the Drawings or directed by the Engineer.

Overhead traffic-sign supports shall be manufactured in accordance with the requirements of section 809.

The signs shall be of the standard regulatory, warning and information signs as detailed on the Drawings and shall be fabricated in accordance with the provisions of the National Road Traffic Act (Act 93 of 1996) and the Southern African Development Community Road Traffic Signs Manual, except where otherwise indicated on the Drawings.

02 MATERIALS

02.01 Structural steel

The structural steel shall comply with the requirements of BS 4360 for the type of steel specified or shown on the Drawings. Where specified, all structural steel, including tubes, shall be galvanized in accordance with the requirements of SANS 32 quality B1 or SANS 121, Table 2 or 3, as applicable.

Steel tubes shall comply with the requirements of SANS 657-1 and shall be D-shaped.

02.02 Bolts, nuts and rivets

Steel bolts and nuts shall conform to the appropriate parts of SANS 1700 or SANS 1143. Aluminium bolts and nuts shall be manufactured from alloy B51S or D65S.

All steel bolts, nuts and washers shall have a hot-dip (galvanized) zinc coating that complies with the requirements of SANS 121, Table 2 or 3, as applicable.

Blind rivets used for fixing sign faces to square tubing framework shall be 4,76 mm rivets manufactured from or coated with a material that will not cause corrosion through electrolytic action. Blind rivets used for joining aluminium extrusions shall be hardened aluminium blind rivets.

02.03 Chromadek steel plate

Steel plate for road signs shall be 1,40 mm thick Chromadek G275 galvanized Iscor steel plate, which has been treated on both sides with an epoxy primer followed by a silicon polyester top coat. The total dry thickness of the treatment shall be at least 0,025 mm.

Where a reflectorized road sign is required, its reverse side shall be painted with a dull grey prime coat and the face with only the specified top coat.

02.04 Other plate material

Other plate material shall be as specified in the Project Specifications.

02.05 Aluminium

Aluminium sections shall be of the sizes detailed on the Drawings, shall be manufactured from grade 6063.T.5 alloy and shall comply with the provisions of BS EN 12020 parts 1 and 2.

Aluminium plate shall be manufactured from grade 5251.H.3 alloy and shall conform to the requirements of BS EN 537 and shall be 2,0 mm in thickness.

02.06 Concrete

Concrete shall be manufactured and placed as specified in section 704. Class 20/19 concrete shall be used for the erection of traffic sign supports, unless otherwise shown on the Drawings or directed by the Engineer.

02.07 Paint

All paints used shall comply with the requirements of SANS 1519-2, including the standards mentioned therein.

Except where reflecting surfaces are specified, the surface of painted traffic signs shall not be excessively glossy. The 60° specular gloss measured in accordance with SANS Method 2813 should, if possible, not exceed 50. No thinners shall be added to the paint.

02.08 Retro-reflective material

Retro-reflective material shall be supplied in the following grades and shall comply with the requirements of SANS 1519-1:

Class I - Engineering-grade retro-reflective material

Class II - Super-engineering-grade retro-reflective material

Class III - High-intensity grade retro-reflective material.

The material shall be supplied with a pressure-sensitive or heat-applied adhesive backing protected by a removable liner.

02.09 Timber poles for sign supports

Timber poles for sign supports shall comply with SANS 457 part 2 or 3, shall be equal to or better than Strength Group B timber poles, and shall be stamped with the SANS mark. The posts shall be treated with a preservative as specified below, and after treatment only one cut per pole will be allowed to obtain the correct length and chamfer at the top of the post. The exposed surface of the cut shall be given two coats of the appropriate preservative.

The poles shall be treated with a pressure process as defined in Paragraph 1 (b) of Schedule B of the Regulations for Combating and Preventing the Spread of Certain Insect Pests affecting Soft Wood, as published in the Government Gazette of 2 August 1968.

The type of preservation material will be specified in the Project Specifications, and shall be copper-chrome-arsenate salts which comply with SANS 673, or creosote complying with SANS 538 or 539.

02.10 Steel reinforcement

Steel reinforcement shall comply with the requirements of section 703.

02.11 Corrosion-protection tape

The corrosion-protection tape used between aluminium and steel shall be Scotchrap 50 or an equivalent approved material.

03 MANUFACTURE OF TRAFFIC-SIGN BOARDS AND SUPPORTS

03.01 Traffic-sign boards

Traffic-sign boards shall be manufactured strictly in accordance with the details tabulated on the Drawings, and shall be manufactured either from steel plate, aluminium plate or extrusion, or from particle board, as may be specified on the Drawings. Particle board shall normally be used only on traffic signs not exceeding 10 m^2 in area.

Wherever possible, the traffic-sign boards shall be manufactured as one unit. Traffic signs which are too large to be transported as one unit may, with the approval of the Engineer, be manufactured in sections. The completed sections shall be assembled in the shop prior to delivery to ensure that all the sections fit together properly and that the legends are properly spaced and aligned. Joints in sign faces shall be provided only at locations and to details approved by the Engineer.

Direct contact between aluminium plate and steel supporting framework shall be avoided by corrosion protection tape being applied to the sign face over the contact areas.

03.02 Welding

All welding of steelwork shall be carried out in accordance with the standards laid down in BS EN 1011. Welding shall be done before painting.

03.03 Structural steel

The relevant provisions of section 809 shall apply to all steel supporting structures for traffic signs.

03.04 Aluminium extrusions

Aluminium extrusions for sign boards shall be joined by blind rivets or bolts. They shall preferably not be joined longitudinally, but if this cannot be prevented without excessive waste, they shall be joined neatly and the joints staggered. No sections shorter than 500 mm shall be used.

Where aluminium extrusions are to be faced with retro-reflective background material, it shall be pre-applied to individual sections before assembly, with the material taken around the face edges of each extrusion for at least 10 mm. Retro-reflective material shall be heated to facilitate binding around edges without damaging the material. Where possible the placing of letters across the joint between two extrusions shall be avoided.

03.05 Galvanizing

Where the galvanizing of structural steel sign-board frames and sign-board supporting structures is specified, it shall be done as long after welding as may be practicable. However, where this is not feasible, the steel sections shall be galvanized before assembly and then welded. All welds shall be thoroughly cleaned and loose material removed and dressed, after which the welds shall be coated with two coats of an approved zinc-rich paint.

Unless otherwise specified in the Schedule of Quantities or the Project Specifications, galvanized steel will not require painting.

Traffic-sign supports shall be constructed in accordance with the details shown on the Drawings.

Where no details for the construction of sign boards, the framework of the sign faces or the attachment thereof to the supporting framework are shown on the Drawings, they shall be designed by the Contractor himself, and he shall submit such details to the Engineer for approval before manufacture.

04 PAINTING

04.01 Colours, symbols and legends

Paint colours, symbols, legends and borders used on traffic signs shall comply with the regulations of the National Road Traffic Act, (Act 93 of 1996) and its Regulations, and also with the requirements of the Southern African Development Community Road Traffic Signs Manual.

The colours and shades shall conform to the colours and shades specified in SANS 1519-2 and shown in SANS 1091.

04.02 Preparation of surfaces and application of paint

The preparation of surfaces and all painting shall be carried out as specified in SANS 1519-2.

Unless otherwise specified, only the faces of aluminium road signs will require painting.

04.03 Time of painting

Traffic sign boards and legends shall not be painted more than six months prior to their erection.

05 STORAGE AND HANDLING

All traffic signs or portions of traffic signs shall be so handled and stored in a weatherproof storeroom to prevent any permanent deformation or damage to painted surfaces.

All unpainted surfaces and steelwork shall be protected against corrosion.

06 ERECTION OF TRAFFIC SIGNS

06.01 Position

Road signs shall be erected in the positions shown on the Drawings or indicated by the Engineer.

06.02 Excavation and backfilling

Excavations for the erection of traffic signs shall be made according to the dimensions shown on the Drawings. Where the excavations are to be backfilled with soil, a 1:12 cement:soil mixture shall be made and thoroughly compacted at optimum moisture content in 100 mm thick layers.

Where posts or structures are to be fixed in concrete, or where concrete footings are to be cast, the concrete, formwork and reinforcement shall comply with the requirements of the appropriate sections of series 7. The holes shall be completely filled with concrete up to the level shown on the Drawings or indicated by the Engineer. The upper surface of the concrete shall be neatly finished with sufficient fall to ensure proper drainage.

06.03 Erection

Traffic signs shall be erected as shown on the Drawings or as directed by the Engineer. During erection the structural steelwork shall be firmly bolted and protected to prevent any buckling or damage being caused during erection or by the equipment used for erection.

Posts to which signs are to be fixed shall be vertical, and the undersides of signs shall be horizontal after completion of erection.

The month and year of erection of the road signs shall be indicated with white paint on the back of the sign in the bottom right-hand corner. The letters and figures shall be 25 mm in height.

Where signs are erected with timber poles, all the holes that are drilled in the timber shall be impregnated with hot creosote.

06.04 Field welding

All welding done during erection shall comply with the requirements for welding during manufacture.

06.05 Painting on Site

All painting done after erection shall comply with the requirements for painting during manufacture.

All places where the paintwork has been damaged during erection shall be made good by the Contractor, at his own cost, to the satisfaction of the Engineer.

06.06 Time of erection

Traffic signs shall be erected immediately prior to the opening of the road or parking area to public traffic, unless otherwise decided by the Engineer.

07 PROTECTION AND MAINTENANCE

The Contractor shall protect the completed traffic signs against all damage until the road or parking area has finally been accepted by the Employer, and he shall maintain the signs until the defects liability period has expired. Damage or defects caused by faulty workmanship or negligence shall be made good by the Contractor, at his own cost, to the satisfaction of the Engineer.

08 DISMANTLING AND RE-ERECTION OF EXISTING TRAFFIC SIGNS

Where ordered by the Engineer, the Contractor shall dismantle existing signs and re-erect them at new positions indicated by him. This work shall be done with as little damage as possible to the signs.

Where required by the Engineer, the signs shall be repainted or repaired and new materials shall be used for part of or the entire supporting structure.

09 MEASUREMENT AND PAYMENT

Item		Unit
612.01	**Sign boards with painted background, symbols, lettering and borders in engineering-grade retro-reflective material with signboards constructed from -**	
612.01.01	Aluminium sheet (2,0 mm thick) with an -	
612.01.01.01	Area not exceeding 2 m^2	square metre (m^2)
612.01.01.02	Area exceeding 2 m^2 but not 10 m^2	square metre (m^2)
612.01.01.03	Area exceeding 10 m^2	square metre (m^2)
612.01.02	Aluminium extrusions (type indicated) all sizes	square metre (m^2)
612.01.03	Sheet steel (Chromadek) with an :	
612.01.03.01	Area not exceeding 2 m^2	square metre (m^2)
612.01.03.02	Area exceeding 2 m^2 but not 10 m^2	square metre (m^2)
612.01.03.03	Area exceeding 10 m^2	square metre (m^2)

The unit of measurement shall be the square metre of completed traffic-sign surface area.

The tendered rates shall include full compensation for the provision of the completed sign board, frame and fixing brackets, including painting, galvanizing if specified, reflective lettering, symbols, legend and border, attaching the traffic-sign board to the sign support, and for all other materials and workmanship, brackets, bolts, nuts, etc, for the completion of the sign-board faces as specified.

For payment purposes a distinction shall be made between traffic-sign boards made from the various materials specified.

Item		Unit
612.02	**Extra over item 612.01 for -**	
612.02.01	Background of retro-reflective material of -	
612.02.01.01	Engineering grade	square metre (m^2)
612.02.01.02	High-intensity grade	square metre (m^2)
612.02.01.03	Super-engineering grade	square metre (m^2)
612.02.02	Lettering, symbols and borders of retro-reflective material of -	
612.02.02.01	High-intensity grade	square metre (m^2)
612.02.02.02	Super-engineering grade	square metre (m^2)

The area measured for payment shall be the full area of the sign face as measured in item 612.01.

The tendered rates paid extra over items 612.01.01, 612.01.02 and 612.01.03 shall be in full compensation for the additional cost of supplying retro-reflective background, symbols, lettering and borders of the types specified in each case.

Item		Unit
612.03	**Sign supports**	
612.03.01	Structural steel	ton (t)

The unit of measurement for structural-steel supporting structures shall be the ton of structural steel used. Bolts and other accessories used in the structure shall not be measured separately and their cost shall be deemed to be included in the rates tendered for structural steel.

612.03.02	Steel tubing	ton (t)

The unit of measurement for supporting structures manufactured from steel tubing shall be the ton of pipes used. Bolts and other accessories shall not be measured separately and their cost shall be deemed to be included in the rates tendered for structural steel.

612.03.03	Timber (diameter and type indicated)	metre (m)

The unit of measurement for timber supporting structures shall be the metre of each diameter post used. Bolts and other accessories shall not be measured separately and their cost shall be deemed to be included in the rates tendered for structural steel.

The tendered rates for sign supports shall include full compensation for the manufacture and erection of the supporting structures, including all bolts, screws, rivets, welding and accessories, together with the painting required, and for the provision of break-away holes in timber supports.

Item		Unit
612.04	**Extra over items 612.03.01 and 612.03.02 for providing**	
612.04.01	Unpainted galvanized steel members	ton (t)
612.04.02	Painted galvanized steel members	ton (t)

The tendered rates paid extra over items 612.03.01 and 612.03.02 shall be in full compensation for the additional costs of providing the treatment specified.

Item		Unit
612.05	**Excavation and backfilling for sign supports**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of excavation measured in place according to the neat dimensions of the footing or excavations as shown on the Drawings or directed by the Engineer. In the case of timber poles not in concrete, the plan area of the excavated hole shall be taken as 0,16 m^2, regardless of the actual size of the excavated hole.

The tendered rate shall be in full compensation for excavating, backfilling and compacting the backfill material, for the disposal of all surplus excavated material and for the supplying of backfill material and mixing it with cement.

Item		Unit
612.06	**Dismantling, storing and re-erecting traffic signs with a surface area of -**	
612.06.01	Up to 2 m^2	number (No)
612.06.02	Over 2 m^2 but not exceeding 5 m^2	number (No)
612.06.03	over 5 m^2 but not exceeding 10 m^2	number (No)
612.06.04	over 10 m^2 but not exceeding exceeding 15m^2	number (No)
612.06.05	etc, in steps of 5 m^2	

The unit of measurement shall be the number of signs of each size group dismantled and re-erected.

The tendered rates shall include full compensation for dismantling the traffic signs and supporting structures, storing and transporting the material to the new site, and the re-erection of the signs.

Payment for excavations, new material and concrete required for re-erection shall be made under the appropriate item, and any repairs and repainting shall be paid for as extra work. No separate payment shall be made for new bolts and nuts required for re-erection, and the cost thereof shall be included in the rates tendered above.

Note:

The following items of work, when specified, shall be carried out, measured and paid for in accordance with the appropriate sections of the Specifications, but shall be listed under this section in the Schedule of Quantities.

Item		Applicable section
(a)	Formwork for sign footings	702
(b)	Steel reinforcement for sign footings	703
(c)	Concrete in sign footings	704
(d)	Overhead traffic sign supports	809

SERIES 6 : ROADS AND PARKING AREAS

SECTION 613 : TRAFFIC MARKINGS

CONTENTS

01 SCOPE

This section covers the permanent marking of road and parking area surfaces with white or yellow painted lines or symbols and the supplying and fixing of retro-reflective road studs as indicated on the Drawings or where required by the Engineer.

02 MATERIALS

02.01 Paint

(a) Road-marking paint

Road-marking paint shall comply with the requirements of SANS 731 parts 1 and 2.

Premix glass bends shall comply with the requirements of SANS 51424.

Drop on material such as glass beads, anti-skid aggregates and mixtures of the two shall comply with the requirements of SANS 51423.

The paint shall be delivered to the Site in sealed containers bearing the name of the manufacturer and the type of paint.

The viscosity of the paint shall be such that it can be applied without thinning.

(b) Retro-reflective road-marking paint

Retro-reflective paint shall comply with the requirements of SANS 731 parts 1 and 2.

(c) Proprietary brand road-marking paint

If specified in the Project Specifications, proprietary brand plastic road-marking materials shall be used.

(d) Colour

The colours to be used shall be bright white or yellow.

The colour of the yellow paint shall match colour Number B49 (golden yellow) in SANS 1091.

02.02 Road studs

Road studs shall be of the size and type indicated on the Drawings, specified in the Project Specifications or listed in the Schedule of Quantities and shall comply with the relevant requirements of SANS 1442.

The Contractor shall submit samples of the type of road studs he proposes to supply to the Engineer for his approval prior to delivery. All studs subsequently used shall be of a quality equal to or better than that of the sample.

03 WEATHER LIMITATIONS

Road-marking paint shall not be applied to a damp surface or at temperatures lower than 10°C, or when, in the opinion of the Engineer, the wind strength is such that it may adversely affect the painting operations.

04 MECHANICAL EQUIPMENT FOR PAINTING

The equipment shall consist of an apparatus to clean the surface, a mechanical road-painting machine and all additional hand-operated equipment necessary to complete the work. The mechanical road-marking machine shall be capable of painting at least two lines simultaneously and shall apply the paint to a uniform film thickness at the rate of application specified hereafter. The machine shall be so designed that it will be capable of painting the traffic markings to a uniform width with sides within the tolerances specified hereafter, without the paint running or splashing. The machine shall further be capable of painting lines of different widths by adjusting the spray jets on the machine or by attaching additional equipment to the machine.

The machine shall be capable of spraying at a speed of not less than 5,0 km/h.

05 SURFACE PREPARATION

Traffic markings shall be applied to bituminous surfaces only after sufficient time has elapsed to ensure that the painted surface will not be damaged by volatile substances evaporating from the bituminous surfacing. In no case shall traffic markings be applied until at least 2 weeks after the completion of the bituminous surfacing or after any longer period required by the Engineer has expired.

Before the paint is applied, the surface shall be clean and dry and completely free from any soil, grease, oil, acid or any other material which will be detrimental to the bond between the paint and the surface. The portions of the surface where the paint is to be applied shall be properly cleaned by means of watering, brooming or with compressed air if required. Where road markings are to be made on a concrete pavement, all laitance and loose curing compound shall be removed. Particular care shall be taken to expose a surface of fresh concrete on all areas where road studs are to be fixed.

06 SETTING OUT OF TRAFFIC MARKINGS

The lines, symbols, figures or marks shall be set out by means of paint spots of the same colour as that of the proposed final lines and marks. These spot marks shall be at such intervals as will ensure that the traffic markings can be accurately applied, and in no case shall they be more than 1,5 m from each other. Normally spots with a diameter of approximately 10 mm should be adequate.

The dimensions and positions of traffic markings shall be as shown on the Drawings or as specified in the National Road Traffic Act, (Act 93 of 1996) and its Regulations and the South African Road Traffic Signs Manual. After spotting, the positions of the proposed road markings such as dotted lines and the starting and finishing points of barrier lines shall be indicated on the road.

These premarkings must be approved by the Engineer before any painting operations may be started.

The positions and outlines of special markings shall be set out in chalk on the finished road and must be approved by the Engineer before they are painted. The use of approved templates will be permissible on condition that the positioning of the markings is approved by the Engineer before painting is commenced.

The position of road studs shall be marked out on the road and shall be approved by the Engineer before they are fixed in position.

07 APPLICATION OF PAINT

The paint shall be applied as figures, signs, letters, symbols, broken or unbroken lines or other marks, as shown on the Drawings or directed by the Engineer.

Paint applied with a machine shall be applied in one layer. Before the road-marking machine is used on the permanent Works, the satisfactory working of the machine shall be demonstrated on a suitable site which is not part of the permanent Works. If adjustments are made to the machine, further testing must be done. Only when the machine has been correctly adjusted, and its use has been approved by the Engineer after testing, may the machine be used on the permanent Works. The operator shall be experienced in the use of the machine.

After the machine itself has been satisfactorily adjusted, the rate of application shall be checked and adjusted, if necessary, before painting on a large scale is commenced.

Where two or three lines are required next to each other, the lines shall be made simultaneously with the same machine. The paint shall be stirred before application, in accordance with the manufacturer's instructions. The paint shall be applied without thinners being added.

Where, under special circumstances, painting is done by hand, two layers of paint shall be applied. The second layer shall not be applied before the first layer has dried out sufficiently. As most road-marking paints react with the bitumen surface of the road, the paint shall be applied with only one stroke of the brush or roller at any one point on the road.

Ordinary road-marking paint shall be applied at a nominal rate of 0,42 litre/m^2, or as directed by the Engineer, and proprietary brand paints shall be applied at the rates specified in the Project Specifications.

Road marking shall be completed before a particular section is opened to traffic. Each layer of paint shall be continuous over the whole area being painted.

08 APPLICATION OF RETRO-REFLECTIVE BEADS

Where retro-reflective paint is required, the retro-reflective glass beads shall be applied by means of a suitable machine immediately after the paint has been applied, in one continuous operation. The rate of application of the beads shall be 0,8 kg/litre of paint or any such other rate as may be indicated by the Engineer. Machines that apply the beads by gravity only shall not be used. The beads shall be sprayed onto the paint layer by means of a pressure sprayer.

09 ROAD STUDS

Road studs shall be of the types indicated on the Drawings and shall be fixed in the positions indicated and approved by the Engineer.

Before any studs are fixed, the surface shall be thoroughly cleaned as specified in clause 05. The studs shall be fixed to the road surface with an approved epoxy resin, in accordance with the manufacturer's instructions, after the road lines have been completed. Sufficient adhesive shall be used to give complete coverage of the contact area and to provide a slight excess. The road studs shall be pressed down onto the prepared area and all excess adhesive pressed out. The excess adhesive shall then be removed immediately with a suitable solvent. The studs shall be protected against impact until the adhesive has hardened.

10 TOLERANCES

Traffic markings shall be constructed to an accuracy within the tolerances given below:

10.01 Width

The width of lines and other markings shall not deviate from the specified width by more than 10 mm.

10.02 Position

The position of lines, letters, figures, arrows, retro-reflective road studs and other markings shall not deviate from the true position specified by more than 20 mm in the transverse direction, or more than 100 mm in the longitudinal direction.

10.03 Alignment of markings

The alignment of any edge of a longitudinal line shall not deviate from the true alignment by more than 10 mm in 15 m.

10.04 Broken lines

The length of segments of broken longitudinal lines shall not deviate from the specified length by more than 150 mm.

11 GENERAL

In broken lines the length of segments and the gap between segments shall be as indicated on the Drawings. If these lengths are altered by the Engineer, the ratio of the lengths of the painted section to the length of the gap between the painted sections shall remain the same. Lines shall not be painted more than 3 months before the road or parking area is opened to public traffic.

Lines on curves, whether broken or unbroken, shall not consist of chords but shall follow the correct radius.

Where plastic road-marking material is used, the Contractor shall produce an approved guarantee from the manufacturer as specified in the Project Specifications.

12 FAULTY WORKMANSHIP OR MATERIALS

If any material which does not comply with the requirements is delivered at the Site or is used in the Works, or if any substandard work is carried out, such material or work shall be removed, replaced or repaired as may be required by the Engineer and at the Contractor's own cost. Rejected traffic markings and paint that has been splashed or has dripped onto the surfacing, kerbs, structures or other such surfaces shall be removed by the Contractor, at his own cost, in such a manner that the markings or spilt paint will not again show up later.

13 PROTECTION

After paint has been applied, the traffic markings shall be protected against damage by traffic or by other causes. The Contractor shall be responsible for the erection, placing and removal of all warning boards, flags, cones, barricades and other protective measures which may be necessary in terms of any statutory regulations and/or as may be recommended in the Southern African Development Community Road Traffic Signs Manual.

14 MEASUREMENT AND PAYMENT

Item		Unit
613.01	**Road-marking paint**	
613.01.01	White lines (broken or unbroken) (width of line indicated)	kilometre (km)
613.01.02	Yellow lines (broken or unbroken) (width of line indicated)	kilometre (km)
613.01.03	White lettering and symbols	square metre (m^2)
613.01.04	Yellow lettering and symbols	square metre (m^2)
613.01.05	Traffic-island markings (any colour)	square metre (m^2)
613.01.06	Kerb markings (any colour)	square metre (m^2)

Item		Unit
613.02	**Retro-reflective road-marking paint**	
613.02.01	White lines (broken or unbroken) (width of line indicated)	kilometre (km)
613.02.02	Yellow lines (broken or unbroken) (width of line indicated)	kilometre (km)
613.02.03	White lettering and symbols	square metre (m^2)
613.02.04	Yellow lettering and symbols	square metre (m^2)
613.02.05	Traffic-island markings (any colour)	square metre (m^2)

Item		Unit
613.03	**Proprietary brand plastic road-marking material** (state particulars)	
613.03.01	White lines (broken or unbroken) (width of line indicated)	kilometre (km)
613.03.02	Yellow lines (broken or unbroken) (width of line indicated)	kilometre (km)
613.03.03	White lettering and symbols	square metre (m^2)
613.03.04	Yellow lettering and symbols	square metre (m^2)
613.03.05	Traffic-island markings (any colour)	square metre (m^2)

The unit of measurement for the painting of lines shall be the kilometre of each specified width of line, and the quantity paid for shall be the actual length of line painted in accordance with the instructions of the Engineer, excluding the length of gaps in broken lines.

The unit of measurement for lettering, symbols or traffic-island markings shall be the square metre, and the quantity to be paid for shall be the actual surface area of lettering, symbols or traffic-island markings painted.

The tendered rate per kilometre or per square metre, as the case may be, for the painting of traffic markings shall include full compensation for procuring and furnishing all materials, including the retro-reflective beads in the case of retro-reflective paint, for the necessary equipment, for painting, protecting and maintenance as specified, including the setting-out of lettering, symbols and traffic-island markings, but shall exclude the setting-out and premarking of lines.

Item		Unit
613.04	**Variation in the rate of application**	
613.04.01	White paint	litre (ℓ)
613.04.02	Yellow paint	litre (ℓ)
613.04.03	Glass beads	kilogram (kg)
613.04.04	Proprietary brand plastic paints	litre (ℓ)

The unit of measurement for variation in the rate of application of paint and glass beads shall be the litre and kilogram respectively.

Payment for variations shall be made as specified in clause 28 of section 001.

Item		Unit
613.05	**Road studs** (type stated)	number (No)

The unit of measurement for road studs shall be the actual number of approved road studs placed.

The tendered rate shall include full compensation for procuring and furnishing all the necessary material, labour and equipment, and for fixing and maintaining as specified.

A distinction shall be made between various types of road studs.

Item		Unit
613.06	**Setting out and the pre-marking of lines (excluding traffic-island markings, lettering and symbols)**	kilometre (km)

The unit of measurement for setting out lines shall be the kilometre of lines set out and marked. Where two or three lines are to be made next to each other, the setting-out of the lines shall be measured only once.

The tendered rate shall include full compensation for setting out and pre-marking the lines as specified, including all materials.

SERIES 6 : ROADS AND PARKING AREAS

SECTION 614: MACADAM LAYERS

CONTENTS

01 SCOPE

This section covers the construction of Macadam type base. Macadam pavements consist of high quality layers constructed with single-sized 13 mm to 53 mm aggregate, which is stabilised by filling the voids with a suitable material.

Drybound Macadam (DM). The coarse aggregate first needs to be interlocked using appropriate rollers. Cohesionless fine filler is then vibrated into the voids without the use of water.

Waterbound Macadam (WM). The coarse aggregate also needs to be interlocked using the appropriate rollers whereafter water may be used to slush the filler into the voids. The filler may be slightly plastic.

Penetration Macadam (PM). Interlock of the coarse aggregate needs to be achieved using the appropriate rollers whereafter a hot tar or bitumen is poured over the coarse aggregate layer coating the large aggregates. The voids are not filled completely by the tar or bitumen.

Slurrybound Macadam (SM). The coarse aggregates are only orientated by means of light pedestrian type rollers or plate compactors. A slurry, produced from sand and bitumen emulsion, is forced into the voids between the coarse aggregate until the voids are filled using the same light pedestrian type rollers. The slurrybound Macadam may also be applied as surfacing.

Composite Macadam (CM). Consists of a lower portion of dry- or waterbound Macadam and a top portion of slurrybound Macadam.

02 MATERIALS

02.01 Water- and drybound Macadam layers

(a) Coarse aggregate

Coarse aggregate for a Macadam base layer shall have been derived from hard, sound, durable rock. It shall not contain any deleterious materials such as clay, shale, mica, etc, and shall conform to the following requirements:

(i) The aggregate crushing value (ACV) shall not exceed 29% for base aggregate when determined in accordance with TMH1 method B1.

(ii) The flakiness index shall not exceed 35% for base coarse aggregate when determined in accordance with TMH1 method B2.

(iii) The percentage of soluble salts, when tested in terms of electrical conductivity (EC), shall have an EC value less than 0,15 Sm^{-1}. Where the EC value is greater than 0,15 the pH value shall be determined and where the pH is less than 6 the material shall be treated with lime until the pH is greater than 10.

Where the pH is above 6 the material may be used but special attention should be given to cover the freshly compacted layer within 12 hours after completion with the overlaying layer (or prime coat) to prevent evaporation and salt crystallisation.

Where the salinity of the water used for construction purposes is so high as to cause a considerable increase in the salinity of the material, the Engineer shall be entitled to determine the soluble salinity from samples taken from the compacted layer within 24 hours and before the prime coat is applied. He may then suspend the use of such water source.

(iv) Grading requirements:

The grading of the coarse aggregate for the base shall conform to the following limits:

Sieve size (mm)	Percentage by mass passing				
	53 mm	37 mm	26,5 mm	19,0 mm	13,2 mm
75	100				
53	85 - 100	100			
37,5	35 - 70	85 - 100	100		
26,5	0 – 15	0 - 50	85 - 100	100	
19,0	0 - 5	0 - 25	0 - 30	85 - 100	100
13,2		0 - 5	0 - 5	0 - 30	85 - 100
9,5				0 - 5	0 - 30
4,75					0 - 5
0,075					

(b) Fine aggregate

Fine aggregate used as filler for the Macadam base layer shall consist of material approved by the Engineer and which can be vibrated in dry (dry-bound) or slashed and vibrated (waterbound) to fill the voids of the compacted coarse aggregate. It shall conform to the following requirements:

(i) Liquid Limit (LL) shall not exceed 25% when tested in accordance with TMH1 method A2.

(ii) Linear Shrinkage (LS) shall not exceed 4% when tested in accordance with TMH1 method A4.

(iii) Plasticity Index (PI) shall not exceed 10% when tested in accordance with TMH1 method A3.

(iv) A maximum size of 4,75 mm and the percentage of the material passing a sieve of nominal aperture size 0,075 mm shall not exceed 12%.

(c) Combined density of coarse and fine aggregate:

Compaction of coarse aggregate shall continue until the coarse aggregate has been thoroughly compacted to “lock-up” condition, until there is no further movement of the aggregate under the compactors and until the condition of the layer is acceptable. Thereafter the fine aggregate shall be washed and vibrated into the voids until the voids are full. The layer shall be compacted to a minimum density of 86% of apparent relative density (ARD - COLTO 8108(b)).

The field densities shall be determined by means of Rondavel test method (TMH1 method ST11). A minimum of four density tests must be conducted per linear kilometre or per contract.

02.02 Slurry-bound Macadam layers

(a) Coarse aggregate

Coarse aggregate for slurry-bound Macadam layers shall have been derived from hard, sound, durable rock and shall conform in all respects to the requirements of coarse Macadam aggregate as listed in clause 02.01(a). The specified grading and ACD for the various layer thicknesses must conform to the Table below.

(b) Fine aggregate for slurry

The aggregate for slurry shall be an approved crusher sand obtained from a parent rock having an ACV not exceeding 30 or a mixture of crusher sand and clean natural sand, where the mixture does not contain more than 25% of natural sand.

The aggregate shall be clean, tough, durable, angular in shape and shall conform to the grading requirements tabled below. The Engineer will order the grade of the fine aggregate required.

Sieve Size (mm)	Percentage passing by mass					
	Fine grade			Medium grade		
6,7				100		
4,75	100			82 - 100		
2,36	90 - 100			56 - 95		
1,18	65 - 95			37 - 75		
0,6	42 - 72			22 - 50		
0,3	23 - 48			15 - 37		
0,15	10 - 27			7 - 20		
0,075	4 -12			4 - 12		
Appropriate layer thick-ness (mm)	25	30	75 (top part)	40	50	75 (bottom part)

The sand equivalent according to TMH1 method B19 shall be 35 minimum.

To ensure proper adhesion, the immersion index of briquettes made with slurry aggregate and 80/100 penetration-grade bitumen shall not be less than 75 when tested in accordance with method C5 of TMH1.

(c) Bitumen binder

The bitumen binder shall be either a 60% anionic emulsion (SANS 309) or a 60% cationic emulsion (SANS 548).

(d) Cement and blast-furnace cement (CEM III) shall comply with the requirements of SANS 50197-1. Only one of the above materials shall be used throughout, as alternative usage will produce undesirable colour differences in the surface.

(e) Slurry mix design

The Contractor shall, at least two weeks before production of the slurry, submit to the Engineer samples of the aggregate, fillers and binders he proposes to use in the mix together with his proposed mix design so that the Engineer may test the materials and if he is satisfied that it meets the specified requirements, confirm the use of the proposed mix.

The penetration and final slurry shall have a stability of not less than 7,0kN, a flow above 2 mm but not more than 6 mm, a void content between 2 and 6% and an immersion index of not less than 75. Test specimens of slurry briquettes for the modified Marshall test shall be prepared in accordance with TB-148 (included in TB-1990) of the International Slurry Surfacing Association.

The slump test for production control of the slurry shall be in accordance with test method CPA/C1. “The determination of the consistency of unmodified slow setting bituminous slurry mixes”.

A flow between 30 and 40 mm should be adequate for slurry mixes to be penetrated or placed by hand.

The following proportions shall apply for tendering purposes only:

- Slurry aggregate $1m^3$
- Binder 240 litre/m^3
- Cement (by mass if required) 1%
- * Water - to achieve specified consistency

  * Note : Moisture in aggregate must be taken into account.

(f) Density requirements

The layer shall be compacted to 90% of maximum theoretical relative density (MTRD - TMH 1 - method C4)

03 REQUIREMENTS BEFORE ANY MACADAM LAYER IS CONSTRUCTED

Before any Macadam layer is constructed, the following requirements shall be met:

- The existing subbase must be broomed and cleaned of all loose material.
- Any damage to the subbase for example potholes must be rectified.
- The Macadam layer shall be supported along the other edge during construction by placing the permanent kerbs or, alternatively, approved side forms such as re-usable hollow metal sections. Alternatively, the adjacent shoulder shall be completed before the Macadam layer is constructed.
- No Macadam layer shall be rolled if the underlying layer, either on account of rain or by any other cause, is so wet as to constitute a danger of the underlying layers being damaged.

04 CONSTRUCTION

Crushed stone Macadam material complying with the requirements specified above shall be dumped in quantities sufficient to ensure that the completed layer will comply with all the requirements with regard to layer thickness, level, cross-section and density. Allowance shall also be made for sufficient extra material to enable the layer to be properly formed.

The Engineer may order that the Macadam layer be constructed in two or more layers, each layer with its different aggregate size. In such cases each layer shall be dumped, spread and compacted before the next layer is placed so that the combined layer will conform to the specified requirements.

The maximum thickness of any Macadam layer compacted in one process shall be 85 mm. Further, where the thickness of a single-sized aggregate base exceeds 85 mm, the Macadam layer shall be constructed in two layers of equal thickness.

The crushed stone material shall be placed to the correct thickness and level and thoroughly compacted by vibrating plate compactors or double-drum walk behind vibrating rollers.

The minimum total centrifugal force of the vibrating compactor shall be 1 500 kg. Compaction shall be continued until the coarse aggregate has been thoroughly compacted to "lock-up" condition, until there is no more movement of the aggregate under the compactors, and until the condition of the layer is acceptable.

04.01 Water-bound or dry-bound Macadam

The water- or dry-bound Macadam layer shall be constructed by hand methods.

(a) Dry-bound

After the shaped and compacted coarse aggregate layer has been approved, a layer of air-dry filler material of thickness about 20 mm shall be evenly spread over the surface of the coarse aggregate. The layer shall then be rolled with a vibrating roller to work the filler material into the voids of the coarse aggregate. The process of spreading and working in further layers of filler material shall be repeated until no more filler can be worked into the voids in the coarse aggregate.

(b) Water-bound

When the filler can not be worked dry, the layer shall be watered. Watering, rolling and sweeping with suitable brooms shall be carried out and extra filler added as necessary, until the voids in the coarse aggregate have been completely filled with filler and a firm base with a closely knit surface is obtained, free from areas of segregated materials, loose aggregate and other irregularities. Care shall be taken not to over-water the aggregate and by doing so soften the supporting layer. All excess fines shall be swept off and the base allowed to dry out to present an exposed mosaic of regular stone faces, free of fine aggregate and foreign material. When it is necessary to enable excess slushed fines and water to be removed to prevent saturation of the base layer, the Contractor shall provide temporary openings in the confining structure and make good the openings when the operation has been completed.

The finished layer shall be true to level and cross-section, uniform and smooth, free from corrugations, humps and depressions and shaped to within the tolerances specified in clause 06.

04.02 Slurry-bound Macadam

The slurry-bound layer shall be constructed using hand methods.

The slurry for constructing the slurry-bound Macadam shall conform to the requirements of clause 02.02. No penetration slurry shall be laid when the air temperature is less than 10°C, and in any event not during rain or when free water is present.

After the shaped and compacted coarse aggregate layer has been approved, a layer of penetration slurry shall be placed evenly over the surface. The slurry shall be mixed by hand using the correct proportion specified, or as instructed by the Engineer. If the Contractor can not produce a proper mix by hand then the Engineer may order him to use an approved concrete mixer. The slurry shall then be spread using hand tools such as rakes, squeegees, etc.

The slurry squad shall spread each batch over the Macadam base. The slurry shall be worked from side to side and criss-cross with the aid of squeegees so as to fill as many spaces and voids as possible. The Macadam base and penetration slurry shall then be worked with a plate or drum vibrating so that the slurry penetrates into the voids of the coarse aggregate. Maneuvering of the plate vibrator compactor needs to be done carefully with no turning on the wet slurry. Turning maneuvers to be done on the adjacent ballast or completed sections.

The process of spreading, vibrating and working in further layers of slurry shall be repeated until no more slurry can be worked into the voids in between the coarse aggregate of the Macadam base. The completed base shall be firm with a close-knit surface, free from areas of segregated materials, loose aggregate and other irregularities. All excess slurry shall be swept off and the base allowed to dry out to present an exposed mosaic of regular stone faces, free of fine aggregate and foreign material. The surface shall be free from tear cracks, corrugation, rutting, depressions, undulations, etc, and shaped to within the tolerances specified in clause 06.

04.03 Composite Macadam

The composite Macadam base shall be constructed using hand methods.

The composite Macadam layer shall consist of a bottom part using normal Macadam layers (dry- or water-bound) and an upper part consisting of a slurry-bound Macadam.

The normal Macadam layer (dry- or waterbound) shall be constructed as specified in clause 04.01 and to the thickness and levels specified on the drawings or as directed by the Engineer. The surface of the thus completed Macadam (dry- or waterbound) shall then be broomed to remove the filler sand to a depth between 5 mm and 10 mm. The thus removed material shall leave adequate space for slurry-bound Macadam to be keyed into and shall be to the approval of the Engineer.

An overlaying slurry-bound Macadam shall then be constructed as specified in clause 04.02 and to the thickness and levels specified on the drawings or as directed by the Engineer. The capping slurry-bound Macadam shall be properly worked, vibrated and keyed into the underlying normal Macadam base until there are no voids left within the composite layer.

The completed surface of the composite Macadam shall be free from tear cracks, corrugations, rutting, depressions, undulations, etc, and shaped to within the tolerance specified in clause 06.

04.04 Final slurry layers

It may be specified that the completed Macadam base be sealed with a slurry seal. A final slurry shall then be applied in accordance with the TRH3 requirements.

The materials and mix designs shall conform to the specified requirements as listed in clause 02.02.

A moist burlap drag shall be drawn over the final slurry to ensure an overall and even texture. The burlap will be dragged perpendicular across the centreline of the road. Should breaking of the emulsion, segregation of the mix or formation of lumps occur during the application of slurry, the slurry operations shall be discontinued at once and any defective material removed from the road. Successive strips of slurry shall overlap transversely by not less than 25 mm or more than 150 mm. Any overlapping and any omitted areas shall be rectified with squeegees. The Contractor shall ensure that either edge of the slurry is finished to the prescribed widths and lines. All stones dislodged in the process of applying the slurry shall be removed on the same day on which the slurry seal has been applied. All spillage of slurry or excess slurry shall be neatly removed from the road and spoiled.

Where slurry is spread by hand, the slurry squad shall complete the spreading of each batch onto the road, using squeegees before the next is discharged. The slurry shall be worked from side to side and criss-cross with the aid of squeegees so as to fill as many spaces as possible.

The finished slurry layer shall present a smooth, dense and homogenous surface, true to level and camber on cross fall and free from tear cracks, corrugation, rutting or any other irregularity. It shall be free from depression or elevations and when a straight edge two metres long is laid on the treated surface parallel or at right angles to the centreline of the road, the surface shall nowhere vary from the lower edge by more than 3 mm along the treated area. The outer edge of the slurry shall be formed neatly in a straight line to the widths ordered by the Engineer.

No slurry shall be laid when the air temperature is less than 10°C and in any event not during or when free water is standing on the surface.

04.05 General

(a) Kerbs and gutters

Care shall be taken during rolling to ensure that concrete edging, kerbs and gutters already laid are not displaced or damaged. Care shall be taken to protect all kerbing and guttering from slurry or bitumen spray by covering it with suitable protective material during construction. Any concrete edging, kerbs or gutters spoiled or damaged during construction shall immediately be replaced or repaired by the Contractor at his own expense.

(b) Excess crushed stone material

Excess crushed stone material shall not be spread over the shoulder or side fills, but shall be loaded and removed from the road. It shall not be re-used unless it has been re-screened, re-tested and again approved for use.

It shall not be mixed with approved material unless screened, tested and again approved for use on its own.

(c) At junctions with existing bituminous surface, the new base shall not be feathered-off to obtain continuity of grade, but the existing work in the vicinity of the joint shall be cut back so as to ensure a full depth compacted Macadam base.

(d) Drainage of Macadam base

The construction of waterbound Macadam layers shall always be from a high point downwards to ensure proper drainage of the layer during construction.

Permanent drainage of Macadam layers must be provided at the lowest point of vertical curves, where Macadam layers meet impermeable pavement layers, at catchpits, etc. Such drains shall consist of an approved geotextile or 12 mm drainage pipes installed on top of the subbase layer underneath the kerb, all as shown on the Drawings or directed by the Engineer.

Such drains shall be constructed, measured and paid for in accordance with Section 501 of these Specifications.

05 PROTECTION AND MAINTENANCE

The Contractor shall protect and maintain the completed Macadam layer at his own expense until the surfacing is applied. Maintenance shall include the immediate repair of any damage to or defects in the layer and shall be repeated as often as is necessary. Repairs shall be made so as to ensure an even and uniform surface to be restored after completion of the repair work. Heavy traffic shall not be allowed directly on any layer for at least two days, or any other period which the Engineer may authorised.

06 CONSTRUCTION TOLERANCES

The completed crushed stone layer shall comply with construction tolerances in clause 601.05. However, the limits for surface regularity specified under clause 601.05.06 shall be relaxed to 10, 15 and 10 for sub-paragraph (a), (b) and (c) respectively.

07 ROUTINE INSPECTION AND TESTS

Routine inspections and tests will be made by the Engineer to determine whether the quality of material and workmanship complies with the requirements of this section.

08 MEASUREMENT AND PAYMENT

Item		Unit
614.01	**Cleaning of subbase**	square metre (m^2)

The unit of measurement shall be the square metre of cleaned subbase. The tendered rate shall include full compensation for removing all loose material, brooming, removal and spoil.

Item		Unit
614.02	**Macadam base constructed from crushed stone aggregate obtained from commercial sources, including the filler sand and slurry:**	
614.02.01	**Dry- or waterbound Macadam**	
614.02.01.01	(Thickness indicated in mm)	square metre (m^2)
614.02.01.02	Etc. for other thicknesses	square metre (m^2)
614.02.02	**Slurry-bound Macadam**	
614.02.02.01	(Thickness indicated in mm)	square metre (m^2)
614.02.02.02	Etc for other thicknesses	square metre (m^2)

The unit of measurement for this item shall be the square metre of completed Macadam base in place and compacted to the specified requirements. The quantity shall be calculated from the specified dimensions of the layer as shown on the Drawings or according to cross-section levels or prescribed by the Engineer. Measurement of a composite Macadam base shall distinguish between the lower dry- or water-bound portion and upper slurry-bound portion of the composite layer.

The tendered rate for this payment item shall include full compensation for procuring, finishing and placing all materials including the crushed aggregate and filler, crusher sand, penetration slurry (including sand and emulsion), for hauling the material over an unlimited free-haul distance, for rolling, slurring, applying bitumen emulsion at the specified rated, correcting the layers, mixing, placing, compacting, finishing, as well as process control testing, protecting and maintaining the work as specified.

Item		Unit
614.03	**Bituminous binder and cement variation**	
614.03.01	Anionic emulsion (60% bitumen)	litre (ℓ)
614.03.02	Cationic emulsion (60% bitumen)	litre (ℓ)
614.03.03	Cement	ton (t)

The unit of measurement in respect of variations shall be the litre of binder measured at mixing temperature and the ton of cement from that specified in the nominal mix. Payment for variations shall be made as specified in clause 28 of Section 001.

Item		Unit
614.04	**Slurry variations for slurry-bound Macadam**	

The unit of measurement of slurry in item 614.04 in respect of an increase or decrease in the specified rates of applications shall be the cubic metre of slurry used in comparison with a nominal rate of 0.046 m^3/m^2. for a 150 mm thick base layer. Should a thinner or thicker base layer be called for, then the nominal rate will be increased or decreased in direct proportion. Payment for variations shall be made as specified in clause 28 of Section 001.

Item		Unit
614.05	**Final slurry using 60% emulsion binder**	
614.05.01	(Thickness indicated in mm)	square metre (m^2)
614.05.02	Etc for other thicknesses	square metre (m^2)

Note: Payment for the penetration slurry in the slurry-bound Macadam base is not included under this item, but under item 614.02.02. Payment for the final slurry seal on top of the Macadam base falls under this item.

The unit of measurement shall include full compensation for procuring and furnishing the binder, active filler, other authorised chemicals, water and all other materials for mixing and constructing the slurry, trail sections, curing, rolling, furnishing, demarcating areas and for all plant labour, handwork and incidentals necessary to complete the work as specified.

Item		Unit
614.06	**Repairing portholes and damaged areas in the existing subbase**	
614.06.01	Chemical stabilized gravel with (percentage indicated) % cement	cubic metre (m^3)
614.06.02	Slurry with aggregate	cubic metre (m^3)

The unit of measurement for repairing potholes and damaged areas in the existing subbase shall be the cubic metre of chemically stabilized gravel or slurry with aggregate placed in accordance with the specified requirements. The quality will be computed in accordance with the authorized dimensions of the layer and as specified by the Engineer.

The tendered rate shall include full compensation for providing the gravel material (G5 quality), stabilizing agent, for all mixing, placing, compacting the gravel to 93% Mod AASHTO density and finishing the area in accordance with the required lines and levels. The tendered rate shall also include full compensation for excavating the existing subbase, cleaning the area of loose material and disposing thereof as specified.

SERIES 7 : STRUCTURES

SECTION 701 : FOUNDATIONS FOR STRUCTURES

CONTENTS

01 SCOPE

This section covers the foundation work for all structures except prefabricated culverts and pipes, and it also covers excavations to accommodate structures and for the founding of structures, as well as dewatering, cofferdams, backfilling, foundation fill, grouting, etc.

Piling is covered under section 807.

02 MATERIALS

02.01 Rock for foundation fill

Rocks shall be hard, angular, field or quarry rocks of a quality that will not disintegrate upon exposure to water or the weather. The rocks shall be free from overburden, shale, organic and other deleterious material. The width and thickness of any rock shall each be at least one third of its length. The average mass of a single rock shall be as specified in the Project Specifications. Not more than ten per cent of the total volume of a rock fill shall consist of rocks with a mass of less than half the mass specified and not more than ten per cent of the volume of rock fill shall consist of rocks with a mass of more than five times the mass specified. At least fifty per cent of the total volume of a rock fill shall consist of rocks with a mass greater than the specified mass.

02.02 Crushed stone for foundation fill

Crushed stone shall be clean, hard, durable stone from approved sources. The aggregate crushing value of the stone shall not exceed 30 when tested in accordance with method Bl of TMH1. Crushed stone for foundation fill shall comply with the grading requirements as specified in the Project Specifications.

02.03 Granular material for foundation fill

Granular material shall be approved granular material of at least gravel subbase material quality.

03 GENERAL

03.01 Subsurface conditions

The Contractor shall note the provisions of the General Conditions of Contract regarding Site conditions.

If, during the course of excavation, the load-bearing strata are found to differ from those shown on the Drawings or set out in the Project Specifications, the Contractor shall immediately notify the Engineer in writing.

The Engineer shall be entitled, as often as he may deem it necessary during the course of excavation, to instruct the Contractor to make additional foundation investigations and to carry out tests at or below the founding level in order to establish safe bearing pressures and founding depths.

03.02 Stream flow

Stream flow shall be maintained and freshwater life shall be preserved at all times. Stream crossings shall be constructed without the stream flow being disrupted at the point of crossing. On completion of the work, all surplus excavated materials, materials used in cofferdams, artificial islands and other temporary works, and also in situ material, shall be removed to the original stream-bed level or from such lower level as may be specified or required by the Engineer. The Contractor shall dispose of all such materials.

04 COFFERDAMS, ARTIFICIAL ISLANDS AND DEWATERING

04.01 Cofferdams

(a) General

Where necessary, cofferdams shall be constructed in waterways, on waterlogged areas and on unstable ground to facilitate construction of the Permanent Works in the dry, to ensure the lateral stability of or to retain the surrounding material and to protect the work under construction against flooding. The Contractor shall not commence with the construction of a cofferdam until he has obtained the Engineer's written permission to do so.

Where it is impracticable to dewater a foundation excavation by pumping methods, the Engineer shall have the right to instruct the Contractor to construct a cofferdam.

(b) Construction requirements

The design and construction of cofferdams shall comply with the requirements of BS 8004 Code of Practice for foundations.

Cofferdams shall be adequately braced, weighted and anchored and shall be as watertight as may be practicable. Where ordered, a concrete foundation seal of an approved thickness shall be constructed before the cofferdam is dewatered. Cofferdams shall be vented so that the water level inside the cofferdam will never be higher than the water level on the outside.

(c) Protection of substructure

No shoring against the permanent structure in the cofferdam shall be allowed until the concrete has reached a strength of 70% of the specified 28-day compressive strength and the method has been approved by the Engineer.

(d) Removal

Cofferdams with all sheeting and bracing shall be completely removed upon completion of the permanent work.

04.02 Artificial islands

Where required, artificial islands shall be constructed to gain access to foundation positions and to carry out foundation work.

The platform for supporting material, plant and equipment shall, where necessary, be consolidated to provide firm support. The Contractor may use any material he may deem suitable to construct the island.

On completion of the work, the Contractor shall remove the artificial island and reinstate the Site to the satisfaction of the Engineer.

04.03 Dewatering of foundation excavations

Over and above his general obligations with regard to dealing with water as specified in clause 27 of section 001, the Contractor shall be responsible for preventing the ingress of water into the foundation excavations. The preventative measures may include the construction and maintenance of intercepting and diversion berms and drainage channels, primarily along the boundaries of the foundation excavations and further supported by a grid of longitudinal and cross drainage channels within the boundaries of the excavations, with all channels effectively draining towards lower lying natural drainage routes or pumps, with all the necessary bailing and pumping equipment supplied, operated and maintained by the Contractor. The preventative measures shall ensure that the foundation excavations are dewatered sufficiently to allow the necessary construction operations to be properly executed.

The dewatering measures, with the exception of pumping, shall be maintained until the backfilling has been completed, after which all settled silt, mud, etc, shall be removed from the exposed surfaces where necessary. Between the various construction stages, pumping may be interrupted as may be decided by the Engineer. The draining or pumping of water from foundation excavations shall be done in such a way that no concrete materials will be carried away.

Where the drainage channels are filled with crushed stone, as directed by the Engineer, this stone will be measured for payment as foundation fill.

04.04 Payment

If a lump sum has been set out in the Schedule of Quantities for the dewatering of foundations and a provisional sum for the construction of cofferdams and artificial islands, the method of payment for work authorized by the Engineer shall be in accordance with the provisions of the relevant pay items of clause 13 of this section. Work not authorized by the Engineer shall not be measured for payment.

If no lump sum or provisional sum has been set out in the Schedule of Quantities, the tendered rates for foundation excavations and backfilling shall include full compensation for the construction of cofferdams and artificial islands and for the dewatering of foundations.

05 EXCAVATION

05.01 Clearing and grubbing, and topsoil

The Contractor shall not commence with the excavations for structures before he has obtained written instructions from the Engineer regarding any clearing and grubbing and any removal and stockpiling of topsoil that may be required.

05.02 Reference surface for excavation

The Contractor shall notify the Engineer in good time of his intentions to commence with a specific excavation so that the average surface level of the undisturbed ground from which the excavation is to be measured can be established and agreed on by the Engineer and the Contractor.

05.03 Excavation limits for payment purposes

For measurement and payment purposes, the limits of the excavations for structures shall be as shown on the Drawings.

Where no excavation limits are shown on the Drawings and the Engineer has decided that formwork has to be provided for the sides of a concrete member, the limits of the excavation for measurement and payment purposes shall be the vertical planes 0,6 m outside the perimeter of the concrete member for which the formwork is to be provided, and the founding level shown on the Drawings.

In suitable stable material, the excavations shall be carried out and trimmed to the neat dimensions of the concrete members shown on the Drawings or as may be directed by the Engineer so that the excavated surfaces will act as forms for the casting of the concrete.

To prevent moisture loss in the concrete where excavated surfaces act as forms for the casting of the concrete, a foundation lining shall be installed as specified in clause 12 of this section, or provided that sufficient space has been made available during excavation, an additional 50 mm of concrete cover over and above the specified cover shall be provided, all as specified on the Drawings or as directed by the Engineer.

05.04 Over-excavation

Over-excavation in hard material shall be backfilled with the same class of concrete as that in the concrete member or with mass concrete as specified or as directed by the Engineer and shall be at the Contractor's expense.

Over-excavation in soft material shall be backfilled with suitable material approved by the Engineer and shall be compacted all at the Contractor’s own expense and as directed by the Engineer.

05.05 Unsuitable material

Boulders, logs or any other unsuitable excavated material shall be taken to spoil.

Where, in the opinion of the Engineer, unsuitable material is encountered at founding level, such material shall be removed and replaced with foundation fill in accordance with the requirements of clause 09 of this section and as directed by the Engineer.

05.06 Preparation of the founding surface

Where hard material suitable for founding is encountered at the founding level, it shall be cut and trimmed to a firm surface, either level, stepped or serrated, as may be required.

Where there are indications that the material at the founding level will be soft material or hard material that will deteriorate rapidly on exposure, the excavation of the final layer with a thickness of 150 mm shall be postponed until just before the blinding layer is placed.

Where shown on the Drawings or ordered by the Engineer, excavations shall be extended to a specified depth below the undersides of the slabs and footings to make provision for the placing of a concrete blinding layer.

05.07 Classification of excavation

For payment purposes, all the material excavated for structures shall be classified as follows:

(a) Hard material

Boulders of 0,15 m^3 each or more in volume, and material that cannot be excavated except by drilling and blasting or with the use of pneumatic tools or mechanical breakers shall be classified as hard material.

(b) Soft material

All material not classified as hard material shall be classified as soft material.

05.08 Blasting

Where blasting is permitted, it shall be carried out in accordance with the requirements of clause 18 of section 001.

05.09 Deterioration of foundation excavations

Where the bottoms or sides of foundation excavations are softened as a result of negligence on the part of the Contractor in allowing stormwater or other water to enter the excavation, the softened material shall be removed and replaced with foundation fill as directed by the Engineer, at the Contractor's expense.

05.10 Excavation safety

The Contractor shall take the necessary precautions to safeguard the stability and safety of the excavations and adjacent structures.

No person's personal safety shall be placed in jeopardy, nor shall any situation be allowed to arise which may result in damage of any nature whatsoever.

All excavations shall be carried out strictly in accordance with the requirements of the Construction Regulations 2003.

05.11 Inspection

No concrete shall be placed before the Contractor has properly cleaned the excavation and it has been inspected and approved by the Engineer.

06 FOUNDING

As there may be possible variations in the anticipated founding conditions, the dimensions and founding levels specified or shown on the Drawings may have to be varied during construction.

The Engineer has full and absolute power in terms of this Contract to order such variations and to specify the actual founding level for each foundation fill and base during construction, and his decision shall be final and binding on the Contractor.

The Contractor shall not be entitled to any additional payment as a result of any such variation in the dimensions or founding depths over and above that provided in clause 13 of this section, regardless of the stage of construction at which the instruction to vary the dimensions or founding depths is given. However, if as a result of such variation order the Contractor is compelled to replace machines and equipment with other machines and equipment in order to complete the work successfully, the Engineer may, at his discretion, reimburse the Contractor for additional expenses incurred, provided that the original machines and equipment were suited to the work required prior to the variation order being issued.

No base shall be founded unless authorized by the Engineer. Each founding level shall be accurately measured and recorded.

The term "founding level" used in these Specifications shall be deemed to have the following meanings in respect of -

- foundation fill,

  the surface of the in situ material that has been prepared to receive foundation fill; and

- footings,

  the underside of the footings.

07 UTILIZATION OF EXCAVATED MATERIAL

Excavated material and material recovered from temporary work shall, in so far as it is suitable, be utilized for backfill. Material unsuitable for use as backfill or in excess of the quantity required to complete the backfill shall be spoiled or utilized as directed by the Engineer.

Excavated material not used for backfill or not taken to spoil but used in the construction of embankments or other parts of the work, as directed by the Engineer, shall be paid for under foundation excavation as well as under the relevant item for the purpose for which it is used.

No haulage shall be paid for excavated material and imported material for backfill where such material is transported within the free-haul boundaries.

Excavated and stockpiled material shall be deposited in such a manner that it will not endanger the uncompleted structure either by direct pressure or indirectly by overloading the banks contiguous to the structure, or in any other way.

08 BACKFILL AND FILL NEAR STRUCTURES

08.01 General

When placing backfill and fill, the following precautions shall be taken:

- In so far as it is practicable, the material shall be placed simultaneously to approximately the same elevation on all sides of a structure or structural member where appropriate. If conditions require that backfill or fill be placed appreciably higher on one side than on the opposite side, the additional material on the higher side shall not be placed until authorized by the Engineer and preferably not until the concrete has been in place for 14 days, or until tests show that the concrete has attained sufficient strength to safely withstand any pressure that will be created by the backfill or fill or by the method of construction.
- The material behind structural members restrained at the top by the superstructure, e.g. portal-type structures, shall be placed as stated on the Drawings or as directed by the Engineer.
- The material behind the walls of concrete culverts shall not be placed until the top slab has been placed and cured, unless otherwise authorized by the Engineer.

08.02 Backfill

Excavated areas around structures, between the structure and the vertical walls of the surrounding excavation, shall be backfilled with approved material in horizontal layers not exceeding 150 mm in depth after compaction, to the level of the original ground surface or to the level specified on the Drawings. Each layer shall be moistened or dried to the optimum moisture content for the material and be compacted to a density of not less than 90% of modified AASHTO density, except in a road prism, where the material shall be compacted to a density of not less than 93% of modified AASHTO density.

In cases where structures are founded on backfill material, the density shall be as specified in the Project Specifications, but shall not be less than 95% of modified AASHTO density.

08.03 Prevention of wedge action

Before the fill in the space between a structure and any adjacent sloping fill and the backfill between a structure and the sloping sides of the surrounding excavation is constructed, the slope of the fill and of the sides of the excavation shall be benched or serrated in order to prevent wedge action between the structure and the fill or the sides of the excavation during backfilling and compaction.

The distance between the exposed face of the structure and the toe of the fill or excavation side shall be sufficient to allow proper compaction.

08.04 Fill within restricted area

The portion of the fill within 3 m of the concrete faces of the structure and other portions of the fill shall be termed "fill within restricted area" only when designated as such on the Drawings.

Fill within the restricted area shall comply with the requirements of clause 10 of section 203, except that it shall be compacted to a density of not less than 93% of modified AASHTO density. In order to achieve the specified density, the Contractor shall, where necessary, import material of suitable quality.

Payment in accordance with item 701.06 for the construction of fill within restricted areas shall be made only in respect of fill designated as "fill within restricted areas" on the Drawings.

09 FOUNDATION FILL

If, during the course of excavation, it is found that the material at the indicated founding depth does not have the required bearing capacity as specified on the Drawings, the excavations shall be extended at the discretion of the Engineer until satisfactory founding material is encountered. The Engineer may then order the Contractor to make up the difference in levels with foundation fill.

Where the foundation fill consists of rock or crushed stone, it shall be constructed in accordance with the requirements of the Project Specifications or as directed by the Engineer.

Foundation fill consisting of granular material shall comply with the requirements specified in section 601 for subbase and shall be constructed in layers not exceeding 150 mm in thickness after compaction. Each layer shall be moistened or dried to optimum moisture content for the material and be compacted to a density of not less than 95% of modified AASHTO density.

Mass concrete fill to be used shall be of the class or mix specified or directed by the Engineer.

Unless otherwise specified or directed by the Engineer, the foundation fill constructed with rock, crushed stone or compacted granular material shall be defined by a prism with vertical sides. The base of the prism lies in the founding plane and coincides with the base of a prismoid with trapezium-shaped sides which extend downwards and outwards at an angle of 60° with the horizontal from the outer edges of the underside of the footing down to the founding level. The upper plane of the prism lies in the plane of the underside of the footing.

Where shown on the drawings or ordered by the Engineer, a concrete blinding, 75 mm thick and of class 15/19 concrete, shall be placed underneath all footings, except where mass concrete fill is used.

Where mass concrete fill is constructed under a footing, it shall be constructed accurately to the final levels of the underside of the footing.

10 GROUTING OF ROCK FISSURES

Where specified, fissures in the rock below and around the footings shall be sealed by pressure grouting with a neat cement or sand-cement grout with a water cement ratio as agreed to by the Engineer. The extent of fissuring shall be established by water testing under pressure.

Holes of at least 40 mm in diameter shall be drilled in positions ordered by the Engineer and grout shall be pumped into these holes under suitable pressure. Grouting shall be carried out in 3 m maximum depth increments to the maximum depth ordered. Care shall be taken to avoid further fracturing of the rock strata by excessive grouting pressure.

Grouting of rock fissures shall be carried out only by specialists who are acceptable to the Engineer.

11 FOUNDATION DOWELS

Where required, foundation dowels of specified material, diameter and length shall be installed at the positions and to the dimensions shown on the Drawings or as directed by the Engineer. After exposing, clearing and trimming of the rock formation, holes of not less than 40 mm in diameter and of specified depths shall be drilled into the rock. Prior to the dowels being installed, the holes shall be cleaned by water jetting or with compressed air and shall be filled with a 2:1 sand:cement grout.

12 FOUNDATION LINING

Where specified or directed by the Engineer, foundation lining shall be installed as described hereafter. The Engineer shall have the right to order the use of lining against the sides of excavations and the underside of footings in lieu of formwork and concrete blinding.

All surfaces to be lined shall be covered with an approved sheeting to provide a clean, impervious layer. The material shall be of sufficient strength to provide a durable working surface and to support the concrete and reinforcement without tearing. The joints between strips shall have a 150 mm overlap and the lining shall be held firmly in position with nails, pegs, etc. Polyethylene sheeting with a minimum thickness of 0,150 mm is generally considered adequate for this purpose.

13 MEASUREMENT AND PAYMENT

Item		**Unit**
701.01	**Additional foundation investigations**	provisional sum

A provisional sum is allowed in the Schedule of Quantities to cover the costs of this work.

The method of payment for the work authorized by the Engineer shall be in accordance with the provisions of the General Conditions of Contract.

Item		**Unit**
701.02	**Excavation for structures**	
701.02.01	Excavation of soft material situated in the following depth ranges:	
701.02.01.01	0 m up to 2 m	cubic metre (m^3)
701.02.01.02	Exceeding 2 m up to 4 m	cubic metre (m^3)
701.02.01.03	Etc in increments of 2 m depth	cubic metre (m^3)

Item		Unit
701.02.02	Extra over subitem 701.02.01 for excavation in hard material irrespective of depth	cubic metre (m^3)
701.02.03	Extra over subitem 701.02.01 for additional excavation required by the Engineer after the excavation has been completed	cubic metre (m^3)

The limits for the successive depth ranges shall be measured down from the average surface level (subclause 05.02 of this section) to the agreed founding level (clause 06 of this section).

The unit of measurement shall be the cubic metre of material measured in the original position before excavation. The quantity of excavation for each depth range shall be calculated from the neat outlines of the excavation limits shown on the Drawings and the depth of excavation completed within each range.

Irrespective of the total depth of the excavation, the quantity of material within each depth range shall be measured and paid for separately.

Where no excavation limits are shown on the Drawings and formwork has to be provided to the sides of concrete members, an additional quantity of excavation shall be measured to 0,6 m outside the concrete perimeter to provide a working space.

Where foundation fill is constructed in an excavation, the quantity of excavated material measured for payment shall be the material excavated between the average ground surface, as described in subclause 05.02 of this section, and the average founding level, based on the horizontal dimensions of the founding surface, as described in clause 09 of this section.

In no case shall any of the following volumes of excavation be included in the measurement for payment:

- The volume of excavation in excess of the above-mentioned limits.
- The volume included within the excavated road prism, contiguous channels, ditches, etc, for which payment is provided elsewhere in the Specifications.
- The volume of water or other liquid (except the volume of mud, muck or similar semi-solid matter, which has not resulted from the construction operations and which cannot be pumped or drained away).

The tendered rates shall include full compensation for excavation in each class of material, including overbreak in hard material, the spoiling or stockpiling of material, the hauling of excavated material within the free-haul boundaries, for any additional excavation the Contractor may require for additional working space outside the authorized limits, for trimming and cleaning the bottoms and sides of excavations, and for strutting, shoring and safeguarding excavations.

If, after a foundation excavation has been completed, cleaned and trimmed ready for blinding, the Engineer orders further excavations on account of changed dimensions and/or founding conditions, an extra-over payment (subitem 701.02.03) for the additional excavation shall be payable in full compensation for any additional costs to the Contractor over and above the normal excavation costs.

Overhaul will be paid in respect of material transported to spoil or stockpile sites provided by the Employer and which lie outside the free-haul boundaries.

Item		Unit
701.03	**Cofferdams and artificial islands**	
703.03.01	Cofferdams	provisional sum
703.03.02	Artificial islands	provisional sum

The provisional sums allowed shall be expended in accordance with the provisions of the General Conditions of Contract.

Item		Unit
701.04	**Dewatering of foundation excavations**	lump sum

Dewatering will be paid for as a lump sum for each structure or series of structures scheduled separately in the Schedule of Quantities. The lump sum shall be paid on a pro rata basis as the work progresses.

The tendered lump sum shall include full compensation for all work and operations required to keep the excavations dewatered and dry and for the removal of silt and mud from the exposed concrete surfaces, all as specified in subclause 04.03 of this section.

Item		Unit
701.05	**Backfill to excavations utilizing -**	
701.05.01	Material from the excavation compacted to	
701.05.01.01	90% of modified AASHTO density	cubic metre (m^3)
701.05.01.02	93% of modified AASHTO density	cubic metre (m^3)
701.05.01.03	96% of modified AASHTO density	cubic metre (m^3)
701.05.02	Imported material compacted to -	
701.05.02.01	90% of modified AASHTO density	cubic metre (m^3)
701.05.02.02	93% of modified AASHTO density	cubic metre (m^3)
701.05.02.03	96% of modified AASHTO density	cubic metre (m^3)

The unit of measurement shall be the cubic metre of backfill material measured in the excavations. The quantity measured shall be calculated from within the neat outlines defined for the excavation under item 701.02 and the height to which the backfilling is constructed.

The height shall be determined by the upper surface of the road prism or the reference ground surface (subclause 05.02 of this section), whichever is the lower, or the specified level as shown on the Drawings.

The tendered rate for each cubic metre of backfill shall include full compensation for furnishing all materials from excavation or temporary stockpiles of excavated material or imported material, and placing all materials within the entire excavation, for transporting the material within the free-haul boundaries, and for preparing, processing, shaping, watering, mixing and compacting the material to the specified densities.

Overhaul will be paid for on material imported from beyond the defined free-haul boundaries from borrow pits provided by the Employer.

Item		Unit
701.06	**Fill within restricted areas (extra over item 203.01)**	cubic metre (m^3)

The unit of measurement shall be the cubic metre, and the quantity shall be taken as the total volume of material within the restricted area as defined in subclause 08.04 of this section. The quantity shall not include the volume of backfill, which is measured and paid for under item 701.05 above.

The tendered rate shall include full compensation for all additional work necessitated due to work being done in the restricted area and for the increased density required in the restricted area.

Item		Unit
701.07	**Foundation fill consisting of**	
701.07.01	Rock	cubic metre (m^3)
701.07.02	Crushed stone	cubic metre (m^3)
701.07.03	Compacted granular material	cubic metre (m^3)
701.07.04	Mass concrete (class indicated)	cubic metre (m^3)
701.07.05	75 mm thick blinding layer, class 15/19 concrete	cubic metre (m^3)

The unit of measurement shall be the cubic metre of approved material placed and compacted below the bases as specified or where directed by the Engineer.

The quantity of foundation fill to be measured for payment shall be the material contained by the prism specified in clause 09 of this section for the minimum foundation fill to be constructed, or otherwise the quantity constructed in accordance with the outlines on the Drawings or as directed by the Engineer.

The tendered rates shall include full compensation for procuring, furnishing, transporting, placing and compacting the material.

Overhaul will be paid for rock fill and granular fill in accordance with the provisions of section 103.

Item		Unit
701.08	**Establishing equipment on Site for the grouting of rock fissures**	lump sum

The tendered lump sum shall include full compensation for establishing on the Site and the subsequent removal of all special plant for the grouting of rock fissures, and for carrying out operations, the costs of which do not vary with the actual amount of work to be done.

This work shall be paid for as a lump sum, 75% of which will become payable when all equipment is on the Site and the first hole has been grouted, and the remaining 25% will become payable after the holes have been grouted and the equipment has been removed from the Site.

Item		Unit
701.09	**Moving equipment to and setting it up at each hole to be drilled for grouting**	number (No)

The unit of measurement shall be the number of positions to which the equipment for drilling and grouting of rock fissures has to be moved and set up in position (which shall equal the number of holes to be drilled).

The tendered rate shall include full compensation for all costs involved in moving and setting up the equipment.

Item		Unit
701.10	**Drilling of holes for grouting -** (diameter indicated)	metre (m)

The unit of measurement shall be the metre of hole drilled.

The tendered rate shall include full compensation for drilling and cleaning the holes as specified.

Item		Unit
701.11	**Grouting of holes**	kilogram (kg)

The unit of measurement for grouting shall be the mass, in kilograms, of cement used in the grouting operation.

The tendered rate shall include full compensation for providing and pumping the grout into the drilled holes as specified by the Engineer.

Item		Unit
701.12	**Dowelling into rock**	
701.12.01	Drilling and cleaning of holes	metre (m)
701.12.02	Supplying and installing dowel bars (type and size indicated)	kilogram (kg)

The unit of measurement for the drilling and cleaning of holes in rock shall be the metre of holes drilled.

The unit of measurement for the dowel bars shall be the mass, in kilograms, of bars actually provided and secured in position.

The tendered rates shall include full compensation for drilling and cleaning the holes, and for supplying, positioning and grouting the dowel bars as specified.

Item		Unit
701.13	**Foundation lining** (type of material and thickness indicated**)**	square metre (m^2)

The unit of measurement for foundation lining shall be the square metre of concrete surface lined.

The tendered rate shall include full compensation for procuring, furnishing and placing all material, and for all labour and incidentals required for the installation of the foundation lining complete as specified.

Note:

The following items of work, when specified, shall be carried out, measured and paid for in accordance with the relevant sections of the Specifications, but will be listed under this section in the Schedule of Quantities.

Item		Applicable section
(a)	Overhaul on excavated material and on material imported for backfill and foundation fill	103
(b)	Temporary stockpiling of excavated material	201

SERIES 7 : STRUCTURES

SECTION 702 : FALSEWORK, FORMWORK AND CONCRETE FINISH

CONTENTS

01 SCOPE

This section covers the design, supply and erection of all falsework and formwork used in the construction of permanent work.

This section also describes the classes of concrete-surface finishes on formed and unformed concrete surfaces.

02 MATERIALS

02.01 General

The materials used in the construction of falsework and formwork shall be suitable for the purpose for which they are required and shall be of a quality that will produce the standard of work specified. The type, grade and condition of the materials shall be subject to the Engineer's approval.

02.02 Falsework

Timber, structural steel and scaffolding used shall be free from defects that may impair the stability of the falsework. The jacks, devices, clamps and fittings shall all be in a good working order and of an adequate design and strength.

02.03 Formwork

(a) Tongued and grooved boarding

Tongued and grooved boarding shall be of suitably dried timber that will not warp, distort or cause discolouration of the concrete. The widths of the boards shall be as specified on the Drawings or as directed by the Engineer. Boards shall be supplied in lengths not shorter than 3 m.

(b) Steel forms to exposed surfaces

For a class F3 surface finish for which steel forms are permitted and for a class F2 surface finish, the individual and assembled panels shall be sufficiently rigid and adequately clamped so that they will not deform or kick during handling or under the pressure of the wet concrete.

The surfaces of forms that are to be in contact with concrete shall be clean, free from deposits or adhering matter, weld runs, ridges and spatter that will impart irregularities and blemishes to the concrete surface. They shall also be free from indentations and warps.

(c) Void formers

Void formers used in permanent work shall be subject to the Engineer's approval.

Where void formers of a particular type or special design are required, details of the material, its thickness, and any relevant information in regard thereto will be specified in the Project Specifications or in the Schedule of Quantities or on the Drawings.

Void formers shall be manufactured from material that will not puncture, tear or be damaged during the course of construction and shall be of such a tight construction that it will prevent any undue loss of the mortar component of the concrete through leakage. The units shall be sufficiently rigid so that they will not be deformed during handling or under the pressure of the wet concrete.

Unless otherwise specified, the metal thickness for mild-steel spiral-lock-formed (seamed) void formers shall be as follows:

(i) Unbraced void formers

- 0,6 mm for diameters of up to 600 mm
- 0,8 mm for diameters exceeding 600 mm and up to 800 mm
- 1,0 mm for diameters exceeding 800 mm and up to 1 000 mm

(ii) Braced void formers

- 0,6 mm for diameters of up to 800 mm
- 0,8 mm for diameters exceeding 800 mm and up to 1 000 mm
- 1,0 mm for diameters exceeding 1 000 mm and up to 1 200 mm
- 1,2 mm for diameters exceeding 1 200 mm.

The thickness specified for braced void formers shall apply to formers internally braced with timber or equivalent braces. The braces shall be at spacings not exceeding 2,0 m and not further than 1,0 m from the end of each unit. Timber cross braces shall consist of members with cross-sectional dimensions of at least 50 mm x 50 mm.

All hollow void-former units shall be provided with a 12 mm diameter drainage hole at each end.

(d) Chamfer and recess fillets

Wooden fillets used to form chamfers and recesses on exposed surfaces shall be of new material, unless otherwise authorized by the Engineer. Other materials intended for use as fillets shall be subject to approval by the Engineer.

(e) Jack rods for sliding formwork

The jack rods, base plates and couplers shall be strong enough to carry the design load under all operating conditions without buckling or becoming distorted or causing damage to the concrete. Jack rods that are to remain permanently embedded in the concrete shall comply with the requirements of clauses 03 and 05 of section 703. Under no circumstances shall bent rods be used in the work.

The jack rods which are used shall have a diameter of at least 25 mm.

03 GENERAL

Notwithstanding the Engineer's approval of the design and drawings prepared by the Contractor for the falsework and formwork and the acceptance of the falsework and formwork as constructed, the Contractor shall be solely responsible for the safety and adequacy of the falsework and formwork and shall indemnify and keep indemnified the Employer and the Engineer against any injury to or claims by persons or losses of or damage to property whatsoever which may arise out of or in consequence of the design, construction, use and maintenance of the falsework and formwork and/or against all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

For works on, over, under or adjacent to any railway line the Contractor shall, inter alia, comply with the requirements for the preparation and submission of drawings for falsework and formwork, and the submission of certificates for the proper construction thereof, all in accordance with the requirements of the owner of such railway line.

After construction of the falsework and formwork, and prior to the placing of reinforcing steel and/or the placing of concrete, the Contractor shall inspect the falsework and formwork. Dimensions shall be checked, unevenness of surface shall be corrected and special attention shall be paid to the adequacy and tightness of bolts, ties and bracings as well as to the soundness of the foundations.

The Contractor shall notify the Engineer at least 24 hours in advance of his intention to place concrete, in order to enable him to inspect all aspects of the completed work. However, before notifying the Engineer, the Contractor shall satisfy himself that the work complies with the Specifications in all respects.

Concrete sections with dimensions smaller than 200 mm shall not be formed with sliding formwork, unless approved by the Engineer in writing.

Where no provision has been made in the Schedule of Quantities for sliding formwork, the Contractor may, in a covering letter to the Tender, submit a lump sum which reflects a saving in the costs for the use of sliding formwork in lieu of conventional formwork. The lump sum quoted shall be accompanied by priced items for items 702.08, 702.09, 702.10 and 703.02, all in accordance with clause 10 of this section and clause 10 of section 703.

04 DESIGN

04.01 General

The Engineer may require the Contractor to submit to him, for his consideration and approval, the design and drawings of the falsework and formwork for any structure.

04.02 Falsework

The Contractor shall make his own assessment of the allowable bearing pressure on the foundation material and shall design the footings and falsework to guard against overloading, differential settlement and unacceptable overall settlement. In assessing the allowable bearing pressure, due consideration shall be given to the effect which wetting has on the foundation material.

When designing the falsework, cognisance shall also be taken of the redistribution of load that may occur on account of the effect of temperature, wind force, the prestressing of curved and skewed structures, stage construction, flooding and debris.

Particular attention shall be given to the provision of transverse and diagonal bracing as well as to web stiffeners on cross bearers.

04.03 Formwork

(a) General

Formwork shall be designed to be sufficiently rigid to ensure that the specified dimensional tolerances can be achieved under the combined action of self-weight, dead loads and imposed loads as well as the additional loads resulting from the rate of concreting, the lift cast in one operation, and the method of placing and compaction.

(b) Sliding formwork

The Contractor shall be responsible for designing the sliding formwork assembly. Prior to fabrication or bringing the assembly and auxiliary equipment to the Site, the Contractor shall submit drawings of the complete sliding formwork assembly to the Engineer for approval. The drawings shall show full details of the forms, jacking frames, access ladders, hanging platforms, safety rails and curing skirts, and also details of the jacks and jack layouts.

The Contractor shall be required to submit to the Engineer, before sliding commences, an instruction manual which details the sliding technique, the jacking procedure, methods of keeping the formwork level, the procedure to be adopted to prevent bonding of the concrete to the forms and the method of releasing the forms in the event of bonding, the instrumentation and monitoring of the slide, correcting for verticality, twisting and levelness, etc.

The formwork panels shall be inclined to give a small taper, and the forms shall be slightly wider at the bottom than at the top. The taper shall be designed to produce the specified concrete thickness at the mid-lift level of the form.

The spacing of the jacks with their jack rods must be so designed that the dead load of the sliding formwork assembly, the frictional load, and the mass of materials, personnel and equipment will be evenly distributed and within the design capacity of the jacks used.

05 CONSTRUCTION

05.01 Falsework

The falsework shall be erected in accordance with the approved drawings which shall incorporate such modifications as may be required by the Engineer.

The Contractor shall take precautions to guard against deterioration of the foundations during the course of construction.

The falsework shall incorporate features that will permit the alignment of the formwork to be adjusted to compensate for any expected settlement and deflection under load.

05.02 Formwork

(a) General

The formwork shall be erected to levels calculated from the information given on the Drawings. The levels shall be adapted to make allowance for the specified precamber as well as for the expected deflection and settlement of the fully loaded falsework and formwork. The levels shall be set out and controlled at intervals not exceeding 2,50 m.

For the construction of the formwork the Contractor may, subject to the provisions of clause 02 of this section, use any material suited to and compatible with the class of surface finish and dimensional tolerances specified for the particular member.

Formwork shall be sufficiently rigid to maintain the forms in their correct position, shape and profile and shall be of such tight construction that the concrete can be placed and compacted without undue loss or leakage of the mortar component of the concrete.

The joints between contiguous formwork elements shall be closely butted and, where necessary, if undue leakage is expected, the joints shall be caulked, taped or packed with a sealing gasket, all at no extra payment. Paper, cloth or similar materials shall not be used for this purpose.

The formwork construction shall permit accurate erection and easy stripping without shock, disturbance or damage to the cast concrete. Where necessary, the formwork assembly shall permit the removal or release of side forms independently of the soffit forms.

Metal supports, ties, hangers and accessories embedded in the concrete shall be removed to a depth of not less than the cover specified for the reinforcement. The use of wire ties is not permitted.

All external corners shall be chamfered by the fixing of fillet strips into the corners of the formwork to form 25 mm x 25 mm chamfers. Re-entrant angles need not be chamfered unless specified.

(b) Formwork to exposed surfaces

The forms and boards shall be arranged to form a uniform and regular pattern in line with and perpendicular to the main axis of the member, unless otherwise approved or directed by the Engineer.

Joints between contiguous members shall, after caulking, taping or sealing, be treated to prevent blemishes, stains and undue marks from being imparted to the concrete surface.

Bolt and tie positions shall be so arranged that they will conform to the symmetry of the formwork panels or boards. Bolts and rivet heads that will be in contact with the formed surface shall be of the countersunk type and shall be treated to prevent marks from forming in the concrete surface.

The formwork at construction joints shall be braced to prevent steps from being formed in the concrete surfaces at the joints between successive stages of construction.

Where moulding or recess strips are specified, they shall be neatly butted or mitred.

(c) Formwork to open joints

The requirements in respect of formwork to open joints shall, unless otherwise specified, apply only to cases where the distance between opposite concrete surfaces is equal to or less than 150 mm.

Formwork to open joints shall be constructed to produce a class F1 surface finish to concealed surfaces or a class F2 or F3 surface finish which corresponds to the in-plane surface finish of the bordering concrete surfaces. The material used and the construction of the formwork shall permit its complete removal to form the open joint. Where polystyrene or a similar material which is susceptible to damage is used to form open joints, it shall be lined with a hard surface on the side to be concreted.

The hard material shall be sufficiently resilient to ensure that the required quality of work can be achieved.

(d) Openings and chases

Openings and chases shall only be provided if detailed or authorized by the Engineer. Frames for openings shall be rigid and firmly secured in position to prevent displacement. Temporary holes shall be so formed that they will not create an irregular pattern in relation to the rest of the exposed formed concrete surface.

(e) Sliding formwork

(i) Plant and equipment

Unless otherwise specified in the Project Specifications, hoisting equipment for sliding formwork that works stepwise with upward movements of between 10 mm to 100 mm is acceptable. However, it is preferable to use linked hydraulic or pneumatic jacks that are reversible and are driven by an electrically operated pump, and that can hoist at a steady rate. The jacks shall have independent controls for regulating verticality and levelness. The jacking system shall ensure that the sliding formwork assembly can be evenly hoisted.

The use of hoisting systems that work without jack rods shall be subject to the Engineer's approval.

All equipment shall be thoroughly tested and inspected before installation and shall be maintained in a good working order throughout the sliding operation.

The Contractor shall keep adequate back-up plant, equipment and quantities of materials on the Site to ensure uninterrupted sliding.

(ii) Instrumentation and monitoring

The Contractor shall supply and install suitable instrumentation on the sliding platform and foundations and at the sides of the structure for monitoring height, verticality, twisting and levelness at regular intervals. The equipment used, its utilization and the frequency of recording the readings shall be approved by the Engineer.

The Contractor shall be responsible for all monitoring work and shall ensure that the records of all readings and measurements taken are filed systematically and are at all times available to the Engineer and the person in control of the sliding operation.

Unless otherwise specified, the verticality of the structure shall be controlled with laser alignment apparatus or optical plummets, and the levelness of the sliding forms with a water-level system with reference control points placed at strategic locations.

Height and verticality shall be monitored at intervals not exceeding 4 hours. The measurements shall immediately be plotted on graphs. When the structure is more than 10 mm out of vertical the Engineer shall be notified immediately.

(iii) Supervision

During the entire duration of the sliding operations, a competent person who is fully acquainted with the sliding technique and the Contractor's methods of construction shall be in attendance on the sliding platform and in control of the sliding operations.

(iv) Construction

The jacking frame shall be constructed with adequate clearance between the underside of the cross members and the top of the formwork to allow the horizontal reinforcement and embedded items to be correctly installed. A control procedure shall be agreed on by the Contractor and the Engineer in order to ensure that all the reinforcement has been placed. At all times there shall be horizontal reinforcement above the level of the top of the formwork panel.

Guides shall be provided to ensure that the vertical reinforcement can be placed correctly and that the specified concrete cover over the reinforcement is maintained.

Where the jack rods are to be recovered, adequate provision shall be made for their removal without damage being caused to the concrete.

Where jack rods occur at openings or chases, adequate lateral support shall be provided to prevent their buckling.

Equipment and material shall be distributed on the working platforms, to distribute the load evenly to the jacks.

Deflector plates shall be provided at the top of the forms of the outside walls to prevent concrete from falling down the outside.

The framework, forms and platforms shall be cleared regularly to prevent the accumulation of concrete remnants.

The Contractor shall take all precautions to prevent contamination of the concrete and reinforcing steel by leaking oil or other causes.

(v) Sliding

The Contractor shall give the Engineer 24 hour's notice of his intention to commence with a slide. Permission to commence with the slide shall not be given by the Engineer before the sliding formwork assembly is fully operative, and the complete stock of all the materials required for the slide and the back-up plant and equipment are on the Site.

The Contractor shall ensure that the rate of sliding is such that the concrete at the bottom of the formwork has obtained sufficient strength to support itself and all loads that may be imposed upon it at the time, and that the concrete does not adhere to the sides of the forms.

The sliding operations shall be continuous, without any interruptions, until the full height of the structure is reached, and shall be geared and organized for an average rate of sliding of 350 mm/h.

(vi) Interruptions

When the sliding operations are delayed for more than 45 minutes, the Contractor shall prevent adhesion of the setting concrete to the formwork panels by easing the forms or by moving them slightly every 10 minutes, or alternatively, where reversible jacks are used, by lowering the forms by 10 mm - 25 mm. Wherever interruptions occur, emergency construction joints shall be formed and treated in accordance with clause 08 of section 704.

Before concreting is restarted, the form shall be adjusted to fit snugly into the hardened concrete so as to avoid steps from forming on the exposed concrete surface. When sliding is recommenced, care shall be taken to prevent the fresh concrete from being lifted off from the old concrete.

(f) Permanent formwork

Void formers shall be secured in position at regular intervals to prevent displacement and distortion during concreting. The void formers shall be supported on precast concrete blocks or rigid welded steel cradles, all subject to the approval of the Engineer. The ties securing the void formers shall be attached to the formwork and cross bearers of the falsework. The void formers shall not be tied to or be supported on the reinforcement.

Fibre-cement plates shall be supported so that the plate spans in the direction parallel to the orientation of the fibres.

(g) Preparation of formwork

The surfaces of forms that are to be in contact with fresh (wet) concrete shall be treated to ensure non-adhesion of the concrete to the form and easy release during stripping of the formwork.

Release compounds and agents shall be subject to the Engineer's written approval and shall be applied strictly in accordance with the manufacturer's instructions, and every precaution shall be taken to avoid contamination of the reinforcement, prestressing tendons and anchorages. In the selection of compounds and agents due regard shall be given to the necessity of maintaining a uniform colour and appearance on exposed concrete surfaces.

Before the concrete is placed, all dirt and foreign matter shall be removed from the forms, which forms shall be thoroughly wetted with water.

06 REMOVAL OF FALSEWORK AND FORMWORK

Falsework and formwork shall not be removed before the concrete has attained sufficient strength to support its own mass and any loads that may be imposed on it. This condition shall be assumed to require that, after the concrete has been placed, the formwork shall remain in position for the appropriate minimum period of time given in table 702/1, unless the Contractor can prove to the satisfaction of the Engineer that shorter periods are sufficient for fulfilling this condition. In such case the formwork may be removed after the agreed shorter periods of time.

Falsework and formwork shall be removed carefully without shock, disturbance or damage being done to the cast concrete or structure. Weather may be regarded as "normal" when atmospheric temperatures adjacent to the concrete, as measured by a maximum and minimum thermometer, do not fall below 15°C, and as "cold" when temperatures measured in the same way fall below 5°C. When minimum temperatures lie between these values, the stripping times shall be between the periods specified for normal and cold weather.

Any period during which the temperature remains below 2°C shall be disregarded in the calculation of the minimum time which shall elapse before forms are removed.

On continuous reinforced concrete structures, the falsework and supporting formwork shall not be removed before the concrete of the last pour has reached the appropriate minimum age given in table 702/1 or the appropriate minimum strength.

Where the structure is constructed in stages, the falsework and supporting formwork shall be removed as specified on the Drawings or as directed by the Engineer.

In lieu of the times specified in table 702/1, the falsework and formwork to soffits of slabs and beams may be removed once the concrete has attained 70% of its specified cube compressive strength. The compressive strength of the concrete shall be established from a representative and adequate number of cubes that have been stored under conditions that simulate the field conditions. Similarly, side forms may be removed when the concrete has attained a cube compressive strength of 2 MPa.

Where sections of structures are required to support loads additional to their own mass before the concrete has attained sufficient strength, the removal times shown in table 702/1 shall not apply, and longer periods of time before the removal of falsework and formwork shall be agreed upon by the Engineer and the Contractor and shall be confirmed in writing.

On prestressed-concrete structures the falsework and supporting formwork shall be removed after the full pre-stressing force relating to the particular stage of construction has been applied, unless otherwise shown on the Drawings or directed by the Engineer.

Table 702/1

REMOVAL OF FALSEWORK AND FORMWORK : MINIMUM TIME IN DAYS

Falsework and formwork to -	Type of cement used					
	Normal cement		Rapid-hardening cement		CEM III*	
	Normal weather	Cold weather	Normal weather	Cold** weather	Normal weather	Cold weather
1. Beam sides, walls and unloaded columns	1	2	1	1	2	4
2. Soffits of slabs and beams:						
(a) spans up to 3 m	4	7	2	4	6	10
(b) spans over 3 m up to 6 m	10	17	5	10	14	24
(c) spans over 6 m up to 12 m	14	24	10	18	21	28
(d) spans over 12m	21	30	18	28	28	36

* Also applicable to a 50/50 mixture of CEM-I and ground granulated blast-furnace slag.
** Shorter periods may be used for sections with a thickness exceeding 300 mm.

07 FORMED SURFACES : CLASSES OF FINISH

07.01 General

In addition to complying with the tolerances specified in clause 03 of section 707, the concrete surface finish on formed surfaces shall also comply with the following requirements.

07.02 Class F1 surface finish

After surface defects have been remedied in accordance with subclause 08.02 of this section, no further treatment of the as-stripped finish shall be required. This finish is required on concealed formed surfaces.

07.03 Class F2 surface finish

This finish shall be equivalent to that obtained by the use of wrought-thicknessed, square-edge timber panels and boards, shutter boards, or from steel forms arranged in a regular pattern. The finish is intended to be left as struck, but surface defects shall be remedied in accordance with subclause 08.02 of this section.

While minor surface blemishes and discolourations will be permitted, large blemishes and severe stains and discolouration shall be made good where directed by the Engineer. This surface finish is intended for exposed formed surfaces that cannot readily be seen by the general public, as in the case of culverts, remote structures and structures with restricted access.

07.04 Class F3 surface finish

This finish shall be that obtained by first producing a class F2 surface finish with joint marks forming a regular pattern approved by the Engineer to fit in with the appearance of the structure. Thereafter all projections shall be removed, irregularities repaired and the surface rubbed or treated to form a smooth finish with a uniform texture, appearance and colour. This surface finish is required on all exposed formed surfaces, unless class F2 finish is specified.

Steel forms shall not be used to form surfaces for which class F3 surface finish has been specified, unless authorized by the Engineer or where provision is made specifically in the Schedule of Quantities.

07.05 Board surface finish

This finish shall be that obtained by using tongued and grooved timber boarding arranged in a regular pattern approved by the Engineer. The finish is intended to be left as struck, but surface defects shall be remedied in accordance with subclause 08.02 of this section and large fins trimmed where directed by the Engineer.

07.06 Protection of surfaces

The Contractor shall ensure that permanently exposed concrete surfaces are protected from rust marks, spillage and stains of all kinds and from any other damage during construction.

08 REMEDIAL TREATMENT OF FORMED SURFACES

08.01 General

Any remedial treatment to surfaces that may be agreed on by the Engineer after an inspection has been made immediately after the removal of the formwork, shall be carried out without delay. No surface may be treated before an inspection has been made by the Engineer.

08.02 Repairs

Surface defects such as small areas of honeycombing cavities produced by form ties, large isolated blowholes, broken corner edges, etc, shall be repaired with mortar consisting of a cement:sand ratio equal to that of the concrete being repaired.

The colour of repaired areas of exposed surfaces shall match the colour of the surrounding concrete.

For the repair of large or deep areas of honeycombing and defects, special methods and techniques, such as pneumatically applied mortar, pressure grouting, epoxy bonding agents, etc, may be used as agreed on by the Engineer.

Where, in the opinion of the Engineer, the extent of the honeycombing or defects is such that the effectiveness of repair work will be in doubt, the Contractor shall, at his own expense, perform a load test in accordance with SANS 10160 or any other test that may be required by the Engineer, to prove that the structural integrity of the repaired member is adequate. Should the tests fail or should the Engineer be of the opinion that the work is substandard or does not comply with the requirements of the Specifications, he can instruct that the structure shall be rebuilt in part or in full at the Contractor's expense.

Where the concrete has been damaged by the concrete having adhered to the formwork panel, the cracked and loose concrete shall be removed; where the fresh concrete has lifted off at construction joints, the crack shall be scraped out immediately on both sides of the wall to a depth of at least 50 mm. The cavities so formed shall thereafter be repaired as described above.

08.03 Rubbing of surfaces

If the finish of exposed formed surfaces does not comply with the requirements in respect of uniformity of texture, appearance and colour, the Contractor shall, when so instructed by the Engineer, rub down the exposed surfaces of the entire structure or any part thereof as specified below.

The surface shall be saturated with water for at least one hour. Initial rubbing shall be carried out with a medium-coarse carborundum stone, with a small amount of mortar in the proportions specified in subclause 08.02 of this section being used on the face. Rubbing shall be continued until all form marks, projections and irregularities have been removed and a uniform surface has been obtained.

The paste produced by the rubbing shall be left in place. The final rubbing shall be carried out with a fine carborundum stone and water. This rubbing shall continue until the entire surface is of a smooth, even texture and is uniform in colour. The surface shall then be washed with a brush to remove surplus paste and powder.

Where the concrete surfaces formed by sliding formwork require treatment for achieving the surface finish specified for the member, the concrete shall, as soon as the surfaces are exposed under the formwork, be floated with rubber-lined floats to the desired finish.

09 UNFORMED SURFACES : CLASSES OF FINISH

09.01 Class U1 surface finish

This surface finish is required on those portions of concrete slabs which are to receive bituminous or concrete surfacing or which are to be covered by backfilling material.

After the concrete has been placed and compacted as specified in clause 07 of section 704, the top surface shall be screeded off with a template to the required cross-section and be tamped with a tamping board to compact the surface thoroughly and to bring mortar to the surface, so as to leave the surface slightly ridged but generally at the required elevation.

09.02 Class U2 surface finish

This surface finish is required on sidewalks, the tops of wingwalls and retaining walls, on the exposed concrete shoulders and unsurfaced areas on bridge decks, and on the inverts of box culverts.

The surface shall first be given a class U1 surface finish, and after the concrete has hardened sufficiently, it shall be wood-floated to a uniform surface free from trowel marks. For non-skid surfaces as on sidewalks and bridge decks, the surface shall thereafter be given a broom finish. The corrugations produced shall be approximately 1 mm deep and uniform in character and width, and shall have a pattern perpendicular to the centre line of the pavement.

09.03 Class U3 surface finish

This surface finish shall be required for bearing areas and tops of concrete railings. The surface shall be given a class U1 finish, and after the concrete has hardened sufficiently, it shall be floated with a steel float to a smooth surface to within the dimensional tolerance specified in subclause 03.07 of section 707.

Rubbing with a carborundum stone after the concrete has hardened may be done, but under no circumstances will plastering be permitted.

10 MEASUREMENT AND PAYMENT

Item		Unit
702.01	**Formwork class F1 surface finish**	
702.01.01	Single-surface formwork	
702.01.01.01	Plane, horizontal	square metre (m^2)
702.01.01.02	Plane, sloping	square metre (m^2)
702.01.01.03	Plane, vertical	square metre (m^2)
702.01.01.04	Curved, cylindrical (radius given)	square metre (m^2)
702.01.01.05	Curved, conical (min and max radii given)	square metre (m^2)
702.01.01.06	Curved, spherical (radius given)	square metre (m^2)
702.01.02	Double-surface formwork (both sides measured)	
702.01.02.01	Plane, horizontal	square metre (m^2)
702.01.02.02	Plane, sloping	square metre (m^2)
702.01.02.03	Plane, vertical	square metre (m^2)

Item		Unit
702.01.02.04	Curved, cylindrical (inside radius given)	square metre (m^2)
702.01.02.05	Curved, conical (inside min and max radii given)	square metre (m^2)
702.01.02.06	Curved, spherical (inside radius given)	square metre (m^2)
702.01.03	Beams	
702.01.03.01	Beam, soffits (see note 5)	square metre (m^2)
702.01.03.02	Beam, sides	square metre (m^2)
702.01.04	Columns	
702.01.04.01	Square and rectangular	square metre (m^2)
702.01.04.02	Cylindrical	square metre (m^2)
702.01.04.03	Other shapes (state details)	square metre (m^2)

The unit of measurement for formwork shall be the square metre of formwork actually in contact with the final concrete surface or the area of the same surface as shown on the Drawings, whichever is smaller.

The tendered rates shall include full compensation for design, erection and subsequent removal of the formwork and supporting falsework, including the supply of all chamfers up to 25 mm x 25 mm in size and for the specified remedial treatment of concrete surfaces. Eighty (80)% of the work done under this item shall be paid on removal of the formwork and the remaining 20% on approval of the formed surface.

The following notes shall apply to this pay item:

(1) Single-surface formwork shall be formwork consisting of a single surface supported only by falsework and not tied to an opposing surface.

(2) Double-surface formwork shall be formwork consisting of two sides (both of which are measured for payment) which can be supported in one direction by ties.

(3) Beams and columns will be measured separately as itemized.

(4) Surfaces inclined at 10° or less to the horizontal shall be classed as horizontal surfaces. Surfaces sloping at between 10° and 85° to the horizontal shall be classed as sloping surfaces. Sloping surfaces exceeding 85° to the horizontal shall be classed as vertical surfaces. Curved surfaces will not be classed in accordance with their slope.

(5) Where provision is made in the Project Specifications, formwork for beam soffits shall be classed into different heights of support categories.

(6) Items of formwork for which provision is made elsewhere shall not be included in this item of payment.

Item		Unit
702.02	**Formwork, class F2 surface finish**	
702.03	**Formwork, class F3 surface finish**	
702.04	**Formwork, board finish**	

The provisions of item 702.01 shall apply equally to the above items, which shall be subdivided as in item 702.01.

Item		Unit
702.05	**Permanent void formers**	
702.05.01	Description of type and size with reference to Drawings	square metre (m^2)
702.05.02	Ditto for other types and sizes	square metre (m^2)

The unit of measurement shall be the square metre of concrete area actually formed with permanent void formers or the area to be formed in accordance with the Drawings, whichever is the smaller.

The tendered rates shall include full compensation for the permanent formwork complete as specified, including anchors to prevent uplift.

Item		Unit
702.06	**Formwork to openings**	square metre (m^2)

The unit of measurement shall be the square metre of formwork actually in contact with the final surface of the concrete in accordance with the Drawings.

The tendered rate shall include compensation for installing and subsequently removing the formwork.

Item		Unit
702.07	**Chamfers larger than 25 mm x 25 mm**	
702.07.01	Size and member indicated	metre (m)
702.07.02	Ditto for other sizes	metre (m)

The unit of measurement shall be the metre length of chamfer formwork provided. Chamfers smaller than 25 mm x 25 mm will not be measured for payment and their cost shall be deemed to be included in the rates tendered for formwork.

The tendered rates shall include full compensation for all labour, equipment and materials necessary to provide and install the chamfers.

Item		Unit
702.08	**Establishment on Site for sliding formwork operations**	lump sum

The tendered lump sum shall include full compensation for the establishment on the Site and the subsequent removal of the complete sliding formwork assembly, special plant, equipment and incidentals for the sliding work, the costs of which will not vary with the actual amount of sliding done.

This work shall be paid for as a lump sum, 75% of which will become payable when the sliding formwork assembly, plant and equipment have been installed on the Site and is ready to be commissioned for the first slide, and the remaining 25% will become payable after all the sliding work has been completed and the aforementioned items have been removed from the Site.

Although payment under this item will only be made when the sliding formwork assembly is operational and ready for the first slide, the tendered lump sum shall not include the cost of erection for the first slide.

Item		Unit
702.09	**Moving to and setting up the sliding formwork assembly at** (description of each structure)	number (No)

The unit of measurement shall be the number of structures, including the first structure, to which the complete sliding formwork assembly has to be moved and set up in position ready to be commissioned.

The tendered rate shall include full compensation for all costs involved in erection for the first structure and in dismantling, moving and re-erecting the complete sliding formwork assembly.

Item		Unit
702.10	**Forming of concrete by sliding formwork for** (description of each structure and class of surface finish to exposed surfaces indicated)	metre (m)

The unit of measurement shall be the metre height of each structure formed by sliding formwork.

The quantity measured shall be the actual height of each structure formed by the sliding technique.

The tendered rate shall include full compensation for the forming of concrete by sliding formwork, complete as specified, and for the remedial treatment of concrete surfaces.

Notes:

(a) For smaller items of construction work such as valve boxes, concrete railings, etc, the formwork can be measured separately without distinction as to vertical or horizontal formwork, or the formwork may be included in the price of the concrete. Where expedient, type items can be measured complete including excavations, formwork, concrete, fittings, etc.

(b) Formwork is not usually measured for precast concrete items as these are itemized complete.

(c) Under certain circumstances the above method of measuring may require modifications to suit a particular case.

(d) The types of unformed concrete surfaces which are to receive a U-type class of finish are specified in clause 09 of this section. The cost of finishing such surfaces shall be included in the rates tendered for concrete, as specified in subclause 04.05 of section 001.

SERIES 7 : STRUCTURES

SECTION 703 : STEEL REINFORCEMENT FOR STRUCTURES

CONTENTS

01 SCOPE

This section covers the supplying and placing of steel reinforcement in concrete structures.

02 MATERIALS

02.01 Steel bars

Steel reinforcing bars shall comply with the requirements of SANS 920. Mild steel shall be hot-rolled bars with plain, round cross-sections. High-yield-stress steel shall be hot-rolled deformed bars.

The use of cold-worked bars shall be subject to the written approval of the Engineer. Cold-worked reinforcing bars shall bear the SANS mark or alternatively be subject to consignment inspection by the SANS at the plant, factory or steel yard, at the Contractor's expense.

The type of bar required shall be identified on the Drawings by the symbols R, Y or Z in accordance with SANS 282.

02.02 Welded steel fabric

Welded steel fabric shall comply with the requirements of SANS 1024.

02.03 Mechanical couplers

The tensile properties as established by way of a test specimen with a maximum gauge length of 610 mm, which consists of reinforcing bars that have been butt-jointed with a mechanical coupler, shall comply with the following requirements:

(a) When tested in accordance with the relevant requirements of subclause 5.3 of SANS 920, the tensile properties shall show an improvement of at least 10% on the requirements of SANS 920.

(b) When the test specimen is subjected to a load equal to 0,58 of the specified minimum yield force of the bar, the elongation measured on the gauge length shall not exceed the calculated theoretical elongation for a 610 mm length of bar, based on a stress of 0,58 of the specified minimum yield stress of the bar and a modulus of elasticity of 200 GPa.

The Contractor shall submit test certificates from a recognized testing authority to the Engineer, certifying that the couplers offered comply with the specified requirements.

The use of mechanical couplers as well as the type offered shall be subject to the written approval of the Engineer.

03 STORAGE OF MATERIALS

Steel reinforcement shall be stacked off the ground and, in aggressive environments, protection shall be provided in the form of sheds or tarpaulins.

04 BENDING OF REINFORCEMENT

Reinforcement shall be cut or cut and bent to the dimensions shown on the bending schedules and in accordance with SANS 82.

High-tensile-steel bars shall not be flame-cut, except with the approval of the Engineer.

Except as provided below, all bars shall be bent cold, and bending shall be done slowly, with a steady, even pressure being used without jerking or impact.

If approved, the hot bending of bars with a diameter of at least 32 mm will be permitted, provided that the strength of the bars will not depend on cold working. Where hot bending is approved, the bars shall be heated slowly to a cherry-red heat (not above 840°C) and, after bending, shall be allowed to cool slowly in air. Quenching with water will not be permitted.

Reinforcing bars that have already been bent shall not be rebent at the location of the original bend without the permission of the Engineer.

05 SURFACE CONDITION

Immediately before the concrete is placed around the reinforcement, the reinforcement shall be clean, free from mud, oil, grease, paint, loose rust, loose mill scale or any other substances that may have an adverse chemical effect on the steel or concrete or will reduce the bond.

06 PLACING AND FIXING

Reinforcement shall be positioned as shown on the Drawings and shall be accurately secured in these positions within the tolerance given in subclause 03.05 of section 707 by means of stools, clips, links, spacers and cover blocks and by tying with 1,6 mm or 1,25 mm diameter annealed wire, or, where permitted by the Engineer, by tack welding.

The cover and spacer blocks required for supporting the reinforcement shall be of approved design and material.

The ends of ties, clips or wire shall not project into the concrete cover.

Where protruding bars will be exposed to the elements for an indefinite period, the bars shall be adequately protected against corrosion and damage and shall be properly cleaned before being permanently encased in concrete.

In members that are formed with sliding formwork, mild-steel spacer "ladders" for the placing and fixing of the wall reinforcement shall be used at spacings indicated on the Drawings or as directed by the Engineer. The ladders and their design shall be approved by the Engineer. The ties of the ladder shall be spaced at multiples of the horizontal bar spacing in the wall, and shall be used to secure the horizontal reinforcement. The laps in the horizontal reinforcement shall be staggered to ensure that no part of two laps in any four consecutive layers will lie in the same vertical plane.

07 COVER

The term "cover" in the context of this section shall mean the clear thickness of concrete between the surface of the reinforcement and the concrete face.

The cover shall be as shown on the Drawings. Where no cover is indicated, the cover provided shall be in accordance with the appropriate values shown in table 703/1. The cover shall be within the tolerance given in subclause 03.05 of section 707.

The cover shall be increased by the expected depth of any surface treatment, e.g. when concrete is bush-hammered or when rebates are provided.

Additional cover as directed by the Engineer shall be provided if porous aggregates are used.

The cover blocks or spacers required to ensure that the specified cover is obtained shall be of a material, shape and design acceptable to the Engineer.

Where concrete spacer blocks are used, they shall be made from a 5 mm maximum size aggregate and shall be of the same strength and from the same material source as the surrounding concrete. The blocks shall be formed in specially manufactured moulds, and the concrete shall be compacted on a table vibrator and afterwards cured, all to the approval of the Engineer.

TABLE 703/1 :

CONCRETE COVER OVER REINFORCEMENT

Condition of exposure	Description of member/surface to which the cover applies		Cover (mm)				
			Concrete class				
			20	25	30	40	50
1. .MODERATE Sheltered from severe rain and not subject to freezing while saturated	1.1 1.2 1.3 1.4	Enclosed surfaces Surfaces protected by an overlay Buried structures/members Structures/members continuously	40	40	30	25	25
	1.5	Concrete cast under water	75	75	NA	NA	NA
	1.6	Surface formed with permanent formwork	20	20	20	20	20
	1.7	Transnet Limited** structures - as for 2.3 to 2.6					
	1.8*	Piles, cast in situ (wet cast against casing)	40	40	40	40	40
	1.9 1.10	Piles, cast in situ (dry cast against soil) Piles, cast in situ (wet cast against soil)	50	50	50	50	50
	1.11	Piles, precast	35	35	35	30	30
2. SEVERE Exposed to driving rain, alternate wetting and drying. Subject to heavy condensation, freezing while wet, corrosive fumes, chemicals, and aggressive soils	2.1 2.2	Exposed surfaces Buried structures/members	NA	50	40	30	25
	2.3	Transnet Limited substructures, exposed surfaces	NA	50	40	40	40
	2.4	Transnet Limited structures, surfaces in contract with soil	NA	50	50	50	50
	2.5	Transnet Limited superstructures	NA	NA	40	40	40
	2.6	Transnet Limited superstructures, surfaces in contact with ballast	NA	NA	50	50	50
	2.7*	Piles, cast in situ (wet cast against casing)	50	50	50	50	50
	2.8 2.9	Piles, cast in situ (dry cast against soil) Piles, cast in situ (wet cast against soil)	75	75	75	75	75
	2.10	Piles, precast	40	40	40	35	35
3. VERY SEVERE Exposed to abrasion, and water with pH below 4,5	3.1	Marine structures	NA	NA	NA	60	50
	3.2	Piles, cast in situ (wet cast against casing)	NA	NA	NA	80	80
	3.3	Piles, precast	NA	NA	NA	50	50

* Shall apply to concrete cast under water

** "Transnet Limited structures" shall mean all structures over or within the property of Transnet Limited.

08 LAPS AND JOINTS

Laps, joints, splices and mechanical couplings shall be made in accordance with the methods and details and at the positions as specified or shown on the Drawings, or as agreed on by the Engineer.

09 WELDING

The welding of reinforcement shall be carried out only where shown on the Drawings or agreed on by the Engineer.

Flash-butt welding shall be carried out only with the combination of flashing, heating, upsetting and annealing to the Engineer's approval, and only machines that automatically control this cycle of operations shall be used.

Metal-arc welding of reinforcement shall be carried out in accordance with SANS 10044 for Grade A welds and the recommendations of the reinforcement manufacturers, subject to the approval of the Engineer and the satisfactory performance of trial joints.

Other methods of welding, e.g. resistance welding, may be used subject to the approval of the Engineer and to their satisfactory performance in trial joints.

Welded joints shall be full-strength welds, the strength of which shall be assessed by destruction tests on samples selected by the Engineer.

10 MEASUREMENT AND PAYMENT

Item		Unit
703.01	**Mechanical couplers for -**	
703.01.01	(Type of steel indicated) -	
703.01.01.01	For (diameter indicated) mm dia bars	number (No)
703.01.01.02	Etc for other diameter bars	
703.01.02	Etc for other types of steel	

The unit of measurement shall be the number of mechanical couplers installed for bars of each type and diameter.

The tendered rates shall include full compensation for the supply and installation of the mechanical couplers complete as specified.

Item		Unit
703.02	**Spacer ladders for -**	
703.02.01	(Structure or portion of structure indicated)	ton (t)
703.02.02	Etc for other structures or portions of structures	

The unit of measurement shall be the ton of steel spacer ladders in place in accordance with the Drawings or as authorized by the Engineer. The tendered rates shall include full compensation for the supply, delivery, cutting, bending, welding and installation of spacer ladders including all tying wire, spacers and waste.

Item		Unit
703.03	**Welded steel fabric for -**	
703.03.01	(Description of structure or portion of structure to which it will apply)	
703.03.01.01	(Reference number or Nominal diameters of longitudinal and transverse wires and their nominal spacing indicated)	kilogram (kg)
703.03.01.02	Etc for other pitches and diameters	
703.03.02	Etc for other structures or portions of structures.	

The unit of measurement for welded steel fabric shall be the kilogram of welded steel fabric in place, and the quantity shall be taken from the bending schedule or calculated from the nett area covered by the mesh, excluding laps, in accordance with the dimensions shown on the Drawings.

The tendered rates shall include full compensation for the supply, delivery, cutting, bending and installation of the welded steel fabric including all tying wire, spacers and waste.

Item		Unit
703.04	**Reinforcement for -** (Description of structure or portion of structure to which it will apply)	
703.04.01	Mild steel	
703.04.01.01	Bars with an 8 mm dia	ton (t)
703.04.01.02	Bars with a 10 mm dia	ton (t)
703.04.01.03	Etc for other diameters	
703.04.02	High-yield-stress steel	
703.04.02.01	Bars with an 8 mm dia	ton (t)
703.04.02.02	Bars with a 10 mm dia	ton (t)
703.04.02.03	Etc for other diameters	
703.04.03	Etc for other types of steel	

Item		Unit
703.05	**Reinforcement for -** (Etc for other structures or portions of structures)	

The unit of measurement shall be the ton of reinforcement in place in accordance with the Drawings or as authorized by the Engineer.

Clips, ties, separators, stools and other steel used for positioning reinforcement not included in the bending schedules, shall not be measured for payment, unless provision has specifically been made therefor in the Project Specifications.

The tendered rates shall include full compensation for the supply, delivery, cutting, bending, welding and installation of the steel reinforcement as shown on the Drawings including all tying wire, spacers and waste.

Note:

The mass of steel reinforcement shall be computed from the nominal bar sizes and the nominal mass per unit length for each nominal bar size.

SERIES 7 : STRUCTURES

SECTION 704 : CONCRETE

CONTENTS

01 SCOPE

This section covers the manufacture, transportation, placing and testing of concrete used where plain, reinforced or prestressed concrete is specified, and the manufacture and placing of no-fines concrete.

02 MATERIALS

02.01 Cement

The cement used for concrete shall be any of the following:

(a) Normal cement conforming to the requirements of SANS 50197-1 (CEM I class 32,5 unless otherwise approved).

The strength class of the cement shall be 32,5N unless otherwise specified in the Project Specifications or approved by the Engineer. Cement extenders, if allowed in terms of the Project Specifications, shall comply with the requirements of SANS 1491-1, SANS 1491-2 and SANS 1491-3 for ground granulated blastfurnace slag, fly ash and condensed silica fume respectively.

(b) Blast-furnace cement (CEM III class 32,5) conforming to the requirements of SANS 50197-1).

(c) A 50/50 mixture of CEM I and ground granulated blast-furnace slag conforming to the requirements of SANS 1491-1. The cement and ground granulated slag may be mixed in the concrete mixer together with the other ingredients of the concrete.

The use of CEM III or a 50/50 mixture of CEM I and ground granulated slag may not be used unless authorized in the Project Specifications or in writing by the Engineer.

The use of CEM III will not be permitted in prestressed concrete members or units.

02.02 Aggregates

Both coarse aggregate (stone) and fine aggregate (sand) shall comply with the requirements of SANS 1083, subject to the following:

(a) The shrinkage of both the fine and the coarse aggregate, when tested in accordance with SANS Standard Method 5836, shall not exceed the following limits:

(i) For use in prestressed concrete, concrete bridge decks and slender columns, the shrinkage of both fine and coarse aggregate shall not exceed 130% of that of the reference aggregate.

(ii) For use in other reinforced concrete members, the shrinkage of the fine aggregate shall not exceed 175% and that of the coarse aggregate 150% of that of the reference aggregate.

(iii) For use in mass concrete substructures and unreinforced concrete head walls and wing walls, the shrinkage of both the fine and the coarse aggregate shall not exceed 200% of that of the reference aggregate.

Where there is any doubt about the shrinkage characteristics of aggregates, the Contractor shall submit a certificate from an approved laboratory, indicating the shrinkage characteristics of the aggregate.

(b) The flakiness index of the stone as determined by TMH1 Method B3 shall not exceed 35.

(c) Aggregates shall not contain harmful amounts of organic materials such as grass, timber or similar materials.

(d) Where 38 mm aggregate is used in 30 MPa and stronger concrete, the aggregate shall be supplied in two nominal sizes, the larger of which shall be 38 mm and the smaller of which shall be 19 mm or 13,2 mm. The relative proportions of large and smaller aggregate used shall be determined by the mix design.

(e) Aggregates that may be potentially alkali reactive shall be assessed in accordance with SANS Standard Method 1245 and if there is a potential danger of any alkali aggregate reaction, the Engineer's decision as to the suitability of the aggregate shall be final and binding.

(f) Aggregates for concrete in contact with sewage or sewage gases shall be of dolomitic origin. All concrete for sewers and sewerage works, except concrete for the following, shall therefore be made with aggregates of dolomitic origin:

- blinding
- mass concrete for foundation fill
- concrete for encasing and bedding pipes

The quantity of insoluble matter in respect of concrete made with aggregates of dolomitic origin, determined according to the method described in SANS 677, Appendix C, shall not be more than 15%.

02.03 Water

Water shall be clean and free from harmful concentrations of acids, alkalis, salts, sugar or other organic or chemical substances. If the water used is not obtained from a public drinking-water main, the Engineer may require the Contractor to have the suitability of the water proved by tests made by an approved laboratory. The costs of these tests or any subsequent tests ordered by the Engineer shall be borne by the Contractor.

02.04 Admixtures

Admixtures shall not be used in concrete without the written approval of the Engineer, who may require that tests be made before they are used, to prove their suitability.

Admixtures, if allowed, shall comply with the following requirements:

(a) Admixtures shall be used only in liquid form and shall be batched in solution in the mixing water by means of a mechanical batcher capable of dispensing the agent in quantities accurate to within 5% of the required amount.

(b) Admixtures shall comply with the requirements of ASTM C494/C494M-99a or AASHTO M-194 and shall be of an approved brand and type.

(c) Air-entraining agents shall comply with the requirements of ASTM C-260 or AASHTO M-154.

(d) Admixtures shall not contain any chlorides.

03 STORAGE OF MATERIALS

03.01 Cement

Cement which is stored on the Site shall be kept under a cover that provides adequate protection against moisture and other factors that may cause deterioration of the cement.

Where the cement is supplied in bags, the bags shall be closely and neatly stacked to a height not exceeding 12 bags, and they shall be so arranged that they can be used in the order in which they were delivered to the Site. Different brands and/or types of the same brand shall be stored separately.

The storage of cement in bulk in silos or similar containers shall be permitted, provided the cement drawn for use is measured by mass and not by volume.

Cement shall not be kept in storage for longer than 6 weeks from the date of manufacture without the Engineer's permission.

The Engineer may order the removal of cement, which is older than 6 weeks, from the Site or the alteration of the design mix if he does allow its use. Alternatively, he may allow the cement to be used in concrete of less critical importance, as in blinding layers.

03.02 Aggregates

Aggregates of different nominal sizes shall be stored separately to avoid the intermixing of the different aggregates and the contamination thereof by foreign matter.

03.03 Storage capacity

The storage capacity provided and the amount of material stored (whether cement, aggregates or water) shall be sufficient to ensure that the progress of the work is not interrupted by lack of materials during concrete-casting operations.

03.04 Deteriorated material

Material that has deteriorated or that has been contaminated or otherwise damaged shall not be used in concrete. Such material shall be removed from the Site without delay.

04 CONCRETE QUALITY

04.01 General

The concrete shall comply with the requirements for strength concrete or for prescribed-mix concrete, as specified in subclauses 04.02 and 04.03 of this clause.

04.02 Strength concrete

The Contractor shall be responsible for the design of the concrete mix and for the proportions of the constituent materials necessary to produce concrete that complies with the requirements specified in table 704/1 for each class of strength concrete.

The Engineer will have the authority to instruct the Contractor to have the concrete mix designed by a specialist organization such as SABS Holdings (Pty.) Ltd. or the Cement and Concrete Institute (CCI), in which case the Contractor will only be reimbursed the invoiced charges of such organization.

The class of strength concrete is indicated by the 28-day cube characteristic compressive strength in MPa and the maximum size of coarse aggregate in the mix. Class 30/38 concrete will therefore mean concrete with a cube characteristic compressive strength of 30 MPa at 28 days and a maximum size of coarse aggregate of 38 mm.

Strength concrete used under this Contract will be one or more of the classes given in table 704/1 unless otherwise specified in these Specifications or in the Project Specifications.

The cement content for any class of concrete shall not exceed 500 kg/m^3 of the concrete, unless otherwise specified.

The slump of the concrete shall be within the range as specified in table 704/3.

Where for reasons of durability or other considerations a minimum cement:water (c:w) ratio is specified in the Project Specifications, such concrete shall be designated by the normal designation followed by a "w" and the minimum c:w ratio in brackets, e.g. class 30/38 (w/2,0) concrete is class 30/38 concrete with a minimum c:w ratio of 2,0.

In such cases the characteristic strength of the mix shall be based on the specified 28-day characteristic compressive strength of the concrete.

Before starting any concrete work on the Site, the Contractor shall furnish the Engineer with samples, for his approval, of the constituent materials of the concrete and a statement of the mix proportions which he proposes to use for each class of concrete indicated in the Schedule of Quantities.

Table 704/1

CLASSES OF CONCRETE

Class of concrete	28-day characteristic compressive strength (MPa)	Maximum size of aggregate (mm)
15/19	15	19
15/38		38
20/13	20	13
20/19		19
20/38		38
25/13	25	13
25/19		19
25/38		38
30/13	30	13
30/19		19
30/38		38
40/13	40	13
40/19		19
40/38		38
50/13	50	13
50/19		19
50/38		38
60/13	60	13
60/19		19
60/38		38

The samples shall be accompanied by evidence that they comply with the requirements for the various materials specified. The statement of mix proportions shall be accompanied by evidence which will indicate that concrete made with the materials in the proposed proportions will have the specified properties.

Evidence shall be in the form of either -

- a statement from an approved laboratory on the results of tests, or
- an authoritative report or record of previous use and experience.

The actual mix proportions used as well as any changes thereto shall be subject to the Engineer's approval, but such approval shall in no way relieve the Contractor of his responsibility to produce concrete with the specified properties.

The Contractor is cautioned that the quality of cement may vary between consignments to an extent that will necessitate adjustments in the cement content of mixes. In order to ensure a uniform quality of concrete, the Contractor shall obtain from the manufacturer the relevant cement quality data for each consignment to ascertain the required adjustment to the cement content. This information shall be submitted to the Engineer.

04.03 Prescribed-mix concrete

The Engineer will be responsible for determining the proportions of each constituent material of the prescribed-mix concrete. The Contractor shall produce the concrete by using the specified materials and in the proportions ordered by the Engineer.

The Contractor shall be responsible for supplying the constituent materials for the concrete and he shall furnish the Engineer, at least four weeks before the start of any concrete work on the Site, with samples of each aggregate for testing purposes. If the materials comply with the Specifications, the Contractor shall supply further samples of sizes indicated by the Engineer for determining the mix proportions for each class of concrete.

The classes of concrete for prescribed mixes shall be specified in the Project Specifications, except for the three "nominal" classes given in Table 704/2 A and B.

Table 704/2A NOMINAL MIXES
(9,5 or 13,2 mm stone)

Constituent or property	Class 1:4:8 concrete	Class 1:3:6 concrete	Class 1:2:4 concrete
Cement (kg)	50	50	50
Aggregate (m^3) sand	0,175	0,130	0,100
stone	0,095	0,080	0,070
Estimated 28-day compressive strength (MPa)	10	15	20

Table 704/2B NOMINAL MIXES
(19,0 or 26,5 mm stone)

Constituent or property	Class 1:4:8 concrete	Class 1:3:6 concrete	Class 1:2:4 concrete
Cement (kg)	50	50	50
Aggregate (m^3) sand	0,170	0,125	0,095
stone	0,145	0,120	0,100
Estimated 28-day compressive strength (MPa)	10	15	20

The Engineer will have the right to vary the proportions of the constituents of the concrete as the work proceeds. Payment for variations will be made at the tendered rates as specified in the Project Specifications.

Notes:

- The maximum size of coarse aggregate in mm required in a mix shall be designated as a suffix to the class, e.g. Class 1:4:8/38.
- The ratio of fine to coarse aggregate shall be adjusted to produce a dense, workable mix.
- The total quantity of water shall include that contained in the aggregates.
- The volume of cement in one 50 kg bag of cement shall be taken as 0,033 m^3.
- The mix should contain only enough water to achieve the required consistence. Consistence may be assessed by eye or measured by carrying out the slump test (SANS 5862-1).

  Recommended slumps are:

  50 - 100 mm for compaction by mechanical vibration

  100 - 150 mm for compaction by hand.

04.04 Consistency and workability

Slump measurements obtained in accordance with the test prescribed in section 903 on concrete used in the Works shall fall within the ranges specified in table 704/3.

The concrete shall be of a suitable workability without the excessive use of water so that it can be readily compacted into the corners of the formwork and around reinforcement, tendons and ducts without segregation of the material.

05 MEASURING OF MATERIALS

(a) Cement

Where cement is supplied in standard bags, it shall be assumed that each bag contains 50 kg. All cement taken from bulk storage containers and from partially used bags shall be batched by mass to an accuracy of within 3 per cent.

Table 704/3
SLUMP VALUES

Type of construction	Slump (mm)*	
	Max	Min
1. Paving, concrete nosings and precast units	75	50
2. Prestressed concrete	75	25
3. Reinforced foundation walls, footings and cast in situ piles (except dry-cast piles)	125	50
4. Slabs, beams columns and reinforced walls	125	50
5. Concrete bases, caissons and substructure walls	100	25

* Where high-frequency vibrators are used, the above values shall be reduced by one-third.

(b) Water

The mixing water for each batch shall be measured, either by mass or by volume, to an accuracy of within 3 per cent.

The amount of water added to the mix shall be adjusted to make allowance for the moisture content (if any) of the aggregates.

(c) Aggregates

All aggregates shall be measured separately by mass, to an accuracy of within 3 per cent, except if otherwise provided in this clause .

The mass of the aggregates and the water demand of the mix shall be adjusted to make allowance for the moisture content of the aggregates.

Aggregates for prescribed-mix concrete as specified in subclause 04.03 of this clause may be measured separately by volume.

Classes 15, 20, 25 and 30 strength concrete may be volume batched in special circumstances, for instance when the volume of concrete required is small. Aggregates for other classes of strength concrete may also be volume batched, subject to the approval of the Engineer and to the quantity of cement being increased, at the Contractor's expense, by 25 kg/m^3 of concrete over and above that which would have been required in the case of batching aggregates by mass.

Batching boxes for volume batching shall be filled without tamping, ramming or consolidation of any kind (other than that occurring naturally during the filling process), and shall be screeded off level with the topmost edges.

Volumes shall be adjusted by supplementary containers of the appropriate size being used. Adjustments made by partly filling the batching boxes to marks on their inside faces will not be permitted.

Fine aggregate shall be tested for bulking at the beginning of and halfway through each concreting shift, and adjustment shall be made to the batch volume to give the true volume required.

Cement may not be measured in gauge boxes, and volume batching shall be planned for whole bags of cement.

06 MIXING

Note:

If ready-mixed concrete is delivered to the Site, the requirements of SANS 878 shall supersede those set out in this section.

06.01 General

The materials for concrete shall be mixed by an experienced operator. Unless otherwise approved, mixing shall be carried out in a mechanical batch mixer of an approved type which shall be capable of producing a uniform distribution of ingredients throughout the batch.

06.02 Charging the mixer

The sequence of charging shall be approved by the Engineer and, unless otherwise instructed, the same sequence shall be maintained.

The volume of the mixed material per batch shall not exceed the manufacturer's rated capacity of the mixer.

06.03 Mixing and discharge

The period of mixing shall be measured from the time when all the materials are in the drum until discharge is commenced.

The mixing period shall be 90 seconds and may only be reduced if, on the grounds of site tests, the Engineer is satisfied that the reduced mixing time will produce concrete with essentially the same strength and uniformity as concrete mixed for 90 seconds. However, the reduced mixing time shall not be less than 50 seconds or the manufacturer's recommended mixing time, whichever is the greater.

A suitable timing device in a good working order shall be attached to the mixer to ensure that the minimum mixing time is complied with.

The first batch to be run in a clean mixer shall contain only 2/3 of the required amount of coarse aggregate to facilitate "coating" of the mixer drum.

Discharge shall be so carried out that the materials in the mix will not segregate. The mixer shall be emptied completely before it is recharged.

06.04 Maintenance and cleaning of the mixer

If the mixer has stopped running for any period in excess of 30 minutes, it shall be thoroughly cleaned out, particular attention being given to the removal of any build-up of materials in the drum, in the loader and around the blades or paddles. Worn or bent blades and paddles shall be replaced.

Before any concrete is mixed, the inner surfaces of the mixer shall be cleaned and all hardened concrete shall be removed.

06.05 Standby mixer

Where sections are cast where it is important for casting to continue without interruption, a standby mixer shall be held in readiness to run at 15 minutes notice in case of a breakdown of the stock mixers.

07 PLACING AND COMPACTION

07.01 General

Concrete shall be transported and placed in a manner that will prevent segregation or loss of constituent materials and contamination.

Concrete shall not be placed in any part of the Works until the Engineer's approval has been given. If concreting is not started within 24 hours of approval having been given, approval shall again be obtained from the Engineer.

Concreting operations shall only be carried out during normal working hours unless the Engineer has approved of concreting being carried out outside normal working hours, in which case proper lighting arrangements shall be made and the lights shall be in working order by noon. Workmen shall not be allowed to work in double shifts, and the Contractor shall provide a fresh team for night shifts.

The placing and compaction of concrete shall at all times be under the direct supervision of an experienced concrete supervisor.

Once concreting has begun, it shall be carried out in a continuous process between construction joints. Concrete shall be placed within 15 minutes of the mixing being completed and within one hour of mixing having started. All excavations and other contact surfaces of an absorbent nature, such as timber formwork, shall be kept damp, but no free water shall be permitted to remain on these surfaces. The formwork shall be clean on the inside.

07.02 Placing

Whenever possible, concrete shall be deposited vertically into its final position. Where chutes are used, their lengths and slopes shall be such as to not cause segregation, and suitable spouts or baffles shall be provided at the lower end to minimize segregation. The displacement of concrete by vibration instead of direct placing will not be allowed.

When casting structural members of substantial thickness, care shall be taken to avoid layering of the concrete, and in so far as is possible, the entire thickness shall be placed in one pass.

Fresh concrete shall not be placed against concrete that has been in position for more than one hour unless a construction joint is formed.

The pumping of concrete and the equipment to be used therefor shall be subject to the written approval of the Engineer. Aluminium pipes shall not be used for this purpose.

In plain (unreinforced) concrete with at least a 300 mm thickness, hard, clean plum stones with a mass of 15 kg - 55 kg may, if approved by the Engineer, be included to replace concrete for up to 20% of the total volume, provided -

- such plums have no adhering films or coatings;
- no plums have a dimension greater than one-third of the smallest dimension of the concrete member, or 300 mm, whichever is the smaller;
- each plum is surrounded by at least 75 mm of concrete; and
- each plum is more or less cubic in shape with no dimension being less than 60% of the longest dimension.

07.03 Placing under water

Normally concrete shall be placed only in the dry. Placing under water shall be allowed only in exceptional circumstances where, in the opinion of the Engineer, dewatering before placing is not feasible. No concrete shall be placed in flowing water.

Underwater concrete shall be placed by means of tremies. Full details of the method proposed for use by the Contractor shall be submitted to the Engineer in advance, for his approval. Placing by skip or pipeline will also be considered in certain circumstances.

During concreting by tremie, air and water must be excluded from the tremie by keeping the pipe filled with concrete at all times. When charging the tremie, a plug formed of suitable paper or sacking shall first be inserted in the top of the pipe. Once concreting has begun, the discharge end of the tremie shall be kept well below the surface of the concrete. Should this seal be broken, the tremie shall be lifted and plugged before concreting is recommenced. Distribution of concrete by lateral movement of the tremie will not be permitted.

The concrete mix used for underwater placing shall be specially designed and approved for this purpose to ensure good fluidity, plasticity and cohesion. The sand and cement content required for these mixes will usually be higher than that of normal mixes.

07.04 Compaction

Concrete shall be fully compacted by approved means during and immediately after placing. It shall be thoroughly worked against the formwork, around reinforcement, tendons, ducts and embedded fittings and into corners in order to form a solid mass free from voids.

The concrete shall be free from honeycombing and planes of weakness and successive layers of the same lift shall be thoroughly bonded together.

Unless otherwise agreed upon by the Engineer, concrete shall be compacted with vibrators. Internal vibrators shall be capable of producing not less than 10 000 cycles per minute and external vibrators not less than 3 000 cycles per minute. A sufficient number of standby vibrators shall be held available in case of breakdowns.

Vibration shall be applied by experienced labour, and over-vibration resulting in segregation, surface water and leakage shall be avoided. Contact with reinforcement and formwork shall, in so far as is practicable, be avoided when internal vibrators are used.

Concrete shall not be subjected to disturbance by vibration within 4 to 24 hours of compaction.

Whenever vibration is applied externally, the design of the formwork and positioning of vibrators shall be so as to ensure efficient compaction and the avoidance of surface blemishes.

Special attention shall be given to the compaction of concrete in the anchorage zones for post-tensioned cables and behind the anchor plates, in the proximity of joint formers, waterstops and ducts and in all places with high concentrations of reinforcing steel or cables.

In cases where the placing and compaction of concrete is difficult, a mix containing smaller-sized aggregate may be used, but only with the approval of the Engineer and after a mix containing such aggregate has been designed and tested.

07.05 Requirements where sliding formwork is used

Where sliding formwork is used, the following additional requirements shall apply:

- The Contractor shall take all the necessary measures to ensure the continuity of operations. All the necessary lighting and standby equipment for mixing, hoisting, placing and compaction shall be provided and all the materials required for completing each structure shall be ready on the Site before casting commences.
- Concrete shall be cast in uniform layers along the formwork so that the top surface of the concrete will not vary by more than 150 mm at any part of the formwork. In addition, the level of the concrete shall never be more than 300 mm below the top of the sliding panel. The working platform must be kept clean, and no concrete which has partially dried out may be swept into the formwork.
- The concrete shall be compacted during and immediately after placing. Care shall be taken not to damage or disturb previously placed concrete. To ensure the proper bonding of successive layers, not more than one hour shall elapse between placing of the successive layers. If delays do occur, layer thicknesses shall be adjusted rather than allowing the time between the placing of the successive layers to exceed one hour.
- Attention is drawn to the other requirements specified in subclause 05.02 (e) of section 702.

08 CONSTRUCTION JOINTS

08.01 General

Concreting shall be done continuously up to the construction joints shown on the Drawings or as approved, except that, if concreting has to be interrupted because of an emergency (such as the mixing plant breaking down or unsuitable weather occurring), a construction joint shall be formed at the place of stoppage in the manner that will least impair the durability, appearance and proper functioning of the concrete.

Unless otherwise shown on the Drawings, the exact position of horizontal construction joints shall be marked on the formwork by means of grout checks in order to obtain truly horizontal joints.

Stub columns, stub walls or kickers on footings shall be cast integrally with the footings and not afterwards, even where a different class of concrete is to be used.

08.02 Preparation of surfaces

When the concrete has set and while it is still green, the surface film and all loose material shall be removed, without disturbing the aggregate, by means of a water jet assisted by light brushing to expose the aggregate and to leave a sound, irregular surface.

Where this is not possible, the surface film shall be removed after the concrete has hardened, by mechanical means appropriate to the degree of hardness of the concrete to expose the aggregate and leave a sound, irregular surface. The roughened surface shall be washed with clean water to remove all laitance, dirt and loose particles.

08.03 Placing fresh concrete at construction joints

When fresh concrete is placed on the same day as that on which the construction joint has been formed, the fresh concrete shall be cast directly against the face of the construction joint.

When concreting recommences a day or more after the construction joint has been formed, the following procedure shall be followed:

- The construction joint shall be kept continuously wet for a period of at least 2 hours before concreting starts, but any further applications of water shall cease just before reconcreting so that the surface will be just damp when further concreting is commenced.
- Any dirt, excess water or loose particles shall be removed prior to reconcreting being started.
- For horizontal construction-joint surfaces, a freshly mixed slurry consisting of sand, cement and water mixed in the same proportions as those used in the concrete, approximately 10 mm thick, shall be applied to the construction-joint surface immediately ahead of concreting. The slurry must still be in a plastic state when applied. For vertical construction-joint faces, a thin coat of a freshly mixed paste of neat cement and water, made with as little water as is practicable, shall be applied to the construction joint immediately before concreting.
- Epoxy resins specially designed for bonding old concrete to new concrete shall be used at construction joints where so directed by the Engineer. The preparation of the construction-joint surface and the application of the epoxy resin shall be strictly in accordance with the manufacturer's recommendations and the Engineer's instructions. The actual brand and type of resin used shall be subject to the Engineer's approval.

09 CURING AND PROTECTION

Formwork shall be retained in position for the appropriate times given in clause 06 of section 702 and, as soon as is practicable in the opinion of the Engineer, all exposed concrete surfaces shall be protected from loss of moisture by one or more of the following methods:

- Retaining formwork in place for the full curing period.
- Ponding the exposed surfaces by means of water, except where atmospheric temperatures are low, i.e. less than 5°C.
- Covering with sand, or mats made of a moisture-retaining material, and keeping the covering continuously wet.
- Continuous spraying of the whole area of the exposed surfaces with water (only on surfaces where ponding or sand cover is not possible).
- Covering with a waterproof or plastic sheeting firmly anchored at the edges.
- Using an approved curing compound applied in accordance with the manufacturer's instructions, except that where the surface has to be subsequently waterproofed, coated or gunited, this method may not be used.
- Steam curing (precast units)

The method adopted for curing shall be subject to the Engineer's approval and shall not cause staining, contamination or marring of the surface of the concrete.

The curing period shall be continuous for at least 5 days for concrete made with ordinary cement, at least 2 days for that made with rapid-hardening cement, and at least 7 days if CEM III cement or a mixture of CEM I cement and ground, granulated blast-furnace slag is used.

When the ambient air temperature falls below 5°C, these minimum curing periods shall be extended by the period during which the temperature of the concrete was below 5°C.

Where sliding formwork is used, the concrete shall be protected against the weather and rapid drying out with a 4 m long skirt attached to the lower perimeter of the formwork and hanging over the working platform. The skirt shall consist of hessian in summer months but of canvas or other suitable material in winter. The skirt shall be weighted at the bottom to prevent it from flapping about in windy conditions.

Where sliding formwork is used, the concrete shall be cured by fog spraying to keep it continuously wet for the periods stated above or until a curing compound is applied. The concrete shall be wetted with a fixed spraybar over the full length of the sliding formwork. The spraybar shall be connected to a suitable high-pressure water supply. Wetting shall be discontinued when the ambient air temperature drops below 5°C, and care shall be taken to ensure that the water will not erode the fresh concrete surface.

10 ADVERSE WEATHER CONDITIONS

10.01 Cold weather

Concrete shall not be placed during falling temperatures when the ambient air temperature falls below 7°C or during rising temperatures when the ambient air temperature is below 3°C. When concrete is placed at air temperatures below 5°C, the temperature of the concrete to be placed shall not be allowed to drop below 10°C before it is placed.

The temperature of placed concrete shall not be allowed to fall below 5°C until the concrete has attained a strength of at least 5 MPa, and the Contractor shall be responsible for all the necessary protective measures to ensure this. All concrete that has been damaged by frost or by the formation of ice in the concrete shall be removed and replaced by the Contractor at his own expense.

10.02 Hot weather

When the ambient air temperature exceeds 32°C during a concreting operation, the Contractor shall take measures, which have been approved by the Engineer, to control the temperature of the concrete ingredients so that the temperature of the placed concrete will not exceed 25°C. Such measures will include the spraying of aggregate stockpiles with water to promote cooling down by evaporation and, where feasible, the shading of stockpiles and the area where the concreting is carried out. Curing shall commence immediately after the concrete has been placed to prevent excessive loss of moisture.

10.03 Additional precautions where sliding formwork is used

When sliding operations take place in cold weather, the water only, or the water and aggregate, shall be heated to ensure that the concrete temperature will not drop below 10°C until it has attained a strength of 5 MPa.

The Contractor shall make all the necessary arrangements to heat the material and protect the concrete against loss of heat. Heated water and aggregate shall be mixed first and the cement added only at temperatures below 30°C.

During cold weather the rate of sliding shall be suitably decreased to ensure that the concrete leaving the bottom of the formwork will have sufficient strength.

11 PIPES AND CONDUITS

No pipes and conduits other than those shown on the Drawings shall be embedded in the concrete without the Engineer's approval. Pipes and conduits passing through concrete walls shall be embedded in the wall simultaneously with the casting of the wall. The clear space between such pipes or between such pipes and any reinforcement shall be at least 40 mm or the maximum size of the aggregate plus 5 mm, whichever is the greater. The amount of concrete cover over pipes and fittings shall be at least 25 mm.

The ends of all ferrules used for bracing formwork shall be neatly finished off to the details shown on the Drawings. Where no details are given on the Drawings, ferrules shall be cut back and the holes filled in with mortar and finished off flush with the concrete surface.

12 APPLIED LOADING

No load shall be applied to any part of a structure until the specified curing period has expired, and any loading applied thereafter shall only be allowed after approval by the Engineer. The Engineer's decision will be based on the type of load to be applied, the age of the concrete, the magnitude of stress induced and the propping of the structure.

No structure shall be opened to traffic until test cubes made of the concrete in all parts thereof have attained the specified minimum 28-day strength.

13 PRECAST CONCRETE

This clause applies to all reinforced and prestressed concrete members other than precast concrete piles, culverts and pipes in so far as they are dealt with separately elsewhere in these Specifications.

All precast members shall be manufactured in accordance with the requirements specified for cast in situ members in so far as these requirements are relevant. In addition, the following shall apply:

- The Contractor shall take all the necessary safety measures and precautions during the handling and erection of precast members and shall ensure the stability of members as positioned prior to casting in.
- Where concrete members are precast off Site, the manufacturer shall keep and make available to the Engineer full records of all the concrete mixes and strength tests pertaining to the members cast. The Contractor shall notify the Engineer in advance of the casting dates to arrange for the inspection and testing of precast members.
- For the purpose of identification, all members shall be marked with paint in neat lettering with the number of the member shown on the Drawings or ordered by the Engineer and an identification number relating to the manufacturing records. Letters, etc shall be so positioned that they will not be visible when the member is placed in its final position in the completed structure.
- All precast members that have been chipped, cracked, warped or otherwise damaged to such an extent that the damage will, in the opinion of the Engineer, impair the appearance, function or structural integrity of the members, shall be rejected or, where so allowed, repaired to the satisfaction of the Engineer.

14 TESTING AND QUALITY CONTROL

14.01 Process control

The Contractor's minimum obligations in terms of clauses 04 and 05 of section 901 shall be the following:

(a) Testing of aggregates

Coarse aggregate shall be tested for grading once for every 100 m^3 delivered on Site and fine aggregate once for every 50 m^3 delivered.

(b) Testing of 28-day compressive strength

The 28-day cube compressive strength of concrete shall be controlled by the Contractor at not less than the following frequencies:

Volume of lot	Minimum No of tests per lot
0 - 75 m^3	3
75 - 150 m^3	4
over 150 m^3	5

Notes:

- A test result shall be the average test value for three cubes prepared from the same batch of concrete.
- Where the Engineer of his own accord runs a full programme of routine tests for 28-day compressive strength he may, at his sole discretion, relieve the Contractor of his obligation to run his own tests, but in such case any reliance placed by the Contractor on the Engineer's tests shall be entirely at the Contractor's risk and no claims resulting from such reliance placed on tests by the Engineer, which may subsequently prove to have been incorrect, will be considered.

(c) Accelerated cube-compressive-strength tests

In the case of major structures, the Contractor is advised to carry out regular accelerated compressive-strength tests in order to predict the 28-day compressive strength of concrete. The methods of testing and predicting 28-day strengths shall be as determined in consultation with the Engineer. Whenever accelerated tests indicate that the 28-day strengths will not be obtained, the Contractor shall immediately effect such changes in materials and mix proportions as may be necessary to ensure future compliance. Accelerated tests shall be additional to the 28-day routine tests.

When specified in the Project Specifications, the use of accelerated tests shall be obligatory.

(d) Control charts

The Contractor shall institute a system of control charts depicting test results of all 28-day concrete strengths and, where applicable, accelerated compressive strengths,

(e) Record keeping

The Contractor shall maintain written records that indicate the following:

- The date on which each section was concreted, the class of concrete, the time taken for placing, and the position of the section in the Works.
- Daily maximum and minimum temperatures.
- Nature of samples and dates on which they were taken, including identification marks.
- Results of tests on samples taken and the description of each concrete section represented by samples.

These records shall be kept in a form agreed upon by the Engineer, a copy of which shall be supplied to the Engineer as soon as results become available.

14.02 Quality control by the Engineer

(a) Criteria for compliance with requirements

Routine inspection and quality control will be carried out by the Engineer as specified in section 901. The criteria for compliance with the requirements specified for 28-day characteristic strength shall be as given in clause 05 of section 902.

(b) Procedure in the event of failure to comply with the requirements

Any lot represented by test cubes which fails to meet the criteria specified for the characteristic strength -

- shall be rejected,

  or

- may be conditionally accepted at reduced payment, subject to the provisions of clause 07 of section 902,

  or

- the Contractor may apply for resubmission of the lot on the basis of cores drilled from the concrete section in question. The methods of taking and testing cores and evaluating the test results shall be as described in subclause 07.03 of section 903. The procedure for determining compliance of test results shall be as specified hereafter in subclause 14.02 (c). The cost of drilling and testing the cores shall be for the Contractor's account, regardless of the outcome of the tests on the cores.

  Before cores are taken, the members concerned shall be cured and allowed to age for at least 28 days but for not more than 56 days.

Where the Engineer so directs, full-scale load tests shall be carried out in accordance with SANS 10160 to determine whether a specific structure or member can be accepted. The cost of such tests shall be for the Contractor's account, regardless of the outcome of the tests. In all cases where concrete has been produced that fails to meet the strength requirements, the Contractor shall immediately take the necessary remedial action by changing the mix proportions to obtain the required strength.

(c) The strength requirements for concrete cores

The actual number of cores to be taken from a resubmitted lot shall depend on the size of the lot and the nature of the structure and will be determined by the Engineer.

The lot shall be deemed to have met the requirements for characteristic strength if the "estimated potential strength" of the cores, determined as specified in subclause 07.03 of section 903, meets the requirements specified in clause 05 of section 902 for 28-day cube-compressive-strength tests.

(d) Testing ordered by the Engineer

Where routine testing of concrete cubes is not carried out on the Site by the Engineer, he may order the Contractor to have the concrete cubes that have been made by the Engineer tested at an approved testing laboratory, in which case payment for such tests shall be made in accordance with the provisions of section 903.

15 NO-FINES CONCRETE

15.01 Materials

Cement, aggregate and water shall comply with the requirements of clause 02 of this section.

Each size of aggregate shall be a single-sized aggregate graded in accordance with SANS 1083.

15.02 Classes of no-fines concrete

No-fines concrete shall be classified by the prefix NF and the size of the aggregate to be used. Class NF 19 means a no-fines concrete with a 19 mm nominal size aggregate.

The volume of aggregate per 50 kg of cement for each class of no-fines concrete shall be as depicted in table 704/4.

Table 704/4

VOLUME OF AGGREGATE

Class	Aggregate per 50 kg cement
NF 38	0,33 m^3
NF 19	0,33 m^3
NF 13	0,27 m^3

15.03 Batching and mixing

Cement shall be measured by mass or full bags of 50 kg each and aggregate shall be measured by volume in approved measuring boxes or barrows.

The quantity of water added shall be just sufficient to form a smooth grout that will adhere to and completely coat each and every particle of aggregate and to be just wet enough to ensure that, at points of contact of the aggregate, the grout will run together to form a small fillet to bond the aggregate together. The mix shall contain no more than 20 litre of water per 50 kg of cement.

Mixing shall be carried out in an approved batch-type mechanical mixer, but small quantities may be hand-mixed.

15.04 Placing

No-fines concrete shall be placed in accordance with the procedure agreed upon by the Engineer. It shall be placed in its final position within 30 minutes of mixing.

The no-fines concrete shall be worked sufficiently to ensure that it completely fills the space to be concreted and that adjacent aggregate particles are in contact with one another. Excessive tamping or ramming shall be avoided and under no circumstances may the no-fines concrete be vibrated.

15.05 Protection

All no-fines concrete shall be protected from the elements and loss of moisture. Protection against loss of moisture shall be accomplished in one or more of the following ways:

- Retaining formwork in place.
- Covering exposed surfaces with sacking or other approved material kept continuously wet.
- Covering exposed surfaces with plastic sheeting.

No-fines concrete placed during cold weather shall be adequately protected against frost for at least 3 days.

16 MEASUREMENT AND PAYMENT

Item		Unit
704.01	**Cast in situ concrete**	
704.01.01	(Class of concrete and portion of structure or use indicated)	cubic metre (m^3)
704.01.02	Etc for other classes of concrete and other uses or portions of the structure	

The unit of measurement for cast in situ concrete shall be the cubic metre of concrete in place. Quantities shall be calculated from the dimensions shown on the Drawings or authorized by the Engineer. No deduction in volume measured for payment shall be made for the volume of any reinforcing steel, inserts and pipes or conduits, with diameters of less than 150 mm embedded in the concrete.

The tendered rates shall include full compensation for procuring, furnishing and storing the materials, providing all plant, mixing, transporting, placing and compacting the concrete, forming the inserts, construction joints (except mandatory construction joints), and contraction joints, curing and protecting the concrete, repairing defective surfaces, and finishing the concrete surfaces as specified. Payment shall distinguish between the different classes of concrete.

Item		Unit
704.02	**Manufacture of precast concrete members** (Indicate class of concrete and describe member with reference to Drawing)	number (No)

The unit of measurement shall be the number of complete members or elements of each type and size, in position in the Works.

The tendered rate for each precast member shall include full compensation for all concrete work, all formwork, all steel reinforcement and all the prestressing required to manufacture the member complete, excluding only pre- stressing in connection with in-situ concrete cast subsequent to the placing of the precast members, for which prestressing separate payment is provided elsewhere in the Schedule of Quantities.

Item		Unit
704.03	**Transportation and erection of precast concrete members** (Description and mass to be given)	number (No)

The unit of measurement shall be the number of precast concrete members of each type and size placed into position.

The tendered rate for each precast member shall include full compensation for all work, costs and equipment necessary for transporting, erecting and placing the precast concrete members into position.

Item		Unit
704.04	**Epoxy bonding of new concrete surfaces to old**	square metre (m^2)

The unit of measurement shall be the square metre of new concrete surface bonded to the old with an approved epoxy bonding agent on the instructions of the Engineer in the manner specified in the Drawings or the Project Specifications.

Only the surfaces of mandatory construction joints bonded in this manner shall be measured for payment. The tendered rate shall include full compensation for the bonding of old and new concrete with an approved epoxy resin, all complete as specified.

Item		Unit
704.05	**Cast in situ no-fines concrete**	
704.05.01	(Class of no-fines concrete and portion of structure or use indicated)	cubic metre (m^3)
704.05.02	Etc for other classes of no-fines concrete and other portions of structures or uses	

The unit of measurement for cast in situ no-fines concrete shall be the cubic metre of no-fines concrete in place. Quantities shall be calculated from the dimensions shown on the Drawings or authorized by the Engineer.

The tendered rates shall include full compensation for procuring, furnishing and storing the materials, providing all plant, mixing, transporting, placing and working the concrete and for curing and protecting the concrete.

Item		Unit
704.06	**Precast no-fines concrete units**	
704.06.01	(Indicate class of no-fines concrete and describe unit with reference to Drawing)	number (No)
704.06.02	Etc for other classes of no-fines concrete and units of other types and sizes	

The unit of measurement shall be the number of complete units of each size and type in position in the Works.

The tendered rate for each precast no-fines concrete unit shall include full compensation for providing all materials, labour, plant and formwork required for the manufacturing of the unit, complete as shown on the Drawings, and for transporting and placing the unit in position.

Item		Unit
704.07	**Design of concrete mixes by a specialist organization appointed by the Engineer**	provisional sum

The provisional sum allowed will be used for reimbursing the Contractor for the actual invoiced charges paid by him to specialist organizations appointed by the Engineer for the design of concrete mixes. No other charges will be paid for.

SERIES 7 : STRUCTURES

SECTION 705 : PRESTRESSING OF CONCRETE

CONTENTS

01 SCOPE

This section covers the materials, equipment and work required for prestressing structural concrete members.

02 DEFINITIONS

The following definitions and terms shall apply to this section:

(a) Anchorage

The device comprising all the components and materials required to retain the force in a tensioned tendon and to transmit this force to the concrete of the structure.

(b) Anchorage reinforcement

The spiral and other reinforcement which form part of the anchorage and which are required to strengthen the anchorage and/or to assist in transmitting the tendon force to the concrete.

(c) Bursting reinforcement

The reinforcing steel required in and adjacent to the anchorage zones to resist the tensile stresses induced in the concrete by the anchorage(s).

(d) Cable

The tendon together with the anchorage, sheathing and all fittings.

(e) Characteristic strength

The manufacturer's guaranteed tensile strength of prestressing steel; no more than 5 per cent of the test results in a statistical sample shall fall below this strength.

(f) Duct

The void formed to house the tendon(s), which may be formed by coring, sheaths or extractable cores.

(g) Prestress

The stress induced in concrete by tensioned tendons,

(h) Prestressed concrete

Structural concrete in which effective internal stresses are induced by means of tensioned tendons.

(i) Pre-tensioning

A method of prestressing where the tendon is tensioned before the concrete has been cast.

(j) Post-tensioning

A method of prestressing where the tendon is tensioned after the concrete has attained its specified strength.

(k) Pull-in

The elastic shortening of the tendon between anchors caused by relative movement between the anchorage or coupler components on account of seating and gripping action at transfer.

(l) Release

The specified elastic shortening of the external tendon between the anchor and the gripping position at the anchorage that shall be achieved at transfer.

(m) Sheath

The tube or casing which encloses the tendon and which temporarily or permanently allows a relative movement between the tendon and the surrounding concrete.

(n) Tendon

The prestressing steel which consists of one or more bars, wires or strands, all of which are tensioned to impart prestress to a concrete member.

(o) Tensioning

The action of inducing and regulating the force in a tendon by means of tensioning and measuring equipment.

(p) Transfer

In the case of post-tensioning, the action of transferring the force from the tensioning equipment (jack) to the anchorage.

In the case of pre-tensioning, the action of transferring the force in the tensioned tendon(s) to the concrete.

03 MATERIALS

03.01 General

All materials and prestressing systems used in the prestressing of structural concrete members shall be subject to the approval of the Engineer.

03.02 Prestressing steel

(a) General

The type of prestressing steel shall be as designated in the Project Specifications and on the Drawings.

The Contractor shall keep proper records of all material analyses and test certificates of the batches of prestressing steel used in the Works. Where required by the Engineer, the Contractor shall produce certificates from recognized testing authorities certifying compliance of the prestressing steel with the relevant standard specifications listed in subclauses 03.02 (b), (c) and (d) of this section.

Where prestressing steel is available in weld-free lengths (production lengths) and lengths containing welds (standard lengths), the batches delivered on the Site shall be clearly labelled for identification.

After manufacture, the prestressing steel shall not under any circumstances be subjected to heat treatment other than that provided for in these Specifications.

(b) Bars

Cold-worked high-tensile alloy steel bars for prestressed concrete shall comply at least with the requirements of BS 4486.

The type of prestressing steel shall be indicated in accordance with the requirements of clause 4.2 of BS 4486, e.g. BS 4486-RR-32-1230 for 32 mm diameter double-ridged bar with a characteristic strength of 1 230 MPa.

(c) Wires and seven-wire steel strand

Steel wire and seven-wire steel strand for prestressed concrete shall comply at least with the requirements of BS 5896.

The type of prestressing steel shall be indicated in accordance with the requirements of clause s 14 and 20 of BS 5896 for wire and strands respectively, e.g.:

(i) BS 5896/2 wire 1770-7-PE-relax 1 for a 7 mm diameter plain wire of class 1 relaxation with a characteristic strength of 1 770 MPa; and

(ii) BS 5896/3 superstrand 1860-12,9-relax 2 for a 12,9 mm diameter superstrand of class 2 relaxation with a characteristic strength of 1 860 MPa.

(d) Straightness

Prestressing bars delivered to the Site shall be straight. Only small adjustments for straightness may be made, which shall be done by hand on the Site at temperatures above 5°C and under the supervision of the Engineer. Where heating is required, it shall be by means of steam or hot water. Bars bent in the threaded portion shall be rejected.

Prestressing wire and strand shall be supplied in coils of sufficiently large diameters to ensure that the wire and strand will reel-off straight.

(e) Surface condition

Prestressing steel shall be clean and free from faults and defects and harmful films and matter that may impair its adhesion to the grout or concrete.

The depth of imperfections or pits on the surface of prestressing steel shall not exceed 0,1 mm for wire with diameters of up to and including 8 mm, or 0,2 mm for bars or wire with diameters exceeding 8 mm.

Tendons may be cleaned by wire brushing or by being passed through a pressure box which contains carborundum powder. Solvent solutions shall not be used for cleaning without the approval of the Engineer.

Prestressing steel shall be delivered to the Site suitably protected against damage and corrosion. Such protection or the use of a corrosion inhibitor, where allowed by the Engineer, shall not have any harmful effects on the steel or concrete or impair the bond.

(f) Galvanizing

Galvanized prestressing steel shall not be used unless specified.

(g) Welds

Prestressing steel used in structural prestressed concrete shall be free from welds. Where the steel is supplied in standard lengths, the welds shall be cut out and delivered to the Engineer.

03.03 Anchorages and couplers

Anchorages and couplers for use in prestressed concrete shall comply with the requirements of BS 4447 and shall be of a proven and approved type, and constructed from durable material completely free from imperfections, and they shall not damage, distort or kink the prestressing steel in a manner that would result in reducing the ultimate tensile-strength. They shall, without failure and/or excessive deformation or relaxation of the force in the tendons, resist the full ultimate tensile strength of the tendons. The characteristic value for anchorages and couplers, determined in accordance with BS 4447, shall not be less than 90%.

The anchorages shall effectively distribute the force in the tendon to the structural member and the resulting local stresses and strains in the member shall be so limited as to prevent damage. Unless otherwise approved, all anchorages and couplers shall be provided with anchorage reinforcement.

Wedges and the insides of barrels or cones shall be clean to allow the free movement and seating of the wedges inside the taper.

The threads of bars, nuts, anchorages and couplers shall be suitably protected against damage and corrosion. The protection shall be removed at the last moment and the threads shall be properly lubricated before use.

03.04 Sheaths

Sheaths shall be of grout-tight construction and of such material and configuration as will allow the transference of bond forces from the grout to the surrounding concrete. The properties of the sheath material shall be such that no corrosion attack of the prestressing steel will be induced. The sheath shall be sufficiently flexible to accept the required curvature without kinking, and shall be strong enough to retain its cross-section and alignment and to resist damage caused by handling, transportation, tying and contact with vibrators during concreting. Unless otherwise approved by the Engineer, the thickness of metal of steel sheaths shall not be less than 0,4 mm.

Metal sheathing shall be delivered to the Site suitably protected against damage and corrosion. At the time of incorporation in the structural member, the sheathing shall be free from loose mill scale, loose rust, lubricants and harmful matter.

Galvanized sheathing shall not be used unless specified.

Unless otherwise specified, the internal diameter of the sheath shall be at least 10 mm greater than the diameter of the tendon. For vertical tendons, and where tendons are to be drawn into cast-in sheaths, the duct area shall be at least three times the cross-sectional area of the tendon.

03.05 Cable supports

Supports of reinforcing steel or structural steel suitably braced to prevent buckling under load shall be used to support the cables.

The cable saddles shall be rigid and secured in position by welding or by equivalent mechanical means to resist gravitational, vibratory and buoyancy forces.

Normal web reinforcement shall not be used to support cables.

Saddles for external cables shall be of special design and material to ensure low friction and to prevent the tendon or parts thereof from grooving the surface. The saddle plates shall be curved to the required radius to prevent the tendon or part thereof from bearing on the end of the plate, and shall incorporate features to ensure the separate seating of individual bars, wires and strands.

03.06 Tendon spacers

Tendon spacers used inside the ducts to separate individual bars, wires or strands of the tendon shall be of a proven and approved type and manufactured from material that will not induce corrosion of the prestressing steel.

03.07 Grout

(a) Materials

In addition to the requirements of subclause 02.03 of section 704, water shall not contain more than 500 mg of Cl-ions per litre of water.

Only CEM I Class 32,5N cement which is less than one month old shall be used. The temperature of the cement shall be less than 40°C.

Fine aggregate shall consist of siliceous granules, finely ground limestones, trass or very fine sand. The aggregate used shall pass through a 0,600 mm sieve. The use of fine aggregate shall be subject to the approval of the Engineer and shall be restricted to grout for ducts with diameters larger than 150 mm. The aggregate content in the grout shall not exceed 30% of the mass of the cement.

The use of admixtures shall be subject to the written approval of the Engineer and will only be considered after tests have shown that their use improves the properties of the grout, e.g. by increasing workability, reducing bleeding or entraining air. Admixtures shall be free from any product liable to damage the steel or the grout itself, such as halides, nitrates, sulphides, sulphates, etc. The amount of admixture to be used shall be in accordance with the manufacturer's instructions.

(b) Properties of the grout

The mixed grout shall have the following properties:

(i) The Cl-ions content shall not exceed 750 mg/litre.

(ii) The viscosity of the grout for horizontal cables shall be 500 cP - 2 500 cP and that for vertical cables 400 cP - 1 500 cP. Twenty minutes after mixing the viscosity shall not exceed 2 500 cP and 1 500 cP for horizontal and vertical cables respectively.

(iii) Three hours after mixing, bleeding at 20°C shall not exceed 2% by volume, and the maximum bleeding shall not exceed 4%. In addition, the separated (bleed) water must be reabsorbed after 24 hours.

(iv) The compressive strength of 100 mm cubes made from the grout and cured in a moist atmosphere for the first 24 hours and thereafter in water at 20°C, shall exceed 20 MPa after 7 days.

03.08 Protection agents for unbonded tendons

The material used for the permanent protection of unbonded tendons shall have the following properties:

- It shall remain free from cracks and shall not become brittle or fluid within the temperature range of -20°C to 70 °C.
- It shall be chemically stable for the life of the structure.
- It shall be non-reactive with the surrounding materials, i.e. concrete, tendons, wrapping or sheathing.
- It shall be non-corrosive or corrosion-inhibiting.
- It shall be impervious to moisture.
- It shall be sufficiently tough to withstand the abrasion caused when a tendon, precoated with the material, is drawn into the sheath.
- It shall have no appreciable shrinkage or excessive volume increase.
- It shall have a suitable viscosity at ambient temperature or require only moderate preheating to permit injection.

03.09 Testing

Prestressing steel, anchorages, couplers and grout shall be tested in accordance with the requirements of subclause 10.02 of section 903. Testing shall be carried out at the frequencies directed by the Engineer.

04 EQUIPMENT

04.01 General

All equipment used shall be in a good working order and shall be properly maintained.

04.02 Tensioning and measuring equipment

Tensioning and measuring equipment shall be able to establish the tendon force to an accuracy of ± 2% during any stage of the tensioning operation.

Unless otherwise authorized by the Engineer, tensioning equipment shall be power driven and shall be able to apply a controlled total force gradually without inducing dangerous secondary stresses in the tendon, anchorage or concrete.

The force in the tendon during tensioning shall be measured by direct-reading load cell(s) (dynamometer) or shall be obtained direct from pressure gauges fitted in the hydraulic system to determine the pressure in the jacks.

Pressure gauges shall be concentric scale gauges which comply with the requirements of SANS 1062. The gauges shall not be less than 150 mm in diameter and shall be used within the range of 50 - 90% of their full capacity at maximum service pressures.

When pressure gauges which do not use glycerine are used, a snubber or similar device shall be fitted to protect the gauge against a sudden pressure release. Provision shall also be made for T-connections to which supplementary control gauges can be attached when required.

Only self-sealing connections shall be used in the hydraulic circuit. Where the pressure-input pipe is connected to the jack, a pipe rupture valve shall be installed in the circuit.

Tensioning equipment shall be calibrated before the tensioning operation and thereafter at frequent intervals, as directed by the Engineer, against a master gauge or proving ring, and the Engineer shall be furnished with a calibration chart. The load-measuring devices shall be calibrated to an accuracy of ± 2%.

Tendon extension shall be measured to an accuracy of ± 2% or ± 2 mm, whichever is the more accurate, and pull-in and release shall be measured to an accuracy of ± 2 mm.

04.03 Grouting equipment

(a) Mixer

Only mechanically operated mixers of a type capable of producing high local turbulences while imparting only a slow motion to the body of the grout shall be used.

The mixer shall be equipped with a screen with openings not exceeding 1 mm and shall be capable of consistently producing grout with a colloidal consistency.

(b) Agitator

Where the capacity of the mixer is insufficient to fill the duct completely with grout, an agitator shall be used.

Mechanical agitators only shall be used, which are capable of maintaining the colloidal condition of the grout fill during the storing and injection processes. The grout shall be delivered at the structure from the agitator, and the system shall make provision for recirculating the grout from the pump back to the agitator.

(c) Injection equipment

The pump shall be of the positive displacement type (piston, screw or similar type), capable of exerting a constant pressure of at least 10 bars and shall incorporate a safety device to prevent the build-up of pressure above 20 bars. The pump shall be fitted with a pressure gauge and a valve that can be locked off without loss of pressure in the cable.

The pump shall be capable of delivering grout in such a way that the speed of the grout in the cable is between 6 m/min and 12 m/min.

All connections in the pipes and between the pipe and the cable shall be airtight. Only threaded, bayonet or similar type connectors shall be used.

05 TECHNICAL DATA

The following technical data for pre-tensioned and post-tensioned structural members, required on the Contract, will be supplied on the Drawings:

(a) Tendon alignment

A diagrammatic layout showing the alignment of each tendon or group of tendons in both horizontal and vertical planes, together with the horizontal and vertical coordinates and curve equations of the centroid of the tendon(s), as may be relevant.

(b) Tendon system

The tendon system on which the design is based.

(c) Tensioning the tendons

Full particulars regarding the partial tensioning of the tendons, the stage during which the tendons shall be tensioned, and the sequence of tensioning to be followed.

(d) Tensioning force

The maximum tensioning force and the effective force at the live anchorage(s), after transfer, as well as the corresponding stress level in the prestressing steel, for each tendon or group of tendons. The forces will be given in MN units, and the stress levels will be expressed as a percentage of the characteristic strength.

(e) Extension

The extension per tendon or group of tendons under the maximum tensioning force, together with the modulus of elasticity (E) on which it has been based, as well as the release to be attained at each live anchorage and the pull-in allowed for.

(f) Prestressing losses in tendons

The losses allowed in the design, which may be caused as listed below, will be given as follows:

(i) Friction loss

The formula used to determine the tendon/duct friction loss together with the values adopted for the friction coefficient (micron) caused by curvature, and the wobble factor (k) caused by the unintentional variation from the specified alignment.

(ii) Elastic deformation of concrete

The elastic factor, which, when multiplied by the compressive stress in the concrete adjacent to the tendon, will give the loss caused by the deformation of the concrete,

(iii) Creep of concrete

The creep factor which, when multiplied by the compressive stress in the concrete adjacent to the tendon will give the loss caused by the creep of the concrete.

(iv) Shrinkage of concrete

The stress loss caused by shrinkage of the concrete.

(v) Relaxation of prestressing steel

The stress loss in MPa at a stress level of 70% of the characteristic strength of the prestressing steel caused by relaxation of the prestressing steel.

(g) Anchorages

The positions where loop or fan-type dead-end anchorages may be used.

(h) Bursting reinforcement

The bursting reinforcement for the prestressing system on which the design is based.

(i) Precamber

The precamber at intervals not exceeding 0,25 times the span length.

(j) Compressive strength of the concrete during transfer.

The compressive strength to be attained by the concrete in the relevant member before transfer may be effected.

06 PRESTRESSING SYSTEMS

The use of all prestressing systems shall be subject to the written approval of the Engineer. Tenderers are advised to obtain approval for the prestressing system they intend to use prior to submitting their Tenders.

Within one month of the award of the Tender or within a period agreed on by the Engineer, the Contractor shall submit full details of the prestressing system(s), materials and equipment he intends to use, as well as of the methods he proposes to adopt for the prestressing and related operations.

The Engineer may, at his discretion, call for further information in the form of detailed drawings, proof of successful previous use, performance certificates from an approved independent testing authority and calculations substantiating the adequacy of the system. The Contractor shall furnish such information within 2 weeks of being called upon to do so, or within a period agreed on by the Engineer. If, after investigating all the information, the Engineer is not satisfied that the structural member can be prestressed satisfactorily with the prestressing system offered by the Contractor, the Engineer reserves the right to order the Contractor to use any system which is suited to the work and which is readily available to the Contractor.

Only minor alterations to the concrete dimensions shown on the Drawings will be considered with a view to accommodating the prestressing system finally selected. Major alterations occasioned by the prestressing system offered by the Contractor which is at variance with the tendon system specified in subclause 05 (b) of this section, shall be treated as "alternative offers" and shall be dealt with as specified in clause 05 of section 001.

07 DRAWINGS PREPARED BY THE CONTRACTOR

All drawings prepared by the Contractor and submitted to the Engineer for consideration shall comply with the requirements of the Engineer.

At least 3 months before he intends to commence with the prestressing work, or within a period agreed on by the Engineer, the Contractor shall furnish the Engineer with drawings detailing the layout and alignment for the individual tendons, the cable supports, modification to the bursting and other reinforcement, anchorage recesses, tensioning sequence, tensioning loads and extensions, as well as requirements for the control of the tensioning operations.

The Contractor will be provided with the necessary standard transparent polyester drawing sheets for the preparation of his drawings. These drawings shall be of the same standard as the Contract Drawings.

Should the technical data of the prestressing system finally selected be at variance with the specified information, it shall be shown on the drawings prepared by the Contractor. Each tendon shall be numbered separately for identification.

When required, the Contractor shall submit calculations in respect of the variation of the tendon force along the length of the tendon, the expected extension, and the bursting forces.

After the drawings and calculations prepared by the Contractor have been approved by the Engineer, the forces, stresses and extensions shown thereon shall not be departed from without authorization by the Engineer.

No work shall be commenced on the prestressing work before the relevant drawings have been accepted and signed by the Engineer.

In his tendered rates the Contractor shall make full allowance for all costs in connection with the furnishing of information, the making of calculations, and the preparation and submission of drawings.

Alternative designs shall comply with clause 05 of section 001 and the relevant provisions of this section.

08 PRECAST WORK

08.01 Casting yard on the Site

Subject to the approval of the Engineer, precast work may be done at any location selected by the Contractor.

Before the proposed casting yard is established, the Contractor shall submit plans to the Engineer which demarcate the site and detail the layout of the yard, together with a flow diagram of the construction stages and storage.

08.02 Manufacture off the Site

The Contractor shall notify the Engineer in advance of the date when tensioning of tendons, the casting of members, and transfer, as may be relevant, will be undertaken.

Within 7 days of transfer, the Contractor shall furnish the Engineer with a certificate which gives the tendon force(s) and extension(s) attained, the records of the cube compressive strength, and the age of the concrete at transfer.

Test results relating to all aspects of the work shall be sent to the Engineer as soon as they become available.

Where the Engineer requires tests to be carried out on completed members, no member to which the tests relate shall be dispatched to the Site until the tests have been satisfactorily completed and the members have been accepted by the Engineer.

08.03 Manufacture

Before work is commenced with, details of the manufacture and phasing of the work shall be submitted to the Engineer for approval. After approval, no changes shall be made to the methods or systems without authorization by the Engineer.

The Contractor shall ensure that the specified precamber has been incorporated in the formwork. The magnitude of precamber shown on the Drawings shall be subject to variation depending on the Contractor's construction programme, and the Contractor shall, before manufacture, ascertain from the Engineer in writing, any increase or decrease in precamber. This procedure shall also apply to the cases where no precamber has been specified.

Lifting and supporting the precast members shall be made only at the points marked and provided therefor on the members.

Precast members which have not been fully tensioned, or which have not been fully tensioned for the relevant stage of erection, or which have ungrouted tensioned tendons, shall not be handled without authorization by the Engineer.

When members with ungrouted tensioned tendons are handled, any possible slip of the tendon at the anchorage shall be guarded against.

Prestressed precast concrete members shall also comply with the requirements of clause 13 of section 704.

09 PRE-TENSIONING

During the period between tensioning and transfer, the force in the tendon shall be fully maintained by some positive means. At transfer, detensioning shall take place slowly to minimize any shock that might adversely affect the transmission length of the tendon.

In the long-line method of pre-tensioning, sufficient locator plates shall be distributed throughout the length of the bed to ensure that the straight tendons are maintained in their proper position during concreting. Where a number of units are manufactured in line, they shall be free to slide in the direction of their length to permit transfer of the tendon force to the concrete along the whole line.

In the individual mould system, the moulds shall be sufficiently rigid to provide the reaction to the tendon force without distortion.

Wherever possible, the mechanisms for holding down or holding up deflected tendons shall ensure that the part in contact with the tendon is free to move in the line of the tendon to eliminate friction losses. If, however, a system is used that develops a frictional force, this force shall be determined by test and due allowance shall be made therefor.

For single tendons, the deflector in contact with the tendon shall have a radius of not less than 5 times the tendon diameter for wire or 10 times the tendon diameter for a strand, and the total angle of deflection shall not exceed 15°.

Transfer of the tendon force to the concrete shall be effected in conjunction with the release of hold-down and hold-up forces as may be approved by the Engineer.

Transfer shall not be effected until cube-compressive-strength tests on the concrete show that the concrete of the particular member has attained a compressive strength of at least 2,5 times the maximum working compressive stress in the concrete or a compressive strength of 35 MPa, whichever is the greater. The transmission length is affected by the concrete strength, and the necessary modification for the concrete strength at transfer shall be made in conjunction with the Engineer.

The tendons shall be cut off flush with the end of the member and the exposed ends covered with a heavy coat of bituminous compound or epoxy resin, as specified in the Project Specifications or as approved by the Engineer.

10 POST-TENSIONING

10.01 Storage, handling and protection

During storage, transit and construction, and after installation, the sheaths, prestressing steel, anchorages and couplers shall be protected against corrosion, damage or permanent deformation. The manner and extent of protection required will depend on the environmental conditions and the length of time before permanent corrosion protection is applied, and shall be approved by the Engineer. Under severe corrosive conditions the materials shall be stored in weather-proof sheds. All materials shall be stored clear of the ground and while in storage shall not be exposed to the weather.

When prestressing steel has been stored on the Site for a prolonged period and there is evidence of deterioration of the steel, the Engineer may call on the Contractor to prove by tests that the quality of the steel has not been significantly impaired and that it still complies with the provisions of these Specifications.

Suitable protection shall be provided to the threaded ends of bars.

After fabrication, the cable ends shall be covered with protective wrapping to prevent the ingress of moisture into the duct.

When the tendon is to be left untensioned for a prolonged period after installation, precautions shall be taken to protect the tendon against corrosion. Corrosion inhibitors, oils or similar materials used as lubrication or to provide temporary protection shall be completely removable before permanent protection is effected.

10.02 Fabrication

All the cutting of prestressing steel shall be performed with a high-speed abrasive cutting wheel or by a method approved by the Engineer. Flame cutting will not be permitted.

Care shall be taken to prevent the prestressing steel or anchorages from coming into contact with splashes from flame-cutting or welding processes in the vicinity.

Wherever possible, all bars, wires or strands tensioned in one operation shall be taken from the same parcel of prestressing steel. The tendon or cable shall be labelled to show the tendon or cable number and to identify the parcel from which the steel has been taken.

Where bars, wires or strands in a tendon are not tensioned simultaneously, tendon spacers shall be used in accordance with the recommendations for the prestressing system or, in the absence thereof, as directed by the Engineer.

Cables shall be fitted at both ends with pipes with diameters of at least 10 mm for the injection of grout or protection agents. The ends of the injection pipes shall be fitted with a clamp, valve or device capable of withstanding a pressure of at least 15 bars without loss of grout or protection agent.

Vent pipes with a diameter of at least 25 mm shall be provided in the ducts at every high point, change of sheath cross-section, and at such intermediate positions as may be required by the Engineer for the satisfactory grouting/protection of long tendons. The vent pipes shall extend to at least 750 mm above the concrete and shall comply with the requirements for injection pipes.

Connections to and joints in sheaths shall be made grout-tight either by special fittings or by taping. With bonded systems the length of taping shall not exceed six sheath diameters. Where oversleeves are used, equal overlaps shall be provided over each length of sheathing. Joints in adjacent sheaths shall be staggered at least 300 mm apart.

10.03 Installation

The installation of tendons shall not commence until the requirements of clause 07 of this section have been complied with.

The cable, sheath or extractable core shall be accurately installed to the specified alignment and securely held in position both vertically and horizontally at intervals appropriate to its rigidity so that it will not be displaced during concreting either by weight of the concrete or buoyancy. The spacing of the cable supports shall furthermore ensure that the tendon can be installed to a smooth alignment without kinks and within the tolerance specified in subclause 03.06 of section 707. A spacing of 1,0 m - 1,5 m should generally not be exceeded.

Extractable cores shall not be coated with release agent unless approved by the Engineer.

Unless otherwise shown on the Drawings, the alignment of the tendon within a distance of 1,0 m from the live anchorage and/or coupler shall be straight. Anchorages shall be set perpendicular to the tendon axis and be firmly secured in position so that they will not move during concreting. External anchorages shall be seated on a thin mortar bedding to bear evenly on the concrete surface and axially to the tendon.

Unless otherwise shown on the Drawings, the minimum concrete cover over the outside surface of the sheath or cable support shall comply with the requirements of clause 07 of section 703, except that the cover shall be not less than 50 mm in the case of sheaths.

The spacing of cables will depend on the size of the cable and shall be so as to achieve the proper placing and compaction of the concrete.

Immediately before concreting, the Contractor shall inspect the sheaths for grout-tightness and shall seal all damaged and suspect sections.

External tendons shall be installed to the same standards and accuracy as specified herein for internal tendons. The tendons shall be temporarily supported at regular intervals along the straight length between saddles. The supports shall consist of rigidly constructed frames secured to the concrete face.

10.04 Concrete strength

Full tensioning of all or part of the tendons shall not commence until the cube-compressive-strength tests on the concrete of the particular member show a compressive strength of 35 MPa or 2,5 times the maximum working compressive stress induced in the concrete by the tendons to be tensioned, whichever is the greater.

Where all or some of the tendons are to be partially tensioned initially, tensioning shall not commence before the concrete has attained the compressive strength indicated on the Drawings.

The compressive strength of the concrete shall be determined from cubes manufactured and tested in accordance with clause 14 of section 704, which have been cured under the same conditions as the structural member which is to be prestressed. The number of concrete cubes required for this purpose shall be as agreed upon with the Engineer.

10.05 Tensioning

(a) Preparation

Within 2 hours of the concrete having been placed, the Contractor shall demonstrate that the sheaths are free from obstructions, that extractable cores can be removed and, where the design permits, that all tendons are free to move in the ducts. Thereafter all water in the ducts shall be expelled with compressed air and the cables sealed until tensioning takes place.

Before tensioning is commenced, side forms and other restraining elements shall be released or removed to give the structural member the freedom to deform under the induced force.

(b) Tensioning sequence

The sequence of tensioning to be followed shall be as shown on the Drawings and/or the drawings prepared by the Contractor in terms of clause 07 of this section.

In his tendered rates the Contractor shall make allowance for all additional costs which he may incur as a result of having to tension fully only some of the tendons at any one stage or on any instant.

Where partial tensioning of the tendons is required, the work shall be executed in accordance with the details on the Drawings or as directed by the Engineer. In his tendered rates the Contractor shall make allowance for all additional costs which he may incur as a result of having to tension partially only some of or all the tendons at any one stage or on any instant.

(c) Assembly of equipment and safety precautions

The tensioning and measuring equipment shall be assembled for tensioning in exactly the same way as that in which they are combined for calibration.

The Contractor shall take all the necessary safety precautions to prevent accidents from happening on account of the malfunctioning or failure of any part of the equipment or material, and he shall accept full responsibility for injury to persons and/or damage to property resulting therefrom.

(d) Friction

The Engineer may require the Contractor to perform friction tests on designated tendons and to revise the relevant theoretical extensions in order to compensate for any discrepancy between the values adopted in the design and the test results.

Where applicable, allowance shall be made in the tensioning force to compensate for friction loss in the jack and in the anchorage.

(e) Tensioning

Tensioning shall be carried out under the supervision of a technician skilled in the use of the prestressing system and equipment and the methods of tensioning to be adopted.

Tensioning shall not commence before the Engineer has been advised of each tensioning operation and has given his approval for the work to start.

The technician and operators shall be supplied with a schedule listing the sequence of tensioning of the various tendons and a tensioning record sheet showing the theoretical gauge readings, jacking forces, extensions, release and pull-in for each tensioning operation. The record sheet shall furthermore make provision for the entering of the corresponding information recorded and observations made during tensioning. A graph of the tensioning force and/or gauge reading versus theoretical extensions shall be appended to the record sheet and the actual extensions measured for each load increment shall be plotted on the graph. Copies of the completed record sheets and graphs shall be submitted to the Engineer within 24 hours of the completion of each tensioning operation.

The Contractor shall note that the extensions shall be regarded as an indirect measurement of the tensioning force and that it shall serve as a control on the tensioning force applied.

The protruding ends of all bars, wires or strands shall be clearly marked for the accurate measuring of extension, release and pull-in.

Before tensioning is commenced on external tendons, a small load shall be applied to each tendon, commencing with the uppermost tendon. The force shall be sufficient to take up all slack and to prevent entanglement of the tendons.

The jacking force shall be increased to approximately 5 - 10% of the final jacking force in order to take up the tendon slack, to determine the zero position for the extension measurements, and to check the gripping devices and the position and alignment of the jacks. Thereafter the load shall be increased gradually to the full specified tensioning force while intermediate gauge readings and extensions are recorded at regular intervals.

The final stage of tensioning shall be deemed to have been satisfactorily accomplished when all the following requirements have been met:

- The tendons have been tensioned to the required force.
- The measured extension of individual tendons is within ±6% of the theoretical extensions.
- The average variation between the measured and theoretical extensions of all the tendons in a structural member is less than ± 3%.
- The release and/or pull-in is within ± 2 mm of the theoretical values.

When the above conditions have not been met individually and collectively, the Contractor shall immediately advise the Engineer and obtain a ruling as to the procedure to be followed.

In the event of the tendon friction being too high, the Contractor may, subject to the approval of the Engineer, inject an approved lubricant into the sheath after first detensioning the tendon.

The cost of the remedial and corrective measures and of the release and retensioning of tendons, which have been occasioned by failure of the operations to meet the above requirements, shall be for the Contractor's account.

After the tensioning has been accepted by the Engineer, the Contractor may cut off the tendons behind the anchorage as described in subclause 10.02 of this section.

10.06 Permanent protection and bonding of tendons

(a) General

After tensioning, all tendons shall receive permanent protection against mechanical damage and corrosion.

Internal tendons shall be protected and bonded to the structural member by cement grout or, when permitted by the Engineer, by sand-cement grout. Where bonding is not important, protection may be afforded by the use of bitumen, petroleum-based compounds, epoxy resins, plastics and similar products, all complying with the requirements of subclause 03.08 of this section, and subject to the approval of the Engineer.

Tendons located outside the structural section (i e external tendons) shall be encased with a dense concrete, a dense mortar, or material which is sufficiently stable and hard, all subject to the approval of the Engineer. The encasement shall be of the thickness shown on the Drawings.

Where bonding of the tendon to the structural concrete is required, this shall be achieved by reinforcement of the concrete encasement to the structure, as detailed on the Drawings.

Protection and bonding of the tendons shall be effected within 7 days of the final tensioning of the tendon(s), or as specified on the Drawings, but shall not take place without the prior approval of the Engineer.

After the permanent protection or bonding has been completed, the anchorages shall be encased in concrete or grout which shall be bonded to the old concrete with an epoxy resin designed for this purpose or shall be completely coated with a corrosion-resistant material. The protection afforded shall in every case prevent the ingress of water or aggressive agents.

(b) Preparation of ducts

Before permanent protection and/or bonding of tendons is effected, the following precautions shall be observed:

- The cables shall be checked for blockages by means of water injection or compressed air.
- Unlined ducts that are to be filled with grout shall be flushed with water to wet the concrete.
- Temporary protection or lubricants which are incompatible with the permanent protection or bonding shall be removed by flushing with water or an inert solution or by any suitable method approved by the Engineer.
- On completion of the above, the excess fluid shall be expelled from the ducts by means of compressed air or shall be displaced by the protection agent or grout, as may be relevant.
- Any blockages, leakages or factors that may in any way affect the permanent protection or bonding shall immediately be reported to the Engineer.

(c) Mixing

(i) Protection agents

The mixing of protection agents shall be strictly in accordance with the manufacturer's instructions.

(ii) Grout

The aggregate, if used, and the cement shall be measured by mass, and the water by mass or volume.

The water cement ratio by mass shall be as low as possible within the range of 0,36 to 0,45, consistent with the fluidity requirements of subclause 03.07 (b) of this section.

When an admixture is used, it shall be dissolved in a part of the mixing water before it is added to the grout.

Mixing shall commence by two-thirds of the cement being added to the main part of the mixing water, then the predissolved admixture, if used, and finally the remainder of the cement. Mixing shall continue for not longer than 4 minutes, after which the grout shall be continually agitated at slow speed throughout the injection operation.

When an aggregate is used in the grout mix, the word "cement" in the preceding paragraph shall be replaced with the term "cement/aggregate component".

(d) Injection

(i) General

The injection of permanent protection agents or grout shall not commence before the Engineer has given his permission for the work to start.

Before injection commences, all air shall be expelled from the injection equipment and hoses and all connections checked for air-tightness.

Injection shall take place from the anchorage or coupler, whichever is situated at the lower end of the cable.

(ii) Protection agents

The injection of protection agents shall be strictly in accordance with the instructions of and the equipment specified by the manufacturer.

(iii) Grout

Immediately after mixing and during injection, the fluidity of the grout shall be tested at regular intervals in accordance with subclause 03.09 of this section.

Injection shall be uninterrupted at a rate of 6 m/min - 12 m/min. As soon as grout with the original consistency flows from the intermediate vent pipes, they shall be successively closed. Injection shall continue until the grout flowing from the vent at the free end is of the same consistency as that of the injected grout. At this stage the vent shall be closed and the final pressure, or a pressure of 5 bars, whichever is the greater, shall be maintained on the grout column for 5 minutes before the valve at the injection end is closed.

All vents shall be kept closed and shall be supported vertically until final setting of the grout has taken place.

On vertical cables a riser pipe with funnel shall be fitted to the top anchor to ensure that the separated (bleed) water migrates upwards without extending into the cable.

If an expanding agent is used in the grout mix, the air vents shall be re-opened after grouting to release any separated water, and shall subsequently be closed again.

Unless a retarder is used in the grout mix, the grout not used within 30 minutes of mixing shall be discarded.

During the course of grouting, 100 mm cubes shall be made for testing in accordance with subclause 03.09 of this section. While the grout is poured into the cube mould, its sides shall be lightly tapped to permit any entrapped air to escape.

Precautions shall be taken not to discharge any escaping grout onto railway lines, public roads or private property.

If a blockage occurs during the course of grouting, the grouting shall be stopped before the maximum grouting pressure is reached, the duct flushed out immediately and the blockage cleared.

Grouting shall not be carried out during frosty weather, and the same requirements as specified for concrete in subclause 10.01 of section 704 shall apply. Care shall be taken to see that the ducts are completely free from frost or ice before grouting commences after frosty weather.

11 LOSS OF PRESTRESS

Any structural member that has lost all or part of its prestress through the failure or malfunctioning of any part of the prestressing component may be rejected by the Engineer and shall be removed from the Works, unless remedial measures approved by the Engineer are successfully carried out on the member. No payment shall be made in respect of any such remedial work done or loss suffered by the Contractor in this regard.

12 CONSTRUCTION TOLERANCES

The work described in this section shall be constructed to the construction tolerances specified in subclause 03.06 of section 707.

13 MEASUREMENT AND PAYMENT

Item		Unit
705.01	**Prestressing tendons**	
705.01.01	Longitudinal tendons	meganewton metre (MN.m)
705.01.02	Transverse tendons	meganewton metre (MN.m)
705.01.03	Vertical tendons	meganewton metre (MN.m)

The unit of measurement shall be the meganewton-metre which is calculated as the product of the characteristic strength of the prestressing steel in megapascals, the cross-sectional area of the tendon in square metres, and the length of the tendon between the faces of the anchorages in metres. In the case of fan and loop anchorages, the "length of the tendon" shall include the length of tendon forming the loop or fan.

The tendered rates shall include full compensation for the preparation and submission of Drawings, the supply, storage, handling and protection of all materials (excluding anchorages and couplers), the fabrication, supporting and installation of the cables, the lubrication, permanent protection and bonding of the tendons, the use of all the equipment, and also for all work and incidentals required for completing the work as specified.

Item		Unit
705.02	**Anchorages and couplers**	
705.02.01	Anchorage at jacking end	meganewton (MN)
705.02.02	Anchorage at dead end	meganewton (MN)
705.02.03	Coupler at jacking end	meganewton (MN)
705.02.04	Coupler at dead end	meganewton (MN)

The unit of measurement shall be the meganewton which is calculated as the product of the characteristic strength of the prestressing steel in megapascals and the cross-sectional area of the tendon, effectively anchored or coupled, in square metres.

The tendered rates shall include full compensation for the supply, storage, handling, fabrication and protection of the complete anchorage or coupler assembly, anchorage reinforcement, construction of recesses for the anchorage or coupler, the tensioning, anchoring-off and/or coupling and the trimming of tendon ends, the use of all equipment, and also for all work and incidentals required for completing the work as specified.

The coupler shall include the complete assembly consisting of the anchorage built into the first-stage construction and the part coupled to it.

The tendered rate for loop or fan anchorages shall exclude the cost of the length of tendon forming the loop or fan.

Item		Unit
705.03	**Extra over item 705.02 for partial tensioning of tendons**	meganewton (MN)

The unit of measurement shall be the meganewton which is calculated as for item 705.02.

The tendered rate shall include full compensation for the use of all equipment, as well as for all work and incidentals required for tensioning and anchoring off the tendons to the specified partial force.

SERIES 7 : STRUCTURES

SECTION 706 : JOINTS IN STRUCTURES

CONTENTS

01 SCOPE

This section covers the supply and installation of all permanent joints that will permit relative movement between contiguous structural members.

02 MATERIALS

02.01 General

All materials used in the forming, construction and sealing of permanent joints, as well as all proprietary or custom-built expansion-joint assemblies shall be subject to the approval of the Engineer.

When required by the Engineer, the Contractor shall submit test certificates from an approved independent testing authority to show that the respective materials comply with the specified requirements, or a certificate from the patent holder or designer to certify that the manufactured item complies in all respects with relevant product specifications.

02.02 Joint filler

Joint filler shall consist of sheets or strips of the following materials complying with the requirements of the relevant specifications listed:

(a) Bitumen-impregnated fibre board and bitumen-impregnated cork board - US Federal Specification HH-F-341 F or AASHTO Specification M213.

(b) Resin-impregnated cork board - US Federal Specification HH-F-341 F.

(c) Flexible foams of expanded polyethylene, polyurethane, PVC or polypropylene - AASHTO Specification M153.

(d) Rigid foams of expanded polyethylene, polyurethane or polystyrene - BS 4840 or BS 3837.

Other joint-filler materials may be used if approved by the Engineer after submission of full specifications and information by the Contractor.

02.03 Sealants

(a) Thermoplastic hot-poured sealants shall comply with the requirements of US Federal Specification SS-S-1401B, BS 2499 or AASHTO Specification M-173.

The sealants shall be of the rubberized bituminous type containing a minimum of 20% natural or synthetic rubber.

(b) Thermoplastic cold-applied sealants shall comply with the requirements of US Federal Specification SS-S-200E(2).

The sealant shall be of the rubberized bituminous type containing a minimum of 20% natural or synthetic rubber.

(c) Thermosetting chemically curing sealants shall comply with the requirements of BS 4254 or ASTM C 920.

The final IRHD (international rubber hardness degree) of the sealant shall be 20 ± 5.

Other sealants may be used if approved by the Engineer after submission of full specifications and information by the Contractor.

02.04 Preformed elastomeric compression seals

Preformed elastomeric compression seals shall comply with the requirements of SANS 1023.

02.05 Waterstops

Waterstops shall be of natural rubber, or plasticized, virgin, non-biodegradable PVC, and of the type specified or shown on the Drawings.

(a) Natural rubber waterstops shall comply with the requirements of CKS 388.

(b) Flexible polyvinyl chloride (PVC) rubber waterstops shall comply with the requirements of CKS 389.

02.06 Accessory materials

(a) Primers

When a primer is to be used in conjunction with the sealant, it shall be of the prescribed proprietary material.

(b) Adhesives

Adhesives used in conjunction with preformed seals shall be of a proven and approved type which is compatible with the material of the seal.

(c) Bond breakers

Polyethylene tape, coated papers, metal foils or similar material may be used where bond breakers are required.

(d) Back-up material

Back-up material shall consist of a compressible material of correct width and shape in order to ensure that it will be in approximately 50% compression after installation and that the sealant can be formed to the specified depth.

Back-up materials shall be compatible with the sealant used. Material containing bitumen or volatiles shall not be used with thermosetting chemically curing sealants.

(e) Cover plates

Steel cover plates shall be of grade 43A steel which complies with the requirements of BS EN 10025, or of grade 300W steel which complies with the requirements of SANS 1431. Galvanizing shall comply with the requirements of SANS 32 and/or SANS 121, as applicable. Anchor bolts shall be of stainless steel grade X10CrNi18-8Co.05-0.155=0.015, which complies with the requirements of BS EN 10088 part 1.

02.07 Storage

All materials used in the forming, construction and sealing of permanent joints and all proprietary or custom built expansion-joint assemblies shall be stored off the ground under cover that provides adequate protection against sunlight, physical or chemical damage or other factors that may cause deterioration.

03 FILLED AND UNFILLED JOINTS

03.01 General

Wherever polystyrene or a similar material which is susceptible to damage is used to form joints, it shall be lined with a hard surface on the side to be concreted. The hard surface shall be sufficiently resilient to ensure that the joint and surfaces can be formed free from defects.

03.02 Filled joints

Filled joints shall be accurately formed to the dimensions shown and with the filler material specified on the Drawings. The filler shall be secured in position so that it will not be displaced during or after concreting if the filler is to remain permanently in the joint.

03.03 Unfilled joints

Unfilled joints shall be accurately formed to the dimensions given on the Drawings, and all external corners chamfered or rounded for at least 5 mm. The concrete face against which the fresh concrete is placed shall be treated in good time with an approved bond breaker.

04 SEALING OF JOINTS

04.01 General

Sealed joints shall be made watertight over the full length of the joints, unless otherwise permitted by the Engineer, and the joint dimensions shall be as shown on the Drawings.

04.02 Preparation of joints

The reaming of joints by sawing or other means shall be undertaken at a stage when edge spalling or ravelling can be avoided and shall be subject to the Engineer's approval.

After removal of the temporary filler material or the breaking-out of the excess concrete, the inside faces of the joint shall be wire-brushed or grit-blasted to remove all laitance and contaminants. Thereafter the joint shall be cleaned and blown out with compressed air to remove all traces of dust. Solvents shall not be used for removing contaminants from concrete and porous surfaces.

Care shall be taken to ensure that primers or adhesives are applied only to surfaces that are absolutely dry. The primer or adhesive shall be applied strictly in accordance with the manufacturer's instructions. Unless otherwise specified, the primer shall be applied within the temperature range of 10°C to 40°C and the sealant shall be applied after the curing period of the primer and within the period during which the primer remains active.

04.03 Sealants

Sealants shall be applied strictly in accordance with the manufacturer's instructions by a person skilled in the use of the particular type of sealant. The trapping of air and the formation of voids in the sealant shall be avoided. The sealant shall be finished to a neat appearance flush with the edges of the concrete or to the specified depth.

Thermoplastic hot-poured sealants shall not be poured into the joints when the temperature of the joint is below 10°C.

The safe heating temperature shall not exceed the specified pouring temperature by more than 10°C.

Two-part thermosetting chemically curing sealants shall not be applied after expiry of the specified potlife period, which shall commence once the base and activator of the sealant have been combined.

04.04 Preformed compression seals

The seal shall be inserted and secured with a lubricant adhesive which covers both sides of the seal over the full area in contact with the inside faces of the joint. The lubricant adhesive shall be applied immediately before the seal is inserted.

The seal shall be installed in a compressed state, with the appropriate equipment, so that the seal will remain in compression even under the most adverse conditions. The final position of the seal shall be as shown on the Drawings or as directed by the Engineer.

Joints in seals shall be bonded or fused and shall be only at positions agreed on by the Engineer.

04.05 Waterstops

(a) General requirements

The waterstops shall be supplied in unjointed standard production lengths. Site jointing shall be limited to the absolute minimum. Where lengths in excess of the standard production lengths are required, such longer lengths shall preferably be factory-jointed.

At intersections, transitions and abrupt changes of direction, factory-moulded watertight junction pieces shall be used so that any site jointing can be restricted to simple joints.

When a waterstop with a centre bulb is intersected, the centre bulb shall be continuous throughout the intersection irrespective of the make-up of the intersection.

(b) Rubber waterstops

All joints shall be vulcanized and shall have a tensile strength of at least eighty (80) per cent of that of the unjointed material for water-retaining structures, and fifty (50) per cent for other structures.

Site joints shall be vulcanized joints made in accordance with the requirements of these Specifications and the manufacturer's instructions, and with equipment prescribed or supplied by the manufacturer and approved by the Engineer.

The vulcanizing process shall be a hot process with strict control on the pressure, the temperature and the time. The vulcanizing temperature shall be between 150°C and 160°C. The rubber shall not be heated above 160°C. The vulcanizing time for the specific type of rubber of the waterstops involved shall be determined with a curometer for the above-mentioned vulcanizing temperatures before a vulcanized joint is made. The recommended pressure between the two sections which must be vulcanized is 3,4 MPa and the minimum allowable pressure is 2,4 MPa.

The contact faces of the sections to be jointed shall be accurately and evenly cut at the angle shown on the Drawings or prescribed by the Engineer to obtain a precise fit and complete contact.

Care shall be taken to keep centre bulbs unobstructed at the joints so that the lateral flexibility of the waterstops will not be affected by the presence of clotted rubber inside the bulbs.
The rubber of the waterstop shall not have any porosity or voids between the contact faces of the sections and/or at the finished vulcanized joint, especially at the centre bulb.

The vulcanizing equipment shall comply with the following minimum requirements:

- The heating elements shall be equipped with an automatic temperature-control device to keep the elements at the required temperature.
- It shall be equipped with an automatic temperature-control device to keep the heating elements at the required temperature, with a device to measure the temperature at the vulcanizing plane, a device to measure the temperature applied to the external faces of the rubber, and with a pressure gauge to regulate the applied pressure within the specified limits in relation to the liquidity of the rubber.
- During the vulcanizing process the pressure shall be spread evenly over the entire contact area, and the pressure plates shall be sufficiently rigid that they will not bend under the applied pressure. The cut-out forms of the pressure plates shall fit accurately over the waterstops so that all the faces of the waterstops will be in contact with the pressure plates.
- The planes of contact of the two sections of the waterstops to be joined together shall be prevented from sliding from each other when pressure is applied to the plates.
- A shield shall be available to shield the apparatus against wind, rain, etc, when joints are made in the open to ensure proper temperature control.
- The apparatus as a whole shall be safe in all respects and shall comply with all the appropriate statutory requirements.

(c) Plasticized, flexible PVC waterstops

The waterstops shall be manufactured from high-quality virgin material and shall not contain any scrap or reclaimed material. The waterstops shall be light coloured so as to reduce heat absorption when exposed to sunlight.

The waterstops shall be precision moulded or extruded to the required cross-sectional profile, they shall be free from porosity or other imperfections, and shall be provided with eyelets so that they can be securely fixed to prevent displacement during concreting.

All joints shall be butt-jointed hot-welded joints. Where joints cannot be factory-made, Site joints shall be made in accordance with the manufacturer's instructions with equipment prescribed or supplied by the manufacturer and approved by the Engineer.

05 PROPRIETARY EXPANSION JOINTS

05.01 General

The use of any type of expansion joint shall be subject to the approval of the Engineer. Tenderers are advised to obtain approval for the type of expansion joint they intend to use prior to submitting their Tenders.

05.02 Dimensions

Attention is drawn to the overall dimensions of the expansion joints and to the limiting concrete dimensions of that portion of the structure that is to accommodate the joints. No alterations to the concrete that will be visible in the final structure nor any major re-arrangements of the prestressing anchorages to accommodate joints of excessive size will be be permitted.

All joints to be installed along a skew shall be accurately dimensioned to ensure compliance with clause 06 of this section.

In the case of bridges, proprietary expansion joints shall include the complete expansion joint assembly traversing the roadway, kerbs, sidewalks and median, and shall include the coping and parapet cover plates as well as the drainage system for draining the expansion joint.

05.03 Design and manufacture

The expansion joint shall be designed to withstand the movements, displacements and rotations specified on the Drawings in conjunction with the loads prescribed in the Code of Practice adopted for the design of the structure without overstressing any part in terms of "working load" requirements or exceeding the requirement for serviceability limit state. The cost of any strengthening of the supporting member required to resist forces imparted by the joint to the structure shall be for the Contractor's account.

The specified movements, displacements and rotations shall be accepted without impairment of the efficacy and the serviceability of the joint.

The expansion joint shall be vibration free and shall comply with the requirements in the Project Specifications in respect of resistance to mechanical wear and other forms of abrasion, resistance to corrosion, skid resistance, water tightness, riding characteristics and accessibility for inspection, maintenance and repair.

Prior to the manufacture of the joints, the Contractor shall submit detail drawings of each expansion joint to the Engineer for his acceptance.

The expansion joints delivered to the Site shall be suitably marked to show clearly the sequence and position of installation.

06 INSTALLATION OF EXPANSION JOINTS

No expansion joint or part thereof shall be installed before the final surfacing levels have been established as based on a complete level survey of the contiguous surfaces. The survey shall be made before the kerbs, channels or bituminous surfacing is constructed.

In the case of bridges, the expansion joint shall form an even surface with the road surface on either side, and the deviation across and along the expansion joint shall comply with the requirements of subclause 05.04 of section 601 for cross-section and subclause 05.06 of section 601 for surface regularity measured with an ordinary straight-edge.

On completion of the installation of proprietary expansion joint(s), the Contractor shall furnish the Engineer with a certificate from the manufacturer or supplier of the joint(s) which certifies that the expansion joints have been properly installed.

The issuing of such a certificate shall not relieve the Contractor of his responsibilities under the Contract. Payment for the inspection of the joints by the manufacturer or supplier and the issuing of the certificate shall be made in accordance with the provisions of subclause 12.04 of section 903.

07 MEASUREMENT AND PAYMENT

Item		Unit
706.01	**Proprietary expansion joints**	
706.01.01	Prime cost sum allowed for the purchase and taking delivery of expansion joints	PC sum
706.01.02	Percentage on prime cost for charges and profit	per cent (%)

Payment for the purchase and taking delivery of proprietary expansion joints shall be in accordance with the provisions of the General Conditions of Contract. (See Note 4 at the end of this clause .)

Item		Unit
706.02	**Installation of proprietary expansion joints**	
706.02.01	(Description of joint, measured per metre)	metre (m)
706.02.02	(Description of joint, measured per number)	number (No)

The unit of measurement shall be either the metre of complete joint of each type installed or the number of complete joints of each type installed.

The tendered rates shall include full compensation for the supply of all materials not covered under item 706.01, for transport, handling and storage, and for all labour, equipment and incidentals required for the installation of the expansion joint complete as detailed. (See Notes 1, 2 and 4 at the end of this clause .)

The tendered rates shall be final and binding, irrespective of the type or make of joint finally installed.

Item		Unit
706.03	**Expansion joints as detailed on the Drawings and/or specified in the Project Specifications** (Description of each type)	metre (m)

The unit of measurement shall be the metre of complete expansion joint of each type installed.

The tendered rate shall include full compensation for the supply of all material, for the manufacture of the expansion joint, for transport, handling and storage, and for all labour, equipment and incidentals required for the installation of the expansion joint complete as detailed. (See Notes 1, 2 and 3 at the end of this clause .)

Item		Unit
706.04	**Filled joints**	
706.04.01	Type and size of joint stated with reference to the Drawings	metre (m)
706.04.02	Etc for other types and sizes	

The unit of measurement for each type and size of filled joint shall be the linear metre of joint measured along its exposed surface.

The tendered rates shall be in full compensation for constructing the joint complete as specified, including the provision of joint filler, joint sealant, and accessory materials. (See Notes 2 and 3 at the end of this clause .)

Item		Unit
706.05	**Joints with preformed elastomeric compression seals**	
706.05.01	Type and size of compression seal and joint stated with reference to the Drawings	metre (m)
706.05.02	Etc for other types and sizes	

The unit of measurement shall be the linear metre of each type and size of joint and compression-seal combination constructed.

The tendered rates shall be in full compensation for constructing the joint complete as specified, including the cutting of the joint where applicable and the provision and installation of the compression seal. (See Notes 2 and 3 at the end of this clause .)

Item		Unit
706.06	**Joints with waterstops**	
706.06.01	Waterstops in a straight joint	
706.06.01.01	Description of joint, type and size of waterstop with reference to the Drawings	metre (m)
706.06.01.02	Etc for other types and sizes	

The unit of measurement shall be the metre of waterstop installed in a straight joint and measured along its central bulb.

The tendered rates shall include full compensation for the supplying, jointing and installing the waterstop, the joining of waterstops on Site, at crossings and elsewhere, for the additional costs of splitting formwork where waterstops have to be accommodated and, where applicable, for the provision of joint filler, joint sealant and accessory materials. (See Notes 2 and 3 at the end of this clause .)

Item		Unit
706.06.02	**Waterstops in a curved joint**	
706.06.02.01	Description of joint, type and size of waterstop with reference to Drawings	metre (m)
706.06.02.02	Etc for other types and sizes.	

The unit of measurement shall be the metre of waterstop installed in a curved joint and measured along its central bulb.

The work for which allowance shall be made in the tendered rates for item 706.06.01 shall also apply to the tendered rates for this item.

Item		Unit
706.06.03	**Factory-moulded intersection pieces**	
706.06.03.01	Description of joint, type and size of waterstop, and the angle of intersection with reference to the Drawings	number (No)
706.06.03.02	Etc for other types, sizes and angles.	

The unit of measurement shall be the number of each type and size of intersection piece installed.

The tendered rates shall include full compensation for supplying and installing the intersection piece, the joining of the intersection piece on Site with straight or curved waterstops, for splitting formwork where required and, where applicable, for the provision of joint filler, joint sealant and accessory materials. (See Notes 2 and 3 below.)

Notes:

(1) Open joints (joints without filler or sealant) shall not be measured and paid for under this section but under item 702.01.

(2) The rates for items in this section shall include full compensation for all formwork necessary for the construction of the joint if the joint is less than 150 mm deep.

Where the joint is more than 150 mm deep, the rates shall include for the forming of any recesses required, but formwork for the opposing inside faces of the joint shall be measured and paid for under section 702, except that, where a joint filler is used, no formwork will be measured over an area where concrete is cast against a joint filler which also acts as permanent formwork.

(3) Filled joints, open joints, joints with preformed elastomeric compression seals and joints with waterstops shall be measured and paid for as such and not as expansion joints even though they may also function as expansion joints.

(4) Separate payment shall not be made for the supply and/or installation of the seal in the proprietary expansion joint or the seal between concrete or epoxy nosing.

SERIES 7 : STRUCTURES

SECTION 707 : CONSTRUCTION TOLERANCES FOR STRUCTURES

CONTENTS

01 SCOPE

This section covers the requirements in regard to the construction tolerances applicable to the various structures and structural elements.

02 DEFINITIONS

Except where otherwise specified, the following aspects of construction to which tolerances apply shall have the meanings assigned to them below:

02.01 Position

The position of a structure or structural element shall be the horizontal position of its reference line(s) and/or reference point(s) in relation to the overall setting-out of the Works as shown on the Drawings.

02.02 Horizontal alignment

The horizontal alignment of a structure or structural element shall be the horizontal alignment of its reference line(s) in relation to the overall setting-out of the Works as shown on the Drawings. Deviation from true horizontal alignment shall be measured in degrees of an arc.

02.03 Leading and cross-sectional dimensions

The leading and cross-sectional dimensions of a structure or structural element shall be the dimensions relating to width, length, height, thickness, etc which collectively determine its shape as shown on the Drawings. Dimensional tolerances which do not relate to leading or cross-sectional dimensions shall be shown on the Drawings.

02.04 Levels

The level of any structure or structural element shall be the level of the upper or lower surface, as the case may be, with reference to an established datum level on the Site as shown on the Drawings.

02.05 Surface regularity

Surface regularity is the shape of a surface with reference to a 3 m straight-edge (or template in the case of curved surfaces) placed on the surface.

The tolerance on surface regularity is expressed as a distance by which the surface tested may deviate from a straight-edge (or template in the case of curved surfaces) held against the surface.

03 TOLERANCES

The tolerances given below are the maximum permissible deviations from the specified dimensions, levels, alignment, positions, etc, as shown on the Drawings of the structures or structural elements.

03.01 Foundation fill

(a) Average level of top of fill ± 25 mm

03.02 Footings

(a) Position 15 mm

(b) Horizontal alignment:

(i) Horizontal alignment of individual elements 5º

(ii) Horizontal alignment of elements as they collectively determine the horizontal alignment of the structure as a whole 1 minute

(c) Dimensions:

(i) Leading dimensions in plan ± 25 mm

(ii) Thickness + 25 mm or- 15 mm

(d) Levels:

Average level of slabs, footings, etc ± 25 mm

03.03 Vertical elements such as columns, walls, piers, abutments, etc

(a) Position 10 mm

(b) Horizontal alignment:

Horizontal alignment of walls, piers, abutments and column groups 2 minutes

(c) Dimensions:

Leading dimensions of walls, piers, abutments, etc ± 25 mm

(d) Thickness of walls, piers and abutments and cross-sectional dimensions of columns:

(i) Plus tolerance 25 mm

(ii) Minus tolerance: 3% of the specified dimensions within the range of 5 mm to 25 mm

(e) Levels:

Average levels of finished or trimmed/cut columns, piers, walls, abutments, etc ±10 mm

(f) Verticality:

(i) In the case of ordinary formwork: 1 in 400 Maximum 25 mm

(ii) In the case of sliding formwork: 1 in 200 Maximum 50 mm

(g) Surface regularity:

(i) In the case of ordinary formwork 3 mm

(ii) In the case of sliding formwork 6 mm

03.04 Horizontal elements of the super-structure such as beams, slabs, etc

(a) Position 10 mm

(b) Horizontal alignment:

Superstructure as a whole 1 minute

(c) Dimensions:

Leading dimensions in plan ± 25 mm

(d) Thickness of slabs, width and depth of beams:

(i) Plus tolerance	15mm
(ii) Minus tolerance:	3% of the specified dimensions within the range of 5 mm to 15 mm

(e) Surface regularity 3 mm

03.05 Reinforcing steel

Except for the requirements set out below, no tolerances are given for the placing and fixing of reinforcing steel. However, the steel shall be neatly and accurately fixed in a manner that is consistent with proper workmanship and the structural integrity of the member. The following requirements shall apply specifically:

(a) Tension steel

The actual position of tension steel shall not deviate from the true position by an amount that would reduce the effective lever arm by more than 2% of the overall depth of the member, or 10 mm, whichever is the greater.

(b) Concrete cover

The concrete cover on reinforcing steel + 20 percent or - 0 percent

(c) Spacing between bars

The spacing between closely spaced parallel bars, especially in beams and columns, shall, unless otherwise detailed, be not less than the maximum size of aggregate used in the concrete.

(d) Bending of reinforcement

The requirements of SANS 282 regarding dimensional tolerances for the cutting and bending of reinforcing steel shall apply, with the proviso that the other requirements stated in this clause shall be met even if the tolerances in SANS 282 are not exceeded.

03.06 Prestressing

Prestressing tendons shall be placed and maintained in position within the following accuracies:

(a) In the direction of the width of the member:

(i) For members of up to 200 mm in depth	± 20 mm
(ii) For members exceeding 200 mm in depth	± 10 mm

(b) In the direction of the depth of the member:

(i) For members of up to 200 mm in depth	± 0,025 x depth
(ii) For members over 200 mm in depth	±,010 x depth within the tolerance range of ± 5 mm to ± 25 mm

03.07 Bearings

Bearings shall be installed to within 5 mm of the positions shown on the Drawings and to within 2 mm of the required levels.

Dimensional tolerances for elastomeric bearings shall comply with the requirements of BS 5400 part 9.2.

03.08 Miscellaneous

(a) Chamfers:

Fillets used to form chamfers shall be made to a tolerance of 1 mm in cross-sectional dimensions, and the actual chamfer on the concrete shall not vary by more than 3 mm from the specified dimensions, as measured from a 3 m straight-edge.

(b) Kerbs, copings, sidewalks, bridge railings, parapets, etc:

The elements shall be constructed to the specified dimensions within a tolerance of plus or minus 5 mm on any dimension. The alignment shall not deviate from the true alignment by more than 10 mm in any place nor shall the alignment deviate by more than 5 mm from the true alignment over any length of 5 m.

04 USE OF TOLERANCES

Attention is drawn to the requirements of clause 25 of section 001 regarding the use of tolerances. In addition, the following shall apply:

Notwithstanding the tolerances stated in this section, the Contractor shall be responsible for ensuring that all components of the work will finally fit together properly and he shall be solely responsible for the cost of rectifying defects and poor fitting arising from any deviations from the specified dimensions regardless of the tolerances specified in this section but having regard to any tolerances specified on the Drawings.

SERIES 8 : SPECIFIC WORKS

SECTION 801 : CONCRETE RESERVOIRS

CONTENTS

01 SCOPE

This section covers various requirements and items of work associated with the construction of concrete reservoirs and which are not covered by other sections of these Specifications. Some of the items in this section, however, apply to other water-retaining structures such as pumping stations, sedimentation tanks, etc.

02 PLANT

Where the Contractor elects to place a crane inside the circumference of the reservoir wall for the duration of the period of construction, he shall communicate with the Engineer in good time to ensure that the design and layout of the panels which form the roof slab and floor allow for such positioning of the crane. Where sections of the roof and floor have to be redesigned to accommodate the crane, the costs of such redesign and the increased cost of construction shall be borne by the Contractor.

The Contractor shall at his own cost provide elevated storage tanks of adequate capacity to ensure that sufficient water will be available before the commencement of every major concrete-casting operation.

All items of plant required for the concreting operations shall be available in sufficient numbers and in a good working order to ensure the availability of adequate plant on standby. All electrically and mechanically powered plant shall be duplicated by mechanically powered standby plant to ensure uninterrupted concreting operations in the event of a power or mechanical failure of the main plant. No separate payment will be made to the Contractor for providing plant for standby purposes.

03 FORMWORK

Only approved tie-rods which consist of solid rods (which remain embedded in the concrete) with removable ends shall be used to hold the formwork of the reservoir walls. The removable tie-rod ends shall be such that they can be removed without damaging the concrete, and no permanently embedded parts of such tie-rods shall have less than 50 mm cover to the finished concrete surface.

The cavities left in the concrete after the tie-rod end cones have been removed shall be soundly caulked with cement mortar to which an approved shrinkage-reducing agent has been added, and shall be neatly finished to a smooth surface uniform with that of the surrounding concrete.

The cost of supplying the special tie-rods as well as of filling the cavities left by the tie-rod cones shall be included in the rates tendered for formwork under the appropriate pay items of section 702.

04 JOINTS

Only horizontal construction joints will be permitted in reservoir walls. The walls shall be cast in lifts of such height that each lift can be poured without interruption in one continuous operation during normal working hours. Concreting shall be carried out from a point on the circumference of the wall, simultaneously in both directions, so as to close the gap with fresh concrete.

Where a joint space is indicated between the bottom of the wall of a prestressed reservoir and its footing, the reinforcement for the wall shall be supported in a manner that will cause its weight not to rest on the materials that form the joint space. The material forming the joint space shall be removed within 14 days of the concrete in the first 2 m height of the wall having been placed, unless otherwise instructed by the Engineer.

05 CONCRETE

Concrete obtained from commercial sources and delivered to the Site in a ready-mixed condition may be used for the construction of a reservoir only with the Engineer's approval.

All concrete used for the construction of a reservoir shall be watertight, and special care shall be taken by the Contractor to ensure watertightness particularly at the construction joints.

06 CRUSHED STONE ON ROOF SLAB

The crushed stone shall be clean and dust-free and shall pass through a 25 mm mesh sieve and shall be retained on a 12 mm mesh sieve. The thickness of the stone layer shall be as shown on the Drawings.

The stone shall not be placed without the permission of the Engineer and not until the concrete of the roof slab has reached the design strength.

The stone shall be immediately spread into position on the roof and no heaping-up of the stone will be allowed.

07 LIGHTNING PROTECTION

When specified in the Project Specifications, reservoirs shall be protected from the effects of lightning by the installation of a lightning-protection system which complies with the requirements of SANS 10313.

The Contractor shall obtain the services of a firm specializing in the supply and installation of such systems. The firm which shall be approved by the Engineer, shall submit drawings of the system to SABS Holdings (Pty.) Ltd for approval, and work may commence only after the approved plan has been submitted to the Engineer. The air-termination system which shall be installed on the circumferential parapet wall on the roof shall be bonded to the steel reinforcement of the wall in the case of reinforced-concrete reservoirs, and to surface-mounted down-conductors in the case of prestressed-reinforced-concrete reservoirs, and special care shall be taken to prevent the corrosion of the reinforcement or any form of electrolysis from taking place.

Where the reinforcement is used as down-conductors, care shall be taken to ensure that, wherever such reinforcing is spliced, positive bonding between the bars forming the splice is obtained.

The reinforcement shall be bonded to the earthing system at points directly below the air-terminal bonds, and the joint between the wall and ring foundation shall, for this purpose, be bridged in an approved manner.

Where surface-mounted down-conductors have to be installed on reinforced-concrete reservoirs as a result of the Contractor's failure to make the necessary provision for the wall reinforcement to be used as down-conductors, the additional costs of installing the surface conductors shall be to the Contractor's account.

08 MISCELLANEOUS ITEMS

Items such as internal and external access ladders, manhole covers and frames, locking devices, handrails, ventilators, rainwater outlets and downpipes, flashings, etc, for the reservoir shall be manufactured, supplied and installed to details and in positions as shown on the Drawings. Ladders and handrails, when made of steel, shall be manufactured in accordance with section 809.

Prior to drilling bolt holes into the concrete for the installation of any of the above items, the Contractor shall, by using a cover meter, ensure that no reinforcing steel is obstructing the proposed bolt-hole positions.

09 STERILIZATION OF RESERVOIRS

Before a reservoir is sterilized, the roof shall have been tested for watertightness as set out in clause 10 below, and the pipelines serving the reservoir shall have been sterilized as described in clause 13 of section 402. The reservoir shall then be thoroughly cleaned out and washed down with clean water.

The roof, beams, columns and walls shall thereafter be thoroughly sprayed down, using pressurized equipment, and the floors shall be scrubbed with water containing 0,015 g per litre of chloride of lime.

On completion of the sterilization, the sterilizing solution shall be run to waste before the reservoir is filled for testing its watertightness.

Should additional work be required to be done inside the reservoir after the watertightness test has been completed, the reservoir shall be resterilized at the Contractor's expense.

10 TESTING FOR WATERTIGHTNESS

Water for the initial filling will be supplied free of charge by the Employer.

The structure shall be filled with water at a uniform rate not exceeding 2,0 m in 24 hours until the top water level has been reached. The water level will then be carefully noted and recorded by the Engineer in relation to a fixed bench-mark, and the structure shall be allowed to remain filled for a period of two weeks to permit complete absorption of water by the concrete.

Any loss of water which may have occurred shall then be made up by again filling the structure to the top water level and by allowing the water to remain undisturbed for a period of not less than four days. The structure shall be considered to be watertight if the drop in level in 96 hours (less the drop caused by evaporation) does not represent more than 0,06% of the volume of the reservoir.

The evaporation shall be measured by the mean drop in level caused by the evaporation of the water in three flat containers floating in the water, being recorded.

The Contractor is free to attend the taking of all measurements by the Engineer.

In the event of an appreciable leakage being evident or visible at any stage of the filling or testing, or in the event of the final degree of watertightness being unsatisfactory, the Contractor shall, when so ordered by the Engineer, discontinue such filling or testing and shall, at his own expense, take approved steps to rectify the leakage, until a test proves that a sufficient degree of watertightness has been obtained.

The watertightness of the reservoir roof shall be tested before that of the reservoir itself by water being continuously sprinkled over the roof in an approved manner so that a film of water is maintained on the surface of the slab. The roof shall be considered watertight if no damp patches are visible on the underside after 48 hours of sprinkling.

Before the expiry of the defects liability period, the Engineer shall have the right to retest the structure for watertightness, results of such further tests will be made available for the information of the Contractor. In the event of these tests indicating an unsatisfactory degree of watertightness, the Engineer will, before issuing the final certificate, again require the Contractor to rectify the leakage, at his own expense, in such a manner as will cause the least interruption of the water supply to consumers and as will ensure the soundness of the work, to the satisfaction of the Engineer.

Should the failure of the reservoir to pass the first or any subsequent test for watertightness necessitate the draining of the structure, the Employer reserves the right to utilise the water by discharging it into its water-reticulation network, in which case the Contractor :

(i) shall not have to pay for the subsequent refilling of the reservoir;

(ii) shall, if applicable, reimburse the Employer for any additional costs incurred to make the water fit for consumption; and

(iii) shall not be entitled to claim for extra time whilst waiting for the water to be discharged into the network.

The costs of retesting the reservoir for watertightness shall be borne by the Contractor.

11 MEASUREMENT AND PAYMENT

Item		Unit
801.01	**Crushed stone on reservoir roof**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of stone placed in position as specified and to the thickness as shown on the Drawings.

Item		Unit
801.02	**Lightning protection**	lump sum

The unit of measurement for installing a lightning-protection system shall be the lump sum.

The tendered sum shall include full compensation for obtaining SABS Holdings (Pty) Ltd approval of the drawings, and for installing and testing the lightning-protection system on the reservoir as specified on the approved drawings.

Item		Unit
801.03	**Miscellaneous items -**	
801.03.01	Measured by number	
801.03.01.01	(Description of item)	number (No)

Item		Unit
801.03.02	Measured by linear metre	
801.03.02.01	(Description of item)	metre (m)
801.03.03	Measured by area	
801.03.03.01	(Description of item)	square metre (m^2)
801.03.04	Measured by volume	
801.03.04.01	(Description of item)	cubic metre (m^3)
801.03.05	Tendered for in a lump sum	
801.03.05.01	(Description of item)	lump sum

The unit of measurement shall be the number, linear metre, square metre, cubic metre or lump sum as applicable to each item.

The tendered rate (or sum) shall include full compensation for the supply of all the required materials, fabrication, loading, transporting to the Site, off-loading and erection. They shall also include full compensation for all nuts, bolts, rivets, washers, holding-down bolts where specified, for cutting, waste and for temporary bracing.

Item		Unit
801.04	**Sterilization of reservoir**	lump sum

The unit of measurement for sterilization shall be the lump sum.

The tendered sum shall include full compensation for all labour, equipment, water, chemicals and other materials required for sterilizing the reservoir as specified.

Item		Unit
801.05	**Testing the reservoir for watertightness**	lump sum

The unit of measurement for testing for watertightness shall be the lump sum.

The tendered sum shall include full compensation for the provision of all labour, plant and materials necessary for testing the reservoir for watertightness as specified, and to the satisfaction of the Engineer.

Note:

The following items of work, when specified, shall be carried out and paid for in accordance with the relevant sections of the Specifications, but will be listed under this section of the Schedule of Quantities.

Item		Applicable section
(a)	Bearings	808
(b)	Structural steel items	809

SERIES 8 : SPECIFIC WORKS

SECTION 802 : CAST IN SITU CONCRETE SEWERS

CONTENTS

01 SCOPE

This section covers the construction of cast in situ concrete sewers and shall be read in conjunction with the sections of these Specifications listed under clause 11 of this section. In the event of any discrepancy between the sections listed under clause 11 and this section, the provisions of this section shall take precedence.

02 INFORMATION TO BE SUPPLIED WITH TENDERS

Whenever the construction of in situ concrete sewers is specified or when their construction is offered as an alternative to specified precast concrete pipes, the Contractor shall supply the following information with his tender (in the case of an alternative offer, this information shall be additional to the information required in clause 05 of section 001):

- Full details of the formwork to be used and of the construction sequence that will be adopted.
- Full details of his proposed method of forming the invert of the cast in situ sewer.

03 EXCAVATION

The excavation of trenches, the preparation of trench bottoms and the excavation of manholes and related structures such as junction structures and inlet and outlet structures for siphons, shall be carried out in accordance with the provisions of section 202 and must be approved by the Engineer before any subsequent activities are commenced.

The minimum trench width shall be the width of the sewer foundation slab plus an additional 600 mm on each side of the foundation slab, unless otherwise specified in the Project Specifications or authorized by the Engineer in writing.

Only trenches excavated to the required depth will be measured for progress payment purposes.

04 BACKFILLING

Backfilling of the sewer shall not commence until tests have shown that the concrete has attained the specified cube strength.

Backfilling with selected material to a height of 300 mm above the top of the sewer shall be carried out as specified in clause 11 of section 302, whereas the balance of the trench shall be backfilled as specified in clause 13 of section 202.

05 FORMWORK

Formwork shall comply with the requirements of section 702 as well as the requirements of this clause.

05.01 Pneumatic rubber formwork

The Contractor may, when so permitted in the Project Specifications, use pneumatic formwork for forming the inside surface of cast in situ concrete sewers. Such formwork shall be SO.CA.P pneumatic rubber formwork or of an approved similar material.

Pneumatic formwork shall incorporate a constant pressure-regulating apparatus and shall be used strictly in accordance with the manufacturer's instructions. Copies of such instructions as well as photographs, pamphlets and other information which may assist in determining the suitability of the formwork shall be submitted with the tender as specified in clause 02.

Tenderers shall furthermore supply not only full details regarding their own experience in using pneumatic formwork, but also the details necessary to prove that the manufacturer of the formwork, is experienced in both its manufacture and its use.

05.02 Formwork to invert of sewer

Irrespective of the type of formwork used, the construction of the sewer in one complete concrete-casting operation will not be allowed. Construction joints shall be positioned as shown on the Drawings.

The method used to form the invert of the sewer must ensure a dense and watertight concrete, monolithic with the invert footing.

The building-up of inverts that are curved in section by hand-packing the concrete or by similar means and then by floating it to the required dimensions will not be allowed unless provided for in the Project Specifications.

The I, in the covering letter to his tender (as specified in clause 02), shall include details regarding his proposals to form and construct the invert of the sewer.

05.03 Removal of formwork

The minimum periods of time required, before internal as well as external formwork may be removed in respect of cast in situ sewers, are based on the use of a special-class-strength concrete as specified in clause 07 and shall be 20 hours under normal weather conditions and 40 hours under cold weather conditions as defined in section 702, irrespective of the type of cement used.

Where normal classes of concrete are used, the removal of formwork shall be in accordance with the times specified in section 702.

06 STEEL REINFORCEMENT

Steel reinforcement for in situ sewers shall comply with the requirements of this clause in addition to the appropriate requirements of section 703.

The minimum cover of concrete over reinforcement shall be as shown on the Drawings. Where the minimum cover is not indicated, the minimum concrete cover measured from the outside of a bar to the concrete surface shall, unless otherwise directed by the Engineer, be not less than the following values:

(a) Surfaces exposed to sewage and sewer gases — 75 mm
(Including the sacrificial layer of 35 mm)

(b) Surfaces not exposed as in (a) and surfaces adjacent to backfill 40 mm

07 CONCRETE

Concrete for cast in situ sewers and related structures shall contain only dolomitic aggregates and shall comply with the requirements of section 704.

07.01 Special-strength concrete

The concrete specified for use in the construction of cast in situ sewers and related structures shall be special-strength concrete designated as class SSC 30/19/360.

This special-class-strength concrete shall comply with all the requirements specified for class 30/19 strength concrete in section 704, except that the cement content per cubic metre of concrete shall not be less than 360 kg/m^3 or more than 400 kg/m^3 and that the cement:water ratio shall not be less than 2,0.

The cement used shall be ordinary CEM I, class 32,5N unless the use of other types of cement such as rapid-hardening cement or sulphate-resisting cement is specified in the Project Specifications.

07.02 Concreting

The sequence of construction of the various parts of the sewer shall be determined by the requirement that no formwork shall be erected against previously cast concrete which has not as yet hardened sufficiently to withstand, without being damaged, the stresses induced by the formwork during erection and by the placing of fresh concrete.

08 JOINTS

Construction joints shall be formed in positions as shown on the Drawings and in accordance with the requirements of section 704. Expansion joints shall be constructed between the individual sections of the sewer and shall comply with the requirements of section 706. Details of the expansion joints and their spacing shall be as shown on the Drawings.

The sealing of the expansion joints on the inside of the sewer shall only be undertaken by a specialist firm recommended by the sealant manufacturer and approved by the Engineer and shall not be undertaken until the concrete is at least 21 days old and until the Engineer has authorized the commencement of the sealing work.

09 TOLERANCES

With reference to the requirements of clause 25 of section 001, cast in situ sewers shall be constructed to the specified dimensions within the following tolerances which, where applicable, shall replace the structural tolerances specified in clause 03 of section 707:

(a) Thickness of concrete cover over reinforcement - 0 mm, + 10 mm

(b) Sewer

(i) Position in plan :
Maximum deviation 25 mm

(ii) Grade : maximum deviation from the specified grade expressed as a percentage of the specified grade 10%

(iii) Invert level ± 10 mm

(iv) Irregularity in invert when tested by a 3 m straight-edge ± 3 mm

(v) Wall thickness :

Plus tolerance 15 mm

Minus tolerance: 3% of the specified dimensions within the range 5 mm to 15 mm

10 TESTING

Details of tests to be carried out on the completed sewer will be specified in the Project Specifications, when applicable.

11 MEASUREMENT AND PAYMENT

Measurement and pay items for the various types of work involved in the construction of the cast in situ concrete sewer shall be the applicable items provided under the following sections of these Specifications:

Section 202	:	Trenching
Section 302	:	Construction of sewers
Section 702	:	Falsework and fixed formwork
Section 703	:	Steel reinforcement
Section 704	:	Concrete
Section 706	:	Joints in structures.

SERIES 8 : SPECIFIC WORKS

SECTION 803 : RAILWAY WORK

CONTENTS

01 SCOPE

This section covers the earthworks and trackwork for the construction of sidings to be used for the conveyance of railway traffic from main lines of Transnet Limited onto and on property not belonging to Transnet Limited, by locomotives belonging to Transnet Limited or the owner of the siding.

The trackwork includes track renewal, rerailing, resleepering, the relaying of tracks and the upgrading and maintenance of the sidings where, in each case, new or second-hand material is used.

All work shall be carried out in accordance with the requirements of The Provision and Construction of Private Sidings, as published by the Office of the Chief Civil Engineer of Transnet Limited Specification E7 : Specification for Works on, over, under or adjacent to a Railway Line.

02 ABBREVIATIONS

For the purposes of this section, the abbreviations listed below shall apply and shall have the meanings given.

BC : Beginning of curve
EC : End of curve
LWR : Long welded rail
PI : Point of intersection
PWI : Permanent Way Inspector of Transnet Limited
PWM : Permanent way material

03 DEFINITIONS

For the purposes of this section, the following words and expressions shall have the meanings hereby assigned to them, except where inconsistent with the context.

(i) Ballast

Crushed stone of a specified type and grading used to support the sleepers.

(ii) Ballast train

A train with trucks for loading or unloading ballast, permanent way material or other material required for carrying out the Contract.

(iii) Ballasting

The operation of supplying ballast and of placing it to support and complete a railway track.

(iv) Beginning of a turn-out

The stock rail joint.

(v) Boxing in and trimming

Placing the correct quantity of ballast between the sleepers and on the ballast shoulders to form the profile shown on the Drawings.

(vi) Check rail

A length of rail installed adjacent and parallel to the rails of a track to prevent derailment.

(vii) Cleaning ballast (screening ballast)

Removing all ballast and fouling matter to a specified depth below the required rail level and screening it to remove the fouling matter, including oversized and undersized stone, returning the ballast to the track, and tamping it.

(viii) Construction siding

A railway track built for the purpose of handling construction traffic, or an incomplete new line on which construction traffic is handled.

(ix) Curving a rail

Giving a rail a permanent set of the required radius by means of a rail-bending machine or a jim-crow.

(x) Destressing of rails

The procedure by which temperature and other stresses in long welded and continuous rails are brought to within acceptable limits.

(xi) Diamond crossing

An arrangement of crossings that enables a train to cross a track without being diverted from one track to another.

(xii) Down-let

A lined drain to carry stormwater down a slope.

(xiii) Railway formation

The prepared surface on which the ballast and track are laid.

(xiv) Gauge

The shortest distance between the running edges of the two rails of a track.

(xv) Insulating joint (block joint)

A rail joint where the adjacent rails are electrically insulated from each other.

(xvi) Laying a track

Laying sleepers on the formation at the correct spacing and square to the centre line, placing rails on the sleepers, applying or tightening the sleeper and rail fastenings, adjusting the gauge and expansion gaps and packing the sleepers.

(xvii) Lifting and tamping

Lifting the track from any elevation to the final required level, and tamping it.

(xviii) Long welded rails

Rails which have been welded into lengths exceeding 36 m in length, and which may be subsequently welded in the track into continuous lengths without any fish-plated joints.

(xvix) Machine (heavy-weight)

A machine which may be used on a track under occupation only and which requires the use of mechanical means for being removed from the track.

(xx) Machine (light-weight)

A machine which may be used on a track not necessarily under occupation and which can be removed expeditiously by operators without the use of mechanical means or special assistance.

(xxi) Maintaining

When applied to earthworks, drains and permanent way, maintain shall mean doing the day-to-day repairs and adjustments necessary to keep earthworks and drains in a good order and the track fit for trains to run at the prescribed speeds.

(xxii) Municipal railway sidings

Railway tracks built for the purpose of handling goods traffic from railway lines of Transnet Limited to individual privately owned railway sidings, and shall include municipal railway feeder lines.

(xxiii) Occupation

A right granted by the owner of a railway line for work to be carried out on an open line or a service line under specified conditions, also at specified times.

(xxiv) Open line

A running line of any length outside the limits of the station yard or, in the case of a siding extension, the service line (or running line of any length) beyond the signalling limits.

(xxv) Packing

Inserting approved material under a sleeper without prior lifting the track, in such a way that the sleeper will have an even bearing over at least 450 mm of its length under each rail seat for the full width of the sleeper, and will carry a train without damage being done to the permanent-way material.

(xxvi) Partial resleepering

Removing from the track and replacing some of the existing sleepers as described under resleepering.

(xxvii) Permanent way

The permanent-way material and ballast laid and fixed in proper position for the safe passage of trains.

(xxviii) Permanent way material

The rails and fastenings, sleepers and fastenings, dowels, splice joints, insulating joints, stop blocks and foot guards, except ballast and points and crossing, used for building a railway track.

(xxix) Points and crossings

The pre-assembled or cast components of turn-outs, single and double slips, scissors and diamond crossings, back, front and pull rods, and switch boxes.

(xxx) Private siding

A length of railway track owned by a person or an organization other than Transnet Limited, which is connected to a track of Transnet Limited.

(xxxi) Rail fastenings

Fish plates, fish bolts, washers, nuts and insulating material.

(xxxii) Railway track

See permanent way.

(xxxiii) Realigning (recentring) a track

Moving a track sideways to correct errors in alignment which have not been brought about by slewing.

(xxxiv) Relaying

Performing the combined operations defined as resleepering and rerailing.

(xxxv) Rerailing

Removing the rails and rail fastenings from the track and replacing them with either new or second-hand rails and rail fastenings of the same or a different mass and/or length, with a minimum disturbance of the sleepers or ballast.

(xxxvi) Resleepering

Removing the sleepers and sleeper fastenings from the track, replacing them with either new or second-hand sleepers and sleeper fastenings of the same or a different type, at the same or a different spacing, all with the minimum disturbance of ballast, and thereafter tamping to give a running top with the minimum temporary restriction in speed.

(xxxvii) Respacing the sleepers

Loosening the sleeper fastenings and moving the sleepers along the length of the track to the required spacing and thereafter tightening the sleeper fastenings and tamping to give a running top capable of carrying trains without a speed restriction.

(xxxviii) Retamping

Lifting the track to the required final rail level, recentring it, then tamping and trimming the ballast, all after the track has been opened to construction traffic.

(xxxix) Running line

A line which is required for the purpose of running trains from one point to another and where the point-to-point distance exceeds 1 km.

(xL) Running rail

The rails comprising a running line.

(xLi) Service line

That portion of the private siding that lies between the track of Transnet Limited and the beginning of the exchange yard or the first shunting line or staging line of a private siding.

(xLii) Shunting lines

Lines that are provided for the shunting of trains and on which frequent stops will be made.

(xLiii) Siding

A portion of a private siding which lies on land belonging to Transnet Limited.

(xLiv) Siding extension

A portion of any private siding which lies on land not belonging to Transnet Limited.

(xLv) Sleeper

An item of permanent-way material designated to support the rails and to hold them at the correct gauge.

(xLvi) Sleeper fastenings

The metal, insulating, elastic or plastic components used for fastening the rails to the sleepers.

(xLvii) Slewing a track

Moving a track sideways to locate it accurately on a new centre line.

(xLviii) Splice joint

An expansion joint inserted in a track laid with long welded rails.

(xLix) Staging lines

Lines provided specifically for the staging of trucks for the purpose of sorting, loading or unloading.

(L) Subballast layer

The uppermost layer of the railway formation.

(Li) Superelevation

The difference in level between the outer and inner rails of a curved track.

(Lii) Table drain

A drain along the edge of the formation.

(Liii) Take-off turn-out

The turn-out from which a siding commences.

(Liv) Tamping (tamping ballast or tracks)

Placing and compacting sufficient ballast under the sleepers to form a firm interlocking mass which will support the sleepers at the correct level and enable trains to run without speed restrictions.

(Lv) Total occupation

Closing of the line to public traffic for a specified period. The line will not be reopened until the Permanent Way Inspector of Transnet Limited certifies that it is safe to do so.

(Lvi) Transition curve

A curve with a uniform rate of change of curvature which connects a straight with a circular curve.

(Lvii) Turn-out

An arrangement of switches and crossings which enables a train to be diverted from one track to another, and includes single and double slips.

(Lviii) Undercut

An excavation made below the formation level or below the bottom of an embankment for the removal of unsuitable material.

(Lix) Vertical curve

A curve connecting two grades so as to give a gradual change in vertical direction from one grade to the other.

(Lx) Work permit

Authority granted by Transnet Limited for work to be done near an open line, a loop line, a shunting line or near any other track of Transnet Limited.

04 MATERIALS

04.01 Materials for earthworks

(a) General

Materials for use in fill and subballast layers shall be obtained from cuttings, approved borrow pits and from such other sources of supply as may be specified or approved from time to time.

(b) Fill material

Fill material shall comply with the requirements of subclause 03.02 of section 203, except that compaction shall be to 93% of modified AASHTO density.

(c) Material for subballast layer

Material for the subballast layer, whether stabilized or not, shall not contain any rocks or stones the maximum dimension of which exceeds 75 mm. The material shall have a plasticity index not exceeding 10 and a CBR of at least 25% at specified in situ density. Compaction of the material shall be to 95% of modified AASHTO density.

04.02 Materials for trackwork

(a) General

All materials shall be subject to the Engineer's approval.

Except in the case of wood sleepers which shall be new the PWM supplied may be new or second-hand and of the size (or mass), class, or type specified in the Project Specifications or as scheduled.

(b) Rails

Rails shall be of class B or better and of standard section. They shall be sound, free from flaws, cracks, splits, and corrosion, and shall have at least one good running edge. Rails shall be at least 6 m in length and shall preferably be of the nominal lengths of 12 m or 18 m. Welds shall be at least 3 m from fish-plated or welded joints.

Where second-hand rails are used :

(i) Rail ends shall not be battered in excess of 2 mm;

(ii) A length of at least 300 mm shall be cropped to remove damaged rail ends;

(iii) Rails shall not have more than the maximum wear given in the last column of table 803/1 appropriate to the mass per metre of the rails; and

(iv) Rails shall have no holes through the web other than fish-bolt holes, which holes shall not be flame-cut.

Table 803/1

MAXIMUM PERMISSIBLE WEAR OF RAILS

Nominal mass of rail in kg/m	Height of rail in mm (min)			Side wear in kg/m (max)
	Class			
	A	B	C	All classes
57	156,5	152,7	148,7	7,5
48	142,6	139,3	136,2	5,2
40	121,0	118,2	115,7	3,1
30	105,2	103,0	100,7	2,3
*21	-	-	-	1,6

* Maximum crown wear 3,0 kg/m.

(c) Junction rails

Junction rails shall be at least 6 m in length and made up of pieces with a length of at least 3,0 m. Welded joints in junction rails shall not interfere with the sleeper spacing. Junction rails shall have the same nominal mass and shall be of the same class as the rails in the existing track at the one end and of the same class of rail as specified for the siding at the other end.

(d) Junction fish plates

Junction fish plates shall have been manufactured in an approved manner.

(e) Fish bolts, nuts and washers

Fish bolts and nuts shall match the type of fish-plates supplied. Washers shall be of the double-coil type. Second-hand fish bolts and nuts shall, in the opinion of the Engineer, be sound in all respects, and shall be used only with new spring washers (of the correct size).

(f) Sleepers and crossing timbers and bearers

(i) Wood sleepers and crossing timbers

Wood sleepers and crossing timbers and bearers shall be of new approved hardwood or of an approved type of laminated softwood, in each case free from splits and other imperfections such as dry rot, knot-holes, worm-holes, borer damage, and fungal attack.

(ii) Steel sleepers

Steel sleepers shall be to a design approved by Transnet Limited. They shall be supplied with rail-to-sleeper fastenings to suit the type of sleeper and the rail section being laid.

(iii) Concrete sleepers

Concrete sleepers shall be of the siding type with sleeper fastenings, all as approved by Transnet Limited.

(g) Fish-plates

Fish plates shall be supplied in pairs and shall be of the correct design for the type of rail being laid. Fish-plates shall be sound in all respects and second-hand fishplates shall be in such condition that the remaining draw is at least 5 mm when the fish bolts are pulled up to a torque of 340 Nm. Fish-bolt holes shall not be worn or deformed.

(h) Rail-to-sleeper fastenings

Sole plates shall be of a type to suit the rail sections specified, and the rail shall have an inward cant of 1 in 20. Second-hand sole plates shall be in a sound condition without any noticeable ridges on the rail-flange seat.

Rail chairs and check-rail chairs shall be suitable for use with the rail sections specified, and shall be supplied complete with rail-to-chair fastenings. Second-hand rail chairs and check-rail chairs shall be in a sound condition.

Coach screws for hardwood sleepers shall be of size M22, type B galvanized, provided that type A shall be used where the nominal thickness of the base plate is 30 mm.

Type B galvanized coach screws shall be used with softwood and laminated softwood sleepers. Fastenings used with concrete sleepers shall be of a type acceptable to Transnet Limited.

(i) Turn-outs, slips and crossings

Turn-outs, slips and crossings shall be supplied complete with crossing bearers of steel or wood and the appropriate rail-to-bearer fastenings. The supply of turn-outs, slips and crossings shall also include stocks and guards, stocks and switches, sole plates, closure rails, lead rails, internal fish plates, fish bolts and nuts, connecting rods, pull rods, steel-plate foot guards, switch boxes, and all other fittings, fastenings, and accessories and, where applicable, notched sole plates and gauge plates.

(j) Stop blocks

Stop blocks of the fixed type or sliding type shall be constructed of class B or a better class of second-hand rails of the same mass per metre as that of the rails to which they are connected, and shall include buffer beams, hardwood bumper blocks, running rails and fastenings, accessories, and bearers.

(k) Derail devices

Derail devices shall be of the type(s) scheduled or given on the Drawings. They may consist of a standard Hayes type, or a stock-and-switch type compounded with the take-off set of points, or a standard scotch block manufactured from 30 kg/m rail or from any suitable rolled-steel section that is not too heavy to handle. Each scotch block shall be supplied with the additional sleepers and fastenings required and fitted with a stout chain and eye bolt to ensure locking in either the on or the off position.

(l) Clearance markers

Clearance markers shall consist of lengths of rail or other approved material with a nominal length of 1,7 m.

(m) Insulated rail joints (block joints) and rail bonds

Insulated rail joints shall consist of laminated-wood fish plates, approved insulation, and insulating shims with a thickness of at least 5 mm between rails.

Rail bonds shall consist of :

(i) in the case of a signal bond, at least two strands of copper wire with a diameter of at least 4 mm, and

(ii) in the case of a traction bond, braided copper wire with a cross-sectional area of at least 20 mm^2, bonded to the rails in an acceptable manner.

(n) Ballast

Ballast shall consist of approved hard broken hornfels, dolerite, tillite, quartzite, or similar crushed stone that complies with requirements for single-sized crushed stone for roads with a nominal size of 53,0 mm as given in SANS 1083, except that the nominal aperture size of the largest sieve used for the grading shall be 63,0 mm (instead of 75,0 mm) and, instead of the appropriate ACV specified in SANS 1083, the stone shall have an abrasion resistance of 34 as determined by the Los Angeles abrasion test. The flakiness index shall be as specified for crushed-stone pavement layers in TRH 14.

Samples and a grading analysis of the stone proposed by the Contractor to be used as a ballast shall be submitted to the Engineer for examination and approval.

(o) Sign boards

Whistle boards, siding-number boards, and any other railway sign boards required shall be of standard Transnet Limited pattern, shall be painted in accordance with standard Transnet Limited practice, and shall comply with the regulations of Transnet Limited. In the case of level crossings, road signs shall conform to the requirements of the National Road Traffic Act (Act 93 of 1996).

05 PLANT AND EQUIPMENT

All tools and equipment for the handling of material and the proper completion of the work shall be provided by the Contractor.

Power or hand-operated equipment shall be of a type approved for the type of fitting being fastened or the operation being carried out.

The use of ballasting machinery will be permitted. However, any heavy-weight and light-weight machines intended for use on a track on which Transnet Limited undertakes shunting shall be subject to approval by the Engineer.

06 EARTHWORKS

06.01 General

Earthworks shall comprise the construction of fills and the subballast layer, which work shall be carried out in accordance with sections 201 and 203. Minor variations to the requirements of these sections are set out in this clause.

06.02 Shallow cuts and fills of depth up to 300 mm

Where the in situ material at formation level is acceptable, the top 200 mm or such other depth as may be directed shall be compacted to the density specified for the subballast layer of embankments and finished to the correct level. Unsuitable soil below formation level shall be removed by excavation to depths, widths, and lengths as directed to permit the placing and compacting to the specified density of backfill. Rock shall be removed to a depth below the finished level of 200 mm or such other depth as may be directed, and shall be replaced by approved compacted material.

06.03 Fill layers

(a) The portion of the fill between the subballast and 1 m below the subballast shall be constructed of material containing no lumps or stones with a maximum dimension in excess of 75 mm and shall be deposited in layers of thickness, before compacting, not exceeding 300 mm.

(b) The portion of the fill more than one metre below the subballast level shall also be constructed in layers with a maximum uncompacted thickness of 300 mm but by using material containing no lumps or stones larger than 300 mm.

(c) Rock excavated from cuttings shall only be used in the portion of the fill described in (b) above and shall be deposited in layers of thickness at least sufficient to accommodate the bulk of the material, provided that the thickness of the uncompacted layer does not exceed 750 mm.

06.04 Subballast layer

The subballast layer shall be at least 200 mm thick and shall be constructed from material complying with the requirements of subclause 04.01(c) of this section.

07 TRACK WORK

07.01 General

(a) Safety

In addition to complying with the requirements of clause 17 of section 001 and in order to protect life and property when working or when handling equipment or material on or near running lines, the Contractor shall take all precautions necessary for keeping personnel, plant and materials outside the space defined by the fixed structure gauge as depicted in specification E7 of Transnet Limited, except that, when work is being carried out under occupation conditions, personnel and plant may be within the said space.

When trucks loaded with PWM are handled, rail transporters, whether moved manually or mechanically, shall be propelled not faster than at 6 km/h on sidings with a length of less than 600 m.

(b) Construction standards

The permanent way shall be constructed in accordance with the details shown on the siding plan and the requirements of Transnet Limited.

The Contractor shall ensure that he and his workmen are familiar with and shall comply with the requirements of Permanent Way Instructions published by the Chief Civil Engineer, Transnet Limited, Johannesburg, and of Transnet Limited Specification E7: Specification for Works on, over, under or adjacent to a Railway Line, and E10: Specification for Plate laying and Ballasting.

(c) Setting out

The Engineer will place pegs on the centre line of straights and at each PI, BC, and EC, and the Contractor shall be responsible for the detailed setting out of tracks and the provision of lift pegs.

(d) Supervision

The Contractor shall appoint a competent and experienced supervisor who has adequate permanent-way experience and is a qualified platelayer, and trackwork shall be carried out only under the personal supervision of the supervisor.

The Engineer may stop the work at any time if such supervisor has not been appointed by the Contractor or is not available on Site.

(e) Stacking and handling of PWM

Material shall be placed clear of the space defined by the fixed structure gauge, and shall be stacked at least 3 m from the centre line of any track. With the exception of wood sleepers, PWM shall not be stacked on ash.

Rails shall be stacked, crown uppermost, on an even bed and so supported as to prevent bending and twisting.

Steel sleepers shall be stacked clear of the ground with alternate layers at right angles to each other, bottoms facing down, and in lots of not more than 100.

Wood sleepers shall be stacked in lots of about fifty. The sleepers of the first layer shall be supported at each end by two parallel sleepers placed on the ground. Subsequent layers shall be stacked so that the sleepers will rest with one end on those below and with the other end on a sleeper placed across the layer below, which will give a stack in which every second layer is horizontal and all alternative layers are sloping.

The top layer shall be a sloping layer (to facilitate drainage) and shall be covered with a protective layer of gravel. The ground within 6 m of each stack of wood sleepers shall be cleared of all grass and weeds.

Concrete sleepers shall be stacked to a height not exceeding 2,5 m.

Bags with rail and sleeper fastenings shall be stacked clear of the ground. Bolts and nuts shall be oiled and stacked under cover to prevent rusting.

(f) Transport

Railway trucks loaded with PWM shall be unloaded within 36 h of the trucks being placed. The Contractor shall bear the cost of any demurrage charges directly attributable to his neglecting to unload within the specified time.

07.02 Laying of sleepers

(a) General

Sleepers shall be laid square to the rails and properly bedded. The nominal spacing of sleepers shall be as shown on the Drawings. Welded joints shall be so located that they will not interfere with sleepers' spacing. All sleeper fittings shall be kept clean while plate laying is in progress. Spring clips, where used, shall be fitted in an approved manner. Coach-screw threads shall be dipped in creosote before the coach screws are screwed down, and T-bolt threads shall be suitably lubricated before the bolts are tightened. Unless otherwise directed, the torque applied when sleeper fastenings are tightened shall be 340 plus or minus 20 Nm.

(b) Wood sleepers

Hardwood sleepers shall be laid with the heart down on the prepared formation. Holes for coach screws, with a diameter of 13 mm for softwood and 17 mm for hardwood, shall be drilled through the sleeper and square to the upper surface of the sleeper. Durable wood taper plugs or dowels with a length of 25 mm shall be inserted and driven to the bottom of the holes, which shall be filled with creosote before the coach screws are screwed home. Coach screws shall not be hammered in. If a coach screw is withdrawn from a sleeper and the hole is not to be re-used, the hole shall be plugged at once with a durable wood taper plug dipped in creosote or tar.

If sole plates or chairs with tapered keys are to be used, the holes at only one end of the wood sleeper may be bored before the sleeper is placed in the track. The holes at the other end of the sleeper must be drilled after the rails have been laid to the correct gauge and keyed to the chairs.

Tapered or spring keys in chairs must be driven in the direction of traffic on unidirectional lines and as the Engineer directs on bi-directional lines.

If chairs with clip or spring fastenings are to be used, all the holes in wood sleepers may be drilled by using a template before the sleepers are placed in the track.

If the Contractor drills holes in wood sleepers incorrectly, he shall, at his own cost, plug the faulty holes with dowels of the correct diameter, 125 mm long, dipped in creosote. If more than 4 holes are drilled incorrectly in any sleeper, the sleeper will be condemned and the cost of its replacement, including that of handling and transport to the Site, will be recovered from the Contractor.

(c) Steel sleepers

Steel sleepers that show signs of obvious damage shall not be used. Clip bolts shall be lubricated with an approved lubricant before they are tightened, but the clip and rail flange shall be kept free from all lubricant. All clip bolts shall be fitted with spring washers unless otherwise directed. The sleeper/clip combination shall be such that the finished trackwork is laid to the gauge required in terms of subclause 07.05 of this section.

(d) Concrete sleepers

No concrete sleepers shall be used if they show any defect or sign of failure of the concrete, or if the seat or shoulder to receive the rail or sole plate has been damaged for more than a quarter of its length in any direction.

Surfaces of concrete sleepers, sole plates, and chairs, and the surfaces of rails that bed on rubber pads shall be brushed and cleaned immediately before rail-laying.

Rubber pads shall be thoroughly cleaned and, while the rail is being laid, they shall be accurately positioned. Pads that show signs of distortion, either during or after plate laying, shall be removed and refitted correctly. Concrete sleepers that are damaged because the fittings were incorrectly assembled or were not kept clean, shall be removed from the track and from the Site of the Works.

Concrete sleepers may not be handled carelessly or dropped. Various makes of concrete sleepers and different types of fastenings shall not be mixed in the track.

The Contractor shall obtain combinations of sleeper clips and details of sleeper fastenings from the Engineer and he shall ensure that the combinations and fastenings do, in fact, give the required gauge before he proceeds to use the material.

Concrete sleepers may not be used on curves sharper than those with a 240 m radius with 30 kg rails or a 300 m radius with heavier rails.

To achieve uniformity, concrete sleepers with identical fastenings shall be grouped together in the sections to be re-sleepered. This grouping shall be subject to the approval of the Engineer before the sleepers are ordered.

07.03 Straightening and bending of rails

Before placing rails on sleepers and before bending them for use in a curve, the Contractor shall remove all kinks in the rails.

During each bending operation the rail shall be so supported on rollers that it will be free to move. Bending may be done with a Jim-crow or by means of any other approved bending machine.

Rail bending shall be carried out only when the rail temperature exceeds 5°C. A rail with a length of 18 m or less that is bent for use in a curve shall be curved over its full length. A rail with a length exceeding 18 m shall be curved over 6 m at both ends for a curve with a radius exceeding 500 m, and throughout its length for a curve with a radius of 500 m and less.

Subject to the aforementioned, curved track rails shall be uniformly bent in accordance with the standard offset for the length of rail used and the radius of the curve.

07.04 Laying of rails

(a) General

Except where the Contractor is required, in terms of the Project Specifications and the Schedule of Quantities, to supply and install a take-off turn-out, rails shall be laid from the end of a take-off turn-out that has already been installed (by Transnet Limited, in the case of track owned by Transnet Limited). PWM surfaces that bear on pads shall be brushed clean before insertion of the pads. Each second-hand rail shall be laid with the better running edge on the gauge side. Second-hand rails shall be matched for height.

If there is a mismatch of more than 1 mm in a running line laid or rerailed with reconditioned rails, the crowns of the rail ends shall be built up or ground on a slope flatter that 1 in 200 to reduce the mismatch to a maximum of 1 mm when the fish plates are in position and the fish bolts are pulled up tight.

No grinding or building-up is to be done to rail ends in yard tracks laid with reconditioned rails.

If any track is to be laid or rerailed with second-hand rails which have not been reconditioned, the Contractor shall select the rails and lay them so that, after the fish plates have been installed and the fish bolts tightened, any mismatch in height will not exceed 2,5 mm. In running lines, the rail end at such joints shall be built up and/or ground on a slope flatter than 1 in 200 to reduce the mismatch to 1 mm.

(b) Locating of joints

Rails shall be laid with square joints. On curves where special rails are 75 mm shorter than rails used on straights, the lead at joints shall not exceed 40 mm, and where special rails 100 mm shorter than straight rails are used, the lead shall not exceed 50 mm. Where no special rails are supplied, the lead of one rail on the other on curves shall not exceed 60 mm.

To ensure, when necessary, that the lead does not exceed 60 mm, the Contractor shall cut the end of the rail so that one fish-bolt hole is in the correct position and shall drill an additional fish-bolt hole. Closure rails should preferably be at least 6 m in length but shall, in any event, be at least 3,5 m in length, and shall be secured to at least 5 sleepers.

(c) Expansion gaps

Expansion gaps shall be left at joint in accordance with the temperature of the rail and the relevant requirements given in table 803/2.

(d) Cutting and drilling

Rails shall be cut with an approved rail saw or cutting disc. Rails shall not be cut with flame cutters or cold sets. The cut surface shall be planar and perpendicular to the long axis of the rail. If possible, the cut shall be so located that any remaining fish-bolt hole will be serviceable.

Fish-bolt holes shall be drilled with an approved rail drill. If fish-bolt holes are drilled incorrectly, a piece of rail shall be cut off and fresh holes drilled at the Contractor's expense. Fish-bolt holes shall not be flame-cut. The nominal diameters of fish-bolt holes shall be :

(i) 35 mm for 57 kg/m rails,

(ii) 32 mm for 48 kg/m rails, and

(iii) 26 mm for 40 kg/m and 30 kg/m rails.

All burrs and rough edges shall be removed after drilling.

(e) Jointing

In the case of electrified lines with bonded rails, fish-plated joints shall be assembled with the nuts on the gauge side of the rails. The fishing surfaces of fish plates and the threads of fish bolts shall be oiled or greased immediately before the joints are assembled, and the fastenings shall be tightened to a torque of 340 ± 20 Nm. Spring washers shall be fitted under all the nuts.

Junction fish plates may be used where required as a temporary measure during rerailing operations, or at stop blocks, or for joints at turn-outs involving different rail sections.

Before any items of permanent way material are assembled, all contact surfaces shall be cleaned, oiled, greased or black-leaded and polished as required, except the contact surfaces between the rails, sleepers and sleeper fastenings which shall be kept free from oil, grease or any foreign matter.

Junction rails shall be used for joining rails of different profile.

Temporary closure rails inserted to allow trains to pass during rerailing may be flame-cut to any length but shall be secured to all the supporting sleepers. Fish-bolt holes need not be drilled in such temporary closure rails, but the fish plates shall be fastened with at least 2 clamps at each joint.

If a temporary closure rail is left in the track overnight, both ends must be fish-plated and fastened with 4 fish bolts. The length of the temporary closure rail shall be at least 3,5 m.

Rail joints near turn-outs, bridges and level crossings shall be made where directed by the Engineer.

(f) Level crossings

On lines within 30 m of an electrified line, the Contractor shall, before use, tar that length of any rail which must be buried at level crossings.

07.05 Gauging and fastening of rails to sleepers

(a) Gauging

(i) Except where otherwise specified (see (ii) below), the gauge shall be 1 065 mm for standard straight track. On curves the gauge shall conform to the appropriate values given in table 803/3.

(ii) At the beginning and end of untransitioned circular curves, the widening of the gauge shall be carried out by the gauge on the straight being gradually increased at the rate of 5 mm per 12 m until the gauge for the curve is attained at the beginning of the circular curve.

(iii) At the beginning and end of transitioned circular curves, the widening of the gauge shall be carried out by the gauge on the transition curve being gradually increased from a point 6 m inside the beginning of the transition curve to a point 6 m short of the beginning of the circular curve. The increase in the gauge shall be at the rate of 5 mm per quarter of the length of the transition curve.

(b) Fastening to wood sleepers

Where sole plates are used on wood sleepers, coach screws shall be screwed home tightly with a box spanner until the full width of the overlap firmly grips the flange of the rail (see also subclause 07.02). For 22 mm diameter coach screws, the diameter of holes in wood sleepers shall be 17 mm. Threads of each coach screw shall be dipped in creosote before the coach screw is inserted in a sleeper. Coach screws shall not be hammered in.

(c) Fastening to steel sleepers

Gauge clips and bolts for steel sleepers shall be so combined during fastening that the finished track will be of the specified gauge.

(d) Fastening to concrete sleepers

Clips for concrete sleepers shall be applied or removed only by means of the recommended and approved puller or lever, as may be applicable. Clips that are not designed to be driven in shall not be driven in.

07.06 Superelevation

Curves shall be provided with the relevant superelevation given on the Drawings or specified in the Project Specifications and for the operating conditions given in the Project Specifications. The superelevation of curves in yard tracks shall not exceed 10 mm. The rate of change of superelevation shall be uniform and shall not exceed 1 in 500. No negative superelevation will be accepted.

07.07 Lifting, tamping and boxing in

Ballast shall be spread at the rate stated in the Project Specifications or given on the Drawings or Scheduled. After plate laying, the track shall be lifted uniformly and evenly, both rails together, care being taken to ensure that the top of the track is kept in line. The track shall be brought to its proper height by successive lifts, each not exceeding 100 mm.

Sleepers shall be firmly tamped underneath the rails but only lightly tamped at the centre. Each sleeper shall be tamped to the same degree of firmness. Joint sleepers shall be tamped last.

After tamping, ballast shall be made up and boxed into line in a neat and workmanlike manner. The finished ballast shall have a top width of 2,6 m and a slope of 1:1,5 on the shoulders. The top of the ballast shall be level with the tops of the sleepers except that, in the case of concrete sleepers, it shall be level with the tops of the centre portions of the sleepers.

On completion, the track shall be true to line, curvature, and grade, and the entire work shall present a neat and workmanlike appearance.

07.08 Turn-outs, slips and crossings

Turn-outs, slips and crossings shall be constructed complete with crossing bearers, standard switch boxes, and foot guards to the standard gauges and clearances required by Transnet Limited (see Transnet Limited specification E 10).

Working parts shall slide freely on the slide chairs.

Switches shall fit the stock rail closely and accurately with a full bearing against the head and shall rest normally on the slide chairs.

No part of a turn-out shall have wear in excess of the maximum given in table 803/1, except that the minimum height of stock rails of stocks and guards and any crossing shall be as follows:

57 kg rail	155 mm
48 kg rail	140 mm
40 kg rail	117 mm
30 kg rail	105 mm.

Each set shall closely match the rails in the line in which it is inserted. Tumbler weights of switch boxes shall be painted with one coat of an approved primer and two coats of an approved white paint.

07.09 Stop blocks

Stop blocks shall be laid, jointed, lifted, tamped, and boxed in as specified in subclauses 07.04, 07.05 and 07.07 of this section. Stop blocks shall be painted with one coat of an approved primer and two coats of an approved white paint.

07.10 Clearance markers

Clearance markers shall be placed between converging tracks at points where the distance between centres is 3,45 m in the case of a 1 065 mm gauge track, and 2,75 m in the case of a 610 mm gauge track. The markers shall consist of second-hand rails bedded with the flange uppermost (or other approved material acceptably bedded) and level with the adjoining ground, or ballast, or excess fill, as may apply. The exposed surface of each clearance marker shall be painted with one coat of an approved primer and two coats of an approved white paint.

07.11 Filling between tracks

The spaces between tracks where shunters and other operating staff are required to walk shall be filled with -

(a) clean-washed power-station ash with good drainage properties, or

(b) an approved fill material,

to within 50 mm of the required finished level. The upper 50 mm shall be filled with aggregate with a nominal size of 6,7 mm.

07.12 Derail devices

Derail devices shall be supplied and installed by the Contractor in the positions shown on the Drawings or as directed. Each derail device shall be painted with one coat of an approved primer and two coats of an approved white paint.

07.13 Signboards

Signboards shall be installed in the positions shown on the Drawings. In the case of level crossings, road signs shall be erected in accordance with the requirements of the National Road Traffic Act, (Act 93 of 1996) and to the correct clearances laid down in the relevant regulations of Transnet Limited.

Table 803/2

EXPANSION GAPS FOR DIFFERENT LENGTHS OF RAIL

Nominal length of rail in m									
9 and 10		12		18		36			
Temperature ° C	Gap in mm	Temperature ° C	Gap in mm	Temperature ° C	Gap in mm	In areas of high temperature		In areas of moderate temperature	
						Temperature ° C	Gap in mm	Temperature ° C	Gap in mm
-5 to 10	7	-5 to 10	8	-5 to 5	12	10 to 20	15	5 to 15	15
10 to 25	5	10 to 20	7	5 to 20	9	20 to 30	12	15 to 20	12
25 to 40	3	20 to 30	5	20 to 30	6	30 to 35	9	20 to 25	9
40 to 50	1	30 to 40	3	30 to 45	3	35 to 45	6	25 to 35	6
50 and over	0	40 to 50	1	45 and over	0	45 to 50	3	35 to 40	3
		50 and over	0			50 to 60	0	40 to 50	0

Table 803/3

TRACK GAUGES ON CURVES

Radius in m	Not check-railed		Check-railed	
	Specified gauge in mm	Maximum permissible gauge in mm	Specified gauge in mm	Maximum permissible gauge in mm
Less than 135	1 085	1 105	1 090	1 105
Equal to 135 and up to 150	1 080	1 100	1 085	1 105
Over 150 and up to 175	1 075	1 095	-	-
Over 175 and up to 200	1 070	1 090	-	-
Over 200	1 065	1 085	-	-

08 TOLERANCES

Permissible tolerance limits shall be as follows:

08.01 For earthworks

The formation shall be constructed to the same dimensional tolerances as given for fill in clause 12 of section 203.

08.02 For trackwork

The permissible deviation (PD) shall be within the appropriate limits of the following limits in respect of degree of accuracy III in the case of a private siding, and degree of accuracy II of work done on Transnet Limited tracks (see table 803/4).

09 TESTING AND INSPECTION

09.01 Testing of earthworks

Testing of earthworks shall comply with the requirements of clause 13 of section 203.

09.02 Inspection of trackwork

When construction is complete, the Contractor shall furnish the Engineer with a Certificate of Completion in the form required by Transnet Limited. The Contractor shall attend upon the PWI or other Transnet Limited officials during the checking of clearances, gauges, superelevations and other features of trackwork. At his own cost, the Contractor shall rectify work that, in the opinion of the PWI, does not comply with the requirements of Transnet Limited.

Table 803/4

TOLERANCES FOR TRACKWORK

	Permissible deviation	
	Degree of accuracy	
	III mm	II mm
(a) Track alignment		
PD from true staked centre line	± 20	± 6
PD from true level of track	± 20	± 3
(b) Track gauge (straights)		
PD from gauges specified in subclause 07.05	± 3	± 3
(c) Straightness of track		
PD from a 5 m straight line	± 5	± 2
(d) Superelevation		
PD at any two points 1 200 mm apart	± 4	± 3
PD at any point in the track	± 14	± 12
(e) Sleeper spacing		
PD from nominal spacing specified	± 25	± 25
PD at joint sleepers	± 10	± 10
(f) Circular curves		
PD from the standard offset for offsets measured on a 10 m chord	± 5	± 5
(g) Structure clearance		
PD of clearance for track laid adjacent to fixed structure	- 0 + 10	- 0 + 10
(h) Platform level		
PD from specified height between rail level and platform level	± 20	± 3
(i) Sleeper dimensions		
PD from nominal length	- 0 + 75	*
PD from nominal width	- 0 + 75	*
PD from nominal depth	- 0 + 25	*
PD from parallel (top and bottom)	± 10	*
PD from parallel (sides)	± 25	*

***** As stated in the Project Specifications if a better accuracy than degree of accuracy III is required.

10 MEASUREMENT AND PAYMENT

Notes:

(a) Pay items for earthworks

All pay items under section 203 : Mass earthworks, shall apply to the construction of earthworks for railway sidings, except item 203.01, which is to be replaced with pay item 803.01 below. The contents of the note at the beginning of clause 14 of section 203 shall also apply to the taking of cross-sections for the calculation of quantities for earthworks for railway sidings.

(b) Payment for down-lets

Down-lets shall be measured and paid for under the relevant pay items of section 503.

Item		Unit
803.01	**Excavation and borrow to fill and subballast layer (soft material)**	
803.01.01	Compaction to a percentage of modified AASHTO density:	
803.01.01.01	Fill to 93% of modified AASHTO density	cubic metre (m^3)
803.01.01.02	Subballast layer to 95% of modified AASHTO density	cubic metre (m^3)
803.01.02	Rock fill processing and compaction	cubic metre (m^3)
803.01.03	Twelve-pass roller-compaction	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material measured in the compacted fill and subballast layers. The quantity measured shall be computed after clearing and grubbing and the removal of topsoil and completion of any preparatory construction-bed treatment which may have been ordered by the Engineer. For measurement a distinction shall be made between the three alternative methods of processing and compacting.

Material excavated for the construction of open drains, subsurface drains, culverts, bridge foundations and other structures shall, if it is of a suitable quality and if directed by the Engineer, be used for the construction of the fill or subballast, and payment shall be made under this item notwithstanding any payment previously made for the excavation of such material. All such material shall be classified as soft excavation. The tendered rates shall also include full compensation for removing and disposing of up to 5% of oversized material after processing, including transport within the specified Site boundaries, except where material is obtained from borrow pits found by the Contractor.

For payment purposes a distinction shall be made between the three methods of processing and compacting specified, as itemized above. Compaction to 98% of proof density shall be paid at the rate tendered for subitem 803.01.01 in accordance with subclause 05.02 of section 203.

Item		Unit
803.02	**Supply, deliver and stockpile track work:**	
803.02.01	Rails	
803.01.01.01	(Length and class of rail stated)	ton (t)
803.01.01.02	Etc for other lengths and classes	
803.02.02	Sleepers	
803.02.02.01	(Type and length of sleeper stated)	number (No)
803.02.02.02	Etc for other types and lengths	
803.02.03	Rail-to-sleeper fastenings for rails other than check and running rails	
803.02.03.01	(Type of fastening stated)	number (No)
803.02.03.02	Etc for other types	
803.02.04	Rail-to-sleeper fastenings for check and running rails	
803.02.04.01	(Type and fastening stated)	set
803.02.04.01	Etc for other types	
803.02.05	Turn-outs, slips and crossings complete but excluding sleepers	
803.02.05.01	(Type and angle stated)	set
803.02.05.02	Etc for other types and angles	
803.02.06	Sleepers for turn-outs, slips and crossings, including fastenings	
803.02.06.01	(Type and angle stated)	set
803.02.06.01	Etc for other types and angles	
803.02.07	Fish plates	
803.02.07.01	(Type stated)	pair (pr)
803.02.07.01	Etc for other types	
803.02.08	Fish bolts, nuts and spring washers	
803.02.08.01	(Type stated)	set
803.02.08.02	Etc for other types	
803.02.09	Stop blocks complete including buffer	
803.02.09.01	(Type stated)	number (No)
803.02.09.02	Etc for other types	
803.02.10	Etc for other items	

The unit of measurement for the supply, delivery and stockpiling of the various items of trackwork shall be the ton, number, set or pair as scheduled.

The rates tendered shall also include full compensation for the cost of stockpiling the material.

Item		Unit
803.03	**Lay and Install plain track work complete using :**	
803.03.01	(Class of rail stated)	metre (m)
803.03.02	Etc for other classes	

The unit of measurement for laying and installing plain track work (PWM) shall be the metre of each class of rail laid complete and approved but excluding ballasting. Measurement shall be along the centre line of the track and no deductions will be made for the lengths occupied by turn-outs (other than take-off turn-outs), slips, crossings, stop blocks, short-radius curves, etc, as they will be paid for as "extra over" to the plain track work.

Where measurement starts at take-off turn-outs, it will be made from the stock rail joint.

The tendered rates shall include full compensation for transporting the materials from the stockpiles, for sorting, laying and installing the material as may apply, for selecting second-hand rails where specified, for alignment of the completed track, the cost of having all materials inspected by the PWI before use, and the cost of fees payable to Transnet Limited for inspection and testing of the siding on completion of the work.

Item		Unit
803.04	**Extra over Item 803.03 for laying and installing the following:**	
803.04.01	Tracks on short-radius curves	
803.04.01.01	(Range of radius stated)	metre (m)
803.04.01.02	Etc for other ranges of radii	
803.04.02	Turn-outs (excluding take-off turn-outs)	
803.04.02.01	(Angle of turn-out stated)	set
803.04.02.02	Etc for other angles	
803.04.03	Slips	
803.04.03.01	(Angle of slip stated)	set
803.04.02.02	Etc. for other angles	
803.04.04	Crossings	
803.04.04.01	(Angle of crossing stated)	set
803.04.04.02	Etc for other angles	

The unit of measurement shall be the metre of curved rail or the number of sets of turn-outs, slips or crossings installed and approved.

The tendered rates shall be extra over the rates tendered under item 803.03 and shall include full compensation for all extra costs involved for carrying out the work as specified or as detailed on the Drawings. Distinction shall be made between different curves, turn-outs, slips and crossings.

Item		Unit
803.05	**Supply and Install take-off turn-out complete**	set

The unit of measurement shall be the number of take-off turnouts installed complete and approved. The tendered rate shall include full compensation for all the activities as specified in the payment paragraph of item 803.03 as well as for the cost of taking temporary occupation, cutting rails, removing an appropriate length of track owned by Transnet Limited and the handing-over of such material in a dismantled form to Transnet Limited, as well as for slewing in (or installing by other means) and connecting up the take-off turn-out.

Item		Unit
803.06	**Welding of rails into long lengths**	number (No)

The unit of measurement shall be the number of welded joints constructed and approved.

The tendered rate shall include full compensation for all labour, plant and materials needed for completing the work as specified.

Item		Unit
803.07	**Provide and distribute ballast and lift, tamp, and box-in the track**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of ballast placed in the final position in accordance with the specified cross-section under all tracks, turn-outs, stop blocks, etc. No deduction will be made for the volume of stone displaced by the sleepers.

The tendered rate shall include full compensation for supplying, stockpiling if necessary, placing and compacting the ballast, for all transport, for lifting the trackwork in successive lifts to the required level and for the boxing-in of the tracks, all as specified. Ballast placed in excess of the specified dimensions shall not be measured for payment.

Item		Unit
803.08	**Provide and install miscellaneous items**	
803.08.01	Rail lubricator	
803.08.01.01	(Type stated)	number (No)
803.08.01.02	Etc. for other types	
803.08.02	Etc. for other items	

The unit of measurement shall be the number of items such as lubricator, clearance marker, track sign, insulating block joint, etc, provided and installed to the satisfaction of the PWI.

The rates tendered shall include full compensation for all labour, plant and materials necessary for providing and installing the item as specified or as shown on the Drawings.

Item		Unit
803.09	**Replace sleepers**	
803.09.01	With rails in position	
803.09.01.01	(Type and length stated)	number (No)
803.09.01.02	Etc for other types and lengths	
803.09.02	On turn-outs, slips and crossings	
803.09.02.01	(Type and angle stated)	set
803.09.02.02	Etc for other types and angles	

The unit of measurement shall be the number of each type and length of sleeper replaced and the number of sets of sleepers replaced for each angle of turn-out, slip and crossing.

The tendered rates shall include full compensation for opening the ballast, releasing sleeper fastenings, removing old sleepers to stockpile and supplying and inserting new sleepers, cleaning fastenings, replacing old fastenings with new ones if necessary, revamping the ballast, aligning the track, and for boxing-in.

Item		Unit
803.10	**Replace the following:**	
803.10.01	Rails	
803.10.01.01	(Length and class of rail stated)	ton (t)
803.10.01.02	Etc. for other lengths and classes	
803.10.02	Turn-outs, slips and crossings	
803.10.02.01	(Type and angle stated)	set
803.10.02.02	Etc for other types and angles	

The unit of measurement shall be the ton of each length and class of rail replaced or the number of sets of turn-outs, slips and crossings replaced for each different angle.

The tendered rates shall include full compensation for removing existing rail fittings, removing rails or sets, cleaning and oiling fittings ready for re-use, supplying and laying new rails or sets, using new or original rail fittings, realigning the track, lifting the released rails, and transporting them to designated stockpile.

Item		Unit
803.11	**Reballasting**	
803.11.01	Repack and box-in existing track work :	
803.11.01.01	By mechanical methods	metre (m)
803.11.01.02	By manual methods	metre (m)
803.11.02	Remove and screen existing ballast :	
803.11.02.01	By mechanical methods	cubic metre (m^3)
803.11.02.02	By manual methods	cubic metre (m^3)

The units of measurement shall be the metre of track-work repacked and boxed-in with ballast, or the cubic metre of ballast removed, screened and replaced. Distinction shall be made between mechanical and manual methods of carrying out the work.

The rates tendered shall include full compensation in the case of subitem 803.11.01 for all costs involved to repack and box in the trackwork and, in the case of subitem 803.11.02 for the sampling, removal, screening, recovery and profiling of the ballast, for lifting, packing and boxing-in of the track work and for disposal of screenings to sites found by the Contractor.

SERIES 8 : SPECIFIC WORKS

SECTION 804 : PIPE JACKING AND BORING

CONTENTS

01 SCOPE

This section covers the insertion, by jacking and boring, of underground pipes without disturbing the surface.

02 APPLICATION

The information regarding pipe jacking contained in this section is not limited to the jacking of circular precast concrete pipe sections but also applies in general to the jacking of rectangular, square and arched precast-concrete sections.

Where boring is to be carried out, the Contractor shall, as is the case for jacking, make use of an approved specialist firm.

03 DEFINITIONS

For the purposes of this section, the following words and expressions shall have the meanings hereby assigned to them except where inconsistent with the context.

(a) Intermediate jacking station

A transverse joint in a jacked structure at which jacking is performed.

(b) Jacking

The action of pushing a pipeline into position.

(c) Jacking frame

A frame on which the jacks are mounted and through which the jacking forces are transmitted.

(d) Jacking structure

An assembly comprising the jacking frame, the permanent pipes to be jacked, and the shield.

(e) Lead pipe

A pipe that has a rebated end over which the trailing end of the shield is fitted and which is intended to be the first pipe to be used in the jacking process.

(f) Pilot hole

A hole with a maximum diameter of 50 mm, drilled to ensure that a subsequently bored, larger hole, will be properly aligned.

(g) Pipe boring

The work involved in boring a horizontal hole and inserting a pipe therein.

(h) Pipe boring pits

Excavations at either end of the boring operation from and between which boring and pipe installation are carried out.

(i) Reception pit

An excavated shaft located at the end of a jacked section of a pipeline, from which the shield is recovered.

(j) Shield

A device located at the leading end of the jacking structure, which is intended to provide protection for workmen at the leading end and to prevent the collapse of the face of the tunnel excavation.

(k) Thrust pit

An excavated shaft at the starting point of a jacking operation, in which the jacking structure and other equipment are installed and from which the jacking operations are carried out.

(l) Thrust plate

A steel plate placed against the end of the pipe against which the jack operates, and which is intended to ensure that the jacking forces are spread uniformly over the end face of the pipe.

(m) Thrust block

A temporary structure constructed inside the thrust pit for the purpose of transferring the jacking forces to the adjacent soil.

04 MATERIALS

04.01 Pipes

Unless otherwise specified, the pipes for jacking shall be reinforced concrete pipes of the SC type and D-load designation 100D which comply with the relevant requirements of SANS 677. The actual diameters of pipes supplied shall be not less than the nominal diameters given on the Drawings or stated in the Schedule of Quantities. In addition to withstanding the specified two (or three) edge-bearing test load, the pipes shall be capable of withstanding, without being damaged, the maximum longitudinal force to be transmitted by the jacks during jacking.

Pipes for pipe boring shall be any of the pipes specified under sections 106, 301 and 401.

04.02 Other precast-concrete sections

Any precast-concrete sections, other than pipes, to be jacked shall comply with the requirements specified in the Project Specifications and as shown on the Drawings.

04.03 Intermediate jacking stations

Under certain circumstances it may be necessary to provide one or more intermediate jacking stations between the thrust and reception pits. Such stations shall consist of a pair of modified jacking pipes. In order to protect and form the joint between these pipes, the Contractor shall provide cylindrical mild steel sleeves with a wall thickness of at least 8 mm and of such length that they overlap the pipes for a distance of at least 150 mm on each side of the joint.

05 PLANT

05.01 General

The Contractor shall in the case of jacking, provide and use suitable equipment for handling pipes and placing them in position for jacking, for jacking the pipes, for the lubrication of the outer surface of the pipeline, and for excavation within the pipe and in the case of pipe boring, for boring the hole and for jointing and inserting the pipes.

05.02 Jacks

The jacks shall be fitted with a suitably calibrated pressure gauge in a good working order which will enable the actual jacking forces to be read at any time during the jacking operation. To transfer the load from the jacks to the pipes, suitable thrust plates and spacers shall be provided.

05.03 Shield

A suitable shield for fitting to the front of the lead pipe shall be provided by the Contractor to protect workmen and prevent the collapse of the face or roof of the excavation ahead of the jacked structure. The shield shall be directionally adjustable.

05.04 Lighting

The Contractor shall provide adequate lighting for the execution of the Works.

05.05 Guides

Where necessary, guides shall be provided within the thrust pit to facilitate initial directional control of the pipes.

05.06 Ventilation

Sufficient ventilation shall be provided to remove dust and to ensure safe working conditions.

06 DESIGN

The Contractor shall furnish detailed design calculations, specifications and working drawings to explain his methods of installation and of providing temporary support for the road, rail track, or other service or structure and any modifications to structures required before pipe jacking commences. The above information shall, when required by the Engineer, also be provided in the case of pipe boring.

The design shall be carried out by a professional engineer with adequate experience in this field. Calculations, specifications and drawings shall be signed by the engineer responsible for their preparation.

07 SAFETY

07.01 General

The Contractor shall at all times observe adequate safety precautions on the Site as specified in clause 17 of section 001. Permission to proceed with the Works shall not in any way detract from the obligations and liabilities of the Contractor in regard to such safety or to the adequacy of the jacking structures and methods of working.

07.02 Safety of existing works

The pipeline shall be jacked or bored through under the relevant road, railway or other service or structure without disrupting the traffic and without disturbing the alignment or levels of the road surface, the tracks, or other relevant service or structure to an extent that may impair the safety of traffic or of the service or structure.

Before commencing work in the vicinity of any structure, the Contractor shall make a detailed examination of the structure, record its condition, and submit a copy of such record to the Engineer.

08 SURVEYING

08.01 General

The Contractor shall take measurements before and after each jacking or boring operation and shall record any change in line or level (or both) of any road, rail track or other service or structure being traversed. A copy of the records shall be submitted to the Engineer on the same day.

08.02 Working under roadways

Before commencing work under a roadway, the Contractor shall measure levels on the road surface directly above the jacking line and for a distance of at least 5 m on each side of the jacking line. These levels shall be measured at 500 mm intervals and 300 mm from the edges of the surfacing. In order to facilitate control of the measuring of levels, the exact position of each spot height shall be discreetly marked on the road surface before the levels are measured.

After completion of the Works, the Contractor shall remeasure the levels in the same manner as before, and he shall submit to the Engineer the final records of levels taken before and after jacking. The submission of such records shall be a prerequisite for any consideration by the Engineer of the acceptability or otherwise of the Works or the issue of any certificate of completion.

If, within the Defects Liability Period, the road shows any sign of settlement in the vicinity of the jacked pipe, the road authority may remeasure the levels on the Site.

The Contractor shall be held responsible for the rectification, to the satisfaction of the road authority and the Engineer, of any deformation that occurs in the road surface as a result of the jacking operation during the said period of one year.

Should level measurements in accordance with this subclause also be required in respect of boring, it will be specified in the Project Specifications.

08.03 Checking the alignment of the pipeline

The Contractor shall check the line and the level of the pipeline at least once during the installation of each pipe length and shall take such corrective action as may be necessary. A copy of the results of all checks and a statement of any corrective measures taken shall be available for inspection on the Site, and a copy shall be given to the Engineer on the same day.

09 BLASTING

No blasting will be allowed for pipe boring. For pipe jacking, no blasting shall be carried out without the prior written permission of the Engineer, and without the necessary approval or clearance having been obtained from the relevant authority.

10 CONSTRUCTION

10.01 General

Jacking, excavation, boring and other specialized work shall be undertaken only by persons fully conversant with the work.

Jacking and boring operations shall commence at the lower level of the pipeline. Should Site conditions necessitate or permit jacking or boring to be carried out from the higher level of the pipeline, the Engineer's written approval shall be obtained before the work commences.

The Contractor shall not commence any work until the Engineer has specified, in writing, that the Contractor may proceed.

10.02 Excavation

Subject to the provisions of clause 09 above, the appropriate requirements of sections 201 and 202 shall apply.

(a) Classification of materials excavated

The materials excavated shall be classified as follows for payment purposes:

(i) Hard material:

Material which cannot be excavated efficiently except with the use of pneumatic tools, blasting or wedging and splitting, and shall include boulders exceeding 0,15 m^3 in volume.

For pipe boring operations, the material penetrated will be classified as hard when the Contractor can prove that the work cannot be efficiently carried out by using normal boring equipment and some other method, such as rock drilling, has to be used.

(ii) Soft material:

All material not classified as hard material.

Notwithstanding the above classification, all material in previously constructed fills, embankments and pavement layers and through which jacking or boring is carried out, shall be classified as soft material.

The decision of the Engineer as to the classification of the material shall be final and binding, and any objection as to the classification shall be made before the pipes are jacked or, in the case of pipe boring, some method other than boring is used.

Special reference shall be made to clause 16 of section 001 regarding the classification of excavated material in restricted areas.

(b) Thrust and reception pits and pipe boring pits

The Contractor shall be responsible for excavating the pits in the positions indicated on the Drawings at each end of the section of pipeline or sleeve that is to be jacked. These pits shall be of dimensions at least equal to the minimum dimensions needed for the Contractor's equipment and for safe and efficient working. The approximate dimensions of the pits that the Contractor intends to excavate shall be agreed upon with the Engineer before work commences. The excavated material shall be stockpiled for later backfilling.

The sides of the pits shall be adequately supported by timbers or by other approved means. Where a pit adjoins a railway line or a heavily used road, the sides of the pit shall be shored during the entire operation to prevent any movement caused by vibration arising from rail or road traffic from occurring.

The Contractor shall ensure that the pits are dewatered at all times.

(c) Jacking of pipes

Excavation shall be such that overbreak is kept to a minimum. No material shall be removed in advance of the leading edge where the leading edge is in unstable or loose material. If the material at the face starts to slip or run, excavation shall be stopped immediately and the Contractor shall take such action as may be necessary to stabilize the material before excavation is resumed.

Should any unforseen cavities be exposed during jacking, such voids shall be filled immediately with grout in a manner approved by the Engineer.

To ensure a minimum of overbreak, the first concrete pipe used shall be so rebated that the outside diameters of the shield and the pipeline will not differ substantially.

The Contractor shall ensure that the head of the excavation is drained at all times.

Under no circumstances will jetting be permitted.

10.03 Jacking procedure

Each pipe shall be advanced by means of hydraulic jacks of adequate capacity which bear against a suitable thrust plate so as to distribute the thrust of the jacks uniformly over the end face of the pipe.

The rear end of each jack shall so bear against a suitably designed structure as to transfer the force to the surrounding material and to distribute it evenly over an area large enough to ensure that the bearing capacity of the soil will not be exceeded and that no structure in the vicinity of the thrust pit will be disturbed.

The Contractor may, with the written permission of the Engineer, inject a suitable lubricant through preformed holes in the structure or in the shield. Resilient packing material shall be inserted between the faces of successive pipe units so as to distribute the thrust evenly over the circumference of the pipes.

At the conclusion of a day's work, the shield shall be jacked up to the tunnel face. If intermediate jacking stations are used, the trailing units shall be jacked forward until the jacks in the intermediate stations are in the unextended position. Spacers shall be placed between the jacking frame and the pipe with all the jacks being in the unextended position and ready to jack in an emergency.

10.04 Pipe boring

After the pits have been completed, and on the written instructions of the Engineer, a pilot hole shall be drilled using suitable equipment. After the pilot hole has been inspected and approved, it shall be enlarged by boring to the diameter required for the installation of the specified pipe.

10.05 Grouting and sealing

Before each jacking operation, the Contractor shall determine, in an approved manner, the average cross-section of the completed excavation ahead of the pipeline and shall submit his calculations to the Engineer on the same day.

These cross-sections, together with the external pipe diameter, shall be used for calculating the approximate volume of grout that will be needed after the entire jacking operation has been completed and will assist in determining whether all voids have been grouted.

When the jacked pipeline is in its final position, a sand - cement grout shall be injected to fill all voids between the jacked pipeline and the surrounding material. The grout shall have a strength equal to or better than a grout consisting of one part of cement and four parts of sand and shall have a slump of 120 mm.

Grouting shall commence at the lower end of the pipeline, and the grout shall be injected through holes drilled through walls of each pipe section.

These holes, which will also be used for checking the progress of the grout, shall be positioned in each side of the pipe on the line of its horizontal diameter, and also in the soffit of the pipe.

All holes in the pipeline shall be sealed with an approved epoxy sealant after the grouting has been completed.

The grouting of the pipes installed by means of pipe boring shall be carried out only on the written instructions of the Engineer and in a manner approved by the Engineer. The grout shall be the same as the grout specified above for jacked pipes.

10.06 Backfilling

When jacking has been completed and the jacking frame and shield have been dismantled, the thrust and reception pits shall be backfilled to the extent indicated on the Drawings or as laid down in the Project Specifications or determined by the Engineer on the Site.

The pipe boring pits shall be backfilled, only when so instructed by the Engineer, using excavated or imported material compacted to at least the density of the undisturbed surrounding material.

When the installed pipe is part of a pipeline, the boring pits will form part of the pipeline trench and as such shall be backfilled in the manner specified in sections 106, 202, 302 and 402 as applicable. Payment for such backfilling will be made under the applicable sections.

Surplus excavated materials shall be disposed of as specified in the Project Specifications or as determined by the Engineer on Site.

11 AS-BUILT DRAWINGS

If an alternative design by the Contractor has been accepted or if the structure shown on the Tender Drawings has been modified to suit the jacking method, the Contractor shall, on completion of the work and before the final payment is made, supply the Engineer with transparencies showing details of the completed structure. Each such transparency shall be certified by the Contractor to be an accurate reflection of the work as constructed.

12 TOLERANCES

Subject to any requirements of the Project Specifications imposed on account of the gradient(s) of the pipeline or in view of the purpose for which it is required, the pipes shall be positioned within the tolerances given below.

Should the difference between the actual and the specified position or alignment of the finished pipeline exceed the value of the said tolerance to an extent as to involve additional costs in respect of locating, installing, supporting or maintaining any service of which the jacked or bored pipe forms part or that has been designed to be laid through the jacked or bored structure, the Contractor shall bear such additional costs, provided that the details of the work to be done to relocate, install, or support the said service have been provided and the order for the work to be done (by the Contractor or by others) has been given by the Engineer within 30 working days of the completion of the jacking or boring operation.

Permissible tolerance limits shall be as follows:

(a)	Pipe jacking		
	(i)	In plan	± 100 mm
	(ii)	Vertical	± 50 mm
	(iii)	Horizontal and vertical displacement between units at joints	10 mm maximum

Adjustment to line or level or both shall be gradual, and the manufacturer's permissible angular deflection of the pipes shall not be exceeded at any point.

(b)	Pipe boring		
	(i)	In plan	± 100 mm
	(ii)	Vertical	± 100 mm

13 MEASUREMENT AND PAYMENT

Item		Unit
804.01	**Establishment on Site for**	
804.01.01	Pipe jacking	lump sum
804.01.02	Pipe boring	lump sum

The tendered lump sums shall include full compensation for the establishment on Site and the subsequent removal of all special equipment and plant for pipe jacking or boring, including the thrust block when applicable, for maintaining the safety of existing structures, services, roads, railways, etc, for bracing, lighting, watching, dewatering and surveying, and for maintaining all temporary works until the work is completed.

This work will be paid for as a lump sum, 80% of which becomes payable when all equipment is on the Site and jacking or boring has commenced, and the remaining 20% will become payable after the work has been completed, the equipment removed and the Site reinstated to a condition acceptable to the Engineer.

Item		Unit
804.02	**Access to and from the thrust and reception pits**	lump sum

The tendered lump sum shall include full compensation for the provision and maintenance of access roads to the thrust and reception pits, the negotiations with land owners where applicable, the erection and maintenance of temporary gates, fences and road signs where applicable, and for the removal and reinstatement of the access roads and temporary works on completion of the jacking operations to the satisfaction of the Engineer and landowners concerned.

The work will be paid for in two installments as specified in pay item 804.01.

Item		Unit
804.03	**Excavating in soft material for**	
804.03.01	Thrust and reception pits	lump sum
804.03.02	Pipe boring pits	lump sum

The tendered lump sums shall include full compensation for all work necessary for excavating the pits to suit the Contractor's equipment, for excavating by hand where applicable, for shoring the sides of the excavation, and for stockpiling the excavated material at predetermined sites. The work shall be carried out as specified in the appropriate clauses of sections 201 and 202 (see also subclause 10.02 (b) of this section).

Ninety per cent (90%) of the lump sum tendered under subitem 804.03.01 shall become payable when the excavations have been completed and jacking has commenced and the remaining 10% after the thrust block and shoring have been removed.

The lump sum tendered under subitem 804.03.02 shall be paid when the pits have been excavated and the boring has commenced.

Item		Unit
804.04	**Extra over item 804.03 for excavating hard material**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material measured in the original position before excavation and classified as hard in terms of sub-clause 10.02 (a). The dimensions of the excavation shall be agreed on as specified in subclause 10.02 (b) of this section.

The tendered rate shall include full compensation for all extra work and effort required for excavating in hard material.

Item		Unit
804.05	**Backfilling the**	
804.05.01	Thrust and reception pits with	
804.05.01.01	Excavated material	cubic metre (m^3)
804.05.01.02	Imported material	cubic metre (m^3)
804.05.02	Pipe boring pits with	
804.05.02.01	Excavated material	cubic metre (m^3)
804.05.02.02	Imported material	cubic metre (m^3)

The unit of measurement for subitem 804.05.01 shall be the cubic metre of suitable excavated or imported material used for backfilling the thrust and reception pits to the extent indicated on the Drawings, laid down in the Project Specifications or determined by the Engineer.

The unit of measurement for subitem 804.05.02 shall be the cubic metre of suitable excavated or imported material used for backfilling the pipe boring pits to the extent determined by the Engineer.

The tendered rates shall include full compensation for loading approved material previously excavated or alternatively for loading the material from approved borrow pits, for transporting it to where required and for off-loading, and placing the material.

The tendered rate shall also include full compensation for compacting the material in respect of subitem 804.05.01, in 150 mm thick layers to 90% of modified AASHTO density and in respect of subitem 805.04.02, in 150 mm thick layers to a density of at least that of the surrounding undisturbed material.

Material shall be imported only on the instructions of the Engineer and overhaul will be payable where the material is transported outside the free-haul boundaries from sources provided by the Employer.

Item		Unit
804.06	**Supply of pipes to be jacked** (description, type and diameter stated)	metre (m)

The unit of measurement shall be the metre of completed jacked pipeline measured between the ends of the completed pipeline continuously through intermediate jacking stations and shall include intermediate jacking pipes.

The tendered rate shall include full compensation for the supply, delivery and storing the pipes, for rubber rings, packing pieces, and the flexible sealing of joints between intermediate jacking pipes.

Item		Unit
804.07	**Jacking of pipes through :**	
804.07.01	Soft material	cubic metre (m^3)
804.07.02	Hard material	cubic metre (m^3)

The unit of measurement shall be the cubic metre of material removed at the working face. The volume of material shall be determined from the outside diameter of the pipe and the length of pipe jacked.

The tendered rates shall include full compensation for handling and positioning the pipes, jacks and subsidiary materials; for jacking the pipes; for drilling and subsequently sealing the grouting holes in pipe barrels; for lubricating; for the provision of ancillary jacking equipment at intermediate stations and for transporting excavated material through the pipe, lifting it to ground level, and loading and carting it off to spoil sites found by the Contractor.

Should the dumping sites be provided by the Employer, overhaul will be payable where material is transported outside the free-haul boundaries.

Distinction shall be made between hard and soft material as classified in terms of subclause 10.02(a).

Item		Unit
804.08	**Boring of holes through :**	
804.08.01	Soft material	
804.08.01.01	Diameter of hole stated	metre (m)
804.08.01.02	Etc. for other diameters	
804.08.02	Hard material	
804.08.02.01	Diameter of hole stated	metre (m)
804.08.02.02	Etc. for other diameters	

The unit of measurement shall be the metre length of hole bored and approved.

The tendered rates shall include full compensation for all labour, equipment (other than equipment provided under item 804.01), materials and appurtenant work necessary to bore the hole including the pilot hole in the positions indicated and as specified and for removing any bored material to spoil sites found by the Contractor. Should spoil sites be provided by the Employer, overhaul will be payable where material is transported outside the free-haul boundaries.

Item		Unit
804.09	**Supplying, jointing and inserting pipes**	
804.09.01	State type, class and diameter of pipe	metre (m)
804.09.02	Etc. for other types, classes and diameter of pipes	

The unit of measurement shall be the metre of each size and type of pipe supplied, jointed and inserted.

The tendered rates shall include full compensation for supplying the pipes, for jointing the pipes where necessary and for inserting the pipes in the bored hole.

Item		Unit
804.10	**The grouting of voids for pipe jacking**	
804.10.01	Unforseen and exposed during jacking	kilogram (kg)
804.10.02	Between pipeline and surrounding material after jacking has been completed	
804.10.02.01	Pipe diameter stated	metre (m)
804.10.02.02	Etc for other pipe diameters	

The unit of measurement for subitem 804.10.01 shall be the mass, in kilograms, of cement used in the grouting operation. The quantity of cement shall be based on a grout mixture consisting of one part cement and four parts of sand by volume. The volume of one pocket of cement (50 kg) shall be taken as being 0,033 m^3.

The unit of measurement for subitem 804.10.02 shall be the metre of each size of pipe grouted.

The tendered rates shall include full compensation for all plant, material and labour necessary for carrying out the work as specified.

Item		Unit
804.11	**The grouting of voids for pipe boring**	
804.11.01	Pipe diameter stated	metre (m)
804.11.02	Etc for other pipe diameters	

The unit of measurement shall be the metre of each size of pipe grouted on the instructions of the Engineer.

The tendered rates shall include full compensation for all plant, material and labour necessary for carrying out the work in a manner approved by the Engineer.

Item		Unit
804.12	**Timbering and shoring left temporarily in the thrust and reception pits and pipe boring pits**	week

The unit of measurement shall be the number of weeks during which the timbering and shoring is left in position for another contractor to construct manholes, etc, under a separate contract.

This item will only apply where the jacking and boring work is carried out under a separate contract or under a nominated subcontract.

The tendered rate shall include full compensation for the removal of the timbering and shoring by the pipe-jacking or pipe-boring contractor when it is no longer required and within one week of having been instructed to do so by the Engineer, in writing.

Note:

The following item of work, when specified, shall be carried out, measured and paid for in accordance with the relevant sections of the Specifications, but shall be listed under this section in the Schedule of Quantities.

Item	Applicable section
(a) Overhaul on excavated or imported material	103

SERIES 8 : SPECIFIC WORKS

SECTION 805 : BUILDING WORK

CONTENTS

01 SCOPE

This section covers the various construction activities associated with the erection of buildings which form part of certain civil projects.

Building work shall be carried out in accordance with the National Building Regulations and the information contained in this section.

Work appurtenant to the erection of buildings such as earthworks, concrete work, structural steelwork, etc, shall be carried out as specified in the appropriate sections of these specifications and will be measured and paid for under those sections.

02 BRICKWORK, PLASTERWORK AND CONCRETE FLOOR FINISHES

General

The design and construction of unreinforced and reinforced masonry walling shall be carried out in accordance with the recommendations and requirements of the SANS Codes of Practice 10164-1 and 10164-2 respectively.

02.01 Materials

(a) Bricks

Burnt clay bricks shall comply with SANS 227 and shall be of the strength class specified in the Project Specifications or shown on the drawings.

Concrete masonry units shall comply with SANS 1215. The use of concrete masonry units will only be permitted if so specified in the Project Specifications or approved by the Engineer in writing.

Satisfactory proof of the load-bearing capacity of the bricks offered shall be submitted before deliveries are made to the Site.

Air bricks shall be well-burnt terracotta and shall be free from cracks and blemishes and shall be lined with copper mosquito gauze.

Three samples of each type of brick shall be submitted to the Engineer for approval. All subsequent deliveries shall be of a standard equal to or better than that of the approved samples

(b) Cement

The cement used in mortar and plaster shall be CEM I strength class 32,5 N complying with SANS 50197-1, or masonry cement strength class 22,5 X complying with SANS 50413-1. CEM I strength class 42,5 shall only be used if so specified in the Project Specifications. Under no circumstances shall masonry cement used in the manufacture of concrete and the various types of cement shall be stored separately on the Site.

Cement shall be stored off the ground in dry storage and shall be used in the order of delivery. Cement that has become affected by dampness shall not be used. Cement containing hard lumps is not fresh and shall be removed from the Site.

(c) Aggregate

Fine aggregate shall be naturally occurring sand or shall consist of crushed rock or gravel, and shall be hard, clean and free from adherent coatings or other deleterious matter. Sand for plaster and mortar shall comply with the requirements of SANS 1090, whereas the aggregates for normal and granolithic floor screeds shall comply with the requirements of BS EN 13139 and BS EN 13813 respectively.

(d) Water

Water shall be clean and free from clay, silt, oil, acid, alkali, organic or other matter which would impair the required strength and durability of the mortar, plaster or floor screed.

(e) Wall ties

Wall ties for cavity walls shall comply in all respects with the requirements of SANS 28 and shall be of the type and size specified in the Project Specifications or on the Drawings. Wall ties for double leave walls shall be flat metal ties of cross-sectional area 20 mm x 3 mm or as approved by the Engineer, placed in accordance with the requirements of SANS 0164-1 or as specified in the Project Specifications or on the drawings. The use of single-wire wall ties will not be permitted.

(f) Damp-proof sheeting

Damp-proof sheeting shall comply with SANS 248, type FV for fibre felt, or SANS 952, type B for embossed polyethylene sheeting.

02.02 Construction of brickwork

(a) Cement mortar

The mortar class shall be as specified in the Project Specifications or indicated on the drawings. If no mortar class is specified, mortar shall be strength class II (7 MPa compressive strength at 28 days). Mortar class III shall only be used if so specified, and the use of mortar class I will not be permitted.

Cement mortar shall, unless otherwise specified, consist of 1 part of common cement (CEM I) to 6 parts of sand by volume for mortar class II. If masonry cement is used, the mortar shall consist of 1 part of masonry cement to 5 parts of sand by volume. The use of lime to increase the workability of mortar shall only be permitted with the written approval of the Engineer. Only lime complying with SANS 523 shall be used, and lime shall only be used with common cement and not with masonry cement. A maximum of 40 ℓ of lime per 50 kg bag of cement is permitted and the mix proportions of cement and sand shall remain unaltered.

If mortar class I is required in terms of the Project Specifications, the mortar shall consist of 1 part of common cement to 4 parts of sand, or alternatively of 1 part of masonry cement to 3 parts of sand.

The ingredients for cement mortar shall be measured in proper gauge boxes on a boarded platform and thoroughly mixed. Alternatively, mixing may be by means of an approved mechanical batch mixer.

Only when the dry ingredients have been thoroughly mixed and a mixture of uniform colour has been obtained may the water be added in small quantities, mixing after each addition, to obtain mortar with the required consistency, i.e. a soft and plastic mix.

Cement mortar shall be used within two hours of adding water to the mix and shall not be used after two hours or if it has begun to set. Mortar shall be turned over frequently until it is used to prevent it from setting.

(b) Brickwork

Dimensions of all brickwork shall be set out and built as shown on the drawings. Notwithstanding the tolerances given in Section 707 of the Standard Specifications, the accuracy of the building shall be such as to enable other building components to be built into the masonry.

Burnt clay bricks shall be kept wet before laying and the top of brickwork shall be wetted before any further bricks are laid. In the case of facing work care shall be taken to ensure that staining of the face of the wall resulting from the wetting of the bricks does not occur. Concrete bricks and building blocks shall not be wetted before being laid. Bricks shall be well buttered with mortar before being laid and all joints shall be thoroughly flushed up as the work progresses. All joints to face brickwork shall be neatly made and key drawn with a 6 mm key.

Brickwork shall be carried up in a uniform manner with no portion being raised more than 1 m above an adjacent portion. The height of walling built in a day shall not exceed 1,3 m without the approval of the Engineer in writing. All perpends, quoins, etc shall be kept strictly true and square and the whole properly bonded together.

Brickwork shall be built in stretcher bond or English bond as specified on the drawings. Walls of one building unit thickness shall be built in stretcher bond. Bats shall not be used except where required for the bond. All joints shall be 10 mm wide and four courses shall measure 340 mm.

Whenever the thickness of a solid wall built in stretcher bond is composed of more than one structural unit, walls shall be bonded together with wall ties or a complete course of headers to every five courses of stretchers. Unless otherwise specified in the Project Specifications or on the drawings, wall ties shall be placed not more than 450 mm apart in every fifth course of brickwork, and shall be staggered vertically. At discontinuities in the brickwork such as control joints and at openings, the ties shall be positioned not more than 4 courses of brickwork apart along the periphery of the opening and 150 mm from the opening. The minimum depth of embedment of the wall ties into each leaf shall be 50 mm.

Cavity walls shall be built to the thickness specified. Unless otherwise specified, the leafs of a cavity wall shall be tied together with wall ties in accordance with the requirements of SANS 0164-1.

Face brickwork shall be kept perfectly clean and rubbing down of the brickwork shall not be allowed. Scaffold boards shall be turned back during heavy rain to avoid splashing. Soiled brickwork shall be cleaned at the Contractor's expense, and the cleaning method shall be approved by the Engineer.

(c) Reinforced brickwork

The construction of reinforced brickwork shall be in accordance with the requirements of SANS Code of Practice 10164-2: The Structural use of Masonry.

Reinforced masonry will be indicated and specified as such in the Project Specifications and on the drawings. Temporary support for reinforced brickwork shall be left in position for at least 7 days unless otherwise approved or instructed by the Engineer.

(d) Key for plaster

Joints of load bearing brickwork receiving plaster shall not be raked out to give a key for plastering or rendering unless approved by the Engineer in writing.

(e) Damp-proofing

A damp-proof course shall be laid over the full width of all the walls at a minimum height of 150 mm above the final ground level or wherever else it may be required, and it shall be lapped for at least 150 mm at angles and joints. A damp-proof course shall also be laid and stepped up under all external sills.

(f) General

Rough and fair cutting shall be performed as required, and the brickwork shall be fitted around any steel work. Face brickwork shall be cut and fitted to suit fittings.

Sleeves, holes and chases for pipes, conduits, switch boxes, distribution boards and the like shall as far as possible be left or formed during the erection of the masonry. Chasing of completed walls or the forming of holes shall only be carried out with the written approval of the Engineer and then only with a tool designed to cut the units cleanly. No horizontal or diagonal chases shall be permitted.

02.03 Plasterwork

(a) General

The faces to be plastered must be clean and free from dust and other loose material. The use of admixtures in mixes for a bonding coat shall only be allowed if approved by the Engineer. If approved, admixtures shall be used in strict accordance with the manufacturer's specifications and recommendations.

Plaster shall, unless otherwise specified, consist of 1 part of common cement (CEM I) to 6 parts of sand by volume. If masonry cement is used, the mortar shall consist of 1 part of masonry cement to 5 parts of sand by volume. The use of lime to increase the workability of plaster shall only be permitted with the written approval of the Engineer. Only lime complying with SANS 523 shall be used, and lime shall only be used with common cement and not with masonry cement. A maximum of 40 ℓ of lime per 50 kg bag of cement is permitted and the mix proportions of cement and sand shall remain unaltered.

Foundation walls or walls under constantly damp conditions shall be plastered using a mix consisting of 1 part of common cement to 4 parts of sand or 1 part of masonry cement to 3 parts of sand.

(b) Plaster coats

A plastered finish may consist of a combination of one or more of the following:

(i) A single coat or first coat, comprising one application of a 1:6 cement:sand mixture with a wood or steel-float finish.

If a first coat, the plaster shall be wood-floated and then scratched, raked or otherwise roughened to provide a mechanical key for the second coat, which shall be applied within 24 hours. Should it be impossible to apply the second coat within 24 hours, the first coat shall be kept moist until the second coat is applied.

(ii) A second coat comprising one application of a 1:6 cement:sand mixture with a wood-float finish.

(iii) A finishing coat comprising a 1:1,5 gypsum: sand mixture with a steel-float finish.

(c) Thickness

The total thickness of the plaster finish shall be 13 mm minimum and 20 mm maximum.

(d) Workmanship

All plaster work shall be finished smooth and ready to receive paint. Plaster shall be flush with the faces of all switch and plug boxes, the interiors of which shall be kept free from plaster.

Plastered surfaces shall be plumb and jambs and reveals shall be formed square. The plasterer shall cut out and make good all cracks, blisters and other defects and leave the plaster work, on completion, in a state which is acceptable to the Engineer.

02.04 Concrete floor finishes

Unless otherwise specified, finishes to concrete floors shall comply with the requirements of SANS 10109-2. The repair of floor finishes not in compliance with the Project Specifications shall be done in accordance with the requirements of SANS 10109-2. The type of finish to concrete floors shall be as specified in the Project Specifications or on the Drawings. Screeds shall be provided where indicated on the Drawings or specified in the Project Specifications. The surface finish and the thickness of the screed shall be as specified on the Drawings or as directed by the Engineer. No payment will be made for floor screeds which have to be constructed as a result of the Contractor failing to place and finish concrete floors to the required specifications.

(a) Normal screeds

Normal (bonded) screeds shall be applied to hardened concrete. Monolithic screeds which are to be applied to concrete still in its plastic state, or unbonded screeds on hardened concrete shall only be constructed if so specified in the Project Specifications or indicated on the Drawings.

The cement used in screeds shall be CEM I strength class 32,5 N complying with SANS 50197-1 unless otherwise specified or approved by the Engineer. The sand shall comply with the requirements of SANS 1083.

Normal screeds shall have a mix proportion of 1 part of cement to 4 parts of sand by volume. A minimum amount of water is to be used but it shall be sufficient to allow adequate compaction. Batches not used within 45 minutes after water has been added to the mix shall not be used and shall be discarded.

Screeds shall be laid on concrete surfaces which are uniform, clean and free of dust, oil or any other contamination. The laitance on the base concrete shall be removed by scabbling or scarification until the coarse aggregate is cleanly exposed. If directed by the Engineer or specified in the Project Specifications, the screed shall be bonded to the base concrete using a sand-cement bonding grout consisting of equal volumes of common cement and fine, clean sand mixed thoroughly with water to obtain a consistency of thick paint. The grout shall be stirred continuously and used within 30 minutes of mixing. The screed shall be laid on the grouted surfaces within a period of 10 to 20 minutes after the grout has been applied and while the grout is still visibly wet. If an alternative bonding agent is approved or specified by the Engineer, it shall be applied strictly in accordance with the manufacturer's specifications.

The floor area which the Contractor intends to screed in one operation shall be approved by the Engineer, but shall generally be as large as is practically possible in monolithic construction. Where joints are present in the base concrete, joints in screeds shall coincide as nearly as possible with joints in the bases. The edges of joints in screeds which will not be covered subsequently shall be rounded to a 3 mm radius.

The surface of the screed shall be finished off as specified or as directed by the Engineer to a true and smooth finish. The entire screed surface shall be free from loose or raised particles of aggregate, trowel marks or from any irregularities, humps or depressions exceeding 5 mm when measured from a 3 m straight edge.

Screeds shall be cured for a period of not less than 7 days directly after being placed as directed by the Engineer, and shall be protected from damage. The proposed method of curing shall be to the Engineer's approval.

No moisture-sensitive finish shall be laid on screeds unless a reliable moisture test shows that the screed is sufficiently dry to receive the covering.

At completion of curing, the floors shall be covered up and protected against damage until all other work has been completed.

(b) Granolithic screeds

Cement shall be CEM I strength class 32,5 N complying with SANS 50197-1 unless otherwise specified or approved by the Engineer. Fine aggregates shall also comply with SANS 50197-1. Sand shall comply with the requirements of SANS 1083. Granolithic screeds shall have a mix proportion of 1 part of cement to 2 parts of aggregate by volume unless otherwise specified. A minimum amount of water required to produce a workable mix shall be used. Batches not used within 45 minutes after water has been added to the mix shall not be used and shall be discarded. The screed shall be rendered with a wood float and struck off with a steel trowel after set has commenced.

The granolithic mixture shall be floated onto the concrete floor slab within 12 hours of the latter having been laid. Where this cannot be done within 12 hours, the concrete surfaces shall be thoroughly hacked, cleaned, watered and treated with an approved cement slurry or with an approved bonding agent, as may be directed, before the granolithic screed is laid.

Where a tinted granolithic screed is specified, it shall be placed in two layers, a lower layer placed to within 6 mm of the finished level and an upper layer into which the pigment has been mixed. No dusting on of colouring material will be allowed.

The surface of all granolithic screeds shall be kept damp for a period of at least 7 days after laying by covering it with polyethylene sheeting or by thickly covering it with wet sand, sawdust or hessian kept moist by frequently sprinkling it with water. At completion of curing, the floors shall be covered up and protected against damage until all other work has been completed.

The granolithic screeds shall be not less than 20 mm thick, finished to falls as shown on the Drawings. The floor area to which the Contractor intends to apply the granolithic screed in one operation shall be approved by the Engineer, but shall generally be as large as is practically possible in monolithic construction. Where joints are present in the base concrete, joints in the screed shall coincide as nearly as possible with joints in the bases. The edges of joints in screeds which will not be covered subsequently shall be rounded to a 3 mm radius. Unless otherwise specified in the Project Specifications or approved by the Engineer the maximum tolerance in the surface flatness of the finished screed shall not exceed 5 mm when measured from a 3 m straight edge. Thresholds shall be finished with granolithic screeds 25 mm thick, treads 25 mm thick, and risers 20 mm thick, including rounded nosings and reedings.

Edges next to walls shall be finished with projecting skirting, 75 mm high, with rounded top edges, unless otherwise specified or instructed by the Engineer.

03 IRONMONGERY

03.01 Materials

(a) General

All steel and iron work shall be delivered clean and free from rust, pitting or other defects. Shop primings shall be applied before delivery and shall consist of a coat of red oxide paint, or any other approved anti-rust paint on all surfaces.

Unless otherwise specified, all materials shall conform at least to the appropriate SANS or BS standards where such standards apply to ironmongery, steel, cast iron or any other related materials.

(b) Pressed steel door frames

Pressed steel door frames shall comply with SANS 1129 and shall be manufactured from 1,6 mm thick mild-steel sheeting, pressed to the required shapes, properly mitred, welded and reinforced, with all welding neatly cleaned off.

Frames shall be of the widths required to suit the thickness of the walls into which they are built and shall be fitted with suitable tie bars and braces at the bottom. Three lugs to be built into the brickwork shall be provided on each jamb.

Rebates in frames and transoms for doors shall be of the widths required to suit the thicknesses of the doors and shall be fitted with a pair of approved steel butt hinges set flush into recesses in the frames. 4,5 mm thick reinforcing plates shall be welded to the backs of the frames at hinge positions.

Heads of frames over double doors shall be drilled where required to form keeps for bolts and shall be fitted with one rubber buffer for each leaf of the door. Frames for single doors shall be fitted with approved chromium striking plates and an adjustable striking-plate keeper boxed in at the back of the frame by a welded-on sheet-metal box. The frames shall be fitted with a minimum of two rubber buffers.

Frames shall be protected against twisting and damage during transit and erection.

(c) Pressed-steel doors

Pressed-steel doors shall be manufactured from 1,6 mm thick steel plate. The doors shall be of standard design, pressed to shape with 40 mm reveals all round. The doors shall be strengthened with full-length vertical V-shaped or other approved sectional strengthening ribs projecting to the outer face. Two horizontal stiffening rails shall also be welded to the inner face of the doors.

A door shall be hung on a pair of 100 mm long steel butt hinges with loose pins. The leaves of the hinges shall be welded to both the door and the door frame, and a 1,6 mm thick steel plate shall be welded to the inner face of the door to protect the lock.

One leaf of double doors shall be fitted at the top and bottom with approved 150 mm cast brass barrel bolts in an approved manner and the other leaf shall be fitted with a lock, the striking plate of which shall be fixed to the first leaf.

Where indicated on the Drawings, doors shall be fitted with louvered ventilation grills of approved design, backed with insect and vermin-proof gauze screening.

(d) Steel window frames

All steel window frames shall comply with SANS 727 and shall be of the types and sizes shown on the Drawings.

Standard industrial types of steel window frames shall be constructed from rolled mild-steel industrial sections, 35 mm wide by 3 mm thick, with opening sections constructed from standard residential sections, 25 mm wide by 3 mm thick, welded at angles and properly jointed at intersections.

Window frames shall be formed perfectly flat, truly square and properly jointed at all angles, and the opening portion shall fit properly on all faces and shall open and close freely.

Glazing bars shall be continuous with jointed intersections, the ends being neatly tenoned into the frame and securely welded in position.

Frames shall be fitted with standard fixing lugs.

Opening sections shall open as indicated on the Drawings, and shall be fitted with steel hinges with brass pins. Pivots shall be fitted with bronze ring centres.

Side hung or top hung opening sections shall be fitted with brass handles and friction stays. Bottom hung sections shall be fitted with friction pivots and spring catches.

Weather bar drips shall be attached to the fixed frames for the complete width of the window at the head of outward opening sections. Composite windows shall preferably be delivered to the Site fully assembled, complete with mullions and transoms.

(e) Door locks and handles

All door locks shall comply with the requirements of SANS 54 and shall be of approved manufacture and pattern. All locks shall be supplied with two keys. Keys shall be distinctly numbered with consecutive numbers and each key shall be stamped with the same number as that of the lock which it controls. No two locks in any one building may have the same key.

External doors shall be fitted with four-lever heavy-duty mortice locks, which shall be master-keyed.

All locks shall be properly installed and, after completion, striker plates shall be adjusted and the locks serviced.

Door handles shall be of cast zinc of approved manufacture and pattern.

(f) Miscellaneous fittings

All retaining devices for doors and windows as well as fittings such as coat hooks, retaining hooks, etc, shall be of solid brass. All fittings shall be secured by screws or set screws of the same material and finish as the fitting.

Fittings to be fixed to plastered walls, masonry or floors shall be fixed direct by means of patent plastic or fibre plugs fitted into drilled holes.

Door stops shall be provided at every door and shall be 40 mm diameter rubber stops.

03.02 Installation of doors and windows

All built-in door and window frames shall be set straight, plumb and level, and shall operate to the satisfaction of the Engineer after fixing has been completed.

Fittings shall be either removed, or wrapped and protected from damage, until all rough trades have been completed.

04 GLAZING

04.01 Materials

(a) Glass

Glass shall comply with the requirements of CKS 55. The quality of all window glass shall be such that surface deterioration will not develop after glazing.

All glass shall be free from bubbles, waviness, scratches, stains or other imperfections.

Unless otherwise specified, sheet glass for glazing shall be flat-drawn clear glass of ordinary glazing quality and of the thicknesses indicated below :

For panes not exceeding 0,75 m^2 in area	3 mm
For panes exceeding 0,75 m^2 but not exceeding 1,5 m^2 in area	4mm

(b) Putty

All putty shall comply with the requirements of SANS 680.

Putty shall not be too hard or soft or caked when used, and shall dry evenly without crazing or cracking.

Defective putty shall be cut out and replaced by the Contractor at his own expense, and any broken glass shall also be so replaced and putty so repainted.

04.02 Glazing

Glass shall be cut in panes to suit all glazed openings with sufficient clearance all round to prevent cracking by expansion, contraction or vibration.

In all cases the glass shall be well bedded and back-puttied and installed as specified in SANS Code of Practice 10137.

All putty shall be carefully trimmed, cleaned off and neatly finished off straight with smooth surfaces and sharp mitres. A paint primer shall be applied as soon as the putty has dried out sufficiently to prevent shrinkage cracks from forming.

The entire glazing operation shall be cleaned before the premises are handed over for occupation.

05 CARPENTRY AND JOINERY

05.01 General

(a) Materials

All timber used for structural purposes shall be of the grade specified and shall comply with the requirements of SANS 1783-1 or SANS 1783-2. Structural timber shall be carefully selected and of the best quality, free from large or dead knots, shakes, waney edges or other defects. Purlins and brandering shall comply with the requirements of SANS 1783-4. Finger-jointed structural timber shall comply with the requirements of SANS 10096 and laminated timber with the requirements of SANS 1460.

Hardwoods and softwoods for joinery shall comply with SANS 1099 and SANS 1783-3 respectively and suitable species shall be used for the various purposes.

Unless otherwise specified, all materials shall conform to the appropriate SANS or BS specification where such standards exist for nails, screws, bolts, adhesives, etc.

(b) Preservative treatment

All structural timber shall be given a preservative treatment suitable for the duty for which the timber is intended in accordance with SANS 10005, and no untreated timber shall be used. The preservative treatment shall not impair the final finish. The timber shall be impregnated throughout. When surface coating is specified, the compounds applied on the surfaces of the timber shall form an unbroken film.

(c) Priming

The jointing surfaces of all joints exposed to the weather and built-in portions of frames shall be thickly primed except where adhesives are specified.

Carpentry and joinery items which are prepared for painting by the manufacturer, shall be knotted and primed before being dispatched to the Site.

Primed surfaces shall be touched up where necessary during the progress of the work or where Site adjustments have been made.

05.02 Carpentry work

(a) Scope of work

Carpentry work shall be carried out in a manner consistent with good workmanship and in compliance with the Drawings.

The carpenter shall perform all cutting away and making good in attendance upon all other trades and he shall provide and maintain temporary coverings required for the protection of any finished work that might be damaged if left unprotected during the progress of the work.

(b) Dimensions

Unwrought timber shall be as sawn and shall be to the dimensions and within the tolerances specified in the relevant SANS Standard Specifications mentioned in subclause 05.01 (a).

(c) Jointing

Unless otherwise specified, all joints shall be secured by means of a suitable type and a sufficient number of approved connectors. All joints shall be carefully made in such a way that they will not impair the strength and stiffness of the beams or members.

(d) Timber roof construction

The plates, joists, rafters, purlins, brandering and other pieces used for the construction of the roof and trusses shall be of the dimensions, spacing and construction, as shown on the Drawings.

All the joints in the framework shall be of the most appropriate type, accurately formed and adequately secured with fasteners as specified.

05.03 Joinery work

(a) Scope of work

Joinery work shall consist of the manufacture, delivery to the Site, and fixing in the buildings, of all joinery shown on the Drawings.

Except where a special finish is specified, the Contractor shall have all stairs, landings, doors, shelves and other joinery work cleaned and scrubbed down and shall leave all his work in a good order to the satisfaction of the Engineer.

(b) Dimensions

All wrought timber shall be sawn, planed, drilled or otherwise machined or worked to the correct sizes and shapes shown on the Drawings.

Reasonable tolerance shall be provided at all connections between joinery works and the building structure to compensate adequately for any irregularities, settlements or any other movements.

(c) Fabrication

The joiner shall perform all the necessary mortising, tenoning, grooving, matching, tonguing, housing, rebating and all the other works necessary for correct jointing. He shall also provide all metal plates, screws, nails and other fixings that may be necessary for doing the specified joinery work properly.

(d) Joints

Where joints are not specifically indicated, they shall be the recognised forms of joints for each position. The joints shall be so made as to comply with part 2 of BS 1186.

(e) Doors and frames

Door frames, linings, panel doors, framed, ledged and braced doors, flush doors, sliding doors, etc, shall be supplied or made by the joiner and shall be installed, fitted or hung as detailed on the Drawings.

All timber shall be wrought and prepared for oiling, staining, varnishing or painting.

(f) Skirtings, cornices, etc

Skirtings, cornices, etc shall not be installed until after the wall coverings have been applied, the flooring laid and ceilings installed, unless otherwise specified.

(g) In situ joinery

In situ joinery work shall not be executed until after all floor, wall and ceiling surfaces have been formed or constructed, unless otherwise instructed.

(h) Ceilings

Ceilings shall consist of plaster board or fibre-cement panels as shown on the Drawings and shall be nailed to the brandering or suspended from the roof structure. The panels shall be separated by exposed tees and insulated with a 50 mm thick fibreglass wool blanket where shown on the Drawings.

06 ROOF SHEETING AND ACCESSORIES

06.01 Materials

(a) Roof sheeting

(i) Galvanized-steel sheeting

Galvanized-steel sheeting shall have a minimum ungalvanized thickness of 0,5 mm and shall be of the profile as scheduled or shown on the Drawings. The sheeting shall comply with the requirements of SANS 3575 or SANS 4998 as applicable for Class Z600 coating and shall have been passivated.

(ii) Fibre-cement sheeting

Fibre-cement sheeting shall have a minimum thickness of 5 mm, shall be of the profile as scheduled or shown on the Drawings, and shall comply with the relevant requirements of SANS 685.

(b) Fasteners

Fasteners and washers shall comply with the requirements of SANS 1273, shall be durable, and shall be protected against corrosion to a standard at least equal to the standard of corrosion protection of the sheeting material with which they are to be used. Fasteners to be used with fibre-cement sheeting shall be hot-dip galvanized fasteners.

Bolts and rivets used with galvanized sheeting shall be at least 4 mm in diameter, and those used with fibre cement sheeting, at least 6 mm in diameter.

Self-tapping screws and blind rivets may be used for side-stitching and as fasteners for ridging, flashings, etc.

(c) Rainwater goods and flashings

Rainwater goods such as launders, gutters, down-pipes, etc, and flashings shall be of the size and materials as scheduled or shown on the Drawings, and the materials shall, if similar, comply with the same requirements as specified for the sheeting. All rainwater goods shall be supplied complete with adequate quantities of suitably shaped brackets and fasteners.

(d) Sealants

Sealants shall comply with the requirements of SANS 110, SANS 1254 or SANS 1305 as applicable or with the sheeting manufacturer's recommendations as approved by the Engineer.

06.02 Construction

Wherever possible, the roof sheets shall be of a single length from eave to eave. However, if these lengths exceed the standard sheet lengths, the number of laps shall be kept to a minimum and shall conform to the manufacturer's recommendations for the roof slopes indicated. End laps shall occur only at purlins and each sheet shall extend beyond the purlin or rail by 150 mm.

Sheeting shall be fixed to purlins with approved screws, each complete with a galvanized steel washer over an approved sealing grommet.

The sides of sheets shall be lapped over for a minimum of one corrugation or according to the manufacturer's recommendations and shall be stitched with approved self-tapping screws or blind rivets.

All laps in sheeting shall be sealed with an approved sealant. Swarf, grindings and surplus fasteners shall be removed from the roof on completion. Holes for fasteners shall be drilled and not punched.

Flashings, ridging, eaves closers, etc, shall be of the size and shape necessary to suit the sheeting used. Flashings shall be of an approved type and shall be properly cut, lapped, shaped, dressed and fixed in an approved manner to render a waterproof finish. Provision shall be made for expansion and contraction in long lengths and at expansion joints of the building.

Gutters shall be fixed on suitable brackets and shall fall to outlets, all as directed by the Engineer. Gutters and brackets shall be standard units.

All downpipes shall be watertight and shall be fixed 25 mm clear of the finished wall face or structure by means of suitable brackets, and at approved spacings. The positions of the downpipes shall be as directed by the Engineer.

07 PLUMBING

07.01 Materials

(a) General

All materials shall be of the best quality and shall be approved by the Engineer before installation. Cracked, chipped, dented or faulty items or materials shall be replaced at the Contractor's expense. Glazed ceramic sanitary ware shall comply with the requirements of SANS 497 and all other materials shall comply with the standards as specified, scheduled or shown on the Drawings.

(b) Water closet (WC) suites

WC suites shall consist of a white glazed vitreous china closet with an S or P trap and seat lugs, a 14 litre low-level matching flat-bottomed flushing cistern placed and fixed on the closet, or a suspended enamelled cast-iron cistern with the flush pipe connected to the flushing rim of the closet with rubber cone joints, and a solid heavy-duty plastic seat with cover, hinges and buffers.

(c) Urinals

Urinals shall be of the type detailed or scheduled, of white glazed vitreous china, wall mounted, with an automatic or a manual flushing system, and chromium-plated fittings.

(d) Wash hand basins

Wash hand basins shall be of white glazed vitreous china or enamelled cast iron, wall mounted on a pair of cast-iron brackets, and fitted with chromium-plated fittings consisting of two taps, outlet and chain, and supplied with a plug and an anti-siphon trap.

(e) Sinks

Sinks shall comply with the requirements of SANS 242 and shall be complete with cabinet, chromium-plated outlet, anti-siphon trap, plug, chain and two bib taps or one mixer tap, all as detailed or as scheduled.

(f) Pipes and tubing

Pipes used in plumbing work shall comply with the requirements of SANS 746 for cast-iron pipes and SANS 62-1 and SANS 62-2 for steel pipes. Copper tubing shall comply with the requirements of SANS 460, and malleable cast-iron fittings with the requirements of SANS 14. Pipes of other materials shall be as specified in the Project Specifications.

07.02 Construction

Plumbing shall be carried out strictly in accordance with the Drawings and with the National Building Regulations.

Steel pipes and their malleable cast-iron fittings shall be joined with red lead and hemp, lead pipes shall have wiped soldered joints, and cast-iron pipes shall be joined by caulking with hemp and metallic lead.

Soil pipes from WCs shall have an internal diameter of a minimum of 100 mm and shall be fitted with a pan connector and an access bend (or an access junction where a vent pipe is used), and carried through walls and into the ground for connection to the sewer. Vent pipes shall be fitted with approved balloon gratings.

Waste pipes from basins and sinks shall have an internal diameter of a minimum of 32 mm and shall discharge into gulleys. Bends for waste pipes shall incorporate cleaning eyes.

Cisterns, basins and sinks shall be connected to the pipe system with 12 mm diameter copper service pipes, and chromium-plated stop-cocks shall be installed for isolation and maintenance purposes.

08 ELECTRICAL WORK

The electrical wiring of buildings shall be carried out by registered and licensed electricians in accordance with the requirements of SANS 10142-1 and the regulations of the Employer.

The electrician shall work in close co-operation with the Contractor to ensure that all conduits, switchboards, plug boxes and switch boxes are installed in their correct position.

The work shall be carried out in accordance with the Drawings and to the satisfaction of the Engineer and the Local Authority.

09 MEASUREMENT AND PAYMENT

Item		Unit
805.01	**Brickwork**	
805.01.01	230 mm thick, outside face: (class indicated), inside face : (class indicated)	square metre (m^2)
805.01.02	230 mm thick, (class indicated)	square metre (m^2)
805.01.03	115 mm thick, (class indicated)	square metre (m^2)

The unit of measurement shall be the square metre of each type of brickwork built, calculated from the leading dimensions of the brickwork. Areas of pipes, etc, built into brickwork shall not be included in the areas measured. At corners and intersections common to more than one brick wall, the areas shall be measured only once.

The tendered rates shall include full compensation for the construction of the brickwork complete as specified, including pointing, the building-in of conduits, beams, pipe sleeves, doors, windows, the raking-out of joints, damp-proof course, etc.

Item		Unit
805.02	**Plaster work**	
805.02.01	Single coat or first coat (thickness indicated)	
805.02.01.01	Wood-float finish	square metre (m^2)
805.02.01.02	Steel-float finish	square metre (m^2)
805.02.02	Second coat (thickness indicated)	square metre (m^2)
805.02.03	Finishing coat	square metre (m^2)

The unit of measurement shall be the square metre of each type of coat completed as specified.

The tendered rates shall include full compensation for the construction of the plasterwork, including the supply of all materials, mixing, applying, finishing, forming reveals, joints, etc, complete as specified.

Item		Unit
805.03	**Concrete Floor Finishes**	
805.03.01	Normal screeds (thickness indicated)	square metre (m^2)
805.03.02	Granolithic screeds (thickness indicated)	square metre (m^2)

The unit of measurement shall be the square metre of floor screed laid, as specified, on floors, steps or areas shown on the Drawings or as designated by the Engineer.

The tendered rates shall include full compensation for the construction of the floor screeds, including the supply of all materials, mixing, laying, finishing, the forming of nosings, reedings, skirtings, etc.

Item		Unit
805.04	**Ironmongery**	
805.04.01	Steel door frames (type and size indicated)	number (No)
805.04.02	Steel door with frame (type and size indicated)	number (No)
805.04.03	Steel window with frame, including glazing and sills (type and size indicated)	number (No)

The unit of measurement shall be the number of steel door frames, steel doors with frames, and steel windows with frames installed complete as specified.

The tendered rates shall include full compensation for the installation of the steel doors, windows, and frames, including the supply of all materials, manufacturing, installing, hinges, handles, locks, barrel bolts, retaining devices, door stops, stays and any other work necessary to complete the work as specified or as shown on the Drawings. The tendered rate for windows shall also include full compensation for glazing, window sills, as specified, and damp-proof sheeting.

Item		Unit
805.05	Structural timber	
805.05.01	Plates (grade and sizes indicated)	metre (m)
805.05.02	Beams (grade and sizes indicated)	metre (m)
805.05.03	Joists (grade and sizes indicated)	metre (m)
805.05.04	Rafters (grade and sizes indicated)	metre (m)
805.05.05	Purlins (grade and sizes indicated)	metre (m)
805.05.06	Roof trusses complete (Drawing No indicated)	number (No)

The unit of measurement shall be the metre of individual types of timber elements or number of complete trusses installed.

The tendered rates shall include full compensation for the supply of all materials, manufacture, cutting, waste, jointing and installation of the timber as shown on the Drawings.

Item		Unit
805.06	**Ceilings**	
805.06.01	Plaster-board ceiling (type and thickness indicated)	
805.06.01.01	Fixed ceiling	square metre (m^2)
805.06.01.02	Suspended ceiling	square metre (m^2)
805.06.02	Fibre-cement ceiling (thickness indicated)	
805.06.02.01	Fixed ceiling	square metre (m^2)
805.06.02.02	Suspended ceiling	square metre (m^2)

The unit of measurement shall be the square metre of fixed or suspended ceiling installed complete as specified.

The tendered rates shall also include full compensation for the construction of the ceilings, including the exposed tees, insulation blanket and brandering as specified, as well as the suspension system where applicable.

Item		Unit
805.07	**Joinery**	
805.07.01	Items measured by number	
805.07.01.01	Doors (type and size indicated)	number (No)
805.07.01.02	Other items measured by number	number (No)
805.07.02	Items measured by length	
805.07.02.01	Skirtings (size indicated)	metre (m)
805.07.02.02	Other items measured by length	metre (m)

The units of measurement shall be the number or metre of each type and/or size of joinery item specified.

The tendered rates shall include full compensation for the supply of all materials, manufacture, cutting, waste, fixing and installation of the joinery items.

Item		Unit
805.08	**Roof sheeting**	
805.08.01	Galvanized (type and profile indicated)	square metre (m^2)
805.08.02	Fibre cement (profile indicated)	square metre (m^2)
805.08.03	Etc for other materials	

The unit of measurement shall be the square metre of net area of roof sheeting installed. The area of overlaps shall not be measured for payment.

The tendered rates shall include full compensation for the installation of the sheeting, including the supply of all materials, cutting, installing, sealing, stitching, flashings, ridging and eaves closers, and any other work necessary for installing the sheeting complete as specified.

Item		Unit
805.09	**Gutters** (size and material to be indicated)	metre (m)
805.10	**Rainwater downpipes** (size and material indicated)	metre (m)

The unit of measurement shall be the metre of each size of gutter or rainwater downpipe installed where directed by the Engineer.

The tendered rates shall include full compensation for the installation of the gutters and downpipes, including the supply of all materials, cutting, installing, jointing, and brackets. The tendered rate shall also include full compensation for stop ends, nozzles, shoes, goose necks, galvanized-wire gratings in gutter outlets, and any other work necessary for installing the gutters and downpipes as specified.

Item		Unit
805.11	**Roof ventilators** (type and material indicated)	number (No)

The unit of measurement shall be the number of roof ventilators installed as shown on the Drawings or directed by the Engineer.

The tendered rate shall include full compensation for the installation of the ventilators, including the supply of all materials, manufacturing and sealing and for the cutting of roof sheeting.

Item		Unit
805.12	**Miscellaneous work**	
805.12.01	Painting of buildings	
805.12.01.01	(Building indicated)	lump sum
805.12.01.02	Etc. for other buildings	
805.12.02	Plumbing in buildings	
805.12.02.01	(Building indicated)	lump sum
805.12.02.02	Etc. for other buildings	
805.12.03	Wiring of buildings	
805.12.03.01	(Building indicated)	lump sum
805.12.03.02	Etc. for other buildings	

The unit of measurement for all painting, plumbing and electrical wiring to be carried out at each building shall be the lump sum.

The lump sums tendered shall also include full compensation for all temporary works and safety precautions and for the protection of the Works, for fittings, etc in the case of wiring, the replacement of defective work and cleaning up after completion, all as specified, for painting in section 806, and for plumbing and wiring in this section and in the applicable regulations.

Note:

The following items of work, when specified, shall be carried out, measured and paid for in accordance with the relevant sections of the Specifications, but shall be listed under this section of the Schedule of Quantities.

Item	Applicable section
Reinforcing steel for reinforced masonry	703
Concrete infill in reinforced masonry	704
Testing of concrete infill	903

SERIES 8 : SPECIFIC WORKS

SECTION 806 : PAINTING

CONTENTS

01 SCOPE

This section covers the preparation of surfaces, painting, and painting materials for the decoration and protection of metal, concrete, wood and other surfaces which are exposed to non-corrosive or mildly corrosive conditions only.

Where surfaces which are exposed to severe conditions are to be protected, the painting systems, the factory's quality-control measures, any supervisory measures, and other appropriate information will be specified in the Project Specifications.

02 GENERAL

No paint shall be applied to any surface containing traces of dust, grit, grease, oil, loose rust, millscale or corrosion products of any kind or to any surface that is not free from moisture. Where necessary, surfaces shall be thoroughly washed to remove all traces of soluble salts and/or corrosive air-borne contaminants prior to painting, and the surfaces shall be dried and painted immediately thereafter.

Welding shall be completed in so far as it is possible before painting commences, but in cases where welding can be done only at a later stage, no paint shall be applied to within 75 mm of the proposed weld position unless otherwise specified. Welds and adjacent parent metal shall be abrasive blasted and/or ground and all contaminants such as flux shall be removed prior to painting.

Surfaces of members which are to rest on concrete or other floors or which will be otherwise inaccessible after erection shall receive the full paint system prior to erection.

Damaged paint areas on metal surfaces shall be cleaned, rust spots removed where applicable and the surrounding paint which is still intact shall be feathered for a distance of 20 mm beyond the damaged area. Spot priming and repair shall consist of all the coats previously applied and shall overlap the damaged area.

Damaged galvanized areas shall be cleaned and any rust spots and any flakes of the coating surrounding the damaged area removed. The coating shall then be restored by zinc spraying or soldering, or painting with a zinc-rich paint, as may be approved by the Engineer.

Where the shop coat is allowed to age for a few months before the final painting is done, light sanding or rubbing with steel wool or scrubbing with clean water using a bristle brush shall be carried out.

Steel to be embedded in concrete shall not be painted below 50 mm from the final level of the concrete.

Each priming coat and each undercoat of paint shall be inspected and approved by the Engineer before any subsequent undercoat or finishing coat is applied.

All finishing colours shall be as specified in the Project Specifications, as shown on the Drawings, or as directed by the Engineer.

03 MATERIALS

Paints shall comply with the requirements of the appropriate specifications below:

03.01 Primers

SANS 312	Red-lead based for structural steel
SANS 678	For wood
SANS 679	Zinc chromate for steel
SANS 723	Etch-wash primer for metals
SANS 912	Calcium plumbate for galvanized iron
SANS 926	Zinc-rich epoxy for steel

03.02 Undercoats

SANS 681 :	For all undercoats

03.03 Finishing coats

SANS 515	For interior use, flat and egg-shell finish
SANS 630	For interior and exterior use, high-gloss enamel
SANS 1586	For interior and exterior use, emulsion paint
SANS 684	For exterior use on structural steel
SANS 801	For interior and exterior use, epoxy-tar paint
SANS 802	For interior and exterior use, bituminous aluminium paint
SANS 887	For interior use, glossy and egg-shell varnish.

The Contractor shall furnish the Engineer with the following information and details regarding the paints and decorative materials for the painting system he proposes to use, for written approval:

(i) The name of the manufacturer and trade name.

(ii) The brand, type or grade of paint and the appropriate SANS specification.

(iii) Manufacturer's data sheets, colour references, instructions for use, including surface preparation, sealers, primers, undercoats, finishing coats, coat thicknesses and curing periods, which shall all be considered as being part of these Specifications if approved by the Engineer.

(iv) Safeguards to protect the applied paint from damage until the work is accepted by the Engineer.

(v) The shelf or pot life of materials, if applicable.

(vi) An undertaking by the manufacturer or supplier that the proposed paint system is suitable for its intended use and that the various coats of paint are compatible with one another.

Where proprietary brands are used, the manufacturer's priming and all subsequent coats of paint suitable for that particular brand shall be employed in accordance with the manufacturer's instructions.

No other materials of a similar nature and quality or from another manufacturer may be used instead of those approved unless permission to do so has been obtained from the Engineer, in writing.

All materials shall be brought onto the Site in containers sealed by the manufacturer. Paints shall not be mixed with another paint of a different quality, type, brand or colour, or thinned or adulterated in any way, but shall be used as supplied by the manufacturer. Any mixing or tinting required shall be carried out by the manufacturer.

Tinting of paint on the Site by the Contractor will only be allowed with the written permission of the manufacturer and the Engineer.

04 INSPECTION AND PRELIMINARY WORK

Before commencing paintwork, the Contractor shall carefully inspect the surfaces to be painted to satisfy himself that the surfaces are in a satisfactory or acceptable condition to receive the paint system specified.

All metal fittings and fastenings shall be removed where applicable before the preparatory processes are commenced. On completion, the metal fittings and fastenings shall be cleaned and refitted in position.

05 WORKMANSHIP AND FINISHES

Paint may be applied by spray, brush or roller depending on the materials used, the surface to be painted, and the manufacturer's instructions.

Every coat of paint, irrespective of the method of application, shall be adequately and permanently keyed or bonded to the base material or previously applied coat, and shall be evenly distributed, continuous, free from sags, runs, brush marks, pin holes or other imperfections, and shall dry to a smooth finish.

An approved water trap and air-regulating valve shall be furnished and installed on all equipment used in spray painting.

Before painting the interiors of buildings they shall be cleaned and the floors shall be washed and kept free from dust during the progress of the interior work.

The Contractor shall protect all nearby surfaces against disfigurement by spatters, splashes and smirches of paint or paint materials. The Contractor shall be responsible for any damage by paint or dirt caused by his operations to vehicles or property or injury to persons and he will be required to provide protective measures to prevent any such damage or injury and make good, where required, at his own expense.

If passing traffic creates dust which may harm or spoil the appearance of external painted surfaces, the Contractor shall sprinkle the adjacent areas with water, at his own cost, for a sufficient distance on each side of the location where painting is being done.

Undercoats shall be tinted by the manufacturer to distinguish between successive coats.

The final coats or finishing coats of paint shall be applied after all the other work in the vicinity has been completed.

The painter shall keep some of the final paint in reserve in the event of his having to make good any patching which may be required as a result of damage or unforeseen circumstances.

Upon completion, the Contractor shall, in the case of buildings, clean all glass, remove all paint spots from walls, floors and fittings, and leave the premises clean and fit for occupation.

All inflammable materials, comprising solvents, thinners, wiping cloths, etc, shall be placed in tightly closed containers and properly disposed of.

06 PAINTING OF PLASTER, CONCRETE OR BRICK SURFACES

06.01 Surface preparation

Surfaces for painting shall be prepared by sand- papering, scraping or wire-brushing to remove loose material, dust, laitance, scum or other deleterious materials or high spots. Defective areas shall be cut out where necessary and made good with an approved non-shrink filler. Cracks shall be cut out, suitably keyed, and given a coat of an approved bonding agent before the filler is applied. All patches shall be rubbed down to an even surface. Surfaces shall be washed and allowed to dry.

Surfaces shall be treated with neutralizing liquid for walls, and if the surface is coarse or textured, either one full coat of pigmented wall sealer or one full filler coat shall be applied in addition to the neutralizing liquid.

06.02 Paint application

Prior to the emulsion paint being applied, the surface shall be sealed with an approved clear sealer and primed with an undercoat diluted to 50%. Emulsion paint (PVA or acrylic) shall then be applied in two finishing coats.

Egg-shell finish (alkyd oil based), oil gloss paint or enamel gloss paint shall be applied as follows: one coat of universal undercoat shall be applied and it shall be followed by one coat of a mixture comprising 50% of the undercoat and 50% of the paint to be used for the finishing coat. A finishing coat of semi-gloss egg-shell, or oil gloss paint or enamel gloss paint shall then be applied.

07 PAINTING OF WOODWORK

07.01 Surface preparation

The surfaces shall be cleaned, sandpapered and rubbed down to a smooth, even face before painting. The moisture content of the timber shall not be more than 20% at the time when the first coat is applied. All cracks, shakes or scars shall be filled flush with a filler approved by the Engineer before painting. The surface shall then be washed with cleaner and allowed to dry.

07.02 Primer application

One coat of an approved wood primer shall be applied. After open-grained timber has been prepared and primed, the grain shall be stopped and filled with synthetic filler and rubbed down with water paper.

All new woodwork shall be properly primed on all surfaces and edges before being fixed in position. All woodwork not previously painted shall be given a prime coat, well brushed in.

07.03 Paint application

One coat of universal undercoat shall be applied followed by one coat of mixture comprising 50% of the undercoat and 50% of the paint to be used for the finishing coat. A finishing coat of oil gloss paint or enamel gloss paint or semi-gloss egg-shell (alkyd oil based) paint shall then be applied.

07.04 Varnish finish

Prepare, stop and apply two coats of gloss varnish or egg-shell varnish.

08 PAINTING OF METAL SURFACES

08.01 General

Wherever possible, all painting shall be done at the fabricator's works, but where this is not feasible, the Engineer may permit the application of the undercoat and finishing coats to be carried out on the Site, in which case a prime coat shall be applied at the fabricator's works prior to the members being dispatched to the Works.

08.02 Surface preparation

The preparation of metal surfaces shall comply with SANS Code of Practice 10064 and shall receive the greatest care to ensure rust-free conditions prior to the paint system being applied.

All surfaces shall be prepared by loose paint, rust, plaster, scale, dust, dirt, grease, etc, being removed and by the defective paint surfaces being repaired or patched before painting or repainting. Damaged shop-primed surfaces shall be thoroughly cleaned of rust and patched with a prime coat.

08.03 Paint application

(a) Iron and steel work

All iron and steel work shall be properly primed with a red-lead-based primer where steel work is likely to be exposed to the elements for longer than 30 days. Zinc-chromate primer may be used where overpainting will be completed within 30 days of priming. Metal-etch wash primers may be used under dry conditions where overpainting will be completed within 24 hours of priming. The dry-film thickness of the prime coat shall not be less than 0,300 mm.

After priming, one coat of universal undercoat shall be applied. If necessary, the undercoat shall be tinted to a shade just lighter than the desired finish with approved liquid stainers. The dry-film thickness shall not be less than 0,250 mm.

The two finishing coats shall either be of alkyd resin-based synthetic enamel, gloss or matt oil paint, or as specified elsewhere. The dry-film thickness shall not be less than 0,250 mm per coat.

When mating surfaces are brought together, both surfaces shall have been given the full treatment specified, but where this cannot be done, each surface shall be given a copious coating of primer and the surfaces drawn together while the paint is still wet.

The portion of structural steel members to be buried in soil, and all bases to a height of 500 mm shall be given two coats of an epoxy-tar primer instead of the zinc-chromate primer specified for other surfaces.

Ungalvanized guardrails shall receive two coats of zinc-chromate primer with a dry-film thickness of 0,200 mm per coat before being dispatched to the Site.

Before the first finishing coat is applied, the guardrails shall be thoroughly washed down to remove all traces of salt and other airborne corrosive materials and dirt or other contaminants.

As soon as the rinsed guardrails are dry, a finishing coat of high-gloss enamel shall be applied to a dry-film thickness of not less than 0,250 mm. This shall be followed by a second coat, as before within 48 hours.

The guardrails shall preferably be given both finishing coats before erection, but where this cannot be done, the Engineer may allow the finishing coats to be applied after erection, provided that all the mating surfaces and inaccessible spots be painted with the finishing coats before erection.

The total dry-film thickness of all the coats of paint on guardrails shall not be less than 0,900 mm.

The surfaces of steel and cast-iron articles, such as floor gratings, grids and manhole covers, shall, after a thorough brushing to remove loose rust, be painted with two coats of epoxy-tar paint, each at least 0,230 mm thick.

(b) Galvanized iron and steel

All traces of protective coating shall be removed with galvanized iron cleaner, and two coats of calcium plumbate primer shall be applied. One coat of tinted universal undercoat and two finishing coats of alkyd resin-based synthetic enamel gloss paint shall be applied.

(c) Non-ferrous metals

Surfaces of aluminium, copper, etc, shall be prepared and cleaned, and one coat of self-etch zinc-chromate wash primer shall be applied. One coat of universal tinted undercoat and two finishing coats of enamel gloss paint shall then be applied. Where non-ferrous metals are not to be painted, the surfaces shall be cleaned, polished and two coats of lacquer applied.

09 PAINTING OF FLOOR SCREEDS

Where chemicals could cause damage to floors, such floors shall be painted with an approved epoxy paint. The type of paint to be used will be specified in the Project Specifications and will depend on the types of chemicals that are used.

The preparation of such floor screeds for painting and the subsequent application of paints shall be carried out strictly in accordance with the manufacturer's instructions.

10 PAINT THICKNESS

Unless otherwise specified, all coats of paint, whether prime coat, undercoat or finishing coat, shall have a dry-film thickness of not less than 0,200 mm, irrespective of the method of application.

11 INSPECTION

The Contractor shall provide the necessary equipment to establish whether the primers, undercoats and finishing coats have been applied to the correct thickness and at the correct applications. The Engineer may take samples of the paints during painting operations for testing and quality control.

12 MEASUREMENT AND PAYMENT

Unless otherwise specified in the Project Specifications or in other sections of these Specifications where painting is required, no separate payment shall be made for painting, the cost of which shall be included in the tendered rates for the supply, manufacture and erection of the items to be painted.

SERIES 8 : SPECIFIC WORKS

SECTION 807 : PILING

CONTENTS

01 SCOPE

This section covers the construction of bearing and tension piles of concrete or steel or a combination of these materials.

02 DEFINITIONS

For the purposes of this section the following words and expressions shall have the meanings hereby assigned to them, unless inconsistent with the context.

(a) Bulbous base

An enlargement of the shaft of a cast in situ concrete pile which is formed at the base of the pile by the hammering-in of semi-dry concrete.

(b) Cut-off level

The level to which a completed pile is trimmed and which is 75 mm above the underside of the pile cap, unless otherwise specified in the Project Specifications.

(c) Dolly

A cushion of hardwood or other material placed on top of the helmet to receive the blows of the hammer.

(d) Helmet

A cover temporarily placed on top of a pile to prevent damage during driving.

(e) Loads

(i) Working load : The theoretical load to be carried by a pile under ordinary service conditions.

(ii) Test load : A load equal to twice the working load and applied to a test pile to confirm its suitability for the load at the specified allowable settlement or uplift.

(f) Obstruction

An obstruction to the installation of a pile as defined in more detail in subclause 08.07.

(g) Raking pile

A pile designed to be installed at an inclination to the vertical.

(h) Rock socket

A hole formed in rock formation on which a pile is founded and into which the bottom end of the pile is cast.

(i) Test pile

Any pile which is to be tested,

(j) Underream

A conical enlargement excavated at the bottom end of a cast in situ pile before concrete is placed.

03 DESIGN

03.01 Piling layout

The piling layout, the proposed sizes and/or capacity and types of the piles, together with the steel reinforcement and class of concrete required, shall be as detailed and specified on the Drawings unless otherwise specified in the Project Specifications.

03.02 Alternative pile and pile layout designs

The critical design-load combinations acting on the underside and at a position indicated on the pile-capping slab, the maximum allowable settlement or uplift of the pile-capping slab, and the technical data necessary for designing alternative piles and/or piling layouts will be provided on the Drawings. Alternative designs shall comply with the provisions of clause 05 of section 001.

03.03 Details to be furnished by the Contractor

In all cases where the choice of the type of pile to be used is left to the Contractor, the full particulars, specifications, calculations and drawings of the piles he proposes to use shall be submitted with his tender.

The Contractor shall, where applicable, submit the following information to the Engineer before doing any piling work:

(a) The method of driving the piles and casings or forming the holes;

(b) the method of dealing with obstructions;

(c) the mass of the hammer;

(d) the set for the last ten blows;

(e) the size of bulbous bases, if any;

(f) the method of placing and compacting concrete in the case of cast in situ piles;

(g) the method of keeping reinforcing steel in place during the placing and compaction of the concrete in cast in situ piles;

(h) details of permanent or temporary casing, if any.

04 MATERIALS

04.01 Concrete and reinforcement

The materials used for concrete and reinforcement in piles shall comply with the relevant requirements of the appropriate sections of series 7. The concrete shall be of the strength specified in the Project Specifications or given on the Drawings.

04.02 Permanent casings

Permanent casings for cast in situ piles shall be of sufficient strength and rigidity to ensure that they can be installed without distortion and will remain undamaged during the placing of adjacent piles. They shall be sufficiently watertight to prevent water from leaking through the casing walls during the placing of concrete.

Where a steel casing is designed to provide part of the strength of the pile, joints in the casing shall be butt-welded in accordance with BS EN 1043-1 and BS EN 1043-2.

04.03 Precast-concrete piles

The piles shall be of reinforced or prestressed concrete and shall be manufactured, handled, stored and installed in accordance with BS 8004 and SANS 10088. unless otherwise specified in these Specifications.

05 PLANT AND EQUIPMENT

The plant and equipment used for driving piles, for forming holes, or for other methods of sinking piles shall be in a good working order and shall meet with the Engineer's approval. All machinery shall comply with the relevant clauses of the Factories, Machinery and Building Work Act, (Act No 22 of 1941), as amended, the Occupational Health and Safety, (Act No 85 of 1993) and the Construction Regulations 2003.

Installation equipment shall be of a design that will ensure that piles can be installed in their proper positions and to their correct alignment and slope.

Equipment for the inspection of pile shafts shall be provided and operated in accordance with the latest amendment or edition of the Code of Practice relating to The Safety of Persons working in small diameter shafts and Test Pits for Civil Engineering purposes obtainable from the South African Institution of Civil Engineers.

06 PILING PLATFORMS

Piling platforms shall include the prepared in situ material, or any temporary structure, excluding the piling equipment, constructed to obtain a level platform from which the piling operations can be carried out, as well as the provision of access to the platform.

The foundation material required to support the piling plant and equipment shall, where necessary, be consolidated to provide firm support. The Contractor may use any material he deems suitable for the construction of piling platforms, but shall note that obstructions to piling encountered within the artificially constructed platform material shall not be measured and paid for.

On completion of the piling, the Contractor shall remove the artificially constructed platforms as well as the access thereto, and shall reinstate the Site to the satisfaction of the Engineer.

For the purposes of this specification, piling platforms shall not be regarded as artificial islands as specified in section 701.

07 SURVEYING

07.01 Setting out

The Contractor shall set out the pile positions and shall stake these positions with a durable marker. Where the level from which the piling is undertaken is above the underside of the pile-capping slab, due allowance shall be made for the offset of the raking piles so that the pile at the underside of the pile-capping slab is in the correct position.

07.02 Ground surface for piling

Prior to the commencement of piling work, the Contractor shall notify the Engineer in good time with a view to ensuring that levels are taken of the ground surface, so that an average ground surface from which the piling is to be measured can be established and agreed on between the Engineer and the Contractor.

Where piling at a site is preceded by excavation or the construction of fill, the surface from which piling is to be undertaken shall be formed as near as possible to the underside of the pile-capping slab, as directed by the Engineer.

07.03 Level and alignment

Prior to and during the course of installation of piles, the level and alignment of the piling frame shall be constantly checked, and any deviation shall be corrected immediately.

08 CONSTRUCTION

08.01 Cast in situ concrete piles

(a) Reinforcement

Reinforcement shall not be placed in the pile holes until immediately before concreting. Before the reinforcement is placed, the bottom of the hole shall be thoroughly cleaned of mud, water and any loose or soft material.

Steel reinforcement shall be accurately kept in position without damage being done to the sides of the hole or the reinforcing cage. Spacers shall be used to keep reinforcement at the required distance from the inside face of the casing and wall of the pile hole and shall not give rise to zones through which ground water may penetrate towards the reinforcement. Reference shall be made to clause 07 of section 703 in regard to the minimum cover over the reinforcement.

The longitudinal bars shall project above the cut-off point by the distance indicated on the Drawings, or by a minimum of forty three (43) times the bar diameter if no dimension is indicated.

The splicing of the reinforcement will be permitted, and the Contractor shall keep available on the Site sufficient steel reinforcement so that an additional length of pile reinforcement can be assembled whenever necessary.

The assembly of this additional reinforcement shall be carried out expeditiously and before the concreting of any specific pile commences. If splices have to be provided, the longitudinal bars shall overlap by a distance of forty three (43) times the diameter of the bar, or as required by the Engineer.

(b) Concreting of piles

The concreting of the piles shall not commence before the Engineer has given his permission to do so.

The concrete, while being proportioned to ensure adequate strength, shall be sufficiently workable to enable proper placing and shall be thoroughly compacted by approved means. Extraction of the temporary casing during concreting shall be done in such a way that no damage is caused to the pile, and that the advancing concrete level is at all times kept considerably above the temporary casing's trailing edge. Concrete shall generally be placed in the dry, but where, in the opinion of the Engineer, this is impracticable, it shall be placed by means of a tremie.

The following requirements shall apply when concrete is placed by tremie:

(i) The cement content shall be not less than 400 kg/m^3 and the slump shall be such that concrete of the specified strength and the desired density can be obtained.

(ii) A temporary or permanent casing shall be installed to the full depth of the hole to prevent fragments of earth from dropping from the sides into the concrete. When concreting is done below drilling mud, the temporary casing may not be necessary except near the top.

(iii) The hopper and tremie shall form a closed system which cannot be penetrated by water.

(iv) The tremie pipe shall be at least 150 mm in diameter for 19,0 mm aggregate and larger for larger aggregates.

(v) The concrete shall be placed in a manner that will prevent the mixing of water and concrete. The tremie pipe shall penetrate into the concrete at all times.

(vi) Concreting of that part of the pile below the water level in the casing shall be completed in one operation and the method of placing the concrete shall be maintained throughout.

(vii) All tremies shall be scrupulously cleaned before and after use.

Concrete shall be placed in a manner that will prevent segregation of the aggregates.

08.02 Precast-concrete piles

(a) Manufacture

The piles may be manufactured in a factory or in a casting yard on the Site of the Works. The Contractor shall ensure that the factory or casting yard is open for inspection by the Engineer at all reasonable times.

The relevant requirements of section 704 shall apply to the concrete work.

The piles shall be cast in approved moulds on a rigid, horizontal platform. Particular care shall be taken to secure the reinforcement, coupler sockets and pile shoes accurately in position. Adequate provision shall be made for the lifting of piles.

Each pile shall be clearly marked with the date of casting and a reference number and with distance marks from the tip of the pile at one metre intervals.

Piles shall be cured for a sufficient period to develop the strength required to withstand, without damage to the pile, the stresses caused by handling, transport, storing and driving. The piles shall be driven in order of age, but shall not be driven before the concrete in the pile has attained the specified strength.

(b) Handling, transport and storage

Care shall be taken at all stages of lifting, handling and transporting to ensure that the piles are not damaged or cracked.

Piles shall be stored on firm ground that will not settle unequally under the weight of the stack of piles. The piles shall be placed on timber supports that are truly level and so spaced as to avoid undue bending of the piles. The supports in the stack shall be located vertically above one another.

(c) Lengthening of precast piles

Wherever required, the piles shall be lengthened by such means and methods as may be approved by the Engineer. Care shall be taken to ensure that the additional length of pile joined is truly axial to the original pile within the tolerance requirements for straightness set out in clause 10 of this section.

Driving shall not be resumed until the pile extension and any bonding agent used has attained the required strength.

08.03 Steel piles

Hollow steel piles may be filled with concrete and, provided that adequate load-transfer connections are provided between the steel and concrete, the concrete may be deemed to assist in carrying the load.

Wherever steel piles are used, they shall be given protective coatings of bitumen, coal-tar pitch or synthetic resins to the satisfaction of the Engineer or as specified in the Project Specifications. Adequate allowance, depending on the severity of the subsurface conditions, shall be made in the cross-sectional area of steel to compensate for a possible reduction in the pile wall thickness on account of abrasion or corrosion during the service life of the pile.

Steel piles shall be used only where permitted in writing by the Engineer.

08.04 Driving

(a) Installation equipment

Piles and pile casings shall be driven with a gravity hammer, a rapid-action power hammer, or by other approved means. During driving operations, the hammer shall not damage any permanent component of the pile. Pile-driver leaders shall be so constructed as to afford freedom of movement to the hammer, and they shall be held in position to ensure adequate support for the pile or pile casing during installation. Inclined leaders shall be used in installing raking piles.

The heads of precast concrete piles shall be protected with packings of resilient material, care being taken to ensure that the packing is evenly spread and held in place. A helmet shall be placed over the packing and shall be provided with a dolly of hardwood or other material.

(b) Water jetting

The Contractor may employ water jetting to install piles in granular material. Jetting shall be discontinued before the leading end of the pile has reached a depth of 80 per cent of the anticipated final depth or a depth as agreed on with the Engineer. After jetting, the piles or their casings shall be driven to the required depth, level or set.

(c) Installation sequence

Unless otherwise specified or ordered, the sequence of installing piles will be left to the Contractor. However, the sequence of driving piles in a group shall be programmed to minimize the creation of consolidated blocks of earth into which the piles cannot be driven or which cause fictitious penetration values.

Piling shall generally commence at the centre of the group and shall be extended progressively to the perimeter piles, unless otherwise agreed on by the Engineer.

The installation of piles shall be undertaken in such a manner that no structural damage, distortion or positioning defects will be caused to previously installed piles or casings.

(d) Heaving of piles

In soils in which the installation of piles may cause previously installed piles to heave, accurate level marks shall be placed on each pile immediately after installation and all piles that have heaved shall be redriven to the required resistance, unless redriving tests on neighbouring piles have shown this to be unnecessary. Piles shall not be concreted nor shall any pile-capping slab be constructed until the piles within a heave-influence zone have been redriven as required.

(e) Bulbous bases

Where required, bulbous bases shall be formed after the driven casing has reached the required depth. The base shall be formed by the surrounding subsoil being progressively displaced by concrete which is placed by repeatedly being hammered by a gravity hammer. The size of the base will depend on the compressibility of the surrounding subsoil but shall in no case have a diameter of less than 1,5 times the diameter of the pile.

08.05 Augering and boring

(a) Auger and bore pile holes

Augering and boring of pile holes shall be carried out as expeditiously as local conditions may permit, taking due account of services or other restrictions on the Site.

Holes shall be cleaned after augering and boring in order to obtain a clean and level surface.

Where indicated by the Engineer, suitable casing shall be installed in those portions of the augered holes where the sides are in danger of caving in before concreting is completed.

While the casing is being extracted, care shall be taken to avoid lifting the concrete and damage to the pile.

The use of water for augering and boring holes or for any other purpose where it may enter the hole will not be permitted. Surface water shall not be allowed to enter the hole.

(b) Underreaming

Where required, the hole shall be enlarged or belled out to form an underream. The excavated earth shall be removed so as to not damage the wall of the hole.

The shape of the underream shall be that of a truncated cone with base diameter depending on the bearing capacity of the founding material, but it shall be not less than one and a half times the shaft diameter. The base angle of the cone between the inclined face and the horizontal plane shall be not less than 60°.

Full safety measures shall be enforced to protect workmen working down a pile hole.

(c) Bulbous bases

Bulbous bases shall comply with the requirements of subclause 08.04 (e).

(d) Inspection of preformed holes

Immediately before the reinforcement is to be installed or the concrete is to be placed, the Engineer shall be informed thereof so that he can inspect the pile holes. When piles are to be underreamed, the excavation shall be inspected twice, the first time before underreaming commences to ensure that suitable founding material has been obtained, and the second time after underreaming has been completed to give approval for the casting of the pile.

08.06 Rock sockets

Where required, rock sockets to the required dimensions shall be formed in a rock formation which is of adequate strength, quality and thickness to transmit the specified load.

For the classification of rock in terms of this subclause, the classification as specified in subclause 08.07 (b) (iv) shall apply.

08.07 Obstructions

(a) Definitions

(i) Identified obstructions

Identified obstructions shall mean any obstructions that have been described on the Drawings or in the Project Specifications and for which provision for payment for the penetration thereof has been made in the Schedule of Quantities.

(ii) Unidentified obstructions

Where provision has been made in the Schedule of Quantities in terms of item 807.08 for penetrating identified obstructions, and obstructions which have not been described are encountered, such obstructions shall be classified as unidentified obstructions and shall be paid for under item 807.09, subject to the condition that the rate of penetration drops to below that achieved for identified obstructions when the same methods and effort are used, or subject to additional methods and effort over and above those required for identified obstructions being required for penetrating the obstruction.

Where no provision has been made in the Schedule of Quantities for penetrating identified obstructions and obstructions are in fact encountered, and, after the methods specified in the submission in terms of subclause 03.03 have been resorted to it is found that the holes cannot be formed in the proper positions and at the correct inclinations and depths, and the Contractor has to resort to additional methods to form the pile holes successfully, such obstructions shall be classified as unidentified obstructions.

(b) Classification of materials

For piling only the following classifications of material shall apply in respect of the identification and description of obstructions.

(i) Matrix

The matrix shall comprise that part of the material that will pass through a 50 mm x 50 mm mesh sieve.

(ii) Coarse gravel

Coarse gravel shall comprise that part of the material (stones, pebbles, cobbles, etc) that will pass through a 200 mm x 200 mm mesh but will not pass through a 50 mm x 50 mm mesh.

(iii) Boulders

Boulders shall mean any rock mass with a uniaxial compressive strength of at least 3 MPa that will pass through a square opening with dimensions equal to the maximum sized boulder specified in the Schedule of Quantities but that will not pass through a 200 mm x 200 mm mesh.

(iv) Rock formation

A rock formation shall be a rock mass with a uniaxial compressive strength of at least 3 MPa that will not pass through a square opening with dimensions equal to the maximum sized boulder specified in the Schedule of Quantities.

Where a boulder is penetrated and part of it is left imbedded in the wall of the hole, such boulder obstruction shall be classified as rock formation.

For the identification of rock in terms of this subclause, the following classification shall apply:

(1) Soft rock : material with a uniaxial compressive strength ranging from 3 MPa to 10 MPa.

(2) Hard rock : material with a uniaxial compressive strength in excess of 10 MPa.

(c) Driven displacement and prefabricated piles

Where obstructions make it difficult to install driven displacement and prefabricated piles in the positions and at the inclination shown and to the proper lengths by the methods specified in the submission in terms of subclause 03.03, the Contractor shall resort to additional methods feasible for the type of pile. If a pile cannot be installed successfully after resorting to such methods, the Engineer may order that an additional pile or piles be installed. All such additional work and piles shall be paid for in accordance with the appropriate tendered rates or, failing which, under item 807.10.

(d) Augered and bored pile holes

Where identified or unidentified obstructions are encountered when augered and bored holes for piles are formed, the Engineer may require that the extent of the obstructions be investigated by the Contractor by drilling into the obstruction with a core-drilling rig, a percussion rig or a jack hammer, as may be decided on by the Engineer.

The Contractor shall supply any of the above equipment within 24 hours of his receiving written instructions from the Engineer.

Payment for investigating obstructions and for time lost whilst the investigations are in progress, as well as payment for eventually penetrating the obstructions after the investigations have been completed, shall be made against the appropriate pay items provided in the Schedule of Quantities.

08.08 Determination of pile length

The design of the piles and pile groups, and the quantities in the Schedule of Quantities are based on the subsurface data shown on the Drawings or contained in the Project Specifications.

The Engineer will determine the depth of piles as work proceeds.

The length of piles will be determined by measuring down from the specified cut-off level to the founding level of the piles. The founding level for piles shall be the underside of the underream, bulbous base, rock socket, the tip of the pile shoe or lower pile end, whichever may be relevant.

Should there be variations in the subsurface conditions as regards material and the height of the water table, the Engineer shall be informed immediately.

If the Contractor is not satisfied that the piles will be capable of carrying the specified loads at the depths determined by the Engineer, he shall have the right to vary the length of pile to reach a founding depth at which he is willing to guarantee the load-bearing capacity of the pile. Such additional length of pile installed shall be measured in accordance with these Specifications and shall be paid for at the tendered rates.

In order to determine final pile lengths and founding levels, the Engineer may require additional foundation investigations to be made and/or that the piles be test-loaded in accordance with subclause 09.

08.09 Piling records

For each pile installed, records of the information listed below, if applicable, shall be kept in a form prescribed by the Engineer, a copy of which shall be submitted to the Engineer as soon as practicable.

(a) The effort used to drive the pile and the resistance to penetration at founding.

(b) A description of the subsurface material, the presence of ground water and the quality of the material on which the pile is founded.

(c) The quality of the materials used in the construction or manufacture of the pile as well as of the permanent casing if used. The method of placing and compacting the concrete in cast in situ piles.

(d) The method of founding the piles, i.e. by way of bulbous bases, underreams, rock sockets, etc, and their dimensions.

(e) The working load of the pile.

(f) The length of the pile and the accuracy of installation in respect of position and inclination.

08.10 Reinforcement

The reinforcement for the piles will be scheduled on the Drawings for quantity purposes only. The number, size, type, the arrangement of bars and the required cover, will be shown. The Contractor shall detail the reinforcement to suit the pile lengths and will be at liberty to substitute bars of different diameters, spacings and types on a basis of equivalent strength, subject to the approval of the Engineer.

Lateral reinforcement shall be mild steel or hard-drawn steel wire, either helical or in the form of stirrups. Lateral reinforcement for precast piles shall comply with BS 8004, and full details of all the reinforcement for precast piles shall be provided by the Contractor.

The reinforcement shall be assembled in rigid cages that will not deform during handling. The space inside the cage shall remain unobstructed to facilitate concreting.

08.11 Stripping of pile heads

Precast piles shall be installed to a level of at least 1,0 m above the cut-off level and cast in situ piles shall be concreted to a level of at least 150 mm above the cut-off level. The excess concrete shall be so stripped off that the remaining sound concrete will project 75 mm into the pile-capping slab.

The concrete shall be so stripped off as to avoid damage to the pile below the cut-off level. In the case of such damage or of defective concrete being in the completed pile, the damaged/defective concrete shall be cut away and made good with new concrete well-bonded to the old concrete, or the pile shall be replaced, as directed by the Engineer all at the Contractor's cost.

The main reinforcement from the piles shall extend for a minimum distance of 43 bar diameters beyond the cut-off level into the pile-capping slab. This reinforcement shall be left straight, unless otherwise detailed or directed by the Engineer.

08.12 Construction of the pile-capping slab

The Contractor shall not be permitted to construct the pile-capping slab before the Engineer has confirmed in writing that all the relevant load tests have been completed and that the piles have been accepted.

09 TEST LOADING

09.01 General

The Engineer may order certain selected piles to be tested for settlement or uplift and will indicate such piles in writing. The procedure for test loading shall comply with the requirements of SANS 10088, unless otherwise specified hereinafter. During the period of testing, the driving of other piles that may affect the testing shall cease.

The Contractor shall provide the necessary plant, equipment, instruments and labour for carrying out the test and for determining accurately the settlement or uplift of the piles under each increase or decrease of load. The plant, equipment and instruments used and the testing procedure to be followed shall meet with the approval of the Engineer.

Within two days of completing the test, the Contractor shall supply the Engineer with the test results and neatly plotted graphs of settlement or uplift as a function of load, load as a function of time and settlement or uplift as a function of time.

09.02 Loading

The test load for both bearing and tension piles shall be applied in increments of 20% of the specified working load, unless otherwise specified in the Project Specification or determined by the Engineer. Successive load increments shall not be applied until the rate of settlement or rise under the acting load has stabilized to a rate of movement not exceeding 0,10 mm in 20 minutes.

When the loading has been completed, the full test load shall be maintained until the movement is less than 0,2 mm in a 24-hour period. Unloading shall be made in decrements of 20% of the specified working load at intervals of not less than 20 minutes.

After each load reduction, the pile movements shall be recorded on all gauges to an accuracy of 0,1 mm at time intervals of 0,5, 1, 2, 5, 10 and 20 minutes, and every 30 minutes thereafter until the next change of load.

The final rebound shall be recorded 24 hours after the entire test load has been removed.

During the test the pile shall first be loaded to 50 per cent of the test load, and then fully unloaded and reloaded to the full test load, and then unloaded.

The allowable settlement or uplift shall be as specified on the Drawings or in the Project Specifications. The test load will be indicated in the Schedule of Quantities.

10 TOLERANCES

The work specified in this section shall conform to the tolerances given below:

10.01 Position

Position in plan	±100 mm

10.02 Diameter or dimensions of sides

Prefabricated piles	+ 25 mm, - 5 mm
Cast in situ piles	+ tolerance : not specified - tolerance : 0 mm

10.03 Pile-head level

Average level of trimmed/cut pile head	± 10 mm

10.04 Verticality

Verticality or rake	1,5°

10.05 Straightness

For precast piles the permissible maximum deviation from straight is 5 mm for piles up to 3 m long and 1 mm more for each additional metre of pile length.

11 DEFECTIVE PILES

The test pile and the piles represented by a test pile shall be classified as being defective if, in terms of clause 09, they are found to have an inadequate bearing capacity, or an inadequate resistance to extraction, or excessive settlement or uplift. Defective piles shall also include piles damaged beyond repair, piles with structural defects, or piles that do not comply with the tolerance requirements of clause 10.

Defective piles shall be corrected at the Contractor's expense by way of one of the following methods approved by the Engineer:

(a) Extracting the pile and replacing it with a new pile.

(b) Installing a new pile adjacent to the defective pile.

(c) Lengthening the pile to the correct length if it is defective in length only.

(d) Altering the design to meet the new conditions caused by the defective pile(s).

12 GUARANTEE

The Contractor shall be liable, for a period of 3 years from the date of completing the last pile on the contract, for the cost, up to the limit of the guaranteed amount, of all damages direct or consequential as well as for the cost of all remedial work resulting from defective piles. The Contractor shall provide a written guarantee underwritten by an approved insurance company to bear all costs for which the Contractor shall become legally liable under the aforesaid conditions, subject to a limit as specified in the Project Specifications. Such a guarantee shall specifically state that it in no way limits the rights of the Employer to recover damages or costs by other means.

13 MEASUREMENT AND PAYMENT

Item		Unit
807.01	**Establishment on Site for piling**	lump sum

The tendered lump sum shall include full compensation for the general levelling of the piling sites, the establishment on Site and subsequent removal therefrom of all special plant and equipment for piling, and for carrying out operations, the cost of which does not vary with the actual amount of piling done. The lump sum shall not exceed 15% of the total amount tendered for the piling unless otherwise provided for in the Project Specifications.

This work will be paid for in a lump sum, 75% of which will become payable when all the equipment is on the Site and the first pile has been installed, and the remaining 25% will become payable after the piles have been completed and the equipment has been removed from the Site.

Item		Unit
807.02	**Additional foundation investigations**	provisional sum

A provisional sum is allowed in the Schedule of Quantities to cover the costs of work carried out for purposes set out in subclause 08.08.

The method of payment for the work authorized by the Engineer shall be in accordance with the provisions of the General Conditions of Contract.

Item		Unit
807.03	**Piling platforms**	lump sum

This work will be paid for in a lump sum for each structure or series of structures scheduled separately in the Schedule of Quantities. Seventy five per cent (75%) of the lump sum will become payable when this work has been constructed, and the remaining 25% will become payable after the piling platforms have been removed.

The tendered lump sum shall include full compensation for the construction, maintenance and protection of piling platforms and any other work or operation required to ensure a level and stable platform as specified.

Item		Unit
807.04	**Moving equipment to and setting it up at each pile position**	number (No)

The unit of measurement shall be the number of positions to which the installation equipment has to be moved and set up in position. The quantity measured shall be the number of piles installed plus the number of piles redriven on instruction of the Engineer. The redriving of defective piles will not be measured for payment.

The tendered rate shall include full compensation for all costs for moving and setting up the equipment.

Item		Unit
807.05	**Auger or bore holes for piles of** (diameter indicated) **through material situated in the following successive depth ranges**	
807.05.01	Augered holes	
807.05.01.01	0 m to 10 m	metre (m)
807.05.01.02	Exceeding 10 m up to 15 m	metre (m)
807.05.01.03	Etc in increments of 5 m depth	
807.05.02	Bored holes	
807.05.02.01	0 m to 10 m	metre (m)
807.05.02.02	Exceeding 10 m up to 15m	metre (m)
807.05.02.03	Etc in increments of 5 m depth	

The limits for the successive depth ranges shall be measured down from the average ground surface (subclause 07.02) to the agreed founding level (subclause 08.08).

The unit of measurement shall be the metre of hole formed.

Irrespective of the total depth of hole, the quantity within each depth range shall be measured and paid for separately.

The tendered rates for forming augered holes shall include full compensation for augering and for disposing of surplus material resulting from the formed hole.

The tendered rates for forming bored holes shall include full compensation for boring, supplying, installing and extracting the driven temporary casing, as well as for the disposal of surplus material excavated from the formed hole.

Item		Unit
807.06	**Driving temporary casing for driven displacement-piling systems to form holes for piles of** (diameter indicated) **through material situated in the following successive depth ranges**	
807.06.01	0 m to 10 m	metre (m)
807.06.02	Exceeding 10 m up to 15 m	metre (m)
807.06.03	Etc in increments of 5 m depth	

The limits for the successive depth ranges shall be measured down from the reference ground surface (subclause 07.02) to the agreed founding level (subclause 08.08).

The unit of measurement shall be the metre of hole formed.

Irrespective of the total depth of hole, the quantity within each depth range shall be measured and paid for separately.

The tendered rates shall include full compensation for supplying, driving and subsequently extracting the temporary casing.

Item		Unit
807.07	**Manufacturing, supplying and delivering prefabricated piles** (type and size indicated)	metre (m)

The unit of measurement shall be a metre of accepted prefabricated pile manufactured and delivered on the Site in accordance with the Engineer's written instructions.

The tendered rate shall include full compensation for supplying all the materials, manufacturing, transporting and delivering to the point of use, and for handling the prefabricated piles.

Item		Unit
807.08	**Installation of prefabricated piles** (type and size indicated) **through material situated in the following successive depth ranges**	
807.08.01	0 m to 10 m	metre (m)
807.08.02	Exceeding 10 m up to 15 m	metre (m)
807.08.03	Etc in increments of 5 m depth	

The limits for the successive depth ranges shall be measured down from a level 75 mm above the underside of the pile-capping slab to the agreed founding level (subclause 08.08).

The unit of measurement shall be the metre of pre-fabricated pile installed, measured to the nearest 0,1 m. That part of the prefabricated pile projecting above a level 75 mm above the underside of the pile-capping slab shall not be measured and paid for.

Irrespective of the total length of pile installed, the quantity within each depth range shall be measured and paid for separately.

The tendered rates shall include full compensation for the hoisting and driving of the pile.

Item		Unit
807.09	**Extra over item 807.05, irrespective of depth, to form augered and bored pile holes through identified obstructions consisting of -**	
807.09.01	Coarse gravel with a matrix content of less than (maximum percentage indicated)	metre (m)
807.09.02	Boulders (maximum size indicated)	metre (m)
807.09.03	Soft rock	metre (m)
807.09.04	Hard rock	metre (m)

The unit of measurement shall be the metre of pile hole formed through the identified obstruction, measured from the depth at which the identified obstruction has been encountered, to the depth at which normal piling can be resumed.

The tendered rates shall include full compensation for all the additional costs and the work required to form the pile hole through the identified obstruction.

Notes:

(a) Subitem 807.09.01 : The matrix content indicated shall be the percentage by volume of matrix in a material containing coarse gravel. Where the maximum percentage indicated is exceeded, such material shall not be classified as an identified obstruction, and payment for forming holes through such material shall be made under item 807.05 only. Unless otherwise specified, the maximum percentage of matrix shall be accepted as 60%.

(b) Where obstructions other than those provided for in this item are present, they shall be described on the Drawings and/or in the Project Specifications and shall be provided for in the Schedule of Quantities under extensions to this item.

Item		Unit
807.10	**Forming augered and bored pile holes through unidentified obstructions**	provisional sum

A provisional sum is allowed in the Schedule of Quantities to cover the costs of this work.

The method of payment for the work authorized by the Engineer shall be in accordance with the provisions of the General Conditions of Contract.

Item		Unit
807.11	**Driving temporary casings for driven displacement-piling systems or installing prefabricated piles through unidentified obstructions**	provisional sum

A provisional sum is allowed in the Schedule of Quantities to cover the costs of this work.

The method of payment for the work authorized by the Engineer shall be in accordance with the provisions of the General Conditions of Contract.

Item		Unit
807.12	**Extra over items 807.05, 807.06 and 807.08 for raking piles**	
807.12.01	Formed holes for piles of (diameter and rake indicated)	metre (m)
807.12.02	Prefabricated pile (type, size and rake indicated)	metre (m)

The unit of measurement shall be the metre of pile hole formed or prefabricated pile installed to the rake shown.

The tendered rates shall include full compensation for all additional work and costs for forming pile holes or installing prefabricated piles to the rake shown.

Item		Unit
807.13	**Forming underreams for piles of** (diameter indicated)	number (No)

The unit of measurement shall be the number of pile holes underreamed.

The tendered rate shall include full compensation for all work to be carried out in forming the underream.

Item		Unit
807.14	**Forming of bulbous bases for piles of** (diameter indicated)	number (No)

The unit of measurement shall be the number of bulbous bases formed.

The tendered rates shall include full compensation for all work to be carried out in forming the bulbous bases, but shall exclude payment for the concrete forming the bulbous base.

Item		Unit
807.15	**Extra over item 807.05 for socketing piles into the rock formation**	
807.15.01	Soft rock	metre (m)
807.15.02	Hard rock	metre (m)

The unit of measurement shall be the metre of the penetration of the pile hole into the rock formation.

The tendered rates shall include full compensation for all work to be carried out to socket into the rock formation. Distinction shall be made between soft rock and hard rock.

Item		Unit
807.16	**Installing and removing temporary casings in augered holes for piles of (diameter indicated)**	metre (m)

The unit of measurement shall be the metre of temporary casing installed as directed by the Engineer, or shown on the Drawings, or specified in the Project Specifications.

The tendered rate shall include full compensation for the supply, installation and removal of temporary casings.

Item		Unit
807.17	**Installing permanent pile casing for piles of** (diameter indicated)	metre (m)

The unit of measurement shall be the metre of permanent casing installed as directed by the Engineer, or shown on the Drawings, or specified in the Project Specifications.

The tendered rate shall include full compensation for the supply and installation of permanent pile casing.

Item		Unit
807.18	**Steel reinforcement in cast in situ piles**	
807.18.01	Mild steel	ton (t)
807.18.01.01	Bars with an 8 mm dia.	ton (t)
807.18.01.02	Bars with a 10 mm dia.	ton (t)
807.18.01.03	Etc. for other diameters	
807.18.02	High-yield-stress steel	ton (t)
807.18.02.01	Bars with an 8 mm dia.	ton (t)
807.18.02.02	Bars with a 10 mm dia.	ton (t)
807.18.02.03	Etc for other diameters	

The unit of measurement for steel bars shall be the ton of reinforcement in place in accordance with the Drawings or as authorized by the Engineer.

Clips, ties, separators and other steel used for positioning reinforcement shall not be measured.

The tendered rates shall include full compensation for the supply, delivery, cutting, bending, welding and fixing of steel, including all tying wire, spacers, supports and waste.

Item		Unit
807.19	**Cast in situ concrete in piles, nder reams, bulbous bases and sockets** (class of concrete indicated)	cubic metre (m^3)

The unit of measurement shall be the cubic metre of concrete placed in the cast in situ piles, underreams, bulbous bases and sockets. The quantity measured for payment shall include the quantity calculated from the nominal pile diameter and length of pile from the founding level to 75 mm into the pile-capping slab, plus the additional quantity of concrete in the underream, bulbous base and socket, as may be relevant.

The tendered rate shall include full compensation for the supply and storage of all materials, for providing all plant, for mixing, transporting, placing, compacting and curing the concrete, and for repairs to defective concrete.

For payment purposes a distinction shall be made between the different classes of concrete.

Item		Unit
807.20	**Extra over item 807.19 for concrete cast under water**	cubic metre (m^3)

The unit of measurement shall be the cubic metre of concrete cast under water, the quantity being calculated as for item 807.19, except that the length of pile under water shall be measured from the founding level to the water surface in the hole immediately before the concrete is cast.

The tendered rate shall include full compensation for all additional work, costs and extra cement required to place the concrete under water.

Item		Unit
807.21	**Splicing/joining prefabricated piles for lengthening** (size of pile indicated)	number (No)

The unit of measurement shall be the number of splices/joints in prefabricated piles for each size of pile.

The tendered rate shall include full compensation for all work required for splicing/joining the piles in accordance with the Specifications.

Item		Unit
807.22	**Stripping/Cutting pile heads** (type and diameter/size of pile indicated)	number (No)

The unit of measurement shall be the number of heads of each type and diameter/size of pile stripped/cut.

The tendered rate shall include full compensation for providing all tools and the stripping/cutting of the pile heads.

Item		Unit
807.23	**Establishment on Site for the load-testing of piles**	lump sum

The tendered lump sum shall include full compensation for the establishment on the Site and the subsequent removal of all special plant and equipment required for carrying out load tests on piles, the costs of which do not vary with the actual number of load tests to be done.

Item		Unit
807.24	**Load tests on piles** (compression/tension, diameter/size and test load (kN) indicated)	number (No)

The unit of measurement shall be the number of load tests actually performed, on the written instructions of the Engineer, for each specified test load.

Test piles, but not anchor piles, shall be measured as specified above for permanent piles. Anchor piles shall be deemed to form part of the testing equipment under this item.

The tendered rate shall include full compensation for the installation of anchor piles and anchors where necessary, the performing of the load tests and the processing and submission of results.

Item		Unit
807.25	**Establishment on Site of the following equipment for the investigation of obstructions:**	
807.25.01	Core-drilling rig	lump sum
807.25.02	Percussion rig	lump sum
807.25.03	Jack hammer	lump sum

The tendered lump sums shall include full compensation for establishment on Site within 24 hours of receiving the Engineer's instructions, and the subsequent removal of the different types of plant and equipment required for carrying out the investigation of obstructions in augered or bored pile holes, the costs of which do not vary with the actual number of investigations done.

Item		Unit
807.26	**Moving to and setting up the drilling equipment for each investigation**	
807.26.01	Core-drilling rig	number (No)
807.26.02	Percussion rig	number (No)
807.26.03	Jack hammer	number (No)

The unit of measurement shall be the number of positions to which each type of equipment has to be moved and set up in position.

The tendered rates shall include full compensation for providing access and working platforms, for all costs of moving and setting up the equipment and, where necessary, for the removal of accesses and working platforms on completion of the investigation.

Item		Unit
807.27	**Investigations of obstructions with the use of :**	
807.27.01	Core-drilling rig	metre (m)
807.27.02	Percussion rig	metre (m)
807.27.03	Jack hammer	metre (m)

The unit of measurement shall be the metre depth of hole drilled by each type of equipment through the obstruction, irrespective of the type of material drilled or the depth of the obstruction below the surface.

The tendered rates shall include full compensation for all labour and material costs in respect of performing the drilling operation as instructed. The rate tendered for subitem 807.27.01 shall also include the cost of extracting the cores.

Item		Unit
807.28	**Standing time for piling equipment during investigations**	hour (h)

The unit of measurement shall be the number of hours that piling equipment must stand idle waiting for the completion of the investigations on the instructions of the Engineer.

The tendered rate shall include full compensation for the equipment being removed temporarily from the pile position, holding it available in a good working condition, and for returning it on completion of the investigation.

Should the Engineer instruct the Contractor to move to another pile position instead of waiting for the investigations to be completed, payment will not be made under this item but under item 807.04 when the equipment is moved to another pile position and again when the equipment is returned on the instructions of the Engineer.

SERIES 8 : SPECIFIC WORKS

SECTION 808 : BRIDGES

CONTENTS

01 SCOPE

This section covers various items of work associated with the construction of bridges which are not covered by other sections of these Specifications. Some items of this section, however apply to structures other than bridges.

02 MATERIALS

02.01 Materials for bearings

(a) General

When requested by the Engineer, the Contractor shall submit test certificates from an approved independent testing authority to show that the respective materials conform to the specified requirements, or a certificate from the patent holder or designer certifying that the manufactured item complies in all respects with the relevant product specifications.

(b) Roofing felt

Roofing felt shall be 3-ply and shall comply with the requirements of SANS 92 for Type 60 roofing felt.

(c) Elastomer

The elastomer used in the manufacture of bearings shall be natural rubber or synthetic rubber.

(i) Natural rubber shall comply with the requirements of BS 1154 for natural rubber Groups Z60 and Z70.

(ii) Synthetic rubber shall comply with the requirements of BS 2752 for synthetic rubber Compounds with an IRHD hardness as specified in the Project Specification.

(d) Polytetrafluoroethylene (PTFE) sheet

PTFE used in conjunction with stainless-steel plates to form low-friction sliding surfaces shall be unfilled (virgin) PTFE and shall comply with the requirements of BS EN ISO 13000 part 1 and 2 for Grade 1 Type 1 PTFE.

The sliding surface of the PTFE may be either smooth or dimpled.

(e) Stainless-steel plate

Stainless-steel plate used in conjunction with PTFE to form low-friction sliding surfaces shall comply with the requirements of BS 1449: Part 2 for Steel 316S16. The texture of the sliding surface shall be equal to or better than 0,20 micron Ra, in accordance with the requirements of BS 1134-1, parts 1 and 2.

(f) Stainless-steel dowels and bolts

Stainless steel used for the manufacture of dowels and holding-down and anchor bolts shall comply with the requirements of BS EN 10088-1 and BS EN 10250-4 for Steel X5 CrNiMo17/12/2, C≥0,07.

(g) Steel plate

Steel used for plate reinforcement in laminated elastomeric bearings shall comply with the requirements of BS EN 10025 for Grade 5275 steel.

(h) Mortar

Mortar beddings for the seating of bearings shall be composed of an approved sand:cement or sand:epoxy resin mortar, or may consist of an approved proprietary mortar. The mortar shall comply with the following strength requirements:

(i) Sand:cement mortar

The 7-day compressive strength of 150 mm cubes made from the mortar and cured in a moist atmosphere for the first 24 hours and thereafter in water of 20°C shall not be less than 1,5 times the average contact stress under the bearing, or 15 MPa, whichever is the greater.

(ii) Sand:epoxy-resin mortar

The cured compressive cube strength of the mortar shall not be less than twice the average contact stress under the bearing or 20 MPa, whichever is the greater.

(iii) Proprietary mortar

The strength requirements for proprietary mortars shall be in accordance with either (i) or (ii) above, as may be relevant.

02.02 Materials for parapets, railings and sidewalks

(a) Concrete

All concrete work shall be carried out in accordance with the requirements of series 7.

(b) Structural steel

Structural steelwork shall be carried out in accordance with the provisions of section 809.

03 BEARINGS

03.01 Roofing felt

Roofing felt used as bearing strips shall consist of at least 3 layers laid on the bearing surface to the dimensions shown on the Drawings.

Where lubricated linings are specified, the roofing felt shall be saturated with used motor oil and thereafter liberally dusted with graphite powder before it is laid on the bearing surface.

03.02 Elastomeric bearings

(a) Technical data

The following technical data for the elastomeric bearings will be supplied on the Drawings, and shall also be supplied on drawings prepared and submitted by the Contractor:

(i) Design loads and deformations

The critical design-load combinations and coexisting rotations and horizontal displacements for each bearing or group of identical bearings.

(ii) Size and construction of bearing

The size and construction of the bearing shall be designated by :

L x B x n(t)

where

L = length of bearing in the transverse direction, in mm

B = width of bearing in the span direction, in mm

t = thickness of individual elastomer layers, in mm

n = number of elastomer layers.

The steel plates shall be encased in an elastomer layer of at least 3 mm thick.

(iii) Hardness and type of elastomer

The IRHD and type of elastomer, viz. the natural or synthetic rubber, from which the specified bearings are to be manufactured.

(iv) Identification

Each bearing shall be identified by a number.

(b) Alternative bearings

Where alternative bearings are offered by the Contractor, they shall be designed in accordance with the requirements of BS 5400 Section 9.1 for the loadings and deformations shown on the Drawings.

Where a bearing is offered which consists of a rubber which differs from that which is specified, the bearing shall be redesigned to make allowance for the variation in hardness and/or type of rubber.

(c) Inspection and testing

On completion of the manufacture of the bearings, the Contractor shall submit bearing pads selected by the Engineer, or specially manufactured sample pads authorized by the Engineer, to an independent testing authority for testing. The tests to be undertaken shall be as directed by the Engineer and shall comply with the relevant requirements of subclause 10.01 of section 903. Payment for this testing, for any damaged bearing pads, and for sample pads shall be made in accordance with the provisions of subclause 12.04 of section 903.

A variation of plus or minus 20% shall be permitted between the actual and theoretical stiffness for compression and shear of the elastomer. Where this variation is exceeded, acceptance of the pads shall be at the sole discretion of the Engineer.

Copies of test results and certificates for the above-mentioned testing shall be submitted by the Contractor to the Engineer in good time to enable the Engineer to assess the information before the bearings are installed.

The dimensional tolerances on bearing pads shall comply with the requirements of subclause 03.07 of section 707.

Before the bearings are dispatched to the Site of the Works, each bearing, with the exception of large bearings as provided in the Project Specifications, shall be subjected simultaneously to a vertical load equal to 150% of the maximum design load and to a sheer distortion equal to 150% of the maximum design value. The bearings shall be visually inspected for defects by the Engineer and shall at no stage under this test show any cracks visible to the naked eye, or other defects. The cost of this testing shall be included in the rate tendered for the supply and installation of the bearing pads.

03.03 Proprietary bearings

(a) General

This clause covers custom-built bearings and bearings manufactured under licence, except elastomeric bearings. Combined bearings consisting of an assembly of an elastomeric bearing in conjunction with a low-friction sliding or mechanical component, shall fall under this clause.

The Tenderer may base his tender on any bearing that complies with the specified requirements, provided that the efficacy of the bearing has been verified by tests and successful previous use, evidence of which, as well as information on the bearing's durability and suitability for the specified use, shall be submitted to the Engineer for consideration.

Details of the product guarantee shall be submitted with the tender.

(b) Drawings and approval

Prior to manufacture, the Contractor shall submit the following information to the Engineer for consideration:

(i) The manufacturer's specification containing detailed information on the design standards, materials, manufacture and technical data.

(ii) Drawings complying with the provisions of subclause 05.03 of section 001 showing the bearing construction and installation details.

All bearings used in the permanent Works shall be subject to the approval of the Engineer.

(c) Technical data

The following technical data for the proprietary bearings required for the Contract will be supplied on the Drawings, and shall also be supplied on the drawings prepared by the Contractor for submission to the Engineer :

(i) Design loads and movement

The maximum and minimum vertical loads and coexisting horizontal loads as well as the maximum horizontal load and coexisting vertical load.

The maximum values in each direction of the reversible and irreversible movements and the rotation about each axis.

(ii) Mechanical fit

Mechanical fit on unidirectional and fixed bearings expressed as the maximum permissible slack (play) between the shear transfer members of the bearing which are required to resist the applied horizontal loads.

(iii) Identification

Identification of each bearing by a number, the degree of freedom of movement (fixed, multi- or unidirectional) and the type of bearing (spherical, elastomer pot, etc).

(d) Design

The bearings shall be designed to accept the specified load combinations in conjunction with the maximum eccentricity and rotation, without overstressing any part in terms of working load requirements or exceeding the requirements for the serviceability limit.

Unless otherwise specified in the Project Specifications or on the Drawings, the following shall be complied with:

(i) The maximum average pressure on the projected area of the PTFE shall not exceed 45 MPa and 30 MPa under maximum load and under dead load respectively. The maximum peak pressure on the PTFE shall not exceed 60 MPa.

(ii) The maximum average contact stress and maximum edge stress on the concrete or mortar bedding shall not exceed 20 MPa and 25 MPa respectively.

(iii) The initial peak static coefficient of friction shall not exceed 0,06 and the final static coefficient of friction shall not exceed 0,04.

(iv) The bearing shall be of such overall dimensions as to fit into the space allowed for its installation. Major alterations to the contiguous members will not be considered.

(e) Construction

Unless otherwise specified in the Project Specifications or on the Drawings, the following requirements shall be complied with :

(i) The IRHD of the elastomer disc in the pot type of bearing shall be 50 ± 5 or 55 ± 5. The elastomer shall be protected along the edge of the disc by either a metal sealing ring or a capping ring moulded integrally with the disc along the perimeter.

(ii) The thickness of the elastomer disc shall not be less than 0,066 times its diameter.

(iii) The PTFE shall be not less than 3 mm thick and shall be recessed into the supporting base to a depth of 0,5 times the thickness of the PTFE plus or minus ± 0,2 mm.

(iv) The minimum dimension of individual PTFE areas shall not be less than 50 mm and their spacing shall be such as to ensure the equal distribution of stress throughout the contiguous members.

(v) The thickness of the stainless-steel sliding plate shall be not less than 1,25 mm. The plate shall be either recessed into or bonded to the base and, in addition, riveted or bolted to the base. The edges of the plate shall be sealed to prevent the ingress of moisture between the plate and the base.

(vi) The slack (play) between the shear transfer members of unidirectional and fixed bearings shall not exceed 2 mm, unless otherwise specified.

(vii) Only silicone grease of an approved type shall be used as lubricant between the sliding surfaces.

(viii) The bearing shall be provided with tight-fitting seals to prevent the ingress of dust or deleterious matter onto the moving parts. The seals shall be of an approved type and shall be sufficiently durable to last for longer than 50 years.

(ix) The assembled bearing shall be supplied with welded or bolted lugs or straps, temporarily securing the moving parts firmly in position to ensure that no undesirable relative movement occurs before or during construction.

(x) The bearing shall be recessed into adaptor plates, or shall be of such construction as will facilitate the removal of the bearing from the installed position without damage being done to any part of the bearing or the surrounding material after the relevant structural member has been raised by 15 mm or by the distance specified.

(xi) Anchor and holding-down bolts shall be of the material specified on the Drawings.

(xii) Corrosion protection of the exposed steel surfaces, with the exception of the stainless-steel sliding plate, shall be as follows :

(1) Preparation of the surfaces by abrasive blasting to a finish equal to the Sa 3 finish of ISO 8501-01.

(2) Metal spraying of the surfaces with zinc in accordance with the requirements of BS EN 22063, Table 1 ZN 200.

(3) Coating of the zinc-sprayed surfaces within 4 hours with a sealer compatible with the zinc and the subsequent coat of paint.

(4) Application of a coat of high-build chlorinated rubber paint of a minimum dry-film thickness of 0,75 mm and of a colour which differs from that of the final coat of paint.

(5) Application of a final coat of high-build chlorinated rubber paint of a minimum dry-film thickness of 0,75 mm and of a dark grey colour.

Surfaces in contact with concrete shall receive at least the treatment described in (1) and (2) above.

(f) Inspection and testing

The Engineer may require that tests be carried out to verify compliance of the bearing with the Specifications and/or its performance under the design loads. Payment for this testing shall be made in accordance with the provisions of subclause 12.04 of section 903.

Test certificates of all tests carried out shall be made available to the Engineer.

The Contractor shall give the Engineer at least 7 days notice prior to the final assembly of the bearings to enable the Engineer to inspect the bearings at the factory.

Under no circumstances may bearings be taken apart and reassembled on the Site, except when it is an unavoidable feature of the installation procedure, in which case the dismantling, installation and reassembly shall be under the supervision of qualified personnel.

Rehabilitation, modification and repair work to bearings shall be carried out only in the factory or at an approved engineering works.

03.04 Storage and handling

The bearings shall at all times be stored under cover and clear of the ground, to protect them from sunlight, oils and chemicals. The bearings shall not be stacked in a manner or on a surface that will cause distortion of the bearings.

The bearings shall be handled with care to ensure that they will not be subjected to impact loads or any other condition that may be harmful.

03.05 Installation of bearings

The concrete surface on elements required to receive bearings shall comply with the requirements of subclause 09.03 of section 702. Plastering of the surface will not be permitted under any circumstances.

Before the mortar bedding is constructed, the concrete surface shall be chipped back to expose the aggregate and leave a sound irregular surface. Bonding of the mortar bedding to the concrete surface shall be in accordance with the manufacturer's recommendations and the Engineer's instructions. The dimensions of the bedding shall be such that the load can be spread at an angle of 45° throughout the bedding. However, the thickness of the bedding shall be not less than 15 mm and 25 mm for proprietary and elastomeric bearings respectively, neither shall the maximum thickness exceed 50 mm.

Unless otherwise shown on the Drawings, the bearings shall be installed on a horizontal plane and shall be in full contact with the concrete and bedding surfaces.

To accommodate soffit irregularities and camber in the case of precast members, the member shall be lowered onto a mortar skim on top of the bearing. The member shall thereafter be propped until the mortar skim has hardened.

The bearings shall be accurately installed to the specified level, alignment and orientation, all within the construction tolerances in accordance with subclause 03.07 of section 707 and the details shown on the Drawings.

Where the bearing has long sliding plates, they shall be rigidly supported to prevent distortion under the weight of the wet concrete and the construction loads.

Before the bearing is incorporated into the structure, it shall be cleaned to remove all deleterious substances and adhering matter, and shall be thereafter wrapped in polyethylene sheeting and adequately sealed to prevent mortar and slush from seeping through onto the bearing during the course of construction.

After installation, the polyethylene wrapping shall be removed, the bearing and the space around the bearing thoroughly cleaned, and the lugs removed as directed by the Engineer.

On completion of the installation of proprietary bearings, the Contractor shall furnish the Engineer with a certificate from the manufacturer or supplier of the bearings certifying acceptance of the installation. Notwithstanding the issuing of such a certificate, the manufacturer or supplier shall not accept any responsibility for the installation of the bearings and shall not relieve the Contractor of his responsibilities under the Contract. Payment for the inspection of the bearings by the manufacturer or supplier and the issuing of the certificate will be made in accordance with the provisions of subclause 12.04 of section 903.

04 CONCRETE PARAPETS

Concrete parapets shall be either solid concrete parapets or open concrete parapets with concrete railings.

Concrete railings shall be cast in situ or precast or a combination of the two, as shown on the Drawings. Wherever possible, precast elements shall be placed with the unformed surface downwards or outwards.

05 METAL RAILINGS

Metal bridge railings shall be constructed to details as shown on the Drawings and in accordance with the provisions of section 809.

All steelwork shall be painted in the shop and on the Site in accordance with the provisions of section 806. If called for on the Drawings or in the Schedule of Quantities, steelwork shall be galvanized and painted; galvanizing shall be done after manufacture, in accordance with SANS 32, quality B1 or SANS 121, Table 2 or 3, as applicable.

06 BRIDGE NUMBER PLATES

Bridge number plates shall be fixed in the position and according to the method of fixing shown on the Drawings. The concrete surface on which the plate is to be fixed shall be suitably prepared before any adhesive is applied, by roughening and removing all surface laitance.

07 CONCRETE SIDEWALKS

Prior to construction of the sidewalks, including kerbs and copings, the bridge deck shall be accurately surveyed to establish final lines and levels. The previously cast bridge-deck area shall be prepared as specified in clause 08 of section 704 to receive sidewalk concrete.

Forms shall be accurately set to final lines and levels and shall be firmly held in position during the placing of the concrete. Stops at the ends of sections shall be accurately placed to ensure that the joints between the adjacent sections are truly perpendicular to the surface of the concrete and at right angles to the edge of the road or to the skew angle of the deck at the expansion joint.

After removal of the forms, the exposed surfaces of the kerbs and copings shall be rubbed in accordance with the requirements of subclauses 08.01 and 08.03 of section 702. All edges shall be rounded to a radius of 20 mm, unless otherwise shown on the Drawings.

08 CONCRETE-SURFACE-FINISH REQUIREMENTS

All formed concrete surfaces of parapets and sidewalks shall have a class F3 surface finish as specified in subclause 07.04 of section 702, and all unformed concrete surfaces shall have a class U3 surface finish in accordance with clause 09.03 of section 702.

09 WEEP HOLES, DRAINAGE PIPES AND CHANNELLING

Weep holes, drainage gullies, pipes and channelling shall be provided in accordance with the details shown on the Drawings or as ordered by the Engineer.

Weep holes shall not be placed within 40 mm of any reinforcement and shall be cleaned to permit the free flow of water on completion of the work.

Drainage pipes shall be non-metal pipes of the material called for on the Drawings and shall, on completion, be cleared of all foreign matter and the interior surface left smooth.

Cast in situ concrete channelling shall be provided next to kerbing where shown on the Drawings and according to the details provided. Concrete work shall be carried out in accordance with the provisions of section 704 and channelling shall be given a class U2 surface finish as specified in subclause 09.02 of section 702. The channelling shall be bonded to the bridge-deck concrete in accordance with the provisions of clause 08 of section 704.

10 DRAINAGE TO RETAINING WALLS AND ABUTMENTS

10.01 General

Drainage shall be provided behind and through the retaining walls and abutments as indicated on the Drawings or ordered by the Engineer.

10.02 No-fines concrete blocks

Blocks shall be of the class of no-fines concrete and to the dimensions specified and shall be placed before backfilling is done.

10.03 Synthetic-fibre filter fabric

Synthetic-fibre filter fabric used in conjunction with no-fines concrete blocks shall be of the type and grade shown on the Drawings or specified in the Project Specifications. Filter fabric shall be placed as shown on the Drawings and shall be protected against sunlight and mechanical damage during storage and installation.

11 PROVISION FOR SERVICES

Service ducts shall be fixed and cast into position in accordance with the requirements of clause 11 of section 704 and the details shown on the Drawings.

The pipes and fittings to be used for the construction of ducting shall be as shown on the Drawings and shall comply with the requirements of clause 02 of section 106.

Ducts shall be provided with stoppers and draw wires and shall be proved, all in accordance with the requirements of section 106.

No separate payment shall be made where ducts are installed in the bridge parapets and end blocks, and the rates tendered for the parapets and end blocks shall include full compensation for the provision and installation of the ducts complete with stoppers, draw wires and, where applicable, inspection eyes.

Where ducts are installed below the level of the bridge sidewalk, payment shall be made in accordance with item 106.04 of section 106.

Where ducts are made of cast in situ concrete channels, such channels shall be constructed, measured and paid for in accordance with the provisions of section 704.

12 TOLERANCES

12.01 Bearings

Bearings shall be installed within the construction tolerances in accordance with subclause 03.07 of section 707.

12.02 Parapets, concrete railings and sidewalks

Parapets, concrete railings and sidewalks shall be constructed within the tolerances specified in subclause 03.08 of section 707.

12.03 Metal railings

Metal railings shall be constructed within the tolerances specified for structural steel in section 809.

13 MEASUREMENT AND PAYMENT

Item		Unit
808.01	**Proprietary bearings**	
808.01.01	The prime cost sum allowed for purchasing and taking delivery of bearings	PC sum
808.01.02	Percentage on prime cost for charges and profit	per cent (%)

Payment for purchasing and taking delivery of proprietary bearings complete with anchor bolts and/or dowels will be in accordance with the provisions of the General Conditions of Contract.

Item		Unit
808.02	**Installation of proprietary bearings** (description of each type and class)	number (No)

The unit of measurement shall be the number of complete bearings of each type and class installed.

The tendered rate shall include full compensation for the supply of all materials not covered under item 808.01, the construction of the bedding, transport, handling and storage, and for all labour, equipment and incidentals required for the installation of the bearings complete as detailed.

The tendered rate shall be final and binding, irrespective of the type or make of bearings finally installed.

Item		Unit
808.03	**Bearings** (description of each type and class)	number (No)

The unit of measurement shall be the number of complete bearings of each type and class installed.

The tendered rate shall include full compensation for the supply of all materials, including anchor bolts and/or dowels, for the construction of the bedding, the manufacture of the bearings, transport, handling and storage, and for all labour, equipment and incidentals required for the installation of the bearings complete as detailed, as well as for the testing of bearings as may be relevant.

Item		Unit
808.04	**Bearing strips** (description of the material and number of layers)	square metre (m^2)

The unit of measurement shall be the square metre of bearing area lined with the specified material, irrespective of the number of layers placed.

The tendered rate shall include full compensation for the supply of all materials, for transport, handling and storage, and for all labour and incidentals required for the installation of the bearing strips complete as detailed.

Item		Unit
808.05	**Bridge parapets/metal railings** (description of type)	metre (m)

The unit of measurement for bridge parapets/metal railings and transitions shall be the metre of parapet (including railing if any) or railing, complete as shown on the Drawing, measured overall, excluding end blocks (if any). Parapets and railings shall be considered to include all work above the level of the top of the sidewalk or, when not placed on a sidewalk, above the top of the bridge-deck concrete, wing wall or retaining wall and shall also include any kerbing and coping forming an integral part of the parapet.

The tendered rate for bridge parapets and railings shall include full compensation for all concrete, formwork, railings and other materials, including fastenings, anchor bolts, etc, required for attaching the railings to the structures and for the manufacture, erection and finishing of the railings. The rates shall exclude only the cost of reinforcing steel, as this shall be measured and paid for under another pay item.

Item		Unit
808.06	**End blocks**	number (No)

The unit of measurement for bridge end blocks shall be the number of end blocks constructed complete as shown on the Drawing.

The tendered rate shall include full compensation for all materials, labour, plant and other incidentals required for constructing the end blocks complete as specified, excluding only reinforcing steel.

Item		Unit
808.07	**Bridge number plates**	number (No)

The unit of measurement shall be the number of bridge number plates supplied and installed. The tendered rates shall include full compensation for supplying and installing the number plates as specified.

Item		Unit
808.08	**Weep holes as shown on the Drawing** (description and size)	metre (m)

Item		Unit
808.09	**Drainage gullies for bridge decks as shown on the Drawing** (description of each type)	number (No)

Item		Unit
808.10	**Drainage pipes** (types and size indicated)	metre (m)

The unit of measurement shall be the metre of weep holes and drainage pipes and the number of deck drainage gullies of each type and size installed.

The tendered rate shall include full compensation for the supply of all materials, the manufacture and installation of weep holes, drainage pipes and gullies.

Item		Unit
808.11	**Precast no-fines concrete drainage blocks** (class of concrete and size of blocks indicated)	number (No)

The unit of measurement shall be the number of blocks in position in the Works.

The tendered rate for each block shall include full compensation for providing all materials, labour, plant and formwork, for manufacturing the blocks complete as shown on the Drawings and specified in clause 15 of section 704.

Item		Unit
808.12	**Synthetic-fibre filter fabric** (type and grade indicated)	square metre (m^2)

The unit of measurement shall be the square metre of filter fabric installed as specified, including the specified overlap.

The tendered rate shall include full compensation for supplying, cutting and installing the filter fabric and for wastage.

Note:

The following items of work, when specified, shall be carried out, measured and paid for in accordance with the relevant sections of the Specifications, but will be listed under this section of the Schedule of Quantities.

Item		Applicable section
(a)	Service ducts (installed below sidewalk level)	106
(b)	Formwork and concrete finish for sidewalks and services channels	702
(c)	Steel reinforcement for sidewalks, parapets, end blocks and services channels	703
(d)	Concrete for sidewalks and services channels	704

SERIES 8 : SPECIFIC WORKS

SECTION 809 : STRUCTURAL STEELWORK

CONTENTS

01 SCOPE

This section covers the manufacture, transportation and erection of structural steelwork.

02 MATERIALS

02.01 Structural steel

Structural steel shall comply with the following requirements: Mild steel: BS 4360, grade 43A; or SANS 1431, grade 300W.

High yield stress steel: BS 4360 grade SOB; or SANS 1431, grade 350W.

The dimensions and properties of rolled-steel sections shall comply with the prescriptions given in the structural-steel tables issued by the SA Institute of Steel Construction.

02.02 Steel tubes

Steel tubes shall comply with the requirements of SANS 657-1.

02.03 Bolts, nuts and washers

Ordinary bolts and nuts shall mean bolts acting in bearing and shear rather than in the friction-grip mode and shall comply with the requirements of the appropriate parts of SANS 1700 or SANS 1143.

Washers for ordinary bolts and nuts shall comply with the requirements of SANS 1149.

High-strength friction-grip bolts, nuts and washers shall comply with the requirements of SANS 1282 and shall be capable of being reliably tensioned to the appropriate load recommended in SANS 10094.

Other friction-grip fasteners equal to the above may be used subject to the Engineer's approval.

Bolts, nuts and washers shall be of the material shown on the Drawings or specified in the Project Specifications.

02.04 Rivets

Mild-steel rivets shall comply with the requirements of SANS 435. High-tensile rivets shall be so manufactured that they can be driven and their heads formed satisfactorily without the physical properties of the steel being impaired.

02.05 Welding consumables

Welding electrodes shall comply with the re

quirements of SANS 455. The handling and storage of all consumables shall be in accordance with BS EN 1043-1 and BS EN 1043-2.

Welding consumables used shall be appropriate for producing weld metal that will yield all-weld test specimens as specified in BS 709, the minimum yield and minimum tensile strengths of both being not less than those of the parent metal.

Welding consumables shall be compatible with the material to be welded.

02.06 Paints

Paints shall comply with the requirements specified in clause 03 of section 806.

03 CODES OF PRACTICE

The design, where undertaken by the Contractor, shall comply with the requirements of SANS 10162 parts 1, 2 and 4.

Welding shall be in accordance with SANS 10044 parts 1 to 5.

04 SHOP DETAILS

When specified in the Project Specifications, the Contractor shall prepare shop details. Immediately on receipt of design drawings and calculations, the Contractor shall satisfy himself that the design drawings contain all the information required for the preparation of the shop details, supporting calculations, and any other necessary drawings. The shop details and other drawings shall be submitted in duplicate to the Engineer for approval at least one month (or such other period as may be stated in the Project Specifications) before the commencement of fabrication.

The Contractor's drawings shall be complete in every respect (including welding details which shall be fully described) and shall be checked by the Contractor prior to submission. One copy of each drawing will be retained by the Engineer and, within 2 weeks (or such other period as may be stated in the Project Specifications) of the date of receipt by the Engineer, the other copy will be returned to the Contractor with the Engineer's comments or written approval as the case may be.

Before the commencement of fabrication, the Contractor shall obtain the Engineer's approval, in writing, of the shop details. The approval given by the Engineer relates to structural adequacy and does not absolve the Contractor from the responsibility for dimensional accuracy.

05 FABRICATION AND ASSEMBLY

05.01 General

Both before and after fabrication, all structural steel shall be within the tolerances specified in clause 08 and shall be flat, straight (unless required to be formed to another shape) and free from twists.

05.02 Identification

At all stages of fabrication, structural steel other than grade 300W and 43A shall be positively identified by grade by means of a suitable marking system.

05.03 Cutting

Cutting may be done by sawing, shearing, cropping or flame cutting provided that the method used will not adversely affect the material properties.

Edges shall be free from any defects or distortions, and all burrs, notches and similar defects shall be removed.

05.04 Holes for fasteners

Holes for fasteners shall not be formed by flame cutting. Holes in light members not thicker than 12 mm or the diameter of the hole, whichever is the smaller, may be punched.

Holes for fasteners up to 25 mm in diameter shall not be more than 2 mm bigger than the fastener diameter, and for larger fasteners not more than 3 mm bigger than the fastener diameter.

Holes for friction-grip fasteners shall be in accordance with SANS 10094.

All burrs shall be removed from holes before assembly.

05.05 Joints in compression

The abutting surfaces of joints which depend on contact for the transmission of load shall be accurately prepared so that the full area intended for bearing is in contact as specified in clause 08.

05.06 Hollow sections

Unless protection against corrosion is provided by other means approved by the Engineer, the interior of any hollow section shall be sealed to prevent the ingress of water into the interior of the member. Vent holes for galvanizing shall be sealed after galvanizing has been completed.

05.07 Alignment of holes

All matching holes for fasteners or pins shall be accurately aligned so that the fasteners can be inserted freely through the assembled members in a direction at right angles to the faces in contact. Drifting to align the holes shall not distort the metal or enlarge the holes.

05.08 Welding

Welding shall be carried out in accordance with the requirements of SANS 10044. Particular attention shall be given to the following points:

- Welding techniques shall be such as to avoid undue distortion and minimize shrinkage stresses.
- All slag shall be removed.
- Where specified in the Project Specifications in respect of certain work, the welders for welding in the workshop or on Site shall have passed the tests for a Grade 1 welder as laid down in SANS 10044 part 4.

05.09 Bolting

The parts to be joined shall be firmly drawn together. Where necessary, washers shall be tapered to give the bolt heads and nuts a full bearing. Where bolt holes have clearances greater than those specified and are acceptable to the Engineer, washers shall be used under the bolt heads and nuts.

The length of each bolt shall be such that, after tightening, at least one full thread will project through the nut and at least one full thread (in addition to the thread run out) will remain clear between the nut and the unthreaded shank.

05.10 Friction-grip fastening

The use of friction-grip bolts shall be in accordance with SANS 10094. Where use is made of other types of friction-grip fasteners, they shall comply with the requirements of SANS 10094 for equivalent fasteners, and shall be assembled and tightened to not less than the load at permanent set as specified in SANS 10094.

05.11 Riveting

Wherever possible, riveting shall be done with pneumatic equipment.

Riveted members shall have all parts firmly drawn together and aligned before riveting is done. Every rivet shall, when driven, completely fill the hole and have a well-formed head or, if countersunk, shall completely fill the countersink.

All loose, eccentric-headed, badly formed, burnt or otherwise defective rivets shall be cut out and replaced at the Contractor's expense.

05.12 Corrosion protection

(a) Painting

After fabrication and before removal from the place of manufacture, steelwork shall be painted as specified in section 806. Where the finishing coats are to be applied on the Site, the shop painting shall include the application of an undercoat.

Galvanized steel shall not be painted unless painting is specifically called for in the Specifications.

(b) Sprayed metal coatings

Where steel surfaces are to be given a sprayed metal coating, it shall be carried out in accordance with the requirements of BS EN 22063. The type of metal used shall be as specified in the Schedule of Quantities or as shown on the Drawings and, unless otherwise specified, the nominal thickness of the metal coating shall be 0,15 mm.

(c) Galvanizing

Where the galvanizing of structural steelwork is called for, the members shall be hot-dip galvanized. Structural steel members shall be given a coating in accordance with SANS 32, quality B1 or SANS 121, Table 2 or 3, as applicable. Sheet steel and strip shall be given a Class M coating in accordance with SANS 3575 or SANS 4998 as applicable.

All nuts, bolts, screws and threaded articles shall be hot-dip galvanized in accordance with the requirements of SANS 121, Table 2 or 3, as applicable.

Cut ends and small damaged areas shall be repaired by the application of a zinc-rich paint or zinc spraying.

06 ERECTION

06.01 General

Apart from the requirements of the Constructions Regulations 2003, where required in the Project Specifications, details of the method of erection shall be submitted to the Engineer for approval. All structural steel shall be so stored, transported, handled and erected that it will not be subjected to undue stress and will not be damaged.

06.02 Safety during erection

During erection of a structure, the steelwork shall be bolted, braced or otherwise secured so as to make adequate provision for all erection loads.

06.03 Alignment

Each part of a structure shall be aligned as soon as possible after erection. Members shall not be permanently connected until a sufficient part of the structure has been aligned, levelled, plumbed and temporarily connected to ensure that it will not be displaced during the erection or alignment of the remainder of the structure.

06.04 Corrections

Drift pins, jacking equipment and the like shall not be used to bring improperly fabricated members into place. A moderate degree of cutting and reaming may be employed for correcting minor misfits, but only if, in the opinion of the Engineer, it will not detract from the appearance or strength of the structure. The flame cutting of holes will not be permitted without the written approval of the Engineer.

06.05 Repairs to paintwork

Repairs to paintwork shall be carried out in accordance with the provisions of section 806.

07 TESTING

07.01 Testing by the Engineer

The Engineer may nominate a testing authority to inspect the Works and to conduct such tests as he may consider necessary to test compliance with the Specifications. Where required, test samples of welds shall be prepared by the Contractor, free of charge, for testing purposes.

The Contractor shall, where required, pay for the cost of testing as described above and shall be reimbursed in accordance with clause 12.04 of section 903.

07.02 Process control

Welds shall be regularly inspected and tested by the Contractor in terms of his obligations described in section 901. This shall include the visual inspection of welds to ensure that there is no undercutting, no uneven lengths, no porosity or no evidence of cracking, and that full fusion has been achieved. If required by the Engineer, cores containing weld and adjacent parent material shall be cut out in doubtful areas. The cores shall be polished and examined and the hole made good.

08 TOLERANCES

Fabrication and assembly tolerances for structural steel shall be as follows:

08.01 General

Unless otherwise specified herein or in the Project Specifications or on the Drawings, fabrication and assembly tolerances on the dimensions for structural steel shall be plus or minus 2 mm. Holes for connections shall be drilled or punched and aligned as specified in subclauses 05.04 and 05.07 respectively.

08.02 Cross-section

The tolerances on cross-sectional dimensions of rolled sections shall be as specified in the Structural Steel Tables published by the SA Institute of Steel Construction.

08.03 Straightness

A structural member, before erection, shall not deviate from straightness (or the specified shape) by more than the following:

- For compression members and beams (other than purlins and sheeting rails) : 1/1 000 of the length between points which are laterally restrained.
- For other members : 1/500 of the overall length, but not more than 25 mm.

08.04 Length

The length of a member shall not deviate from its intended length by more than the following:

- For compression members faced at both ends for bearing purposes : ± 1 mm.
- For other members : + 0 - 4 mm.
- For members such as trusses and lattice girders the above tolerances apply to the members as a whole.
- The length of component parts shall be such that the member can be properly assembled with the required accuracy.

08.05 Bearing surfaces

Where two steel surfaces are required to be in contact in bearing, the maximum clearance between the bearing surfaces shall not exceed 1 mm when the members in contact are aligned.

08.06 Accuracy of erection

Steelwork shall not be out of plumb over any vertical distance by more than 5 mm or 1/1000 of the distance, whichever is the greater.

Handrails shall, in the opinion of the Engineer, be visually straight and of the specified shape.

09 MEASUREMENT AND PAYMENT

Item		Unit
809.01	**Structural steel items**	
809.01.01	Measured by mass	
809.01.01.01	(Description of item)	ton (t)
809.01.02	Measured by linear metre	
809.01.02.01	(Description of item)	linear metre (m)
809.01.03	Measured by area	
809.01.03.01	(Description of item)	square metre (m^2)
809.01.04	Measured by number	
809.01.04.01	(Description of item)	number (No)

The unit of measurement shall be the ton of structural steel contained in the structural item as erected, the metre of completed item as installed, the square metre of completed item as installed or the number of units of each item complete as installed.

For items measured by mass, no deductions in mass shall be made for punching, borings, sheared edges, milling, planing and cut-outs and no additions in mass shall be made for rivets, bolts, nuts, washers, welding fillets or temporary bracing. Tolerances and other permissible deviations shall be ignored.

The tendered rates shall include full compensation for preparing shop details where required in terms of the Project Specifications, the supply of all the required materials, fabrication, process control, loading, transporting to the Site, off-loading and erection. They shall also include full compensation for all nuts, bolts, rivets, washers, holding-down bolts where specified, for cutting, waste and temporary bracing, and for transportation.

Item		Unit
809.02	**Corrosion protection by**	
809.02.01	Painting	
809.02.01.01	(Description of item)	lump sum
809.02.02	Sprayed metal coating (type of metal and the thickness of coating indicated)	
809.02.02.01	(Description of item)	lump sum
809.02.03	Hot-dip galvanizing	
809.02.03.01	(Description of item)	lump sum

The unit of measurement shall be the lump sum.

The tendered rates shall include full compensation for applying the specified corrosion protection, including surface preparation, materials, labour, tools, equipment and all the necessary incidentals.

SERIES 9 : QUALITY CONTROL

SECTION 901 : GENERAL REQUIREMENTS

CONTENTS

01 SCOPE

This section covers the general responsibilities of the Contractor for ensuring that the quality of workmanship and materials provided under the Contract comply with the requirements of the Contract. It also describes the Engineer's responsibilities and authority regarding acceptance control and lays down general principles in dealing with substandard work and remedial measures.

02 DEFINITIONS

For the purpose of this section in particular and these Specifications in general, the following words and expressions shall, unless inconsistent with the context, have the meanings hereby assigned to them.

(a) Acceptance control

The systematic inspection and testing by the Engineer, for the purpose of establishing compliance with the requirements specified, of the materials and workmanship produced under this Contract by the Contractor.

(b) Process control

The systematic control by the Contractor of the properties and quality of materials and workmanship produced under this Contract, in order to ensure that they will comply with the requirements specified. It includes the testing by the Contractor of materials and workmanship where necessary.

03 ENGINEER'S RESPONSIBILITIES

In respect of quality control the Engineer's responsibilities are to observe and inspect the quality of work and workmanship produced under this Contract. This shall not be deemed to imply that the Engineer will necessarily be able to inspect each and every aspect of each item of work produced or to observe every action or method of operation employed in constructing the Works. Acceptance of any item of work will therefore not necessarily mean that the Engineer has inspected and approved all aspects of work accepted, and any faults or defects discovered after acceptance shall be rectified by the Contractor if the Engineer so requires and at the Contractor's own cost. Any reliance therefore placed by the Contractor on the acceptance given by the Engineer shall be at his own risk.

The Engineer will be responsible for the acceptance or rejection of all the work and materials supplied under this Contract as and when such work or materials are submitted for approval by the Contractor.

04 CONTRACTOR'S RESPONSIBILITIES

The responsibility for producing work and workmanship and for supplying materials conforming in all respects to the specified requirements shall be that of the Contractor. For this purpose he shall employ the necessary supervision, inspection, testing and other facilities as may be necessary to ensure compliance with the requirements of the Specification. Where necessary, any process of the manufacture of materials such as concrete or asphalt used in the Works shall be controlled by a method of process control as described in clause 05 hereinafter.

Any work or materials not conforming to the Specifications shall be removed and replaced with work or materials conforming to the Specifications or, subject to the Engineer's approval, be improved by such remedial measures as the Engineer may approve so that they will conform to the Specifications.

The Contractor shall from time to time submit items of work which have been completed to the Engineer for approval. Before submitting such work, he shall conduct such tests and inspections as may be necessary to establish conformance with the requirements specified and shall submit the results of such tests and inspections together with his application for approval. The Contractor shall be responsible for ensuring that all work is eventually submitted to and approved by the Engineer.

Materials used in the construction of the Works shall be systematically inspected and, where applicable, tested by the Contractor to ensure compliance with the specified requirements. Copies of the results of such tests or inspections shall be furnished to the Engineer as soon as they become available.

05 PROCESS CONTROL

Where specified in the case of work such as layerwork for roads, and in the case of materials produced on the Site such as concrete, the Contractor shall institute a system of process control to ensure that only work and materials conforming to the Specifications are produced.

The Contractor shall use such recognised methods of process control as are described in the draft publication TRH5 Statistical concepts of quality assurance and their application in road construction. The actual methods and the frequency of testing shall be subject to the Engineer's approval, but in the case of limited production the Engineer may relax these requirements.

The Contractor's attention is drawn to the various sections of the Specifications where the minimum requirements regarding the required frequency of testing are set out in the relevant clauses. These are the minimum requirements, and the Contractor shall, where necessary to ensure compliance with adequate confidence, increase the frequency of testing.

The Contractor shall take immediate steps to rectify any deviation or danger of deviation from the specified requirements indicated by his process-control system, and the Engineer will have the authority to inspect and be given details of tests and testing procedures to satisfy himself that the Contractor is carrying out an adequate process-control system.

06 ACCEPTANCE CONTROL

All work produced under this Contract shall be subject to acceptance control in the sense that it shall be submitted to the Engineer for final acceptance.

The Contractor shall institute a systematic procedure of submission that will ensure that all elements of the work are submitted for acceptance.

The Engineer will inspect and test such work for conformance with the specified requirements and on the basis of such tests and inspections either accept or reject such work.

In recognition of the fact that the properties of work and materials produced are subject to inherent variation which would inevitably result in a small percentage of tests on each property falling outside the specified limits, a system of judgment for compliance based on statistical concepts has, wherever possible, been introduced to ensure with a predetermined measure of confidence that no work containing more than an acceptable percentage of defects is accepted.

Where such statistical methods of judgement cannot be used on account of practical difficulties, full compliance with the specified properties is required.

07 CONDITIONAL ACCEPTANCE OF SUB-STANDARD WORK

Where work is submitted for approval and found not to comply with the Specifications, the Contractor shall be responsible for breaking down and removing such work and replacing it with work that conforms to the specified requirements.

In certain instances it is recognised that the financial consequences to the Contractor by having to remove and replace substandard work may be very serious, whereas the reduced performance of such work, if accepted, may have less serious implications for the Employer. In view of the overall benefits of accepting such work at reduced payment, the Engineer will be entitled, but not obliged, to accept such work conditionally at reduced payment if, in his absolute discretion, this procedure may be desirable in the circumstances.

Conditional acceptance of substandard work shall be subject to the conditions specified in clause 09 of section 902 and to the following:

(a) Each offer of conditional acceptance and the corresponding reduced payment shall be subject to confirmation by the Engineer.

(b) Conditional acceptance or an offer of conditional acceptance shall not constitute a waiver of the requirements of the Contract but shall be regarded as a supplementary agreement in terms thereof.

08 REMEDIAL WORK

When any part of the work or any equipment or any material is found upon examination by the Engineer not to conform to the requirements or is at any stage after final acceptance damaged so that it no longer conforms to the requirements of the Specifications, the Engineer may order its complete removal and replacement, at the Contractor's expense, with satisfactory work, equipment or material, or he may permit the Contractor to apply remedial measures in order to make good any such defects or damage.

The actual remedial measures taken shall at all times be entirely at the Contractor's own initiative, risk and cost, but subject to the Engineer's approval.

In particular, remedial measures shall ensure full compliance with the Specifications of the final product, shall neither endanger nor damage any other part of the Works, and shall be carefully controlled and submitted to the Engineer for examination when completed or at any intermediate stage as may be required.

09 MEASUREMENT AND PAYMENT

Full compensation for the Contractor's obligations regarding quality control as described in this section, including the costs of supervision, tests and the establishment of testing facilities on the Site, if necessary, shall be included in payment, at the tendered rates, for the construction of the relevant items of work or materials and payment at the tendered rates for his preliminary and general items.

SERIES 9 : QUALITY CONTROL

SECTION 902 : STATISTICAL JUDGEMENT SCHEME FOR ACCEPTANCE CONTROL

CONTENTS

01 SCOPE

This section describes the scheme used for determining, by means of tests and measurements and by applying statistical judgement procedures, whether certain requirements specified in the Specifications in regard to the properties of materials and workmanship are being complied with.

It also covers the requirements in regard to the control to be exercised by the Contractor for monitoring the quality of his work and materials and the routine tests and inspections to be carried out by the Engineer.

02 GENERAL

Certain requirements and limit values are laid down in the Specifications in regard to the properties of materials and workmanship to be supplied. Tests shall be conducted and measurements taken for controlling the relevant properties of the workmanship and materials supplied, and the results of such tests and measurements shall be assessed on the basis of the prescribed criteria for compliance with the specified requirements.

Wherever possible, acceptance criteria shall be determined by way of statistical principles described in this section. Wherever impracticable and where no statistical judgement criteria have been prescribed, the specified requirements and limit values shall be fully complied with.

Despite acceptance of those properties judged by these statistical methods, the materials or work submitted will be rejected when other properties (which are not controlled by statistical methods) fail to comply with the requirements of the Specifications, or where there are other causes for rejection such as obviously defective workmanship or excessively variable properties, visible signs of poor workmanship, and similar considerations which constitute sufficient grounds for rejecting the work without any further testing.

The Engineer shall be entitled to assess separately any specified portion of a lot if, in his opinion, it exhibits significant deviations as compared with the remainder of the lot.

In order not to change the Contractor's or the Employer's risks, the statistical judgement scheme shall be strictly adhered to in all cases where it is used, and decisions based on this scheme shall not be altered. It shall be a condition of this Contract that the theoretical validity of the statistical judgement scheme be accepted and that the validity of the decisions made on the basis of this judgement scheme cannot be disputed on the grounds of statistical theory or a specified or implied producer's risk, or unjust on the grounds of enrichment.

03 DEFINITIONS

For the purposes of this section the following words and symbols shall have the following meanings:

03.01 Lot

A lot is a sizeable portion of work or quantity of material which is assessed as a unit for the purposes of quality control, and selected to represent material or work produced by essentially the same process and from essentially the same materials.

03.02 Random sample

A random sample is a group of "n" test measurements at "n" separate test positions or on "n" sample portions obtained from the lot in an unbiased manner.

Random sampling shall mean stratified random sampling, unless inconsistent with the context.

03.03 Sample mean ($\bar{x}_n$)

$\bar{x}_n$ is the arithmetic mean of a set of "n" test results constituting the sample.

03.04 Specification limit (L_s)

This is the limit value of the property of any product outside which not more than a specified percentage of the population of values representing an acceptable product property is allowed to lie. The specification limit may be a single lower limit L_s or a single upper limit L'_s, or a double limit L_s, consisting of a lower limit L'_s and an upper limit L'_s.

03.05 Acceptance limit for sample mean (L_a)

This is the limit value of a product property within which the sample mean shall lie for a product to be acceptable.

For a lower-limit specification, this acceptance limit is denoted by L_a For an upper-limit specification, this acceptance limit is denoted by L'_a. For a double-limit specification, the lower and upper limits are denoted by L_a and L'_a.

03.06 Acceptance limits for individual test values (L'_e)

This is the limit values of a product property within which the sample values representing a product shall lie for the product to be acceptable.

The limit values will depend on the sample sizes "n" and may be a lower limit L_e, an upper limit L'_e, or double limits L_e and L'_e.

03.07 Conditional acceptance

This is the acceptance of a lot at reduced payment in lieu of rejection. Conditional acceptance shall be subject to the provisions of clause 07.

03.08 Outliers

Where, in a sample, one or more test results differ significantly from the other values obtained, this difference could be ascribed to an assignable cause, in which case such test result shall be regarded as an outlier and disregarded when assessing the lot. To determine whether or not a test result is an outlier, the method given in subclause 04.04 shall be adopted.

03.09 First submission

The submission of a lot for approval will be classified as a first submission when actually submitted for the first time or when submitted for a second time on the basis of a second set of test values which shall be regarded as a first submission in terms of sub clause 04.05, because the properties of the first and the second sets of test values differ significantly.

03.10 Re-submission

The submission of a lot for approval for a second time shall be classified as a resubmission should it be regarded as a resubmission in terms of subclause 04.05, as the properties of the first and second sets of test values do not differ significantly.

03.11 Payment-reduction factor (f_r)

This is the factor by which payment at contract rates shall be multiplied for calculating payment for conditionally accepted work.

04 GENERAL REQUIREMENTS

04.01 Determining the lot size

(a) Road-construction layers

The lot size shall normally be a section compacted in one process where essentially the same materials and construction equipment have been used. Where production is on a continuous basis, a lot shall normally mean the product of one day's work and shall not exceed the product of two full days' work. However, a lot of any smaller size may be ordered by the Engineer where -

- the properties under investigation exhibit abnormal local variation within the normal lot size;
- an area is obviously of a different quality than the rest;
- the rate of production is very high.

(b) Concrete

The lot size shall be determined by the Engineer, with due regard to the size and the type of structure in which the concrete is placed, the specific portion of the structure, and the total quantity of concrete placed in a day. The lot sizes in concrete structures could therefore vary considerably, and, particularly in the case of small structures, it could be necessary to combine samples of the same grade of concrete from different structures, provided the concrete has been obtained from the same concrete plant and has been cast in the same period.

(c) Other

In other cases, as for example in material stockpiles where the definition of a lot in accordance with subclause 03.01 does not apply directly, the Engineer will determine lot sizes in accordance with circumstances pertaining to each case.

04.02 Random sampling

When any lot is tested, whether a normally sized lot or an isolated section which clearly exhibits an abnormal variation of the properties under consideration, all samples shall be taken in a stratified random pattern. For this purpose use shall be made of tables of random numbers, and the instructions in publication TMH5, Sampling for Road Construction Materials, shall be followed.

04.03 Sample sizes

For purposes of acceptance control, the Engineer will, in advance, determine sample size "n". The larger the sample, the more reliable the result will be, and no sample sizes may be smaller than those given in subclause 05.01.

04.04 Outliers

Test results shall be scanned for possible outliers. Where there is reason to believe that a test result may be erroneous, it shall, if possible, be re-examined by further testing, and, if there is reasonable evidence to suggest that the test result is erroneous, it shall be regarded as an outlier, rejected, and replaced with a fresh test result. Where repeating a test or re-examining a test result is impossible, the method described below shall be used for identifying outliers:

Calculate the value of T_o from

$$T_o = \frac{x_o - \bar{x}_n}{S_n}$$

where $\bar{x}_n$ and S_n are the arithmetic mean and the sample standard deviations respectively, and x_o is the value of the test result differing most from the mean.

Compare the value of T_o with the value of T for the applicable value of "n", from the following table:

No of observations (n)	Critical values (T)
4	1,46
5	1,67
6	1,82
7	1,94
8	2,03
9	2,11
10	2,18
11	2,23
12	2,29
13	2,33
14	2,37
15	2,41
16	2,44
17	2,47
18	2,50
19	2,53
20	2,56

If the absolute value of T_o is greater than T, then x_o is an outlier.

04.05 Re-submission

Where a lot has been accepted conditionally or has been rejected, the Engineer may agree to its resubmission for approval if -

- it has been reworked and the Engineer is satisfied that a proper attempt was made to improve the properties which were unacceptable;

  or

- where, in his opinion there are valid technical reasons therefore.

In both cases a fresh sample shall be taken, and a fresh (second) set of test values determined.

The first and second sets of test values shall then be compared with each other to determine whether their properties differ significantly.

Where in the opinion of the Engineer a significant difference does occur, the submission of the lot shall be regarded as a first submission and assessed as such, and only the second set of test values shall then be used for this purpose.

Where in the opinion of the Engineer no significant difference occurs, the submission of the lot shall be regarded and assessed as a resubmission. Where a lot is resubmitted, it shall be assessed on the same basis as a first submission, except that the original and the second set of sample results shall be combined for purposes of assessment.

05 PROCEDURES

The statistical judgement procedures described below will apply to the corresponding product properties for purposes of acceptance control.

05.01 Surface levels of fills and pavement layers

At least 50, but preferably more, level measurements shall be taken according to a stratified random pattern of each lot of completed layer work, and the specified levels shall then be determined. Outliers shall be identified and examined.

The lot will be considered to comply with the requirements in respect of surface levels if, before any repair work is undertaken, at least 90% of the level measurements show a deviation from the specified levels which is smaller than the H_{90} tolerance specified in the relative sections in regard to each layer.

Isolated spots, where the surface levels deviate by more than the appropriate H_{max} tolerance of the specified levels shall be repaired to bring the deviation to within the H_{90} tolerance.

05.02 Layer thicknesses of pavement layers

At least 30, but preferably more, layer thicknesses shall be determined in accordance with a stratified random pattern for each lot of completed layer work. Layer thicknesses may be determined by means of level measurements taken before and after construction of the layer in exactly the same position, but may be augmented by thickness measurements taken by means of holes made in the layer. In the case of asphalt layers, the Engineer may require thickness determinations to be made only by means of measurements on drilled cores, in which case the minimum number of cores per lot shall be 20 instead of 30.

Outliers shall be identified, disregarded, and, if possible, replaced.

The lot will be considered to comply with the requirements for layer thickness if -

- at least 90% of all the thickness measurements taken before any thickness repairs are made is equal to or greater than the specified thickness, minus the $D_{\mathbf{90}}$ tolerance specified in the appropriate section; and
- the mean layer thickness of the lot is not less than the specified thickness, minus the $D_{\mathbf{mean}}$ tolerance.

Isolated spots where the actual thickness is less than the specified thickness less the $D_{\mathbf{max}}$ tolerance shall be repaired so as to fall within the D_{90} tolerance.

05.03 Relative compaction of pavement layers

At least 4 relative density determinations shall be taken in the case of selected layers and at least 6 in the case of all other pavement layers in accordance with a random pattern. After outliers have been examined and replaced, compliance with the specified density requirements shall be determined as follows:

The sample mean $\bar{\mathbf{x}}_{\mathbf{n}}$ shall be at least equal to or higher than the acceptance limit ($L_{\mathbf{a}}$) for the sample mean as given in table 902/1, and no single test value shall be lower than the acceptance limit ($L_{\mathbf{e}}$) for single values.

05.04 Cementitious-binder content of stabilized layers and uniformity of mix

Take 10 samples according to a random pattern and determine their cementitious-binder content. Examine the results for outliers and replace them if any.

As described in subclause 08.04(a) of section 903, the test results shall be adapted to make provision for the presence of minerals, which may affect the test results in the material to be stabilized.

The quantity of cementitious binder in the mixed material determined by taking 10 samples per lot and testing them as specified, shall fall within the following limits:

- The mean cementitious-binder content shall be not less than 91% of the specified binder content.
- The cementitious binder content in not more than 2 of the 10 samples may be lower than 70% of the specified binder content.

The requirements for uniformity of the mix shall apply only on condition that the variation of these adjustments fall within the limits specified in subclause 08.04(a) of section 903.

05.05 05.05 Binder content of asphalt

Take at least 4 specimens of asphalt in a random pattern and determine the binder content. Examine the results and replace any outliers as specified.

Table 902/1

ACCEPTANCE LIMITS IN RESPECT OF COMPACTION

Layer	Prescribed density	Unit of Measurement	Minimum average density for the following sample sizes						Minimum value for any single test for the following sample sizes					
			4	5	6	7	8	9	4	5	6	7	8	9
Selected layer	90%	Mod AASHTO-density	90.1	90.4	90.6	90.7	90.9	91.0	86.4	86.2	86.0	85.9	85.8	85.7
	93%	Mod AASHTO-density	93.1	93.4	93.6	93.7	93.9	94.0	89.4	89.2	89.0	88.9	88.8	88.7
	95%	Mod AASHTO-density	95.1	95.4	95.6	95.7	95.9	96.0	91.4	91.2	91.0	90.9	90.8	90.7
Subbase	95%	Mod AASHTO-density	95.1	95.4	95.6	95.7	95.9	96.0	91.4	91.2	91.0	90.9	90.8	90.7
	97%	Mod AASHTO-density	97.1	97.4	97.6	97.7	97.9	98.0	93.4	93.2	93.0	92.9	92.8	92.7
Gravel base	98%	Mod AASHTO-density	98.1	98.4	98.6	98.7	98.9	99.0	94.4	94.2	94.0	93.9	93.8	93.7
	97%	Mod AASHTO-density	97.1	97.4	97.6	97.7	97.9	98.0	93.4	93.2	93.0	92.9	92.8	92.7
Crushed-stone base and subbase	86%	Apparent density	86.1	86.4	86.5	86.7	86.8	86.9	82.7	82.6	82.4	82.3	82.2	82.1
	88%	Apparent density	88.1	88.4	88.5	88.7	88.8	88.9	84.7	84.6	84.4	84.3	84.2	84.1
Asphalt base and surfacing	100%	97% of theoretical density minus % of voids in mix	100.1	100.3	100.5	100.6	100.7	100.8	97.1	96.9	96.8	96.7	96.6	96.5
Shoulders and wearing course	93%	Mod AASHTO-density	93.2	93.6	93.8	94.0	94.2	94.3	87.9	87.6	87.4	87.2	87.0	86.9

Determine the sample mean and assess the lot by using the following criteria: The binder content of asphalt mixes shall not deviate from the specified binder content by more than the values given in table 902/2.

Table 902/2

ACCEPTANCE LIMITS FOR BITUMINOUS-BINDER CONTENT

Sample size (number)	Maximum deviation of the sample mean from the specified binder content (% of binder)	
	Gap-graded and semi-gap-graded mixes	Continuous and open-graded mixes
2	0,51	0,37
3	0,44	0,33
4	0,41	0,30
5	0,38	0,28
6	0,36	0,27
7	0,35	0,26
8	0,33	0,25

Sample size (number)	Maximum deviation of any single test value from the specified binder content (% of binder)	
	Gap-graded and semi-gap-graded mixes	Continuous and open-graded mixes
2	0,76	0,54
3	0,81	0,58
4	0,84	0,60
5	0,87	0,62
6	0,89	0,64
7	0,91	0,65
8	0,92	0,66

05.06 Concrete : 28 day cube compressive strength

Take at least the minimum number of samples as given in table 902/4 according to a random pattern and make test cubes. Test them for cube compressive strength after 28 days. Examine the results for outliers and disregard if any. The results are then assessed according to the criteria set out below.

A lot will comply with the requirements for the characteristic strength if it meets the following requirements:

(1) $\overline{x} \geq L_S + \Delta A$ where

$\overline{x}$ = a mean value of the 28-day cube compressive strength tests

L_S = characteristic strength specified in subclause 04.02 of section 704, e.g. for class 20/38 concrete L_S = 20 MPa

Δ_A = the applicable value given in Table 902/3

(2) No single test value is lower than the value $L_S - \Delta_B$ where

Δ_B = the applicable value given in Table 902/3.

06 CONTROLLING MORE THAN ONE PROPERTY

Where more than one property of a lot is being controlled, the lot shall be accepted if all the properties comply with the specified requirements, but if one or more of the properties do not comply with the requirements, the lot shall be rejected, or it may be conditionally accepted subject to the provisions of clause 07.

07 CONDITIONAL ACCEPTANCE

07.01 General

Where a lot is rejected under the statistical judgement scheme described in this section but the test results are such that the lot complies with the requirements for conditional acceptance specified hereafter, the Engineer may accept the lot conditionally, that is, the lot may be accepted at reduced payment in lieu of complete rejection, provided that -

- conditional acceptance shall be in the sole discretion of the Engineer and is not an option which may be exercised by the Contractor or a right he may claim;
- the lot is approved in respect of all other requirements not judged by the statistical judgement scheme;
- the Contractor shall have the option to remove and reinstate at his own cost conditionally accepted work with work which complies with the requirements for acceptance at full payment;
- conditional acceptance and the corresponding reduced payment shall apply only in respect of the work and properties listed in subclause 07.02 below.

Table 902/3

ACCEPTANCE FACTORS FOR STRENGTH CONCRETE

Sample size (n)	Δ_A (MPa)	Δ_B (MPa)
3	0,5	3,9
4	1,1	4,2
5	1,4	4,5
6	1,7	4,7
7	1,9	4,9
8	2,1	5,0
9	2,2	5,2
10	2,3	5,3
11	2,4	5,4
12	2,5	5,5
13	2,6	5,6
14	2,7	5,7
15	2,7	5,8

Table 902/4

MINIMUM SAMPLE SIZES FOR STRENGTH CONCRETE (STRUCTURAL)

Volume of lot (m^3)	Minimum sample size
0 - 20	4
21 - 40	6
41 - 70	9
71 - 100	12
101 - 150	14
>150	16

07.02 Properties to which conditional acceptance applies

Conditional acceptance may be applied in respect of the properties of structures listed below in table 902/5.

Table 902/5

PROPERTIES TO WHICH CONDITIONAL ACCEPTANCE MAY APPLY

Property	Structure
Relative compaction	(i) Asphalt base or surfacing (ii) Chemically stabilized layers
Bituminous-binder content	Asphalt base or surfacing
Cementitous-binder content	Chemically stabilized layers
28-day cube compressive	All structural concrete (excepting concrete pavements)

Notes:

1. See sub clause 12.02 of section 610 for details regarding reduced payments in the case of defective concrete strength or layer thickness in concrete pavements.
2. Conditional acceptance shall not apply to crushed-stone layers, but where compaction to 88% of apparent density has been specified but cannot be attained, the Engineer may accept the layer at payment at the rate for compaction to 86% of apparent density on condition that the layer complies with the requirements for this compaction standard.

07.03 Criteria for conditional acceptance

In terms of the judgment scheme two requirements shall always apply to the properties to which conditional acceptance applies, viz one in relation to the sample mean $(\overline{x}_n)$, and one in relation to individual test values x_n.

A lot may be conditionally accepted when it complies with one of the two requirements for acceptance, but not with the second requirement provided it complies with the requirements for conditional acceptance in relation to the second requirement. There are therefore always two cases:

Case I

The lot complies with the requirement for sample mean, but not in all cases with the requirement for individual test values.

The lot may be accepted conditionally, subject to the following additional conditions:

- In regard to the relative compaction of pavement layers, the bituminous-binder content of asphalt and the concrete cube compressive strength, not more than one test value may not comply with the requirements of individual test values.
- In regard to the cementitious-binder content, the binder content may be below 70% of the specified binder content in not more than 13 cases.

Case 2

The lot complies with the requirements for individual test values but not with the requirements for sample mean.

The lot may be accepted conditionally on condition that the sample mean x_n lies within the rejection limit L_1 given in table 902/6.

Table 902/6

REJECTION LIMITS $(L_r$ and $L'_r)$ FOR THE SAMPLE MEAN $(\overline{x}_n)$

Property	Structure	Rejection limits (L_r and L'_r)
Relative compaction	(a) Chemically stabilized layers.	$L_r = (L_a - 2{,}0)\%$ relative compaction
	(b) Asphalt base or surfacing	$L_r = (L_a - 1{,}0)\%$ relative compaction
Cube compressive strength	All strength-concrete (excluding pavement concrete)	$L_r = 0{,}85L_a$
Bituminous-binder content %	Asphalt	$L_r = (L_a - 0{,}2)\%$ binder $L'_r = (L'_a + 0{,}2)\%$
Cementitious-binder content	Chemically stabilized layers	$L_r = 0{,}80\ L_a$

07.04 Determining the payment reduction factor (f_r)

Where a lot is conditionally accepted, compensation will be reduced by multiplying the tender rates for the items concerned, as set out below, with the payment reduction factor f_r .

The factor f_r is determined as follows in regard to the two cases set out in subclause 07.03 above.

Case I

The lot complies with the requirements for sample mean, but not in all cases with the requirements for single values.

f_r is always taken as being equal to 0,85.

Case 2

The lot complies with the requirements for single values, but not with the requirements for sample mean (x_n).

For conditional acceptance at a lower limit

$$f_r = 0{,}67 + 0{,}3\left\{\frac{\overline{x}_n - L_r}{L_a - L_r}\right\}$$

For conditional acceptance at an upper limit

$$f_r = 0{,}67 + 0{,}3\left\{\frac{L'_r - \overline{x}_n}{L'_r - L'_a}\right\}$$

(See clause 03 for definitions of symbols).

07.05 Applying the payment-reduction factor

The payment-reduction factor shall be applied to the following payment items as may apply and be described in the Specifications:

- Chemically stabilised layers

  Items 604.01, 604.02 and as applicable, 203.01 or 601.02 and 601.03

- Asphalt base and surfacing

  Items 606.01 and 606.02

- Concrete

  Items 704.01, 704.02 and 704.03

  No reduction shall apply to payment items for formwork, reinforcing or tendons.

- General

  Where payment items are incorporated in the Project Specifications or have been amended in the Schedule of Quantities, the payment-reduction factor shall apply to the payment items corresponding to the payment items mentioned above.

  Where a lot is conditionally accepted in regard to more than one property, the payment-reduction factor for each property shall be calculated, and the factor giving rise to the largest reduction shall be applied, except in the case of concrete pavements when the provisions of subclause 12.02 of section 610 shall be referred to.

08 PROCESS CONTROL BY THE CONTRACTOR

The requirements of clause 04 of section 901 shall apply in respect of the Contractor's obligation to institute and implement a control system for monitoring the quality of the work and materials supplied.

For continuous concrete and asphalt-production processes, the Engineer may order the Contractor to augment the above control system by introducing a process-control system for monitoring the various properties to be controlled. The specific system to be applied shall be subject to the Engineer's approval, and the attention of the Contractor is drawn to the systems described in clause 4.4 of TRH5, which will normally be regarded as suitable.

The Contractor shall take immediate steps to rectify any deviation from the specified requirements indicated by his process-control system, and the Engineer shall have the right to inspect and be given all details of tests and testing procedures in an order to satisfy himself that the Contractor is implementing an adequate process-control system.

09 ROUTINE TESTS AND INSPECTION BY THE ENGINEER

The Engineer will at regular intervals inspect and test materials and completed work for compliance with the specified requirements, and, where applicable, the specified judgement scheme will be applied. The testing frequencies and sample and lot sizes for routine testing shall be at the Engineer's discretion.

All sections of completed work shall be submitted to the Engineer for routine inspection and testing, and the Contractor shall not cover up or construct any work on top of sections of completed work before being advised by the Engineer of the outcome of his tests and inspection. The Contractor shall arrange the submission of work for testing in a manner as will afford the Engineer reasonable opportunity for inspecting and testing.

SERIES 9 : QUALITY CONTROL

SECTION 903 : TESTING

CONTENTS

01 SCOPE

This section describes the requirements for testing laboratories and testing equipment and the various sampling and testing methods to be used for testing the properties of the materials and workmanship to be provided under this Contract.

These requirements shall apply to all tests and testing carried out for the purposes of this Contract whether carried out by or on behalf of the Engineer or the Contractor.

Certain sampling and testing procedures not covered in the other sections of the Specifications by reference to the standard methods mentioned in clause 03 are given in this section.

02 TESTING LABORATORIES AND EQUIPMENT

When the Contractor elects to carry out all or part of his testing by using independent laboratories, the laboratories must be approved in advance by the Engineer for each Contract. Should, in the opinion of the Engineer, the standard of work produced by such laboratories be not acceptable, he may in his absolute discretion withdraw any approval previously given for the use of such a laboratory and the Contractor shall not be entitled to any damages or other compensation as a result of such withdrawal of approval.

When the Contractor elects to do his own testing, the laboratory and equipment, and the quality, training and experience of the personnel manning the laboratory shall be such as will ensure proper testing and shall furthermore be subject to the Engineer's approval. All equipment shall be regularly calibrated and tested for accuracy.

The Engineer's laboratories will be subject to the same requirements as those of the Contractor.

03 STANDARD METHODS OF TESTING

Testing shall be done in accordance with the appropriate standard method specified in the Specifications and, where no standard method is specified, testing shall be done in accordance with the methods described in the following documents, in order of precedence.

(a) Standard Methods of Testing Road Construction Materials, published by the National Institute for Transport and Road Research as part of the series Technical Methods for Highways (abbreviated TMH1 and TMH6).

(b) The specifications, test methods, codes of practice and co-coordinating specifications of the Standards South Africa (abbreviated SANS and CKS).

(c) The specifications of the British Standards Institution (abbreviated BS).

(d) The specifications of the American Society for Testing and Materials (abbreviated ASTM).

(e) The specifications of the American Association of State Highway and Transportation Officials (abbreviated AASHTO).

Note:

In all cases the latest amendment or revision which is valid on the closing date of the Tender is implied when reference is made to any one of the above standards in the Specifications.

04 THE COSTS OF TESTING

04.01 Process control

The cost of testing undertaken by the Contractor in terms of his obligations under clause 04 of section 901 for purposes of process control, including the taking of samples, reinstating where samples have been taken, and all testing equipment, labour, materials, etc, shall be included in the rates tendered for the various items of work supplied and will not be paid for separately.

04.02 Producing certificates

Where the properties of materials or manufactured products are required in these Specifications to comply with specified specifications published by a standards authority, the Contractor shall produce, when called upon to do so, certificates from the manufacturer confirming that the materials or products supplied comply with the relevant specifications. The cost of providing such certificates shall be borne by the Contractor. Where specified that a product shall comply with an SANS specification, it will mean that the product shall carry the SANS mark, in which case a certificate will not be required.

04.03 Testing materials and products covered by certificates

The Engineer shall be entitled to take samples of and order tests to be made on products and materials in respect of which certificates of compliance may be required as described in sub clause 04.02 above. The Contractor shall be paid at the appropriate rates if the cost of such tests are itemized in the Schedule of Quantities, and, if no appropriate rates exist, such tests shall be classed as extra work in terms of the General Conditions of Contract, provided that such tests indicate compliance with the Specifications, otherwise the cost shall be borne by the Contractor.

05 PROCEDURES FOR TAKING AND SUBMITTING SAMPLES OF MATERIALS

Where the Contractor is required in these Specifications to submit samples of materials or mixtures to the Engineer for approval prior to their being used in the Works, the use of these materials or mixtures without the Engineer's written approval shall constitute default on the part of the Contractor. All samples shall be submitted in sufficient time for proper testing.

The Engineer's approval of any material or mixture shall in no way relieve the Contractor of his obligation to provide materials, mixtures and workmanship in accordance with the Specifications.

All samples for testing shall be taken in a random pattern unless otherwise ordered by the Engineer.

The Engineer shall have full access to the Works for the taking of samples. The Contractor shall render any assistance necessary for the taking of samples and shall be responsible for the reinstatement of pavement layers or other structures at the positions where samples have been taken. Full compensation for rendering assistance with sampling and for reinstatement where samples are taken shall be included in the rates tendered for the various items of work tested, and no additional payments will be made in this respect.

Table 903/1 shall serve as a guide for the submission of materials in respect of the time and quantity required for testing, approval and mix design. As the time stated in this schedule makes no allowance for possible rejection and resubmission of alternative materials, the Contractor shall submit any doubtful material at an early stage and together with alternative materials in order to minimize any delays with regard to the final approval.

The Contractor shall note that any samples submitted direct to the Engineer's laboratory for approval shall be accompanied by a letter signed by the Contractor.

06 TESTS ON AGGREGATES

Aggregates shall be tested on a regular basis by the Contractor as part of his process control as they are being produced or delivered to the Site. The minimum testing frequency shall be as given in table 903/2.

07 TESTS ON CONCRETE

07.01 The making, curing and 28-day compressive-strength determination of concrete test cubes.

The making, curing and compressive-strength determination of concrete test cubes shall be carried out in accordance with SANS method 5863. In addition, the following shall apply:

(a) One test result shall be the average value of three compressive-strength determinations done on cubes prepared from the same sample. Different test results from tests on production concrete must be obtained from separate batches of concrete.

(b) Test cubes prepared from concrete produced on the Site shall preferably be laboratory-moulded and cured. The concrete shall be hand mixed after it has been transported to the laboratory, and the specimens shall be moulded within 30 minutes of mixing.

(c) Field-made specimens shall be handled with extreme care and shall on no account be jarred or dropped during transport to the laboratory for curing. On no account may specimens be transported on the back of a truck without their being placed on foam plastic at least 75 mm thick.

07.02 The consistency or slump test

The consistency or slump test shall be performed in accordance with SANS 5862-1.

07.03 Concrete core testing for strength

Where sections of concrete which have failed to meet the Specifications are desired to be further examined by the extraction and testing of concrete cores, 100 mm or 150 mm cores shall be drilled and tested. The sampling and testing procedure to be followed shall be in accordance with SANS 5865, and the interpretation of the test results shall be in accordance with the publication Concrete Core Testing for Strength - Concrete Society Technical Report No 11, published by the Concrete Society (Great Britain).

The instructions of this report shall be followed to determine the "estimated potential strength", which shall be compared with the specified 28-day cube strength specified for each type of concrete. The corrections to be applied to the actual core strength to allow for excess voidage, any included steel, and the length/diameter ratio of cores shall be as stated in this publication, and the correction for curing history shall be determined by the Engineer in accordance with this publication and such other information as he may consider appropriate.

The Engineer's decisions regarding the properties, suitability and measure of compliance of the concrete represented by cores tested as described above shall be final and binding.

07.04 Flexural strength test (modulus of rupture)

The procedure for sampling and the making, curing, storing and testing of test beams and the moulds used shall be in accordance with SANS method 5864.

07.05 Strength of finishes to concrete floors

The procedure for assessing the strength and compliance with the specifications of concrete floor toppings and screeds shall be in accordance with the methods specified in SANS 10109-2

08 THE SAMPLING AND TESTING OF ROAD-CONSTRUCTION MATERIALS

08.01 General

The sampling of all road-construction materials shall be carried out in accordance with the methods specified in TMH5. The testing of road-construction material shall be carried out in accordance with the methods specified in TMH1, except that, in respect of concrete testing and sampling, the provisions of clause 07 above shall apply.

In addition, and more specifically, the provisions of the subclauses below shall apply in respect of the various tests and options described in the documents referred to above.

08.02 The sampling and testing of soils, gravels and crushed stone in fills and pavement layers

(a) Sampling

Samples for the determination of maximum dry density (MDD) and optimum moisture content (OMC) shall be taken as follows after the mixing operations have been completed.

Establish the positions for field-density determinations in accordance with Chapter 4 of TMH5. At the positions of the field-density determinations, mark a strip 1 m wide across the full width of the road and sample the material at four or five positions across the full width of the strip and for the full depth of the layer. Combine the samples of each strip into one sample.

(b) Maximum dry density (MDD) and optimum moisture content (OMC)

The samples are prepared and tested in accordance with Test Method A7 of TMH1. Prior to compaction, the entire sample shall be brought to a moisture content approximately 2% below the expected optimum moisture content by the addition of water or by mixing to facilitate drying-out. The apparent density of crushed-stone material shall be determined in accordance with the method described in sub clause 08.01 (e) below.

Table 903/1

SCHEDULE OF QUANTITIES AND TIMES FOR THE SUBMISSION OF MATERIALS FOR QUALITY APPROVAL AND MIX DESIGN

Material submitted	Proposed use	Submission for quality approval only		Submission for quality approval and mix design	
		Min time to be allowed for testing and approval	Min quantity to be submitted	Min time to be allowed for testing, approval and mix design	Min quantity to be submitted
Crushed stone	Coarse aggregate for concrete	2 weeks	50 kg of each size of stone	10 weeks	150 kg of each size of stone for each class of
	Bituminous surface dressing	2 weeks	50 kg of each size of stone	N/A	N/A
	Asphalt mixes	2 weeks	50 kg of each size of stone	6 weeks	100 kg of each size of stone
	Crushed-stone base or subbase	3 weeks	50 kg of each size of stone	N/A	N/A
Crusher dust and/or sand	Fine aggregate for concrete	2 weeks	50 kg of each size of dust fraction	10 weeks	150 kg of each type proposed for use for each class of concrete
	Asphalt mixes	2 weeks	15 kg of each size of dust fraction	6 weeks	150 kg of each type proposed for use
	Slurry seal or sand seal	2 weeks	15 kg of each type proposed for use	6 weeks	50 kg
Gravel	Subbase and/or base	4 weeks	200 kg of each sample	N/A	N/A
Other materials e.g. paint, cement, additives, etc	As specified	As directed by the Engineer			

(c) Determination of field densities

Field densities may be determined in accordance with Method A10(a) or A10(b)T of TMH1 for soils and gravels and shall be determined in accordance with one of the methods described in Method A10(b)T for crushed-stone layers. In the event of a dispute over test results, only Method C (direct transmission) of Method A10(b)T shall be used for crushed-stone layers, and this method or Method A10(a) in the case of soil or gravel layers.

(d) Time limitations

For chemically stabilized layers, the OMC and MDD determinations shall be completed within the time limits given, and field-density determinations shall be completed within 24 hours of completing the compaction of the layer. Where the latter requirement cannot be complied with in the case of retesting, due allowance shall be made for any increase or decrease in density occurring in some stabilized materials over a period of time after compaction.

The MDD, OMC and field-density determinations for unstabilized materials shall preferably be completed within 24 hours of completing the compacting of the layers.

(e) Determination of the apparent density of crushed-stone materials

The apparent density of crushed-stone material shall be determined as follows:

(i) Apparatus

- A balance to measure 5 kg accurately to within 0,5 g.
- A pycnometer, e.g. a preservative jar with a flat ground rim.
- A temperature-controlled bath with a thermostat capable of controlling the temperature to 25°C + 1°C.
- A thermometer 0°C - 100°C.
- A drying oven capable of maintaining temperatures between 105°C and 110°C.
- Towels.
- 10% Teepol solution,

Table 903/2

TESTING FREQUENCY OF AGGREGATES (m^3 aggregate/test)

Test or property	Crushed-stone base or subbase	Hand-placed concrete pavements and structural concrete	Asphalt	Surfacing stone	Slurry seal	Ballast	Test method
Coarse aggregates (stone)							
Grading (sieve analysis)	2 500	100	300	250	50	2 500	SANS 201
ACV	5 000	-	5 000	1 000	-	-	SANS 5841
10% FACT	-	o/s	-	-	-	-	SANS 5842
Flakiness Index	5 000	o/s	2 500	250	-	5 000	SANS 5847
Polishing	-	-	o/s	-	-	-	SANS 5848
Immersion index	-	-	o/s	-	-	-	TMH1 C.5
Absorption	-	-	o/s	-	-	-	TMH1 C.4 (B)
Shrinkage	2 500	o/s	-	-	-	-	SANS 5836
Los Angeles abrasion test	-	-	-	-	-	5 000	SANS 5846
Fine aggregate (sand)							
Grading (sieve analysis)	-	50	300	-	50	-	SANS 201
Shrinkage	-	o/s	-	-	-	-	SANS 5836
Sand equivalent	-	-	200	-	o/s	-	SANS 5838
Moisture content	-	(a)	-	-	-	-	SANS 5855 (1)
Bulking	-	(b)	-	-	-	-	SANS 5856
Organic impurities	-	o/s	-	-	-	-	SANS 5832

NOTES:

o/s = once per source and thereafter whenever a change in the relevant property is suspected

(a) = at the beginning and halfway through each shift and after a shower of rain

(b) = as for (a) above, but applies to volume batching only

(ii) Method

- Take 3 000 g - 4 000 g of the material as obtained from a density hole in the road. All the material obtained from the hole should preferably be used. If it is too much for one pycnometer, the material can be divided between two pycnometers.
- Dry the material to a constant mass in an oven at 105°C-110°C.
- Make sure that the pycnometer is clean and determine its mass, together with that of a marked sheet of glass.
- Place the dried sample in the pycnometer and determine the mass of the pycnometer, glass sheet and sample together. (The sample should not exceed half the volume of the pycnometer.)
- Add clean water to the pycnometer until it is approximately three-quarters full. Add three drops of the 10% Teepol solution to the water, close the pycnometer and shake it thoroughly for one to two minutes.
- Fill the pycnometer with water almost to the brim and place it in a thermostatically controlled bath at 25°C. Leave it for 30 minutes without disturbing.
- Remove the pycnometer without shaking or jarring it and place it on a spread-out towel. Fill it with water and slide the glass sheet carefully over the brim from one side. Make sure that no air bubbles are trapped beneath the glass sheet. Dry the pycnometer and the glass sheet carefully all over and determine the mass of the filled pycnometer plus the glass sheet.
- Remove the contents of the pycnometer, clean it, and fill it in the same manner with water with a temperature of 25°C. Dry the pycnometer and determine the mass of the pycnometer filled with water, together with the glass sheet.

(iii) Calculation

The apparent density of the material is calculated as follows:

Mass of pycnometer + glass sheet = a

Mass of pycnometer + glass sheet+ material = b

Mass of material only = (b - a)

Mass of pycnometer + material + water + glass sheet = c

Mass of pycnometer + water + glass sheet = d

Apparent density of material =

$$\frac{(b-a)}{(d-a)-(c-b)}$$

(iv) Notes:

(1) Do not add any chemicals other than Teepol solution to water.

(2) No suction should be applied to the water to remove the air.

(3) The temperature of the water should be 25°C plus or minus 1°C and no other temperature should be used.

(4) Where two pycnometers are used, the apparent density shall be calculated from the weighted average of the two results.

08.03 Testing of bitumen, tar and asphalt

(a) Tests described in standard specifications for tars, bitumens and bituminous emulsions

Whenever specified or ordered by the Engineer, the Contractor shall supply him with certificates issued by the manufacturer or the specifying authority that the bitumen, tar or bituminous emulsions delivered to the Site comply with the test requirements specified in the relevant specifications.

The Engineer shall have the authority to order the Contractor to have such materials tested by an approved laboratory for compliance with all or any of the requirements specified. The results of such tests shall be submitted direct to the Engineer by the testing laboratory and, if requested, copies of results shall be sent to the Contractor.

The cost of tests shall be borne as specified in clause 12.

(b) Determination of air permeability of compacted Marshall specimens

Air-permeability determinations for compacted Marshall specimens shall be carried out as described in the NITRR publication TRH8.

(c) Determination of film thickness

The film thickness of the binder in asphalt mixes shall be determined as described in the NITRR publication TRH8.

08.04 Tests relating to chemical stabilization of soils and gravels

(a) Test for cementitious binder content

The test method used for determining the cementitious binder content of soils, gravels or crushed stone that has been mixed with a chemical stabilizing agent shall be determined by the Engineer and may be any test method regarded by the Employer as being acceptable at the time.

When determining the cementitious binder content, due allowance shall be made for the presence of naturally occurring MgO or CaO in the unstabilized material which may affect the results of such tests. If the standard deviation of the natural CaO plus MgO content of the untreated material exceeds 0,35%, any determination of the cementitious binder content shall be ignored.

Sample holes shall be spaced at random or as directed by the Engineer transversely as well as longitudinally over the area to be tested, and if the material is road-mixed, samples shall be taken from the top and bottom of each hole. The minimum number of samples per test shall be 10.

(b) Canvas-patch test for the spread rate of cementitious binder

The following method shall be used to determine the spread rate of the chemical stabilizing agent when bulk distributors are used.

At least 10 clean canvas patches, each measuring 1 m x 1 m, are placed flat on the road in selected positions in relation to the bulk distributor's track. After the passage of the bulk distributor, the canvas patches are carefully lifted and all the material on the patches is transferred to a container and the mass measured. The total mass of stabilizing agent on each patch is then recorded and the average rate of application is determined. Instead of canvas patches, flat metal trays may be used for collecting the stabilizing agent.

09 TESTS FOR THE SURFACE REGULARITY AND TEXTURE OF PAVEMENTS

09.01 Determination of texture depth on gap-graded asphalt surface course with precoated chips and on concrete pavements with wire-broom texture

The texture depth shall be determined by the sand-patch test as described below:

Sand required:

Dry, natural sand with a rounded particle shape, which will pass through a 0,300 mm sieve and will be retained on a 0,150 mm sieve.

Method

- Demarcate a 450 mm wide strip on the surface to be tested with chalk line marks.
- Measure 500 m of dry sand and pour it onto the surface at the beginning of the demarcated strip.
- Spread the sand slowly and evenly between the lines with a rubber squeegee, and apply a fair amount of pressure.
- Ensure that the entire surface between the lines is covered with sand.
- Keep on spreading the sand with slow strokes while exerting pressure on the squeegee until no more sand is displaced.
- Measure the length of the strip to the nearest 10 mm. The texture depth in mm is $\frac{1111}{a}$,

  where a is the length of the sand strip a in mm.

09.02 Straight-edge test for surface irregularities on surfaces with coarse surface textures

When measuring surface irregularities on surfaces with coarse surface textures, such as grooved concrete pavements, crushed-stone pavement layers, natural gravel base, asphalt with rolled-in chips, surface dressings and other similar surfaces, the following procedure shall be followed:

A metal wedge 100 mm long and 50 mm wide shall be constructed with a taper of 7,5 in the horizontal and 1,0 in the vertical and tapering to a feather edge (50 mm wide). Parallel lines spaced at 7,5 mm intervals shall be engraved on the sloping face, which shall be numbered to indicate the positions where the wedge is 1,0 mm, 2,0 mm, etc, thick.

When measuring surface irregularities, the 3,0 m straight-edge, which shall have sharp right-angled corners at the bottom, shall be placed on the road and the wedge inserted below the straight-edge at the position where a surface irregularity is to be measured. The size of the irregularity shall be determined according to the mark to which the wedge can be inserted, thin end first, without the straight-edge being lifted.

09.03 The use of a rolling straight-edge for measuring surface irregularities

The rolling straight-edge to be used shall be the type designed by the Transport and Road Research Laboratory of Great Britain (TRRL) and manufactured by Messrs Farnel and Company, or any other type approved by the Engineer.

The machine shall be calibrated on a purpose-made calibrating bed and the bell set to register exactly at the required deflection. During measuring care shall be taken to move the machine at a suitably slow speed and not so fast that it will register incorrectly as a result of vibrations, sway or other effects induced by movement over an irregular surface.

The number of irregularities exceeding the specified limit and the distance traversed shall be recorded, and the number of irregularities per 100 m shall be calculated for each run.

Further recommendations regarding the operation and maintenance of the rolling straight-edge are contained in the TRRL Report No 290/1970.

The surface irregularities on each carriageway shall be measured by two runs of the rolling straight-edge, suitably spaced over the width of the carriageway, as directed by the Engineer. Where the Engineer and the Contractor agree, one run instead of two runs may be made.

10 STRUCTURAL TESTS

The following tests shall apply specifically with regard to structures and structural elements:

10.01 Tests on laminated elastomeric bearings

The following tests shall be performed on the completed bearings, sample pads or test specimens prepared for the purpose, as may be relevant:

Bond test, tests to BS 1154 or BS 2752, weathering test, compression and shear-stiffness tests.

(a) Bond test

The test specimens for this purpose shall be prepared from one of the selected bearings or sample pads which may have been used previously for tests specified in subclause (c) below.

The test shall be performed in accordance with Method B as specified in BS 903 : Part A21.

The adhesion value during separation shall not be less than 9 N/mm width of the test specimen.

(b) Test to BS 1154 or BS 2752

The test specimens shall be prepared either as for the bond test or from test sheets made from the rubber used in the manufacture of the bearing.

The physical properties of the rubber in respect of hardness, tensile strength, elongation at break and compression set shall comply with the requirements specified in BS 1154 or BS 2752, both in the "as received" and in the aged condition.

The respective tests shall be as described in the relevant part of BS 903, viz:

Determination of hardness	BS 903 : Part A26
Determination of tensile strength and elongation at break	BS 903 : Part A2
Determination of compression set	BS 903 : Part A6
Accelerated aging tests	BS ISO 188

(c) Weathering test

The tests shall be performed as specified in BS ISO 4665.

At the end of the test period, and after having been subjected to an ozone concentration of 50 plus or minus 5 parts per hundred million at 50°C plus or minus 1°C, the test specimens shall be free from cracks visible to the naked eye.

(d) Compression and shear-stiffness tests

(i) Compression stiffness

The bearings or sample pads shall be loaded to 150% of the design load, which load shall be maintained for a period of 2 minutes. The loading shall then be reduced to 10% of the design load and maintained at this value for 10 minutes when gauge readings shall be taken. The bearings or sample pads shall then be reloaded to 150% of the design load and maintained at this value for 10 minutes. Gauge readings shall be taken and used in conjunction with the earlier readings to evaluate the stiffness.

The compression stiffness shall be plus or minus 20% of the theoretical value.

(ii) Shear stiffness

A testing procedure similar to that for testing the compression stiffness shall be followed, the loading being such as will maintain steady shear distortions of 10% and 150% respectively of the design shear distortion. In practice it may be convenient to test two bearings or sample pads attached to a common shear plate, where one of the bearings is tested in compression.

The shear stiffness shall be within plus or minus 20% of the theoretical value.

Provided that the performance in both compression and shear tests is satisfactory, the bearings shall subsequently be used for installation in the structure. No surface flaws shall become apparent during the tests, and bearings or sample pads shall not show any irregularities in their deflected shape.

10.02 Prestressed concrete : Testing of pre-stressing steel, anchorage assemblies, couplings and grout

(a) General

Where so directed by the Engineer, the Contractor shall make arrangements for samples of the materials intended for use in the Works to be tested by an approved independent testing authority. The costs of testing prestressing steel, anchorage assemblies and couplings shall be paid for as specified in subclause 12.04 of this section. Control testing of the viscosity and bleeding of grout shall be regarded as part of the Contractor's duties under process control and shall not be paid for separately.

Material represented by samples failing to meet the specified requirements shall be removed and replaced by suitable material.

(b) Anchorages and couplers

Anchorages and couplers shall be tested in accordance with the requirements of sub-clause 03.03 of section 705. The anchorages and couplers shall be assembled according to the practical application on the construction Site, using all the components which are necessary for anchoring, but excluding the sheathing.

(c) Prestressing steel

Prestressing steel shall be tested in accordance with the requirements of subclause 03.02 of section 705. Should any test piece fail to satisfy the specified requirements for the prestressing steel, the material represented by that sample shall not be used without it being further tested, and if further testing is unsuccessful, it shall be replaced with materials conforming to the specifications.

(d) Grout

The fluidity of grout shall be measured with a flow cone, immersion apparatus or a viscometer. The instrument shall be accurately calibrated in a laboratory so that the specified viscosity of the grout can be controlled satisfactorily.

The procedure for conducting the flow-cone test for measuring the fluidity of grout shall be as follows:

- Unless otherwise approved by the Engineer, the flow cone shall be as shown in figure 1, page 903-10.
- Immediately after the grout has been mixed, the pre-wetted flow cone, which is held firmly with its top rim in a level position, shall be filled with grout to the level indicated by the preset pointer, whilst the bottom orifice is held closed by putting a finger over it.
- As soon as the required volume of grout (± 1 750 mℓ) is reached, the finger shall be removed to allow the grout to flow out freely through the bottom orifice. The flow time for emptying the cone shall be determined to the nearest second with a stop watch.
- The times obtained during grouting shall be compared with the times determined in the laboratory for grouts of the specified viscosities.

- The bleeding of grout shall be measured in a metal or glass container which has an internal diameter of approximately 100 mm and a height of approximately 120 mm. The grout and water levels in the container shall be controlled with a metal bridge into which two adjustable studs A and B are secured. For details of the apparatus see figure 2, page 903-10.

The procedure for determining the bleeding of grout shall be as follows:

- Studs A and B in the metal bridge shall be so adjusted and locked that the distances from the lower tips of the studs to the bottom of the container will be approximately 100 mm and 107 mm respectively. The volumes V_A and V_B for the container at the respective levels of the stud settings shall thereafter be determined to the nearest millilitre.
- The container shall be filled with freshly mixed grout to a level where the grout will just touch the tip of stud A, which points downwards. The bridge shall then be removed and the container tightly sealed to prevent evaporation. The container shall then be stored at 20°C and kept free from vibrations for the entire duration of the test.
- Three hours after the grout has been mixed, the container shall be opened and the free (bleed) water poured off. The bridge shall be placed over the container with the tip of stud B pointing downwards, and water shall be poured onto the grout with a measuring apparatus until the water touches the tip of stud B. The volume of water added shall be determined to the nearest millilitre and shall be designated as $\triangle V$.
- The percentage bleeding shall be calculated from the formula -

$$\left[1 - \frac{(V_B - \Delta V)}{V_A}\right] \times 100$$

10.03 The testing of welds in structural steel

(a) Visual inspection of welds

Welds shall be visually inspected to check that -

(i) they are substantially uniform in appearance and that there is no cracking or unacceptable undercutting or porosity,

(ii) full fusion is being obtained while welding is in progress, and

(iii) dimensional requirements in accordance with BS 5135 are satisfied.

(b) Destructive and non-destructive testing

Destructive and non-destructive testing shall be carried out as specified in SANS 10044-3.

11 TESTS ON PIPELINES

See section 303 for the testing of sewers and section 403 for the testing of water pipelines.

12 CLASSIFYING THE TESTS

For the purposes of this section tests are defined as follows:

Ordinary tests are tests which are constantly conducted by the Contractor on a regular basis in terms of clauses 04 and 05 of section 901, for which no specified pay items have been provided, and which include the following, inter alia:

- Tests for determining the properties of all natural materials such as sand, stone, water, soil, gravel, etc. provided by the Contractor for use in the Works.
- Tests on processed natural materials such as aggregate for concrete, asphalt and seals, purchased or produced on Site by the Contractor.
- Tests for determining the properties of products such as concrete and asphalt, etc, produced specially for use on the Works by the Contractor, or purchased from commercial producers or subcontractors.
- Tests on completed elements of construction such as fills, pavement layers, concrete structures, etc, for establishing compliance with the specified properties.

Special tests are tests which have to be conducted by the Contractor only at the specific request of the Engineer, and include the following:

- Tests on commercial products such as cement, lime, paint, bituminous products, pipes, valves, and bridge bearings. The requirements are specified as a whole or in part with reference being made to the specifications of a standards organisation such as Standards South Africa.
- Special tests on structures or elements of structures to determine their efficacy, for the payment of which clear provision has been made in the Specifications and the Schedule of Quantities.
- Any test requested by the Engineer purely for purposes of acceptance control. Such tests, however, will not be classified as a special test if the test is requested because the Contractor has neglected to conduct sufficient or proper tests in terms of clause 04 of section 901 and with a view to submitting the result to the Engineer for his approval of completed work or materials.

Payment will be made under the pay items of clause 13 only in regard to special tests. Payment for ordinary tests shall be included in the rates tendered by the Contractor for the items of work to which the ordinary tests relate.

13 MEASUREMENT AND PAYMENT

Item		Unit
903.01	**Provision of testing equipment**	
903.01.01	Concrete-cube testing press	number (No)
903.01.02	Concrete-beam testing press	number (No)
903.01.03	150 mm x 150 mm x 150 mm concrete-cube moulds	number (No)

Item		Unit
903.01.04	700 mm x 150 mm x 150 mm concrete-beam moulds	number (No)
903.01.05	Concrete-mould vibrating table	number (No)
903.01.06	Concrete and asphalt core-drilling machine for 100 mm and 150 mm cores	number (No)
903.01.07	Concrete and asphalt saw	number (No)
903.01.08	Air meter for concrete mix	number (No)
903.01.09	Rolling straight-edge	number (No)

The unit of measurement shall be the number of each item provided by the Contractor for the period required.

The tendered rates shall include full compensation for supplying, installing, testing, calibrating and maintaining the equipment and for replacing any defective equipment. Seventy five per cent (75%) of the amount tendered will be paid when the equipment is supplied and installed if necessary, and the remaining 25% when the equipment is no longer required and is removed from the Site on the Engineer's instructions.

Item		Unit
903.02	**Extraction of concrete and asphalt cores for special tests**	
903.02.01	Extraction of cores when a coring machine has been ordered under item 903.01.06	
903.02.01.01	100 mm concrete cores	number (No)
903.02.01.02	150 mm concrete cores	number (No)
903.02.01.03	100 mm asphalt cores	number (No)
903.02.02	Extraction of cores including the provision of a coring machine	
903.02.02.01	100 mm concrete cores	number.(No)
903.02.02.02	150 mm concrete cores	number (No)
903.02.02.03	100 mm asphalt cores	number (No)

The unit of measurement shall be the number of cores extracted and suitable for testing as ordered by the Engineer.

The tendered rates under subitem 903.02.01 shall include full compensation for all labour required for extracting the cores. The tendered rates under subitem 903.02.02 shall include full compensation for all the labour tools and equipment required for extracting cores. In both cases the rates shall include the making good where cores have been extracted.

No payment will be made under this item if the special tests for which the cores are to be used do not qualify for payment under item 903.03.

Item		Unit
903.03	**Special tests on concrete and asphalt**	
903.03.01	Compressive-strength tests on concrete cubes	number (No)
903.03.02	Modulus of rupture tests on concrete beams	number (No)
903.03.03	Compressive-strength tests on concrete cores	number (No)
903.03.04	Asphalt tests on cores	number (No)

The unit of measurement shall be the number of tests made in accordance with the Engineer's instructions.

The tendered rates under subitems 903.03.01 and 903.03.02 shall include full compensation for preparing the samples, curing, storing and dispatching the samples to an approved laboratory, and for having the tests performed.

The tendered rates for subitems 903.03.03 and 903.03.04 shall include full compensation for dispatching the cores to an approved laboratory for preparing and testing the cores.

Payment will not be made for any special test should the test indicate that the Specifications have not been complied with.

Item		Unit
903.04	**Special tests on welded specimens**	
903.04.01	Specimen welded connection (type stated)	number (No)
903.04.02	Etc for other types.	

The unit of measurement shall be the number of specimens of each type successfully tested.

The tendered rates shall include full compensation for the provision of all materials, equipment and labour to make up the specimen and for testing it to destruction.

Payment will only be made where the test indicated compliance with the Specifications.

Item		Unit
903.05	**Special test for the solubility of concrete according to SANS 677 Appendix C'**	number (No)

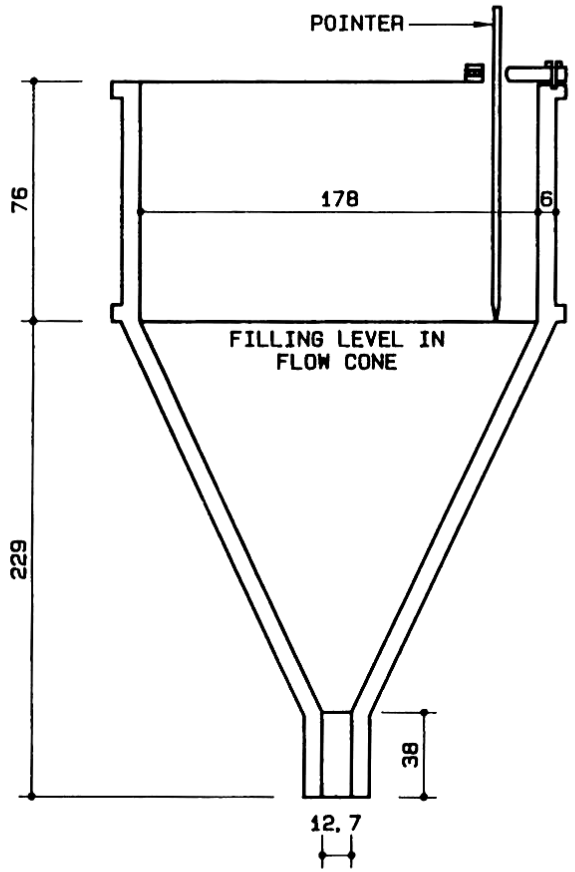
The unit of measurement shall be the number of tests carried out by an approved laboratory in accordance with the requirements of subclause 02.02(f) of section 704.

The tendered rate shall include full compensation for all the material, transport, labour and equipment necessary for testing the samples of concrete made with aggregates of dolomitic origin, for solubility and for testing the sample.

Payment will not be made if a special test indicates non-compliance with the Specifications.

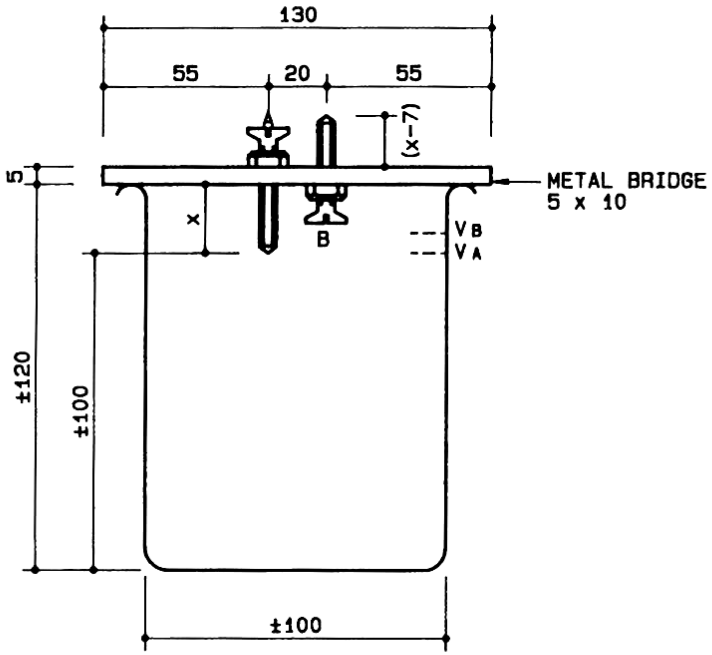
Item		Unit
903.06	**Other special tests requested by the Engineer**	
903.06.01	Cost of testing	prime cost sum (PC sum)
903.06.02	Charge on prime cost sum	percentage (%)

Payment for special tests as requested by the Engineer in terms of clause 12 will be made in accordance with the provisions of the General Conditions of Contract. Payment will not be made for any special test should the test indicate that the Specifications have not been complied with.



FLOW CONE

FIGURE 1



METAL OR GLASS CONTAINER

FIGURE 2

ANNEXURE A

LIST OF STANDARD SPECIFICATIONS AND CODES OF PRACTICE TO WHICH REFERENCE IS MADE IN THE SPECIFICATIONS

SOUTH AFRICAN NATIONAL STANDARDS (SANS)

Reference	Description
SANS 4	Locks, latches and associated furniture for doors (domestic type)
SANS 14	Malleable cast iron fittings threaded to ISO 7-1
SANS 28	Metal ties for cavity walls
SANS 32	Internal and/or external protective coatings for steel tubes - Specification for hot dip galvanized coatings applied in automatic plants
SANS 62-1	Steel pipes. Part 1: Pipes suitable for threading and of a nominal size not exceeding 150 mm
SANS 62-2	Steel pipes. Part 2: Screwed pieces and pipe fittings of a nominal size not exceeding 150 mm.
SANS 92	Bituminous roofing felt
SANS 110	Sealing compounds for the building industry, two-component, polysulphide base
SANS 121 Table 2 or 3	Hot dip galvanized coatings on fabricated iron & steel articles - Specifications and test methods
SANS 135	Metallic coatings - Electrode deposited coatings of nickel plus chromium and of copper plus nickel plus chromium
SANS 201	Fine content and dust content sieve analysis of aggregates
SANS 227	Burnt clay masonry units
SANS 242	Stainless steel sinks with draining boards (for domestic use)
SANS 248	Bituminous damp-proof courses
SANS 280	Hole location in fencing posts and droppers (105-1)
SANS 282	Bending dimensions and scheduling of steel for concrete
SANS 307	Penetration grade bitumens
SANS 308	Cutback bitumen
SANS 309	Anionic bitumen road emulsions
SANS 435	Mild steel rivets
SANS 455	Covered electrodes for the manual arc welding of carbon and carbon manganese steels
SANS 457-2	Wooden poles, droppers, guard posts and spacer blocks. Part 2: Softwood Species
SANS 457-3	Wooden poles, droppers, guard posts and spacer blocks. Part 3: Hardwood Species
SANS 460	Plain-ended solid drawn copper tubes for potable water
SANS 497	Glazed ceramic sanitary ware
SANS 515	Decorative paint for interior use
SANS 538	High temperature wood preserving creosote
SANS 539	Wood preserving creosote (lurgi-gasification process)
SANS 546	Cast iron fittings for asbestos-cement pressure pipes
SANS 548	Cationic bitumen road emulsions
SANS 558	Cast iron surface boxes and manhole and inspection covers and frames
SANS 559	Vitrified clay sewer pipes and fittings
SANS 630	Decorative high gloss enamel paints

SANS 657-1	Steel tubes for non-pressure purposes. Part 1: Sections for scaffolding, general engineering and structural applications
SANS 664	Cast iron gate valves for waterworks
SANS 673	Mixtures of copper-chromium-arsenic compounds for timber preservation
SANS 675	Zinc-coated fencing wire (plain and barbed)
SANS 677	Concrete non-pressure pipes
SANS 678	Primers for wood for interior and exterior use
SANS 679	Zinc chromate primers for steel
SANS 680	Glazing putty for wooden and metal window frames
SANS 681	Undercoats for paints
SANS 684	Structural steel paint
SANS 685	Fibre-cement sheets (flat and profiled)
SANS 719	Electric welded low carbon steel pipes for aqueous fluids (large bore)
SANS 723	Wash primer (metal etch primer)
SANS 727	Windows and doors made from rolled mild steel sections
SANS 731-1	Road and runway markings. Part 1: Single-pack solvent-borne and water-borne paints
SANS 731-2	Road and runway markings. Part 2: Single-pack water-borne paints
SANS 746	Cast-iron pipes and pipe fittings for use above ground in drainage installations
SANS 748	Road tar binders prepared from coke oven crudes
SANS 749	Road tar binders prepared from Lurgi-gassification crudes
SANS 791	Unplasticized poly vinyl chloride (PVC-U) sewer and drain pipes and pipe fittings
SANS 801	Epoxy-tar paints
SANS 802	Bituminous aluminium paint
SANS 819	Fibre-cement pipes, couplings and fittings for sewerage, drainage and low-pressure irrigation
SANS 824	Lime for soil stabilization
SANS 878	Ready-mixed concrete
SANS 887	Varnish for interior use
SANS 912	Calcium plumbate primer
SANS 920	Steel bars for concrete reinforcement
SANS 921	Pitch-impregnated fibre pipes, couplings and fittings
SANS 926	Two pack zinc-rich epoxy primer
SANS 927	Precast concrete kerbs, edgings and channels
SANS 935	Hot-dip (galvanized) zinc coatings on steel wire
SANS 952	Polyolefin film for damp-proofing and waterproofing in buildings
SANS 966-1	Components of pressure pipe systems. Part 1: Unplasticized poly (vinyl chloride) (PVC-U) pressure pipe systems
SANS 966-2	Components of pressure pipe systems. Part 2: Modified poly (vinyl chloride) (PVC-M) pressure pipe systems
SANS 974-1	Rubber joint rings (non-cellular). Part 1: Joint rings for use in water, sewer and drainage systems
SANS 986	Precast reinforced concrete culverts
SANS 1023	Preformed elastomeric compression joint seals
SANS 1024	Welded steel fabric for reinforcement of concrete
SANS 1058	Concrete paving blocks
SANS 1062	Pressure and vacuum gauges

SANS 1083	Aggregates from natural sources - Aggregates for concrete
SANS 1090	Aggregates from natural sources - Aggregates for plaster and mortar
SANS 1091	National colour standard for paint
SANS 1099	Hardwood furniture timber
SANS 1123	Pipe flanges
SANS 1128-1	Fire fighting equipment. Part 1: Components of underground and above-ground hydrant systems
SANS 1128-2	Fire fighting equipment. Part 2: Hose couplings, connectors and branch pipe and nozzle connections
SANS 1129	Steel doorframes
SANS 1143	Mushroom- and countersunk-head bolts and nuts
SANS 1149	Flat and taper steel washers
SANS 1151	Portable rechargeable fire extinguishers - Halogenated hydrocarbon type extinguishers
SANS 1217	The production of painted and powder-coated steel pipes
SANS 1223	Fibre-cement pressure pipes and couplings
SANS 1260	Invert bitumen emulsion
SANS 1273	Fasteners for roof and wall coverings in the form of sheeting
SANS 1282	High-strength bolts, nuts and washers for friction-grip joints
SANS 1294	Precast concrete manhole sections and slabs
SANS 1305	Sealing compounds for the building industry, one-component, silicone-rubber-base
SANS 1350	Guardrails for roads (w-section)
SANS 1373	Chain-link fencing and its wire accessories
SANS 1431	Weldable structural steels
SANS 1442	Roadstuds
SANS 1460	Laminated timber (glulam)
SANS 1519-1	Road signs. Part 1: Retro-reflective sheeting material
SANS 1519-2	Road signs. Part 2: Performance requirements for road signs
SANS 1586	Emulsion paints
SANS 1601	Structured wall pipes and fittings of unplasticized poly (vinyl chloride) (PVC-U) for buried drainage and sewerage systems
SANS 1620	Barbed tape security barriers
SANS 1700	Fasteners
SANS 1783-1	Sawn softwood timber. Part 1: General Requirements
SANS 1783-2	Sawn softwood timber. Part 2: Stress graded structural timber and timber for frame wall construction
SANS 1783-3	Sawn softwood timber. Part 3: Industrial timber
SANS 1783-4	Sawn softwood timber. Part 4: Brandering and battens
SANS 2813	Paints and Varnishes - Determination of Specular gloss of non-metallic paint films at 20, 60 and 85
SANS 3575	Continuous hot-dip zinc-coated steel sheet of commercial, lock-forming and drawing qualities
SANS 4427	Polyethylene (PE) pipes for water supply - Specifications
SANS 4998	Continuous hot-dip zinc-coated carbon steel sheet of structural quality
SANS 5121	Water covering capacity of aluminium pigment for paint
SANS 5767	Cleanliness of blast-cleaned steel surfaces for painting (assessed by pictorial standards)
SANS 5769	Cleanliness of blast-cleaned steel surfaces for painting (assessed by freedom from dust and debris)

SANS 5772	Profile of blast-cleaned steel surfaces for painting (determined by micrometer profile gauge)
SANS 5832	Organic impurities in fine aggregates (limit test)
SANS 5836	Effect of fine and coarse aggregate on the shrinkage and expansion of cement: aggregate mixes (mortar prism method)
SANS 5838	Sand equivalent value of fine aggregates
SANS 5841	Aggregate crushing value of coarse aggregates
SANS 5842	FACT value (10% fine aggregate crushing value) of coarse aggregates
SANS 5846	Abrasion resistance of coarse aggregates (Los Angeles machine method)
SANS 5847	Flakiness index of coarse aggregates
SANS 5848	Polished stone value of aggregates
SANS 5855 (1)	Free water content of aggregates
SANS 5856	Bulking of fine aggregates
SANS 5862-1	Concrete tests - Consistence of freshly mixed concrete - Slump test
SANS 5862-2	Concrete tests - Consistence of freshly mixed concrete -Flow test
SANS 5862-3	Concrete tests - Consistence of freshly mixed concrete - Vebe test
SANS 5862-4	Concrete tests - Consistence of freshly mixed concrete - Compacting factor and compaction index
SANS 5863	Concrete tests - Compressive strength of hardened concrete
SANS 5864	Concrete tests - Flexural strength of hardened concrete
SANS 5865	Concrete tests - The drilling, preparation and testing for compressive strength of cores taken from hardened concrete
SANS 10005	The preservative treatment of timber
SANS 10044	Welding: Parts 1-7
SANS 10064	The preparation of steel surfaces for coating
SANS 10088	Pile foundations
SANS 10090	Community Protection against Fire
SANS 10094	The use of high-strength friction grip bolts
SANS 10096	The manufacture of finger-jointed structural timber
SANS 10102-1	Selection of pipes for buried pipelines. Part 1: General provisions
SANS 10102-2	Selection of pipes for buried pipelines. Part 2: Ridged pipes
SANS 10109-1	Concrete floors part 1: Bases to concrete flooring
SANS 10109-2	Concrete floors part 2: Finishes to concrete floors
SANS 10112	The installation of polyethylene and poly (vinyl chloride) PVC-U and PVC-M pipes
SANS 10137	The installation of glazing in buildings
SANS 10142-1	The wiring of premises. Part 1: Low-voltage installations
SANS 10143	Building drawing practice
SANS 10160	The General procedures and loadings to be adopted for the design of buildings
SANS 10161	The design of foundations for buildings
SANS 10162-1	The structural use of steel. Part 1: Limit states design of hot-rolled steelwork
SANS 10162-2	The structural use of steel. Part 2: Limit states design of cold formed steelwork
SANS 10162-4	The structural use of steel. Part 4: The design of cold-formed stainless steel structural members
SANS 10164-1	The structural use of masonry Part 1: Unreinforced masonry walling

SANS 10164-2	The structural use of masonry Part 2: Structural design and requirements for reinforced and pre-stressed masonry
SANS 10268-1	Welding of thermoplastics - Welding processes. Part 1: Heated-tool welding
SANS 10268-2	Welding of thermoplastics - Welding processes. Part 2: Electrofusion welding
SANS 10268-3	Welding of thermoplastics - Welding processes. Part 3: Electrofusion welding
SANS 10268-4	Welding of thermoplastics - Welding processes. Part 4: Hot-gas extrusion welding
SANS 10268-5	Welding of thermoplastics - Welding processes. Part 5: Solvent welding
SANS 10268-6	Welding of thermoplastics - Welding processes. Part 6: Ultrasonic welding, staking and insertion
SANS 10268-10	Welding of thermoplastics - Welding processes. Part 10: Weld defects
SANS 10313	The protection of structures against lightning
SANS 10400	The application of the National Building Regulations
SANS 50197-1	Cement. Part 1: Composition, specifications and conformity criteria for common cements
SANS 50197-2	Cement. Part 2: Conformity evaluation
SANS 50413-1	Masonry cement. Part 1: Specification
SANS 50413-2	Masonry cement. Part 2: Test Methods
SANS 51423	Road marking materials - Drop on materials - Glass beads, anti-skid aggregates and mixtures of the two
SANS 51424	Road marking materials - Premix glass beads

SANS CO-ORDINATING SPECIFICATIONS)

Reference	Description
CKS 55	Glass for glazing
CKS 82	Steel posts, stays, standards and droppers for strained wire fences
CKS 146	Gates, steel with tubular frames (for farm and domestic use)
CKS 176	Galvanized corrugated steel drainage pipes
CKS 388	Rubber waterstops
CKS 389	Flexible poyvinyl chloride waterstops
CKS 437	Components of curved galvanized corrugated steel structures in compacted earth surrounds

TMH's & TRH's (Dept of Transport)

Reference	Description
TMH5	Sampling methods for road construction materials.:
TMH6	Special methods for testing roads.
TRH5	Statistical concepts of quality control and their application in road construction.
TMH1	Standard methods of testing road construction materials.
TMH2	National standard for the spraying performance of binder distributors.
TRH3	Surfacing seals for rural and urban roads and compendium of design methods for surfacing seals used in the RSA
TRH8	Selection and design of hot-mix asphalt surfacings for highways
TRH14	Guidelines for road construction materials

BRITISH STANDARDS INSTITUTION (BS)

Reference	Description
BS 78-2	Specification for cast iron Spigot and socket pipes (vertically cast) and spigot and socket fittings
BS EN 512	Fibre Cement Products. Pressure pipes & joint
BS EN 537	Parts 1 - 4. Aluminium and Aluminium alloys
BS EN 593	Industrial valves. Metallic butterfly valves
BS EN 681-1	Elastomeric seals. Material requirements for pipe joint seals used in water and drainage applications. Vulcanized rubber.
BS EN 681-2	Elastomeric seals. Material requirements for pipe joint seals used in water and drainage applications. Thermoplastic elstomers.
BS 812-101	Guide to sampling and testing aggregates
BS 903	Physical testing of rubber
BS EN 1043-1	Destructive tests on welds in metallic materials. Hardness test on arc welded joints
BS EN 1043-2	Destructive tests on welds in metallic materials. Micro hardness testing on welded joints
BS 1134-1	Assessment of surface textures. Methods and Instrumentation
BS 1134-2	Assessment of surface textures. Guidance and General Information
BS 1154	Natural rubber compounds - Specification
BS 1186-2	Timber for and workmanship in joinery. Specification for workmanship
BS 1377-3	Method of test for soils for civil engineering purposes. Chemical and electro-chemical tests
BS 1449 part 2	Steel plate, sheet and strip. Specification for stainless and heat-resisting steel plate, sheet and strip.
BS 2035	Specification for cast iron flanged pipes and flanged fittings
BS 2499-1	Hot applied joint sealants for concrete pavements
BS 2752	Specification for chloroprene rubber compounds
BS 3837-1	Specification for expanded polystyrene boards
BS 4254	Specification for two-part polysulphide-based sealants
BS 4447	Specification for the performance of prestressing anchorages for post-tensioned construction

BS 4486	Specification for hot rolled and processed high tensile alloy steel bars for the prestressing of concrete
BS ISO 4665	Methods of testing vulcanised rubber (903-7)
BS 4840-2	Rigid polyurethane (PUR) foam in slab form. Specification for PUR foam for use in refrigerator cabinets, cold rooms and stores.
BS 5400 part 9.2	Steel, concrete and composite bridges
BS 5896	Specification for high tensile steel wire and strand for the prestressing of concrete
BS 5911-114	Precast concrete pipes, fittings and ancillary products. Specification for porous pipes.
BS 8004	Code of practice for foundations
BS EN 10025	Hot rolled products of non-alloy structural steels. Technical delivery instructions
BS EN 10088-1	Stainless steels. List of stainless steels
BS EN 10224	Non-alloy steel tubes and fittings for the conveyance of aqueous liquids, including water for human consumption.
BS EN 10250-4	Open die. forgings for general Engineering purposes - Stainless steels
BS EN 12020-1	Aluminium and aluminium alloys. Extruded precision profiles in alloys EN AW-6060 and EN AW-6063. Technical conditions for inspection and delivery
BS EN 12020-2	Aluminium and aluminium alloys. Extruded precision profiles in alloys EN AW-6060 and EN AW-6063. Tolerances on dimensions and form
BS EN 13101	Steps for underground man entry chambers. Requirements, marking, testing and evaluation of conformity
BS EN 13139	Aggregates for mortar
BS EN 13813	Screed material and floor screeds. Screed material. Properties and requirements
BS EN 22063	Metallic and other inorganic coatings. Thermal spraying. Zinc, aluminium and their alloys
BS EN ISO 13000-1	Plastics. Polytetrafluoroethylene (PTFE) semi-finished products. Requirements and designation
BS EN ISO 13000-2	Plastics. Polytetrafluoroethylene (PTFE) semi-finished products. Preparation of test specimens and determination of properties

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

Reference	Description
AASHTO M 213	Pro-formed expansion joint fillers for concrete paving and structural construction (non-extruding and resilient bituminous types)
AASHTO M 148	Liquid membrane-forming compounds for curing concrete
AASHTO M 153	Pre-formed expansion joint fillers for concrete paving and structural construction (non-extruding and resilient non-bituminous types)
AASHTO M-154	Chemical admixtures for concrete (704-1)
AASHTO M-173	Hot-poured elastic concrete joint sealer
AASHTO M-194	Air-entraining admixtures for concrete (704-1)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

Reference	Description
ASTM-C 260	Air entraining admixtures for concrete
ASTM-C 494/C494M	Chemical admixtures for concrete
ASTM-C 920	Sealants, Elastomeric joint
ASTM-D 2835	Lubricant for installation of preformed compression seals in concrete pavements

US FEDERAL SPECIFICATIONS

Reference	Description
SS-S-200E(2)	Sealant, joint, two component, jet blast resistant, for Portland Cement Concrete Pavement.
SS-S-1401C(1)	Sealant, joint, non-jet fuel resistant, Hot applied, for Portland Cement Concrete and Asphalt Pavements
HH-F-341 F	Fillers, expansion-joint; bituminous (asphalt and tar) and non-bituminous for concrete

MISCELLANEOUS PUBLICATIONS REFERRED TO IN THE SPECIFICATIONS

Reference	Organization	Description
AWWA C205-00	American Water Works Association	Cement-Mortar Protective Lining and Coating for steel Water pipe - 4 in (100 mm) and larger
DIN 3202 Part 4		Face to face and centre to face dimensions of valves
ANSI/API 116.1 Rev 67:	American National Standards Institute	Two component elastomeric scaling compounds for the building trade.
ISO 8501-1	Swedish Standard:	Standard booklet with high quality colour pictures for the preparation of steel substrates before application of paints and related products
8040-03	California State Specification	Binder (adhesive), Epoxy resin base
API 1104	American Petroleum Institute	Welding of Pipelines and Related Facilities
Southern African Development Community	Southern African Development Community Road Traffic Signs Manual	
International Slurry Surfacing Association	Slurry-bound Macadam	
South African Institution of Civil Engineers (SAICE)	The Safety of Persons Working in small diameter shafts and Test Pits for Civil Engineering Purposes	
WISA	Operator's Handbook on Sewage Purification chapter 25: Safety Precautions.	
Transnet Limited	Specification E7 : Specification for Works on, over, under or adjacent to a railway line.	
	Specification E10: Specification for plate laying and ballasting.	
	The provision and construction of private sidings.	
	Permanent way instructions.	
Concrete Manufacturer’s Association	Concrete Pipe Handbook.	
National Building Research Institute (CSIR)	X/Bou 2-34: The NBRI air test for sewers and drains.	
The Concrete Society (Great Britain)	Technical Report No 11: Concrete core testing for strength.	
Transport and Road Research Laboratory (Great Britain)	TRRL Report No 290/1970: Methods of texturing new concrete road surfaces to provide adequate skidding resistance.	
Dept of the Environment of Great Britain	Technical Memorandum (Bridges) No BE 1/76.	
Southern Africa Institute of Steel Construction	Structural steel tables. 7th Revision 1997	

GOVERNMENT ACTS AND REGULATIONS

Atmospheric Pollution Prevention Act, 1965 (Act 45 of 1965)

Construction Regulations 2003, Government Gazette No 25207

Engineering Profession Act, 2000 (Act 46 of 2000)

Environmental Conservation Act, 1989 (Act 73 of 1989)

Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002)

Minerals Act, 1991 (Act 50 of 1991)

National Environmental Management Act, 1998 (Act No 107 of 1998)

National Monuments Act, 1969 (Act 28 of 1969)

National Parks Act, 1976 (Act 57 of 1976)

National Road Traffic Act, 1996 (Act 93 of 1996)

Regulations for combating and preventing the spread of certain insect pests affecting soft wood, Government Gazette, 2 August 1968

The Atmospheric Pollution Prevention Act, 1965 (Act 450 of 1965)

The Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983)

The Explosives Act, 2003 (Act 2615 of 2003)

The Explosives Regulations, 2002

The Mines Health and WorksSafety Act ,1996, (Act 27 of 1996)

The National Water act, 1998 (Act 36 of 1998)

The Occupational Health and Safety Act, 1993 (Act 85 of 1993)

SECTION 3

FORM OF OFFER AND ACCEPTANCE

FORM OF OFFER AND ACCEPTANCE

FORM OF OFFER AND ACCEPTANCE

Offer

The Employer, identified in the Acceptance signature block, has solicited offers to enter into a contract in respect of the following works:

Sunnyside Office Development Bulk Earthworks, Lateral Support and Services Relocation.

The Tenderer, identified in the Offer signature block below, has examined the documents listed in the Tender Data, and by submitting this Offer has accepted the Conditions of Tender.

By the representative of the Tenderer, deemed to be duly authorised, signing this part of this Form of Offer and Acceptance, the Tenderer offers to perform all of the obligations and liabilities of the Contractor under the Contract including compliance with all its terms and conditions according to their true intent and meaning for an amount to be determined in accordance with the Conditions of Contract identified in the Contract Data.

THE OFFERED TOTAL OF THE PRICES INCLUSIVE OF VALUE ADDED TAX IS

……

……Rand (in words); R……..…… (in figures).

This Offer may be accepted by the Employer by signing the Acceptance part of this Form of Offer and Acceptance and returning one copy of this document to the Tenderer before the end of the period of validity stated in the Tender Data, whereupon the Tenderer becomes the party named as the Contractor in the Conditions of Contract identified in the Contract Data.

For the Tenderer:

……..
Signature

……..
Name

…….
Capacity

Name of address of organisation:

……..

……..

……..

Signature and name of witness:

…….
Signature

…….
Name

Date ……

Acceptance

By signing this part of this Form of Offer and Acceptance, the Employer identified below accepts the Tenderer's Offer. In consideration thereof, the Employer shall pay the Contractor the amount due in accordance with the Conditions of Contract identified in the Contract Data. Acceptance of the Tenderer's Offer shall form an agreement between the Employer and the Tenderer upon the terms and conditions contained in this Agreement and in the Contract that is the subject of this Agreement.

Deviations from and amendments to the documents listed in the Tender Data and any addenda thereto listed in the Tender Deliverables as well as any changes to the terms of the Offer agreed by the Tenderer and the Employer during this process of offer and acceptance, are contained in the Schedule of Deviations attached to and forming part of this Agreement. No amendments to or deviations from said document are valid unless contained in this Schedule, which must be duly signed by the authorised representative(s) of both parties.

The Tenderer shall within two weeks after receiving a completed copy of this Agreement, including the Schedule of Deviations (if any), contact the Employer's agent (whose details are given in the Contract Data) to arrange the delivery of any bonds, guarantees, proof of insurance and any other documentation to be provided in terms of the Conditions of Contract identified in the Contract Data at, or just after, the date this Agreement comes into effect. Failure to fulfil any of these obligations in accordance with those terms shall constitute a repudiation of this Agreement.

For the Employer:

……..
Signature

……..
Name

…….
Capacity

Name of address of organisation:

……..

……..

……..

Signature and name of witness:

…….
Signature

…….
Name

Date ……

SECTION 4

BILLS OF QUANTITIES

BILLS OF QUANTIIES

Item No		Quantity	Rate	Amount	

BULK EARTHWORKS AND LATERAL SUPPORT

PROVISIONAL BILLS OF QUANTITIES

BILL NO 1

PRELIMINARIES

BUILDING AGREEMENT AND PRELIMINARIES

The JBCC Series 2000 Principal Building Agreement (edition 5 July 2007) prepared by the Joint Building Contracts Committee Inc. amended as hereinafter described, shall be the **agreement**

The JBCC Series 2000 **Preliminaries** (May 2005) prepared by the Joint Building Contracts Committee Inc. amended as hereinafter described shall be deemed to be incorporated in these **bills of quantities**

Contractors are referred to the above-mentioned documents for the full intent and meaning of each clause thereof

These clauses are hereinafter referred to by clause number and heading only. Where standard clauses or alternatives are not entirely applicable to this contract such modifications, corrections or supplements as will apply are given under each relevant clause heading and such modifications, corrections or supplements shall take precedence notwithstanding anything contrary contained in the above-mentioned documents

Where any item is not relevant to this specific contract such item is marked N/A, signifying "not applicable"

STRUCTURE OF THIS PRELIMINARIES BILL

Section A : A recital of the headings of the individual clauses of the aforementioned **JBCC Principal Building Agreement**

Section B : A recital of the headings of the individual clauses of the aforementioned Preliminaries document

Carried Forward R

	Brought Forward		R		
	Section C : Any special clauses to meet the particular circumstances of the project				
	PREAMBLES FOR TRADES				
	The Model Preambles for Trades (2008 edition) as published by the Association of South African Quantity Surveyors shall be deemed to be incorporated in these **bills of quantities** and no claim arising from brevity of description of items fully described in the said Model Preambles for Trades will be entertained				
	Supplementary preambles, Projects Specification and the document titled "Standard Specifications for Municipal Civil Engineering Works" are incorporated in the Bill of Quantities. Such supplicatory Preambles and Specifications shall take precedence over provisions of the Model Preambles.				
	The **contractor's** prices for all items throughout these **bills of quantities** must take account of and include for all of the obligations, requirements and specifications given in the Model Preambles and in any supplementary preambles				
	Carried Forward		R		

	Brought Forward		R		
	PRICING				
	If option A as set out in clause B10.3.1 hereinafter is to be used for the adjustment of the **preliminaries** each item priced is to be allocated to one or more of the three categories "F", "T" or "V" as the case may be below such item, where:				
	F · An amount which shall not be varied				
	V · An amount which shall be varied in proportion to the **contract value** as compared with the **contract sum**				
	T · An amount which shall be varied in proportion to the **construction period** as compared to the initial **construction period** excluding revisions to the **construction period** for which the **contractor** is not entitled to adjustment of the **contract value** in terms of the **agreement**				
	SECTION A - PRINCIPAL BUILDING AGREEMENT				
	DEFINITIONS (A1)				
1/1/1	Clause 1.0 - Definitions and interpretation	Item			
	Carried Forward		R		

	Brought Forward		R		
	Clause 1.0 is deemed to be amended by the addition of the following definitions and amendments: **"Parties"** means the person or entity named in the **schedule** or appointed by the **employer** to deal with specific aspects of the **works** **"Confidential Information"** means any information disclosed by that party to the receiving party prior to the conclusion of this agreement, in terms of this agreement or otherwise in connection with agreement **"the Project"** means the Bulk Earthworks, Lateral Support and Service Relocation Works on the Sunnyside Office Development **"the Tender"** means the invitation to prospective service providers to provide the Employer with Bulk Earthworks,Lateral Support and Service Relocation works. 1.6.1 **"Hand"** be inserted before the word **"Delivered** 1.6.3 the word **"successful"** be inserted before the word **"transmission"** 1.6.4 the word **"successful"** be inserted before the word **"transmission"**				
	OBJECTIVE AND PREPARATION (A2 - A14)				
1/1/2	Clause 2.0 - Offer, acceptance and performance	Item			
1/1/3	Clause 3.0 - Documents Clause 3.1 is deleted	Item			
	Carried Forward		R		

	Brought Forward		R		
	Clause 3.3. is deleted and replaced with the following: Where the employer requires the contractor to waive his lien or right of continuing possession of the works as stated in the schedule, the contractor shall do so prior to taking possession of the works. The waiver shall be according to the JBCC Waiver of Contractors Lien Form or such other form as stated in the schedule. The Contractor shall simultaneously with the signing of every selected or domestic subcontract, deliver to the Principal Agent an undertaking and cession in respect of contractors lien which shall mutatis mutandis conform to the JBCC Waiver of Contractors Lien form. Clause 3.5 is amended by the following; Delete the word "not" in 3rd line - Sentence should read: "Formal signatories are required to render this agreement binding." Clause 3.0 is amended by the addition of the following: Clause 3.12 All documentation for this project to be managed and controlled with BIM 360 and the contractor is to make his own arrangements in complying with the requirements. Clause 3.0 is amended by the addition of the following: Clause 3.13 All documentation for the project will be issued in the English language and the contractor is to make his own arrangements for translating this documentation into a language suitable for his purposes and that of his n/s subcontractors. The contractor and his n/s subcontractors rely on such translated documents entirely at their own risk				
1/1/4	Clause 4.0 - Design responsibility Clause 4.0 is amended by the addition of the following: Clause 4.4 Without limiting or derogating from the employer's rights [4.2], the contractor shall	Item			
	Carried Forward		R		

	Brought Forward		R		
	Clause 4.4.1 ensure that every n/s subcontractor, simultaneously with the signing of the relevant n/s agreement, signs (in terms of a written signing authority acceptable to the principal agent) and delivers to the employer a design, materials and workmanship warranty and undertaking (design warranty) in favour of the employer. Clause 4.4.2 provide to the employer evidence of suitable and sufficient professional indemnity insurance for all n/s subcontractors whose subcontract involves design work other than for temporary works Clause 4.5 Pending delivery of the design warranty [4.4.1] and the required evidence of professional indemnity insurance [4.4.2], the contractor shall, notwithstanding anything to the contrary in the agreement and without limiting or derogating from the employer's rights [4.2], be responsible for the design undertaken by the relevant n/s subcontractor				
1/1/5	Clause 5.0 - Employer's agents Clause 5 is deemed to be amended by the addition of the following clause: 5.3.4 The Emloyer's Legal Department must be copied in any and all notices, as contemplated herein.	Item			
1/1/6	Clause 6.0 - Site representative	Item			
	Carried Forward		R		

	Brought Forward		R		
	Clause 6.0 is amended by the addition of the following: Clause 6.3 The names and CV's of the contractor's proposed management team (for both day and nightshift) shall be submitted to the principal agent prior to commencement on site and, after the principal agent's agreement on the composition and competence thereof has been obtained, no changes shall be made nor shall any member of the said team be removed from the project while remaining in the employ of the contractor, without the principal agent's prior written approval. It is required to provide contactable references and the Principal Agent will conduct interviews with the proposed Site Agent, Senior Foreman and Safety Office that will be dedicated to nightshift.				
1/1/7	Clause 7.0 - Compliance with regulations Clause 7.0 is amended by the addition of the following clauses: Clause 7.2 The employer reserves the right to pay direct (i.e. not through the contractor) for all or any permanent connections to local or other authority services, for which provisional amounts have been included within the selected sub-contract bill section hereof. In the event of the employer paying direct for these charges, the contractor will not be entitled to a ten percent (10%) mark-up in terms of Clause 32.4. All such provisional amounts included in the contract sum will be omitted.	Item			
	Carried Forward		R		

	Brought Forward		R		
	Clause 7.3 Without limiting the generality of the provisions of clause 7.0 of the **agreement**, the **contractor's** attention is drawn to the provisions of the Construction Regulations, 2003 issued in terms of the Occupational Health and Safety Act, 1993 in which it is specifically stated that the **employer** shall prepare a documented health and safety specification for the **works** and that the **employer** shall ensure that the **contractor** has made provision for the cost of health and safety measures during the execution of the **works**. The **contractor** shall price opposite this item for compliance with the act and the regulations and the provisions of the aforementioned health and safety specification. The **contractor** shall: 1. Comply with the health and safety specification for the **works** 2. Prepare and agree with the health and safety consultant the health and safety plan for the **works** 3. Co-operate with the health and safety consultant in all respects 4. Manage the compliance of all subcontractors with the regulations and with the health and safety plan and specification 5. Conform to the conditions contained in the **employer's** health and safety specification Clause 7.4 The contractor shall take all reasonable precautions to maintain the health and safety of persons in and about the execution of the works. Without limitation the contractor hereby:				
	Carried Forward		R		

	Brought Forward		R		
	Clause 7.4.1 acknowledges and confirms that the contract sum includes a sufficient amount for proper compliance with all applicable health & safety laws and regulations and the health and safety rules, guidelines and procedures provided for the proper maintenance of health and safety in and about the execution of works; and Clause 7.4.2 undertakes, in and about the execution of the works, to comply with all Health and Safety requirements and with all applicable health and safety laws and regulations and rules and guidelines and procedures otherwise provided for under the agreement and shall ensure that all subcontractors, employees and others under the contractor's direction and control, likewise observe and comply with the foregoing Clause 7.4.3 submits a health and safety plan incorporating health and safety consultant				
1/1/8	Clause 8.0 - Works risk Clause 8.5 is amended by the following; add wording at end of the sentence "only if such making good of physical loss and repairs have been approved in writing by the employer."	Item			
1/1/9	Clause 9.0 - Indemnities Clause 9.2.2 is deleted	Item			
1/1/10	Clause 10.0 - Works insurances Clause 10.1 Delete wording joint names of the parties and replace with name of the contractor. PIC has insurance cover for its entire portfolio and does not take out insurance on a project basis.	Item			
1/1/11	Clause 11.0 - Liability insurances	Item			
1/1/12	Clause 12.0 - Effecting insurances	Item			
	Carried Forward		R		

	Brought Forward		R		
	Clause 12.2. is deleted and replaced with the following: The contractor responsible for effecting the insurances shall make available to the employer, before commencement of the construction period, documentary evidence that insurances have been effected. A copy of the insurance policies shall be provided to the other party within thirty (30) calendar days of the commencement of the construction period. Approval by the other party shall be deemed unless a reasonable objection is lodged within fourteen (14) calendar days of receipt of such policies. Where required, the contractor shall provide evidence of renewal to the other party before the expiry of the current period of insurance.				
	Clause 12.3 Delete first and last sentence.				
	Clause 12.5 is deleted				
1/1/13	Clause 13.0 - Assignment	Item			
	Clause 13.1 is deemed to be amended to read as follows:				
	Neither the **employer** nor **contractor** shall assign or cede his rights or obligations				
1/1/14	Clause 14.0 - Security				
		Item			
	Clause 14.8 is deleted				
	Carried Forward		R		
	Section No. 1 PRELIMINARIES Bill No. 1				

	Brought Forward		R		
	Clause 14.0 is amended by the addition of the following clause: 14.9 In the event that the value of the works (excluding adjustments in terms of the contract price adjustment provisions) were to increase during the course of the contract by an amount of 15% or more of the contract sum, upon written request from the principal agent, the contractor shall immediately arrange to have the construction guarantee guaranteed sum adjusted to reflect the increased contract value. The cost of obtaining the adjusted guarantee, if any, will be dealt with in terms of Clause 32.0. **EXECUTION (A15 - A23)**				
1/1/15	Clause 15.0 - Preparation for and execution of the works Clause 15.10 is added; Provide Air conditioned office accommodation for meetings suitable for 20 persons as well as additional air conditioned office space for two workstations complete with desks , internet data connection and chairs. The office accommodation is to be kept clean and fit for use at all times Clause 15.11 is added; Transformation Imperatives and B-BBEE Clause 15.12 is added; In the conduct of the business, the contractor undertakes to actively promote and encourage employment equity and, in particular not to discriminate against any person on the basis of race, colour, sex, religion, age, national or ethnic origin, political belief, veteran status or handicap.	Item			
	Carried Forward		R		

	Brought Forward		R		
	Clause 15.13 is added; the contractor is to comply with the transformation agenda as contemplated by the Public Investment Corporation, which is to contribute towards strengthening South Africa's democracy through social, moral and economic imperatives. In concluding this agreement, the contractor commits to the implementation of the Public Investment Corporation transformation imperatives, in as far as possible, in the day to day operation of its business. The definitions of the imperatives below, are reflective and can be interpreted in accordance with the Broad-Based Black Economic Empowerment Act of 2013. The key elements shall include.				
	Clause 15.14 is added; Ownership - measuring effective ownership by black people , wherein ownership should be 51% black owned or 35% woman owned;				
	Clause 15.5 is added; Management Control - measuring effective control of the entitys black people as well as initiatives intended to achieve equity in the workplace which should be aimed at reaching 51% black owned;				
	Clause 15.6 is added; Subcontracting at least 30% of the contract value to an Emerging Micro Enterprise or Qualifying Small Enterprise;				
1/1/16	Clause 16.0 - Access to the works	Item			
1/1/17	Clause 17.0 - Contract instructions	Item			
1/1/18	Clause 18.0 - Setting out of the works	Item			
	Clause 18.0 is amended by the addition of the following clause:				
	Carried Forward		R		

	Brought Forward		R		
	Clause 18.5 The contractor shall notify the principal agent if any encroachments of adjoining foundations, buildings, structures, pavements, boundaries, etc exist in order that the necessary arrangements may be made for the rectification of any such encroachments				
	Clause 18.6. is added: Where the contractor fails to comply with the requirements of clause 18 to the satisfaction of the principal agent, progressively as the structure is constructed, the principal agent shall notify the contractor to comply within seven (7) calendar days, failing which and without any further notice, the employer shall be entitled to commission other parties to do so on the contractor's behalf and at the contractor's expense. The contractor shall provide general attendance and all reasonable assistance to such parties				
1/1/19	Clause 19.0 - Temporary works and plant	Item			
1/1/20	Clause 20.0 - Nominated subcontractors	Item			
1/1/21	Clause 21.0 - Selected subcontractors	Item			
	Clause 21.0 is deemed to be amended by the addition of the following clause:				
	Clause 21.3.2 is deemed to be deleted				
	Clause 21 is amended by the addition of the following clause:				
	Clause 21.11 The contractor is to satisfy himself and give notice to the principal agent to such effect that tenderers to be appointed as selected subcontractors can fulfil the provisions of clauses 21.2.1 and 21.2.2 prior to the opening of the selected subcontract tenders.				
	Carried Forward		R		

	Brought Forward		R		
	Clause 21.12 is added; Notwithstanding the provision of the contractor's general attendance in accordance with the n/s agreement, general attendance shall be deemed to include for the contractor to provide free of charge to any n/s subcontractor erected fit for use scaffolding by the contractor (owned or hired) as may reasonably be required by such n/s subcontractor for the execution of the relevant subcontract works				
1/1/22	Clause 22.0 - Employer's direct contractors	Item			
	Clause 22.6. is added: The contractor shall not be entitled to any percentage, profit or discount on the value of any work executed by direct contractors but shall nevertheless allow these direct contractors to have access to the works, allocate reasonable space in the building for the storage of their materials, tools and equipment, and co-ordinate via the principal agent the work of such direct contractors as necessary, all to the satisfaction of the principal agent. The contractor shall allow the direct contractor's, to use, free of charge, hoisting and cranage by arrangement by the principal agent, ablution facilities, water and power supply on the site, and shall not in any way hinder or prevent the execution of their work				
1/1/23	Clause 23.0 - Contractor's domestic subcontractors	Item			
	COMPLETION (A24 - A30)				
1/1/24	Clause 24.0 - Practical completion	Item			
	Clause 24 is amended by the addition of the following clause:				
	24.11. Without derogating from the generality of the requirements for practical completion the following specific requirements shall apply:				
	24.11.1 The practical completion list of outstanding work and defects must be completed and attended to in its entirety.				
	24.11.2 The contractor is to state that compliance has been achieved with respect to the full scope of the works.				
	Carried Forward		R		

	Brought Forward		R		
	24.11.3 All defects noted on the quality control sheets issued by the principal agent of the employer during the currency of the contract and under cover of contract Instructions are to have been completed and attended to their entirety.				
	24.12 Practical completion				
	24.12.1 The contractor shall inspect the works to satisfy himself that the stage of completion of the works in terms of clause 24 has been achieved.				
	24.12 Should the contractor, in the opinion of the principal agent, not have achieved practical completion of any area of the works on the date for practical completion as stated in the schedule, the employer may, notwithstanding the contractor's on-going responsibilities under this agreement take possession and occupation of such area(s) on the basis that:-				
	Penalties will only reduce as defined in the penalty schedule and on practical completion being achieved, regardless of possible beneficial occupation being given to the client for direct order fit -outs. Insurance will only transfer on practical completion being the date practical completion has been achieved.				
	24.12.1 Such possession and occupation by the employer shall not be construed as the achievement of practical completion by the contractor or the works or any part thereof.				
	24.12.2 The principal agent shall notify the contractor in writing of each area of the works which shall be occupied and possessed by the employer in terms hereof				
	Carried Forward		R		

	Brought Forward		R		
	24.12.3 For the purposes of completing his responsibilities under this agreement including but not limited to achieving practical completion of the works, the contractor shall continue to have access to any area/a of the works so occupied and possessed by the employer, but subject to such reasonable terms and conditions as the employer may impose in connection with such access.				
1/1/25	Clause 25.0 - Works completion	Item			
1/1/26	Clause 26.0 - Final completion	Item			
1/1/27	Clause 27.0 - Latent defects liability period	Item			
	Clause 27.2.2 is deleted				
1/1/28	Clause 28.0 - Sectional completion	Item			
1/1/29	Clause 29.0 - Revision of date for practical completion	Item			
	Clause 29.2.10 is deemed to be deleted				
	Clause 29.0 is deemed to be amended by the addition of the following clauses:				
	Clause 29.5 Delete "40" and replace with "20".				
	29.9 A revision of the date for **practical completion** in terms of this clause will only be considered when work on the critical path of the programme for the **works** is affected (clause 29.0)				
	29.10 No claims for a revision of the date for **practical completion** due to time lost on account of inclement weather shall be considered unless the number of **working days** actually lost on this account during any month is in excess of the allowable number of **working days** lost for the same period as calculated from the table hereunder				
	Carried Forward		R		

	Brought Forward		R		
	January 4 days February 3 days March 2 days April 2 days May 0 days June 0 days July 0 days August 0 days September 0 days October 2 days November 3 days December 3 days				
	The actual number of **working days** lost due to inclement weather during the **construction** period shall be determined by the **principal agent** on a monthly basis (clause 29.1)				
	Clause 29.11. The removal and replacement of materials and/or workmanship that do not conform to specification or drawings shall not constitute grounds for a revision of the date for practical completion nor for an adjustment to the contract value (clause 29.3)				
	Clause 29.12 is added: Notwithstanding anything to the contrary the contractor shall not be entitled to a revision of the date for practical completion for delays arising from municipal or other interruption in energy and water supply to the site				
	Clause 29.12.1 Irrespective of whether or not the principal agent rules that the contractor is entitled to an extension of time or a revision of the date for practical completion, the principal agent shall nevertheless, at any time, be entitled to instruct the contractor in writing to accelerate the progress of the remaining works to ensure that the works are completed by the original date for practical completion or revised date as the case may be				
	Carried Forward		R		

	Brought Forward		R		
	Clause 29.12.2 Upon receipt of such instruction, the contractor shall take all necessary steps to ensure that the works are completed timeously including the provision by him of additional resources, plant, manpower, etc. and the working of additional overtime or additional overtimes beyond that contemplated at the time of tender (at all times adhering to the regulations and requirements of all authorities) and by all other adequate and proper means and methods. The contractor shall prove that such steps are being taken if called upon to do so. Clause 29.12.3 Should the contractor deem that such instruction to accelerate is not practically possible, the contractor shall within (7) seven calendar days of the instruction provide the principal agent with suitable proof as to why the instructed acceleration is not possible.				
1/1/30	Clause 30.0 - Penalty for late or noncompletion The penalty for the **works** that does not reach **practical completion** by the required date as set out in clause 42.2.8 Clause 30.0 is deemed to be amended by the addition of the following clauses: 30.3 Where the **contractor** fails to bring the **works** or **sections** thereof to **works completion** within forty (40) **working days** of the date of the issue the **works completion** list or revision thereof in terms of clause 30.4, the **contractor** shall be liable to the **employer** for the **penalty** per **calendar day** for noncompletion of the **works** at the rate stated in clause 30.7. The **principal agent** shall calculate the **penalty** due from and including forty one (41) **working days** after the date or revised date in terms of clause 30.4 of the issue of the **works completion** list up to and including the actual date of **works completion** of the **works** or **section** thereof	Item			
	Carried Forward		R		

	Brought Forward		R		
30.4	The **contractor** may request additional time for the completion or rectification of works on the **works completion** list, within 5 working days from receipt of the **works completion** list, failing which the **principal agent** shall not consider such claim. The granting of additional time will be by decision of the **principal agent**				
30.5	Where the **contractor** fails to bring the **works** or **sections** thereof to **final completion** within one hundred and twenty (120) **calendar days** of the date of the **certificate of works completion** or revision thereof in terms of clause 30.6, the **contractor** shall be liable to the **employer** for the **penalty** per **calendar day** for noncompletion of the **works** or each **section** thereof at the rate stated in clause 30.7. The **principal agent** shall calculate the **penalty** due from and including one hundred and twenty one (121) **calendar days** after the date of the **certificate of works completion** or revised date in terms of clause 30.4, up to and including the actual date of **final completion** of the **works** or **section** thereof				
30.6	The **contractor** may request additional time for the completion or rectification of works on the **defects completion** list, within 5 working days from receipt of the **defects completion** list, failing which the **principal agent** shall not consider such claim. The granting of additional time will be by decision of the **principal agent**				
30.7	The **penalty** will be calculated as follows:				
For the works that did not reach **works completion** or **final completion**					
	Penalty amount: R 60 000/calendar day				
	Carried Forward		R		

	Brought Forward		R		
	30.8 Where the **employer** levies such a **penalty** the **principal agent** shall detail the amount for recovery in terms of clause 33.1.1				
	30.9 The **contractor** shall agree with the **principal agent** in writing at least five (5) working days before access to the **works** is required for the completion or rectification of works on the **works completion** list. Should the **contractor** not be allowed access to the **works** as agreed date the **contractor** will be granted additional time for completion of the **works** equal to the time access was refused				
	PAYMENT (A31 - A35)				
1/1/31	Clause 31.0 - Interim payment to the contractor				
	Clause 31.0 is deemed to be amended to read as follows:				
	31.9 The **employer** shall pay the **contractor** the amount certified in an interim **payment certificate** within thirty (30) **calendar days** following the date of submission of the **contractors** payment claim to the quantity surveyor. Payment shall be subject to the **contractor** giving the quantity surveyor a valid **tax** invoice for the amount due	Item			
	Carried Forward		R		

	Brought Forward		R		
	Clause 31.9 Delete and replace with following 31.9.1 The employer shall pay the amount certified in an interim payment certificate by the last calendar day of the month, provided that the employer receives the interim payment certificate from the Principal Agent on or before the 5th calendar day of the month for which the services are being rendered, failing which the invoices will be paid by the last calendar day of the following month. 31.9.2 Should the 5th calendar day of the month fall on a weekend or public holiday, documentation should be provided by the first working day subsequent to the 5th calendar day. 31.9.3 Furthermore, the contractor shall ensure that a statement accompanies the invoice issued as per the amount certified by the Pricipal Agent on the all interim payment certificates requested for payment. 31.9.4 No payment will be effected if the contractor is not in possession of a valid Tax Clearance Certificate issued by the South African Revenue Services. Clause 31.16.1 is deleted				
1/1/32	Clause 32.0 - Adjustment to the contract value Clause 32.4 is deleted Clause 32.6 Delete "40" and replace with "20". Clause 32.0 is deemed to be amended by the addition of the following clauses: 32.16 All fluctuations in costs, with the exception of fluctuations in the rate of Value Added Tax shall be for the account of the **contractor**. Clause 32.13 shall therefore not apply		Item		
	Carried Forward		R		

	Brought Forward		R		
	32.17 Where prices are submitted by the **contractor** or **nominated/selected subcontractors** during the progress of the **works** in respect of **contract instructions** or in regard to a claim under the terms of the **agreement** and notwithstanding the fact that such prices may be used in an interim **payment certificate**, there is to be no presumption of acceptance. Should the **principal agent** wish to accept any such prices prior to the issue of the final **payment certificate**, it will be in writing				
1/1/33	Clause 33.0 - Recovery of expense and loss	Item			
	Clause 33 is deemed to be amended by the addition of the following clauses:				
	Clause 33.1.4 is deemed to be deleted				
	New clause 33.7 shall be added as follows:				
	33.7 Payment of compensatory interest in terms of 31.10 shall not apply				
1/1/34	Clause 34.0 - Final account and final payment	Item			
	Carried Forward		R		

	Brought Forward		R		
	Clause 34.10 - Delete and replace with following: 34.10.1 The employer shall pay the amount certified in the final payment certificate by the last calendar day of the month, provided that the employer receives the final payment certificate from the Principal Agent on or before the 5th calendar day of the month for which the services are being rendered, failing which the invoices will be paid by the last calendar day of the following month. 34.10.2 Should the 5th calendar day of the month fall on a weekend or public holiday, documentation should be provided by the first working day subsequent to the 5th calendar day. 34.10.3 Furthermore, the contractor shall ensure that a statement accompanies the invoice issued as per the amount certified by the Principal Agent on the final payment certificates requested for payment. 34.10.4 No payment will be effected if client is not in possession of a valid Tax Clearance Certificate issued by the South African Revenue Services. Clause 34.0 is deemed to be amended by the addition of the following clauses:				
	Carried Forward		R		

	Brought Forward		R		
	34.15 The employer shall not pay any **interest** on amounts payable to the **contractor** for one hundred and forty seven (147) **working days** after the date of issue of the certificate of **practical completion**. The **employer** shall, however, pay **interest** to the **contractor** at the rate stipulated in clause 34.11 on any amounts payable to the **contractor** more than one hundred and forty seven (147) **working days** after the date of issue of the certificate of **practical completion** but only for such period as the settlement of the **final account** is delayed by the non-performance of the **principal agent** or the **employer** or his **agents**. In evaluating non-performance for purposes of this clause a reasonable time shall be allowed by the **principal agent** to the **employer** or his **agents** to respond to any matter brought to his/their attention and which may affect the settlement of the **final account**				
1/1/35	Clause 35.0 - Payment to other parties	Item			
	CANCELLATION (A36 - A39)				
1/1/36	Clause 36.0 - Cancellation by employer - contractor's default	Item			
	Clause 36.5.1 is deemed to be amended to read as follows:				
	36.5.1 The employment of the **contractor** shall be cancelled and the execution of the **works** shall cease. The **contractor** shall vacate the **works** and the **site** subject to provisions of 36.5.6. The **contractor** shall remain responsible for the **works** as certified at termination, however responsibility for the **site** shall apply in terms of Clause 8.1 until possesion is relinquished to the **employer**				
1/1/37	Clause 37.0 - Cancellation by employer - loss and damage	Item			
	Clause 37.3.8 - Delete [27.2.2] and replace with [27.2.1]				
1/1/38	Clause 38.0 - Cancellation by contractor - employer's default	Item			
	Carried Forward		R		

	Brought Forward		R		
	Clause 38.1.1 - is deleted				
	Clause 38.1.4 - is delete				
	Clause 38.2 Delete "10" and replace with "14".				
1/1/39	Clause 39.0 - Cancellation - cessation of the works	Item			
	DISPUTE (A40)				
1/1/40	Clause 40.0 - Settlement of disputes	Item			
	Clause 40.0 is deleted and substituted with the following:				
	40.1 In the event of any dispute between the **parties** to this **agreement**, the **parties** shall first attempt to resolve the dispute through their respective senior representatives at a meeting, which shall be convened at the written instance of the party declaring the dispute				
	40.2 If the **parties** fail to resolve the dispute at a meeting so convened, or such meeting fails to take place, the party declaring the dispute shall be entitled to refer the dispute either for arbitration or to a competent court of law				
	40.3 Should the party declaring the dispute refer the dispute for arbitration, then the arbitration process shall be conducted in accordance with the arbitration rules and procedures of the Republic of South Africa, and in particular, considering the following:				
	40.3.1 the **parties** shall elect or agree to an **arbitrator** who shall preferably be an attorney with at least fifteen (15) years of experience in the field of commercial litigation				
	40.3.2 the **arbitrator** shall immediately after appointment, specify the time limits within which the **parties** must submit any further written submissions or pleadings (if required)				
	Carried Forward		R		

	Brought Forward		R		
	and the time, date and place where the arbitration will take place				
	40.3.3 the **arbitrator** shall be entitled to make such practical rulings as may be necessary to expedite the proceedings, the intention of the **parties** being to settle such dispute in the shortest possible time				
	40.3.4 the finding of the **arbitrator** shall be final and binding upon the **parties**				
	40.3.5 the **arbitrator** shall be paid by the **parties** in such proportions as the **arbitrator** may decide to be just and equitable under the circumstances and shall also be entitled to make a ruling on the share of the costs of the arbitration to be paid by each party				
	40.3.6 nothing in this clause shall however prevent a party from approaching a competent court of law for an interdict or similar urgent temporary relief pending the decision of the **arbitrator**				
	SUBSTITUTE PROVISIONS (A41)				
1/1/41	Clause 41.0 - State clauses		N/A		
	CONTRACT VARIABLES (A42)				
	THE SCHEDULE				
1/1/42	Clause 42.0 - Pre-tender information		Item		
	42.1 CONTRACTING AND OTHER PARTIES				
	Carried Forward		R		

	Brought Forward		R		
42.1.1	Employer: The Unemployment Insurance Fund represented by the Public Investment Corporation SOC Pty Ltd Postal address: Private Bag X187 Pretoria Republic of South Africa 0001 E-mail:enquiries4@pic.gov.za				
[*1.2*]	Physical address: Public Investment Corporation No 1 Central Square Menlyn Maine Corner Aramist Avenue & Corobay Avenue Waterkloof Glen Extension 2 0181				
42.1.2 [5.*1]*	**Principal Agent**: Project Manager Physical address:				
42.2	CONTRACT DETAILS				
42.2.1	**Works** description: Bulk Earthworks, Lateral Support and Service Relocation for Sunnyside Office Development in Sunnyside Pretoria				
42.2.2	**Site** description:Sunnyside Office Development The site is situated on Corner Steve Biko And Trevenna Street Sunnyside Pretoria				
	Carried Forward		R		

Section No. 1
PRELIMINARIES
Bill No. 1

	Brought Forward		R		
	42.2.3 Work or installations by **direct contractors -** Yes [*22.2*]				
	42.2.6 Period for the commencement of the **works** [*15.3*] after the **contractor** takes possession of the **site** - 7 working days				
	42.2.8 For the **works** in **sections**: No [*24.3.1*] The date for **practical completion** [*28.1*] and the **penalty** per **calendar day**				
	Anticipated **Practical Completion** March 2020 and the **penalty** are R 60 000/**calendar day**				
	42.2.9 The **law** applicable to this **agreement** shall be [*1.2*] that of the Republic of South Africa. The Jurisdiction of the Gauteng Provincial Division of the High Court of South Africa shall be applicable in respect of any disputes arising out of this **agreement**				
	42.3 INSURANCES				
	42.3.1 Contract works insurance (including SASRIA) to be effected by the [10.1#, *10.2#, 12.1#*] **Contractor** For the sum of: Contract sum plus 20%				
	42.3.2 Supplementary insurance in respect of neighbouring buildings due to blasting to be effected by - Yes [10.1#, **Contractor** 10.2#, For the sum of: R 30 000 000 12.1#]				
	42.3.3 Public liability insurance to be effected by the [*11.1#, 12.1#*] **Contractor** For the sum of: R 15 000 000				
	Carried Forward		R		

	Brought Forward		R		
	42.3.4 Lateral Support insurance to be effected by - Yes [*11.1#,* **Contractor** *12.1#*] For the sum of: R 15 000 000				
	42.4 DOCUMENTS				
	42.4.1 Waiver of the **contractor's** lien or right of [*3.3,* continuing possession is required - Yes *15.1.3,* *31.16.2#*]				
	42.4.2 Construction document copies to [*3.7*] be supplied to the **contractor** free of charge No of 0. (Documents including drawings will be issued electronicaly).				
	42.4.3 Provisional **Bills of quantities** are drawn up in [1.1] accordance with the latest edition of the City of Tshwane Standard Specifications For Municipal Civil Engineering Works 3rd Edition 2005				
	42.4.4 N/A				
	42.4.5 **JBCC** Engineering General Conditions are [*3.4*] to be included in the **contract documents** - No				
	42.4.6 The **contract value** is to be adjusted using [*31.5.3]* **CPAP** indices - No				
	[*32.13*] Fixed price rates not subject to adjustment by **CPAP**				
	42.4.7 Details of changes made to the provisions [*3.10]* **JBCC** Standard documentation Refer to Preliminaries and General section of the Bill of Quantities for all changes made to the JBCC Agreement.				
	Carried Forward		R		

	Brought Forward		R		
	Clause 42.0 - Post - tender information				
	42.5 Contract details				
	42.5.1 **Contractor**: [*1.2*] Physical address:				
	42.5.2 The accepted **contract sum** inclusive of **tax** is: R				
	42.5.3 The latest day of the month for the issue of an [*31.3*] interim **payment certificate** (day of month): 5th of the month				
	42.5.4 The **preliminaries** amounts shall be paid in [*32.12*] terms of (option A or B): B				
	42.5.5 The **preliminaries** amounts shall be adjusted [*32.12*] in terms of (option A or B): A				
	42.5.6 The **payment guarantee** to be effected by the [*3.1#*] **employer** for the sum of: N/A				
	42.5.7 The **securities** to be provided by the **contractor** are:				
	[*14.3*] (1) Variable **construction guarantee** (yes/no): Yes				
	[*14.4*] (2) Fixed **construction guarantee** (yes/no): No				
	[*14.5*] (3) **Advance payment guarantee** (yes/no): No				
	42.5.8 The annual building holiday period after [*29.7.2*] the commencement of the **construction period** is as follows: 13 December 2019 - 13 January 2020				
	42.6 Documents				
	Carried Forward		R		

	Brought Forward		R		
	42.6.1 **Contract documents** marked and annexed hereto: (Refer to Index for all annexed) 42.6.2 Signed set of **contract documents** originals [*3.6.1#*] held by **principal agent** - yes 42.7 Dispute resolution 42.7.1 Refer to clause 40.0 herein 42.7.2 Where adjudication is elected: Refer clause 40.0 herein 42.7.3 Where arbitration is elected or is required in terms of 40.5: Refer to clause 40.0 herein 42.7.4 Where mediation is elected in terms of 40.6: N/A 42.8 Signatures of the contracting parties: Refer to Principal Building Agreement				
	Carried Forward		R		

	Brought Forward		R		
	SECTION B - PRELIMINARIES				
	DEFINITIONS AND INTERPRETATION (B1)				
1/1/43	Clause 1.0 - Definitions and interpretation	Item			
	DOCUMENTS (B2)				
1/1/44	Clause 2.1 - Checking of documents	Item			
1/1/45	Clause 2.2* - Provisional bills of quantities	Item			
	Clause 2.2 is deemed to be amended by the addition of the following paragraph: These bills of quantities are in the Multiple Procurement format i.e. the bulk earthworks, lateral support and service relocation are provisionally measured and the subsequent trades are budgetary allowances and subcontract amounts				
1/1/46	Clause 2.3* - Availability of construction documentation	Item			
	Clause 2.3 is deemed to be amended by the addition of the following paragraph: The **budgetary allowances** and **subcontract amounts** allocated for subsequent trades included in this document will be separately procured, based on multiple procurement of **nominated/selected subcontractors** during the **construction period**				
1/1/47	Clause 2.4* - Interests of agents	Item			
1/1/48	Clause 2.5 - Priced documents	Item			
1/1/49	Clause 2.6 - Tender submission	Item			
	Clause 2.6 is deemed to be amended by the addition of the following paragraph:				
	Carried Forward		R		

	Brought Forward		R		
	Notwithstanding anything contained in this clause, tenders shall be valid for a period of 90 **calendar days** from the tender closing date				
	THE SITE (B3)				
1/1/50	Clause 3.1* - Defined works area	Item			
1/1/51	Clause 3.2* - Geotechnical investigation	Item			
1/1/52	Clause 3.3 - Inspection of the site	Item			
	The **contractor** shall take full responsibility and accordingly indemnify the **employer** in respect of any failure by the **contractor** to adequately inspect the site and no claims by the **contractor** shall be entertained resulting from such failure				
1/1/53	Clause 3.4* - Existing premises occupied	N/A			
1/1/54	Clause 3.5* - Previous work - dimensional accuracy	Item			
1/1/55	Clause 3.6* - Previous work - defects	Item			
1/1/56	Clause 3.7* - Services - known	Item			
1/1/57	Clause 3.8 - Services - unknown	Item			
1/1/58	Clause 3.9* - Protection of trees	Item			
1/1/59	Clause 3.10 - Articles of value	Item			
1/1/60	Clause 3.11* - Inspection of adjoining properties	Item			
	MANAGEMENT OF CONTRACT (B4)				
1/1/61	Clause 4.1 - Management of the works	Item			
1/1/62	Clause 4.2 - Programme for the works	Item			
	Carried Forward		R		

	Brought Forward		R		
1/1/63	Clause 4.3 - Progress meetings	Item			
1/1/64	Clause 4.4 - Technical meetings	Item			
1/1/65	Clause 4.5 - Labour and plant records	Item			
	SAMPLES, SHOP DRAWINGS AND MANUFACTURER'S INSTRUCTIONS (B5)				
1/1/66	Clause 5.1 - Samples of materials	Item			
1/1/67	Clause 5.2 - Workmanship samples	Item			
1/1/68	Clause 5.3 - Shop drawings	Item			
1/1/69	Clause 5.4 - Compliance with manufacturer's instructions	Item			
	TEMPORARY WORKS AND PLANT (B6)				
1/1/70	Clause 6.1 - Deposits and fees	Item			
1/1/71	Clause 6.2* - Enclosure of the works	Item			
1/1/72	Clause 6.3 - Advertising	Item			
1/1/73	Clause 6.4 - Plant, equipment, sheds and offices	Item			
1/1/74	Clause 6.5* - Main noticeboard	Item			
1/1/75	Clause 6.6* - Subcontractors' noticeboard	Item			
	TEMPORARY SERVICES (B7)				
1/1/76	Clause 7.1 - Location	Item			
1/1/77	Clause 7.2# - Water	Item			
1/1/78	Clause 7.3# - Electricity	Item			
	Carried Forward		R		

	Brought Forward		R		
1/1/79	Clause 7.4# - Telecommunication facilities	Item			
1/1/80	Clause 7.5# - Ablution facilities	Item			
	PRIME COST AMOUNTS (B8)				
1/1/81	Clause 8.1 - Responsibility for prime cost amounts	Item			
	ATTENDANCE ON N/S SUBCONTRACTORS (B9)				
1/1/82	Clause 9.1 - General attendance	Item			
1/1/83	Clause 9.2* - Special attendance	Item			
1/1/84	Clause 9.3 - Commissioning - fuel, water and electricity	Item			
	FINANCIAL ASPECTS (B10)				
1/1/85	Clause 10.1 - Statutory taxes, duties and levies	Item			
1/1/86	Clause 10.2# - Payment of preliminaries	Item			
1/1/87	Clause 10.3# - Adjustment of preliminaries	Item			
	Clause 10.3 is deemed to be amended by the addition of the following paragraph: Should the **contractor** select option B but fails to provide the information required prior to the signing of the **agreement**, the **principal agent** shall have the right to select either option A or B for the adjustment of **preliminaries**. Should the **principal agent** select option B he shall be entitled to make assumptions at his discretion regarding the information which the **contractor** would normally have provided prior to the signing of the **agreement**				
1/1/88	Clause 10.4 - Payment certificate cash flow	Item			
	Carried Forward		R		

	Brought Forward		R		
	GENERAL (B11)				
1/1/89	Clause 11.1* - Protection of the works	Item			
1/1/90	Clause 11.2* - Protection/isolation of existing/sectionally occupied works	Item			
1/1/91	Clause 11.3 - Security of the works	Item			
1/1/92	Clause 11.4 - Notice before covering work	Item			
1/1/93	Clause 11.5* - Disturbance	Item			
1/1/94	Clause 11.6 - Environmental disturbance	Item			
1/1/95	Clause 11.7 - Works cleaning and clearing	Item			
1/1/96	Clause 11.8 - Vermin	Item			
1/1/97	Clause 11.9 - Overhand work	Item			
1/1/98	Clause 11.10 - Instruction manuals and guarantees	Item			
1/1/99	Clause 11.11 - As built information	Item			
1/1/100	Clause 11.12 - Tenant installations	Item			
	SCHEDULE OF VARIABLES (B12)				
1/1/101	Clause 12.1 - Pre-tender information	Item			
	Where no information is given it shall mean that either no details or specific requirements are available or if so indicated that the clause is not relevant to this specific contract				
	Clause 12.1.1 - Provisional bills of quantities [B2.2]				
	The quantities are provisional - yes				
	Carried Forward		R		

	Brought Forward		R		
	Clause 12.1.2 - Availability of construction documentation [B2.3]				
	Construction documentation is complete - No				
	Clause 12.1.3 - Interests of agents [B2.4]				
	Clause 12.1.4 - Defined works area [B3.1]				
	Clause 12.1.5 - Geotechnical investigation [B3.2]				
	The geotechnical report was prepared by GCS Geotechnical and was annexed to the tender enquiry document				
	Clause 12.1.6 - Existing premises are not occupied during construction [B3.4]				
	Clause 12.1.7 - Previous work - dimensional accuracy [B3.5]				
	Clause 12.1.8 - Previous work - defects [B3.6]				
	Clause 12.1.9 - Services - known [B3.7]				
	Clause 12.1.10 - Protection of trees [B3.9]				
	Clause 12.1.11 - Inspection of adjoining properties [B3.11]				
	In addition to the requirements of Clause B3.11 a photographic survey the conditions of the adjoining buildings, roads, etc. Shall be compiled cooperation with the Employer's agents.				
	Carried Forward		R		

	Brought Forward		R		
	Clause 12.1.12 - Enclosure of the works [B6.2]				
	Specific Request:				
	Site perimeter hoarding has to be included in this Contract and must be erected. This hoarding will be taken over and maintained by the main contractor at the end of the bulk earthworks and lateral support contract.				
	Temporary Hoarding 2000mm high above ground level over flat or sloping terrain including 0.5mm galvanised corrugated sheeting fixed to SABS CCA treated poles 100/125mm 2400mm high at 2000mm centres cast into concrete bases executed complete (296m). Including 6000mm x 1800mm high gate including steel frame, corrugated sheet, bolts and pad locks, etc.				
	Clause 12.1.13 - Offices [B6.4.3]				
	Clause 12.1.14 - Main noticeboard [B6.5]				
	Clause 12.1.15 - Subcontractors' noticeboard [B6.6]				
	A notice board is required - Yes				
	Clause 12.1.16 - Water [B7.2]				
	Option selected: A Contractor				
	Clause 12.1.17 - Electricity [B7.3]				
	Option selected: A Contractor				
	Clause 12.1.18 - Telecommunications [B7.4]				
	Telephone (yes) Facsimile (yes) E-mail (yes)				
	Clause 12.1.19 - Ablution facilities [B7.5]				
	Carried Forward		R		

	Brought Forward		R		
	Option selected: A Contractor				
	Clause 12.1.20 - Protection of existing/sectionally occupied works [B11.2]				
	Protection is required - no				
	Clause 12.1.21 - Special attendance [B9.2]				
	Clause 12.1.22 - Protection of the works [B11.1]				
	Clause 12.1.23 - Disturbance [B11.5]				
	Clause 12.1.24 - Environmental disturbance [B11.6]				
1/1/102	Post-tender information [B12.2]	Item			
	Clause 12.2.1 - Payment of preliminaries [B10.2]				
	Option selected:				
	Clause 12.2.2 - Adjustment of preliminaries [B10.3]				
	Option selected:				
	Clause 12.2.3 - Additional agreed preliminaries items				
	SECTION C - SPECIFIC PRELIMINARIES				
1/1/103	Clause C1 - Confidentiality	Item			
	The **contractor** undertakes to maintain in confidence any and all information regarding this project and shall obtain appropriate similar undertakings from all **subcontractors** and suppliers. Such information shall not be used in any way except in connection with the execution of the **works**				
	No information regarding this project shall be published or disclosed without the prior written consent of the **employer**				
1/1/104	Clause C2 - Contract instructions	Item			
	Carried Forward		R		

	Brought Forward		R		
	Contract instructions issued are to be recorded in triplicate in a contract instruction book which is to be supplied and maintained on **site** by the **contractor.** The top copy must remain on the site until it is countersigned by the **principal agent** and will only become a legal **contract instruction** once signed by the **principal agent**				
1/1/105	Clause C3 - Guarantees	Item			
	Where guarantees are called for, the **contractor** shall obtain a written guarantee, addressed to the **employer**, from the firm supplying the materials and/or doing the work and shall deliver same to the **principal agent** not later than the **works completion** date. The guarantee shall state that workmanship, materials and installation are guaranteed for a specified period from the **final completion** date and that any defects that may arise during the specified period shall be made good at the expense of the firm supplying the materials and/or doing the work, upon written notice from the **principal agent** to do so. This guarantee will not be enforced if the work is damaged by **defects** in the construction of the building in which case the responsibility for replacement shall rest entirely with the **contractor**. The **principal agent** shall be the sole judge of the cause responsible for **defects** in the **works** and his decision shall be final and binding in terms of clause A40.2 of the **agreement**				
1/1/106	Clause C4 - User requirements	Item			
	There is a possibility that certain **works** related to users' requirements may have to be delayed and may consequently not be executed prior to the dates of **practical completion**				
	Carried Forward		R		

	Brought Forward		R		
	The **employer** reserves the right to omit such work without compensation to the **contractor** for any loss which may be incurred as a result of such omission. Should the **contractor** be instructed to do so he shall execute this work under the conditions pertaining to this **agreement** on the basis that a separate amount for **preliminaries** appurtenant to this work (if applicable) is agreed to between the **contractor** and the **principal agent** and on condition that instructions to proceed with such work is given to him within a period of three (3) calendar months after date of **practical completion** of the **works**				
1/1/107	Clause C5 - Overtime	Item			
	Should overtime be required to be worked for any reason whatsoever, the costs of such overtime is to be borne by the **contractor** unless the **principal agent** has specifically authorised, in writing, prior to execution thereof, that costs for such overtime are to be borne by the **employer**				
1/1/108	Clause C6 - Co-operation of contractor for cost management	Item			
	It is specifically agreed that the **contractor** accepts the obligation of assisting the **agents** in implementing proper cost management on this project. The **contractor** will be advised by the **principal agent** of all cost management procedures which will be implemented to ensure that the **final account** does not exceed the budget				
1/1/109	Clause C7 - Control of sand, dust, mud, light and noise pollution on site, public spaces, public roads, etc	Item			
	The **contractor** shall be responsible for and take all precautions in controlling all forms of pollution during the **contract period** due to noise, artificial light, wind-blown sand, dust, etc in the dry season and deposits of mud etc in the wet season by whatever means necessary and daily removal of deposits etc, all to the satisfaction of the **principal agent** and any costs, claims, etc will be for the **contractor's** account				
1/1/110	Clause C8 - Environmental Management Plan	Item			
	Carried Forward		R		

Section No. 1
PRELIMINARIES
Bill No. 1

	Brought Forward		R		
	The **contractor** shall be responsible for and take all precautions in controlling all requirments in terms of the Environmental Management Plan during the **contract period**, all to the satisfaction of the **principal agent** and any costs, claims, etc will be for the **contractor's** account				
1/1/111	Clause C10 - Local Labour The **contractor** shall make use of local labour. It is desirable by the **employer** that all unskilled labour be recruited from the local areas of the vicinity of the **works**. The **contractor** will demonstrate his effort to fulfill compliance with this requirement	Item			
1/1/112	Clause C11 - Joint Venture Requirement The employer is open to consider bidders that form or already have an existing Joint Venture/Consortium agreement in place to achieve a Broad Based Black Economic Empowerment Status Level. For Joint Venture/Consortium the following additional information will be required: · Consolidated Generic BEE Certificate. · Ownership and Executive Management information. · A formal signed JV Agreement, indicating the leading company as well as the other companys role and responsibilities. · Skills transfer plan between the parties must be submitted.	Item			
1/1/113	Clause C12 - GREEN STAR The contractor to make necessary allowances for works relating to Green Star building requirements.	Item			
	Clause C13: GENERAL				
	Carried Forward		R		

	Brought Forward		R		
	Clause 13.1: Contractor to be responsible The contractor acknowledges that the principal objective of his appointment is his expert knowledge in the execution of the scope of work of this contract. The contractor shall be solely responsible for all aspects of the construction of the works including but not limited to management, resourcing, programming and co-ordination of sequencing of work all as required for the type of project described and within the time limits and quality standards specified. Clause 13.2: Notice Boards, Media Releases, Advertising, Etc. All rights of publication of articles in the media, together with any advertising relating to, or in any way connected with this project, shall vest with the employer. The contractor together with his subcontractors shall not, without the written consent of the employer, cause any statement or advertisement to be printed, screened or aired by the media, or have any advertising signage displayed on site. Clause 13.3: Method Statement The contractor shall produce, when required to do so by the principal agent, a method statement outlining the methods of construction and labour and plant resources that he proposes to use in the execution of the works. Any approval given or observation made by the principal agent shall not relieve the contractor of his sole responsibility to adopt the methods of construction and to provide the labour and plant resources necessary for the due and proper timeous execution of the works.				
	Carried Forward		R		

	Brought Forward		R		
	Clause 13.4: Overloading The contractor shall take all necessary steps to ensure that no damage occurs due to overloading of any portion of the works or temporary works, scaffolding, etc. The contractor shall submit details of his proposed loading, storage, plant erection, etc., to the principal agent for their approval prior to proceeding with such loading, storing or erecting and shall comply with and pay for the principal agents requirements in connection with the provision of temporary support work, etc. Any damage caused to the works by overloading shall be made good by the contractor at his sole expense. Clause 13.5: Structural Safety The contractor shall take all reasonable measures to ensure that all alteration works are structurally practicable and safe. The contractor shall provide and price under the relevant demolition item, for all necessary temporary propping and support which may be required. Clause 13.6: Condemned Work The contractor shall remove from the site all materials not conforming to the relevant specification and condemned by the principal agent, whether incorporated in the works or not. He shall replace such material and re-execute the affected work in accordance with the contract and without expense to the employer. The contractor shall also bear the expense of making good any other work damaged or destroyed by such removal or replacement Clause 13.7: Photographic Record A two weekly photographic record is to be provided by the contractor, recording the state of progress of the works. Copies of each photograph annotated with the location and date, are to be made available to the employer via the principal agent.				
	Carried Forward		R		

	Brought Forward		R		
	Clause 13.8: Mode of Procedure Notwithstanding anything to the contrary contained herein, the principal agent at all times reserves the right to direct the order in which the various parts of the contract are to be executed. The contractor shall give priority to any individual section or portion of the works that, in the opinion of the principal agent, requires to be expedited. Should the contractor and/or principal agent be of the opinion that such instruction warrants a revision of date for practical completion and / or an adjustment to the contract value then this will be dealt with in terms of clause 29 and clause 32. Should it appear, in the principal agents opinion, that work in any area is not being executed in accordance with the requirements of the programme, the contractor shall provide additional manpower and resources and shall work additional overtime and do everything else required to bring the work back to programme to the satisfaction of the principal agent. Clause 13.9: Continuous Supply of Electricity The contractor shall allow for the provision of suitable standby generated power including all connection, fuel and maintenance costs to meet the requirement of the contract.				
	Carried Forward		R		

	Brought Forward		R		
	Clause 13.10: Royalties, Patent Rights and Fees The contractor shall indemnify the principal agent against any action, claim, demand, costs or expenses arising from or incurred by reason of any infringement of letters, patent design, trademark, name, copyright or other protected rights in respect of any machine, plant, work, materials, thing, system or method of using, fixing, working or arrangement used or fixed or supplied by the contractor, but such indemnity shall not cover any use of the equipment or part thereof otherwise than in accordance with theprovisions of the specification. All payments and royalties payable in one sum or by instalments or otherwise, shall be included by the contractor in the price and shall be paid by him to those to whom they may be due or payable. In the event of any claim being made or action brought against the principal agent arising out of the matter referred to in this clause, the contractor shall be promptly notified thereof and may, at his own expense, conduct negotiations for the settlement of the same and/or litigation, that may arise therefrom. The principal agent shall not, unless and until the contractor shall have failed to take over and conduct the negotiations of litigation, make any admission which might be prejudicial thereto. The conduct by the contractor of such negotiations or litigation shall be conditional upon the contractor having first given the principal agent such reasonable security as shall from time to time be required by the principal agent, to cover the amount ascertained or agreed or estimated, as the case may be, or any compensation, damage, expenses and costs for which the principal agent may become liable in respect of such infringement as aforesaid. The principal agent shall, at the request of the contractor, afford all available assistance for the purpose of contesting any such claim or action and shall be repaid the expenses incurred in doing so. The conduct by the contractor of such negotiations or litigation shall be conditional upon the contractor having first given the principal agent such reasonable security as shall from time to time be required by the principal agent, to cover the amount ascertained or agreed or estimated, as the case may be, or any				
	Carried Forward		R		

	Brought Forward		R		
	compensation, damage, expenses and costs for which the principal agent may become liable in respect of such infringement as aforesaid. The principal agent shall, at the request of the contractor, afford all available assistance for the purpose of contesting any such claim or action and shall be repaid the expenses incurred in doing so. Clause C14: INTERFERENCE WITH TRAFFIC FLOW AND NEARBY PROPERTIES All operations necessary for the execution of the works and for the construction of any temporary works shall not interfere unnecessarily or improperly with the access of the public to permanent roads and footpaths. The Contractor shall indemnify the Employer in respect of all claims, demands, proceedings, damages, costs, charges and expenses whatsoever arising out of or in respect of or in relation to any such matters. The Contractor shall at all times accommodate such provisions as may be necessary in the opinion of the Principal Agent to ensure that disruption to the occupants of the nearby buildings or the public is kept to an absolute minimum. The Contractor shall make all necessary provisions in his rates for his requirements and no additional entitlement on the part of the Contractor in compliance with these requirements shall be entertained. The Contractor must reinstate the existing streets, pavings, kerbs, etc. to their original condition on completion of the building operations to the satisfaction of the Principal Agent. The programme must be structured in such a way to keep the disruption to traffic as little as possible. Sufficient signs shall be erected to re-direct traffic where the road is closed off for construction including flag workmen, traffic signs as per the drawings.				
	Carried Forward		R		

	Brought Forward		R		
	Clause C15: BLASTING OPERATION The contractor is deemed to have accepted full responsibility during any blasting operations that may be carried out, should blasting be permitted. The Contractor shall take all necessary precautions for the safety of all persons, buildings, etc. and is to observe all conditions set forth in Government and Local Authorities regulations in connection with the use of explosives and pay all costs and fees. All blasting is to be carried out by a licensed blaster. Clause C16: INFRINGEMENT WARRANTY The Contractor hereby: Warrants to the Employer that he has the right to perform the contract works; Warrants that in so performing the contract works that he shall not infringe the rights of any other person. Clause C17: SITE OFFICE FOR USE BY CLIENT AND CLIENTS CONSULTANTS The Contractor to provide Air conditioned office accommodation for meetings suitable for 20 persons as well as additional air conditioned office space for two workstations complete with desks , internet data connection and chairs. The office accommodation is to be kept clean and fit for use at all times. CLAUSE C18 ADDITIONAL PRELIMINARY REQUIREMENTS				
	Carried Forward		R		

	Brought Forward		R		
	Note: The condition of Contract and Payment Condition shall be in accordance with the Principal Building Agreement as detailed in the above Preliminary and General Items. The method of measurements and payment of items in the Bills of Quantities shall be in accordance with the specifications and the document titled "Standard Specifications for Municipal Civil Engineering Works".The tenderer must price against the following items for any cost associated with complying with the requirements of the above documents, where such requirements are not covered by the Preliminary and General in section A, B and C above				
1/1/114	GENERAL (Series 0) Section 001: General Requirements and Preliminary & General charges compliance (001.01)	Item			
1/1/115	Locate existing services 001.02	Item			
1/1/116	Extra over item 001.02, location of existing services for cross cuts as per City of Tshwane requirements and specifications for wayleave approval. PIC001.02.01	Item			
1/1/117	Excavate by hand to expose existing services and backfill 001.03	Item			
1/1/118	Extra over item 001.03, excavate by hand to expose existing services and backfill cross-cuts as per CoT requirements for wayleave approval	Item			
	Environmental Management PIC001.06				
	Carried Forward		R		
	Section No. 1 PRELIMINARIES Bill No. 1				

	Brought Forward		R		
1/1/119	Compliance with Environmental Management Plan PIC001.06.01	Item			
1/1/120	Environmental Control Officer PIC001.06.02	Item			
	Additional survey requirements				
1/1/121	Survey by contractor to determine setting out coordinates to engineers approval PIC 002.04.01	Item			
1/1/122	Checking and confirmation of survey of setting out details by independent contractor to engineers approval PIC 002.04.02	Item			
	Documents Managements				
1/1/123	All documentation for this project to be managed and controlled with BIM 360 and the contractor is to make his own arrangements and allow all cost associated in complying with the requirements.	Item			
	Community liaison officer				
1/1/124	Monthly Wage COT Level rate p/m	Item			
	Carried Forward		R		

	BILL NO 1 - PRELIMINARY AND GENERAL	Page No		Amount
01	PRELIMINARIES	-50-		
	TOTAL CARRIED TO FINAL SUMMARY		R	

Item No	Description	Unit	Quantity	Rate	Amount
	BILL NO 2 - BULK EARTHWORKS				
SERIES 1	**ANCILLARY WORK**	-50-			
Section 101	**Site Clearing and Grubbing**				
101.01.01	Areas	m²	10,361		
101.01.02	Strips up to 1m wide	m	1,072		
101.02	**Cutting and removing large trees with a girth -**				
101.02.01	exceeding 1m and up to and including 2m	no	11		
101.03	**Grubbing and the removal of the girth -**				
101.03.01	exceeding 1m and up to and including 2m	no	11		
101.05	**Removal and disposal of specific elements**				
101.05.01	Concrete kerbing / kerbing combinations	m	525		
101.05.02	Concrete or brick elements (reinforced or unreinforced)				
101.05.02.01	Concrete elements (unreinforced)	m³	2,385		
101.05.02.02	Concrete elements (reinforced)	m³	804		
101.05.02.03	Brick structures (incl walls)	m³	50		
101.05.03	Asphalt surfacing	m²	982		
PIC101.05.04	Interlocking / non-interlocking paving blocks	m²	1,120		
PIC101.07	**Removal and disposal of rubble not measurable elsewhere**	m³	500		
	Total Carried to Summary			**R**	

Item No	Description	Unit	Quantity	Rate	Amount
SERIES 2	**EARTHWORKS**				
Section 202	**Trenching**				
202.01, PIC 202.01	**Trench excavation**	-50-			
202.01.01	**0m to 1,0m wide**				
202.01.01.02	Over 1,0m deep and up to 1,5m deep	m^3	851		
202.01.01.03	Over 1,5m deep and up to 2,0m deep	m^3	52		
202.01.01.04	Over 2,0m deep and up to 2,5m deep	m^3	250		
202.01.01.05	Over 2,5m deep and up to 3,0m deep	m^3	536		
202.02	Extra over items 202.01 for excavating in:				
202.02.01	Intermediate excavation	m^3	273		
202.02.02	Hard material	m^3	496		
202.03	Excavations and backfill outside the normal trench profile	m^3	72		
202.04	Hand Excavation (Extra over 202.01)	m^3	540		
202.06	The backfilling of trenches excluding backfill around pipe barrel with material obtained from excavation.	m^3	1,254		
202.07	Extra over items 202.06 for using backfill material obtained				
202.07.01	From borrow areas	m^3	557		
202.07.02	From sources provided (reinforced or unreinforced)	m^3	526		
202.10	Removal of spoil material -				
202.10.01	To positions indicated on the Drawings or by the Engineer.	m^3	-821		
202.10.02	To dumping areas to be provided by the Contractor	m^3	304		
202.12	Extra over item 202.06 for additional compaction of backfill to 93% of modified AASHTO density in road reserves	m^3	100		
202.15	Reinstatement of bitumen surfaced roads	m^2	982		
	Total Carried to Summary			**R**	

ITEM	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
SERIES 2	**EARTHWORKS**				
Section 203	**Mass Earthworks** *Ref Dwgs: 1600073-08-81-C-501 - 522*				
203.03, PIC **203.03, PIC** **203.03A**	**Excavate and spoil of -**				
203.03.01	Soft material	m³	60,880		
203.03.02	Intermediate material	m³	73,359		
203.03.03	Hard material	m³	58,391		
203.03.04		m³	20,136		
203.03.05	Boulder material class B	m³	20,136		
	(reinforced or unreinforced)				
	Total Carried to Forward			**R**	

ITEM	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
	Total Brought Forward			**R**	
203.08	**Preparation and compaction of construction bed material to 90% of modified AASHTO density**	m^3	500		
)3.10, PIC 203.1	**In situ treatment of the construction bed**				
203.10.01	In situ treatment by ripping	m^3	1,541		
203.10.02	In situ treatment by blasting	m^3	3,083		
)3.11, PIC 203.1	**Finishing off slopes**				
203.11.01	Excavation slopes	m^2	8,211		
	Total Carried to Summary			**R**	

Item No	Description	Unit	Quantity	Rate	Amount
SERIES 3	**SEWERS**				
Section 302	**Construction**				
	Ref Dwgs: 1600073-08-81-C-201	-50-			
)2.01, PIC 302.(	**Supplying, laying and jointing of sewer pipes irrespective of depth or width of trench**				
301.01.01	250mm uPVC PIPE 400kPa (SABS 1601)	m	220		
301.01.02	315mm uPVC PIPE 400kPa (SABS 1601)	m	70		
302.02	**Constructing of pipe beddings**				
302.02.01	Class B bedding				
302.02.01.01	250mm uPVC PIPE Class 34	m^3	84		
301.02.01.02	315mm uPVC PIPE Class 34	m^3	30		
302.03	**Concrete encasing of pipes**	m^3	25		
302.06	**Construction of vertical**				
	Ref Dwgs: 7515-S206				
302.06.02	Type D (4) house connections:				
302.06.02.02	Exceeding 1,5m but not exceeding 2,0 m in depth	No	4		
302.08	**Marker blocks**	No	2		
302.09	**(reinforced or unreinforced) deep**				
302.09.01	For sewers 315mm in diameter and smaller				
302.09.01.01	1.2m diameter manhole, refer to Dwg CoT -7515-S101	No	3		
302.10	**Extra-over item 302.09 for the construction of manholes in excess of 1.0m deep** *Ref Dwgs: 7515-S203*				
302.10.01	For sewers 315mm in diameter and smaller	No	7		
302.12	**Supplying and installing manhole covers and frames**				
302.12.03	Precast concrete cover with type 2A CI frame	No	10		
302.12.04	Precast concrete cover with type 4 CI frame	No	10		
	Total Carried to Forward			**R**	

Item No	Description	Unit	Quantity	Rate	Amount
	Total Brought Forward			**R**	
302.14	**Supplying and placing selected backfill material around and up to to 300mm above pipe barrels using**				
302.14.01	Excavated material	m^3	25		
302.14.02	Imported material	m^3	10		
302.16	**Connecting to existing manholes** *Ref Dwgs: 7515-S210*				
302.16.01	250mm pipe diameter, all classes	No	15		
302.16.02	315mm pipe diameter, all classes	No	15		
302.20	**Preliminary work prior to the construction of a manhole on an existing pipeline**				
302.20.01	250mm UPVC sewer pipe	No	15		
302.20.02	315mm UPVC sewer pipe	No	15		
	Total Carried to Summary			**R**	

Item No	Description	Unit	Quantity	Rate	Amount
SERIES 3	**SEWERS**				
Section 303	**Testing**				
303.01	**Testing of manhole**	-50- No	7		
303.02	**Air testing of sewers**				
303.02.02	250mm	m	220		
303.02.02	315mm	m	70		
	Total Carried to Summary			**R**	

Item No	Description	Unit	Quantity	Rate	Amount
SERIES 4	**WATER RETICULATION AND WATER MAINS** *Ref Dwgs: 1600073-08-81-C-101*				
		-50-			
Section 402	**Construction**				
02.01, PIC 402.0	**Supplying, laying and jointing of water pipes irrespective of depth:**				
402.01.01	PVC-U class 12 pipes with spigot and socket joints				
402.01.01.06	250mm Ø	m	667		
402.02.01	**Bends (Class 12)**				
402.02.01.01	250mm Ø x 11,25 deg (reinforced or unreinforced)	No	20		
402.02.01.02	250mm Ø x 22.5 deg	No	20		
402.02.01.03	250mm Ø x 45 deg	No	20		
402.02.01.04	250mm Ø x 90 deg	No	20		
402.02.02.02	250mm Ø - 160mm Ø unequal tees	No	7		
402.02.04	End caps (Class 12)				
402.02.04.02	250mm Ø	No	20		
	Total Carried to Forward			**R**	

ITEM	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
	Total Brought Forward			**R**	
402.04	**Providing thrust blocks using class 15/19 concrete** *Ref Dwgs: 7515-W210*	m³	1		
402.05	**Supplying and placing unscreened selected backfill material** *Ref Dwgs: 7515-W211*				
402.05.01	Material from trench excavations, other trenches or other	m³	26		
402.05.02	Material from commercial sources	m³	26		
402.06	Extra over item 402.05 for screening excavated material for selected backfill	m³	10		
402.07	**Valve chambers complete for -** *Ref Dwgs: 7515-W203*				
402.07.01	Gate valves not exceeding 250 mm in dia:				
402.07.02.01	250 mm Ø	No	5		
402.08	**Installation of marker blocks** *Ref Dwgs: 7515-W203*				
402.08.01	Concrete marker blocks	No	2		
402.10	**Sterilizing of pipelines**				
402.10.01	250mm Ø	m	667		
	Total Carried to Forward			**R**	

ITEM	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
	Total Brought Forward			**R**	
B402.12	**Miscellaneous items**				
B402.12.01	Connect to existing reticulation and switch over to new system.	Lump sum	1		
B402.12.02	Remove and replace existing water connections and meters for pipe diameters:				
402.12.02.01	50mm	No	10		
402.12.02.02	110mm	No	10		
402.12.02.03	160mm	No	10		
402.12.02.04	200mm	No	10		
402.12.02.05	250mm	No	10		
	Total Carried to Summary			**R**	

Item No	Description	Unit	Quantity	Rate	Amount
SERIES 4	**WATER RETICULATION AND WATER MAINS**				
SECTION 403	**SECTION 403 : TESTING**	-50-			
403.01	Hydraulic field-testing of pipelines				
403.01.01	250mm Ø	m	667		
	Total Carried to Summary			**R**	

Item No	Description	Unit	Quantity	Rate	Amount
SERIES 5	**DRAINAGE AND EROSION PROTECTION** *Ref Dwgs: 1600073-08-81-C-301*				
Section 502	**Prefabricated Culverts, Stormwater**	-50-			
502.02.01.01	450mm Ø	m	115		
502.10	**Cast in situ concrete** *Ref Dwgs: 1600073-08-81-C-310*				
502.10.03	Inlet and outlet structures, catchpits, manholes and junction boxes. Including form work, reinforcing and surface finishes.				
502.10.03.01	Class 20/19	m^3	5		
	Total Carried to Forward			**R**	

ITEM	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
	Total Brought Forward			**R**	
502.16	**Manholes, catchpits, precast inlet and outlet structures and junction boxes complete**				
502.16.01	Manholes	No	3		
502.16.02	Catchpits	No.	1		
502.20	**Accessories**				
502.20.01	Manhole covers including frames				
502.20.01.02	Combination precast concrete / cast iron frame and cover	no	3		
502.20.03	Step Irons	no	10		
502.20.04.01	Catchpit cover slabs Class 25/19 concrete	no	5		
	Total Carried to Summary			**R**	

Item No	Description	Unit	Quantity	Rate	Amount
SERIES 5	**DRAINAGE AND EROSION PROTECTION**				
Section 504	**Open Drains** *Ref Dwgs: 1600073-08-81-C- 301-310*				
504.04	**Channels**				
504.04.01	300mm wide (top width) V-Drain. (The tendered rate shall include full compensation for procuring,furnishing and installing the channel complete in all respects including excavation where necessary by hand, trimming the excavations and disposing of excavation material as directed by the Engineer.	Lump Sum			
	Total Carried to Summary			**R**	

	BILL NO 2 - BULK EARTHWORKS SUMMARY	Page No		Amount
SERIES 1	**ANCILLARY WORK**			
101	Site Clearing and Grubbing	-52-		
SERIES 2	**EARTHWORKS**			
202	Trench Excavation	-53-		
203	Mass Earth Works	-55-		
SERIES 3	**SEWERS**			
Section 302	Construction	-57-		
Section 303	Testing	-58-		
SERIES 4	**WATER**			
Section 402	Construction	-61-		
Section 403	Testing	-62-		
SERIES 5	**DRAINAGE AND EROSION PROTECTION**			
502	Prefabricated Culverts and stormwater	-64-		
504	Erosion Protection	-65-		
	TOTAL CARRIED TO FINAL SUMMARY		**R**	

Item No	Description	Unit	Quantity	Rate	Amount
	BILL N0 3 - LATERAL SUPPORT				
	SERIES 7: STRUCTURES				
	SECTION PIC708: GROUND ANCHORS AND SHOTCRETE				
	PIC708.04: Ground Anchors				
PIC708.04.01	Moving to and setting up the equipment at each position for drilling the holes	number (No)	2,439		
PIC708.04.02	**Drill holes with diameter of 115mm to the specified depths and inclinations of 10O below the horizontal**				
a	0 - 6m	m	15,246		
b	6m to 9m	m	6,237		
c	9m to 12m	m	3,860		
PIC708.04.03	Water Tests	number (No)	2,439		
PIC708.04.04	Grouting and Re-drilling	m	7,603		
PIC708.04.05	**Anchorages and Couplers**				
a	Bars with anchorage at Jacking End				
i.	High Yield 25mm Bars x 12m - 220kN	No.	1,233		
ii	High Yield 25mm Bars x 9m - 220kN	No.	729		
iii		No.	437		
iv	High Yield 25mm Bars x 4m - 220kN	No.	40		
b	Coupler at Jacking End				
i.	High Yield 25mm Bars - 220kN	No.	2,439		
PIC708.04.06	Extra Over for Establishment on site for SDA Drilling Equipment	Lump Sum	1		
PIC708.04.07	**Extra Over for SDA Drill holes with diameter of 115mm to the specified depths and inclinations of 10O below the horizontal**				
i.	R25N Hollow Bar	m	72		
ii	R32S Hollow Bar	m	72		
PIC708.04.08	Grouting of Anchors	m	25,343		
	Total Carried to Forward			**R**	

Item No	Description	Unit	Quantity	Rate	Amount
	Total Brought Forward			**R**	
	708.07: SHOTCRETE				
PIC708.07.01	drawings	m2	7,900		
703	Steel Reinforcement for Structures				
703.03	Welded Steel Fabric				
703.03.01	In shotcrete walls both faces				
703.03.01.01	Mesh Ref. 395	t	63		
703.04	Reinforcement for gunite wall corners				
703.04.02	High yield steel				
703.04.02.02	Bars with a 10mm dia (Y10)	t	1		
PIC708.07.02	Subsoil Drainage				
i	Zipcore drain at 1.5m/2m centres	m	6,500		
ii	75mm uPVC outlets to drainage layer	m	130		
PIC708.07.03	Monitoring	Lump Sum	1		
PIC708.07.04	Finishing of shotcrete along brow of cut face	m	530		
	Total Carried to Summary			**R**	

	BILL NO 3 - LATERAL SUPPORT SUMMARY	Page No		Amount
SERIES 7	STRUCTURES	-68-		
	TOTAL CARRIED TO FINAL SUMMARY		R	

BILL NO	FINAL SUMMARY	Page No		Amount
1	**PRELIMINARY AND GENERAL**	-51-		
2	**BULK EATHWORKS**	-66-		
3	**LATERAL SUPPORT**	-69-		
	SUB-TOTAL			
	Contingencies			
	Allow a contingency amount at 5% of the contract amount to be used as directed by the Employer.	%		
			R	
	ADD: VALUE ADDED TAX @15%		**R**	
	TOTAL CARRIED TO FORM OF TENDER		**R**	

SECTION 5

DAYWORK RATES

DAYWORK RATES

DAYWORK AND EQUIPMENT RATES

DAYWORK RATES

Where in the opinion of the Principal Agent any extra work cannot properly be measured or valued, the Contractor shall be allowed Daywork rates therefore, as stated herein or, if not so stated, then calculated upon the net cost of the materials used at the then current market value plus the percentage addition stated herein together with the labour and plant costs involved. The total thus arrived at shall be the total amount recoverable by the Contractor for performing such work.

The cost to the Contractor or sub-contractor of materials, being the net cost (at current market prices) actually paid for such materials after the deduction of cash discounts or if materials are supplied from the Contractor's or sub-contractor's stock then the cost of such materials shall be based upon the current market price plus the cost of delivery to Site; to which nett cost 5 per cent thereof shall be added.

The cost of labour to the Contractor or sub-contractor, being all items of direct cost of labour actually remunerated to the workmen concerned which shall include the cost of all allowances in terms of the Industrial Conciliation Act (where applicable) or any other wager determination applying in the area or any other charge or expense which is normally binding as well as all statutory levies to education and training funds as may be applicable relating to the class or labour concerned at the time when and in the area where the Daywork is executed to which labour costs 10 per cent shall be added.

Hourly base rates for labour shall be the current market rates for labour based upon standard working hours and shall be applied in respect of the time spent by workers directly engaged on the particular Dayworks including any operators operating mechanical plant and transport and erecting and dismantling other plant.

If a claim is made that individual workmen have been paid wages and allowances in excess of the minimum legalised rates, then proof must be furnished that such workmen had been so paid prior to the commencement of the extra work referred to.

Time lost due to inclement weather shall be excluded from the time charged.

Other direct cost, being any related to direct costs such as mechanical plant and transport, other than costs of material and labour and shall be the nett costs thereof without any percentage added.

The rates for mechanical plant shall be commercial hire rates current at the time of executing the Daywork and shall include fuel and insurance costs.

The above percentages shall cover head office charges; site staff including site supervision; third party and Contractor's workmen's compensation and unemployment insurance fund contributions; use, repair and sharpening of non-mechanical hand tools; use of erected scaffolding, staging trestles and the like; use of tarpaulins, protective clothing, artificial lighting, safety and welfare facilities, storage and the like as may be available on the Site; and profit. Supporting vouchers reflecting the time spent and materials used each week shall be delivered for verification to the Principal Agent, or an agent appointed by the Principal Agent, not later than twenty-one days after the end of the week concerned. Should the Contractor fail to submit the vouchers within this time, the Principal Agent, or an agent appointed by the Principal Agent, shall determine a fair price for the work.

When calculating Daywork rates, it shall be understood that:

i) the time of gangers and charge hands working with their gangs shall be paid for under the appropriate items but the time of foremen, Engineers, site agents and the like shall not be included, being covered by site supervision and staff and be included in the Preliminary and General Items;

ii) wage rates must be supplied for all categories of labour required for the execution of the Contract. Where a rate is not provided the most appropriate rate in the opinion of the Principal Agent will be selected from those supplied and the work executed under this schedule will be priced on this basis. Wage rates shall include wages, direct supervision, profit and consumables (i.e. welding rods, cleaning materials, etc.);

iii) the Employer shall be entitled to the use of any of the Contractor's plant available on Site for Daywork purposes. A rate for the use of such plant must be provided for each type of plant normally available on

Site. Where the Contractor has plant on Site for which a Daywork rate has not been provided, it shall be deemed that the costs related to such item of plant has been included in Preliminary and General Items and such plant will be available for use in the execution of Daywork at no further charge to the Employer. The rates submitted are deemed inclusive of Driver/Operator and all fuels, lubricants, maintenance and profit.

Where the Contractor does not have a required item of plant of site, negotiations will be made for such plant to be obtained for hire form any other source and such negotiations will be the subject of a separate agreement;

iv) any materials supplied under the Schedule where a rate therefore is provided elsewhere in the Tender, such rate will be applied for work executed at Daywork rates;

v) rates quoted herein shall be on the same basis as per all other prices and/or rates.

DAYWORKS RATES SCHEDULES

DAYWORK RATES SCHEDULES

WAGE RATES

Categories of Labour	Rate / hour Normal	Rate / hour Overtime

MATERIALS

Percentage addition on net cost of materials not already included in the Contract to cover Contractor's profit, waste, etc.:

……%

PLANT AVAILABLE ON SITE

Description	Wet Rate / hour	Wet Rate / hour standing time

SECTION 6

RETURNABLE DOCUMENTS REQUIRED FOR TENDER EVALUATION PURPOSES

6.1 SITE VISIT CERTIFICATE

CERTIFICATE OF TENDERER'S VISIT TO SITE

This is to certify that I, ...

Contractor of (Company) .....

_____ .....

In the presence of (Witness) .....

.....

Visited the Site on (Date) .....

Having previously studied the contract documents including the drawings as used for the preparation of the Bill of Quantities, I carefully examined the Site.

I have made myself familiar with all local conditions that are likely to influence the work and the cost thereof.

I further certify that I am satisfied with the description of the work and that I understand perfectly the work to be done, as specified and implied for the execution of this contract.

_____
Contractor

_____
Witness

6.2 PROGRAM OF WORKS

6.3 METHOD STATEMENT

6.4 PROOF OF PLANT AND EQUIPMENT

PROOF OF PLANT AND EQUIPMENT

Description	Owned	Leased (Letter required if leased)

6.5 SCHEDULE OF DEVIATIONS

SCHEDULE OF DEVIATIONS

The extent of deviations from the tender documents issued by the Employer prior to the tender closing date is limited to those permitted in terms of the Conditions of Tender.

A Tenderer's covering letter shall not be included in the final contract document. Should any matter in such, letter, which constitutes a deviation as aforesaid become the subject of agreements reached during the process of, offer and acceptance, the outcome of such agreement shall be recorded here.

Any other matter arising from the process of offer and acceptance either as a confirmation, clarification or change to the tender documents and which it is agreed by the Parties becomes an obligation of the contract shall also be recorded here.

Any change or addition to the tender documents arising from the above agreements and recorded here, shall also be incorporated into the final draft of the Contract.

PAGE	CLAUSE OR ITEM

By the duly authorised representatives signing the Schedule of Deviations, the Employer and the Tenderer agree to and accept the foregoing Schedule of Deviations as the only deviations from and amendments to the documents listed in the Tender Data, as well as any confirmation, clarification or change to the terms of the offer agreed by the Tenderer and the Employer during this process of offer and acceptance.

It is expressly agreed that no other matter whether in writing, oral communication or implied during the period between the issue of the tender documents and the receipt by the Tenderer of a completed signed copy of this Agreement shall have any meaning or effect in the contract between the parties arising from this Agreement.

For the Tenderer		For the Employer
……..	Signature	……..
……..	Name	……..
……..	Capacity	……..
Name and address of organisation		Name and address of organisation
……..		……..
……..		……..
……..	Witness Signature	……..
……..	Witness Name	…….
……	Date	…….

6.6 LIST OF SUBCONTRACTORS

LIST OF SUBCONTRACTORS

In terms of the conditions of this Tender, we submit the following names of sub-contractors who may be called upon to execute portion/s of the Contract Works in the disciplines mentioned:

SUB-CONTRACTOR	WORK DISCIPLINES

IF NOT USED, BAR AND INITIAL THE SPACE.

SIGNATURE OF TENDERER:

……..

COMPANY STAMP:

……..

……..

……..

……..

……..

ADDRESS:

……..

……..

……..

6.7 PROPOSED ORGANOGRAM

6.8 SCHEDULE OF EXPERIENCE

SCHEDULE OF EXPERIENCE

As required in the Instruction to Tenderers I/we furnish herewith evidence of my/our experience in work similar to the work described in this Tender.

AUTHORITY	NATURE OF WORK	VALUE	YEAR COMPLETED

IF NOT USED, BAR AND INITIAL THE SPACE.

SIGNATURE OF TENDERER:

……..

COMPANY STAMP:

……..

……..

……..

……..

……..

ADDRESS:

……..

……..

……..

6.9 AUTHORITY OF SIGNATORY

AUTHORITY FOR SIGNATORY

Signatories for companies shall confirm their authority thereto by attaching a duly signed and dated copy of the relevant of the board of directors, to this form

An example is shown below:

By resolution of the Board of Directors passed at a meeting held on _____

Mr/Mrs _____ whose signature appears below, has been duly authorised to sign all documents in connection with the Tender for

Sunnyside Office Development Bulk Earthworks, Lateral Support and Services Relocation and any Contract which may arise thereon on

Behalf of _____

(Block capitals) _____

_____

SIGNED ON BEHALF OF THE COMPANY : _____

IN HIS/HER CAPACITY AS : _____

DATE : _____

SIGNATURE OF SIGNATORY : _____

WITNESSES : _____

6.10 FINANCIAL INFORMATION

FINANCIAL INFORMATION

ANNUAL TURNOVER 2017:

ANNUAL TURNOVER 2018:

ANNUAL TURNOVER 2019:

Attach business latest audited financial statements. If not attached, please provide reasons:

List of major suppliers with contact persons and telephone numbers:

SUPPLIER NAME **CONTACT PERSON** **TEL**

1._____

2._____

3._____

INSURANCE HELD BY SELECTED SUB-CONTRACTOR (Please specify insurance company as well as limit of cover).

SELECTED SUB-CONTRACTOR'S INDEMNITY: COMPANY: .....

LIMIT: .....

PUBLIC LIABILITY: ..... COMPANY: .....

LIMIT: .....

GUARANTEE: ..... COMPANY: .....

LIMIT: .....

6.11 MATERIALS ON SITE

MATERIALS ON SITE

APPLICATION FOR ADVANCE IN RESPECT OF UNFIXED MATERIALS ON SITE

CONTRACTOR : _____

PROJECT : _____

EMPLOYER : _____

I/We, hereby apply an advance in respect of unfixed Materials on Site to the value of

R _____ all as indicated on the attached schedule

I/We certify that these materials have been supplied without suspensive condition and are my/our bone fide property, ownership of which has passed to me/us according to law, and attached hereto the following:

1. Proof of ownership of the said materials
2. Cession of rights in accordance with page 3 hereof
3. Proof of insurance
4. Proof of constructive delivery
5. Written acceptance of the materials by the architect

or

Indemnity in favour of the Employer against any loss which the Employer may suffer as the result of payment for unfixed materials

_____ _____

Date For and on behalf of the Contractor who by his Signature warrants that he is authorised hereto

_____

As witness

SCHEDULE OF MATERIALS AND GOODS ON SITE

ITEM NO.	DESCRIPTION	QUANTITY	RATE	AMOUNT
			SUB-TOTAL R	
			15% VAT R	
			TOTAL R	

6.12 DECLARATION OF CRIMINAL RECORD

DECLARATION OF CRIMINAL RECORD

I / We the under-mentioned in my / our capacity as indicated hereby declare that there are no criminal proceedings being instituted neither are any such investigation pending against me / us or that I / we have previously been found guilty of theft or fraud.

Full Name(s)	ID Number	Capacity	Signature
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			

THUS DONE and SIGNED at _____

On this _____ day of _____

_____

TENDERER(S) DULY AUTHORISED SIGNATORY

WITNESSES: 1. _____ 2. _____

6.13 SUPPLY OF ADDITIONAL INFORMATION

SUPPLY OF ADDITIONAL INFORMATION

Tender number:	
Tender invited for:	**Sunnyside Office Development Bulk Earthworks, Lateral Support and Services Relocation**

Further conditions of Tender:
It is a further condition of tender that PUBLIC INVESTMENT CORPORATION reserves the right to call from any Tenderer for any further relevant information which information must be forthcoming within a stipulated period for the tender to remain valid.

6.14 DECLARATION OF GOOD STANDING REGARDING TAX

DECLARATION OF GOOD STANDING REGARDING TAX

CURRENT TENDER DETAILS	
Tender number:	
Tender invited for:	**Sunnyside Office Development Bulk Earthworks, Lateral Support and Services Relocation**

It is a further condition of tender that:	
1	The taxes of any Tenderer be in order or suitable arrangements to the satisfaction of the SA Revenue Service have been made in this regard.
1.1	The required Declaration(s) be duly completed in respect of all tenders, the omission of which may render any such tender invalid.
1.1.1	Any Company, Close Corporation or each Partner to a Partnership, Member of an Association, Party to a Consortium, Partner of a Joint Venture, Sub-contractor *etc.* completes a separate Declaration.
1.2	In the event of a Declaration being found to be incorrect, PUBLIC INVESTMENT CORPORATION, in addition to any other remedy it may have, shall have the right to –
1.2.1	recover from the Contractor all costs, losses or damages incurred or sustained as a result of the award of the contract; and / or
1.2.2	***cancel the contract and claim any damages which may be suffered by having to make less favourable arrangements after such cancellation; and / or***
1.2.3	Impose on the Contractor a penalty not exceeding five per cent of the value of such contract.

DECLARATION

SOUTH AFRICAN REVENUE SERVICE	Tender No Closing Date :

DECLARATION OF GOOD STANDING REGARDING TAX

PARTICULARS

1. NAME OF TAXPAYER / TENDERER :
_____

2. TRADE NAME : _____

3. IDENTIFICATION NO : (If applicable)	
4. COMPANY / CLOSE CORPORATION REGISTRATION NO :	
5. INCOME TAX REFERENCE NO :	
6. VAT REGISTRATION NO : (If applicable)	
7. PAYE EMPLOYER'S REGISTRATION NO : (If applicable)	
8. MONETARY VALUE OF TENDER :	

DECLARATION

It is hereby declared that the Income Tax, Employees Tax (PAYE plus SITE) and Value-Added Tax (VAT) obligations of the above-mentioned taxpayer, which include the rendition of returns and payment of the relevant taxes :

(i) have been satisfied in terms of the relevant Acts; or

(ii) * that suitable arrangements have been to the satisfaction of the Receiver of Revenue,

SIGNATURE CAPACITY DATE

PLEASE NOTE: ** The declaration (ii) cannot be made unless formal written arrangements have been made with the Receiver of Revenue with regard to any outstanding payments / outstanding tax returns.*

6.15 DECLARATION OF INTEREST

DECLARATION OF INTERESTS

Please complete the following questionnaire:

1. Any legal person, including persons employed by the state[1], or persons having a kinship with persons employed by the state, including a blood relationship, may make an offer or offers in terms of this invitation to bid (includes a price quotation, advertised competitive bid, limited bid or proposal). In view of possible allegations of favouritism, should the resulting bid, or part thereof, be awarded to persons employed by the state, or to persons connected with or related to them, it is required that the bidder or his/her authorized representative declare his/her position in relation to the evaluating/adjudicating authority where-
   1.1. the bidder is employed by the state; and/or
   1.2. the legal person on whose behalf the bidding document is signed, has a relationship with persons/a person who are/is involved in the evaluation and or adjudication of the bid(s), or where it is known that such a relationship exists between the person or persons for or on whose behalf the declarant acts and persons who are involved with the evaluation and or adjudication of the bid.
2. In order to give effect to the above, the following questionnaire must be completed and submitted with the bid.

   2.1. Full Name of bidder or his or her representative:

   ……

   2.2. Identity Number:

   ……

   2.3. Position occupied in the Company (director, trustee, shareholder[2]):

   ……

   2.4. Company Registration Number:

   ……

   2.5. Tax Reference Number:

   ……

   2.6. VAT Registration Number:

   ……

[1] "State" means –

a. any national or provincial department, national or provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act No. 1 of 1999);
b. any municipality or municipal entity;
c. provincial legislature;
d. national Assembly or the national Council of provinces; or
e. Parliament.

[2] Shareholder" means a person who owns shares in the company and is actively involved in the management of the enterprise or business and exercises control over the enterprise.

2.7. The names of all directors / trustees / shareholders / members, their individual identity numbers, tax reference numbers and, if applicable, employee / persal numbers must be indicated in paragraph 3 below.

……

……

……

……

2.8. Are you or any person connected with the bidder presently employed by the state? **YES / NO**

2.8.1. If so, furnish the following particulars:

Name of person / director / trustee / shareholder/ member: ..……

Name of state institution at which you or the person connected to the bidder is employed:

……

……

……

Position occupied in the state institution: ……
Any other particulars:

……

……

……

2.8.2. If you are presently employed by the state, did you obtain the appropriate authority to undertake remunerative work outside employment in the public sector? **YES / NO**

2.8.2.1. If yes, did you attached proof of such authority to the bid document? **YES / NO**

Note: Failure to submit proof of such authority, where applicable, may result in the disqualification of the bid.

2.8.2.2. If no, furnish reasons for non-submission of such proof:

……..

……..

……..

2.8.3. Did you or your spouse, or any of the company's directors / trustees / shareholders / members or their spouses conduct business with the state in the previous twelve months? **YES / NO**

2.8.3.1. If so, furnish particulars:

……

……..

…….

2.9. Do you, or any person connected with the bidder, have any relationship (family, friend, other) with a person employed by the state and who may be involved with the evaluation and or adjudication of this bid? **YES / NO**

2.9.1. If so, furnish particulars.

…….
…….
…….

2.10. Are you, or any person connected with the bidder, aware of any relationship (family, friend, other) between any other bidder and any person employed by the state/PIC who may be involved with the evaluation and or adjudication of this bid? **YES/NO**

2.10.1. If so, furnish particulars.

…….
…….
…….

2.11. Do you or any of the directors / trustees / shareholders / members of the company have any interest in any other related companies whether or not they are bidding for this contract? **YES/NO**

2.11.1. If so, furnish particulars:

…….
…….
…….

3. Full details of directors / trustees / members / shareholders.

Full Name	Identity Number	Personal Tax Reference Number	State Employee Number / Personnel Number

DECLARATION

I, THE UNDERSIGNED (NAME)……

CERTIFY THAT THE INFORMATION FURNISHED IN PARAGRAPHS 2 and 3 ABOVE IS CORRECT.

I ACCEPT THAT THE PIC MAY REJECT THE BID OR ACT AGAINST ME SHOULD THIS DECLARATION PROVE TO BE FALSE.

……. ……
Signature Date

……. ……
Position Name of bidder

6.16 COMPANY INFOMATION

COMPANY INFORMATION

Please complete the following questionnaire:

1. COMPANY NAME:

2. OTHER TRADING NAMES:

3. TYPE OF ORGANIZATION: (PUBLIC COMPANY ('LIMITED'), PRIVATE COMPANY ('(PTY) LTD'), CLOSE CORPORATIONS ('CC'))

4. PHYSICAL AND POSTAL ADDRESS OF THE COMPANY:

Postal Code:	**Postal Code:**

5. CONTACT DETAILS

Contact Name	
Contact Number	
Cell Number	
Email Address	
Alternative Contact	
Email Address	
Contact Number	

6. COMPANY INFORMATION

Average no. of employees:	
Average annual turnover:	
Type of Enterprise: (e.g. Generic, Qualifying small enterprise, Exempted Micro Enterprise)	
Industry in which the entity operates:	

7. BANKING DETAILS

Banker:	
Auditor:	
Year of Establishment:	
Registration number of entity:	
Sector:	

*A letter from your

bank with a bank stamp or cancelled cheque must be submitted.

7. TAX REGISTRATION DETAILS:

Income Tax Reference Number:	
VAT Registration Number:	
PAYE Registration Number:	

8. LIST OF SHAREHOLDERS:

***ID Documents of board of directors/members, owners, shareholders or executive committee must be submitted.**
*** CIPC Documents must be attached.**

B-BBEE (Broad-based Black Economic Empowerment) Status Details:
Please tick the relevant box(es):

STATUS	INDICATION
The company has been independently verified (assessed / rated / certified) *Please submit the B-BBEE verification certificate.*	☐
The company is in the process of being verified. Please submit letter from verification agency. *(i.e. verification to be completed within a maximum of 2 months)*	☐

1.Declaration

Bidder Name: _____

Signature: _____

Designation: _____

I declare that:

- All information provided is true and correct
- The signatory of the bid document is duly authorised
- Documentary proof regarding any bid issue, will, when required be submitted to the satisfaction of the PIC

PIC will upon detecting that:

- The B-BBEE status level of contribution has been claimed or obtained on a fraudulent basis;
- Any of the conditions have not been fulfilled act against the bidder.

I understand that:

PIC may:

- Disqualify the bidder from the bidding process;
- Recover all costs, losses or damages it has incurred or suffered as a result of the bidder's conduct
- Cancel the contract and claim any damages which has suffered as a result of having less favorable arrangements due to cancellation
- Restrict the bidder, its shareholders and directors or only shareholders and directors who acted on fraudulent basis, from obtaining business from any organ or state for a period not exceeding 10 years after audit alteram partem (hear the other side) rule has been applied; and
- Forward the matter for criminal prosecution

Thus signed and accepted on this _____st / nd / rd / th day of _____ , 20_____ at

_____:

Who warrants his / her authority hereto

For and on behalf of:

_____

6.17 CIDB GRADE CERTIFICATE

6.18 B-BBEE CERTIFICATE

6.19 CERTIFICATE OF TENDERING ENTITY DETAILS

6.20 CONSTRUCTION GUARANTEE

Construction Guarantee

for use with the JBCC Principal Building Agreement

GUARANTOR DETAILS AND DEFINITIONS

Guarantor means _____

Physical address _____

Guarantor's signatory 1 _____ Capacity _____

Guarantor's signatory 2 _____ Capacity _____

Employer means _____

Contractor means _____

Principal Agent means _____

Works means _____

Site means _____

Agreement means The JBCC Series 2000 Principal Building Agreement

Contract Sum means The accepted amount inclusive of tax of _____

Amount in words _____

Guaranteed Sum means The maximum aggregate amount of _____

Amount in words _____

Construction Guarantee *(Insert Variable or Fixed)* _____ *(Insert expiry date)* _____

AGREEMENT DETAILS

Sections: Total sections *(No or n/a)* _____ Last section *(No / Identification or n/a)* _____

Principal Agent issues: Interim payment certificates, Final payment certificate, Practical completion certificate/s and Final completion certificate/s

1.0 VARIABLE CONSTRUCTION GUARANTEE

1.1 Where a variable Construction Guarantee in terms of the Agreement has been selected this 1.0 with 3.0 to 13.0 shall apply. The Guarantor's liability shall be limited to the diminishing amounts of the Guaranteed Sum as follows:

GUARANTOR'S LIABILITY	PERIOD OF LIABILITY
1.1.1 Maximum Guaranteed Sum (not exceeding 10.0% of the contract sum) in the amount of: _____ Amount in words: _____	From and including the date of issue of this Construction Guarantee and up to and including the date of the interim payment certificate certifying in excess of 50% of the contract sum
1.1.2 Reducing to the Guaranteed Sum (not exceeding 6.0% of the contract sum) in the amount of: _____ Amount in words: _____	From and including the day after the date of the aforesaid interim payment certificate and up to and including the date of the only practical completion certificate or last practical completion certificate where there are sections

1.1.3	Reducing to the Guaranteed Sum (not exceeding 4.0% of the contract sum) in the amount of:	From and including the day after the date of the applicable practical completion certificate and up to and including the date of the only final completion certificate or last final completion certificate where there are sections

Amount in words: _____

1.1.4	Reducing to the Guaranteed Sum (not exceeding 2.0% of the contract sum) in the amount of:	From and including the day after the date of the applicable final completion certificate and up to and including the date of the final payment certificate where payment is due to the Contractor, whereupon this Construction Guarantee shall expire. Where the final payment certificate reflects payment due to the Employer, this Construction Guarantee shall expire upon payment of the full amount certified

Amount in words: _____

1.2 For avoidance of doubt the Guarantor's liability limits set out in 1.1.1 to 1.1.4 shall apply in respect of any claim received by the Guarantor during the period in question

2.0 FIXED CONSTRUCTION GUARANTEE

2.1 Where a fixed Construction Guarantee in terms of the Agreement has been selected this 2.0 with 3.0 to 13.0 shall apply. The Guarantor's liability shall be limited to the amount of the Guaranteed Sum as follows:

GUARANTOR'S LIABILITY	PERIOD OF LIABILITY
Maximum Guaranteed Sum (not exceeding 5.0% of the contract sum) in the amount of:	From and including the date of issue of this Construction Guarantee and up to and including the date of the only practical completion certificate or the last practical completion certificate where there are sections, upon which this Construction Guarantee shall expire

Amount in words: _____

3.0 The Guarantor hereby acknowledges that:

3.1 Any reference in this Guarantee to the Agreement is made for the purpose of convenience and shall not be construed as any intention whatsoever to create an accessory obligation or any intention whatsoever to create a suretyship

3.2 Its obligation under this Guarantee is restricted to the payment of money

4.0 Subject to the Guarantor's maximum liability referred to in 1.0 or 2.0 , the Guarantor hereby undertakes to pay the Employer the sum certified upon receipt of the documents identified in 4.1 to 4.3:

4.1 A copy of a first written demand issued by the Employer to the Contractor stating that payment of a sum certified by the Principal Agent in an interim or final payment certificate has not been made in terms of the Agreement and failing such payment within seven (7) calendar days, the Employer intends to call upon the Guarantor to make payment in terms of 4.2

4.2 A first written demand issued by the Employer to the Guarantor at the Guarantor's physical address with a copy to the Contractor stating that a period of seven (7) calendar days has elapsed since the first written demand in terms of 4.1 and that the sum certified has still not been paid therefore the Employer calls up this Construction Guarantee and demands payment of the sum certified from the Guarantor

4.3 A copy of the said payment certificate which entitles the Employer to receive payment in terms of the Agreement of the sum certified in 4.0

5.0 Subject to the Guarantor's maximum liability referred to in 1.0 or 2.0 , the Guarantor undertakes to pay the Employer the Guaranteed Sum or the full outstanding balance upon receipt of a first written demand from the Employer to the Guarantor at the Guarantor's physical address calling up this Construction Guarantee stating that:

5.1 The Agreement has been cancelled due to the Contractor's default and that the Construction Guarantee is called up in terms of 5.0. The demand shall enclose a copy of the notice of cancellation; or

5.2 A provisional sequestration or liquidation court order has been granted against the Contractor and that the Construction Guarantee is called up in terms of 5.0. The demand shall enclose a copy of the court order

6.0 It is recorded that the aggregate amount of payments required to be made by the Guarantor in terms of 4.0 and 5.0 shall not exceed the Guarantor's maximum liability in terms of 1.0 or 2.0

7.0 Where the Guarantor is a registered insurer and has made payment in terms of 5.0, the Employer shall upon the date of issue of the final payment certificate submit an expense account to the Guarantor showing how all monies received in terms of the Construction Guarantee have been expended and shall refund to the Guarantor any resulting surplus. All monies refunded to the Guarantor in terms of this Construction Guarantee shall bear interest at the prime overdraft rate of the Employer's bank compounded monthly and calculated from the date payment was made by the Guarantor to the Employer until the date of refund

8.0 Payment by the Guarantor in terms of 4.0 or 5.0 shall be made within seven (7) calendar days upon receipt of the first written demand to the Guarantor

9.0 The Employer shall have the absolute right to arrange his affairs with the Contractor in any manner which the Employer deems fit and the Guarantor shall not have the right to claim his release from this Construction Guarantee on account of any conduct alleged to be prejudicial to the Guarantor

10.0 The Guarantor chooses the physical address as stated above for all purposes in connection herewith

11.0 This Construction Guarantee is neither negotiable nor transferable and shall expire in terms of either 1.1.4 or 2.1, or payment in full of the Guaranteed Sum or on the Guarantee expiry date, whichever is the earlier, where after no claims will be considered by the Guarantor. The original of this Construction Guarantee shall be returned to the Guarantor after it has expired

12.0 This Construction Guarantee, with the required demand notices in terms of 4.0 or 5.0, shall be regarded as a liquid document for the purpose of obtaining a court order

13.0 Where this Construction Guarantee is issued in the Republic of South Africa the Guarantor hereby consents in terms of Section 45 of the Magistrate's Courts Act No 32 of 1944, as amended, to the jurisdiction of the Magistrate's Court of any district having jurisdiction in terms of Section 28 of the said Act, notwithstanding that the amount of the claim may exceed the jurisdiction of the Magistrate's Court

Signed at _____ Date _____

Guarantor's Signatory 1 _____ Guarantor's Signatory 2 _____

Witness _____ Witness _____

Guarantor's seal or stamp

6.21 WAIVER OF LIEN

Waiver of Contractor's Lien

for use with the JBCC Principal Building Agreement or JBCC Minor Works Agreements

DEFINITIONS

Contractor _____

Employer _____

Agreement _____
(Principal Building Agreement or Minor Works Agreement)

Works *(description)* _____

_____

Site _____
(property title deed description)

AGREEMENT

The Contractor waives, in favour of the Employer, any lien or right of retention that is or may be held in respect of the Works to be executed on the Site

~~This waiver shall only come into effect on provision by the Employer of a Payment Guarantee for fulfilment of his obligations in terms of the identified Agreement~~

Thus done and signed at _____ on _____

_____ _____
Name of signatory Capacity of signatory

_____ _____
As witness For and on behalf of the Contractor who by signature hereof warrants authorisation hereto