



FREE STATE DEPARTMENT OF POLICE, ROADS AND TRANSPORT

PR&T/BID06/2021/22

CONTRACT NUMBER: C104/2021

**APPOINTMENT OF CONSTRUCTION COMPANY FOR THE SPECIAL MAINTENANCE OF
TWEESPRUIT ACCESS ROAD, SS604/S34**

VOLUME 1

Prepared for:

Prepared By:

**FREE STATE DEPARTMENT OF POLICE,
ROADS & TRANSPORT
P.O BOX 690
BLOEMFONTEIN
9301
TEL: +27 51 409 8575
FAX: 086 759 9456
www.fs.gov.za**

**FREE STATE DEPARTMENT OF POLICE,
ROADS & TRANSPORT
P.O BOX 690
BLOEMFONTEIN
9301

www.fs.gov.za**

.....	
NAME OF BIDDER	
R.....	
BID AMOUNT	

**THE SPECIAL MAINTENANCE OF TWEESPRUIT ACCESS ROAD : SS604/S34 FROM (KM 0.0)
TO (KM 6.4KM)**

CONTENTS

<u>SECTION</u>	<u>DESCRIPTION</u>	<u>PAGE</u>	<u>COLOUR</u>

FOREWORD (ii) White

THE TENDER

PART T1	TENDERING PROCEDURES	T1-2	
T1.1	TENDER NOTICE AND INVITATION TO TENDER	T1-3	White
T1.2	STANDARD CONDITIONS OF TENDER	T1-4	Pink
T1.3	TENDER DATA	T1-14	Pink
PART T2	RETURNABLE DOCUMENTS	T2-1	
T2.1	LIST OF RETURNABLE DOCUMENTS	T2-2	Yellow
T2.2	RETURNABLE SCHEDULES	T2-3	Yellow
T2.2.1	RETURNABLE SCHEDULES REQUIRED FOR TENDER EVALUATION PURPOSES	T2-3	Yellow
T2.2.2	PREFERENTIAL PROCUREMENT SCHEDULES AND AFFIDAVIT	T2-33	Yellow
T2.2.3	PRO-FORMS TO BE SUBMITTED BY SUCCESSFUL TENDERER	T2-34	Yellow

THE CONTRACT

PART C1	AGREEMENT AND CONTRACT DATA	C1-1	
C1.1	FORM OF OFFER AND ACCEPTANCE	C1-3	Yellow
C1.2	CONTRACT DATA	C1-7	Yellow
PART C2	PRICING DATA	C2-1	
C2.1	PRICING INSTRUCTIONS	C2-2	Yellow
C2.2	BILL OF QUANTITIES	C2-5	Yellow
PART C3	SCOPE OF WORK	C3-1	
C3.1	STANDARD SPECIFICATIONS	C3-3	Blue
C3.2	PROJECT SPECIFICATIONS	C3-4	Blue
C3.3	PARTICULAR SPECIFICATIONS	C3-76	Blue
PART C4	SITE INFORMATION	C4-1	C4.1
	LOCALITY PLAN	C4-3	Green

FOREWORD

This document consists of two sections, namely the **TENDER** and the **CONTRACT**.

THE TENDER consists of two parts, namely:

- ☐ **T1 : Tendering Procedures** Volume 1
- ☐ to be complied with by every Tenderer submitting a tender offer,
- and
- ☐ **T2 : Documents to be returned by the Tenderer** Volume 1
- ☐ including the returnable schedules and forms to be completed by each Tenderer, some of which will eventually be incorporated into the contract between the successful Tenderer and the Employer.

THE CONTRACT consists of four parts, namely:

- ☐ **C1 : Agreements and Contract Data** Volume 1
- ☐ **C2 : Pricing Data** Volume 1
- ☐
- ☐ **C3 : Scope of Work** Volume 1
1 (Specifications and Project Specifications)
- and
- ☐ **C4 : Site Information** Volume 1

THE SPECIAL MAINTENANCE OF TWEESPRUIT ACCESS ROAD, SS604/S34 (KM 6.400)

THE TENDER

PART T1 : TENDERING PROCEDURES

PART T1 : TENDERING PROCEDURES

CONTENTS

<u>SECTION</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
T1.1	TENDER NOTICE AND INVITATION TO TENDER	T1-3
T1.2	STANDARD CONDITIONS OF TENDER	T1-4
T1.3	TENDER DATA	T1-14

T1.1 TENDER NOTICE AND INVITATION TO TENDER

T1.1.1 The Department of Police, Roads and Transport, Free State Provincial Government, invites tenders for **"THE SPECIAL MAINTENANCE OF TWEESPRUIT ACCESS ROAD, SS604 AND S34 : KM0.00 TO KM 6.400**

T1.1.2 Tenderers should have a **CIDB** Contractor grading designation of 6 CEPE or 7 CE or higher.

T1.1.3 Tenderers must be registered with the **CIDB** in a **CE** class of construction works.

T1.1.4 Preferences

The Tender will be subjected to **B-BBEE** preferential procurement policy framework as amended.

Evaluation and Adjudication of bids: bid will be evaluated and adjudicated in terms of the Department of Police, Roads and Transport *Supply Chain Management Policy and Preferential Procurement Framework Act No. 5 of 2010. The 90/10 in preferential procurement points system as outlined in the bid document will apply. Preferential points will be given in terms of the Preferential Procurement Regulations, 2017.*

T1.1.5 Tender Documents

The tender documents will be given to the respective contractors on the day of tender briefing

Queries relating to the issues of these documents may be addressed to:

Mr V Ntaka
Tel no. 051 409 8687
Fax no.051 409 8683
E-mail: ntakav@freetrans.gov.za

T1.1.6 Compulsory Briefing Session with representatives of the Employer will take place at:

Date: 19 October 2021

Time: 10H00

Venue: 26 Hartley Street, Hamilton, Bloemfontein, 9300

T1.1.7 The closing time, date and venue for receipt of tenders will be 11h00 on 07th December 2021 at the Ground Floor, Perm Building, 45 Charlotte Maxeke street, Bloemfontein, 9300 **NO LATE TENDERS WILL BE ACCEPTED.**

T1.1.8 Telegraphic, telephonic, telex, facsimile and late tenders will not be accepted. Requirements for sealing, addressing, delivery, opening and assessment of tenders are stated in the Tender Data.

T1.2 STANDARD CONDITIONS OF TENDER

The Conditions of Tender are the Standard Conditions of Tender as contained in Annexure F of the CIDB Standard for Uniformity in Construction Procurement.

The Standard Conditions of Tender make several references to the Tender Data for details that apply specifically to this tender. The Tender Data shall have precedence in the interpretation of any ambiguity or inconsistency between it and the Standard Conditions of Tender.

Each item of data given below is cross-referenced to the clause in the Standard Conditions of Tender to which it mainly applies.

Clause

number Wording

F.1 GENERAL

F.1.1 Actions

The Employer and each tenderer submitting a tender offer shall comply with these conditions of tender. In their dealings with each other, they shall discharge their duties and obligations as set out in F.2 and F.3, timeously and with integrity, and behave equitably, honestly and transparently.

F.1.2 Tender documents

The documents issued by the Employer for the purpose of a tender offer are listed in the Tender Data.

F.1.3 Interpretation

F.1.3.1 The Tender Data and additional requirements contained in the Tender Schedules, that are included in the returnable documents, are deemed to be part of these Conditions of Tender.

F.1.3.2 These Conditions of Tender, the Tender Data and Tender Schedules, which are only required for tender evaluation purposes, shall not form part of any contract arising from the invitation to tender.

F.1.3.3 For the purposes of these conditions for the calling for expressions of interest, the following definitions apply:

- a) **comparative offer** means the Tenderer's financial offer after the factors of non-firm prices, all unconditional discounts and any other tendered parameters that will affect the value of the financial offer have been taken into consideration
- b) **corrupt practice** means the offering, giving, receiving or soliciting of anything of value to influence the action of the Employer or his staff or agents in the tender process; and
- c) **fraudulent practice** means the misrepresentation of the facts in order to influence the tender process or the award of a contract arising from a tender offer to the detriment of the Employer, including collusive practices intended to establish prices at artificial levels

F.1.4 Communication and Employer's Agent

Each communication between the Employer and a Tenderer shall be to or from the Employer's Agent only, and in a form that can be read, copied and recorded. Writing shall be in the English language.

The Employer shall not take any responsibility for non-receipt of communications from or by a Tenderer. The name and contact details of the Employer's Agent are stated in the Tender Data.

F.1.5 The Employer's right to accept or reject any tender offer

F.1.5.1 The Employer may accept or reject any variation, deviation, tender offer, or alternative tender offer, and may cancel the tender process and reject all tender offers at any time before the formation of a contract. The Employer shall not accept or incur any liability to a Tenderer for such cancellation and rejection, but will give reasons for such action upon written request to do so.

F.1.5.2 The Employer may not, subsequent to the cancellation or abandonment of a tender process or the rejection of all tender offers, re-issue a tender covering substantially the same scope of work within a period of six months unless only one tender was received and such tender was returned unopened to the Tenderer.

F.2 TENDERER'S OBLIGATIONS

F.2.1 Eligibility

Submit a tender offer only if the Tenderer complies with the criteria stated in the Tender Data and the Tenderer, or any of his principals, is not under any restriction to do business with Employer.

F.2.2 Cost of tendering

Accept that the Employer will not compensate the Tenderer for any costs incurred in the preparation and submission of a tender offer, including the costs of any testing necessary to demonstrate that aspects of the offer satisfy requirements.

F.2.3 Check documents

Check the tender documents on receipt for completeness and notify the Employer of any discrepancy or omission.

F.2.4 Confidentiality and copyright of documents

Treat as confidential all matters arising in connection with the tender. Use and copy the documents issued by the Employer only for the purpose of preparing and submitting a tender offer in response to the invitation.

F.2.5 Reference documents

Obtain, as necessary for submitting a tender offer, copies of the latest versions of standards, specifications, Conditions of Contract and other publications, which are not attached but which are incorporated into the tender documents by reference.

F.2.6 Acknowledge addenda

Acknowledge receipt of addenda to the tender documents, which the Employer may issue, and if necessary apply for an extension to the closing time stated in the Tender Data, in order to take the addenda into account.

F.2.7 Site visit and clarification meeting

Attend, where required, a site visit and clarification meeting at which Tenderers may familiarize themselves with aspects of the proposed work, services or supply and raise questions. Details of the meeting(s) are stated in the Tender Data.

F.2.8 Seek clarification

Request clarification of the tender documents, if necessary, by notifying the Employer at least five working days before the closing time stated in the Tender Data.

F.2.9 Insurance

Be aware that the extent of insurance to be provided by the Employer (if any) may not be for the full cover required in terms of the Conditions of Contract identified in the Contract Data. The Tenderer is advised to seek qualified advice regarding insurance.

F.2.10 Pricing the tender offer

F.2.10.1 Include in the rates, prices, and the tendered total of the prices (if any) all duties, taxes (except Value Added Tax (VAT), and other levies payable by the successful Tenderer, such duties, taxes and levies being those applicable 14 days before the closing time stated in the Tender Data.

F.2.10.2 Show VAT payable by the Employer separately as an addition to the tendered total of the prices.

F.2.10.3 Provide rates and prices that are fixed for the duration of the contract and not subject to adjustment except as provided for in the Conditions of Contract identified in the Contract Data.

F.2.10.4 State the rates and prices in Rand unless instructed otherwise in the Tender Data. The Conditions of Contract identified in the Contract Data may provide for part payment in other currencies.

F.2.11 Alterations to documents

Not make any alterations or additions to the tender documents, except to comply with instructions issued by the Employer, or necessary to correct errors made by the Tenderer. All signatories to the tender offer shall initial all such alterations. Erasures and the use of masking fluid are prohibited.

F.2.12 Alternative tender offers

F.2.12.1 Submit alternative tender offers only if a main tender offer, strictly in accordance with all the requirements of the tender documents, is also submitted. The alternative tender offer is to be submitted with the main tender offer together with a schedule that compares the requirements of the tender documents with the alternative requirements the Tenderer proposes.

F.2.12.2 Accept that an alternative tender offer may be based only on the criteria stated in the Tender Data or criteria otherwise acceptable to the Employer.

F.2.13 Submitting a tender offer

F.2.13.1 Submit a tender offer to provide the whole of the works, services or supply identified in the Scope of Work, unless stated otherwise in the Tender Data.

F.2.13.2 Return all returnable documents to the Employer after completing them in their entirety, either electronically (if they were issued in electronic format) or by writing in black ink.

- F.2.13.3 Submit the parts of the tender offer communicated on paper as an original plus the number of copies stated in the Tender Data, with an English translation of any documentation in a language other than English, and the parts communicated electronically in the same format as they were issued by the Employer.
- F.2.13.4 Sign the original and all copies of the tender offer where required in terms of the Tender Data. The Employer will hold all authorized signatories liable on behalf of the Tenderer. Signatories for Tenderers proposing to contract as joint ventures shall state which of the signatories is the lead partner whom the Employer shall hold liable for the purpose of the tender offer.
- F.2.13.5 Seal the original and each copy of the tender offer as separate packages marking the packages as "ORIGINAL" and "COPY". Each package shall state on the outside the Employer's address and identification details stated in the Tender Data, as well as the Tenderer's name and contact address.
- F.2.13.6 Where a two-envelope system is required in terms of the Tender Data, place and seal the returnable documents listed in the Tender Data in an envelope marked "Financial Proposal" and place the remaining returnable documents in an envelope marked "Technical Proposal". Each envelope shall state on the outside the Employer's address and identification details stated in the Tender Data, as well as the Tenderer's name and contact address.
- F.2.13.7 Seal the original tender offer and copy packages together in an outer package that states on the outside only the Employer's address and identification details as stated in the Tender Data.
- F.2.13.8 Accept that the Employer shall not assume any responsibility for the misplacement or premature opening of the tender offer if the outer package is not sealed and marked as stated.

F.2.14 Information and data to be completed in all respects

Accept that tender offers, which do not provide all the data or information requested completely and in the form required, may be regarded by the Employer as non-responsive.

F.2.15 Closing date and time

- F.2.15.1 Ensure that the Employer receives the tender offer at the address specified in the Tender Data not later than the closing date and time stated in the Tender Data. Proof of posting shall not be accepted as proof of delivery. The Employer shall not accept tender offers submitted by telegraph, telex, facsimile or e-mail, unless stated otherwise in the Tender Data.
- F.2.15.2 Accept that, if the Employer extends the closing date stated in the Tender Data for any reason, the requirements of these conditions of tender apply equally to the extended deadline.

F.2.16 Tender offer validity

- F.2.16.1 Hold the tender offer(s) valid for acceptance by the Employer at any time during the validity period stated in the Tender Data after the closing date stated in the Tender Data.
- F.2.16.2 If requested by the Employer, consider extending the validity period stated in the Tender Data for an agreed additional period.

F.2.17 Clarification of tender offer after submission

Provide clarification of a tender offer in response to a request to do so from the Employer during the evaluation of tender offers.

This may include providing a breakdown of rates or prices and correction of arithmetical errors by the adjustment of certain rates or item prices (or both). **No change in the total of the prices or substance of the tender offer is sought, offered, or permitted.** The total of the prices stated by the Tenderer shall be binding upon the Tenderer.

F.2.18 Provide other material

F.2.18.1 Provide, on request by the Employer, any other material that has a bearing on the tender offer, the Tenderer's commercial position (including notarized joint venture agreements), preference arrangements, or samples of materials, considered necessary by the Employer for the purpose of a full and fair risk assessment.

Should the Tenderer not provide the material, or a satisfactory reason as to why it cannot be provided, by the time for submission stated in the Employer's request, the Employer may regard the tender offer as non-responsive.

F.2.18.2 Dispose of samples of materials provided for evaluation by the Employer, where required.

F.2.19 Inspections, tests and analysis

Provide access during working hours to premises for inspections, tests and analysis as provided for in the Tender Data.

F.2.20 Submit securities, bonds, policies, etc.

If requested, submit for the Employer's acceptance before formation of the contract, all securities, bonds, guarantees, policies and certificates of insurance required in terms of the Conditions of Contract identified in the Contract Data.

F.2.21 Check final draft

Check the final draft of the contract provided by the Employer within the time available for the Employer to issue the contract.

F.2.22 Return of other tender documents

If so instructed by the Employer, return all retained tender documents within 28 days after the expiry of the validity period stated in the Tender Data.

F.2.23 Certificates

Include in the tender submission or provide the Employer with any certificates as stated in the Tender Data.

F.3 THE EMPLOYER'S UNDERTAKINGS

F.3.1 Respond to clarification

Respond to a request for clarification received up to five working days prior to the tender closing time stated in the Tender Data and notify all Tenderers who drew procurement documents.

F.3.2 Issue addenda

If necessary, issue addenda that may amend or amplify the tender documents to each Tenderer during the period from the date of the Tender Notice until seven days before the tender closing date stated in the Tender Data.

If, as a result a Tenderer applies for an extension to the closing date stated in the Tender Data, the Employer may grant such extension and, will then notify it to all Tenderers who drew documents.

F.3.3 Return late tender offers

Return tender offers received after the closing date or time stated in the Tender Data, unopened, (unless it is necessary to open a tender submission to obtain a forwarding address), to the Tenderer concerned.

F.3.4 Opening of tender submissions

F.3.4.1 Unless the two-envelope system is to be followed, open valid tender submissions in the presence of Tenderers' agents who choose to attend at the time and place stated in the Tender Data. Tender submissions for which acceptable reasons for withdrawal have been submitted will not be opened.

F.3.4.2 Announce at the opening held immediately after the opening of tender submissions, at a venue indicated in the Tender Data, the name of each Tenderer whose tender offer is opened, the total of his prices, preferences claimed and time for completion, if any, for the main tender offer only.

F.3.4.3 Make available the record outlined in F.3.4.2 to all interested persons upon request.

F.3.5 Two-envelope system

F.3.5.1 Where stated in the Tender Data that a two-envelope system is to be followed, open only the Technical Proposal of valid tenders in the presence of Tenderers' agents who choose to attend at the time and place stated in the Tender Data and announce the name of each Tenderer whose Technical Proposal is opened.

F.3.5.2 Evaluate the quality of the Technical Proposals offered by Tenderers, then advise Tenderers, who remain in contention for the award of the contract, of the time and place when the Financial Proposals will be opened. Open only the Financial Proposals of Tenderers, who score in the quality evaluation above the minimum number of points for quality stated in the Tender Data, and announce the score obtained for the Technical Proposals and the total price and any preferences claimed. Return unopened Financial Proposals to Tenderers whose Technical Proposals failed to achieve the minimum number of points for quality.

F.3.6 Non-disclosure

Not disclose to Tenderers, or to any other person not officially concerned with such processes, information relating to the evaluation and comparison of tender offers, the final evaluation price and recommendations for the award of a contract, until after the award of the contract to the successful Tenderer.

F.3.7 Grounds for rejection and disqualification

Determine whether there has been any effort by a Tenderer to influence the processing of tender offers and instantly disqualify a Tenderer (and his tender offer) if it is established that he engaged in corrupt or fraudulent practices.

F.3.8 Test for responsiveness

F.3.8.1 Determine, on opening and before detailed evaluation, whether each tender offer properly received:

- a) meets the requirements of these Conditions of Tender,
- b) has been properly and fully completed and signed, and
- c) is responsive to the other requirements of the tender documents.

F.3.8.2 A responsive tender is one that conforms to all the terms, conditions, and specifications of the tender documents without material deviation or qualification. A material deviation or qualification is one which, in the Employer's opinion, would:

- a) Detrimentially affect the scope, quality, or performance of the works, services or supply identified in the Scope of Work,
- b) Change the Employer's or the Tenderer's risks and responsibilities under the contract, or
- c) Affect the competitive position of other Tenderers presenting responsive tenders, if it were to be rectified.

F.3.8.3 Reject a non-responsive tender offer, and not allow it to be subsequently made responsive by correction or withdrawal of the non-conforming deviation or reservation.

F.3.9 Arithmetical errors

F.3.9.1 Check responsive tender offers for arithmetical errors, correcting them in the following manner:

- a) Where there is a discrepancy between the amounts in figures and in words, the amount in words shall govern.
- b) If a Bill of Quantities (or Schedule of Quantities or Schedule of Rates) applies and there is an error in the line item total resulting from the product of the unit rate and the quantity, the line item total shall govern and the rate shall be corrected.
- c) Where there is an obviously gross misplacement of the decimal point in the unit rate, the line item total as quoted shall govern, and the unit rate will be corrected.
- d) **Where there is an error in the total of the prices either as a result of other corrections required by this checking process or in the Tenderer's addition of prices, the total of the prices shall govern and the Tenderer will be asked to revise selected item prices (and their rates if a Bill of Quantities applies) to achieve the tendered total of the prices.**

F.3.9.2 Consider the rejection of a tender offer if the Tenderer does not correct or accept the correction of his arithmetical errors in the manner described above.

F.3.10 Clarification of a tender offer

Obtain clarification from a Tenderer on any matter that could give rise to ambiguity in a contract arising from the tender offer.

F.3.11 Evaluation of tender offers

F.3.11.1 General

Appoint an evaluation panel of not less than three persons. Reduce each responsive tender offer to a comparative offer and evaluate it using the tender evaluation method that is indicated in the Tender Data and described below:

Method 1 : Financial offer (N/A)	1) Rank tender offers from the most favourable to the least favourable comparative offer. 2) Recommend highest ranked Tenderer for the award of the contract, unless there are compelling and justifiable reasons
Method 2 : Financial offer and preferences	1) Score tender evaluation points for financial offer. 2) Confirm that Tenderers are eligible for the preferences claimed and if so, score tender evaluation points for preferencing. 3) Calculate total tender evaluation points. 4) Rank tender offers from the highest number of tender evaluation points to the lowest. 5) Recommend Tenderer with the highest number of tender evaluation points for the award of the contract, unless there are compelling and justifiable reasons not to do so.
Method 3 : Financial offer and quality (N/A)	1) Score quality, rejecting all tender offers that fail to score the minimum number of points for quality stated in the Tender Data. 2) Score tender evaluation points for financial offer. 3) Calculate total tender evaluation points. 4) Rank tender offers from the highest number of tender evaluation points to the lowest. 5) Recommend Tenderer with the highest number of tender evaluation points for the award of the contract, unless there are compelling and justifiable reasons not to do so.
Method 4 : Financial offer, quality and preferences (N/A)	1) Score quality, rejecting all tender offers that fail to score the minimum number of points for quality stated in the Tender Data. 2) Score tender evaluation points for financial offer. 3) Confirm that Tenderers are eligible for the preferences claimed, and if so, score tender evaluation points for preferencing. 4) Calculate total tender evaluation points. 5) Rank tender offers from the highest number of tender evaluation points to the lowest. 6) Recommend Tenderer with the highest number of tender evaluation points for the award of the contract, unless there are compelling and justifiable reasons not to do so.

Score financial offers, preferences and quality, as relevant, to two decimal places.

F.3.11.2 Scoring financial offers

Score the financial offers of remaining responsive tender offers using the following formula:

NFO = $W1 \times A$ where :

NFO = the number of tender evaluation points awarded for the financial offer.

- W1 = the maximum possible number of tender evaluation points awarded for the financial offer as stated in the Tender Data.
- A = a number calculated using either formulas 1 or 2 below as stated in the Tender Data.

Formula	Basis for comparison	Option 1	Option 2
1	Highest price or discount	$(1 + \frac{(P - P_m)}{P_m})$	P/P_m
2	Lowest price or percentage commission/fee	$(1 - \frac{(P - P_m)}{P_m})$	P_m/P

Where :

P_m = the comparative offer of the most favourable tender offer.
P = the comparative offer of tender offer under consideration.

F.3.11.3 Scoring quality (functionality)

Score quality in each of the categories stated in the Tender Data and calculate total score for quality.

F.3.12 Insurance provided by the Employer

If requested by the proposed successful Tenderer, submit for the Tenderer's information the policies and / or certificates of insurance which the Conditions of Contract identified in the Contract Data, require the Employer to provide.

F.3.13 Acceptance of tender offer

F.3.13.1 Accept tender offer only if the Tenderer satisfies the legal requirements stated in the Tender Data.

F.3.13.2 Notify the successful Tenderer of the Employer's acceptance of his tender offer by completing and returning one copy of the Form of Offer and Acceptance before the expiry of the validity period stated in the Tender Data, or agreed additional period. Providing the Form of Offer and Acceptance does not contain any qualifying statements, it will constitute the formation of a contract between the Employer and the successful Tenderer as described in the Form of Offer and Acceptance.

F.3.14 Notice to unsuccessful Tenderers

After the successful Tenderer has acknowledged the Employer's notice of acceptance, notify other Tenderers that their tender offers have not been accepted.

F.3.15 Prepare contract documents

If necessary, revise documents that shall form part of the contract and that were issued by the Employer as part of the tender documents to take account of :

- addenda issued during the tender period,
- inclusion of some of the returnable documents,
- other revisions agreed between the Employer and the successful Tenderer, and
- the Schedule of Deviations attached to the Form of Offer and Acceptance, if any.

F.3.16 Issue final contract

Prepare and issue the final draft of contract documents to the successful Tenderer for acceptance as soon as possible after the date of the Employer's signing of the Form of Offer and Acceptance (including the Schedule of Deviations, if any).

Only those documents that the conditions of tender require the Tenderer to submit, after acceptance by the Employer, shall be included.

F.3.17 Complete adjudicator's contract

Unless alternative arrangements have been agreed or otherwise provided for in the contract, arrange for both parties to complete formalities for appointing the selected adjudicator at the same time as the main contract is signed.

F.3.18 Provide copies of the contract

Provide to the successful Tenderer the number of copies stated in the Tender Data of the signed copy of the contract as soon as possible after completion and signing of the Form of Offer and Acceptance.

T1.3 TENDER DATA

T1.3.1 GENERAL

The Conditions of Tender in Section T1.2 are the Standard Conditions of Tender as contained in Annexure F of SANS 294 – *Construction Procurement Processes, Methods and Procedures* which contain references to the Tender Data for details that apply specifically to this tender. The Tender Data in this Section T.1.3 shall be read with the Standard Conditions of Tender in order to expand on the Tenderer's obligations and the Employer's undertakings in administering the tender process in respect of the project under consideration. The Tender Data hereafter shall have precedence in the interpretation of any ambiguity or inconsistency between it and the Standard Conditions of Tender. Each item of Tender Data given below is cross-referenced to the relevant clause in the Standard Conditions of Tender.

T1.3.2 TENDER DATA APPLICABLE TO THIS TENDER

<u>Clause number</u>	<u>Wording</u>

F1.	GENERAL

1. COMPULSORY BRIEFING MEETING

Compulsory briefing meeting will be held and bidders who fail to comply will be disqualified.

2. EVALUATION CRITERIA

The Bids will be evaluated on a Three Stage Process:

- Stage 1: Pre-Qualification for Preferential Procurement
- Stage 2: Functionality – 40 Points
- Stage 3: 80/20 Preference Points System (Price and B-BBEE Status)

Stage 1 Pre-qualification for preferential procurement

- BBBEE Contributor Level 1
- 6 CE PE or 7 CE Grading or Higher
- Only QSE will be considered and Bidders must attach their latest Annual financial statements which must be duly signed by an accredited accountant or accounting firm

Bidders who fail to meet the above pre-qualifying criteria will be disqualified.

Stage 2: Functionality

Functionality Assessment is based on the Grid below:

Criterion	Description of criteria	Scoring	Points	Total Points Allocation
Experience	Bidders must submit 5 reference/ Recommendation letters of a similar work undertaken over the past 3 years and Certified Completion Certificate. Reference/ Recommendation letters will only be considered valid if they meet the following criteria: ✓ If on an official client letterhead, ✓ If it refers to provision of similar goods or services provided. ✓ If not older than 3 years, ✓ If contains contact details, signed and dated by authorised personnel.	5 projects of similar type & above	10	10
		3 – 4 projects of similar type	7	
		1 – 2 projects of similar type	4	
		0 – Project of similar type	0	
Capacity	Key staff: Attach CV's and copies of qualifications of Contracts Manager and site Agent for points to be allocated. Failure to attach will result in no points being allocated.	Contracts Manager Years of experience 4 years or more and qualification in Civil Engineering N. Dip, B. Tech, Degree etc. attached CV and employment contracts	10	10
		Contracts Manager Years of experience 2 years up to but not including 4 years and qualification in Civil Engineering N. Dip, B. Tech, Degree etc. attached CV and employment contracts	5	
		Contracts Manager less than 2 years of experience and qualifications in Civil Engineering N. Dip, B. Tech, Degree etc. attached CV and employment contracts	2	
		Site Agent Years of experience 4 or more years and qualification in Civil Engineering N. Dip, B. Tech, Degree etc. attached CV and employment contracts	5	5
		Site Agent Years of experience 2 years up to but not including 4 years and qualification in Civil Engineering N. Dip, B. Tech, Degree etc. attached CV and employment contracts	3	
		Site Agent less than 2 years of experience and qualifications in Civil Engineering N. Dip, B. Tech, Degree etc. attached CV and employment contracts	1	

	Capacity to deliver (equipment): Registration Certificates to prove ownership of plant its critical and Bidders must attach proof thereof / In case of rental a lease agreement must be attached and registration certificates.	Number of Graders	2 Graders = 2 points	2	10
			1 Grader = 1 point		
			0 Grader = 0 point		
		Excavator	1 Excavator= 2 points	2	
			0 Excavator = 0 point		
		Tipper trucks	3 Tipper trucks =3 points	3	
			2 Tipper trucks = 2 points		
			1 Tipper trucks = 1 point		
			0 Tipper trucks = 0 point		
		Backhoe Loader (TLB)	1 TLB = 1 point	1	
			0 TLB = 0 Point		
		Smooth drum Roller (SDR)	1 SDR =1 point	1	
0 SDR =0 point					
Pneumatic Tyred roller (PTR)	1 PTR = 1 point	1			
	0 PTR= 0 point				
Participant or graduate of CDP	Must have participated in any Free State contractor development programme. Valid Proof to be attached	Proof attached	2,5	2,5	
		Non submission	0		
Locality: Locally based office within Mantsopa Local Municipality	Municipal services (water, sanitation, rates, and electricity) clearance certificate or Lease Agreement with a Current Bill of Account not owing more than Ninety (90) days	Local Municipality based offices (Municipal rates and Taxes to be attached).	2,5	2,5	
		Outside local Municipality Free State Province based offices	1		
		Outside Free State Province based offices	0		
Total					40

NB: A tender that fails to obtain the minimum qualifying score of 24 points for functionality as indicated in the GRID above is not an acceptable tender, further all tenders that obtained the minimum qualifying score for functionality must be evaluated in terms of price and the preference point system.

Stage 3: Price and B-BBEE Status

Assessment for Stage 3 will be evaluated on 80/20 preferential point system:

- Price : 80
- B-BBEE Status Level : 20

Price: 80

Points for price will be calculated according to clause 7, 1 item 1 of the PPPFA (Effective from April 2017) as follows:

$$P_s = 80 \left(1 - \frac{P_t - P_{min}}{P_{min}} \right)$$

P_s = Points scored for price of tender under consideration

P_t = Rand value of tender under consideration

P_{min} = Rand value of lowest acceptable tender

B-BBEE Status Level: 20

- Points will be awarded to bidders for attaining the B –BBEE status level of contributor in accordance with the table below:

B-BBEE Status Level of Contributor	Number of points (80/20 system)
1	20
2	18
3	14
4	12
5	8
6	6
7	4
8	2
Non-compliant Contributor	0

- Bidders to submit a valid and original (or certified copy) of the B-BBEE Status Level Verification Certificate substantiating their B-BBEE rating issued by a Registered Auditor approved by SANAS or a Verification Agency accredited by SABS.

3. CLOSING DATE, TIME AND VENUE FOR SUBMISIONS

The bid documents must be placed in a sealed envelope, titled **“REQUEST FOR THE ADVERTISEMENT AND APPOINTMENT OF A CONTRACTOR WITH MINIMUM 6CE PE or 7CE or HIGHER FOR SPECIAL MAINTENANCE OF TWEESPRUIT ACCESS ROAD, S604/ S34 IN MOTHEO REGION AT THE DEPARTMENT OF POLICE, ROADS AND TRANSPORT, FOR A PERIOD OF 12 MONTHS”** with the closing date and bid number must be clearly written or typed on the envelope.

4. AWARDING

The highest scoring bid will be awarded according to BID Requirements.

The envelope must be deposited in the Bid Box on the following address:

Ground floor, Perm Building, Department of Police, Roads & Transport, 45 Charlotte Maxeke (Old - Maitland) Street, Bloemfontein, 9300.

Closing date for the bid documents is 11h00 on the 07th December 2021

Notes:

- The service provider shall bear the cost associated with the completion and submission of the bid document.
- The Department of Police, Roads and Transport selection of qualifying bidders will be at the department's sole discretion and will be final.
- The department is not bound to accept any particular bid, and reserves the right to annul the selection process at any time prior the contract award, without incurring any liability to the bidder.
- Bidders who submit false any information will be disqualified
- Validity period for tender period is 180 days after advertisement.

NB: No late /faxed or emailed bids will be accepted.

F.1.2 Tender documents

The tender documents issued by the Employer comprise of:

a) **VOLUME 1:** PROJECT DOCUMENT

This volume is the Project Document for the identified BID No. PR&T/BID06/2021/22 and contains the following sections:

THE TENDER

PART T1 : TENDERING PROCEDURES

- T1.1 TENDER NOTICE AND INVITATION TO TENDER
- T1.2 STANDARD CONDITIONS OF TENDER
- T1.3 TENDER DATA

PART T2 : RETURNABLE DOCUMENTS

- T2.1 LIST OF RETURNABLE DOCUMENTS
- T2.2 RETURNABLE SCHEDULES

THE CONTRACT

PART C1 : AGREEMENTS AND CONTRACT DATA

- C1.1 FORM OF OFFER AND ACCEPTANCE
- C1.2 CONTRACT DATA

PART C2 : PRICING DATA

- C2.1 PRICING INSTRUCTIONS
- C2.2 BILL OF QUANTITIES

PART C3 : SCOPE OF WORK

- C3.1 STANDARD SPECIFICATIONS
- C3.2 PROJECT SPECIFICATIONS
- C3.3 PARTICULAR SPECIFICATIONS

PART C4 : SITE INFORMATION

c) VOLUME 2 : BOOK OF DRAWINGS

There is no Volume 2 - Book of Drawings for C/2021

The following documents also form part of the tender and contract, but must be purchased by each of the Tenderers themselves:

d) VOLUME 3 :

1. **The GCC 2015 – General Conditions of Contract for Construction Works, Third Edition**, is obtainable from SAICE, Private Bag X200, Halfway House, 1685.
 2. **The COTO Standard Specifications for Road and Bridge Works for South African Road Authorities 2020**, issued by the Committee of Transport Officials.
 3. **SCC (Special Conditions of Contract)**
 4. **SARTISM (South African Road Traffic Signs Manual)**
 5. **SAPEM (South African Pavement Engineering Manual)**
 6. **SABITA Manual (South African Bitumen Association)**
 7. **SANS 3001 (South African National Standard 3001)**
- f) ***The Occupational Health and Safety Act No 85 and Amendment Act No 181 of 1993, and the Construction Regulations GNR.929 of 25 June 2014 (Government Gazette No 25207 of 18 July 2003, Notice No R1010).*** This document is obtainable separately, and Tenderers shall obtain their own copies.
- g) In addition Tenderers are advised, in their own interest, to obtain their own copies of the following acts, regulations and standards referred to in this document as they are essential for the Tenderer to get acquainted with the basics of construction management, the implementation of preferential construction procurement policies and participation of targeted enterprises and labour.
- (i) The Construction Industry Development Board Act No 38 of 2000 and the Regulations in terms of the CIDB Act 38/2000, Government Notice No 692 of 9 June 2004, and amendments
 - (ii) SANS 10396:2003 Implementing Preferential Construction Procurement Policies using Targeted Procurement Procedures
 - (iii) SANS 1914:2003 Targeted Construction Procurement, Parts 1 to 6, dealing with Participation of Targeted Enterprises, Joint Ventures, Targeted Labour etc.
- The Project Document and the drawings shall be obtained from the Employer or his authorized representative at the physical address stated in the Tender Notice, upon payment of the deposit stated in the Tender Notice.
- (iv) Asphalt Academy May 2009 publication "TG2 Second Edition, Technical guideline: Bitumen Stabilised Materials".

F.1.4 Communication and Employer's Agent

The Employer's Agent is : Mr V Ntaka

Address : Medfontein Building 303, St. Andrew Street, BLOEMFONTEIN.
Tel no : 051 409 8687
Fax no : 051 409 8683
e-mail : ntakav@freetrans.gov.za

The Engineer Mrs RE Seate (Appointed Project Manager)

Address : Hamilton, Motheo Roads Office
Tel no : +27 51 435 7591
Fax no : +27 51 434 1181
e-mail : mohamik@freetrans.gov.za/kmohami@yahoo.com

F2.1 Eligibility

F2.1.1 Only those Tenderers who have in their employ management and supervisory staff satisfying the requirements of the Scope of Work for labour intensive competencies for supervisory and management staff are eligible to submit tenders. NQF Level 5 will be a minimum requirement for supervisors.

F2.1.2 The following Tenderers who are registered with the CIDB, or are capable of being so registered prior to the evaluation of submissions, are eligible to submit tenders:

- a) contractors who have a contractor grading designation equal to or higher than a contractor grading designation determined in accordance with the sum tendered for **6 CE PE or 7 CE or Higher** class of construction work; and
- b) contractors registered as potentially emerging enterprises with the CIDB who are registered in one contractor grading designation lower than that required in terms of a) above
- c) Tenderers need to ensure that they are registered in the grading in which they tender if their tender price differs from the grading as specified

F2.1.3 Joint Ventures are eligible to submit tenders provided that:

- a) every member of the joint venture is registered with the CIDB;
- b) the lead partner has a contractor grading designation in the 6 CE PE or 7 CE or Higher class of construction work; or
- c) In case of a joint venture, the combined contractor grading designation calculated in accordance with the Construction Industry Development Board Regulations is equal to or higher than a contractor grading designation determined in accordance with the sum tendered for an CEPE class of construction work.

F2.7 Site visit and clarification meeting

The arrangements for a compulsory clarification meeting are as stated in the Tender Notice and Invitation to Tender.

NOTE : NON-ATTENDANCE OF THIS MEETING WILL DISQUALIFY THE TENDER

- (a) The Attendance List will be accepted as the official attendance of the clarification meeting. Signing the Attendance List of this meeting is the responsibility of the Tenderer attending the meeting and site inspection.

It is important for prospective Tenderers to note that the name of the company on the Attendance List will be accepted as the legitimate Tenderer, which was represented by the person who signed the Attendance List.

- (b) Addenda of additional or changed contractual information will only be forwarded to Tenderers who attended the official site visit and clarification meeting.

F2.12. Alternative tender offers

Should a Tenderer wish to submit an alternative tender offer, the only criteria permitted for such alternative tender offer is that it demonstrably satisfies the Employer's standards and requirements, the details of which may be obtained from the Employer's Agent.

Calculations, drawings and all other pertinent technical information and characteristics as well as modified or proposed Pricing Data must be submitted with the alternative tender offer to enable the Employer to evaluate the efficacy of the alternative and its principal elements, to take a view on the degree to which the alternative complies with the Employer's standards and requirements and to evaluate the acceptability of the pricing proposals. Calculations must be set out in a clear and logical sequence and must clearly reflect all design assumptions. Pricing Data must reflect all assumptions in the development of the pricing proposal.

Acceptance of an alternative tender offer will mean acceptance in principle of the offer. It will be an obligation of the contract for the Tenderer, in the event that the alternative is accepted, to accept full responsibility and liability that the alternative offer complies in all respects with the Employer's standards and requirements.

The modified Pricing Data must include an amount equal to 0% of the amount tendered for the alternative offer to cover the Employer's costs of confirming the acceptability of the detailed design before it is constructed.

F2.13 Submitting a tender offer

F2.13.5 Tender offers shall be submitted as an original only.

F2.13.7 The Employer's address :

The Head
Department of Police, Roads and Transport
P O Box 690
Room 226
Medfontein Building
St Andrew Street
BLOEMFONTEIN
9300

Location of tender box : Perm Building, 45 Charlotte Maxeke, Bloemfontein, 9300

Identification details : BID No.: PR&T/BID06/2021/22

**Description of project : SPECIAL MAINTENANCE OF
TWEESPRUIT ACCESS ROADS, S604/S34**

F2.15 Closing time

The closing date for submission of tender offers is as stated in the Tender Notice and Invitation to Tender.

F2.16 Tender offer validity

The tender offer validity period is **180** days from the closing date for submission of tenders.

F2.18 Provide other material

The Tenderer shall, when requested by the Employer to do so, submit the names of all management and supervisory staff that will be employed to supervise the labor-intensive portion of the works with satisfactory evidence that such staff members satisfy the eligibility requirements.

F2.23 Certificates

The following certificates need to be included in the Tender:

- a) A valid Tax Clearance Certificate for the Tenderer or for each of the JV partners if tendered in a Joint Venture, issued by the South African Revenue Services;
- b) The Tenderer's CIDB Registration Certificate or the Joint Venture's members' CIDB Registration Certificates with an indication of the senior partner.

F3.4 Opening of tender submissions

Tender submissions will be opened at 45 Charlotte Maxeke Street, Room 219, Perm Building, Bloemfontein.

F3.5 Two-envelope system

The two-envelope system will not be followed for this contract.

F3.11 Evaluation of tender offers

F3.11.1 Due to the nature of the tendering process, with negotiated rates, the tenders will be evaluated and the rates balanced to suit the particular Contractor's circumstance.

F3.11.2 Scoring quality

No points will be allocated to scoring of quality.

F3.13 Acceptance of tender offer

F3.13.1 Tender offers will only be accepted if:

- a) the tender offer is signed by a person authorized to sign on behalf of the Tenderer;
- b) the Tenderer submitted an original valid Tax Clearance Certificate issued by the South African Revenue Services;
- c) Tenderer's declaration of compliance with the Occupational Health and Safety Act No 85 of 1993 and the Construction Regulations 2014 is included with his tender submission;
- d) a Tenderer who submitted a tender as a Joint Venture has included an acceptable Joint Venture Agreement with his tender;
- e) the Tenderer or a competent authorized representative of the contractor who submitted the tender has attended the compulsory clarification meeting or site inspection;
- f) the Tenderer included with its tender the contractor's CIDB Registration Certificate (or certified copy thereof) as proof that it is registered in accordance with the Construction Industry Development Board Act No. 38 of 2000 and the Regulations 2003 promulgated in terms of the Act ;

- g) the Tenderer or any of its directors is not listed on the Register of Tender Defaulters in terms of the Prevention and Combating of Corrupt Activities Act of 2004 as a person prohibited from doing business with the public sector; and
- h) the Tenderer has not:
 - i) abused the Employer's Supply Chain Management System; or
 - ii) failed to perform on any previous contract and has been given a written notice to this effect
- i) has completed the Compulsory Enterprise Questionnaire and there are no conflicts of interest which may impact on the Tenderer's ability to perform the contract in the best interests of the Employer or potentially compromise the tender process.

F3.18 Provide copies of the contract

The Employer will provide the successful Tenderer, now the Contractor, with one copy of the complete, signed contract document.

**THE SPECIAL MAINTENANCE OF TWEESPRUIT ACCESS ROAD; SS604 AND S34 (KM 0.0) AND
(KM 6.400)**

PART T2 : RETURNABLE DOCUMENTS

CONTENTS

<u>SECTION</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
T2.1	LIST OF RETURNABLE DOCUMENTS	T2-2
T2.2	RETURNABLE SCHEDULES	T2-3
T2.2.1	RETURNABLE SCHEDULES REQUIRED FOR TENDER EVALUATION PURPOSES	T2-3
T2.2.2	PREFERENTIAL PROCUREMENT SCHEDULES AND AFFIDAVIT	T2-25
T2.2.3	FORMS TO BE SUBMITTED BY SUCCESSFUL TENDERER	T2-36

T2.1 LIST OF RETURNABLE DOCUMENTS

The Tender Document must be submitted as a whole. All forms must be properly completed as required, and the document shall not be taken apart or altered in any way whatsoever.

All the certificates and forms to be provided with the tender are listed in the Tender Data under F2.23: Certificates, and under the returnable schedules and forms in T2.2 hereafter.

The list of returnable documents comprises the following :

1. All the certificates listed in the Tender Data under F2.23 : Certificates ;
2. All the returnable schedules and forms listed in T2.2.1 : Returnable Schedules Required for Tender Evaluation Purposes ;
3. All the returnable documents listed in T2.2.2 : Preferential Procurement Schedules and Affidavits that will be incorporated into the Contract ;
4. All the agreements and forms listed in T2.2.3: Forms to be completed by the successful Tenderer ;
5. All the forms and agreements in the Contract Data in C1.2, where some of the forms (agreements) need to be completed only by successful Tenderer ;
6. Pricing Data in C2.2 : Bill of Quantities.

T2.2 RETURNABLE SCHEDULES

T2.2.1 RETURNABLE SCHEDULES REQUIRED FOR TENDER EVALUATION PURPOSES

<u>SECTION</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
SCHEDULE A	CERTIFICATE OF AUTHORITY	T2-5
SCHEDULE B	COMPULSORY ENTERPRISE QUESTIONNAIRE	T2-8
SCHEDULE C	PROPOSED SUBCONTRACTORS	T2-15
SCHEDULE D	TENDERER'S KEY PERSONNEL	T2-17
SCHEDULE E	PRELIMINARY PROGRAMME	T2-19
SCHEDULE F	AMENDMENTS, QUALIFICATIONS AND ALTERNATIVES	T2-21
SCHEDULE G	TENDERER'S HEALTH AND SAFETY PLAN AND DECLARATION	T2-23
SCHEDULE H	TAX CLEARANCE CERTIFICATE/S	T2-28
SCHEDULE I	PREFERENCIAL PROCUREMENT REGULATIONS 2017	T2-30
SCHEDULE J	DECLARATION OF INTEREST	T2-36
SCHEDULE K	DECLARATION OF BIDDER'S PAST SUPPLY CHAIN MANAGEMENT PRACTICES	T2-44
SCHEDULE L	CERTIFICATE OF INDEPENDENT BID DETERMINATION	T2-46
SCHEDULE M	INVITATION TO BID	T2-50

T2.2.2	PREFERENTIAL PROCUREMENT SCHEDULES AND AFFIDAVITS THAT WILL BE INCORPORATED INTO THE CONTRACT	T2-25
T2.2.3	FORMS TO BE SUBMITTED BY THE SUCCESSFUL TENDERER	T2-36

NOTE : The Tenderer is required to complete each and every schedule and form listed above to the best of his ability, as the evaluation of tenders and the eventual contract will be based on the information provided by the Tenderer.

Failure of a Tenderer to complete the schedules and forms to the satisfaction of the Employer will inevitably prejudice the tender and may lead to rejection on the grounds that the tender is not responsive.

The same applies to the Preferential Procurement Schedule in T2.2.2.

SCHEDULE A : CERTIFICATE OF AUTHORITY

Indicate the status of the Tenderer by ticking the appropriate box hereunder. The Tenderer must complete the certificate set out below for the relevant category.

(i) COMPANY	(ii) CLOSE CORPORATION	(iii) PARTNERSHIP	(iv) JOINT VENTURE	(v) SOLE PROPRIETOR

(i) CERTIFICATE FOR COMPANY

I, ..., Managing Director of the Board of Directors of
, hereby confirm that by resolution of the Board (copy
 attached) taken on 20....., Mr/Ms, acting in the capacity
 of, was authorized to sign all documents in connection
 with this tender and any contract resulting from it, on behalf of the company.

Managing Director : (ii)

CERTIFICATE FOR CLOSE CORPORATION

We, the undersigned, being the key members in the business trading as
 hereby authorise Mr/Ms
, acting in the capacity of
, to sign all documents in connection with this tender
 and any contract resulting from it, on our behalf.

NAME	ADDRESS	SIGNATURE	DATE

**Note : This certificate is to be completed and signed by all of the key members upon
 whom rests the direction of the affairs of the Close Corporation as a whole.**

(iii) CERTIFICATE FOR PARTNERSHIP

We, the undersigned, being the key partners in the business trading as,

..... hereby authorize Mr/Ms
 acting in the capacity of
, to sign all documents in
 connection with this tender and any contract resulting from it, on our behalf.

NAME	ADDRESS	SIGNATURE	DATE

Note : This certificate is to be completed and signed by all of the key partners upon whom rests the direction of the affairs of the Partnership as a whole.

(iv) CERTIFICATE FOR JOINT VENTURE

We, the undersigned, are submitting this tender offer in Joint Venture and hereby authorize Mr/Ms
, authorized signatory of the
 company, acting in the capacity of lead partner, to sign all
 documents in connection with this tender offer and any contract resulting from it, on our behalf.

This authorization is evidenced by the attached power of attorney signed by legally authorized signatories of all the partners to the Joint Venture.

NAME OF FIRM	ADDRESS	AUTHORIZING SIGNATURE, NAME AND CAPACITY
Lead partner		

Note : This certificate is to be completed and signed by all of the key partners upon whom rests the direction of the affairs of the Partnership as a whole.

(v) CERTIFICATE FOR SOLE PROPRIETOR

I, ..., hereby confirm that I am the sole owner of the

business trading as
.....

Signature of sole owner :

REGISTRATION CERTIFICATE / AGREEMENT / ID DOCUMENT

Important note to Tenderer :

Registration Certificates for Companies, Close Corporations and Partnerships, or Agreements and Powers of Attorney for Joint Ventures, or ID documents for Sole Proprietors, all as referred to in the foregoing forms and in T2.1, must be attached here.

SCHEDULE B : ` COMPULSORY ENTERPRISE QUESTIONNAIRE

The following particulars must be furnished. In the case of a Joint Venture, separate enterprise questionnaires in respect of each partner must be completed and submitted.

Section 1 : Name of enterprise : Section 2

: VAT registration number : Section 3 :

CIDB registration number :

Section 4 : Particulars of sole proprietors and partners in partnerships :

Name*	Identity number*	Personal income tax number*

* Complete only if sole proprietor or partnership and attach separate page if more than 3 partners

Section 5 : Particulars of companies and close corporations

Company registration number Close

corporation number Tax reference

number

Section 6 : Record of service of the state

Indicate by marking the relevant boxes with a cross, if any sole proprietor, partner in a partnership or director, manager, principal shareholder or stakeholder in a company or close corporation is currently or has been within the last 12 months, in the service of any of the following:

☐ a member of any municipal council	☐ an employee of any provincial department, national or provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act 1 of 1999)
☐ a member of any provincial legislature	☐ a member of an accounting authority of any national or provincial public entity
☐ a member of the National Assembly or the National Council of Province	☐ an employee of Parliament or a provincial legislature
☐ a member of the board of directors of any municipal entity	
☐ an official of any municipality or municipal entity	

If any of the above boxes are marked, disclose the following :

Name of sole proprietor, partner, director, manager, principal shareholder or stakeholder	Name of institution, public office, board or organ of state and position held	Status of service (tick appropriate column)	
		Current	Within last 12 months

Note : Insert separate page if necessary

Section 7 : Record of spouses, children and parents in the service of the state

Indicate by marking the relevant boxes with a cross, if any spouse, child or parent of a sole proprietor, partner in a partnership or director, manager, principal shareholder or stakeholder in a company or close corporation is currently or has been within the last 12 months, been in the service of any of the following:

☐ a member of any municipal council	☐ an employee of any provincial department, national or provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act 1 of 1999)
☐ a member of any provincial legislature	
☐ a member of the National Assembly or the National Council of Province	☐ a member of an accounting authority of any national or provincial public entity
☐ a member of the board of directors of any municipal entity	☐ an employee of Parliament or a provincial legislature
☐ an official of any municipality or municipal entity	

If any of the above boxes are marked, disclose the following :

Name of spouse, child or parent	Name of institution, public office, board or organ of state and position held	Status of service (tick appropriate column)	
		current	Within last 12 months

Note : Insert separate page if necessary

The undersigned, who warrants that he/she is duly authorized to do so on behalf of the enterprise :

- i) confirms that neither the name of the enterprise or the name of any partner, manager, director or other person, who wholly or partly exercises, or may exercise, control over the enterprise appears on the Register of Tender Defaulters established in terms of the Prevention and Combating of Corrupt Activities Act of 2004;
- ii) confirms that no partner, member, director or other person, who wholly or partly exercises, or may exercise, control over the enterprise appears, has within the last five years been convicted of fraud or corruption;
- iii) confirms that I / we are not associated, linked or involved with any other tendering entities submitting tender offers and have no other relationship with any of the Tenderers or those responsible for compiling the scope of work that could cause or be interpreted as a conflict of interest;
- iv) confirms that the contents of this questionnaire are within my personal knowledge and are to the best of my belief both true and correct.

Signed

Date

Name

Position

Enterprise
name

SCHEDULE C : PROPOSED SUBCONTRACTORS

I/We hereby notify you that it is my/our intention to employ the following subcontractors for work in this contract.

If I/we am/are awarded a contract I/we agree that this notification does not change the requirement for me/us to submit the names of proposed subcontractors in accordance with requirements of the contract for such appointments. If there are no such requirements in the contract, then your written acceptance of this list shall be binding between us.

a) Subcontractors : CIDB grading 5CE to 7CE

NAMES OF PROPOSED SUBCONTRACTORS	NATURE AND EXTENT OF WORK TO BE SUBCONTRACTED	CIDB GRADING	AMOUNT

b) Subcontractors : CIDB grading 1CE to 4CE and unregistered ABE's if available

NAMES OF PROPOSED SUBCONTRACTORS	NATURE AND EXTENT OF WORK TO BE SUBCONTRACTED	CIDB GRADING	AMOUNT

SIGNATURE :

ATTACH PRE-TENDER AGREEMENTS HERE

SCHEDULE D : TENDERERS' KEY PERSONNEL

NAME	POSITION	NQF QUALIFICATION

SIGNATURE :

**ATTACH COPIES OF NOE CERTIFICATES FOR LABOUR INTENSIVE CONSTRUCTION OF
RELEVANT SUPERVISORS**

ATTACH PRELIMINARY PROGRAM HERE

SCHEDULE F : AMENDMENTS, QUALIFICATIONS AND ALTERNATIVES

The Tenderer should record any amendments and alternatives he may wish to make to the tender documents in this schedule. Alternatively a Tenderer may state such amendments and alternatives in a covering letter to his tender and reference such letter in this schedule.

The Tenderer's attention is drawn to clause F3.3 if the Standard Conditions of Tender referenced in the Tender Data regarding the Employer's handling of material deviations and qualifications.

These amendments and qualifications, if accepted by the Employer, will be incorporated in the Form of Offer and Acceptance, Schedule of Deviations.

(a) AMENDMENTS AND QUALIFICATIONS

PAGE	CLAUSE OR ITEM NO	PROPOSED AMENDMENT AND QUALIFICATIONS

*[Notes: (1) Amendments to the General and Special Conditions of Contract are not acceptable;
(2) The Tenderer must give full details of all the financial implications of the amendments and qualifications in a covering letter attached to his tender.]*

(b) ALTERNATIVES

PROPOSED ALTERNATIVE	DESCRIPTION OF ALTERNATIVE

*[Notes: (1) Individual alternative items that do not justify an alternative tender, and an alternative offer for time for completion should be listed here.
(2) In the case of a major alternative to any part of the work, a separate Bill of Quantities, programme, etc, and a detailed statement setting out the salient features of the proposed alternatives must accompany the tender.
(3) Alternative tenders involving technical modifications to the design of the works and methods of construction shall be treated separately from the main tender offer.]*

SIGNATURE :

ATTACH ALTERNATIVES HERE

SCHEDULE G : CONTRACTOR'S HEALTH AND SAFETY PLAN AND DECLARATION

In terms of Clause 4(4) of the OHSA 1993 Construction Regulations 2014 (referred to as "the Regulations" hereafter), a Contractor may only be appointed to perform construction work if the Employer is satisfied that the Contractor has the necessary competencies and resources to carry out the work safely in accordance with the Occupational Health and Safety Act No 85 of 1993 and the OHSA 1993 Construction Regulations 2014.

To that effect a person duly authorized by the Tenderer must complete and sign the declaration hereafter in detail.

Declaration by Tenderer

1. I the undersigned hereby declare and confirm that I am fully conversant with the Occupational Health and Safety Act No 85 of 1993 (as amended by the Occupational Health and Safety Amendment Act No 181 of 1993), and the OHSA 1993 Construction Regulations 2003.
2. I hereby declare that my company has the competence and the necessary resources to safely carry out the construction work under this contract in compliance with the Construction Regulations and the Employer's Health and Safety Specifications.
3. I hereby undertake, if my tender is accepted, to provide, before commencement of the works under the contract, a suitable and sufficiently documented Health and Safety Plan in accordance with Regulation 5(1) of the Construction Regulations, which plan shall be subject to approval by the Employer.
4. I confirm that copies of my company's approved Health and Safety Plan, the Employer's Safety Specifications as well as the OHSA 1993 Construction Regulations 2014 will be provided on site and will at all times be available for inspection by the Contractor's personnel, the Employer's personnel, the Engineer, visitors, and officials and inspectors of the Department of Labour.
5. I hereby confirm that adequate provision has been made in my tendered rates and prices in the Bill of Quantities to cover the cost of all resources, actions, training and all health and safety measures envisaged in the OHSA 1993 Construction Regulations 2014, including the cost for specific items that may be scheduled in the Bill of Quantities.
6. I hereby confirm that I will be liable for any penalties that may be applied by the Employer in terms of the said Regulations for failure on my part to comply with the provisions of the Act and the Regulations as set out in Regulation 30 of the Regulations.
7. I agree that my failure to complete and execute this declaration to the satisfaction of the Employer will mean that I am unable to comply with the requirements of the OHSA 1993 Construction Regulations 2014, and accept that my tender will be prejudiced and may be rejected at the discretion of the Employer.
8. I am aware of the fact that, should I be awarded the contract, I must submit the notification required in terms of Regulation 3 of the OHSA 1993 Construction Regulations 2014 before I will be allowed to proceed with any work under the contract.

SIGNATURE :

CONTRACTOR'S SAFETY PLAN

The Tenderer shall attach to this page (or submit it separately) the Contractor's Health and Safety Plan as required in terms of Regulation 5 of the Occupational Health and Safety Act 1993 Construction Regulations 2014, and referred to in Form K.

The Contractor's Health and Safety Plan shall cover at least the following aspects as applicable:

1. Safety of subcontractors (Refer Construction Regulations 2014 Clause 5: Principal Contractors and Contractors)
 - ☐ Methods to ensure the approval, implementation and maintenance of all health and safety aspects regarding his subcontractors.
2. Monitoring the health and safety on the construction site on a regular basis (Refer Clause 6: Supervision of Construction Work)
 - ☐ Details of the Construction Supervisor and his appointed assistants (if any);
 - ☐ Details of the Construction Safety Officer, full-time or part-time;
 - ☐ Details of the suitability and competency of the Construction Supervisor and Construction Safety Officer regarding health and safety aspects of the construction works.
3. Assessment of risks on the construction site (Refer Clause 7: Risk Assessment)
 - ☐ Details of a proper risk assessment on which his health and safety plan is based;
 - ☐ Ways in which all construction employees are informed, instructed and trained regarding the work procedures and the related hazards.
4. Risk items (Refer Clauses 8 to 28: Risk items to be addressed)
 - ☐ Details of the design, management, responsibilities, worker training, work methods, procedures, maintenance and any other requirements necessary for him and his subcontractor, if applicable, to work safely and in a healthy environment as stipulated in these clauses.

Contractor's OHS Management System checklist

1. OHS Policy and Management

		Yes	No
1.1	Is there a written company health and safety policy?		
1.2	Does the company have an OHS Management System?		
1.3	Is there a company OHS Management Manual or Plan?		
1.4	Are health and safety responsibilities clearly identified for all levels of staff?		

2. Safe Work Practices and Procedures

		Yes	No
2.1	Has the company prepared safe operating procedures or specific safety instructions relevant to its operations?		
2.2	Does the company have any permit to work systems?		
2.3	Is there a documented incident investigation procedure?		
2.4	Are there procedures for maintaining, inspecting and assessing the hazards of plant operated/owned by the company?		
2.5	Are there procedures for storing and handling hazardous substances?		
2.6	Are there procedures for identifying, assessing and controlling risks associated with manual handling?		

3. OHS Training

		Yes	No
3.1	Is health and safety training conducted in the company?		
3.2	Is a record maintained of all training and induction programs undertaken for employees in the company?		

4. Health and Safety Workplace Inspection.

		Yes	No
4.1	Are regular health and safety inspections at worksites undertaken?		
4.2	Are standard workplace inspection checklists used to conduct health and safety inspections?		
4.3	Is there a procedure by which employees can report hazards at workplaces?		

5. Health and Safety Consultation.

		Yes	No
5.1	Is there a workplace health and safety committee?		
5.2	Are employees involved in decision making over OHS matters?		
5.3	Are there employee elected health and safety representatives?		

6. OHS Performance Monitoring.

		Yes	No
6.1	Is there a system for recording and analyzing health and safety performance statistics?		
6.2	Are employees regularly provided with information on company health and safety performance?		
6.3	Has the company ever been convicted of an occupational health and safety offence?		

7. **Does your company's health and safety plan contain the following elements?**

		Yes	No
7.1	Description of the contract		
7.2	OHS Structure of work undertaken under this contract		
7.3	Induction and safety training		
7.4	Safe work practices and procedures for specific work undertaken		
7.5	Risk assessments for specific works undertaken		
7.6	Workplace inspection schedule for duration of contract		
7.7	OHS consultative processes to be followed		
7.8	Emergency procedure for this specific contract		
7.9	Incident recording and investigation on procedures		
7.10	Health and safety performance monitoring arrangements to be implemented during contract		

SBD1

**PART A
INVITATION TO BID**

YOU ARE HEREBY INVITED TO BID FOR REQUIREMENTS OF THE (NAME OF DEPARTMENT/ PUBLIC ENTITY)					
BID NUMBER:	PR&T/BID06/2021/22	CLOSING DATE:	7 TH DEC 2021	CLOSING TIME:	11H00
DESCRIPTION	REQUEST FOR APPOINTMENT OF A CONTRACTOR WITH A MINIMUM CIDB GRADING OF 6EC PE OR 7CE OR HIGHER, FOR SPECIAL MAINTENANCE OF TWEESPRUIT ACCESS ROAD, SS604 IN MOTHEO REGION AT THE DEPARTMENT OF POLICE, ROADS AND TRANSPORT, FOR A PERIOD OF TWELVE (12) MONTHS				

- BID RESPONSE DOCUMENTS MAY BE DEPOSITED IN THE BID BOX**

SITUATED AT (STREET ADDRESS)

DEPARTMENT OF POLICE , ROADS AND TRANSPORT					
45 PERM BUILDING, CHARLOTTE MAXEKE STREET					
TENDER BOX GROUND FLOOR (SECURITY ENTRANCE)					
BLOEMFONTEIN					
9323					
SUPPLIER INFORMATION					
NAME OF BIDDER					
POSTAL ADDRESS					
STREET ADDRESS					
TELEPHONE NUMBER	CODE		NUMBER		
CELLPHONE NUMBER					
FACSIMILE NUMBER	CODE		NUMBER		
E-MAIL ADDRESS					
VAT REGISTRATION NUMBER					
	TCS PIN:		OR	CSD No:	
B-BBEE STATUS LEVEL VERIFICATION CERTIFICATE [TICK APPLICABLE BOX]	☐ Yes ☐ No		B-BBEE STATUS LEVEL SWORN AFFIDAVIT		☐ Yes ☐ No
IF YES, WHO WAS THE CERTIFICATE ISSUED BY?					
AN ACCOUNTING OFFICER AS CONTEMPLATED IN THE CLOSE CORPORATION ACT (CCA) AND NAME THE APPLICABLE IN THE TICK BOX	☐	AN ACCOUNTING OFFICER AS CONTEMPLATED IN THE CLOSE CORPORATION ACT (CCA)			
	☐	A VERIFICATION AGENCY ACCREDITED BY THE SOUTH AFRICAN ACCREDITATION SYSTEM (SANAS)			
	☐	A REGISTERED AUDITOR NAME:			

[A B-BBEE STATUS LEVEL VERIFICATION CERTIFICATE/SWORN AFFIDAVIT(FOR EMEs& QSEs) MUST BE SUBMITTED IN ORDER TO QUALIFY FOR PREFERENCE POINTS FOR B-BBEE]			
ARE YOU THE ACCREDITED REPRESENTATIVE IN SOUTH AFRICA FOR THE GOODS /SERVICES /WORKS OFFERED?	☐ Yes ☐ No [IF YES ENCLOSE PROOF]	ARE YOU A FOREIGN BASED SUPPLIER FOR THE GOODS /SERVICES /WORKS OFFERED?	☐ Yes ☐ No [IF YES ANSWER PART B:3 BELOW]
SIGNATURE OF BIDDER		DATE	
CAPACITY UNDER WHICH THIS BID IS SIGNED (Attach proof of authority to sign this bid; e.g. resolution of directors, etc.)			
TOTAL NUMBER OF ITEMS OFFERED		TOTAL BID PRICE (ALL INCLUSIVE)	
BIDDING PROCEDURE ENQUIRIES MAY BE DIRECTED TO:		TECHNICAL INFORMATION MAY BE DIRECTED TO:	
DEPARTMENT/ PUBLIC ENTITY	DEPARTMENT OF POLICE , ROADS AND TRANSPORT	CONTACT PERSON	Mrs RE SEATE
CONTACT PERSON	Mr T. Makhetha	TELEPHONE NUMBER	082 059 9706
TELEPHONE NUMBER	051 409 8891	FACSIMILE NUMBER	
FACSIMILE NUMBER	N/A	E-MAIL ADDRESS	mohamik@freetrans.gov.za
E-MAIL ADDRESS	MakhethaT@freetrans.gov.za		

SBD1, PART B

TERMS AND CONDITIONS FOR BIDDING

1. BID SUBMISSION:
1.1. BIDS MUST BE DELIVERED BY THE STIPULATED TIME TO THE CORRECT ADDRESS. LATE BIDS WILL NOT BE ACCEPTED FOR CONSIDERATION. 1.2. ALL BIDS MUST BE SUBMITTED ON THE OFFICIAL FORMS PROVIDED–(NOT TO BE RE-TYPED) OR ONLINE 1.3. BIDDERS MUST REGISTER ON THE CENTRAL SUPPLIER DATABASE (CSD) TO UPLOAD MANDATORY INFORMATION NAMELY: (BUSINESS REGISTRATION/ DIRECTORSHIP/ MEMBERSHIP/IDENTITY NUMBERS; TAX COMPLIANCE STATUS; AND BANKING INFORMATION FOR VERIFICATION PURPOSES). B-BBEE CERTIFICATE OR SWORN AFFIDAVIT FOR B-BBEE MUST BE SUBMITTED TO BIDDING INSTITUTION. 1.4. WHERE A BIDDER IS NOT REGISTERED ON THE CSD, MANDATORY INFORMATION NAMELY: (BUSINESS REGISTRATION/ DIRECTORSHIP/ MEMBERSHIP/IDENTITY NUMBERS; TAX COMPLIANCE STATUS MAY NOT BE SUBMITTED WITH THE BID DOCUMENTATION. B-BBEE CERTIFICATE OR SWORN AFFIDAVIT FOR B-BBEE MUST BE SUBMITTED TO BIDDING INSTITUTION. 1.5. THIS BID IS SUBJECT TO THE PREFERENTIAL PROCUREMENT POLICY FRAMEWORK ACT 2000 AND THE PREFERENTIAL PROCUREMENT REGULATIONS, 2017, THE GENERAL CONDITIONS OF CONTRACT (GCC) AND, IF APPLICABLE, ANY OTHER LEGISLATION OR SPECIAL CONDITIONS OF CONTRACT.
2. TAX COMPLIANCE REQUIREMENTS
2.1 BIDDERS MUST ENSURE COMPLIANCE WITH THEIR TAX OBLIGATIONS. 2.2 BIDDERS ARE REQUIRED TO SUBMIT THEIR UNIQUE PERSONAL IDENTIFICATION NUMBER (PIN) ISSUED BY SARS TO ENABLE THE ORGAN OF STATE TO VIEW THE TAXPAYER'S PROFILE AND TAX STATUS. 2.3 APPLICATION FOR TAX COMPLIANCE STATUS (TCS) OR PIN MAY ALSO BE MADE VIA E-FILING. IN ORDER TO USE THIS PROVISION, TAXPAYERS WILL NEED TO REGISTER WITH SARS AS E-FILERS THROUGH THE WEBSITE WWW.SARS.GOV.ZA. 2.4 BIDDERS MAY ALSO SUBMIT A PRINTED TCS TOGETHER WITH THE BID. 2.5 IN BIDS WHERE CONSORTIA / JOINT VENTURES / SUB-CONTRACTORS ARE INVOLVED, EACH PARTY MUST SUBMIT A SEPARATE PROOF OF TCS / PIN / CSD NUMBER. 2.6 WHERE NO TCS IS AVAILABLE BUT THE BIDDER IS REGISTERED ON THE CENTRAL SUPPLIER DATABASE (CSD), A CSD NUMBER MUST BE PROVIDED.
3. QUESTIONNAIRE TO BIDDING FOREIGN SUPPLIERS

3.1. IS THE BIDDER A RESIDENT OF THE REPUBLIC OF SOUTH AFRICA (RSA)?

YES NO ☐ ☐

3.2. DOES THE BIDDER HAVE A BRANCH IN THE RSA?

YES NO ☐ ☐

3.3. DOES THE BIDDER HAVE A PERMANENT ESTABLISHMENT IN THE RSA? ☐ ☐

YES NO

3.4. DOES THE BIDDER HAVE ANY SOURCE OF INCOME IN THE RSA?

YES NO

IF THE ANSWER IS “NO” TO ALL OF THE ABOVE, THEN, IT IS NOT A REQUIREMENT TO OBTAIN A TAX COMPLIANCE STATUS / TAX COMPLIANCE SYSTEM PIN CODE FROM THE SOUTH AFRICAN REVENUE SERVICE (SARS) AND IF NOT REGISTER AS PER 2.3 ABOVE.

NB: FAILURE TO PROVIDE ANY OF THE ABOVE PARTICULARS MAY RENDER THE BID INVALID

SBD 2

TAX CLEARANCE REQUIREMENTS

It is a condition of bid that the taxes of the successful bidder must be in order, or that satisfactory arrangements have been made with South African Revenue Service (SARS) to meet the bidder's tax obligations.

1. In order to meet this requirement bidders are required to complete in full the attached form TCC 001 "Application for a Tax Clearance Certificate" and submit it to any SARS branch office nationally. The Tax Clearance Certificate Requirements are also applicable to foreign bidders / individuals who wish to submit bids.
2. SARS will then furnish the bidder with a Tax Clearance Certificate that will be valid for a period of 1 (one) year from the date of approval.
3. The original Tax Clearance Certificate must be submitted together with the bid. Failure to submit the original and valid Tax Clearance Certificate will result in the invalidation of the bid. Certified copies of the Tax Clearance Certificate will not be acceptable.
4. In bids where Consortia / Joint Ventures / Sub-contractors are involved, each party must submit a separate Tax Clearance Certificate.
5. Copies of the TCC 001 "Application for a Tax Clearance Certificate" form are available from any SARS branch office nationally or on the website www.sars.gov.za.
6. Applications for the Tax Clearance Certificates may also be made via eFiling. In order to use this provision, taxpayers will need to register with SARS as eFilers through the website www.sars.gov.za.

**APPLICATION FOR TAX CLEARANCE CERTIFICATE
(IN RESPECT OF BIDDERS)**

1. Name of taxpayer / bidder:

2. Trade name:

3. Identification number:

4. Company / Close Corporation registration number:

5. Income tax reference number

6. VAT registration number (if applicable)

7. PAYE employer's registration number (if applicable)

Signature of contact person requiring Tax Clearance Certificate:

.....

Name:

Telephone number: Code:..... Number:

Address:												
	Postal Code											

DATE: 20____ / ____ / ____

PLEASE NOTE THAT THE COMMISSIONER FOR THE SOUTH AFRICAN REVENUE SERVICE (SARS) WILL NOT EXERCISE HIS DISCRETIONARY POWERS IN FAVOUR OF ANY PERSON WITH REGARD TO ANY INTEREST, PENALTIES AND / OR ADDITIONAL TAX LEVIABLE DUE TO THE LATE- OR UNDERPAYMENT OF TAXES, DUTIES OR LEVIES OR THE RENDITION RETURNS BY ANY PERSON AS A RESULT OF ANY SYSTEM NOT BEING YEAR 2000 COMPLIANT

SBD 3.1

PRICING SCHEDULE – FIRM PRICES (PURCHASES)

NOTE: ONLY FIRM PRICES WILL BE ACCEPTED. NON-FIRM PRICES (INCLUDING PRICES SUBJECT TO RATES OF EXCHANGE VARIATIONS) WILL NOT BE CONSIDERED

IN CASES WHERE DIFFERENT DELIVERY POINTS INFLUENCE THE PRICING, A SEPARATE PRICING SCHEDULE MUST BE SUBMITTED FOR EACH DELIVERY POINT

Name of bidder..... Bid number:

Closing Time 11:00

Closing date

OFFER TO BE VALID FOR.....DAYS FROM THE CLOSING DATE OF BID.

ITEM NO.	QUANTITY	DESCRIPTION	BID PRICE IN RSA CURRENCY ** (ALL APPLICABLE TAXES INCLUDED)

- Required by:

- At:

- Brand and model

- Country of origin

- Does the offer comply with the specification(s)? *YES/NO

- If not to specification, indicate deviation(s)

- Period required for delivery
*Delivery: Firm/not firm

- Delivery basis

Note: All delivery costs must be included in the bid price, for delivery at the prescribed destination.

** "all applicable taxes" includes value- added tax, pay as you earn, income tax, unemployment insurance fund contributions and skills development levies.

*Delete if not applicable

SBD 4

DECLARATION OF INTEREST

1. Any legal person, including persons employed by the state¹, 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 an advertised competitive bid, a limited bid, a proposal or written price quotation). 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 authorised representative declare his/her position in relation to the evaluating/adjudicating authority where-
 - the bidder is employed by the state; and/or
 - 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, shareholder², member):
.....
 - 2.4 Registration number of company, enterprise, close corporation, partnership agreement or trust:
.....
 - 2.5 Tax Reference Number:.....
 - 2.6 VAT Registration Number:.....
 - 2.6.1 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.

"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.

"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 Are you or any person connected with the bidder presently employed by the state? **YES / NO**

2.7.1 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:

.....

2.7.2 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**

2.7.2.1 If yes, did you attach 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.

2.7.2.2 If no, furnish reasons for non-submission of such proof:

.....

2.8 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**

2.8.1 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 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 Number	Income Reference	State Number	Employee / Persal Number

●

● **4DECLARATION**

I, THE UNDERSIGNED (NAME).....

CERTIFY THAT THE INFORMATION FURNISHED IN PARAGRAPHS 2 and 3 ABOVE IS CORRECT.
I ACCEPT THAT THE STATE MAY REJECT THE BID OR ACT AGAINST ME SHOULD THIS
DECLARATION PROVE TO BE FALSE.

.....
Signature

.....
Date

.....
Position

.....
Name of bidder

PREFERENCE POINTS CLAIM FORM IN TERMS OF THE PREFERENTIAL PROCUREMENT REGULATIONS 2017

This preference form must form part of all bids invited. It contains general information and serves as a claim form for preference points for Broad-Based Black Economic Empowerment (B-BBEE) Status Level of Contribution

NB: BEFORE COMPLETING THIS FORM, BIDDERS MUST STUDY THE GENERAL CONDITIONS, DEFINITIONS AND DIRECTIVES APPLICABLE IN RESPECT OF B-BBEE, AS PRESCRIBED IN THE PREFERENTIAL PROCUREMENT REGULATIONS, 2017.

1. GENERAL CONDITIONS

1.1 The following preference point systems are applicable to all bids:

- the 80/20 system for requirements with a Rand value of up to R50 000 000 (all applicable taxes included); and
- the 90/10 system for requirements with a Rand value above R50 000 000 (all applicable taxes included).

1.2

- a) The value of this bid is estimated to **exceed/not exceed** R50 000 000 (all applicable taxes included) and therefore the preference point system shall be applicable; or
- b) Either the 80/20 or 90/10 preference point system will be applicable to this tender (*delete whichever is not applicable for this tender*).

1.3 Points for this bid shall be awarded for:

- (a) Price; and
- (b) B-BBEE Status Level of Contributor.

1.4 The maximum points for this bid are allocated as follows:

	POINTS
PRICE	
B-BBEE STATUS LEVEL OF CONTRIBUTOR	
Total points for Price and B-BBEE must not exceed	100

1.5 Failure on the part of a bidder to submit proof of B-BBEE Status level of contributor together with the bid, will be interpreted to mean that preference points for B-BBEE status level of contribution are not claimed.

1.6 The purchaser reserves the right to require of a bidder, either before a bid is adjudicated or at any time subsequently, to substantiate any claim in regard to preferences, in any manner required by the purchaser.

2. DEFINITIONS

- (a) **“B-BBEE”** means broad-based black economic empowerment as defined in section 1 of the Broad-Based Black Economic Empowerment Act;
- (b) **“B-BBEE status level of contributor”** means the B-BBEE status of an entity in terms of a code of good practice on black economic empowerment, issued in terms of section 9(1) of the Broad-Based Black Economic Empowerment Act;
- (c) **“bid”** means a written offer in a prescribed or stipulated form in response to an invitation by an organ of state for the provision of goods or services, through price quotations, advertised competitive bidding processes or proposals;
- (d) **“Broad-Based Black Economic Empowerment Act”** means the Broad-Based Black Economic Empowerment Act, 2003 (Act No. 53 of 2003);
- (e) **“EME”** means an Exempted Micro Enterprise in terms of a code of good practice on black economic empowerment issued in terms of section 9 (1) of the Broad-Based Black Economic Empowerment Act;
- (f) **“functionality”** means the ability of a tenderer to provide goods or services in accordance with specifications as set out in the tender documents.
- (g) **“prices”** includes all applicable taxes less all unconditional discounts;
- (h) **“proof of B-BBEE status level of contributor”** means:
 - 1) B-BBEE Status level certificate issued by an authorized body or person;
 - 2) A sworn affidavit as prescribed by the B-BBEE Codes of Good Practice;
 - 3) Any other requirement prescribed in terms of the B-BBEE Act;
- (i) **“QSE”** means a qualifying small business enterprise in terms of a code of good practice on black economic empowerment issued in terms of section 9 (1) of the Broad-Based Black Economic Empowerment Act;
- (j) **“rand value”** means the total estimated value of a contract in Rand, calculated at the time of bid invitation, and includes all applicable taxes;

3. POINTS AWARDED FOR PRICE

3.1 THE 80/20 OR 90/10 PREFERENCE POINT SYSTEMS

A maximum of 80 or 90 points is allocated for price on the following basis:

80/20

or

90/10

$$P_s = 80 \left(1 - \frac{P_t - P_{\min}}{P_{\min}} \right) \quad \text{or} \quad P_s = 90 \left(1 - \frac{P_t - P_{\min}}{P_{\min}} \right)$$

Where

P_s = Points scored for price of bid under consideration

P_t = Price of bid under consideration

$P_{\min}$ = Price of lowest acceptable bid

4. POINTS AWARDED FOR B-BBEE STATUS LEVEL OF CONTRIBUTOR

- 4.1 In terms of Regulation 6 (2) and 7 (2) of the Preferential Procurement Regulations, preference points must be awarded to a bidder for attaining the B-BBEE status level of contribution in accordance with the table below:

B-BBEE Status Level of Contributor	Number of points (90/10 system)	Number of points (80/20 system)
1	10	20
2	9	18
3	6	14
4	5	12
5	4	8
6	3	6
7	2	4
8	1	2
Non-compliant contributor	0	0

5. BID DECLARATION

- 5.1 Bidders who claim points in respect of B-BBEE Status Level of Contribution must complete the following:

6. B-BBEE STATUS LEVEL OF CONTRIBUTOR CLAIMED IN TERMS OF PARAGRAPHS 1.4 AND 4.1

- 6.1 B-BBEE Status Level of Contributor: . = ...(maximum of 10 or 20 points)
(Points claimed in respect of paragraph 7.1 must be in accordance with the table reflected in paragraph 4.1 and must be substantiated by relevant proof of B-BBEE status level of contributor.

7. SUB-CONTRACTING

- 7.1 Will any portion of the contract be sub-contracted?

(*Tick applicable box*)

YES	☐	NO	☐

- 7.1.1 If yes, indicate:

- i) What percentage of the contract will be subcontracted.....%
- ii) The name of the sub-contractor.....
- iii) The B-BBEE status level of the sub-contractor.....
- iv) Whether the sub-contractor is an EME or QSE

(*Tick applicable box*)

YES		NO	

- v) Specify, by ticking the appropriate box, if subcontracting with an enterprise in terms of Preferential Procurement Regulations, 2017:

Designated Group: An EME or QSE which is at least 51% owned by:	EME √	QSE √
Black people		
Black people who are youth		
Black people who are women		
Black people with disabilities		
Black people living in rural or underdeveloped areas or townships		
Cooperative owned by black people		
Black people who are military veterans		
OR		
Any EME		
Any QSE		

8. DECLARATION WITH REGARD TO COMPANY/FIRM

8.1 Name of company/firm:.....

8.2 VAT registration number:.....

8.3 Company registration number:.....

8.4 TYPE OF COMPANY/ FIRM

- ☐ Partnership/Joint Venture / Consortium
☐ One person business/sole propriety
☐ Close corporation
☐ Company
☐ (Pty) Limited
 [TICK APPLICABLE BOX]

8.5 DESCRIBE PRINCIPAL BUSINESS ACTIVITIES

.....

8.6 COMPANY CLASSIFICATION

- ☐ Manufacturer
☐ Supplier
☐ Professional service provider
☐ Other service providers, e.g. transporter, etc.
 [TICK APPLICABLE BOX]

8.7 Total number of years the company/firm has been in business:.....

8.8 I/we, the undersigned, who is / are duly authorised to do so on behalf of the company/firm, certify that the points claimed, based on the B-BBE status level of contributor indicated in paragraphs 1.4 and 6.1 of the foregoing certificate, qualifies the company/ firm for the preference(s) shown and I / we acknowledge that:

- i) The information furnished is true and correct;
- ii) The preference points claimed are in accordance with the General Conditions as indicated in paragraph 1 of this form;
- iii) In the event of a contract being awarded as a result of points claimed as shown in paragraphs 1.4 and 6.1, the contractor may be required to furnish documentary proof to the satisfaction of the purchaser that the claims are correct;
- iv) If the B-BBEE status level of contributor has been claimed or obtained on a fraudulent basis or any of the conditions of contract have not been fulfilled, the purchaser may, in addition to any other remedy it may have –
 - (a) disqualify the person from the bidding process;
 - (b) recover costs, losses or damages it has incurred or suffered as a result of that person's conduct;
 - (c) cancel the contract and claim any damages which it has suffered as a result of having to make less favourable arrangements due to such cancellation;
 - (d) recommend that the bidder or contractor, its shareholders and directors, or only the shareholders and directors who acted on a fraudulent basis, be restricted by the National Treasury from obtaining business from any organ of state for a period not exceeding 10 years, after the *audi alteram partem* (hear the other side) rule has been applied; and
 - (e) forward the matter for criminal prosecution.

WITNESSES

- 1.
- 2.

.....
SIGNATURE(S) OF BIDDERS(S)

DATE:
ADDRESS
.....
.....

SBD 8

• DECLARATION OF BIDDER'S PAST SUPPLY CHAIN MANAGEMENT PRACTICES

- 1 This Standard Bidding Document must form part of all bids invited.
- 2 It serves as a declaration to be used by institutions in ensuring that when goods and services are being procured, all reasonable steps are taken to combat the abuse of the supply chain management system.
- 3 The bid of any bidder may be disregarded if that bidder, or any of its directors have-
 - a. abused the institution's supply chain management system;
 - b. committed fraud or any other improper conduct in relation to such system; or
 - c. failed to perform on any previous contract.
- 4 In order to give effect to the above, the following questionnaire must be completed and submitted with the bid.

Item	Question	Yes	No
4.1	Is the bidder or any of its directors listed on the National Treasury's Database of Restricted Suppliers as companies or persons prohibited from doing business with the public sector? (Companies or persons who are listed on this Database were informed in writing of this restriction by the Accounting Officer/Authority of the institution that imposed the restriction after the <i>audi alteram partem</i> rule was applied). The Database of Restricted Suppliers now resides on the National Treasury's website(www.treasury.gov.za) and can be accessed by clicking on its link at the bottom of the home page.	Yes ☐	No ☐
4.1.1	If so, furnish particulars:		
4.2	Is the bidder or any of its directors listed on the Register for Tender Defaulters in terms of section 29 of the Prevention and Combating of Corrupt Activities Act (No 12 of 2004)? The Register for Tender Defaulters can be accessed on the National Treasury's website (www.treasury.gov.za) by clicking on its link at the bottom of the home page.	Yes ☐	No ☐
4.2.1	If so, furnish particulars:		

4.3	Was the bidder or any of its directors convicted by a court of law (including a court outside of the Republic of South Africa) for fraud or corruption during the past five years?	Yes ☐	No ☐
4.3.1	If so, furnish particulars:		
4.4	Was any contract between the bidder and any organ of state terminated during the past five years on account of failure to perform on or comply with the contract?	Yes ☐	No ☐
4.4.1	If so, furnish particulars:		

CERTIFICATION

I, THE UNDERSIGNED (FULL NAME).....

**CERTIFY THAT THE INFORMATION FURNISHED ON THIS DECLARATION FORM
IS TRUE AND CORRECT.**

**I ACCEPT THAT, IN ADDITION TO CANCELLATION OF A CONTRACT, ACTION
MAY BE TAKEN AGAINST ME SHOULD THIS DECLARATION PROVE TO BE
FALSE.**

.....

Signature

.....

Date

.....

Position

.....

Name of Bidder

CERTIFICATE OF INDEPENDENT BID DETERMINATION

- 1 This Standard Bidding Document (SBD) must form part of all bids¹ invited.
- 2 Section 4 (1) (b) (iii) of the Competition Act No. 89 of 1998, as amended, prohibits an agreement between, or concerted practice by, firms, or a decision by an association of firms, if it is between parties in a horizontal relationship and if it involves collusive bidding (or bid rigging).² Collusive bidding is a *pe se* prohibition meaning that it cannot be justified under any grounds.
- 3 Treasury Regulation 16A9 prescribes that accounting officers and accounting authorities must take all reasonable steps to prevent abuse of the supply chain management system and authorizes accounting officers and accounting authorities to:
 - a. disregard the bid of any bidder if that bidder, or any of its directors have abused the institution's supply chain management system and or committed fraud or any other improper conduct in relation to such system.
 - b. cancel a contract awarded to a supplier of goods and services if the supplier committed any corrupt or fraudulent act during the bidding process or the execution of that contract.
- 4 This SBD serves as a certificate of declaration that would be used by institutions to ensure that, when bids are considered, reasonable steps are taken to prevent any form of bid-rigging.
- 5 In order to give effect to the above, the attached Certificate of Bid Determination (SBD 9) must be completed and submitted with the bid:

¹ Includes price quotations, advertised competitive bids, limited bids and proposals.

² Bid rigging (or collusive bidding) occurs when businesses, that would otherwise be expected to compete, secretly conspire to raise prices or lower the quality of goods and / or services for purchasers who wish to acquire goods and / or services through a bidding process. Bid rigging is, therefore, an agreement between competitors not to compete.

CERTIFICATE OF INDEPENDENT BID DETERMINATION

I, the undersigned, in submitting the accompanying bid:

(Bid Number and Description)

in response to the invitation for the bid made by:

(Name of Institution)

do hereby make the following statements that I certify to be true and complete in every respect:

I certify, on behalf of: _____ that:

(Name of Bidder)

1. I have read and I understand the contents of this Certificate;
2. I understand that the accompanying bid will be disqualified if this Certificate is found not to be true and complete in every respect;
3. I am authorized by the bidder to sign this Certificate, and to submit the accompanying bid, on behalf of the bidder;
4. Each person whose signature appears on the accompanying bid has been authorized by the bidder to determine the terms of, and to sign the bid, on behalf of the bidder;
5. For the purposes of this Certificate and the accompanying bid, I understand that the word "competitor" shall include any individual or organization, other than the bidder, whether or not affiliated with the bidder, who:
 - (a) has been requested to submit a bid in response to this bid invitation;
 - (b) could potentially submit a bid in response to this bid invitation, based on their qualifications, abilities or experience; and
 - (c) provides the same goods and services as the bidder and/or is in the same line of business as the bidder

SBD 9

6. The bidder has arrived at the accompanying bid independently from, and without consultation, communication, agreement or arrangement with any competitor. However communication between partners in a joint venture or consortium³ will not be construed as collusive bidding.
7. In particular, without limiting the generality of paragraphs 6 above, there has been no consultation, communication, agreement or arrangement with any competitor regarding:
 - (a) prices;
 - (b) geographical area where product or service will be rendered (market allocation)
 - (c) methods, factors or formulas used to calculate prices;
 - (d) the intention or decision to submit or not to submit, a bid;
 - (e) the submission of a bid which does not meet the specifications and conditions of the bid; or
 - (f) bidding with the intention not to win the bid.
8. In addition, there have been no consultations, communications, agreements or arrangements with any competitor regarding the quality, quantity, specifications and conditions or delivery particulars of the products or services to which this bid invitation relates.
9. The terms of the accompanying bid have not been, and will not be, disclosed by the bidder, directly or indirectly, to any competitor, prior to the date and time of the official bid opening or of the awarding of the contract.
10. I am aware that, in addition and without prejudice to any other remedy provided to combat any restrictive practices related to bids and contracts, bids that are suspicious will be reported to the Competition Commission for investigation and possible imposition of administrative penalties in terms of section 59 of the Competition Act No 89 of 1998 and or may be reported to the National Prosecuting Authority (NPA) for criminal investigation and or may be restricted from conducting business with the public sector for a period not exceeding ten (10) years in terms of the Prevention and Combating of Corrupt Activities Act No 12 of 2004 or any other applicable legislation.

.....
Signature

.....
Date

.....
Position

.....
Name of Bidder

³ Joint venture or Consortium means an association of persons for the purpose of combining their expertise, property, capital, efforts, skill and knowledge in an activity for the execution of a contract.

ANY ENQUIRIES REGARDING THE BIDDING PROCEDURE MAY BE DIRECTED TO:

Department Department of Police, Roads and Transport

Contact Person: Mr V Ntaka

Tel: 051 409 8687

Fax: 051 409 8683

E-mail address: nakav@freetrans.gov.za

ANY ENQUIRIES REGARDING TECHNICAL INFORMATION MAY BE DIRECTED TO:

Department: Department of Police, Roads and Transport

Contact Person: Mr RE Seate

Tel: 082 059 9706

Fax: 086 7599 435

E-mail address: kmohami@yahoo.com

**THE SPECIAL MAINTENANCE OF TWEESPRUIT ACCESS ROAD, SS604 AND
S34: KM 0.0 TO KM 6.400**

PART C1: AGREEMENT AND CONTRACT DATA

THE CONTRACT

PART C1 : AGREEMENTS AND CONTRACT DATA

PART C2 : PRICING DATA

PART C1 : AGREEMENTS AND CONTRACT DATA**CONTENTS**

<u>SECTION</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
C1.1	FORM OF OFFER AND ACCEPTANCE	C1-3
C1.2	CONTRACT DATA	C1-7

C1.1 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:

THE SPECIAL MAINTENANCE OF TWEESPRUIT ACCESS ROAD, SS604 AND S34: KM 0.0 TO KM 6.4

The Bidder, identified in the Offer signature block below, has examined the documents listed in the Bid Data and addenda thereto as listed in the Returnable Schedules, and by submitting this Offer has accepted the Conditions of Bid.

By the representative of the Bidder, deemed to be duly authorized, signing this part of this Form of Offer and Acceptance, the Bidder 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 Bidder before the end of the period of validity stated in the Bid Data, whereupon the Bidder becomes the party named as the Contractor in the Conditions of Contract identified in the Contract Data.

For the Bidder

.....
Signature

.....
Name

.....
Capacity

Name and address of organization

.....

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 Bidder'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 Bidder's Offer shall form an agreement between the Employer and the Bidder upon the terms and conditions contained in this Agreement and in the Contract that is the subject of this Agreement.

The terms of the contract, are contained in:

Part C1: Agreements and Contract Data, (which includes this Agreement)
 Part C2: Pricing Data
 Part C3: Scope of Work.
 Part C4: Site Information

and drawings and documents or parts thereof, which may be incorporated by reference into Parts C1 to C4 above.

Deviations from and amendments to the documents listed in the Bid Data and any addenda thereto as listed in the Bid Schedules as well as any changes to the terms of the Offer agreed by the Bidder 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 documents are valid unless contained in this Schedule, which must be duly signed by the authorised representative(s) of both parties.

The Bidder 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. Failure to fulfil any of these obligations in accordance with those terms shall constitute a repudiation of this Agreement.

Notwithstanding anything contained herein, this Agreement comes into effect on the date when the Bidder receives one fully completed original copy of this document, including the Schedule of Deviations (if any). Unless the Bidder (now Contractor) within five days of the date of such receipt notifies the Employer in writing of any reason why he cannot accept the contents of this Agreement, this Agreement shall constitute a binding contract between the parties.

For the Employer:

.....
 Signature

.....
 Name

.....
 Capacity

Name and address of organisation:

.....

.....

Signature and name of witness:

Signature

.....

Name

Date:

Schedule of Deviations

Notes:

1. The extent of deviations from the Bid documents issued by the Employer prior to the Bid closing date is limited to those permitted in terms of the Conditions of Bid,
2. A Bidder'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,
3. Any other matter arising from the process of offer and acceptance either as a confirmation, clarification or change to Bid documents and which it is agreed by the Parties becomes and obligation of the contract shall also be recorded here,
4. Any change or addition to the Bid documents arising from the above agreements and recorded here, shall also be incorporated into final draft or the Contract,

1. Subject

.

Details

.

2. Subject

.

Details

.

By the duly authorised representatives signing this Schedule of Deviations, the Employer and the Bidder agree to and accept the foregoing Schedule of Deviations as the only deviations from and amendments to the documents listed in the Bid Data and addenda thereto as listed in the Bid Schedules, as well as any confirmation, clarification or changes to the terms of the offer agreed by the Bidder 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 Bid documents and the receipt by the Bidder 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 Bidder:

For the Employer:

.....

Signature

.....

.....	Name	
.....	Capacity	
Name and address of organisation:	Name and address of organisation:	
.....		
.....		
.....		
.....	Witness Signature	
.....	Witness Name	
.....	Date	

Confirmation of Receipt

The Bidder, (now Contractor), identified in the Offer part of this Agreement hereby confirms receipt from the Employer, identified in the Acceptance part of this Agreement, of one fully completed original copy of this Agreement, including Schedule of Deviations (if any) today:

the(day)

of(month)

20(year)

at(place)

For the Contractor: ..
Signature

.....
Name

.....
Capacity

Signature and name of witness:

.....
Signature

.....
Name

C1.2 CONTRACT DATA**CONTENTS**

<u>SECTION</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
C1.2.1	CONDITIONS OF CONTRACT	C1-8
C1.2.2	CONTRACT SPECIFIC DATA	C1-10
C1.2.3	DATA PROVIDED BY THE TENDERER	C1-16

C1.2 CONTRACT DATA

Clause	Statement	Data
The <i>conditions of contract</i> are the core clauses and the clauses for main Option based on the GCC 2015 – (General Conditions of Contract for Construction Works, 2015)		
	Dispute resolution Option and secondary Options of the GCC 2015	2. Basis of Contract 4.4 Subcontracting 5. Time and Related Matters 5.14: Completion 5.9 Instructions 6.3: Variations 6.7: Measurement of Works 6.10: Payments 7.8: Defects 10. Claims and Disputes
1.1	The Employer is	Free State Provincial Government represented by Head of Department: Department of Police, Roads and Transport
	Address	<u>Physical:</u> 45 Charlotte Maxeke Street Bloemfontein 9300 <u>Postal:</u> P.O Box 690 Bloemfontein 9300 Telephone No: (051) 409 8575
	The Project Manager is:	Mrs RE Seate <u>Physical:</u> Medfontein Building Bloemfontein 9300 E-Mail: tholangm@icloud.com Tel No: 051 409 8595 Fax No: (086) 7599 435

1.1	The works are:	THE SPECIAL MAINTENANCE OF TWEESPRUIT ACCESS ROAD, SS604 AND S34: KM 0.0 TO KM 6.400
	The following matters will be included in the Risk Register:	✓ Underground water conditions ✓ Working in close proximity of operations ✓ Damages to existing infrastructure ✓ Material supply & logistics ✓ Traffic Management
2.1	The Site Information is in	Part C4
2.1	The Works Information is In	Part C3
1.3.2	The <i>law of the contract</i> is the law of	the Republic of South Africa subject to the jurisdiction of the Courts of South Africa
1.3.3	The <i>language of this contract</i> is	English
5.1	The <i>period for reply</i> is	14 calendar days from the issuing of the package order.
5	Time	
5.5	The <i>completion date</i> for the whole of the <i>works</i> is	The Duration of the contract shall be 12 months from the date of site handover
5.6.3	The <i>Contractor</i> is to submit a program for approval within	14 calendar days from the issuing of the package order.
5.3	The <i>starting date</i> is	The date of the site handover meeting
5.6	The <i>Contractor</i> submits revised programs at intervals no longer than	14 days from receiving request from the project manager
5.14	The <i>Employer</i> is not willing to take over the <i>works</i> before the Completion Date	
7.8	Testing and Defects	

7.8.1	The <i>defects date</i> is	12 Months (twenty four months) after practical works completion
7.8.1	The <i>defect correction period</i> is	2 weeks
6.10	Payment	
6.7	The <i>assessment interval</i> is monthly on the	Last week of the month (fourth week) day of each successive month
6.10	The <i>currency of this contract</i> is the	South African Rand
6.10	The period within which payments are made is	Payment will be effected within 30 (thirty days) following the submission of valid Tax Invoice, Progress reports, Correct signed EPWP reports and appointment letter
51.4	The <i>interest rate</i> is	The interest rate will not be applicable for any contractors within the panel of contractors
6.3	Variation Orders	
6.3	Variation Orders caused by the following will not be regarded for the purpose of this contract: 1. Inclement weather 2. Community and Labour unrests 3. Political instability 4. Material unavailability The above mentioned delays on the contract shall only carry an additional time extension and no additional cost to the project. Refer to the signed general framework contract.	
6.3	Assessing Variation Orders	
	The assessment shall be done with conditions of this contract and that of the general framework contract and their respective GCC modules. Clauses detailed in the general framework contract shall govern over those of the package order.	
8	Risks and Insurances	

8.3	These are additional <i>Employer's risks</i>	1. No additional risks are accepted by the <i>Employer</i> other than those which are provided for in this contract. 2. The employer shall furthermore be exonerated from any loss of or damage to works, plant and materials due to strikes, riots and civil commotion not confined to the contractor's employee's, the contractor is thus required to allow for such risks. 3. (the contractor will be liable for any risk due to his non- compliant)
8.3	<i>Contractor's risk</i>	From the starting date until the Defects Certificate has been issued, the risks which are not carried by the Employer are carried by the Contractor
8.6	<i>Employer insurances</i>	The Employer does not provide any insurance for the project
8.6	The minimum limit of indemnity for insurance in respect of death of or bodily injury to employees of the <i>Contractor</i> arising out of and in the course of their employment in connection with this contract for any one event is	R5,000,000-00 per claim, number of claims Unlimited
9.	Termination	
9.1	Reasons for termination	Additional reasons for termination are those stipulated in the General Framework contract signed by the contractor and employer, these conditions shall govern over those stipulated in this clause.

		Further termination of the framework contract may result due as stipulated in the Framework agreement.
10	Data for main option clause	
B	Option B	Priced Contract with Bill of Quantities
6.7	The <i>method of measurement</i> is	- for the <i>Standard Specifications for Road and Bridge Works for South African Road Authorities: 2020</i> <i>Edition of COTO (Committee of Transport Officials) 2020</i>
11	Data for Option W1	
W1.1	The <i>Adjudicator</i> is	Both parties will agree as and when a dispute arises. If the parties cannot reach an agreement on the <i>Adjudicator</i>, the chairman of the Association of Arbitrators will appoint an <i>Adjudicator</i>
W1.2(3)	The <i>Adjudicator nominating body</i> is:	The Chairman of the Association of Arbitrators (Southern Africa) If no <i>Adjudicator nominating body</i> is entered, it is: the Association of Arbitrators (Southern Africa)
W1.4(2)	The <i>tribunal</i> is:	Arbitration
W1.4(5)	The <i>arbitration procedure</i> is	The Rules for the Conduct of Arbitrations of the Association of Arbitrators (Southern Africa) The place where arbitration is to be held is Bloemfontein The person or organization who will choose an arbitrator - if the Parties cannot agree a choice or - if the arbitration procedure does not state who selects an arbitrator, is The Chairman of the Association of Arbitrators (Southern Africa)

Page 86	Price adjustment for inflation (CPA)	
Page 86	Defined terms	The calculation of CPA shall be as per the attached specification for calculating CPA.
6.3	Variations	The following values for the different factors are to be used: X = 0.10 a = 0.10 - Labour b = 0.55 - Equipment c = 0.15 - Material d = 0.20 - Fuel The different values for the calculation of the price adjustment factor shall be for the area of Free State: Other urban areas. The Diesel index shall be for the Witwatersrand Area. The Base month is one month prior to submission of quotations or as stipulated in the General Framework contracts. Only applicable for contract duration of more 12 months of commencement date.
6.2.3	Performance bond	
6.2.3	The amount of the performance bond is	10% of the contract value including VAT
	Advanced payment to the Contractor	
	Advanced Payment	There will be no advanced payment made to the contractor
6.10.3	Retention	
6.10.3	The <i>retention percentage</i> is	1. 10% of the Contract Amount, two retention guarantees (5% each) are required from the contractor within 14 days of site handover of which one will be handed over to the contractor upon works completion (Practical Completion) 2. Upon submission of the required guarantees, no retention shall be

		subtracted from interim payments made to the contractor.
Page 96	<i>Additional conditions of contract</i>	
	The <i>additional conditions of contract</i> are:	
5.8	Non-working times	The non-working times are Sundays. The special non-working days are the construction industry year end break, all foreseeable statutory election days as declared by National Government, and the following statutory public holidays as declared by National Government: New Year's Day, Human Rights Day, Good Friday, Family Day, Freedom Day, Workers' Day, Youth Day, National Women's Day, Heritage Day, Day of Reconciliation, Christmas Day and the Day of Goodwill. The construction industry year end break commences on the first working day after 15 December and ends on the first working day after 5 January of the following year.
5.12	Extension of time for Completion	In general, extension of time for the completion of Works will, in terms of the General conditions of Contract, be granted only for additional work and for circumstances which could not have been foreseen, and are beyond the control of the Contractor. No extension of time for completion will be granted on account of normal inclement weather, but extension of time shall be determined for abnormal rainfall or wet conditions in accordance with the formula given below, separately for each calendar month or part thereof.

5.13	Penalty for the delays	The penalty for failing to complete the Works is 0,05% of the Contract Sum per day, up to a maximum limit of twenty-five thousand rand per day (R25,000,00 per day).
6.9.2	Special Material	Price adjustments for variations in the costs of special materials are allowed. Special materials shall be limited to bitumen and bitumen products only.
6.10.2	Material on site	The percentage advance on materials not yet built into the Permanent Works is 80%.
7.2	Quality of materials and Workmanship	The source of supply of all materials including all stone, sand, gravel or soil or any other natural material required in the execution of the Works shall be located by the Contractor. No material shall be used until it has been approved by the Engineer
7.8	Defects	In the event of the Contractor not completing all the outstanding work within the period specified by the Employer in terms of the contract, the Employer shall have the right to extend the Period of Maintenance by the additional time taken by the Contractor to complete such outstanding work to the satisfaction of the Employer. The full retention applicable to the Period of Maintenance shall apply to such extension.

4.10	Targeted Local labour	1. Minimum Labour Employment for this contract is 4 people per million of Contract Value (Excl. VAT, Contingencies and CPA) should be appointed with a minimum of six months at a payment rate of R166/day. 2. 25% of labour must be retained for the entire duration of the contract. 3. Recruitment of labour for annual targets shall be conducted as follows ✓ 30% - at the beginning of Financial year ✓ 30% - three months after the initial appointment ✓ 40% - midway into the financial year 4. The employment demographics are as follows: ✓ Youth – 55% ✓ Female – 60% ✓ Disabled – 2% 5. Wherever feasible labour will be deployed to Local Municipalities for service delivery at the cost of the Contractor.
5.11	Temporary Suspension of Works	Planned Annual allocated budget available can be reduced at the Employer's discretion. In the event that annual budget is reduced or exhausted, the Contractor shall not be allowed stop the Works and or claim interest on the unpaid Works. No claim shall be submitted to the Department once the budget is depleted.
5.6	Works Schedule	Activities specified on the Bill of Quantities under Section A should include all work items and

		provisional sums and should be priced by the tenderer evenly. Tender amount should be calculated according Section A of the Bill of Quantities.
4.10	Socio – Economic of Community	1% of Contract Value shall be invested into local Community.
4.10	Skills Development	- Two (2) Civil Engineering Students shall be appointed for experiential Training with stipend of R10000.00 each per month, signed off reports must be submitted to respective Departmental Project Managers. - Members of Community must also be trained in Labour Intensive Works

PART C2 PRICING DATA

DEPARTMENT OF POLICE, ROADS AND TRANSPORT**THE SPECIAL MAINTENANCE OF TWEESPRUIT ACCESS ROAD, SS604 AND
S34: KM 0.0 TO KM 6.400
C2 –PRICING DATA****C2.1 PRICING INSTRUCTIONS**

This Bill of quantities forms part of the contract documents and must be read in conjunction with all the other documents comprising the contract documents. For the purposes of this bill of quantities, the following words shall have the meanings hereby assigned to them.

Unit	:	The unit of measurement for each item of work as defined in the standard specifications or the project specifications.
Quantity	:	The number of units of work for each item.
Rate	:	The payment per unit of work for which the tenderer tenders to do the work.
Amount	:	The product of the quantity and the rate tendered for an item.
Lump Sum:		An amount tendered for an item, the extent of which is described in the schedule of quantities, the specifications or elsewhere, but of which the quantity of work is not measured in units.

Bill of Quantities

- Measurement and payment shall be in accordance with the relevant provisions of the COLTO Standard Specification for Road and Bridge Works for State Authorities (1998 edition), subject to the following amendments and additions:
- The units of measurement described in the Bill of Quantities are metric units. Abbreviations used in the Bill of Quantities are as follows:

mm	=	millimetre
m	=	metre
km	=	kilometre
m ²	=	square metre
m ² .pass	=	square metre-pass
ha	=	hectare
m ³	=	cubic metre
m ³ .km	=	cubic metre-kilometre
l	=	litre
kl	=	kilolitre
MPa	=	megapascal
h	=	hour
kg	=	kilogram
t	=	ton (1000 kg)
No.	=	number
sum	=	lump sum
MN	=	meganewton
MN.m	=	meganewton-metre
P C sum	=	Prime Cost sum
Prov sum	=	Provisional sum

%	=	per cent
kW	=	Kilowatt

- 3 For the purposes of the Bill of Quantities, the following words shall have the meanings hereby assigned to them:

Unit:	The unit of measurement for each item of work as defined in the COLTO Standard Specification for Road and Bridge Works for State Authorities (1998 edition).
Quantity:	The number of units of work for each item.
Rate:	The agreed payment per unit of measurement.
Amount:	The product of the quantity and the agreed rate for an item.
Lump sum:	An agreed amount for an item, the extent of which is described in the Bill of Quantities but the quantity of work of which is not measured in any units.

- 4 Unless otherwise stated, items are measured net in accordance with the drawings, and no allowance is made for waste. Attention is directed to the provisions of clause 1220 of the standard specifications regarding the measurements of quantities for payment. Except where specified otherwise than in clause 1220, the net measurement or mass of the finished work in place shall be taken for payment, and any volume or mass of work in excess of that prescribed, shall be excluded.
- 5 The prices and rates to be inserted in the Bill of Quantities are to be the full inclusive prices for the work described under the several items. Such prices and rates shall cover all costs and expenses that may be required in and for the execution of the work described, and for all the risks, obligations and responsibilities specified in the general conditions of contract, special conditions of contract, standard specifications and project specifications shall be considered as provided for collectively in the items of payment given in the bill of quantities.

Such prices and rates shall also cover full compensation for completing and maintaining, during the defects liability period, all the work shown on the drawings and specified in the standard specifications and project specifications and the cost of all general risks, liabilities, and obligations set forth or implied in the Contract Data, as well as overhead charges and profit. Reasonable prices shall be inserted, as these will be used as a basis for assessment of payment for additional work that may have to be carried out.

- 6 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 shall not be paid for but will be considered to be covered by other prices or rates elsewhere in the Bill of Quantities.

If the tenderer should group a number of items together and tender one lump sum for each group of items, this single tendered lump sum shall apply to that group of items and not to each individual item, or should he indicate that full compensation for any item has been included in the rate for another item, the rate for the item included in another item shall be deemed to be nil.

The tendered lump sums and rates shall be valid irrespective of any change in the quantities during the execution of the contract

- 7 Reasonable compensations will be received where no pay item appears in respect of work required in terms of the Contract, which is not covered in any other pay item.
- 8 The short descriptions of the items of payment given in the Bill of Quantities are only for the purposes of identifying the items. More details regarding the extent of the work under each item appear in the scope of work, Reference shall, inter alia, be made to the drawings, standard specifications, project specifications, general conditions of contract and special conditions of contract for more detailed information regarding the extent of work entailed under each item.
9. The item numbers appearing in the Bill of Quantities refer to the corresponding item numbers in the COLTO Standard Specification for Road and Bridge Works for State Authorities (1998 edition). Item numbers prefixed by the letter B refer to payment items described under part B of the project specifications, those with C to payment items described under part C, and so on for further parts of the project specifications.

Item numbers in schedule B of the schedule of quantities are, in addition, preceded by the number of each separate part of schedule B of the schedule of quantities, e.g. payment item 62.02 described in the standard specifications (clause 6210), when used in part 3 of schedule B of the schedule of quantities, would be numbered 3/62.02, and if this payment item had been amended in part B of the project specifications, the payment item would be indicated as 3/B62.02.

- 10 The quantities set out in the schedule of quantities are only approximate quantities. The quantities of work finally accepted and certified for payment, and not the quantities given in the schedule of quantities, will be used to determine payments to the Contractor

The validity of the contract shall in no way be affected by differences between the quantities in the schedule of quantities and the quantities finally certified for payment. Work is valued at the rates or lump sums tendered, subject only to the provisions of sub clause 1209 (a) of the standard specifications.

- 11 The amount of work or the quantities of material stated in the schedule of quantities shall not be considered as restricting or extending the amount of work to be done or quantity of material to be supplied by the Contractor
- 12 The statement of quantities of material or the amount of work in the schedule of quantities shall not be regarded as authorization for the Contractor to order material or to execute work. The Contractor shall obtain the Engineer's detailed instructions for all work before ordering any materials or executing work or making arrangements in this regard
- 13 The provisions of clause 10.1 of the general conditions of contract shall apply to provisional sums and prime cost sums.
- 14 Subject to the conditions stated in paragraph 15 below, the rates and lump sums filled in by the tenderer in the schedule of quantities shall be final and binding with regard to submitting the tender, and may not be adjusted should there be any mistakes in the extensions thereof and in the total sums appearing in the tender. Should there be any discrepancies between the tender sum and the correctly extended and totalled bill of quantities, the tendered sum will be regarded as being correct, and the Employer shall have the right to make adjustments to the tender rates to reconcile the tender sum with the total of the bill of quantities. In such an event the Contractor will be consulted but, failing agreement between the parties, the decision of the Employer shall be final and binding. Adjustment of the tender rates will take place prior to the signing of the contract. In their own interest tenderers must make doubly sure of the correctness of their tendered rates, the extensions and the tender sum.
- 15 A tender may be rejected if the unit rates or lump sums for some of the items in the schedule of quantities are, in the opinion of the Employer, unreasonable or out of proportion, and if the tenderer fails, within a period of seven (7) days of having been notified in writing by the Employer to adjust the unit rates or lump sums for such items, to make such adjustments.
- 16 Those parts of the contract to be constructed using labour-intensive methods have been marked in the bill of quantities with the letters LI in a separate column filled in against every item so designated. The works, or parts of the works so designated are to be constructed using labour-intensive methods only. The use of plant to provide such works, other than plant specifically provided for in the scope of work, is a variation to the contract. The items marked with the letters LI are not necessarily an exhaustive list of all the activities, which must be done by hand, and this clause does not over-ride any of the requirements in the generic labour intensive specification in the Scope of Works.
- 17 Payment for items which are designated to be constructed labour-intensively (either in this schedule or in the Scope of Works) will not be made unless they are constructed using labour-intensive methods. Any unauthorized use of plant to carry out work, which was to be done labour-intensively will not be condoned, and any works so constructed will not be certified for payment.

C2.2 BILL OF QUANTITIES

TENDER NO.: PR&T/BID06/2021/22			Tweespruit Access Road; SS604/S34			
C1.2			GENERAL REQUIREMENTS AND PROVISIONS			
ITEM		DESCRIPTION	UNIT	QTY	RATE	AMT
C1.2.1		Environmental Management				
	C1.2.1.1	Monitoring of compliance with and reporting on the EMP	month	12		R -
	C1.2.1.2	Dedicated environmental officer (If specified in the Contract Documentation)	month	12		R -
C1.2.2		Programming and Reporting				
	C1.2.2.1	Submission of a Scheme 1 Programme	lump sum	lump		
	C1.2.2.2	Reviewing and updating a Scheme 1 Programme	month			R -
	C1.2.2.3	Submission of a Scheme 2 Initial Programme	lump sum	lump		
	C1.2.2.4	Submission of a Scheme 2 Full Programme	lump sum	lump		
	C1.2.2.5	Reviewing and updating a Scheme 2 programme every month	month			R -
	C1.2.2.6	Preparation and submission of all information and reports specified in the Contract Documentation	month			R -
C1.2.3		Routine road maintenance of existing public roads within the Site of the Works or other				
	C 1.2.3.1	Grass cutting	hectare (ha)	2		R -
	C1.2.3.2	Drain cleaning	kilometre (km)	1		R -
	C1.2.3.3	Cleaning out culverts	cubic metre (m³)	20		R -
	C1.2.3.4	Collection of rubbish / litter	kilometre (km)	8		R -
	C1.2.3.5	Base patching using crushed stone material	cubic metre (m³)			R -
	C1.2.3.6	Base and/or surface patching using cold premixed asphalt	kilogram (kg)	125		R -
	C1.2.3.7	Base and/or surface patching using hot plant mixed asphalt	ton (t)	100		R -
	C1.2.3.8	Replacement of damaged guardrails including posts	metre (m)	30		R -
	C1.2.3.9	Grading of temporary gravel deviations and existing roads used as detours	kilometre (km)	2		R -
	C1.2.3.10	Watering of temporary gravel deviations and existing roads used as detours	kilolitre (kl)	100		R -
	C1.2.3.11	Other road maintenance work ordered by the Engineer	provisional sum	Prov	Sum	
	C1.2.3.12	Handling cost, profit and all other charges in respect of item C1.2.3.11	percentage (%)	R -	10,00%	R -
	C1.2.3.13	Liaison with the routine road maintenance contractor	month			R -
C1.2.4		Stakeholder liaison	month	12		R -
C1.2.5		Safety				
	C1.2.5.1	Health and safety plan	lump sum	lump		
	C1.2.5.2	Implementation of health and safety plan	month	12		R -
C1.2.6		Work adjacent to properties				
	C1.2.6.1	Survey of adjacent properties	number (No.)			R -
	C1.2.6.2	Preventive and/or mitigation measures	provisional sum	Prov	Sum	
	C1.2.6.3	Handling cost, profit and all other charges in respect of item C1.2.6.2	percentage (%)	R -	10,00%	R -
C1.2.7		Road safety audits				
	C1.2.7.1	Stage 4 work zone traffic management audit	provisional sum	Prov	Sum	
	C1.2.7.2	Handling cost, profit and all other charges in respect of item C1.2.6.1	percentage (%)	R -	10,00%	R -
	C1.2.7.3	Stage 5 pre-opening stage traffic safety audit	provisional sum	Prov	Sum	
	C1.2.7.4	Handling cost, profit and all other charges in respect of item C1.2.6.3	percentage (%)	R -	10,00%	R -
C1.2.8		Dayworks				
	C1.2.8.1	Personnel				
	(a)	Unskilled labourer	hour (h)			R -
	(b)	Semi-skilled labourer	hour (h)			R -
	(c)	Skilled labourer	hour (h)			R -
	(d)	Gang leader	hour (h)			R -
	(e)	Foreman	hour (h)			R -
	(f)	Skilled artisan	hour (h)			R -
	C1.2.8.2	Construction equipment (specify size and/or model number)				
	(a)	Motor grader	hour (h)			R -
	(b)	Vibratory roller	hour (h)			R -
	(c)	Pneumatic roller	hour (h)			R -
	(d)	Front end loader	hour (h)			R -
	(e)	Tractor loader backhoe	hour (h)			R -
	(f)	Excavator	hour (h)			R -
	(g)	Compressor	hour (h)			R -
	(h)	Other equipment (specify)	hour (h)			R -
	C1.2.8.3	Vehicles (specify size)				
	(a)	Light delivery vehicle	kilometre (km)			R -
	(b)	Flatbed truck	kilometre (km)			R -
	(c)	Dump truck	kilometre (km)			R -
	(d)	Other vehicles (specify)	kilometre (km)			R -
	C1.2.8.4	Materials				
	(a)	Procurement of materials	provisional sum	Prov	Sum	
	(b)	Contractor's handling costs, profit and all other charges in respect of item C1.2.8.4(a)	percentage (%)	R -	10,00%	R -
C1.2.9		Disposal of non-useable assets				
	C1.2.9.1	Disposal of non-useable assets identified in the Contract Documentation at time of tender	rate (per asset)			
	C1.2.9.2	Disposal of non-useable assets not identified at time of tender	provisional sum	Prov	Sum	
	C1.2.9.3	Handling cost, profit and all other charges in respect of item C1.2.9.2	percentage (%)	R -	10,00%	R -
PC1.2.10		Dispute Adjudication Board (DAB)				
	C1.2.10.1	Employer's contribution to DAB (50%)	prime cost (PC) sum	Prime	Cost	
TOTAL CARRIED FORWARD TO SUMMARY						R -

TENDER NO.: PR&T/BID06/2021/22				Tweespruit Access Road; SS604/S34		
C1.3		CONTRACTOR'S SITE ESTABLISHMENT AND GENERAL OBLIGATIONS				
ITEM		DESCRIPTION	UNIT	QTY	RATE	AMT
PC1.3.1		The Contractor's general obligations				
	C1.3.1.1	Fixed obligations	lump sum	1		R -
	C1.3.1.2	Value-related obligations	lump sum	1		R -
	C1.3.1.3	Time-related obligations				
		(a) Mobilisation period	month	12		R -
		(b) Execution of the works	month	12		R -
	C1.3.1.4	Suspension Cost				
		(a) De-establishment	number	1		R -
		(b) Re-establishment	number	1		R -
		(c) Suspension period	month	2		R -
		(d) Engineer's cost	prime cost (PC) sum	prime	cost	
C1.3.2		Contract sign boards	square metre (m²)	12		R -
TOTAL CARRIED FORWARD TO SUMMARY						R -

TENDER NO.: PR&T/BID06/2021/22			Tweespruit Access Road; SS604/S34			
C1.4		FACILITIES FOR THE ENGINEER				
ITEM		DESCRIPTION	UNIT	QTY	RATE	AMT
C1.4.1		Site accommodation				
	C1.4.1.1	Offices and conference room	square metre (m ²)	120		R -
	C1.4.1.2	Laboratories	square metre (m ²)	120		R -
	C1.4.1.3	Open concrete working floors and verandas	square metre (m ²)	120		R -
	C1.4.1.4	Roofs over open concrete working floors and	square metre (m ²)	120		R -
	C1.4.1.5	Store rooms inside the laboratory	square metre (m ²)	10		R -
	C1.4.1.6	Car ports	number (No.)	4		R -
	C1.4.1.7	Ablution unit (equipped as specified)	number (No.)	6		R -
	C1.4.1.8	Change room with a shower	number (No.)	2		R -
	C1.4.1.9	Kitchen unit (equipped as specified)	number (No.)	1		R -
	C1.4.1.10	Type A prefabricated house (equipped as specified)	number (No.)			R -
	C1.4.1.11	Type B prefabricated house (equipped as specified)	number (No.)			R -
	C1.4.1.12	Type C prefabricated house (equipped as specified)	number (No.)			R -
	C1.4.1.13	Rented housing paid for by the Contractor	provisional sum	Prov	Sum	
	C1.4.1.14	Contractor's handling costs, profit and all other	percentage (%)	R -	10,00%	R -
C1.4.2		Items measured by area				
	C1.4.2.1	Shelving as specified, complete with brackets	square metre (m ²)	40		R -
	C1.4.2.2	Work benches with a concrete slab top	square metre (m ²)	10		R -
	C1.4.2.3	Work-benches with a wooden top	square metre (m ²)	10		R -
	C1.4.2.4	Constant-temperature baths of concrete and/or plastered brick	square metre (m ²)	10		R -
	C1.4.2.5	Concrete footings and pedestals for laboratory	square metre (m ²)	20		R -
	C1.4.2.6	Roller blinds, opaque type	square metre (m ²)	15		R -
	C1.4.2.7	Venetian blinds	square metre (m ²)	10		R -
	C1.4.2.8	Notice boards	square metre (m ²)	20		R -
	C1.4.2.9	White boards	square metre (m ²)	15		R -
	C1.4.2.10	Galvanised wire mesh fencing for store rooms	square metre (m ²)	20		R -
	C1.4.2.11	Galvanised wire mesh store room gate with a	square metre (m ²)	20		R -
C1.4.3		Items measured by number				
	C1.4.3.1	Office swivel chair	number (No.)	4		R -
	C1.4.3.2	Office chair	number (No.)	12		R -
	C1.4.3.3	Draughtsman's stool	number (No.)	4		R -
	C1.4.3.4	Laboratory high chair	number (No.)	4		R -
	C1.4.3.5	Office desk with 3 drawers (at least one lockable drawer)	number (No.)	5		R -
	C1.4.3.6	Typist desk (L-shaped)	number (No.)	2		R -
	C1.4.3.7	Drawing table	number (No.)	1		R -
	C1.4.3.8	Conference table	number (No.)	1		R -
	C1.4.3.9	Bookcase	number (No.)	2		R -
	C1.4.3.10	Filing cabinet	number (No.)	4		R -
	C1.4.3.11	General purpose steel cabinet with shelves	number (No.)	2		R -
	C1.4.3.12	Wall mounted pivot plan filing system	number (No.)	2		R -
	C1.4.3.13	220/250 volt power outlet plug point	number (No.)	8		R -
	C1.4.3.14	400/231 volt 3-phase power outlet plug point	number (No.)	6		R -
	C1.4.3.15	Single 1500m, 58 watt fluorescent tube ceiling	number (No.)	12		R -
	C1.4.3.16	Single 1500mm, 22 watt LED tube ceiling light	number (No.)	12		R -
	C1.4.3.17	11 watt compact fluorescent bulb ceiling light	number (No.)	8		R -
	C1.4.3.18	7 watt LED bulb ceiling light	number (No.)	8		R -
	C1.4.3.19	Wash-hand basin	number (No.)	4		R -
	C1.4.3.20	Laboratory basin	number (No.)	2		R -
	C1.4.3.21	Extractor fan	number (No.)	2		R -
	C1.4.3.22	Fume cupboard	number (No.)	2		R -
	C1.4.3.23	Fire extinguisher 9,0 kg, dry powder type	number (No.)	4		R -
	C1.4.3.24	Air-conditioning unit	number (No.)	4		R -
	C1.4.3.25	Heater	number (No.)	4		R -
	C1.4.3.26	Concrete specimen curing bath	number (No.)	2		R -
	C1.4.3.27	Waste paper basket	number (No.)	2		R -
	C1.4.3.28	UPS / Voltage stabiliser	number (No.)	2		R -
	C1.4.3.29	A3 / A4 colour printer, copier, scanner	number (No.)	2		R -
	C1.4.3.30	A4 colour printer, copier, scanner	number (No.)	2		R -
	C1.4.3.31	Rain gauge	number (No.)	2		R -
	C1.4.3.32	Minimum/maximum atmospheric temperature	number (No.)	2		R -
	C1.4.3.33	Digital thermometer	number (No.)	2		R -
	C1.4.3.34	Mobile outdoor weather station	number (No.)	1		R -
	C1.4.3.35	3,0m aluminium straight edge complete with two measuring wedges	number (No.)	2		R -
	C1.4.3.36	Measuring wheel	number (No.)	4		R -
	C1.4.3.37	First aid kit	number (No.)	4		R -
	C1.4.3.38	Standpipe complete with 30m of 19mm dia. heavy duty hose nine	number (No.)	1		R -

TWEESPRUIT ACCESS ROAD PROJECT

TENDER NO.: PR&T/BID06/2021/22				Tweespruit Access Road; SS604/S34			
C1.5				ACCOMMODATION OF TRAFFIC			
ITEM			DESCRIPTION	UNIT	QTY	RATE	AMT
C1.5.1			Accommodation of pedestrian and non-motorised traffic				
	C1.5.1.1		Accommodation of pedestrian and non-motorised traffic	month	12	R	-
	C1.5.1.2		Construction of temporary pedestrian walkways and/or cycle paths:				
		(a)	Gravel surfaced pedestrian walkways / cycle paths	square metre (m ²)	120	R	-
		(b)	Bitumen surfaced pedestrian walkways / cycle paths	square metre (m ²)	30	R	-
		(c)	60mm concrete block paved pedestrian walkways / cycle paths	square metre (m ²)	60	R	-
C1.5.2			Accommodation of vehicular traffic	month	12	R	-
C1.5.3			Liaison with traffic authorities	month	12	R	-
C1.5.4			Construction of temporary deviations <i>The applicable payment items required for the construction of temporary deviations shall be</i>				
C1.5.5			Maintenance of temporary deviations				
	C1.5.5.1		Grass cutting	hectare (ha)	3	R	-
	C1.5.5.2		Drain cleaning	kilometre (km)	1,5	R	-
	C1.5.5.3		Cleaning out culverts	cubic metre (m ³)	12	R	-
	C1.5.5.4		Collection of rubbish / litter	kilometre (km)	4	R	-
	C1.5.5.5		Base patching using crushed stone material	cubic metre (m ³)		R	-
	C1.5.5.6		Base and/or surface patching using cold premixed	kilogram (kg)	300	R	-
	C1.5.5.7		Base and/or surface patching using hot plant	tonne (t)	180	R	-
	C1.5.5.8		Replacement of damaged guardrails	metre (m)		R	-
	C1.5.5.9		Grading of temporary deviations and existing	kilometre (km)	4	R	-
	C1.5.5.10		Watering of temporary deviations and existing roads used as detours	kilolitre (kl)	400	R	-
	C1.5.5.11		Other road maintenance work ordered by the Engineer	provisional sum	Prov	Sum	
	C1.5.5.12		Handling cost, profit and all other charges in	percentage (%)	R -	10,00%	R -
C1.5.6			Removal of temporary deviations	kilometre (km)		R	-
C1.5.7			Temporary traffic control facilities				
	C1.5.7.1		Delineators including mounting bases and ballast:				
		(a)	Single sided, reversible left or right (size	number (No.)	250	R	-
		(b)	Double sided, reversible left or right (size	number (No.)	400	R	-
	C1.5.7.2		Traffic cones, minimum height 750mm	number (No.)	120	R	-
	C1.5.7.3		Flagmen	man-shift	30	R	-
	C1.5.7.4		Traffic controllers	man-shift	15	R	-
	C1.5.7.5		Provision of illuminated traffic signs:				
		(a)	Sign mounted flashing amber lights (2 lights with the specified power supply) mounted on a backing board which is:				
		(i)	900mm wide x 150mm high	number (No.)	20	R	-
		(ii)	1200mm wide x 200mm high	number (No.)	16	R	-
		(b)	Flashing LED illuminated arrow board	number (No.)	12	R	-
		(c)	Illuminated road sign – R & TR series (diameter	number (No.)	24	R	-
		(d)	Illuminated road sign – TW series (length of sides	number (No.)	24	R	-
		(e)	Mobile variable message sign	number (No.)	10	R	-
		(f)	Mobile variable message sign with a speed measuring and display capability	month	12	R	-
	C1.5.7.6		Maintenance of illuminated traffic signs:				
		(a)	Sign mounted flashing amber lights (a pair of two	month	12	R	-
		(b)	Flashing LED illuminated arrow board	month	12	R	-
		(c)	Illuminated road sign – R & TR series (diameter	month	12	R	-
		(d)	Illuminated road sign – TW series (length of sides	month	12	R	-
		(e)	Mobile variable message sign	month	12	R	-
		(f)	Mobile variable message sign with a speed	month	12	R	-
	C1.5.7.7		Traffic calming devices:				
		(a)	25mm high x 100mm wide asphalt rumble strips	metre (m)	20	R	-
		(b)	50mm high x 500m wide asphalt rumble strips	metre (m)	4	R	-
		(c)	150mm high x 3m wide asphalt speed control	metre (m)	2	R	-
	C1.5.7.8		Traffic control stations	month	3	R	-
	C1.5.7.9		Cleaning of traffic control facilities	month	3	R	-
C1.5.8			Traffic safety officer	man-month	12	R	-
C1.5.9			Traffic safety vehicle	month	12	R	-
C1.5.10			Tow trucks				
	C1.5.10.1		Provision of a tow truck on call for light vehicles	month	3	R	-
	C1.5.10.2		Provision of a tow truck on call for heavy vehicles	month	3	R	-
C1.5.11			Provision of safety equipment for visitors				
	C1.5.11.1		Provision of reflective safety vests for visitors	number (No.)	10	R	-
	C1.5.11.2		Provision of hard hats for visitors	number (No.)	10	R	-
C1.5.12			Additional traffic accommodation facilities				
	C1.5.12.1		Provision of additional traffic accommodation	provisional sum	Prov	Sum	
	C1.5.12.2		Handling cost, profit and all other charges in	percentage (%)	R -	10,00%	R -
TOTAL CARRIED FORWARD TO SUMMARY						R	-

TENDER NO.: PR&T/BID06/2021/22			Tweespruit Access Road; SS604/S34			
C1.6			CLEARING AND GRUBBING			
ITEM		DESCRIPTION	UNIT	QTY	RATE	AMT
C1.6.1		Clearing				
	C1.6.1.1	Clearing with machines and some hand labour where necessary	hectare (ha)	1,5		R -
	C1.6.1.2	Clearing with hand labour only when labour enhanced work is specified	hectare (ha)	1		R -
	C1.6.1.3	Clearing for new fence lines (over a width of 2,0m)	kilometre (km)	1		R -
	C1.6.1.4	Clearing for service trenches (over the agreed width required)	square metre (m ²)	800		R -
C1.6.2		Grubbing				
	C1.6.2.1	Grubbing with machines and some hand labour	hectare (ha)	1		R -
	C1.6.2.2	Grubbing with hand labour when labour	hectare (ha)	1		R -
	C1.6.2.3	Grubbing by hand for new fence lines (over a	kilometre (km)	1		R -
	C1.6.2.4	Grubbing by hand for service trenches (over the	square metre (m ²)	800		R -
C1.6.3		Removal and grubbing of large trees and tree stumps:				
	C1.6.3.1	Girth equal to or exceeding 1,0m up to and including 2,0m	number (No.)	36		R -
	C1.6.3.2	Girth exceeding 2,0m up to and including 3,0m	number (No.)	24		R -
	C1.6.3.3	Girth exceeding 3,0m	number (No.)	10		R -
	C1.6.3.4	Removal of trees in forests and plantations	hectare (ha)	1		R -
C1.6.4		Removal of buildings and structures				
	C1.6.4.1	... (Identify type and location of each building or structure with a separate sub-item)	lump sum	lump	sum	
C1.6.5		Spreading organic matter and covering with soil	cubic metre (m ³)	50		R -
C1.6.6		Mulching selected organic matter	cubic metre (m ³)	20		R -
C1.6.7		Re-clearing of previously cleared areas	hectare (ha)	0,5		R -
C1.6.8		Conservation of vegetation:				
	C1.6.8.1	Establishment of a temporary nursery	number (No.)	1		R -
	C1.6.8.2	Removal, storage and maintenance of shrubs	number (No.)	10		R -
	C1.6.8.3	Removal, storage and maintenance of trees, girth	number (No.)	10		R -
	C1.6.8.4	Removal, storage and maintenance of trees, girth exceeding 1,0m up to and including 2,0m	number (No.)	10		R -
	C1.6.8.5	Removal, storage and maintenance of trees, girth exceeding 2,0m up to and including 3,0m	number (No.)	10		R -
	C1.6.8.6	Removal, storage and maintenance of trees, girth exceeding 3,0m	number (No.)	10		R -
C1.6.9		Conservation of topsoil:				
	C1.6.9.1	Stockpiling topsoil	cubic metre (m ³)	100		R -
	C1.6.9.2	Windrowing topsoil	cubic metre (m ³)	120		R -
C1.6.10		Disposal of hazardous waste material:				
	C1.6.10.1	Disposal of hazardous waste material at an approved hazardous waste material facility	provisional sum	Prov	Sum	
	C1.6.10.2	Handling cost, profit and all other charges in	percentage (%)	R -	10,00%	R -
TOTAL CARRIED FORWARD TO SUMMARY						R -

TENDER NO.: PR&T/BID06/2021/22				Tweespruit Access Road; SS604/S34			
C1.7				LOADING AND HAULING			
ITEM		DESCRIPTION	UNIT	QTY	RATE	AMT	
C1.7.1		Loading					
	C1.7.1.1	Loading from stockpile using machines and some	cubic metre (m ³)	150		R -	
	C1.7.1.2	Loading from heaps or windrows using machines and/some hand labour where necessary	cubic metre (m ³)	150		R -	
	C1.7.1.3	Loading by hand only from stockpile or heaps	cubic metre (m ³)	100		R -	
C1.7.2		Hauling					
	C1.7.2.1	Hauling material for use in the Works and off-loading it on the site of the Works:					
	(a)	Soil, gravel, crushed stone and pavement layer material	cubic metre - kilometre (m ³ - km)	7600		R -	
	(b)	Boulders and hard material	cubic metre - kilometre (m ³ - km)	600		R -	
	C1.7.2.2	Hauling material to spoil and off-loading it at a designated spoil or stockpile area:					
	(a)	Cleared and grubbed material (<i>organic matter and all other unsuitable or waste material</i>)	cubic metre - kilometre (m ³ - km)	2000		R -	
	(b)	Soil and gravel material	cubic metre - kilometre (m ³ - km)	1600		R -	
	(c)	Boulders, hard material and concrete	cubic metre - kilometre (m ³ - km)	400		R -	
TOTAL CARRIED FORWARD TO SUMMARY						R -	

TENDER NO.: PR&T/BID06/2021/22

Tweespruit Access Road; SS604/S34

DRAINS					
	DESCRIPTION	UNIT	QTY	RATE	AMT
	Excavation for open drains:				
C3.1.1.1	Excavating all material situated within the				
	(a) 0m to 1,5m	cubic metre (m ³)		R	-
	(b) Exceeding 1,5m and up to 3,0m	cubic metre (m ³)		R	-
	(c) Etc. in increments of 1,5m	cubic metre (m ³)		R	-
C3.1.1.2	Extra over sub-item C3.1.1.1 for excavation in	cubic metre (m ³)		R	-
C3.1.1.3	Extra over sub-item C3.1.1.1 for excavation in	cubic metre (m ³)		R	-
C3.1.1.4	Excavating soft material situated 0m to 1,5m	cubic metre (m ³)		R	-
C3.1.1.5	Excavating intermediate material situated 0m to	cubic metre (m ³)		R	-
	Clearing, shaping and disposal of accumulated sediment in existing unlined open drains				
C3.1.2.1	Using conventional methods	cubic metre (m ³)		R	-
C3.1.2.2	Using labour enhanced construction methods	cubic metre (m ³)		R	-
	Excavation, clearing and disposal of accumulated sediment in existing lined drains and drainage systems				
C3.1.3.1	Using conventional methods (up to 1,5m):				
	(a) Manholes and inlet and outlet structures	cubic metre (m ³)		R	-
	(b) Culvert barrels	cubic metre (m ³)		R	-
	(c) Concrete or other lined side drains	cubic metre (m ³)		R	-
C3.1.3.2	Using conventional methods (in excess of 1,5m):				
	(a) Manholes and inlet and outlet structures	cubic metre (m ³)		R	-
	(b) Culvert barrels	cubic metre (m ³)		R	-
	(c) Concrete or other lined side drains	cubic metre (m ³)		R	-
C3.1.3.3	Using labour enhanced construction methods:				
	(a) Manholes and inlet and outlet structures	cubic metre (m ³)		R	-
	(b) Culvert barrels	cubic metre (m ³)		R	-
	(c) Concrete or other lined side drains	cubic metre (m ³)		R	-
	Excavation and disposal of material for subsoil drainage systems:				
C3.1.4.1	Excavating in all material situated within the				
	(a) 0m to 1,5m	cubic metre (m ³)		R	-
	(b) Exceeding 1,5m and up to 3,0m	cubic metre (m ³)		R	-
	(c) Etc. in increments of 1,5m	cubic metre (m ³)		R	-
C3.1.4.2	Excavating soft material situated within 0m to	cubic metre (m ³)		R	-
C3.1.4.3	Excavating intermediate material situated within	cubic metre (m ³)		R	-
C3.1.4.4	Extra over sub-item C3.1.4.1 for excavation in	cubic metre (m ³)		R	-
C3.1.4.5	Extra over sub-item C3.1.4.1 for excavation	cubic metre (m ³)		R	-
C3.1.4.6	Excavation and disposal of material for composite				
	(a) Trench width of ... and depth of ...	metre (m)		R	-
	(b) Etc. for width of ... and depth of ...	metre (m)		R	-
	Impermeable backfilling to subsoil drainage				
C3.1.5.1	Un-stabilised natural gravel obtained from	cubic metre (m ³)		R	-
C3.1.5.2	G5 material obtained from commercial sources	cubic metre (m ³)		R	-
C3.1.5.3	Extra over items C3.1.5.1 and C3.1.5.2 for	cubic metre (m ³)		R	-
	Construction of banks and dykes:				
C3.1.6.1	Banks and dykes using conventional methods	cubic metre (m ³)		R	-
C3.1.6.2	Banks and dykes using labour enhanced	cubic metre (m ³)		R	-
	Natural permeable material in subsoil drainage				
C3.1.7.1	Crushed stone obtained from approved sources	cubic metre (m ³)		R	-
C3.1.7.2	Crushed stone obtained from commercial sources	cubic metre (m ³)		R	-
	Natural permeable material in subsoil drainage				
C3.1.8.1	Natural sand obtained from approved sources	cubic metre (m ³)		R	-
C3.1.8.2	Natural sand from commercial sources (state	cubic metre (m ³)		R	-
	Pipes in subsoil drainage systems:				
C3.1.9.1	U-PVC pipes and fittings, normal duty, complete w	metre (m)		R	-
	Polymer film sheeting or similar approved				
C3.1.10.1	0,15mm thick	square metre (m ²)		R	-
C3.1.10.2	0,25mm thick	square metre (m ²)		R	-
	Geotextiles (indicate type, grade, etc.)	square metre (m ²)		R	-
	Composite drainage systems				
C3.1.12.1	In-plane drainage systems (state size, type of	metre (m)		R	-
C3.1.12.2	Vertical subsoil strip drainage systems (state	metre (m)		R	-
C3.1.12.3	Panel drainage systems (state size, type of core	metre (m)		R	-
C3.1.12.4	Alternative drainage systems as detailed in	metre (m)		R	-
	Concrete outlet structures, manhole boxes,				
C3.1.13.1	Outlet structures (specify each type and drawing	number (No.)		R	-
C3.1.13.2	Inspection boxes (specify each type and drawing	number (No.)		R	-
C3.1.13.3	Junction boxes (specify each type and drawing	number (No.)		R	-
C3.1.13.4	Cleaning eyes (specify each type and drawing	number (No.)		R	-
	Caps for subsoil drain pipes:				
C3.1.14.1	Concrete caps	number (No.)		R	-
C3.1.14.2	Cast metal iron caps	number (No.)		R	-
C3.1.14.3	Other (Glass fibre reinforced, PVC etc.) (specify)	number (No.)		R	-
	Repairing or replacing existing drainage	provisional sum	Prov	Sum	
	Loading and hauling of material in excess of	cubic metre -		R	-
	Backfilling existing eroded side drains	cubic metre (m ³)		R	-
	Backfilling of drains with selected material	cubic metre (m ³)		R	-
	Exposing of existing subsoil drains	cubic metre (m ³)		R	-
	Breaking into existing drainage structures and	number (No.)		R	-
	Clearing of existing subsoil drains				
C3.1.21.1	Cleaning rod, brush and flushing	metre (m)		R	-
C3.1.21.2	Hydro jetting	metre (m)		R	-
	Test flushing of subsoil drain pipe systems	number (No.)		R	-
	Subsoil drain outlet marker (type or drawing	number (No.)		R	-
	Submission of as built drawings by the	provisional sum	Prov	Sum	
	TWEESPRUIT ACCESS ROAD				PROJECT
	SPECIFICATIONS				
	RRIED FORWARD TO SUMMARY				R -

TENDER NO.: PR&T/BID06/2021/22			Tweespruit Access Road; SS604/S34			
C3.2		CULVERTS				
ITEM		DESCRIPTION	UNIT	QTY	RATE	AMT
C3.2.1		Excavation for culvert structures:				
	C3.2.1.1	Excavating in all material situated within the				
		(a) 0m to 1,5m	cubic metre (m ³)	200	R	-
		(b) Exceeding 1,5m and up to 3,0m	cubic metre (m ³)	40	R	-
		(c) Etc. in increments of 1,5m	cubic metre (m ³)		R	-
	C3.2.1.2	Excavating soft material 0m to 1,5m below the	cubic metre (m ³)		R	-
	C3.2.1.3	Excavating intermediate material 0m to 1,5m	cubic metre (m ³)		R	-
	C3.2.1.4	Extra over sub-item C3.2.1.1 for excavation in	cubic metre (m ³)		R	-
	C3.2.1.5	Extra over sub-item C3.2.1.1 for excavation in	cubic metre (m ³)		R	-
C3.2.2		Backfilling				
	C3.2.2.1	Using the excavated material	cubic metre (m ³)	60	R	-
	C3.2.2.2	Using imported selected material:				
		(a) From commercial sources (<i>State type</i>)	cubic metre (m ³)	50	R	-
		(b) From sources on site (<i>State type</i>)	cubic metre (m ³)		R	-
	C3.2.2.3	Extra over sub-items C3.2.2.1 and C3.2.2.2 for				
		(a) With wet mixture (<i>specify cement content</i>) of 3%	cubic metre (m ³)		R	-
		(b) With dry mixture (<i>specify cement content</i>) of 3%	cubic metre (m ³)		R	-
		(c) Variation in cement	kilogram (kg)		R	-
	C3.2.2.4	Extra over sub-items C3.2.2.1 and C3.2.2.2 for	cubic metre (m ³)		R	-
C3.2.3		Concrete pipe culverts:				
	C3.2.3.1	On Class A bedding (<i>type and diameter</i>)	metre (m)		R	-
	C3.2.3.2	On Class B bedding (<i>type and diameter</i>)	metre (m)		R	-
	C3.2.3.3	On Class C bedding (<i>type and diameter</i>)	metre (m)		R	-
	C3.2.3.4	On Class D bedding (<i>type and diameter</i>)	metre (m)		R	-
	C3.2.3.5	Provision of skew ends of pipe culvert (<i>type and</i>	number (No.)		R	-
C3.2.4		Metal and U-PVC culverts:				
	C3.2.4.1	... (<i>size, wall thickness and type indicated</i>)	metre (m)		R	-
	C3.2.4.2	Provision of skew or bevelled ends for metal	number (No.)		R	-
	C3.2.4.3	Anchor bolts (<i>size and type indicated</i>)	number (No.)		R	-
	C3.2.4.4	Protective coating to metal culverts (<i>culvert size;</i>	metre (m)		R	-
C3.2.5		Rectangular culverts with prefabricated				
	C3.2.5.1	Prefabricated portal culverts; wall and roof	metre (m)		R	-
	C3.2.5.2	Prefabricated floor slabs (<i>size and type</i>)	metre (m)		R	-
	C3.2.5.3	Prefabricated roof slabs (<i>size and type indicated</i>)	metre (m)		R	-
		Extra over items C3.2.3, C3.2.4 and C3.2.5 for	metre (m)		R	-
C3.2.6		Cast in situ concrete and formwork:				
C3.2.7						
	C3.2.7.1	In Class A bedding, screeds, concrete backfill and	cubic metre (m ³)		R	-
	C3.2.7.2	In complete in situ floor slabs for rectangular	cubic metre (m ³)		R	-
	C3.2.7.3	In walls, excluding formwork but including Class	cubic metre (m ³)		R	-
	C3.2.7.4	In roof slabs for rectangular culverts, excluding	cubic metre (m ³)		R	-
	C3.2.7.5	In inlet and outlet structures including kerbs,	cubic metre (m ³)		R	-
	C3.2.7.6	Formwork of concrete under items C3.2.7.3 to 5	square metre (m ²)		R	-
	C3.2.7.7	Concrete linings for the inverts of metal culverts,	cubic metre (m ³)		R	-
C3.2.8		Concrete backfill or encasement for culverts	cubic metre (m ³)		R	-
		(<i>Type and Class of concrete indicated</i>)				
C3.2.9		Prefabricated concrete inlets and outlets to	number (No.)		R	-
C3.2.10		Reinforcement:				
	C3.2.10.1	Mild steel bars	ton (t)		R	-
	C3.2.10.2	High-tensile steel bars	ton (t)		R	-
	C3.2.10.3	Welded steel fabric	kilogram (kg)		R	-
	C3.2.10.4	Other material (<i>specify</i>)	kilogram (kg)		R	-
C3.2.11		Anchoring of reinforcing steel:	number (No.)		R	-
C3.2.12		Demolition of concrete members or elements:				
	C3.2.12.1	Full member or element (<i>location and</i>	cubic metre (m ³)		R	-
	C3.2.12.2	Partial member or element (<i>location and</i>	cubic metre (m ³)		R	-
C3.2.13		Removing and re-laying existing culverts:				
	C3.2.13.1	Removing and stacking existing culverts for re-use	metre (m)	40	R	-
		(<i>size and type indicated</i>)				
	C3.2.13.2	Removing and re-laying existing culverts without	metre (m)		R	-
		stacking (<i>size and type of bedding indicated</i>)				
	C3.2.13.3	Re-laying existing culverts from stacking (<i>size</i>	metre (m)		R	-
		<i>and type of bedding indicated</i>)				
C3.2.14		Protective mastic asphalt coating for	square metre (m ²)		R	-
C3.2.15		Manholes and catch pits, with prefabricated				
	C3.2.15.1	Prefabricated floors (installed at a standard depth				
		(a) ... (<i>size and type indicated</i>)	number (No.)		R	-
		(b) ... (<i>size and type indicated etc.</i>)	number (No.)		R	-
	C3.2.15.2	Prefabricated roofs:				
		(a) ... (<i>size and type indicated</i>)	number (No.)		R	-
		(b) ... (<i>size and type indicated etc.</i>)	number (No.)		R	-
	C3.2.15.3	Prefabricated walls:				
		(a) ... (<i>size and type indicated</i>)	metre (m)		R	-
		(b) ... (<i>size and type indicated etc.</i>)	metre (m)		R	-
	C3.2.15.4	Extra over item C3.2.15.1 and C3.2.7.2 for	metre (m)		R	-

C3.2.16		Brickwork (Engineering bricks):					
	C3.2.16.1	115mm thick	square metre (m ²)			R	-
	C3.2.16.2	230mm thick	square metre (m ²)	100		R	-
	C3.2.16.3	345mm thick	square metre (m ²)			R	-
	C3.2.16.4	... (specify thickness)	square metre (m ²)			R	-
C3.2.17		Plaster	square metre (m ²)			R	-
C3.2.18		Benching	cubic metre (m ³)			R	-
C3.2.19		Accessories					
	C3.2.19.1	Manhole frames (description and reference to	number (No.)			R	-
	C3.2.19.2	Inlet grids or covers (description and reference to	number (No.)			R	-
	C3.2.19.3	Manhole frames (type, load bearing and SANS	number (No.)			R	-
	C3.2.19.4	Manhole covers or gratings (type, load bearing	number (No.)			R	-
	C3.2.19.5	Inlet channel frames (type, load bearing and	number (No.)			R	-
	C3.2.19.6	Inlet channel gratings (type, load bearing and	number (No.)			R	-
	C3.2.19.7	Step irons (description and SANS specification	number (No.)			R	-
	C3.2.19.8	... (etc. for other accessories)	number (No.)			R	-
C3.2.20		Anchors for pipes (description)	number (No.)			R	-
C3.2.21		Prefabricated reinforced-concrete skew end	number (No.)			R	-
C3.2.22		Cutting of concrete pipes (diameter indicated)	number (No.)			R	-
C3.2.23		Breaking into existing drainage structures and	number (No.)			R	-
C3.2.24		Compaction of bedding for inlets, outlets,					
	C3.2.24.1	Preparation and compaction of in situ bedding	cubic metre (m ³)			R	-
	C3.2.24.2	Extra-over sub-item C3.2.24.1 for compaction to	cubic metre (m ³)			R	-
C3.2.25		Painting of exposed steel bars with two coats	litre (l)			R	-
C3.2.26		Repair with cementitious mortar or concrete	litre (l)			R	-
C3.2.27		Repair with epoxy mortar	litre (l)			R	-
TOTAL CARRIED FORWARD TO SUMMARY						R	-

TENDER NO.: PR&T/BID06/2021/22				Tweespruit Access Road; SS604/S34		
C3.3				CONCRETE KERBING AND CHANNELING, ASPHALT BERMS, CHUTES, DOWNPIPES, AS WELL AS CONCRETE, STONE PITCHED AND GABION LININGS FOR OPEN DRAINS		
ITEM		DESCRIPTION	UNIT	QTY	RATE	AMT
C3.3.1		Concrete kerbing:				
	C3.3.1.1	Prefabricated kerbing <i>(description of type of kerb ... (state type of kerb and bedding with reference</i>	metre (m)		R	-
		(a) ... <i>(state type of kerb and bedding with reference</i>	metre (m)		R	-
		(b) ... <i>(etc. for other types)</i>	metre (m)		R	-
	C3.3.1.2	Cast in situ kerbing				
		(a) ... <i>(state type of kerb, class of concrete with</i>	metre (m)		R	-
		(b) ... <i>(etc. for other types)</i>	metre (m)		R	-
C3.3.2		Concrete kerbing-channeling combination:				
	C3.3.2.1	Prefabricated kerbing-channeling <i>(description of</i>				
		(a) ... <i>(state type of kerb and bedding with reference</i>	metre (m)		R	-
		(b) ... <i>(etc. for other types)</i>	metre (m)		R	-
	C3.3.2.2	Cast in situ kerbing-channeling <i>(description with</i>				
		(a) ... <i>(state type of kerb and bedding with reference</i>	metre (m)		R	-
		(b) ... <i>(etc. for other types)</i>	metre (m)		R	-
C3.3.3		Extra over items C3.3.1 and C3.3.2 for				
	C3.3.3.1	On curves of radii more than or equal to 5,0m but	metre (m)		R	-
		On curves with radii more than or equal to 1,0m	metre (m)		R	-
	C3.3.3.3	On curves with radii less than 1,0m	metre (m)		R	-
		Extra over item C3.3.2 for drop kerbs at	metre (m)		R	-
C3.3.4		Asphalt berms				
	C3.3.5.1	Asphalt berms placed where there are no vehicle	metre (m)		R	-
	C3.3.5.2	Asphalt berms placed at existing vehicle restraint	metre (m)		R	-
	C3.3.5.3	Prime coat <i>(type indicated)</i>	square metre (m ²)		R	-
	C3.3.5.4	Bond coat <i>(type indicated)</i>	square metre (m ²)		R	-
C3.3.6		Concrete chutes (typical designs):				
	C3.3.6.1	Prefabricated concrete chutes <i>(description of</i>	metre (m)		R	-
	C3.3.6.2	Cast in situ concrete chutes <i>(description, with</i>	metre (m)		R	-
	C3.3.6.3	Stone pitched chutes <i>(description with reference</i>	metre (m)		R	-
C3.3.7		Cast in situ concrete chutes (measured by				
	C3.3.7.1	Concrete <i>(class indicated)</i>	cubic metre (m ³)		R	-
	C3.3.7.2	Formwork <i>(surface finish indicated)</i>	square metre (m ²)		R	-
	C3.3.7.3	Stone pitched chutes				
		(a) Grouted stone pitching <i>(type of chute indicated)</i>	square metre (m ²)		R	-
		(b) Grouted stone pitching on a concrete bed <i>(class</i>	square metre (m ²)		R	-
C3.3.8		Linings for open drains:				
	C3.3.8.1	Cast in situ concrete lining <i>(class of concrete and type of open drain indicated)</i>	cubic metre (m ³)	50	R	-
	C3.3.8.2	Class U2 surface finish to cast in situ concrete	square metre (m ²)		R	-
	C3.3.8.3	Stone pitched lining (200mm thickness)				
		(a) Grouted stone pitching <i>(type of open drain</i>	square metre (m ²)		R	-
		(b) Grouted stone pitching on a concrete bed <i>(class</i>	square metre (m ²)		R	-
C3.3.9		Formwork to cast in situ concrete lining for				
	C3.3.9.1	To sides with formwork on the internal face only	square metre (m ²)	100	R	-
	C3.3.9.2	To sides with formwork on both internal and	square metre (m ²)		R	-
	C3.3.9.3	To ends of slabs	square metre (m ²)		R	-
C3.3.10		Sealed joints in concrete and stone pitched	metre (m)		R	-
C3.3.11		Concrete screed or backfill below chutes	cubic metre (m ³)		R	-
C3.3.12		Reinforcement:				
	C3.3.12.1	Mild steel bars	ton (t)		R	-
	C3.3.12.2	High-tensile steel bars	ton (t)		R	-
	C3.3.12.3	Welded steel fabric	kilogram (kg)		R	-
	C3.3.12.4	Other material <i>(specify)</i>	kilogram (kg)		R	-
C3.3.13		Polymer film sheeting (thickness specified) for	square metre (m ²)		R	-
C3.3.14		Cutting bituminous surfacing and pavement	metre (m)		R	-
C3.3.15		Energy dissipaters in outlet structures				
	C3.3.15.1	Precast concrete blocks in outlet structures	number (No.)		R	-
	C3.3.15.2	Stones set in outlet structures	square metre (m ²)		R	-
C3.3.16		Demolition and removal of existing kerbs	cubic metre (m ³)		R	-
TOTAL CARRIED FORWARD TO SUMMARY					R	-

TENDER NO.: PR&T/BID06/2021/22			Tweespruit Access Road; SS604/S34			
C4.1			BORROW MATERIALS			
ITEM		DESCRIPTION	UNIT	QTY	RATE	AMT
C4.1.1		Compiling and implementing M&U plans				
	C4.1.1.1	For borrow pits (<i>list all borrow pits separately</i>)	number (No.)			R -
	C4.1.1.2	For quarries (<i>list all quarries separately</i>)	number (No.)			R -
C4.1.2		Additional material investigations during the				
	C4.1.2.1	Cost of additional trial pits and/or drilling and	provisional sum	Prov	sum	
	C4.1.2.2	Handling costs and profit in respect of item	percentage (%)	R	- 10%	R -
C4.1.3		Construction and maintenance of temporary				
	C4.1.3.1	Temporary unsealed roads	kilometre (km)			R -
	C4.1.3.2	Cost to repair existing public roads or streets	provisional sum	Prov	sum	
	C4.1.3.3	Handling cost and profit in respect of item	percentage (%)	R	- 10%	R -
C4.1.4		Removing of the overburden				
	C4.1.4.1	In borrow pits	cubic metre (m ³)			R -
	C4.1.4.2	In quarries:				
	(a)	Soft material	cubic metre (m ³)			R -
	(b)	Hard material (by blasting)	cubic metre (m ³)			R -
C4.1.5		Excavating of materials in the borrow pits and				
	C4.1.5.1	Soft excavation	cubic metre (m ³)			R -
	C4.1.5.2	Boulder excavation class A	cubic metre (m ³)			R -
	C4.1.5.3	Boulder excavation class B	cubic metre (m ³)			R -
	C4.1.5.4	Hard excavation (other than by blasting)	cubic metre (m ³)			R -
	C4.1.5.5	Hard excavation (by blasting)	cubic metre (m ³)			R -
C4.1.6		Providing crushing, screening and related				
	C4.1.6.1	Single-stage crushing plant	number (No.)			R -
	C4.1.6.2	Two-stage crushing plant	number (No.)			R -
	C4.1.6.3	Multiple-stage crushing and screening plant	number (No.)			R -
	C4.1.6.4	Screening plant	number (No.)			R -
	C4.1.6.5	... etc, for other plants (<i>as stated by the</i>	number (No.)			R -
C4.1.7		Producing the material by				
	C4.1.7.1	Single-stage crushing	cubic metre (m ³)			R -
	C4.1.7.2	Two-stage crushing	cubic metre (m ³)			R -
	C4.1.7.3	Multiple-stage crushing including screening	cubic metre (m ³)			R -
	C4.1.7.4	Screening only	cubic metre (m ³)			R -
	C4.1.7.5	... etc, for other plants (<i>as stated by the</i>	cubic metre (m ³)			R -
C4.1.8		Moving and re-erecting the crushing,				
	C4.1.8.1	Single-stage crushing plant	number (No.)			R -
	C4.1.8.2	Two-stage crushing plant	number (No.)			R -
	C4.1.8.3	Multiple-stage crushing and screening plant	number (No.)			R -
	C4.1.8.4	Screening plant	number (No.)			R -
	C4.1.8.5	... etc, for other plants (<i>as stated by the</i>	number (No.)			R -
C4.1.9		Breaking down oversize material	cubic metre (m ³)			R -
C4.1.10		Compacting the floor of the stockpile sites	cubic metre (m ³)			R -
C4.1.11		Constructing a platform for the stockpile site	cubic metre (m ³)			R -
C4.1.12		Stockpiling the material				
	C4.1.12.1	Material from a producing plant	cubic metre (m ³)			R -
	C4.1.12.2	Material directly from the excavation	cubic metre (m ³)			R -
C4.1.13		Removing surplus material from the stockpile	cubic metre (m ³)			R -
C4.1.14		Removing the fill platform and temporary				
	C4.1.14.1	Fill platform	cubic metre (m ³)			R -
	C4.1.14.2	Temporary banks	cubic metre (m ³)			R -
C4.1.15		Shaping and finishing the borrow pit and				
	C4.1.15.1	Shaping and finishing the borrow pit and quarry				
	(a)	Borrow pits (<i>list all borrow pits separately</i>)	hectare (ha)			R -
	(b)	Quarries (<i>list all quarries separately</i>)	hectare (ha)			R -
	(c)	Stockpile sites	hectare (ha)			R -
	C4.1.15.2	Finishing of the borrow pit and quarry areas, and				
	(a)	Borrow pits (<i>list all borrow pits separately</i>)	hectare (ha)			R -
	(b)	Quarries (<i>list all quarries separately</i>)	hectare (ha)			R -
	(c)	Stockpile sites	hectare (ha)			R -
C4.1.16		Personnel				
	C4.1.16.1	Materials manager	month			R -
	C4.1.16.2	Excavation controller	month			R -
	C4.1.16.3	Stockpile controller	month			R -
C4.1.17		Weighbridge facility				
	C4.1.17.1	Providing, erecting and removal of a weighbridge	lump sum	lump	sum	
	C4.1.17.2	Operating the weighbridge	month			R -
C4.1.18		Compensation to landowners or legal				
	C4.1.18.1	Amount allowed, expenditure to be approved or	provisional sum	Prov	Sum	
	C4.1.18.2	Handling costs and profit in respect of item	percentage (%)	R	- 10%	R -
C4.1.19		Excavating hard material	cubic metre (m ³) or ton (t)			R -
C4.1.20		Producing the material by				
	C4.1.20.1	Single stage crushing	cubic metre (m ³) or ton (t)		R -	R -
	C4.1.20.2	Multi-stage crushing and screening	cubic metre (m ³) or ton (t)		R -	R -
C4.1.21		Stockpiling the crushed material	cubic metre (m ³) or ton (t)		R -	R -
TOTAL CARRIED FORWARD TO SUMMARY						R -

TENDER NO.: PR&T/BID06/2021/22			Tweespruit Access Road; SS604/S34			
C4.2			CUT MATERIALS			
ITEM		DESCRIPTION	UNIT	QTY	RATE	AMT
C4.2.1		Compiling and implementing M&U plans for				
	C4.2.1.1	Cuttings exceeding 5 000 m ³ up to 10 000 m ³	number (No.)			R -
	C4.2.1.2	Cuttings exceeding 10 000 m ³ up to 20 000 m ³	number (No.)			R -
	C4.2.1.3	Cuttings exceeding 20 000 m ³ up to 50 000 m ³	number (No.)			R -
	C4.2.1.4	Cuttings exceeding 50 000 m ³ up to 100 000 m ³	number (No.)			R -
	C4.2.1.5	Cuttings larger than 100 000 m ³	number (No.)			R -
C4.2.2		Additional material investigations during the				
	C4.2.2.1	Cost of additional trial pits and/or drilling and	provisional sum	Prov	Sum	
	C4.2.2.2	Handling costs and profit in respect of item	percentage (%)	R -	10%	R -
C4.2.3		Excavating of materials in cuttings, material obtained from				
	C4.2.3.1	Soft excavation	cubic metre (m ³)	13500		R -
	C4.2.3.2	Boulder excavation class A	cubic metre (m ³)		R -	R -
	C4.2.3.3	Boulder excavation class B	cubic metre (m ³)		R -	R -
	C4.2.3.4	Hard excavation (other than by blasting)	cubic metre (m ³)		R -	R -
	C4.2.3.5	Hard excavation (by blasting)	cubic metre (m ³)		R -	R -
C4.2.4		Excavating of materials in box cuts, material				
	C4.2.4.1	Soft excavation	cubic metre (m ³)		R -	R -
	C4.2.4.2	Boulder excavation class A	cubic metre (m ³)		R -	R -
	C4.2.4.3	Boulder excavation class B	cubic metre (m ³)		R -	R -
	C4.2.4.4	Hard excavation (other than by blasting)	cubic metre (m ³)		R -	R -
	C4.2.4.5	Hard excavation (by blasting)	cubic metre (m ³)		R -	R -
C4.2.5		Excavating of materials in designated				
	C4.2.5.1	Soft excavation	cubic metre (m ³)		R -	R -
	C4.2.5.2	Boulder excavation class A	cubic metre (m ³)		R -	R -
	C4.2.5.3	Boulder excavation class B	cubic metre (m ³)		R -	R -
	C4.2.5.4	Hard excavation (other than by blasting)	cubic metre (m ³)		R -	R -
	C4.2.5.5	Hard excavation (by blasting)	cubic metre (m ³)		R -	R -
C4.2.6		Widening of existing cuttings				
	C4.2.6.1	Soft excavation	cubic metre (m ³)		R -	R -
	C4.2.6.2	Boulder excavation class A	cubic metre (m ³)		R -	R -
	C4.2.6.3	Boulder excavation class B	cubic metre (m ³)		R -	R -
	C4.2.6.4	Hard excavation (other than by blasting)	cubic metre (m ³)		R -	R -
	C4.2.6.5	Hard excavation (by blasting)	cubic metre (m ³)		R -	R -
C4.2.7		Removal of unsuitable stable cut material to				
	C4.2.7.1	In layer thicknesses of 200mm and less	cubic metre (m ³)			R -
	C4.2.7.2	In layer thicknesses exceeding 200mm	cubic metre (m ³)			R -
C4.2.8		Excavate material to spoil in sites designated				
	C4.2.8.1	Soft excavation, overburden and unsuitable	cubic metre (m ³)			R -
	C4.2.8.2	Boulder excavation class A	cubic metre (m ³)			R -
	C4.2.8.3	Boulder excavation class B	cubic metre (m ³)			R -
	C4.2.8.4	Hard excavation (other than by blasting)	cubic metre (m ³)			R -
	C4.2.8.5	Hard excavation (by blasting)	cubic metre (m ³)			R -
C4.2.9		Excavate material to spoil in sites designated				
	C4.2.9.1	Soft excavation, overburden and unsuitable	cubic metre (m ³)			R -
	C4.2.9.2	Boulder excavation class A	cubic metre (m ³)			R -
	C4.2.9.3	Boulder excavation class B	cubic metre (m ³)			R -
	C4.2.9.4	Hard excavation (other than by blasting)	cubic metre (m ³)			R -
	C4.2.9.5	Hard excavation (by blasting)	cubic metre (m ³)			R -
C4.2.10		Backfilling of the unavoidable overbreak in				
	C4.2.10.1	Compliant gravel material	cubic metre (m ³)			R -
	C4.2.10.2	Soil cement (stiff mix with 3% cement)	cubic metre (m ³)			R -
	C4.2.10.3	Soil cement (wet mix with 5% cement)	cubic metre (m ³)			R -
	C4.2.10.4	Concrete class 15 MPa	cubic metre (m ³)			R -
C4.2.11		Breaking down oversize material				
C4.2.12		Finishing the side slopes				
	C4.2.12.1	Cuttings:				
	(a)	In soft material	square metre (m ²)	8000		R -
	(b)	In boulder material class A and B	square metre (m ²)			R -
	(c)	In hard material	square metre (m ²)	2000		R -
	(d)	In soft material using labour enhanced methods of	square metre (m ²)			R -
	C4.2.12.2	Designated excavations	square metre (m ²)			R -
	C4.2.12.3	Designated excavations using labour enhanced	square metre (m ²)			R -
TOTAL CARRIED FORWARD TO SUMMARY						R -

TENDER NO.: PR&T/BID06/2021/22			Tweespruit Access Road; SS604/S34			
C4.4			COMMERCIAL MATERIALS			
ITEM		DESCRIPTION	UNIT	QTY	RATE	AMT
C4.4.1		Commercial materials identified by the Employer from commercial, private or other non-commercial suppliers (specify the source/s)				
	C4.4.1.1	Pavement layer material:				
		(a) Type G1 material	cubic metre (m ³)			R -
		(b) Type G2 material	cubic metre (m ³)			R -
		(c) Etc. for other Type G3 to G9 materials	cubic metre (m ³)			R -
		(d) Etc. for other Type G3 to G9 materials	cubic metre (m ³)			R -
		(e) Etc. for other Type G3 to G9 materials	cubic metre (m ³)			R -
		(f) Etc. for other Type G3 to G9 materials	cubic metre (m ³)			R -
		(g) Etc. for other Type G3 to G9 materials	cubic metre (m ³)			R -
		(h) Etc. for other Type G3 to G9 materials	cubic metre (m ³)			R -
		(i) Etc. for other Type G3 to G9 materials	cubic metre (m ³)			R -
		(j) Etc. for other Type G3 to G9 materials	cubic metre (m ³)			R -
		(k) Etc. for other Type G3 to G9 materials	cubic metre (m ³)			R -
		(l) Etc. for other Type G3 to G9 materials	cubic metre (m ³)			R -
		(m) Sand for the base and shoulder layers	cubic metre (m ³)			R -
		(n) Sand for a subbase layer	cubic metre (m ³)			R -
		(o) Sand for a selected layer	cubic metre (m ³)			R -
		(p) Natural or crushed gravel material for an unsealed	cubic metre (m ³)			R -
		(q) Natural or crushed gravel material for the wearing	cubic metre (m ³)			R -
	C4.4.1.2	Macadam material:				
		(a) Coarse aggregate	cubic metre (m ³)			R -
		(b) Fine aggregate	cubic metre (m ³)			R -
	C4.4.1.3	Drainage blanket layer material	cubic metre (m ³)			R -
	C4.4.1.4	Soil cement material (pre-blended by the supplier)	cubic metre (m ³)			R -
	C4.4.1.5	Fill material in the earthworks:				
		(a) Normal or coarse fill	cubic metre (m ³)			R -
		(b) Rock fill	cubic metre (m ³)			R -
		(c) Sand	cubic metre (m ³)			R -
	C4.4.1.6	Pioneer material	cubic metre (m ³)			R -
C4.4.2		Commercial materials identified by the Contractor from commercial, private or other non-commercial suppliers				
	C4.4.2.1	Pavement layer material:				
		(a) Type G1 material	cubic metre (m ³)			R -
		(b) Type G2 material	cubic metre (m ³)			R -
		(c) Etc. for other Type G3 to G9 materials	cubic metre (m ³)	1600		R -
		(d) Etc. for other Type G3 to G9 materials	cubic metre (m ³)			R -
		(e) Etc. for other Type G3 to G9 materials	cubic metre (m ³)			R -
		(f) Etc. for other Type G3 to G9 materials	cubic metre (m ³)			R -
		(g) Etc. for other Type G3 to G9 materials	cubic metre (m ³)			R -
		(h) Etc. for other Type G3 to G9 materials	cubic metre (m ³)			R -
		(i) Etc. for other Type G3 to G9 materials	cubic metre (m ³)			R -
		(j) Etc. for other Type G3 to G9 materials	cubic metre (m ³)			R -
		(k) Etc. for other Type G3 to G9 materials	cubic metre (m ³)			R -
		(l) Etc. for other Type G3 to G9 materials	cubic metre (m ³)			R -
		(m) Sand for the base and shoulder layers	cubic metre (m ³)			R -
		(n) Sand for a subbase layer	cubic metre (m ³)			R -
		(o) Sand for a selected layer	cubic metre (m ³)			R -
		(p) Natural or crushed gravel material for an unsealed	cubic metre (m ³)			R -
		(q) Natural or crushed gravel material for the wearing	cubic metre (m ³)			R -
	C4.4.2.2	Macadam material:				
		(a) Coarse aggregate	cubic metre (m ³)			R -
		(b) Fine aggregate	cubic metre (m ³)			R -
	C4.4.2.3	Drainage blanket layer material	cubic metre (m3)			R -
	C4.4.2.4	Soil cement material (pre-blended by the supplier)	cubic metre (m3)			R -
	C4.4.2.5	Fill material in the earthworks:				
		(a) Normal or coarse fill	cubic metre (m ³)	80		R -
		(b) Rock fill	cubic metre (m ³)	60		R -
		(c) Sand	cubic metre (m ³)	60		R -
	C4.4.2.6	Pioneer material	cubic metre (m ³)			R -
C4.4.3		Cost to procure commercial materials				
	C4.4.3.1	Cost of procuring	provisional sum	Prov	Sum	
	C4.4.3.2	Handling cost and profit in respect of item	percentage (%)	R	-	10%
C4.4.4		Cementitious stabilising agents				
	C4.4.4.1	Cement	ton (t)	220		R -
	C4.4.4.2	Road lime	ton (t)	20		R -
	C4.4.4.3	Etc. for other agents	ton (t)			R -
C4.4.5		Bituminous stabilising agents				
	C4.4.5.1	Penetration grade bitumen (specify grade)	ton (t)			R -
	C4.4.5.2	Emulsion stable grade (specify type)	ton (t)			R -
C4.4.6		Fillers for bituminous stabilisation (specify	ton (t)			R -
C4.4.7		Sampling and material testing by a commercial laboratory for the stabilisation designs				
	C4.4.7.1	Cost of sampling and material testing	provisional sum	Prov	Sum	
	C4.4.7.2	Handling cost and profit in respect of item C4.4.7.1	percentage (%)	R	-	10%
TOTAL CARRIED FORWARD TO SUMMARY						R -

TENDER NO.: PR&T/BID06/2021/22			Tweespruit Access Road; SS604/S34			
C4.5		ALTERNATIVE MATERIALS				
ITEM		DESCRIPTION	UNIT	QTY	RATE	AMT
C4.5.1		Additional material investigations				
	C4.5.1.1	Cost of sampling and laboratory testing	provisional sum	Prov	Sum	
	C4.5.1.2	Handling cost and profit in respect of item	percentage (%)	R -	10%	R -
C4.5.2		Removing unwanted material from alternative				
	C4.5.2.1	Contaminant material	provisional sum	Prov	Sum	
	C4.5.2.2	Handling cost and profit in respect of item	percentage (%)	R -	10%	R -
	C4.5.2.3	Hazardous material	provisional sum	Prov	Sum	
	C4.5.2.4	Handling cost and profit in respect of item	percentage (%)	R -	10%	R -
C4.5.3		Cost to procure alternative materials identified				
	C4.5.3.1	Cost of procuring	provisional sum	Prov	Sum	
	C4.5.3.2	Handling cost and profit in respect of item	percentage (%)	R -	10%	R -
TOTAL CARRIED FORWARD TO SUMMARY					R	-

TENDER NO.: PR&T/BID06/2021/22				Tweespruit Access Road; SS604/S34			
C5.1				ROADBED			
ITEM			DESCRIPTION	UNIT	QTY	RATE	AMT
C5.1.1			Roadbed construction and compaction:				
	C5.1.1.1		Compaction of in-situ material to 90% of MDD	cubic metre (m ³)	8000	R	-
	C5.1.1.2		Compaction of in-situ material to 93% of MDD	cubic metre (m ³)		R	-
	C5.1.1.3		Compaction of imported material to 90% of MDD	cubic metre (m ³)		R	-
	C5.1.1.4		Compaction of imported material to 93% of MDD	cubic metre (m ³)		R	-
	C5.1.1.5		Compaction of in-situ sand roadbed to 95% of	cubic metre (m ³)		R	-
	C5.1.1.6		Compaction of in-situ sand roadbed to 100% of	cubic metre (m ³)		R	-
C5.1.2			Excavate material to spoil sites designed by the Employer:				
	C5.1.2.1		Excavate material to spoil from roadbed				
		(a)	Soft excavation	cubic metre (m ³)		R	-
		(b)	Boulder excavation Class A	cubic metre (m ³)		R	-
		(c)	Boulder excavation Class B	cubic metre (m ³)		R	-
		(d)	Hard excavation (other than by blasting)	cubic metre (m ³)		R	-
		(e)	Hard excavation (by blasting)	cubic metre (m ³)		R	-
	C5.1.2.2		Excavate material to spoil from roadbed				
		(a)	Soft excavation	cubic metre (m ³)		R	-
		(b)	Intermediate excavation	cubic metre (m ³)		R	-
C5.1.3			Excavate material to spoil sites designed by				
	C5.1.3.1		Excavate material to spoil from roadbed				
		(a)	Soft excavation	cubic metre (m ³)		R	-
		(b)	Boulder excavation Class A	cubic metre (m ³)		R	-
		(c)	Boulder excavation Class B	cubic metre (m ³)		R	-
		(d)	Hard excavation (other than by blasting)	cubic metre (m ³)		R	-
		(e)	Hard excavation (by blasting)	cubic metre (m ³)		R	-
	C5.1.3.2		Excavate material to spoil from roadbed				
		(a)	Soft excavation	cubic metre (m ³)		R	-
		(b)	Intermediate excavation	cubic metre (m ³)		R	-
C5.1.4			Removal of unsuitable material to spoil:				
	C5.1.4.1		In layer thicknesses of 200mm and less				
		(a)	Stable material	cubic metre (m ³)		R	-
		(b)	Unstable material	cubic metre (m ³)		R	-
	C5.1.4.2		In layer thicknesses exceeding 200mm				
		(a)	Stable material	cubic metre (m ³)		R	-
		(b)	Unstable material	cubic metre (m ³)		R	-
C5.1.5			In-situ treatment of roadbed in hard material:				
	C5.1.5.1		In-situ treatment by ripping	cubic metre (m ³)		R	-
	C5.1.5.2		In-situ treatment by drilling and blasting	cubic metre (m ³)		R	-
	C5.1.5.3		In-situ treatment by drilling and splitting the	cubic metre (m ³)		R	-
C5.1.6			Roller-pass compaction:				
	C5.1.6.1		Grid rollers	square metre (m ²)		R	-
	C5.1.6.2		Pad foot vibratory rollers	square metre (m ²)		R	-
	C5.1.6.3		Smooth drum vibratory rollers	square metre (m ²)		R	-
	C5.1.6.4		Other vibratory rollers (<i>specify</i>)	square metre (m ²)		R	-
	C5.1.6.5		Impact rollers	square metre (m ²)		R	-
	C5.1.6.6		Pneumatic rollers	square metre (m ²)		R	-
	C5.1.6.7		High energy impact compactor/roller (HEIC)	square metre (m ²)		R	-
	C5.1.6.8		Other rollers (<i>specify</i>)	square metre (m ²)		R	-
C5.1.7			Construction of a roadbed trial section:				
	C5.1.7.1		Non wetting-up collapsing soil trial section at in-	cubic metre (m ³)		R	-
	C5.1.7.2		Non wetting-up collapsing soil trial section by	cubic metre (m ³)		R	-
	C5.1.7.3		Wetting-up collapsing soil trial section				
	C5.1.7.4		Inactive and normal clay	cubic metre (m ³)		R	-
		(a)	By material modification	cubic metre (m ³)		R	-
		(b)	By lime modification	cubic metre (m ³)		R	-
		(c)	By removal of material	cubic metre (m ³)		R	-
	C5.1.7.5		Active clay				
		(a)	Roadbed construction using lime	cubic metre (m ³)		R	-
		(b)	Roadbed construction by removal of active clay	cubic metre (m ³)		R	-
	C5.1.7.6		Roller-pass compaction.	cubic metre (m ³)		R	-
C5.1.8			Construction of the roadbed in collapsing soil:				
	C5.1.8.1		Non wetting-up collapsing soil roadbed	cubic metre (m ³)		R	-
	C5.1.8.2		Non wetting-up collapsing soil roadbed	cubic metre (m ³)		R	-
	C5.1.8.3		Non wetting-up collapsing soil roadbed	cubic metre (m ³)		R	-
	C5.1.8.4		Wetting-up collapsing soil roadbed construction	cubic metre (m ³)		R	-
	C5.1.8.5		Water for wetting-up collapsing soil roadbed	kilolitre (kl)		R	-
C5.1.9			Construction of roadbed comprising normal and inactive clay:				
	C5.1.9.1		By material modification	cubic metre (m ³)		R	-
	C5.1.9.2		By lime modification	cubic metre (m ³)		R	-
	C5.1.9.3		By removal of material	cubic metre (m ³)		R	-
C5.1.10			Construction of roadbed comprising active				
	C5.1.10.1		Roadbed construction using lime	cubic metre (m ³)		R	-
	C5.1.10.2		Roadbed construction by removal of active clay	cubic metre (m ³)		R	-
C5.1.11			Construction of roadbed comprising a pioneer				
C5.1.12			Excavation for benches:				
	C5.1.12.1		Excavation for benches				
		(a)	Side-cut to fill in soft material	cubic metre (m ³)		R	-
		(b)	Side-cut to spoil in soft material	cubic metre (m ³)		R	-
	C5.1.12.2		Excavation for benches using labour enhancement				
		(a)	Side-cut to fill				
		(i)	Soft material	cubic metre (m ³)		R	-
		(ii)	Intermediate material	cubic metre (m ³)		R	-
		(b)	Side-cut to spoil				
		(i)	Soft material	cubic metre (m ³)		R	-
		(ii)	Intermediate material	cubic metre (m ³)		R	-
C5.1.13			Construction of a levelling layer:				
	C5.1.13.1		Over roadbed treatment in hard material	cubic metre (m ³)		R	-
	C5.1.13.2		Over a constructed pioneer layer compacted to	cubic metre (m ³)		R	-
TOTAL CARRIED FORWARD TO SUMMARY						R	-

TENDER NO.: PR&T/BID06/2021/22			Tweespruit Access Road; SS604/S34			
C5.3			ROAD PAVEMENT LAYERS			
ITEM		DESCRIPTION	UNIT	QTY	RATE	AMT
C5.3.1		Compiling and implementing M&U plans for the construction of all the pavement layers.	number (No.)			R -
C5.3.2		Construction of pavement layers				
	C5.3.2.1	Construction of layers using conventional construction methods:				
		(a) Lower selected subgrade layer (layer thickness	cubic metre (m ³)			R -
		(b) Lower selected subgrade layer (layer thickness	cubic metre (m ³)			R -
		(c) Upper selected subgrade layer (layer thickness	cubic metre (m ³)			R -
		(d) Upper selected subgrade layer (layer thickness	cubic metre (m ³)			R -
		(e) Sand layer (layer thickness indicated) compacted	cubic metre (m ³)			R -
		(f) Sand layer (layer thickness indicated) compacted	cubic metre (m ³)			R -
		(g) Gravel wearing course layer (layer thickness	cubic metre (m ³)			R -
		(h) Gravel shoulder layer (layer thickness indicated)	cubic metre (m ³)			R -
		(i) Lower subbase gravel layer (unstabilised) (layer	cubic metre (m ³)			R -
		(j) Lower subbase gravel layer (chemically	cubic metre (m ³)			R -
		(k) Upper subbase gravel layer (unstabilised) (layer	cubic metre (m ³)			R -
		(l) Upper subbase gravel layer (chemically stabilised)	cubic metre (m ³)			R -
		(m) Gravel base layer (unstabilised) (layer thickness	cubic metre (m ³)			R -
		(n) Gravel base layer (chemically stabilised) (150mm layer thickness) compacted to 97% of MDD	cubic metre (m ³)	8000		R -
		(o) G5B crushed rock/boulder subbase layer (layer	cubic metre (m ³)			R -
		(p) G5B crushed rock/boulder base layer (layer	cubic metre (m ³)			R -
		(q) G5A crushed rock/boulder subbase layer (layer	cubic metre (m ³)			R -
		(r) G5A crushed rock/boulder base layer (layer	cubic metre (m ³)			R -
		(s) G4A crushed rock/boulder lower subbase layer	cubic metre (m ³)			R -
		(t) G4A crushed rock/boulder upper subbase layer	cubic metre (m ³)			R -
		(u) G4A crushed rock/boulder subbase layer	cubic metre (m ³)			R -
		(v) G3 crushed stone subbase layer (unstabilised or	cubic metre (m ³)			R -
		(w) G3 crushed stone base layer (layer thickness	cubic metre (m ³)			R -
		(x) G2 crushed stone base layer (layer thickness	cubic metre (m ³)			R -
		(y) G2 crushed stone base layer (layer thickness	cubic metre (m ³)			R -
		(z) G1 crushed stone base layer (layer thickness	cubic metre (m ³)			R -
		(aa) G1 crushed stone base layer (layer thickness	cubic metre (m ³)			R -
		(bb) Bound macadam layer (layer thickness indicated)	cubic metre (m ³)			R -
		(cc) PMPL wet lean-mix concrete layer (cube	cubic metre (m ³)			R -
	C5.3.2.2	Construction of layers using labour				
		(a) Lower selected subgrade layer (layer thickness	cubic metre (m ³)			R -
		(b) Upper selected subgrade layer (layer thickness	cubic metre (m ³)			R -
		(c) Sand layer (layer thickness indicated) compacted	cubic metre (m ³)			R -
		(d) Sand layer (layer thickness indicated) compacted	cubic metre (m ³)			R -
		(e) Gravel wearing course layer (layer thickness	cubic metre (m ³)			R -
		(f) Gravel shoulder layer (layer thickness indicated)	cubic metre (m ³)			R -
		(g) Lower gravel subbase layer (layer thickness	cubic metre (m ³)			R -
		(h) Upper gravel subbase layer (layer thickness	cubic metre (m ³)			R -
		(i) Gravel base layer (layer thickness indicated)	cubic metre (m ³)			R -
		(j) Gravel base layer (layer thickness indicated)	cubic metre (m ³)			R -
		(k) Bound macadam layer (layer thickness indicated)	cubic metre (m ³)			R -
		(l) Soil cement or soilcrete (layer thickness	cubic metre (m ³)			R -
		(m) Soil cement or soilcrete (layer thickness	cubic metre (m ³)			R -
		(n) Emulsion treated base material (G1 or G2	cubic metre (m ³)			R -
C5.3.3		Construction of crushed stone base supplied	cubic metre (m ³)			R -
C5.3.4		Deductions for G1 crushed stone base	ton (t)			R -
C5.3.5		Breaking down oversize layer material on the				
	C5.3.5.1	By additional normal grid rolling as per clause	square metre-pass (m ² -pass)			R -
	C5.3.5.2	By tamping roller	square metre-pass (m ² -pass)			R -
	C5.3.5.3	By pad foot vibratory roller	square metre-pass (m ² -pass)			R -
	C5.3.5.4	By vibratory roller	square metre-pass (m ² -pass)			R -
	C5.3.5.5	By any other roller type	square metre-pass (m ² -pass)			R -
C5.3.6		Removal of oversize material	cubic metre (m ³)			R -
C5.3.7		Recombining recovered material	cubic metre (m ³)			R -
C5.3.8		Processing of coarse gravel subbase or base	cubic metre (m ³)			R -
C5.3.9		Construction of a trial section:				
	C5.3.9.1	Construction of a trial section using conventional methods of construction				
		(a) Stabilised gravel layer (300mm layer thickness) trial section	cubic metre (m ³)			R -
		(b) Crushed stone subbase layer (layer thickness	cubic metre (m ³)			R -
		(c) Crushed stone base layer (layer thickness	cubic metre (m ³)			R -
		(d) PMPL layer (layer thickness indicated) trial	cubic metre (m ³)			R -
		(e) Bound macadam layer (layer thickness indicated)	cubic metre (m ³)			R -
		(f) ... (any other)	cubic metre (m ³)			R -
	C5.3.9.2	Construction of a trial section using labour				
		(a) Stabilised gravel layer (layer thickness indicated)	cubic metre (m ³)			R -
		(b) Gravel base layer (layer thickness indicated) trial	cubic metre (m ³)			R -
		(c) Bound macadam layer (layer thickness indicated)	cubic metre (m ³)			R -
		(d) ... (any other)	cubic metre (m ³)			R -
C5.3.10		Removal of a completed trial section				
	C5.1.10.1	Stabilised layer	cubic metre (m ³)	500		R -
	C5.3.10.2	PMPL layer	cubic metre (m ³)			R -
	C5.3.10.3	Crushed stone layer	cubic metre (m ³)			R -
C5.3.11		Riding quality measurements:				
	C5.3.11.1	Using a 3.0m straight edge	kilometre (km)			R -
	C5.3.11.2	Using a rolling straight edge	kilometre (km)			R -
	C5.3.11.3	Using an inertial profilometer	kilometre (km)			R -
C5.3.12		Surface regularity payment adjustments	provisional sum	Prov	Sum	
TOTAL CARRIED FORWARD TO SUMMARY						R -

TENDER NO.: PR&T/BID06/2021/22				Tweespruit Access Road; SS604/S34		
C5.4				STABILISATION		
ITEM		DESCRIPTION	UNIT	QTY	RATE	AMT
C5.4.1		Pre-treatment of gravel layers:				
	C5.4.1.1	Pre-treatment of <i>(insert layer thickness)</i> gravel	cubic metre (m ³)		R	-
	C5.4.1.2	Pre-treatment of <i>(insert layer thickness)</i> gravel	cubic metre (m ³)		R	-
C5.4.2		Chemical stabilisation:				
	C5.4.2.1	Chemical stabilisation (300mm thickness indicated) of pavement layers (Subbase)	cubic metre (m ³)	8000	R	-
	C5.4.2.2	Chemical stabilisation (layer thickness indicated) of pavement layers (layer to be stabilised indicated) using labour enhanced methods of construction	cubic metre (m ³)		R	-
C5.4.3		Stabilised crushed stone PMPL layer:	cubic metre (m ³)		R	-
C5.4.4		Wet lean-mix concrete pavement PMPL layer	cubic metre (m ³)		R	-
C5.4.5		Cementitious stabilisation agents for pavement layers:				
	C5.4.5.1	Addition of cementitious stabilisation agents				
	(a)	Cement (for pavement layer)	ton (t)	420	R	-
	(b)	And so forth for other agents (for pavement)	ton (t)	50	R	-
	C5.4.5.2	Addition of cementitious stabilisation agents				
	(a)	Cement (for pavement layer)	ton (t)		R	-
	(b)	And so forth for other agents (for pavement)	ton (t)		R	-
C5.4.6		Addition of cementitious stabilisation agents				
	C5.4.6.1	Cement	ton (t)		R	-
	C5.4.6.2	And so forth for other agents	ton (t)		R	-
C5.4.7		Bituminous stabilisation of pavement layers				
	C5.4.7.1	Bituminous stabilisation (layer thickness)	litre (l)		R	-
	C5.4.7.2	Bituminous stabilisation (layer thickness)	litre (l)		R	-
C5.4.8		Bituminous stabilisation agent (specify agents)				
	C5.4.8.1	60% anionic emulsion	litre (l)		R	-
	C5.4.8.2	60% cationic emulsion	litre (l)		R	-
	C5.4.8.3	Foamed bitumen	litre (l)		R	-
	C5.4.8.4	... (any other)	litre (l)		R	-
C5.4.9		Filler for bituminous stabilisation				
	C5.4.9.1	Filler for bituminous stabilisation (specify agents)	ton (t)		R	-
	C5.4.9.2	Filler for bituminous stabilisation spreading the	ton (t)		R	-
C5.4.10		Provision and application of water for curing	kilolitre (kl)		R	-
C5.4.11		Curing by covering with the subsequent layer	square metre (m ²)		R	-
C5.4.12		Curing with a membrane (type of material to be				
	C5.4.12.1	Cut back bitumen	litre (l)		R	-
	C5.4.12.2	Inverted bitumen emulsion	litre (l)		R	-
	C5.4.12.3	Spray grade emulsion	litre (l)		R	-
	C5.4.12.4	Curing compound for PMPL layers	litre (l)		R	-
C5.4.13		Trial section for a PMPL layer (specify width)	square metre (m ²)		R	-
C5.4.14		Trial section for a chemically stabilised layer	cubic metre (m ³)		R	-
C5.4.15		Trial section for a bituminously stabilised	square metre (m ²)		R	-
C5.4.16		Mechanical modification	cubic metre (m ³)		R	-
C5.4.17		Addition of a soil binder	cubic metre (m ³)		R	-
TOTAL CARRIED FORWARD TO SUMMARY					R	-

TENDER NO.: PR&T/BID06/2021/22				Tweespruit Access Road; SS604/S34			
C5.5				RECONSTRUCTION OF PAVEMENT LAYERS			
ITEM			DESCRIPTION	UNIT	QTY	RATE	AMT
C5.5.1			Compiling and implementing M&U plans for the reconstruction of an existing road pavement	number (No.)		R	-
C5.5.2			Reconstruction preparatory work:				
	C5.5.2.1		Undivided carriageway:				
		(a)	Uniform section from km ... to km ... (specify)	kilometre (km)		R	-
		(b)	Uniform section from km ... to km ... (specify)	kilometre (km)		R	-
		(c)	Additional uniform sections	kilometre (km)		R	-
	C5.5.2.2		Divided carriageway:				
		(a)	Uniform section from km ... to km ... (specify)	kilometre (km)		R	-
		(b)	Uniform section from km ... to km ... (specify)	kilometre (km)		R	-
		(c)	Additional uniform sections	kilometre (km)		R	-
C5.5.3			Construction equipment for sampling of in-situ material for mix design procedure	number (No.)	4	R	-
C5.5.4			Sampling of in-situ material for mix design procedure	number (No.)	5	R	-
C5.5.5			Construction of a trial section using a recycler	cubic metre (m ³)	500	R	-
C5.5.6			Construction of a trial section using conventional construction equipment	cubic metre (m ³)		R	-
C5.5.7			Pre-milling existing wearing course material:				
	C5.5.7.1		Pre-milling an asphalt wearing course (depth of pre-milling varies between 10mm and 40mm maximum)	square metre (m ²)		R	-
	C5.5.7.2		Pre-milling a seal wearing course (depth of pre-milling varies between 10mm and 25mm)	square metre (m ²)		R	-
C5.5.8			Pre-pulverising material in the existing pavement				
	C5.5.8.1		Asphalt wearing course (up to 50mm)	cubic metre (m ³)	2800	R	-
	C5.5.8.2		Crushed stone base (specify nominal depth)	cubic metre (m ³)		R	-
	C5.5.8.3		Stabilised crushed stone (specify nominal depth)	cubic metre (m ³)		R	-
	C5.5.8.4		Stabilised gravel layer (specify nominal depth)	cubic metre (m ³)		R	-
C5.5.9			Temporarily blading layer material to windrow	cubic metre (m ³)		R	-
C5.5.10			Roller-pass compaction of an exposed pavement layer				
	C5.5.10.1		Smooth drum vibratory rollers	square metre (m ²)		R	-
	C5.5.10.2		Other vibratory rollers (specify)	square metre (m ²)		R	-
	C5.5.10.3		Pneumatic-tyred rollers	square metre (m ²)		R	-
	C5.5.10.4		Other rollers (specify)	square metre (m ²)		R	-
C5.5.11			Watering the exposed pavement layer	kiloitre (kl)	20000	R	-
C5.5.12			Removal of surplus material from site	cubic metre (m ³)	1600	R	-
C5.5.13			Cross mixing of material (specify nominal depth)	cubic metre (m ³)		R	-

C5.5.14			In-situ reconstruction of a pavement layer using a recycler to construct a stabilised selected layer				
	C5.5.14.1		Chemically stabilised selected layer compacted to 95% of MDD:				
		(a)	Using non-cemented material compacted to 97% MDD ... 150mm thick	cubic metre (m ³)			R -
		(b)	Using cemented material compacted to 97% MDD, 300mm thick layer	cubic metre (m ³)			R -
		(c)	Using a combination of non-cemented and cemented material compacted to 97% MDD ... 300mm thick	cubic metre (m ³)			R -
		(d)	Using pre-pulverised material (as per item C5.5.8) compacted to 97% MDD ... 150mm thick	cubic metre (m ³)			R -
	C5.5.14.2		Emulsion stabilised selected layer compacted to 95% of MDD:				
		(a)	Using non-cemented material compacted to ...	cubic metre (m ³)			R -
		(b)	Using cemented material compacted to ... mm	cubic metre (m ³)			R -
		(c)	Using a combination of non-cemented and	cubic metre (m ³)			R -
		(d)	Using pre-pulverised material (as per item C5.5.8)	cubic metre (m ³)			R -
	C5.5.14.3		Foam stabilised selected layer compacted to 95%				
		(a)	Using non-cemented material compacted to ...	cubic metre (m ³)			R -
		(b)	Using cemented material compacted to ... mm	cubic metre (m ³)			R -
		(c)	Using a combination of non-cemented and	cubic metre (m ³)			R -
		(d)	Using pre-pulverised material (as per item C5.5.8)	cubic metre (m ³)			R -
C5.5.15			In-situ reconstruction of a pavement layer using a recycler to construct a stabilised subbase layer				
	C5.5.15.1		Chemically stabilised subbase layer compacted to 97% of MDD:				
		(a)	Using non-cemented material compacted to ... mm thick (<i>specify</i>)	cubic metre (m ³)			R -
		(b)	Using cemented material compacted to 97% MDD ... 150mm thick	cubic metre (m ³)			R -
		(c)	Using a combination of non-cemented and	cubic metre (m ³)			R -
		(d)	Using pre-pulverised material (as per item C5.5.8) compacted to 97% MDD ... 150mm thick	cubic metre (m ³)			R -
	C5.5.15.2		Emulsion stabilised subbase layer compacted to				
		(a)	Using non-cemented material compacted to ...	cubic metre (m ³)			R -
		(b)	Using cemented material compacted to ... mm	cubic metre (m ³)			R -
		(c)	Using a combination of non-cemented and	cubic metre (m ³)			R -
		(d)	Using pre-pulverised material (as per item C5.5.8)	cubic metre (m ³)			R -
	C5.5.15.3		Foam stabilised subbase layer compacted to 97%				
		(a)	Using non-cemented material compacted to ...	cubic metre (m ³)			R -
		(b)	Using cemented material compacted to ... mm	cubic metre (m ³)			R -
		(c)	Using a combination of non-cemented and	cubic metre (m ³)			R -
		(d)	Using pre-pulverised material (as per item C5.5.8)	cubic metre (m ³)			R -
C5.5.16			In-situ reconstruction of a pavement layer using a recycler to construct a stabilised base layer				
	C5.5.16.1		Chemically stabilised base layer compacted to 100% of MDD:				
		(a)	Using non-cemented material compacted to ... mm thick (<i>specify</i>)	cubic metre (m ³)			R -
		(b)	Using cemented material compacted to 98% MDD ... 150mm thick	cubic metre (m ³)			R -
		(c)	Using a combination of non-cemented and	cubic metre (m ³)			R -
		(d)	Using pre-pulverised material (as per item C5.5.8) compacted to 98% MDD ... 150 mm thick	cubic metre (m ³)			R -
	C5.5.16.2		Emulsion stabilised subbase layer compacted to				
		(a)	Using non-cemented material compacted to ...	cubic metre (m ³)			R -
		(b)	Using cemented material compacted to ... mm	cubic metre (m ³)			R -
		(c)	Using a combination of non-cemented and	cubic metre (m ³)			R -
		(d)	Using pre-pulverised material (as per item C5.5.8)	cubic metre (m ³)			R -
	C5.5.16.3		Foam stabilised subbase layer compacted to				
		(a)	Using non-cemented material compacted to ...	cubic metre (m ³)			R -
		(b)	Using cemented material compacted to ... mm	cubic metre (m ³)			R -
		(c)	Using a combination of non-cemented and	cubic metre (m ³)			R -
		(d)	Using pre-pulverised material (as per item C5.5.8)	cubic metre (m ³)			R -
C5.5.17			In-situ reconstruction of a pavement layer using conventional construction equipment to construct a stabilised selected layer				
	C5.5.17.1		Chemically stabilised selected layer compacted to				
		(a)	Using non-cemented material compacted to ...	cubic metre (m ³)			R -
		(b)	Using cemented material compacted to ... mm	cubic metre (m ³)			R -
		(c)	Using a combination of non-cemented and	cubic metre (m ³)			R -
		(d)	Using pre-pulverised material (as per item C5.5.8)	cubic metre (m ³)			R -
	C5.5.17.2		Emulsion stabilised selected layer compacted to				
		(a)	Using non-cemented material compacted to ...	cubic metre (m ³)			R -
		(b)	Using cemented material compacted to ... mm	cubic metre (m ³)			R -
		(c)	Using a combination of non-cemented and	cubic metre (m ³)			R -
		(d)	Using pre-pulverised material (as per item C5.5.8)	cubic metre (m ³)			R -
	C5.5.17.3		Foam stabilised selected layer compacted to 95%				
		(a)	Using non-cemented material compacted to ...	cubic metre (m ³)			R -
		(b)	Using cemented material compacted to ... mm	cubic metre (m ³)			R -
		(c)	Using a combination of non-cemented and	cubic metre (m ³)			R -
		(d)	Using pre-pulverised material (as per item C5.5.8)	cubic metre (m ³)			R -
C5.5.18			In-situ reconstruction of a pavement layer using conventional construction equipment to construct a stabilised subbase layer				
	C5.5.18.1		Chemically stabilised subbase layer compacted to				
		(a)	Using non-cemented material compacted to ...	cubic metre (m ³)			R -
		(b)	Using cemented material compacted to ... mm	cubic metre (m ³)			R -
		(c)	Using a combination of non-cemented and	cubic metre (m ³)			R -
		(d)	Using pre-pulverised material (as per item C5.5.8)	cubic metre (m ³)			R -
	C5.5.18.2		Emulsion stabilised subbase layer compacted to				
		(a)	Using non-cemented material compacted to ...	cubic metre (m ³)			R -
		(b)	Using cemented material compacted to ... mm	cubic metre (m ³)			R -
		(c)	Using a combination of non-cemented and	cubic metre (m ³)			R -
		(d)	Using pre-pulverised material (as per item C5.5.8)	cubic metre (m ³)			R -
	C5.5.18.3		Foam stabilised subbase layer compacted to 97%				
		(a)	Using non-cemented material compacted to ...	cubic metre (m ³)			R -
		(b)	Using cemented material compacted to ... mm	cubic metre (m ³)			R -
		(c)	Using a combination of non-cemented and	cubic metre (m ³)			R -
		(d)	Using pre-pulverised material (as per item C5.5.8)	cubic metre (m ³)			R -

C5.5.19			In-situ reconstruction of a pavement layer using conventional construction equipment to construct a stabilised base layer				
	C5.5.19.1		Chemically stabilised base layer compacted to 98 % of MDD:				
		(a)	Using non-cemented material compacted to ...	cubic metre (m ³)		R	-
		(b)	Using cemented material compacted to 98% MDD (150mm thick layer)	cubic metre (m ³)		R	-
		(c)	Using a combination of non-cemented and	cubic metre (m ³)		R	-
		(d)	Using pre-pulverised material (as per item C5.5.8)	cubic metre (m ³)		R	-
	C5.5.19.2		Emulsion stabilised base layer compacted to				
		(a)	Using non-cemented material compacted to ...	cubic metre (m ³)		R	-
		(b)	Using cemented material compacted to ... mm	cubic metre (m ³)		R	-
		(c)	Using a combination of non-cemented and	cubic metre (m ³)		R	-
		(d)	Using pre-pulverised material (as per item C5.5.8)	cubic metre (m ³)		R	-
	C5.5.19.3		Foam stabilised base layer compacted to 102%				
		(a)	Using non-cemented material compacted to ...	cubic metre (m ³)		R	-
		(b)	Using cemented material compacted to ... mm	cubic metre (m ³)		R	-
		(c)	Using a combination of non-cemented and	cubic metre (m ³)		R	-
		(d)	Using pre-pulverised material (as per item C5.5.8)	cubic metre (m ³)		R	-
C5.5.20			Material shortfall or make-up material				
	C5.5.20.1		For selected layer	cubic metre (m ³)		R	-
	C5.5.20.2		For subbase layer	cubic metre (m ³)	1500	R	-
	C5.5.20.3		For base layer	cubic metre (m ³)		R	-
C5.5.21			Finishing the stabilised layer				
	C5.5.21.1		Slush trial section with:				
		(a)	Water	square metre (m ²)	1800	R	-
		(b)	Diluted emulsion	square metre (m ²)		R	-
	C5.5.21.2		Slush reconstructed section with:				
		(a)	Water	square metre (m ²)	50000	R	-
		(b)	Diluted emulsion	square metre (m ²)		R	-
	C5.5.21.3		Application of a diluted emulsion spray	litre (l)		R	-
C5.5.22			Excavate pavement layers for patching in existing pavements				
	C5.5.22.1		Excavate the following layers:				
		(a)	Asphalt layers with a surface area:				
		(i)	Not exceeding 20 m ² , including for edge repairs	cubic metre (m ³)		R	-
		(ii)	Exceeding 20 m ² but not exceeding 50 m ²	cubic metre (m ³)		R	-
		(iii)	Exceeding 50 m ² but not exceeding 100 m ²	cubic metre (m ³)		R	-
		(b)	Cemented layers with a surface area:				
		(i)	Not exceeding 20 m ² , including for edge repairs	cubic metre (m ³)		R	-
		(ii)	Exceeding 20 m ² but not exceeding 50 m ²	cubic metre (m ³)		R	-
		(iii)	Exceeding 50 m ² but not exceeding 100 m ²	cubic metre (m ³)		R	-
		(c)	Any other layers (specify layer) with a surface				
		(i)	Not exceeding 20 m ² , including for edge repairs	cubic metre (m ³)		R	-
		(ii)	Exceeding 20 m ² but not exceeding 50 m ²	cubic metre (m ³)		R	-
		(iii)	Exceeding 50 m ² but not exceeding 100 m ²	cubic metre (m ³)		R	-
	C5.5.22.2		Excavate the following layers using labour				
		(a)	Asphalt layers with a surface area:				
		(i)	Not exceeding 20 m ² , including for edge repairs	cubic metre (m ³)		R	-
		(ii)	Exceeding 20 m ² but not exceeding 50 m ²	cubic metre (m ³)		R	-
		(iii)	Exceeding 50 m ² but not exceeding 100 m ²	cubic metre (m ³)		R	-
		(b)	Cemented layers with a surface area:				
		(i)	Not exceeding 20 m ² , including for edge repairs	cubic metre (m ³)		R	-
		(ii)	Exceeding 20 m ² but not exceeding 50 m ²	cubic metre (m ³)		R	-
		(iii)	Exceeding 50 m ² but not exceeding 100 m ²	cubic metre (m ³)		R	-
		(c)	Any other layers (specify type) with a surface				
		(i)	Not exceeding 20 m ² , including for edge repairs	cubic metre (m ³)		R	-
		(ii)	Exceeding 20 m ² but not exceeding 50 m ²	cubic metre (m ³)		R	-
		(iii)	Exceeding 50 m ² but not exceeding 100 m ²	cubic metre (m ³)		R	-
C5.5.23			Edge break cutting back when narrower than				
	C5.5.23.1		Edge break cutting back when narrower than	metre (m)		R	-
	C5.5.23.2		Edge break cutting back when narrower than	metre (m)		R	-
C5.5.24			Edge break patching when narrower than				
	C5.5.24.1		Edge break patching using emulsion treated base	metre (m)		R	-
	C5.5.24.2		Edge break patching using labour enhanced	metre (m)		R	-
C5.5.25			Compacting the floor of the excavation for	square metre (m ²)		R	-
C5.5.26			Backfill patching excavations in existing				
	C5.5.26.1		Backfill with the following pavement layer				
		(a)	Chemically stabilised pavement layer material				
		(i)	Not exceeding 20 m ² , including for edge repairs	cubic metre (m ³)		R	-
		(ii)	Exceeding 20 m ² but not exceeding 50 m ²	cubic metre (m ³)		R	-
		(iii)	Exceeding 50 m ² but not exceeding 100 m ²	cubic metre (m ³)		R	-
		(b)	Emulsion treated base, or ETB pavement material				
		(i)	Not exceeding 20 m ² , including for edge repairs	cubic metre (m ³)		R	-
		(ii)	Exceeding 20 m ² but not exceeding 50 m ²	cubic metre (m ³)		R	-
		(iii)	Exceeding 50 m ² but not exceeding 100 m ²	cubic metre (m ³)		R	-
	C5.5.26.2		Backfill with the following pavement layer material				
		(a)	Chemically stabilised pavement material (specify				
		(i)	Not exceeding 20 m ² , including for edge repairs	cubic metre (m ³)		R	-
		(ii)	Exceeding 20 m ² but not exceeding 50 m ²	cubic metre (m ³)		R	-
		(iii)	Exceeding 50 m ² but not exceeding 100 m ²	cubic metre (m ³)		R	-
		(b)	Emulsion treated base, or ETB pavement material				
		(i)	Not exceeding 20 m ² , including for edge repairs	cubic metre (m ³)		R	-
		(ii)	Exceeding 20 m ² but not exceeding 50 m ²	cubic metre (m ³)		R	-
		(iii)	Exceeding 50 m ² but not exceeding 100 m ²	cubic metre (m ³)		R	-
TOTAL CARRIED FORWARD TO SUMMARY							R -

TENDER NO.: PR&T/BID06/2021/22				Tweespruit Access Road; SS604/S34			
C8.2				COVER SPRAYS, FOG SPRAYS AND REJUVENATION SPRAYS			
ITEM			DESCRIPTION	UNIT	QTY	RATE	AMT
C8.2.1			Cover sprays, fog sprays and rejuvenation				
	C8.2.1.1		65% Cationic spray grade emulsion				
		(a)	Indicate dilution (Diluted 50% Emulsion 50% Water)	litre (ℓ)	52000	Included	
	C8.2.1.2		60% Anionic stable grade emulsion				
		(a)	Indicate dilution (Diluted 50% Emulsion 50% Water)	litre (ℓ)	108000	Included	
	C8.2.1.3		Cutback Inverted bitumen emulsion	litre (ℓ)			R -
	C8.2.1.4		Certified rejuvenator (state type and certification)	litre (ℓ)			R -
C8.2.2			Extra over item C8.2.1 for labour enhanced				
	C8.2.2.1		65% Cationic spray grade emulsion				
		(a)	Indicate dilution (Diluted 50% Emulsion 50% Water)	litre (ℓ)			R -
	C8.2.2.2		60% Anionic stable grade emulsion				
		(a)	Indicate dilution (Diluted 50% Emulsion 50% Water)	litre (ℓ)	260000	Included	
	C8.2.2.3		Cutback inverted bitumen emulsion	litre (ℓ)			R -
	C8.2.2.4		Certified rejuvenator (state type and certification)	litre (ℓ)			R -
TOTAL CARRIED FORWARD TO SUMMARY							R -

TENDER NO.: PR&T/BID06/2021/22			Tweespruit Access Road; SS604/S34			
C8.3			TEXTURE TREATMENT			
ITEM		DESCRIPTION	UNIT	QTY	RATE	AMT
C8.3.1		Texture treatment				
	C8.3.1.1	Application of slurry for texture improvement, applied by hand (<i>Chrusher Sand, Anionic Stable grade Emulsion, SS60</i>)	cubic metre (m ³)	1300	Included	
	C8.3.1.2	Application of slurry for texture improvement, applied by spreader box (<i>indicate aggregate grade, type of emulsion, filler type</i>)	cubic metre (m ³)			R -
	C8.3.1.3	Application of microsurfacing for texture	cubic metre (m ³)			R -
TOTAL CARRIED FORWARD TO SUMMARY						R -

TENDER NO.: PR&T/BID06/2021/22		Tweespruit Access Road; SS604/S34				
C10.1		GENERAL REQUIREMENTS FOR SURFACE TREATMENTS				
ITEM		DESCRIPTION	UNIT	QTY	RATE	AMT
C10.1.1		Single seals including a cover spray, if				
	C10.1.1.1	Using 5.0mm aggregate	square metre (m ²)		R	-
	C10.1.1.2	Using 7.1mm aggregate	square metre (m ²)		R	-
	C10.1.1.3	Using 10mm aggregate	square metre (m ²)		R	-
	C10.1.1.4	Using 14mm aggregate	square metre (m ²)		R	-
	C10.1.1.5	Using 20mm aggregate	square metre (m ²)		R	-
C10.1.2		Single seals including a cover spray, if specified (indicate grade of aggregate and type of binder) spreading the aggregate by (state:				
	C10.1.2.1	Using 5.0mm aggregate	square metre (m ²)		R	-
	C10.1.2.2	Using 7.1mm aggregate	square metre (m ²)		R	-
	C10.1.2.3	Using 10mm aggregate	square metre (m ²)		R	-
	C10.1.2.4	Using 14mm aggregate	square metre (m ²)		R	-
	C10.1.2.5	Using 20mm aggregate	square metre (m ²)		R	-
C10.1.3		Multiple stone seals including a cover spray, if				
	C10.1.3.1	20mm and 10mm aggregate (state grade of	square metre (m ²)		R	-
	C10.1.3.2	20mm and 7.1mm aggregate (state grade of	square metre (m ²)		R	-
	C10.1.3.3	14mm and 7.1mm aggregate (state grade of	square metre (m ²)		R	-
	C10.1.3.4	14mm and 5.0mm aggregate (state grade of	square metre (m ²)		R	-
	C10.1.3.5	20mm with a split application of 7.1mm aggregate	square metre (m ²)		R	-
C10.1.4		Embargo period effects				
	C10.1.4.1	Re-establishment of sealing team after embargo	lump sum	lump	sum	
	C10.1.4.2	Extra-over for sealing during the specified	square metre (m ²)		R	-
C10.1.5		Sand or Grit seals using:				
	C10.1.5.1	Sand seal (state grades of aggregate and types	square metre (m ²)		R	-
	C10.1.5.2	Grit seal (state grades of aggregate and types of	square metre (m ²)		R	-
C10.1.6		Sand or Grit seals using (state: walk behind				
	C10.1.6.1	Sand seal (state grades of aggregate and types	square metre (m ²)		R	-
	C10.1.6.2	Grit seal (state grades of aggregate and types of	square metre (m ²)		R	-
C10.1.7		Graded aggregate (Otta) seals using:				
	C10.1.7.1	Single minus 20mm aggregate (state grades of	square metre (m ²)		R	-
	C10.1.7.2	Single minus 14mm aggregate (state grades of	square metre (m ²)		R	-
	C10.1.7.3	Single minus 10mm aggregate (state grades of	square metre (m ²)		R	-
	C10.1.7.4	Extra over for sand seal (state grades of	square metre (m ²)		R	-
C10.1.8		Graded aggregate (Otta) seals, with aggregate				
	C10.1.8.1	Single minus 20mm aggregate (state grades of	square metre (m ²)		R	-
	C10.1.8.2	Single minus 14mm aggregate (state grades of	square metre (m ²)		R	-
	C10.1.8.3	Single minus 10mm aggregate (state grades of	square metre (m ²)		R	-
	C10.1.8.4	Extra over for sand seal (state grades of	square metre (m ²)		R	-
C10.1.9		Bituminous binder variations:				
	C10.1.9.1	70/100 Penetration grade bitumen	litre (l)		R	-
	C10.1.9.2	60% Stable-grade emulsion	litre (l)		R	-
	C10.1.9.3	Cationic Stable grade emulsion (indicate bitumen	litre (l)		R	-
	C10.1.9.4	Cationic Spray-grade emulsion (indicate bitumen	litre (l)		R	-
	C10.1.9.5	Homogeneous modified binder (indicate type and	litre (l)		R	-
	C10.1.9.6	Non-homogeneous modified binder (indicate	litre (l)		R	-
	C10.1.9.7	Homogeneous modified binder (indicate type) hot	litre (l)		R	-
	C10.1.9.8	Homogeneous modified binder S-E1 with 4.5%	litre (l)		R	-
	C10.1.9.9	Homogeneous modified binder S-E1 with 9%	litre (l)		R	-
	C10.1.9.10	MC-3000 cut-back bitumen	litre (l)		R	-
	C10.1.9.11	Precoating fluid (state type)	litre (l)		R	-
C10.1.10		Aggregate variation (state grade):				
	C10.1.10.1	5mm aggregate	cubic metre (m ³)		R	-
	C10.1.10.2	7.1mm aggregate	cubic metre (m ³)		R	-
	C10.1.10.3	10mm aggregate	cubic metre (m ³)		R	-
	C10.1.10.4	14mm aggregate	cubic metre (m ³)		R	-
	C10.1.10.5	20mm aggregate	cubic metre (m ³)		R	-
	C10.1.10.6	Sand	cubic metre (m ³)		R	-
	C10.1.10.7	Grit	cubic metre (m ³)		R	-
C10.1.11		Application of cover spray:				
	C10.1.11.1	60% Anionic Stable-grade emulsion	litre (l)		R	-
	C10.1.11.2	60% Diluted Anionic stable-grade emulsion	litre (l)		R	-
	C10.1.11.3	Diluted Cationic spray-grade emulsion (indicate	litre (l)		R	-
	C10.1.11.4	Diluted SC-E1 (indicate % bitumen and dilution	litre (l)		R	-
C10.1.12		Application of cover spray by hand:				
	C10.1.12.1	60% Anionic Stable-grade emulsion	litre (l)		R	-
	C10.1.12.2	60% Diluted Anionic Stable-grade emulsion	litre (l)		R	-
	C10.1.12.3	Diluted Cationic Spray-grade emulsion (indicate	litre (l)		R	-
	C10.1.12.4	Diluted SC-E1 (indicate % bitumen and dilution	litre (l)		R	-
C10.1.13		Precoating of aggregate using a dedicated				
	C10.1.13.1	Product containing low flashpoint solvent (indicate	litre (l)		R	-
	C10.1.13.2	Product containing no low flashpoint solvent	litre (l)		R	-
C10.1.14		Precoating of aggregate using a frontend				
	C10.1.14.1	Product containing low flashpoint solvent (indicate	litre (l)		R	-
	C10.1.14.2	Product containing no low flashpoint solvent	litre (l)		R	-
C10.1.15		Precoating of aggregate by hand				
	C10.1.15.1	Product containing low flashpoint solvent (indicate	litre (l)		R	-
	C10.1.15.2	Product containing no low flashpoint solvent	litre (l)		R	-

TWEESPRUIT ACCESS ROAD SPECIFICATIONS

TENDER NO.: PR&T/BID06/2021/22			Tweespruit Access Road; SS604/S34			
C11.1			PITCHING, STONEMWORK, CAST IN SITU CONCRETE FOR PROTECTION AGAINST EROSION			
ITEM		DESCRIPTION	UNIT	QTY	RATE	AMT
C11.1.1		Foundation trenches for stone masonry walls				
	C11.1.1.1	Excavating foundation trenches in soft material	cubic metre (m ³)		R	-
	C11.1.1.2	Excavating foundation trenches in intermediate	cubic metre (m ³)		R	-
C11.1.2		Stone pitching				
	C11.1.2.1	Plain stone pitching				
	(a)	Method 1	square metre (m ²)		R	-
	(b)	Method 2	square metre (m ²)		R	-
	C11.1.2.2	Grouted stone pitching with mortar	square metre (m ²)		R	-
	C11.1.2.3	Grouted stone pitching on a concrete bed	square metre (m ²)		R	-
C11.1.3		Riprap				
	C11.1.3.1	Packed riprap (<i>"critical mass of stone" and</i>	cubic metre (m ³)		R	-
	C11.1.3.2	Extra over item C11.1.3.1 for constructing packed	cubic metre (m ³)		R	-
	C11.1.3.3	Dumped riprap (<i>critical mass of stone and</i>	cubic metre (m ³)		R	-
	C11.1.3.4	Filter layer consisting of:				
	(a)	Crushed stone	cubic metre (m ³)		R	-
	(b)	Filter sand	cubic metre (m ³)		R	-
	(c)	Geotextile (<i>type, class and grade stated</i>)	square metre (m ²)		R	-
C11.1.4		Stone masonry walls:				
	C11.1.4.1	Plain packed stone walls	cubic metre (m ³)		R	-
	C11.1.4.2	Cement-mortared stone walls	cubic metre (m ³)		R	-
	C11.1.4.3	Extra over items C11.1.4.1 and C11.1.4.2 for	cubic metre (m ³)		R	-
C11.1.5		Concrete pitching or paving				
	C11.1.5.1	Cast in situ concrete pitching or paving (<i>class of</i>	square metre (m ²)		R	-
	C11.1.5.2	Prefabricated concrete grass blocks (<i>type and</i>	square metre (m ²)		R	-
	C11.1.5.3	Welded steel fabric used for cast in situ pitching	kilogram (kg)		R	-
C11.1.6		Concrete edge beams (<i>class of concrete</i>	cubic metre (m ³)		R	-
C11.1.7		Provision of approved herbicide and ant				
	C11.1.7.1	Provision of materials	prime cost (PC) sum	Prime	Cost	
	C11.1.7.2	Contractor's charges and profit added to the	percentage (%)	R	-	10%
TOTAL CARRIED FORWARD TO SUMMARY					R	-

TENDER NO.: PR&T/BID06/2021/22				Tweespruit Access Road; SS604/S34		
C11.6			ROAD SIGNS			
ITEM		DESCRIPTION	UNIT	QTY	RATE	AMT
C11.6.1		Road signboards with painted or coloured				
	C11.6.1.1	Aluminium sheet (2,0mm thick):				
		(a) Area 0 to 0,5 m ²	square metre (m ²)		R	-
		(b) Area exceeding 0,5 m ² but not 2,0 m ²	square metre (m ²)		R	-
		(c) Area exceeding 2,0 m ² but not 10 m ²	square metre (m ²)		R	-
		(d) Area exceeding 10 m ²	square metre (m ²)		R	-
	C11.6.1.2	Aluminium composite sheet				
		(a) Area 0 to 0,5 m ² (indicate plate thickness, 2,0 or	square metre (m ²)		R	-
		(b) Area exceeding 0,5 m ² but not 2,0 m ² (indicate	square metre (m ²)		R	-
		(c) Area exceeding 2,0 m ² but not 10 m ² (3,0mm	square metre (m ²)		R	-
		(d) Area exceeding 10 m ² (3,0mm plate thickness)	square metre (m ²)		R	-
	C11.6.1.3	Prepainted galvanized steel plate:				
		(a) Area 0 to 0,5 m ²	square metre (m ²)		R	-
		(b) Area exceeding 0,5 m ² but not 2,0 m ²	square metre (m ²)		R	-
		(c) Area exceeding 2,0 m ² but not 10 m ²	square metre (m ²)		R	-
		(d) Area exceeding 10 m ²	square metre (m ²)		R	-
	C11.6.1.4	Prepainted galvanized steel profiles (200mm high				
		(a) Area 0 to 0,5 m ²	square metre (m ²)		R	-
		(b) Area exceeding 0,5 m ² but not 2,0 m ²	square metre (m ²)		R	-
		(c) Area exceeding 2,0 m ² but not 10 m ²	square metre (m ²)		R	-
		(d) Area exceeding 10 m ²	square metre (m ²)		R	-
	C11.6.1.5	Other material (details indicated):				
		(a) Area 0 to 0,5 m ²	square metre (m ²)		R	-
		(b) Area exceeding 0,5 m ² but not 2,0 m ²	square metre (m ²)		R	-
		(c) Area exceeding 2,0 m ² but not 10 m ²	square metre (m ²)		R	-
		(d) Area exceeding 10 m ²	square metre (m ²)		R	-
	C11.6.1.6	Extra over items C11.6.1.1 to C11.6.1.4 for	square metre (m ²)		R	-
	C11.6.1.7	Regulatory signs, permanent				
		(a) 600mm diameter (signboard material,	number (No.)		R	-
		(b) 900mm diameter (signboard material,	number (No.)		R	-
		(c) 1200mm diameter (signboard material,	number (No.)		R	-
	C11.6.1.8	Regulatory signs, temporary				
		(a) 600mm diameter (signboard material,	number (No.)		R	-
		(b) 900mm diameter (signboard material,	number (No.)		R	-
		(c) 1200mm diameter (signboard material,	number (No.)		R	-
	C11.6.1.9	Warning signs, permanent				
		(a) 600mm size (signboard material, background	number (No.)		R	-
		(b) 900mm size (signboard material, background	number (No.)		R	-
		(c) 1200mm size (signboard material, background	number (No.)		R	-
		(d) 1500mm size (signboard material, background	number (No.)		R	-
	C11.6.1.10	Warning signs, temporary				
		(a) 600mm size (signboard material, background	number (No.)		R	-
		(b) 900mm size (signboard material, background	number (No.)		R	-
		(c) 1200mm size (signboard material, background	number (No.)		R	-
		(d) 1500mm size (signboard material, background	number (No.)		R	-
	C11.6.1.11	Supplementary plates to permanent regulatory or	square metre (m ²)		R	-
	C11.6.1.12	Supplementary plates to temporary regulatory or	square metre (m ²)		R	-
C11.6.2		Extra over on item C11.6.1 for using:				
	C11.6.2.1	Background of retro-reflective material:				
		(a) Class I	square metre (m ²)		R	-
		(b) Class III	square metre (m ²)		R	-
		(c) Class IV specify a) or b)	square metre (m ²)		R	-
	C11.6.2.2	Lettering, symbols, numbers, arrows, emblems				
		(a) Class III	square metre (m ²)		R	-
		(b) Class IV specify a) or b)	square metre (m ²)		R	-
C11.6.3		Road sign supports (overhead road sign				
	C11.6.3.1	Steel tubing (diameter and wall thickness	ton (t)		R	-
	C11.6.3.2	Timber (diameter and type indicated)	metre (m)		R	-
C11.6.4		Kilometre Markers				
	C11.6.4.1	Kilometre markers on posts (type and post	number (No.)		R	-
	C11.6.4.2	Replace marker boards on existing kilometre	square metre (m ²)		R	-
C11.6.5		Excavation and backfilling for road sign supports (not applicable to kilometre posts)				
	C11.6.5.1	Excavating soft material and backfilling	cubic metre (m ³)		R	-
	C11.6.5.2	Excavating soft or intermediate material and	cubic metre (m ³)		R	-
	C11.6.5.3	Extra over item C11.6.5.1 and C11.6.5.2 for	cubic metre (m ³)		R	-
	C11.6.5.4	Extra over item C11.6.5.1 for hard material	cubic metre (m ³)		R	-
	C11.6.5.5	Imported backfill material from commercial	cubic metre (m ³)		R	-
C11.6.6		Dismantling, storing and re-erecting road				
	C11.6.6.1	Area 0 to 0,5 m ²	square metre (m ²)		R	-
	C11.6.6.2	Area exceeding 0,5 m ² but not 2,0 m ²	square metre (m ²)		R	-
	C11.6.6.3	Exceeding 2,0 m ² but not 10 m ²	square metre (m ²)		R	-
	C11.6.6.4	Exceeding 10 m ²	square metre (m ²)		R	-
C11.6.7		Dismantling and storing of road signs and				
	C11.6.7.1	Dismantling and storing of road signs with a				
		(a) Area 0 to 0,5 m ²	square metre (m ²)		R	-
		(b) Area exceeding 0,5 m ² but not 2,0 m ²	square metre (m ²)		R	-
		(c) Exceeding 2,0 m ² but not 10 m ²	square metre (m ²)		R	-
		(d) Exceeding 10 m ²	square metre (m ²)		R	-
	C11.6.7.2	Dismantling and storing of overhead signs with a				
		(a) Area exceeding 0 m ² but not 2,0 m ²	square metre (m ²)		R	-
		(b) Exceeding 2,0 m ² but not 10 m ²	square metre (m ²)		R	-
		(c) Exceeding 10 m ²	square metre (m ²)		R	-
C11.6.8		Danger plates at culverts/structures				
	C11.6.8.1	Size 150 x 600mm (state post type and reflective	number (No.)		R	-
	C11.6.8.2	Size 200 x 800mm (state post type and reflective	number (No.)		R	-
	C11.6.8.3	Size 300 x 1200mm (state post type and	number (No.)		R	-
C11.6.9		Installation of traffic signals				
	C11.6.9.1	Specialist installation of traffic signals	prime cost (PC) sum	Prime	Cost	
	C11.6.9.2	Handling cost, profit and all other charges of sub	percentage (%)	R	10%	
C11.6.10		Disposing of road signs with a surface area				
	C11.6.10.1	Area 0 to 0,5 m ²	square metre (m ²)		R	-
	C11.6.10.2	Area exceeding 0,5 m ² but not 2,0 m ²	square metre (m ²)		R	-
	C11.6.10.3	Exceeding 2,0 m ² but not 10 m ²	square metre (m ²)		R	-
	C11.6.10.4	Exceeding 10 m ²	square metre (m ²)		R	-
C11.6.11		Disposing of overhead road signs:				
	C11.6.11.1	Up to 10 m ²	square metre (m ²)		R	-
	C11.6.11.2	Exceeding 10 m ²	square metre (m ²)		R	-
TOTAL CARRIED FORWARD TO SUMMARY					R	-

TENDER NO.: PR&T/BID06/2021/22			Tweespruit Access Road; SS604/S34			
C11.9		FINISHING THE ROAD AND ROAD RESERVE AND TREATING OLD ROADS				
ITEM		DESCRIPTION	UNIT	QTY	RATE	AMT
C11.9.1		Finishing the road and road reserve:				
	C11.9.1.1	Dual carriageway road	kilometre (km)			R -
	C11.9.1.2	Single carriageway road	kilometre (km)	7		R -
C11.9.2		Treatment of old roads and temporary deviations				
	C11.9.2.1	Conventional construction methods	kilometre (km)			R -
	C11.9.2.2	By hand only	kilometre (km)			R -
TOTAL CARRIED FORWARD TO SUMMARY						R -

TENDER NO.: PR&T/BID06/2021/22				Tweespruit Access Road; SS604/S34			
C20.1				TESTING MATERIALS AND JUDGEMENT OF WORKMANSHIP			
ITEM			DESCRIPTION	UNIT	QTY	RATE	AMT
C20.1.1			Special tests on elastomeric bearings (150%	number (No.)			R -
C20.1.2			Special tests requested by the Engineer				
	C20.1.2.1		Employer's contribution to concrete durability				
		(a)	Tests for water sorptivity	prime cost (PC) sum	Prime	Cost	
		(i)	Handling costs and profit in respect of item	percentage (%)	R -		R -
		(b)	Tests for oxygen permeability	prime cost (PC) sum	Prime	Cost	
		(i)	Handling costs and profit in respect of item	percentage (%)	R -		R -
		(c)	Tests for chloride conductivity	prime cost (PC) sum	Prime	Cost	
		(i)	Handling costs and profit in respect of item	percentage (%)	R -		R -
		(d)	Tests for concrete cover	prime cost (PC) sum	Prime	Cost	
		(i)	Handling costs and profit in respect of item	percentage (%)	R -		R -
	C20.1.2.2		Employer's contribution to other special tests				
		(a)	... (Specify test)	prime cost (PC) sum	Prime	Cost	
		(i)	Handling costs and profit in respect of item	percentage (%)	R -		R -
C20.1.3			Providing testing equipment:				
	C20.1.3.1		Core drill	number (No.)			
C20.1.4			Special tests using Automated Road condition				
	C20.1.4.1		Using Highspeed Inertial Non-Contact laser	prime cost (PC) sum	Prime	Cost	
		(a)	Handling cost and profit in respect of item	percentage (%)	R -		R -
	C20.1.4.2		Using Direct Contact Devices (Clause	prime cost (PC) sum	Prime	Cost	
		(a)	Handling cost and profit in respect of item	percentage (%)	R -		R -
	C20.1.4.3		Rutting measurements (Clause A20.1.5.5 d)(i))	prime cost (PC) sum	Prime	Cost	
		(a)	Handling cost and profit in respect of item	percentage (%)	R -		R -
	C20.1.4.4		Surface macro texture (Clause A20.1.5.5 b))	prime cost (PC) sum	Prime	Cost	
		(a)	Handling cost and profit in respect of item	percentage (%)	R -		R -
	C20.1.4.5		Deflection measurements (FWD) (Clause	prime cost (PC) sum	Prime	Cost	
		(a)	Handling cost and profit in respect of item	percentage (%)	R -		R -
PC20.1.5			Financial contribution for an independent site	month			R -
PC20.1.6			Payment of independent site laboratory	Note to compiler: Add this pay			
	C20.1.6.1		Direct payment by contractor	prime cost (PC) sum	Prime	Cost	
		(a)	Handling cost and profit in respect of item	percentage (%)	R -		R -
TOTAL CARRIED FORWARD TO SUMMARY							R -

TENDER NO.: PR&T/BID06/2021/22			Tweespruit Access Road; SS604/S34			
SECTION D - D1000			TRAINING, COACHING, GUIDANCE, MENTORING AND ASSISTANCE			
ITEM		DESCRIPTION	UNIT	QTY	RATE	AMT
D10.01		Target Group Participation				
	(a)	Contract Participation Performance bonus	prime cost (PC) sum	Prime	Cost	
D10.02		Stakeholder and Community Liaison and				
	(a)	Cost of liaison, social facilitation and PLC support	prime cost (PC) sum	Prime	Cost	
	(b)	Handling cost and profit in respect of sub-item	percentage (%)	R -	10%	R -
D10.03		Tender Process for Targeted Enterprises				
	(a)	Contractor's charge for the management and execution of the Targeted Enterprise procurement process:				
	(i)	Procurement process for the totality of all tenders concluded for the appointment of Targeted Enterprise subcontractors of CIDB 1 and 2 contractor grading	number (No.)			R -
	(ii)	Procurement process for the totality of all tenders	number (No.)			R -
	(iii)	Procurement process for the totality of all tenders concluded for the appointment of Targeted Enterprise subcontractors of CIDB 5 and higher contractor grading	number (No.)			R -
	(iv)	Procurement process for the totality of all tenders concluded for the appointment of Targeted Enterprise suppliers	number (No.)			R -
	(b)	Targeted Enterprise Procurement Coordinator	month			R -
D10.04		Responsibilities of the Contractor towards				
	(a)	Contractor's establishment, management,	month			R -
	(b)	Targeted Enterprise Construction Manager (Labour)	Person.Month			R -
	(c)	Targeted Enterprise Site Supervisors	Person.Month			R -
D10.05		Construction Works by Targeted Enterprises				
	(a)	Payments associated with the construction works carried out by Targeted Enterprise subcontractors of CIDB 1 and 2 contractor grading designation appointed in terms of Section D	provisional sum	Prov	Sum	
	(b)	Handling costs and profit in respect of payment	percentage (%)	R -		R -
	(c)	Fluctuation between the main contractor's rates	lump sum	lump	sum	
	(d)	Preliminary and General Obligations of Targeted	lump sum	lump	sum	
D10.06		Training, coaching, guidance, mentoring and assistance				
	(a)	Training Costs				
	(i)	Accredited NQF training	provisional sum	Prov	Sum	R 80 000,00
	(ii)	Accredited generic skills training	provisional sum	Prov	Sum	R 80 000,00
	(iii)	Community skills training	provisional sum	Prov	Sum	R 80 000,00
	(iv)	Handling cost and profit in respect of subitems	percentage (%)		10%	R -
	(b)	Student experiential training				
	(i)	Student stipends	prime cost (PC) sum	Prime	Cost	
	(ii)	Provision of experiential training	Person.Month	12		R -
	(c)	Other costs during training (<i>specify</i>)	provisional sum	Prov	Sum	R 40 000,00
	(d)	Training venue	lump sum	lump	sum	R 32 000,00
TOTAL CARRIED FORWARD TO SUMMARY						R 312 000,00

ER NO.: PR&T/BID06/2021/22		Tweespruit Access Road; SS60	
C2.3 SUMMARY OF PRICING SCHEDULE			
TENDER NO.: PR&T/BID06/2021/22			
FOR: SPECIAL MAINTENANCE OF TWEESPRUIT ROAD: SS604/S34			
GENERAL			
C1.2	GENERAL REQUIREMENTS AND PROVISIONS	R0,00	
C1.3	CONTRACTOR'S SITE ESTABLISHMENT AND GENERAL OBLIGATIONS	R0,00	
C1.4	FACILITIES FOR THE ENGINEER	R0,00	
C1.5	ACCOMMODATION OF TRAFFIC	R0,00	
C1.6	CLEARING AND GRUBBING	R0,00	
C1.7	LOADING AND HAULING	R0,00	R0,00
SERVICES			
C2.2	DRY SERVICES		
C2.3	WET SERVICES		
C2.4	ENERGY AND OTHER SERVICES		R0,00
DRAINAGE			
C3.1	DRAINS	R0,00	
C3.2	CULVERTS	R0,00	
C3.3	CONCRETE KERBING AND CHANNELING, ASPHALT BERMS, CHUTES, DOWNPIPES,	R0,00	R0,00
EARTHWORKS AND PAVEMENT LAYERS MATERIALS			
C4.1	BORROW MATERIALS	R0,00	
C4.2	CUT MATERIALS	R0,00	
C4.4	COMMERCIAL MATERIALS	R0,00	
C4.5	ALTERNATIVE MATERIALS	R0,00	R0,00
EARTHWORKS AND PAVEMENT LAYERS CONSTRUCTION			
C5.1	ROADBED	R0,00	
C5.2	FILL	R0,00	
C5.3	ROAD PAVEMENT LAYERS	R0,00	
C5.4	STABILISATION	R0,00	
C5.5	RECONSTRUCTION OF PAVEMENT LAYERS	R0,00	R0,00
CONCRETE LAYERS			
C6.1	PAVER LAID CONCRETE LAYERS		
C6.2	SEGMENTAL BLOCK PAVING LAYERS		R0,00
MAINTENANCE AND REPAIR CONCRETE LAYERS			
C7.1	REPLACEMENT OF EXISTING JOINT SEALANT	R0,00	
C7.2	REPAIR TO CONCRETE PANELS AND CONCRETE ADJACENT TO UNCONTROLLED	R0,00	
C7.3	REMOVAL AND REINSTATEMENT OF EXISTING CONCRETE LAYERS	R0,00	
C7.4	REINSTATEMENT OF SLAB SUPPORT BY GROUT INJECTION	R0,00	
C7.5	REINSTATEMENT OF RIDING QUALITY	R0,00	
C7.6	REINSTATEMENT OF SURFACE TEXTURE	R0,00	R0,00
PRETREATMENT AND REPAIR EXISTING LAYERS			
C8.1	PRIME COAT	R0,00	
C8.2	COVER SPRAYS, FOG SPRAYS AND REJUVENATION SPRAYS	R0,00	
C8.3	TEXTURE TREATMENT	R0,00	
C8.4	RUT AND/OR DEPRESSION CORRECTION	R0,00	
C8.6	GEOSYNTHETIC CRACK SEALING	R0,00	
C8.7	PLANING	R0,00	
C8.9	REPAIR OF SURFACE DEFECTS	R0,00	R0,00
ASPHALT LAYERS			
C9.1	ASPHALT LAYERS	R0,00	R0,00
SURFACE TREATMENTS			
C10.1	GENERAL REQUIREMENTS FOR SURFACE TREATMENTS	R0,00	R0,00
ANCILLIARY ROAD WORKS			
C11.1	PITCHING, STONework, CAST IN SITU CONCRETE FOR PROTECTION AGAINST	R0,00	
C11.3	GUIDE BLOCKS AND KILOMETRE MARKERS		
C11.5	FENCING	R0,00	
C11.6	ROAD SIGNS	R0,00	
C11.7	ROAD MARKINGS AND ROAD STUDS	R0,00	
C11.8	LANDSCAPING AND PLANTING PLANTS	R0,00	
C11.9	FINISHING THE ROAD AND ROAD RESERVE AND TREATING OLD ROADS	R0,00	R0,00
GEOTECHNICAL			
C12.1	PILING	R0,00	
C12.2	GROUND ANCHORS	R0,00	
C12.3	GROUND IMPROVEMENT	R0,00	
C12.4	LATERAL SUPPORT	R0,00	
C12.5	SHOTCRETE	R0,00	
C12.6	MECHANICALLY STABILISED EARTH WALLS AND GABIONS	R0,00	
C12.7	TRENCHLESS METHODS	R0,00	
C12.8	GROUND DRAINAGE	R0,00	
C12.9	SLOPE PROTECTION MEASURES	R0,00	
C12.10	HARD EXCAVATION BY BLASTING	R0,00	
C12.11	GEOSYNTHETICS	R0,00	
C12.12	CONSTRUCTION DEWATERING	R0,00	R0,00

STRUCTURES			
C13.1	FOUNDATIONS	R0,00	
C13.2	FALSEWORK, FORMWORK AND CONCRETE FINISH	R0,00	
C13.3	STEEL REINFORCEMENT	R0,00	
C13.4	CONCRETE	R0,00	
C13.5	PRESTRESSING	R0,00	
C13.6	BEARINGS	R0,00	
C13.7	JOINTS	R0,00	
C13.8	ANCILLARY STRUCTURAL ELEMENTS	R0,00	
C13.9	STRUCTURAL STEELWORK FOR MINOR STRUCTURES	R0,00	
C13.10	PAINTING OF MINOR STRUCTURES	R0,00	
C13.11	STRUCTURAL STEELWORK FOR MAJOR STRUCTURES	R0,00	
C13.12	STRUCTURAL STEEL PROTECTIVE TREATMENT OF MAJOR STRUCTURES	R0,00	
C13.13	INCREMENTAL LAUNCHING OF BRIDGE DECKS	R0,00	
C13.14	SPECIALIST STRUCTURES	R0,00	R0,00
REPAIR AND REHABILITATION STRUCTURES			
C14.1	ACCESS FOR BRIDGE REHABILITATION	R0,00	
C14.2	CORROSION SURVEY METHODS AND TESTING OF NEAR SURFACE CONCRETE	R0,00	
C14.3	DEMOLITION AND REMOVAL OF STRUCTURAL CONCRETE AND STEELWORK	R0,00	
C14.4	SURFACE AND STRUCTURAL REPAIR OF CONCRETE MEMBERS	R0,00	
C14.5	ANCHORING OF REINFORCEMENT, GROUTING AND CRACK INJECTION	R0,00	
C14.6	SPRAYED CONCRETE FOR STRUCTURES	R0,00	
C14.7	PROTECTIVE COATINGS AND TREATMENTS FOR CONCRETE	R0,00	
C14.8	EXTERNAL BONDING OF STEEL AND CARBON FIBRE	R0,00	
C14.9	REPAIR AND REPLACEMENT OF ANCILLARY STRUCTURAL ELEMENTS	R0,00	
C14.10	JACKING OF BRIDGE STRUCTURES	R0,00	
C14.11	REPAIR OF STEEL ELEMENTS	R0,00	R0,00
QUALITY ASSURANCE			
C20.1	TESTING MATERIALS AND JUDGEMENT OF WORKMANSHIP	R0,00	R0,00
SECTION D: STAKEHOLDER AND COMMUNITY LIAISON, AND TARGET LABOUR AND TARGETED ENTERPRISES UTILISATION AND DEVELOPMENT			
D1010	TRAINING, COACHING, GUIDANCE, MENTORING AND ASSISTANCE	R312 000,00	R0,00
SUBTOTAL A		R0,00	
Work to be completed during the following 14 day contract works period exceeds 14 days			
COVID 19 COMPLIANCE PLAN:			
2,5% of Subtotal A		R0,00	
SUBTOTAL A		R0,00	

A1.1 GENERAL PREAMBLE

PART A: SPECIFICATIONS**A1.1.1 SCOPE**

The scope of each Section is given in Part A of each Section of every Chapter of this Standard Specification. Each Part A and Part B of each Section of every Chapter generally contain the following standard headings:

- Scope
- Definitions
- General
- Design by Contractor / Performance based systems
- Materials
- Construction equipment
- Execution of the works
- Workmanship

Part A of this Section A1.1 only contains definitions that are generic and which are relevant or applicable to the other Sections and Chapters of this Standard Specification.

The intention is that this Standard Specification should be compatible with the applicable Conditions of Contract. However, due to differences in the terminology and terms of the different standard contract conditions, there are instances where there may be conflict between the Conditions of Contract and the requirements given in this Standard Specification. In such instances the terminology and provisions given in the Conditions of Contract will prevail.

A1.1.2 DEFINITIONS

Definitions of various items are given in Part A of each Section of every Chapter of this Standard Specification where they are most applicable. Where relevant these definitions shall apply throughout this Standard Specification.

The definitions for the various contractual terms are given in the Conditions of Contract but as various contract conditions may be used the terminology used and the definitions of the terms may differ. The terms below are therefore defined for the purposes of interpreting this Standard Specification. In the event of any discrepancy, the terms given in the applicable Conditions of Contract shall be used. The meaning of any other contractual terms not defined below shall be as given in the applicable Conditions of Contract.

The meaning of any other words and phrases used in this Standard Specification shall be interpreted in accordance with the applicable definitions and/or descriptions given in the unabridged version of the Oxford English Dictionary.

Conditions of Contract - addresses the risks, liabilities and obligations of the contracting parties and the agreed procedures for the administration of the contract. The latest edition, or the applicable edition as defined in the Contract Documentation, of one of the following three standard conditions of contract, which have been recommended by the South African Construction Industry Development Board (CIDB) for road and bridge Works, shall apply as specified in the Contract Documentation:

- Conditions of Contract for Construction for Building and Engineering Works designed by the Employer as published by the International Federation of Consulting Engineers (FIDIC Red Book).
- General Conditions of Contract for Construction Works as published by the South African Institution of Civil Engineering (GCC).
- NEC Engineering and Construction Contract Documentation as published in the United Kingdom.

Contract - is a binding legal agreement between the Employer and the Contractor in terms of which the Works as defined in the Contract Documentation shall be carried out.

Contract Documentation - includes all the documents which define the content and terms of the Contract entered into by the Employer and the Contractor. The Contract Documentation usually consists of the following documents:

- Conditions of Contract.
- Contract Agreement.
- Drawings.
- Letter or Form of Tender.
- Letter or Form of Acceptance.
- Pricing Schedule.
- Project Specifications.
- Scope of the Works.
- Special (or Particular) Conditions of Contract.
- Standard Specification (this document) and
- any other documents forming part of the contract.

Contractor - is the person or firm named as the Contractor in the Contract Documentation and who is responsible for the construction of the Works in accordance with the applicable Contract Documentation.

Dayworks - are used to determine payment for work which cannot be quantified in specific units in the Pricing Schedule, or for additional work ordered by the Engineer during the construction period which was not foreseen at tender stage and for which no applicable rates exist in the Pricing Schedule.

Defects Notification Period - also referred to as the defects liability period or the maintenance period, or the defect correction period, is the period allowed for the discovery and notification of any defects in the Works that must be rectified by the Contractor as specified in the Contract Documentation.

Drawings - are the drawings of the Works included in the Contract Documentation and any additional or modified drawings signed and issued by (or on behalf of) the Employer in accordance with the Contract.

Employer - is the person, entity or firm named as the Employer in the Contract Documentation for whom the Works are to be carried out and who is responsible for the payment and acceptance of the Works.

Engineer - is the person, entity or firm appointed by the Employer, or another person who may be delegated to assist the Engineer in terms of the applicable Conditions of Contract, to manage aspects of the Contract and to supervise the construction of the Works in accordance with the applicable Contract Documentation. Depending on the applicable Conditions of Contract "Engineer" should be read as follows: FIDIC – Engineer
GCC – Employer's Agent NEC – Project Manager or Supervisor

Guideline documents - are technical documents which contain specifications related to certain aspects of road construction. These documents may be included, or referred to, in the Contract Documentation, either as additional specifications to be adhered to if so specified in the Contract Documentation or as additional guidelines to best construction practice for the benefit of the Contractor should he choose to follow them.

Pricing Schedule - contains the payment items required for the Works, together with the estimated quantities and the agreed rates for each payment item. The Pricing Schedule is also sometimes referred to as the bill of quantities or the schedule of quantities.

Project Specifications - contain the additional project specific requirements applicable to the construction of the Works to the required quality and standard for a particular contract.

Road reserve - the entire area, as demarcated, proclaimed or due to be proclaimed, which is reserved for a road.

Site / Site of the Works - shall mean the entire road reserve, inclusive of road junctions and property accesses, required for construction of the Works as defined by the limits of construction given in the Contract Documentation. It shall also include areas within statutory building lines where work has to be carried out and any additional lengths of road required for the placement of advanced warning road signs and/or traffic accommodation measures beyond the limits of construction as shown on the drawings. Where the following places are provided by the Employer the Site shall also include areas outside of the road reserve required for construction camps, site offices, laboratories and housing, borrow areas, spoil areas and stockpile areas. The exact extent of the limits of the construction will be verified once the Site is handed over to the Contractor.

Site Agent / Contractor's Representative / Construction Manager - the person appointed by the Contractor to act on behalf of the Contractor on the site of the Works.

Special Conditions of Contract - (sometimes referred to as the Particular Conditions of Contract) are additional Conditions of Contract which apply specifically to a particular contract.

Standard Specification - contains the standard requirements applicable to the construction of the road and bridge Works to the required quality and standard.

Taking-over Certificate - is issued to indicate completion of the Works as defined in the relevant Conditions of Contract that are applicable to the particular contract. Depending on the applicable Conditions of Contract "Taking-over Certificate" should be read as follows: FIDIC – Takingover Certificate GCC – Certificate of Completion NEC – Take over

Performance Certificate - this certificate is issued to indicate the end of the Defects Notification Period and it is also sometimes referred to the final approval certificate as defined in the relevant Conditions of Contract that are applicable to the particular contract.

Works - means all the temporary and permanent work required to be done as defined in the Contract Documentation.

Word gender interpretation - except where the context requires otherwise, words indicating one gender include both genders.

C1.1.1 PREAMBLE

The general measurement and payment conditions which are applicable to all the Chapters of this Standard Specification as well as elsewhere in the Contract Documentation, unless specified differently, are given below.

The measurement and payment of the various items required for the Works is described in the payment items which are given in Part C of each separate Section contained in the different Chapters of this Standard Specification. Each Part C of each separate Section contains a list of items that are not measured separately as well as a list of items that are measured and paid for using items specified in other Sections or Chapters.

If additional payment items are required for a particular contract they will be specified in the Contract Documentation for that contract.

The following terms relating to payment shall be applicable as specified in the Conditions of Contract and shall have the meanings given below:

- **Lump sum** - a fixed sum tendered by the Contractor which covers all his costs, incidentals, overheads and profit for providing materials and supervising and carrying out the work and/or services that are specified under the relevant pay item.
- **Prime cost sum** - a sum to cover the actual cost of the supply of materials and/or work that will be provided by a supplier and/or subcontractor that will be nominated by the Employer or a sum to cover the costs of items and/or services provided by an outside provider where the cost is not known in advance.
- **Provisional sum** - a sum to cover the actual cost of materials and/or work that cannot be clearly defined before the Contract was awarded. The Contractor will usually be asked to obtain several quotations for the materials and/or work required and submit them to the Engineer who will approve one of the quotations and instruct the Contractor to appoint the selected service provider or subcontractor. Alternatively, the Contractor may be asked to submit a price for providing the materials and carrying the work out himself for approval by the Engineer.

If alternative meanings are given in the Conditions of Contract those meanings will apply instead of the meanings given above.

C1.1.2 MEASUREMENT

C1.1.2.1 Pricing Schedule

The quantities set out in the Pricing Schedule (sometimes referred to as the bill or schedule of quantities) are estimated quantities and are used for the comparison of tenders and for awarding the contract. It must be clearly understood that only the actual quantities of work done, or materials supplied, will be measured for payment and that the scheduled quantities may be increased or decreased as provided for in the Contract Documentation.

C1.1.2.2 Measurement of completed work

a) Units of measurement

All work shall be measured in accordance with the SI System of metric units.

b) Calculation of quantities

All distances along the centre line of the road as shown on the drawings are horizontal distances. These horizontal centre line distances will be used in calculating the quantities of fill and pavement layers, as well as other items of work where applicable, for purposes of payment. All cross-sections shall be taken in a vertical plane.

All materials which are specified to be measured in a vehicle shall be hauled in vehicles of such type and size that the actual volume may be readily and accurately determined. Unless all vehicles are of uniform capacity, each vehicle shall bear a plainly legible identification mark indicating its specific approved capacity.

The quantity of bituminous materials to be paid by volume shall be measured at the specified application temperature.

All quantities shall be measured to two decimal places.

c) Measurement of structures

Quantities shall be calculated from the dimensions shown on the drawings or as authorised by the Engineer.

No deduction in volume measured for payment shall be made for the volume of any individual, or closely grouped, reinforcing steel bars, inserts, pipes and conduits which have a cross-sectional area up to and including 20 000 mm² and which are embedded in the concrete. **d) Measurement of the depth of trenches and foundation excavations**

Where trenches or foundation excavations are required below the level of mass excavations for the road prism, the depth of excavation of the trenches or foundations shall be measured along the centreline of the trench from the resultant ground level after completion of the mass excavation, unless the Engineer is satisfied that the excavation of the trenches or foundations from the original ground level or any lower level was unavoidable. Where trenches are excavated in accordance with the fill method in the completed or partly completed road prism, the depth of excavation shall be measured along the centreline of the trench from the levels at which the Engineer instructed the Contractor to commence trench excavations.

e) Measurement of monthly paid items

All items of work which are paid per month shall be paid for the month, or part thereof, during which the item has to be provided in terms of the Contract Documentation and/or as ordered by the Engineer. Measurement of any monthly paid items which have not been completed by, or which still have to be provided after, the contractual time for completion of the Works, or of the relevant section of the Works, shall not be paid for unless otherwise approved by the Employer.

C1.1.3 PAYMENT**C1.1.3.1 Contract rates****a) Computation of payment and applicability of contract rates**

In computing the final contract amount, payment shall be based on the actual quantity of authorised work done in accordance with the specifications, instructions and drawings. The contract rates shall apply, subject to the provisions of the Contract Documentation, irrespective of whether the actual quantities are more or less than the scheduled quantities.

b) No rate or price entered in the Pricing Schedule

Where no rate or price has been entered against a pay item in the Pricing Schedule by a Contractor, it shall be accepted that no compensation for such work is required, or will be paid, regardless of the final measured quantity of any work described in that pay item being required and carried out.

c) No pay item entered in the Pricing Schedule

Where, a pay item described in this Standard Specification does not appear in the Pricing Schedule for a specific contract it means that the pay item should not be required for that specific contract. However, if any item of work that is not included in the Pricing Schedule is required, and is approved by the Engineer, the Contractor shall receive reasonable compensation for such work unless anything to the contrary has been determined elsewhere. The compensation shall be determined in accordance with the provisions of the applicable Conditions of Contract with respect to additional work.

d) Prime cost and provisional sums

Any prime cost or provisional sums shall be paid in accordance with the provisions of the applicable Conditions of Contract.

C1.1.3.2 Rates to be inclusive**a) Inclusivity of rates**

The contract rates in the Pricing Schedule shall include for all costs incurred for executing and completing the Works as specified, for procuring, furnishing, placing and installing all materials, for procuring and providing labour, supervision, construction equipment, tools, wastage, transport, loading and off-loading, handling, maintenance until the item of work is taken over by the Employer, temporary work, testing, quality control including process control, overheads, profit, risk and other obligations and for all other incidentals which may not be shown separately in the Pricing Schedule but are necessary for the completion of the Works.

b) Rates to include for work carried out under partial width construction conditions and in restricted areas

No additional compensation shall be made for any work that is carried out under partial width construction conditions or is constructed in restricted narrow, short and/or confined areas. Payment shall be made strictly in accordance with the applicable contract rates.

The Contractor shall take full cognisance of all the information given in the Contract Documentation, the nature of the Works and the conditions on the Site of the Works before submitting his contract rates and, in doing so, the Contractor shall ensure that all additional costs associated with partial width construction or construction in restricted narrow, short and/or confined areas, including all costs that are associated with any changes in construction methods or techniques, construction equipment, additional labour and supervision personnel, reduced productivity and increased inefficiencies, are included in the contract rates for the relevant applicable items of work.

This Clause shall apply in full to all pay items except where these requirements may be specifically amended in each case in the Contract Documentation.

C1.1.3.3 Procurement, furnishing and placing material**a) Procuring and furnishing ... (material)**

Where any of the words "supply", "procure", "provide", "provision of" or "furnish (material)" are used in the description of a pay item, it shall mean the supply and delivery to the point of use of all materials of any kind required for the work covered by the particular pay item, including all tax, purchase costs, claims, damages, royalties and all loading and transport costs involved, except where specific pay items for loading and/or hauling the material are provided in the Pricing Schedule for that particular contract. **b) Placing material**

The phrase "placing material" shall mean the off-loading, spreading, blending, processing / in-situ recycling, watering, mixing, shaping and compacting (where specified) of the material required to construct the Works, as well as the procuring, furnishing, and applying and admixing of water; the breaking-down of oversize material, the removing of oversize material which cannot be broken down, correcting irregular or uneven surfaces or layers, the thickness of which is not to specification, finishing-off within the specified tolerances and to the specified surface finish, the refilling of test / sampling holes and protecting and maintaining the completed work. In the case of asphalt layers and bituminous seals, 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 protecting and maintaining the completed work.

The phrase "procuring, furnishing and placing" shall mean procuring and furnishing in addition to placing, all as defined above.

C1.1.3.4 Pay item descriptions

The descriptions under the pay items in the various Chapters of this Standard Specification, indicating the work for which allowance shall be made in the contract rates for such pay items, are for the guidance of the Contractor and do not necessarily include or repeat all the details of work and materials required by and/or described in the Standard Specification.

The pay item descriptions shall be read in conjunction with the relevant specifications and drawings, and the contract rates in the Pricing Schedule shall be inclusive as specified in Clause C1.1.3.2 above.

C1.1.3.5 Payment for materials on the site

Payment for materials on site shall be made as provided for in the Contract Documentation for procured materials on the site which have not yet been incorporated into the Works subject to the submission of acceptable proof of payment for the relevant materials. Proof of delivery to site shall not be acceptable as proof of payment for the materials. Where not specified in the Contract Documentation payment will be calculated at 80 % of the materials purchase price, or, in the case of crushed stone which has not been purchased but has been produced on the site, at 80 % of a fair evaluation of the cost of providing such crushed material on site.

The Employer may, at his sole discretion, allow payment under "materials on the site" in respect of articles manufactured and stored off site, subject to the submission of acceptable proof of payment for the relevant materials, subject to the submission of acceptable proof of their ownership as being that of the Contractor and subject to the articles being clearly marked with the Contractor's name, the contract number and other particulars in accordance with the Engineer's instruction.

Where payment of 80 % of the materials purchase price has been made by the Employer, the ownership of the material shall be transferred to the Employer.

C1.1.3.6 Rate-only items

An item in the Pricing Schedule against which no quantity is given but a rate only is required, the Contractor shall fill in a rate or amount which will constitute payment for work which may be done in terms of this item. Such a rate-only item is used where it is estimated that little or no work will be required under the item, or where the item is to be considered as an alternative for another item where a quantity is given, or for variations in rates of application or mix proportions in terms of Clause C1.1.4.

Work under rate-only items will be paid for only if the work has been executed in terms of a written instruction issued by the Engineer.

C1.1.3.7 Payment items from different Sections

In the Contract Documentation, whenever a payment item is specified in a particular Section and required to be used in another Section of the Pricing Schedule then the relevant payment item number will be preceded by a reference to the Section in which it is being used.

For example, the loading and hauling payment items from Section C1.7 may be inserted into the Pricing Schedule for the loading and hauling of the material required for the pavement layers which are paid for under the payment Section C5.3 as follows:

C5.3/1.7.1.1	Loading from stockpile	cubic metres (m ³)
C5.3/1.7.2.1	Hauling material for use in the Works and off-loading it on the site of the Works	cubic metre kilometres (m ³ -km)

C1.1.3.8 Reduced payments and penalty/damage amounts with respect to the contract price adjustment amount

Where provision for reduced payments, or for the deduction of penalty or damage amounts, is made in the Contract Documentation, such reduced payments shall not be deducted from the value of work done in calculating the contract price adjustment amount.

C1.1.4 VARIATION FROM SPECIFIED NOMINAL RATES OF APPLICATION OR FROM NOMINAL MIX PROPORTIONS

The various Sections of these specifications specify nominal rates of application or nominal mix proportions for materials such as bituminous materials, aggregates, fillers, stabilizing agents, paint and the like. The contract rates are based on these nominal rates of application and mix proportions.

Where such nominal rates of application or nominal mix proportions are specified, provision is made for deviations in the quantities of material in consequence of the rates of application or mix proportions specified by the Engineer in each particular case in consideration of the available materials and the conditions on the site.

Where the actual rates of application or nominal mix proportions used in the Works vary from the specified nominal rates and mix proportions, adjustment of compensation will be made either:

- as a payment to the Contractor in respect of any authorised increase in quantities which exceed those specified nominal rates of application or mix proportions (including tolerances), where such increase has been specified by the Engineer or

- as a refund to the Employer in respect of the decrease in quantities which are less than those specified nominal application rates or mix proportions (including tolerances), irrespective of whether such decrease results from an authorised decrease in the rates of application or mix proportions, or from unauthorised reductions on the part of the Contractor.

Payment for a prescribed rate of application or mix proportion shall be based on the actual rate of application or mix proportion used, provided that this does not exceed the prescribed rate of application or mix proportion, including any tolerance in the rate of application or mix proportion which is included in the Contract Documentation. If the actual rate of application or mix proportion exceeds the prescribed rate or proportion, no additional payment shall be made above the allowed tolerance limit. If the actual rate of application or mix proportion is below the prescribed rate of application or mix proportion payment shall be based on the actual rate of application or mix proportion regardless of any tolerance allowed. Notwithstanding the above, the Engineer shall be fully entitled to reject work which has not been constructed in accordance with the specifications or the rates of application or mix proportions prescribed in the Contract Documentation or by the Engineer.

The Employer shall be refunded for any decrease in the specified rates of application or mix proportions at the same rate per unit of measurement as the contract rate for additional materials required by an increase in the rates of application or mix proportions.

A1.2 GENERAL REQUIREMENTS AND PROVISIONS PART A: SPECIFICATIONS

A1.2.1 SCOPE

This Section covers matters which relate to this Standard Specification and/or the Contract Documentation as a whole. It establishes generic requirements that may also be applicable to other sections of this Standard Specification to avoid repetition in the other sections.

It includes payment items for general items that are not included elsewhere in this Chapter 1 or in the other Chapters and for dayworks that are applicable to all the Chapters.

A1.2.2 DEFINITIONS

Acceptance Quality Control - encompasses those actions carried out by the Employer and/or the Engineer to inspect, sample, test and measure each constructed part or section of the Works to determine whether the quality and workmanship is acceptable in terms of the Specifications.

Process Quality Control - encompasses those actions carried out by the Contractor to assess and control materials and construction processes to ensure that the quality of the final product/s meets all the specified requirements. It includes a quality plan with defined actions, inspections, sampling, testing and measurement for each construction process to ensure that the quality control process is carried out effectively.

Stakeholder liaison - the process whereby the Employer and the Contractor engage with interested and affected parties, in particular the local authorities, local residents, schools etc., in order to inform them how the Works will affect the local community, to discuss how any adverse effects of the Works on the local community and/or environment can be eliminated or alleviated and to provide any health and safety information that is relevant to the local community regarding construction of the Works.

A1.2.3 GENERAL

The following Clauses include specifications for various general items which are not included in any of the other specific Chapters and Sections.

A1.2.3.1 Contractor's activities in respect of property outside the road reserve provided by the Employer

The Contractor may occupy and make use of property outside the road reserve that is provided by the Employer for purposes of executing the contract, on condition that:

- The Contractor complies strictly with the requirements of such statutory provisions, particularly with respect to the matters relating to serving written notice to the owner before the Contractor enters the property.
- The Contractor shall provide the Engineer with a copy of the written notice and inform the Engineer of any further consultations that may have taken place, or additional agreements reached, with the property owner.
- The Contractor adheres to all the written agreements made by the Employer with owners of the property outside the road reserve in respect of the following matters:
 - The location, extent and use of borrow pits, haul roads, construction roads and bypasses outside the road reserve,
 - any compensation paid by the Employer or the Contractor, if applicable, for land or materials taken or for land temporarily used or occupied,
 - the reinstatement of property occupied, used, damaged or destroyed, or compensation therefor in lieu of reinstatement,
 - the procedures for the moving of fencing, services and any other items and
 - any similar matter directly related to the Contractor's activities on the property.

The Contractor shall comply with all the environmental requirements and all other current legislation and regulations which are applicable to the land outside the road reserve which is being used by the Contractor for carrying out the Works.

On completion of his operations the Contractor shall obtain from the owner concerned a written statement to the effect that:

- The Contractor has fulfilled his obligations under any written agreement that the Employer has made with the owner.
- The owner is satisfied that all property occupied, including borrow pits, haul roads and construction roads, has been properly restored and is in a satisfactory condition.
- With respect to fences, services or any other items moved, altered, damaged or affected in any way the owner is satisfied that everything has been handed back to him by the Contractor in a satisfactory condition.

All such statements shall be signed and dated and copies shall be delivered to the Engineer. The obtaining of any such written statements will not relieve the Contractor of the execution of any of his obligations to the satisfaction of the Employer or the owner or authority concerned.

A1.2.3.2**Contractor's activities in respect of property which is not provided by the Employer**

Should the Contractor use property which is not provided by the Employer, for haul roads, site offices and workshops, the Engineer's offices and laboratory, or for storing of equipment or materials required for construction or disposal, it shall be subject to the following:

- The Engineer shall agree to the use of any property selected for this purpose.
- Such property shall be physically separated from any production plant or activities and suitably fenced in.
- The area used for the aforesaid purpose shall be surveyed, and, where the land does not belong to the Contractor, he shall sign a lease agreement with the owner of such property in respect of the full period for which such property shall be used for such purpose. The lease agreement shall stipulate that the property owner shall not have any right whatsoever to any material stockpiled on such property during the duration of the contractual lease agreement.
- A lease agreement shall be concluded by the Contractor with the owner or owners of such property for the full period that such property is required. The lease agreement shall provide for possible extensions to match the duration of the contract. The lease agreements shall also provide for the contract being terminated by Contractor's default or liquidation and the resulting possibility for the lease agreement to be taken over by a succeeding Contractor.
- Copies of all lease agreements shall be submitted to the Engineer for comment prior to signature by the signing parties and copies of the final signed agreements shall be lodged with the Engineer. Notwithstanding the Engineer's comments on the conditions of a lease the Contractor shall be solely responsible for adherence to the terms of the lease agreements.
- Suitable permanent reference beacons shall be placed next to any material storage area, at the cost of the Contractor, to demarcate the storage area and, if applicable, for use by the Engineer for taking cross-sections for determining quantities.
- Only material that is to be used for the Works shall be stored on such property.
- The Contractor shall comply with all the requirements of the environmental and any other legislation which is applicable to the property being used.

On completion of his operations, the Contractor shall obtain, from the owner concerned, a written statement to the effect that:

- The Contractor has fulfilled his obligations under any written agreement that he made with the owner.
- The owner has received all the compensation he is entitled to and is also satisfied that all property that was occupied, including borrow pits, haul roads and construction roads, has been properly restored and handed over to the owner in a satisfactory condition.
- With respect to fences, services or any other items moved, altered, damaged or affected in any way the owner is satisfied that everything that was affected has been handed back to him by the Contractor in a satisfactory condition.

All such statements shall be signed and dated and copies shall be delivered to the Engineer. The obtaining of any such written statements will not relieve the Contractor of the execution of any of his obligations to the satisfaction of the Employer or the owner or authority concerned.

A1.2.3.3**Environmental management**

The Contractor shall ensure that the project complies with all the requirements that have been set out in the Environmental Authorisation (EA), the Environmental Management Plan (EMP), the Water Use Licenses (WUL) for the extraction of water as well as for working within a certain distance of watercourses and their associated specific conditions and permits.

Before any construction may commence the Contractor shall ensure that he has a copy of all licenses and permits required in terms of the EA, the EMP and for the WULs that were obtained by the Employer prior to the Contract being awarded. The Contractor shall also ensure that he obtains all other outstanding permits required to comply with the requirements of the EA, the EMP and the WULs, in particular the WUL for the extraction of the amount of water he requires from rivers and streams. The Contractor shall supply a copy of all required licenses and permits to the Engineer for his records.

Where specified the Contractor shall carry out a search and rescue of environmentally sensitive/endangered vegetation and prepare all necessary rehabilitation plans.

All Contractors are required to comply with all the applicable current rules, regulations, standards, policies and legislation, especially those contained in the following Acts and in any subsequent amendments thereto:

- The National Environmental Management Act No. 107 of 1998 (regulates duty of care principle).
- The National Water Act No. 36 of 1998 (guides the management of water and its associated resources in South Africa).
- The National Environmental Waste Act 59 of 2008.

The Contractor shall carry out all the work in accordance with the environmental legislation and authorisations which are applicable to the Contract. Permits are issued with stringent guidelines, monitoring procedures and other requirements and the Contractor shall ensure full compliance with all of them.

All waste material shall be disposed of in accordance with the applicable legislation and requirements. The Contractor shall confirm what the waste disposal requirements in the area are with the relevant provincial and local authorities before he commences his site establishment. The Contractor shall have a written waste management and disposal plan which classifies the types of unsuitable and waste material on the site to be disposed of and identifies the approved disposal sites. Hazardous waste must be collected and disposed of separately from general waste at an approved hazardous waste site.

If specified in the Contract Documentation, the Contractor shall also provide a dedicated, full time environmental officer who will be responsible for the environmental monitoring, compliance and reporting duties.

A1.2.3.4**Extension of time for delays caused by rainfall**

This Clause specifies the conditions under which extensions of time for rainfall delays will be measured.

Any delays caused by rainfall shall be determined in terms of one of the three methods given below. The applicable method for a particular contract shall be specified in the Contract Documentation. The rainfall delay determined by using the specified method shall entitle the Contractor to an equivalent extension of the time for completion without the need for formal claim procedures. (If none of the methods given below are specified in

the Contract Documentation then any claims for rainfall related extensions of time will be dealt with according to the applicable Conditions of Contract.)

Any other delays caused by exceptionally adverse weather conditions that have not already been taken into account as specified above shall be dealt with in accordance with the applicable Conditions of Contract.

The Contractor shall take cognisance of all the temperature, wind speed, moisture content and curing related limitations and/or restrictions that are applicable to some items of the Works as specified in the relevant clauses of this Standard Specification. No extensions of time will be measured or granted for any delays caused by the Contractor's compliance with these limitations and/or restrictions.

a) Method 1 (Rainfall formula)

If specified in the Contract Documentation the formula below shall be used to calculate separately the delay for each calendar month or part thereof due to rainfall. It shall be calculated each month during the period referred to in the Conditions of Contract as the time for completion of the Works (including any extension thereof that may have been granted), or until the issue date of the Taking-over Certificate, whichever is the shorter period. The delay calculated for a given month shall be used to determine the interim extension of time granted for that month. At the end of the applicable period referred to above, the aggregate of the monthly delays will be taken into account for the final determination of the total extension of time for the Contract. Such determination will not be subject to normal claim procedures.

$$V = (Nw - Nn) + [(Rw - Rn) \square X]$$

If any value of V is negative and its absolute value exceeds Nn, then V shall be taken as equal to minus Nn.

The delay for a part of a month shall be calculated by substituting pro rata values for the variables in the equation.

The symbols in the above rainfall formula shall have the following meanings:

V = Delay due to rain in calendar days in respect of the calendar month under consideration.

Nw = Actual number of days during the calendar month on which a rainfall of Y mm or more per day has been recorded.

Rw = Actual rainfall in mm for the calendar month under consideration.

Nn = Average number of days in the relevant calendar month, as derived from existing rainfall records provided in the Contract Documentation, on which a rainfall of Y mm or more per day has been recorded.

Rn = Average total rainfall in mm for the calendar month, as derived from existing rainfall records supplied in the Contract Documentation.

X = 20, unless specified otherwise in the Contract

Documentation. Y = 10, unless specified otherwise in the

Contract Documentation.

Extension of time for rainfall shall apply in addition to any other approved contract extension of time due to other causes. The total delay that will be taken into account for the determination of the total extension of time for the contract shall be the algebraic sum of the monthly totals for the period under consideration calculated to one decimal, and the delay shall be applied to the contract duration after any other caused and approved contract extensions of time have been applied. The total delay caused by rainfall shall not exceed the duration past the issue of the Taking-over Certificate. Should the grand total be negative, the time for completion shall not be reduced on account of rainfall.

The total extension of time for any calendar month shall not exceed (Nc - Nn) calendar days, where Nc = the number of calendar days in the month under consideration.

The factor (Nw - Nn) shall be considered to represent a fair allowance for variations from the average number of days during which rainfall equals or exceeds Y mm per day.

The factor [(Rw - Rn) □ X] shall be considered to represent a fair allowance for variations from the average for the number of days during which rainfall does not equal or exceed Y mm per day, but when wet conditions prevent or disrupt work.

This formula does not take into account any flood damage, which could cause further or concurrent delays and which should be treated separately in so far as extension of time is concerned. It also does not deal with other types of weather which may cause delays, for instance snowfalls, abnormally strong wind and extreme temperatures. All such delays shall be dealt with separately in accordance with the terms of the Conditions of Contract.

Accurate rainfall measurements shall be collected at a suitable point or various points on the site as approved by the Engineer and recorded each calendar day at 08h00 unless otherwise agreed to by the Engineer. The Contractor shall, at his own expense, take all necessary precautions to ensure that the rain gauges cannot be interfered with by unauthorised persons. Failure by the Contractor to submit and agree such records in good time may prejudice his entitlement to extension of time on account of rainfall.

Information regarding existing rainfall records, if available from a suitable rainfall station near the site, will be supplied in the Contract Documentation, together with calculations of rain delays for previous years in accordance with the above formula. The average of these delays will be regarded as predictable normal rain delays which the Contractor shall accommodate in his programme, and for which no extension of time will be considered.

If no suitable rainfall records are available, Method 1 will not apply.

A1.2.3.5 Handing-over of the Site of the Works

The Site of the Works will be handed over to the Contractor for construction purposes, subject to such conditions as may be specified in the Contract Documentation regarding matters such as:

- The sequence in which sections of the Works will be handed over and must be completed.
- The maximum total length of temporary deviations that will be allowed to be in operation at any time.
- The number of half or partial width construction sections that will be permitted on the Site of the Works at any one time.

- The minimum length of existing or newly completed full width, unrestricted road sections that must be open to traffic between any half or partial width construction sections.
- Any other matters relating to the Contractor's use and occupation of the road reserve.

A1.2.3.6 Health and safety

The Contractor shall always comply with the requirements of the health and safety plan, drawn up by the Contractor in compliance with all current and applicable health and safety legislation, the Employer's health and safety specification and the Contractor's own health and safety requirements to ensure that the Contractor complies fully with all current legislation and regulations as well as with any additional health and safety requirements that may be specified in the Contract Documentation. The Contractor's health and safety plan shall be developed to address all risks specific to the Works as identified in risk assessments carried out by the Contractor and/or by the Employer.

The Employer and /or his construction health and safety agent may also monitor the Contractor's compliance with the requirements stipulated in the Employer's health and safety specification as well as the requirements set out in the Contractor's health and safety plan.

A1.2.3.7 Legal and contractual requirements and responsibility to the public and the Employer

The Contractor shall comply with all the legislative and regulatory requirements of all the relevant statutory bodies pertaining to his site establishment and to the execution of the Works. The Contractor shall also comply with the requirements given in the Contract Documentation and with his legal and general obligations to the public, particularly with regard to obtaining and maintaining all the insurances and sureties required for the duration of the Contract and the Defects Notification Period.

A1.2.3.8 Tolerances

The work specified in all the chapters of this Standard Specification shall comply with the various dimensional and other tolerances specified in each case. No representation is made that the full specified tolerances will be available independently of each other, and the Contractor is cautioned that the liberal or full use of any one or more 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.

Where no tolerances are specified, the standard of workmanship shall be in accordance with normal good practice.

A1.2.3.9 Monthly reports

The Contractor shall prepare monthly reports on progress, delays incurred, plant returns, OHS and EMP compliance, staff training, empowerment, capacity building, small Contractor development, labour and staff returns and any other information required by the Employer and/or the Engineer which is specified in the Contract Documentation.

The Contractor's monthly reports shall be submitted to the Engineer at least two working days prior to the applicable scheduled monthly site meetings.

A1.2.3.10 Notices, signs and advertisements

The Contractor shall not erect any signs, notices or advertisements on the Works or the site of the Works without the written approval of the Engineer.

Details of the official contract sign boards (if any) that should be erected will be given in the Contract Documentation or issued by the Engineer. These signs are to be erected in positions determined by the Engineer not later than one month after the Contractor has been given access to the site. They shall be maintained in a clean and legible condition throughout the contract and removed immediately upon completion of the Works.

No signboards other than those specified above will be permitted on or adjacent to the Works, except that the Contractor may permit each of his subcontractors to display one signboard, and one only, of less than 2 m² at the Works office. All advertisements, notices and temporary signs shall be removed by the Contractor immediately upon completion of the Works.

A1.2.3.11 Ordering of daywork

Daywork shall be undertaken strictly in accordance with the provisions of the Conditions of Contract. No daywork shall be undertaken unless specified by the Engineer. Such a written instruction shall include a full description of the work to be carried out. Before commencing any daywork the Contractor shall obtain the Engineer's agreement regarding the estimated duration of the dayworks, the numbers of each category of staff to be employed, the materials to be used and the construction equipment and vehicles that will be required to carry out the work.

The Contractor shall provide the Engineer with a daily report that records the actual duration, numbers of staff and materials, equipment and vehicles used each day for approval of the dayworks.

A1.2.3.12 Ownership of assets and disposal of non-useable assets

Unless otherwise stated in the Contract Documentation the Employer is the owner of all existing moveable and immoveable assets in the road reserve.

Non-useable assets are assets that have reached the end of their economic life, are no longer needed or need to be replaced. A disposal plan for these non-useable assets will be given in the Contract Documentation. The Contractor shall submit rates for the disposal of each of the identified non-useable assets listed in the Contract Documentation. The tendered rates could be positive or negative depending on the cost of disposing of them against the value that the Contractor may wish to place upon them.

A provisional sum may also be provided to cover the cost of the disposal of any non-useable assets that may be identified during the construction of the Works. A record must be kept of all such non-useable assets that are disposed of. Any income derived from the sale of these assets will be offset against the provisional sum.

A1.2.3.13 Prevention of damage to nearby properties and services

All buildings that could be affected by excessive ground vibrations generated during the construction operations will be identified in the Contract Documentation, or by the Engineer, and categorised in accordance with the descriptions given in Table A1.2.3-1 below.

Before commencing any construction work on the site of the Works which involves the use of vibratory or impact compaction equipment, pavement breakers, piling equipment, pneumatic drills and hammers and excavators or overhead cranes in the vicinity of any public or privately owned buildings the Contractor shall arrange with the property owner for an inspection, and, if permitted by such owner, a photographic survey, of all the items on the property that could be affected by the construction equipment and/or construction processes that the Contractor intends to use.

Written and photographic records must be made of any existing defects, cracks or any other potential weaknesses and the Contractor shall discuss with the property owner and record in writing what preventive and/or mitigation measures that will be taken to avoid or prevent any damage from occurring to the items on the property as a result of the construction work. The Contractor and the property owner should sign and date these records and a copy shall then be submitted to the Engineer for comments if required and for record purposes.

The Contractor shall prepare a written and photographic record of any overhead services or other obstructions on or near the property boundaries such as power lines, telephone lines, fences, walls, signage etc. that could be affected by the construction activities, in particular by cranes, excavators and similar construction equipment that could encroach on the property. These records shall be given to the Contractor's safety officer and the relevant safety plans shall be amended to include preventative measures for any damage to property or any injuries to the Contractor's personnel and members of the public that could occur.

The Contractor shall note the presence of any underground pipelines which may be affected by the construction activities, in particular jointed pipes. The Contractor shall comply with the provisions of Clause A2.3.1.2d(ii) of Chapter 2 with respect to the location and protection of existing services. All vulnerable underground services shall be exposed by hand excavation so that their condition and potential vulnerability to heavy vibrations can be assessed. The Contractor shall discuss with the relevant service authority and record in writing what preventive and/or mitigation measures will be taken to prevent any damage to the vulnerable services that could occur due to the proposed compaction or blasting operations. The Contractor and the service authority owner should sign and date these proposed preventive and/or mitigation measures and a copy shall then be submitted to the Engineer for comments if required and for record purposes.

The Contractor shall use suitable construction equipment and/or modify the working methods to ensure that the maximum peak particle velocities generated by the construction equipment, as measured on the ground surface with a triaxial seismograph vibration monitor placed at the corner of the building closest to the source of the vibration, or directly above the pipeline, do not exceed the values given in Table A1.2.3-1 below:

Table A1.2.3-1: Peak particle velocity limits

STRUCTURE / PIPELINE TYPE AND CONDITION	MAXIMUM PEAK PARTICLE VELOCITY (PPV) (mm/sec measured at a frequency of 50 Hz)
Fragile buildings (old and / or poorly constructed)	2,5
Old or low quality houses	5,0
Well built houses	12,5
Concrete structures	12,5
Industrial buildings	12,5
Steel pipelines	15,0
uPVC pipelines	10,0
Asbestos cement / fibre cement pipelines	5,0

NOTE: The PPV values given in the above table are subject to review during the period that this Standard Specification is still published as a Draft Standard.

At the start of any work involving equipment that will generate ground vibrations all vulnerable structures must be monitored closely by the Contractor. If there are any signs that any damage is being caused by the ground vibrations the work shall be stopped immediately and the Engineer shall be informed. The level of the ground vibrations generated at the closest corner of the affected building shall then be measured and checked against the allowable limits given in Table A1.2.3-1 above. The Engineer shall then decide if work may continue or if the Contractor must alter his working methods to reduce the ground vibration levels.

Any damage that may occur to buildings, structures, fencing, walls, services and anything else on the property that may be affected by the construction activities shall be repaired or rectified to the satisfaction of the owner at the Contractor's expense unless the Engineer is satisfied that all the necessary and specified precautions were taken by the Contractor and the damage was unavoidable.

A1.2.3.14 Remedial work

The Contractor shall replace, repair or make good any part of the Works or any equipment or material that is found not to conform to the specified requirements, or is damaged so that it no longer conforms to the specified requirements, in accordance with the Conditions of Contract before the Taking-over Certificate will be issued.

A1.2.3.15 Routine maintenance

In addition to the Contractor's maintenance responsibility stemming from his obligations under care of the Works, the Contractor shall also be responsible for all routine maintenance of the public roads within the site of the Works and other public roads being used as detours from the date of handing over of the site until the completion of the Works. This routine maintenance responsibility shall include all the maintenance of all existing roads, road furniture, fixtures and the like and shall typically comprise grass cutting, rubbish removal, the clearing and repair of existing drainage systems, repair of existing guardrails and signs, patching, assistance with clearance at accident scenes and attending to any structural damage caused by traffic during the contract period.

In circumstances where another Contractor has been appointed by the Employer to carry out routine maintenance activities over the same section of the road, the Contractor may be required to attend meetings with the routine maintenance contractor to co-ordinate maintenance activities.

The potential exists for an agreement to be reached whereby the routine maintenance contractor may continue to perform certain responsibilities such as the cutting of grass and the collection of rubbish, in which event the Contractor shall make allowance in his construction activities and Works programme to accommodate the routine maintenance contractor and to provide reasonable access to allow him to carry out such work.

A1.2.3.16 Site meetings

The Contractor shall attend regular (at least monthly) meetings on the site with the Employer and the Engineer, at dates and times to be determined by the Employer and/or the Engineer. Such meetings will be held for evaluating the progress of the Works, compliance with the environmental management and the health and safety regulations and for discussing matters pertaining to the contract which any of the parties represented may wish to raise. To this effect the Contractor will be obliged to compile a formal monthly report, drafted in consultation with the Engineer where necessary, and to submit these monthly reports to the Engineer at least two working days before each site meeting.

A1.2.3.17 Site security

The Contractor is responsible for keeping unauthorised persons off the Site of the Works in accordance with the requirements of the Conditions of Contract. The Contractor shall therefore carefully assess the security measures of whatever nature that may be required at the location of the Engineer's site office and laboratory, the Contractor's offices, stores and workshops, the Site of the Works including quarries, borrow pits, stockpile sites and manufacturing yards as well as any traffic accommodation site facilities and equipment which may be placed on the approaches to / exits from the Site of the Works.

The Contractor shall then make all necessary arrangements to provide adequate security measures which will prevent access to the Site of the Works and to the Contractor's and Engineer's site facilities by any unauthorised persons and will also prevent damage to, or theft of, any facilities, equipment, plant, materials and parts of the Works which have not yet been handed over to the Employer.

The security measures provided for the Engineer's site offices and laboratories, and for the Engineer's site accommodation situated on or adjacent to the Site of the Works, shall include security fencing and gates, security lights and burglar alarm systems linked to an armed response company and a night watchman.

The security measures provided for the Engineer's rented housing shall consist of an acceptable burglar alarm system linked to an armed response company.

A1.2.3.18 Stakeholder liaison

The initial stakeholder liaison required will normally be undertaken by the Employer and/or the Engineer. The outcomes and agreements resulting from all such stakeholder liaison will be taken into account and included in the Contract Documentation. This process may involve the establishment of a Project Liaison Committee (PLC) and the employment of a Project Liaison Officer (PLO) by the Employer.

When the Contract has been awarded the Contractor shall undertake further stakeholder liaison to develop and manage relationships with all stakeholders, communities and individuals who are, or who may be, impacted by the Works. The stakeholder and community liaison shall be carried out in accordance with the Employer's social facilitation principles and processes where provided.

The Contractor shall also identify all other potential stakeholders in addition to those already identified in the Contract Documentation. Stakeholders include the road users who will be affected by the Works, pedestrians and non-motorised traffic that may need to traverse or cross the site of the Works as well as some or all of the following persons, parties or entities:

- Relevant Provincial departments.
- Relevant Municipal departments.
- Traditional authorities.
- Community interest groups.
- Organised youth representation.
- Organised women representation.
- Organised disabled people representation.
- Organised labour representation.
- Other structured community groups such religion, education, farming, etc.
- Transport industry forums, e.g. Bus and taxi organisations.
- Business sector forums.
- Road user forums.
- Ratepayers organisations.
- Environmental interest groups.
- Road safety interest groups.
- Ward committees.
- Any other recognised relevant and representative structure.

As part of the stakeholder liaison process the Contractor shall:

- Listen to and record the stakeholder's concerns regarding how they may be affected by the Works and to inform them on what measures the Contractor can and will take to alleviate their concerns and mitigate any adverse effects of the Works that are identified.
- Inform and educate all affected parties about the safety risks associated with the Works in so far as the Works will impact on the local road users, residents and school children.

The Contractor shall analyse the influence of all stakeholders on the project and develop strategies to communicate with them and to manage competing expectations so that he can mitigate issues that would otherwise delay the project. All stakeholders shall be provided with relevant information about the Works via community meetings, newspaper advertisements, radio broadcasts, electronic communication media and information leaflets as appropriate.

Where a PLC has been established by the Employer, the Contractor shall use the PLC as the official communication channel, with the assistance of the PLO where one has been appointed by the Employer/Engineer. The Contractor shall delegate someone to participate in the PLC meetings and to assist and/or hold the PLC accountable for the organisation of community meetings and the effective dissemination of relevant information to all stakeholders and affected communities.

The stakeholder liaison process may also include issues related to the employment of local labourers and sub-contractors chosen by the Contractor and/or employed in accordance with any targeted labour recruitment and/or targeted enterprises selection requirements that may be specified in the Contract Documentation. All labour and sub-contractor related matters, and any associated risks, are and shall remain the responsibility of the Contractor irrespective of the Employer's and/or Engineer's role/assistance provided in establishing a PLC and/or providing a PLO.

A1.2.3.19 Temporary drainage and dewatering

The Contractor shall be responsible for the provision of temporary drainage works such as drains, open channels, banks etc., and for providing and operating temporary pumps and such other equipment as may be necessary for adequately protecting, draining and dewatering the Works and any temporary Works, deviations and detours on existing roads if required.

The Contractor shall ensure that any temporary drainage works and/or dewatering operations do not cause erosion or flooding of other parts of the Works or adversely affect the stability of any excavated trenches or slopes. If the Contractor becomes aware of any potential signs of slope / trench instability he shall immediately suspend the work and withdraw all personnel from the area and fence and/or barricade it to prevent access. The Contractor, who remains responsible for compliance with the OHS regulations, shall then propose, design and implement all measures required to rectify the situation.

Unless specifically reflected in the pricing schedule, all such measures shall be deemed to be included in the rates for the Works.

A1.2.3.20 Road safety audits

If stated in the Contract Documentation, two types of road safety audits shall be carried out on the Contract, namely a work zone traffic management audit before any construction work commences and a pre-opening stage road safety audit when the construction work is almost complete.

a) Work zone traffic management audit

Before any construction work commences the Contractor shall appoint an independent qualified road safety auditor to carry out an audit which shall be undertaken in terms of the requirements given in the latest version of the South African Road Safety Audit Manual (SARSAM) for a Stage 4 construction work zone traffic management audit.

The auditor / audit team shall, when carrying out this audit, recognise the guidance given to contractors in the South African Road Traffic Signs Manual, Volume 3, Chapter 13 as well as the traffic accommodation specifications given in Section A1.5 of this Chapter.

Particular attention shall be paid to the following aspects:

- The appropriateness of the proposed traffic management scheme, especially in transition areas.
- Adequacy of the advance warning arrangements.
- Proposed work zone speed limits.
- Conflicts between permanent and temporary road signs and any other road features.
- Any aspects of the proposed signage, barrier and detour layouts that could possibly be misread by / be confusing to road users or may violate normal driver expectancy.
- The likelihood of dust and/or mud obscuring safety signage.
- The appropriateness and adequacy of any proposed vehicle restraint systems / barriers, the installation thereof and the safety of the terminals.
- Adequate provision for pedestrians and public transport vehicles if applicable.
- Conflict points between construction vehicles and the public road users.
- The effect, and mitigation of, traffic congestion during peak periods.
- The effect of an accident if it occurs within the deviation areas.

b) Pre-opening stage road safety audit

Just before the construction work is completed the Contractor shall appoint an independent qualified road safety auditor to carry out an audit which shall be undertaken in terms of the requirements given in the latest version of the South African Road Safety Audit Manual (SARSAM) for a Stage 5 pre-opening stage road safety audit.

The auditor / audit team shall, when carrying out this audit, recognise the guidance given to contractors in the South African Road Traffic Signs Manual, as well as the construction specifications for road signs, guardrails and road markings given in Chapter 11 of this Standard Specification.

Particular attention shall be paid to the following aspects:

- Has sufficient provision been made for all the different users of the road project?
- Has adequate protection been provided for all potential roadside hazards?
- Are there any variations between the approved design and the constructed Works which may adversely influence the safety of the road users?
- Are all the road signs, road markings, road furniture and lighting arrangements, if applicable, correctly erected and positioned in accordance with the specified requirements and do they meet the required specified standards?
- Have all temporary traffic accommodation arrangements, construction equipment and construction materials / debris that may be a direct physical hazard or may cause any road user confusion been removed or safely repositioned?

A1.2.3.21 Water

The Contractor shall make his own arrangements for procuring, transporting, storing, distributing and applying the water needed for construction and other purposes, except where otherwise specified.

Obtaining water from streams, rivers, dams or boreholes shall be subject to the Contractor obtaining the required permit from the relevant authority.

Obtaining water from a municipal or other water supply authority shall be subject to the Contractor entering into a supply agreement with the relevant supply authority.

The suitability of water for construction purposes shall be determined in accordance with the acceptance parameters given in the following clauses of this Standard Specification:

- Water for backfilling trenches and for concrete required for services work – Clause A2.1.5.3 of Chapter 2.

- Water for testing pipelines – Clause A2.3.8.3b) of Chapter 2.
- Water for earthworks and pavement layers – Clause A4.1.5.18 of Chapter 4.
- Water for stabilisation of pavement layers – Clause A5.4.5.6 of Chapter 5.
- Water for concrete pavements – Clause A6.1.5.2 of Chapter 6.
- Water for diluting bitumen emulsion – Clause A10.1.5.6 of Chapter 10.
- Water for grout – Clause A12.3.5.1 of Chapter 12.
- Water for shotcrete – Clause A12.5.5.4 of Chapter 12.
- Water for concrete structures – Clause A13.4.5.3 of Chapter 13.
- Water for cementitious repair mortar or concrete – Clause A14.4.5.3 of Chapter 14.
- Water for sprayed concrete – Clause A14.6.5.3 of Chapter 14.

A1.2.3.22 Wayleaves/Agreements and Permits

a) Wayleaves/Agreements (Planning and Design Approvals)

The Employer will be responsible for obtaining the necessary planning and design approvals for the work described in the Contract Documentation or shown on the drawings. In terms of this Standard Specification such approval is deemed to be granted in accordance with the terms of what are referred to as “wayleaves”. Before commencing any work the Contractor shall ask the Engineer to obtain all the applicable wayleaves from the Employer.

If specified in the Contract Documentation, the Contractor shall be responsible for applying for certain wayleaves and, if so specified, the Contractor shall determine and comply with the wayleave application processes specified by the road authority responsible for the road reserve and by any other service authority/provider whose services are known to exist in the road reserve.

The applications for such wayleaves shall be submitted timeously by the Contractor to ensure that wayleaves can be issued before the work is programmed to start. Applications for wayleaves shall be submitted with the relevant design drawings.

The Contractor shall pay all fees and charges for wayleaves to the road authority responsible for the road reserve or to any other service authority/provider whose services exist in the road reserve.

The Contractor shall comply with all conditions pertaining to the approval of wayleaves that may be imposed by the road authority or by the relevant service provider.

b) Permits and other approvals (Construction or Work Permits)

The Contractor shall be responsible for obtaining the necessary approvals, permissions or authorisations to carry out the work described in the Contract Documentation. In terms of this Standard Specification such approvals, permissions or authorisations are deemed to be granted in terms of what are referred to as “construction permits” or “work permits”. The Contractor shall be responsible for obtaining the necessary construction or work permits from all the relevant road authorities or service authorities/providers whose services are known to exist in the road reserve.

The Contractor shall determine and comply with the construction permit application processes specified by the road authority responsible for the road reserve or by any relevant service authorities/providers.

The applications for construction and/or work permits shall be submitted to the relevant road authority or service authority/provider timeously to ensure that construction permits can be issued before the Works are programmed to start. Applications for construction and/or work permits shall be submitted with the relevant drawings.

The Contractor shall pay all fees and charges for construction and/or work permits to the road authority responsible for the road reserve or to the relevant service authority/provider.

The Contractor shall comply with all conditions included in the construction and/or work permits that may be imposed by the road authorities or by the service authorities/providers. Such conditions may include, but are not limited to:

- Giving adequate notice of commencement of work.
- Providing adequate supervision of the Works and compliance with health and safety regulations.
- Compliance with environmental and water use requirements.
- Providing access to and conducting progress inspections required by the road authority or service provider.
- Specific requirements for road and service crossings.
- Specific requirements for location of services and/or co-location of services for multiple service providers.
- Specific requirements for temporary and permanent reinstatement of services, road crossings etc. Provision of adequate notice of and carrying out of inspections on completion of the Works.
- Provision of record drawings and documentation to the relevant authorities, service authorities/providers and to the Employer if required.

The Contractor shall familiarize himself with, and comply with, all local by-laws applicable to work in the road reserve.

Only work described in a construction/work permit may be done and only at the locations covered by the permit. The work described in the permit shall commence and shall be completed within the period stipulated by the road authority or service authority/provider, failing which the construction/work permit may lapse and re-application for the permit will then be required.

A1.2.3.23 Work in restricted areas

The Contractor shall programme the work and select the working methods and equipment taking due cognizance of all restrictive conditions indicated in the Contract Documentation regarding the location, size and spacing of the various construction areas, any specific work sequences that may be required and any traffic accommodation or other factors that may affect the programme of work.

As stated in Clause C1.1.3.2 no additional compensation shall be made for work that could be considered as partial width construction or for construction in restricted narrow, short and/or confined areas unless otherwise specified in the Contract Documentation.

A1.2.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

A1.2.4.1 Designs and drawings for the permanent Works provided by the Contractor

Where the Contractor is required to prepare any designs and/or drawings for the permanent Works they shall be prepared as specified below and in accordance with any further requirements that may be specified by the Engineer. The drawings shall comply in all respects with the requirements of the Employer. If provided by the Employer, the Contractor shall use the master standard drawing sheets and schedules as masters for all drawings prepared by him and submitted to the Engineer for consideration.

The Contractor shall submit to the Engineer for comment two A0 paper copies of each drawing and all relevant design calculations prepared by, or on behalf of, the Contractor and signed by a registered competent person. Electronic versions of the drawings and all relevant design calculations should also be provided in the specified format. The standard of detailing and quality of print shall be the same as those of the drawings supplied to the Contractor under the Contract Documentation.

Accepted designs and/or drawings shall form an integral part of the Contract Documentation. Any designs and/or drawings not accepted by the Engineer will not be permitted on the site of the Works for construction purposes and/or used for the manufacture of any item. Notwithstanding the acceptance and/or signing of the designs and/or drawings by the Engineer or the Employer, the Contractor shall take full responsibility for all details, discrepancies, omissions, errors, etc. in respect of the said designs and/or drawings as well as for all consequences arising therefrom.

The Contractor shall submit only fully completed and checked designs and/or drawings in accordance with this Standard Specification and shall not be entitled to claim for any delays resulting from the submission of incomplete or incorrect drawings. Unless already specified elsewhere in the Contract Documentation, the Contractor shall agree with the Engineer the amount of time required by the Engineer to consider and comment on the designs and/or drawings. The same time frame requirements will apply to any resubmissions of the designs and/or drawings that may be required.

A1.2.4.2 Designs and drawings for temporary works provided by the Contractor

The Contractor shall be responsible for the design and execution of all temporary work and structures that are required for the construction and completion of the Works. This includes all deviations, temporary drainage and flood diversion or control measures, drilling and blasting, excavations, scaffolding, shuttering, shoring, support structures and all other work that is necessary for the construction of the permanent Works.

The design of all such temporary work must be carried out by experienced persons who are suitably and, where required by legislation, professionally qualified to carry out such designs. The Contractor shall ensure that the design of all temporary works has been carried out in accordance with all relevant legislation and that the construction / erection of the temporary works is carried out by and supervised by competent, experienced persons.

All design calculations and drawings required for the temporary works shall be submitted to the Engineer for comment when the Contractor is requested to do so. Unless already specified elsewhere in the Contract Documentation, the Contractor shall agree with the Engineer the amount of time required by the Engineer to consider and comment on the designs and/or drawings. The same time frame requirements will apply to any resubmissions of the designs and/or drawings that may be required.

A1.2.4.3 Performance based systems

The specifications pertaining to the provision and implementation of performance based systems are given in Part D of the various Sections of each of the Chapters of this Standard Specification where applicable.

A1.2.5 MATERIALS

A1.2.5.1 General

The Contractor shall confirm the quantities of all manufactured items or materials required for the completion of the Works with the Engineer before finalizing any orders or production processes.

The Contractor, before using manufactured articles or materials that are required to comply with any specification, shall furnish the Engineer with certificates showing that the materials do comply with that specification. Where so specified, materials shall bear the official mark of the appropriate authority. All materials and products which should comply with a South African National Standard Specification (SANS) shall carry the certification mark of a SANAS accredited certification body.

Samples ordered or specified for inspection, comment and/or approval by the Engineer prior to the manufactured articles or materials being ordered, procured or used in the Works shall be delivered to the Engineer's site office at least seven calendar days, or such longer period that may be specified in the Contract Documentation, before such comment or approval is required.

Unless otherwise specified, all proprietary materials shall be used and placed in strict accordance with the relevant manufacturer's current published instructions. Agrément certified products shall be used and placed in accordance with their Agrément certification criteria.

All manufactured articles or materials supplied by the Contractor for the permanent Works shall be new and unused unless stated otherwise in the Contract Documentation. Manufactured articles and materials to be included in the Works shall not be damaged in any way and, should they be damaged during manufacture, delivery or by the Contractor during handling, transportation, storage, installation or testing they shall be replaced, or repaired to comply with the original specification, by the Contractor at his own cost.

All places where articles and materials are being manufactured or obtained for use in the Works, and all the processes in their entirety connected therewith, shall be open to inspection by the Engineer (or other persons authorised by the Engineer) at all reasonable times.

A1.2.5.2 Mix designs

Unless otherwise specified in the Contract Documentation, the Contractor shall be responsible for the design of all material mixes. The Contractor shall make allowance for the material mix design approval process in the Contractor's programme. Before commencing with the associated construction activities, the Contractor shall be responsible for the following procedures in connection with the design of material mixes:

- Sampling and testing of construction materials to determine their properties and suitability for use in materials mixes and in the Works, all according to relevant standard methods and procedures.
- Production of the required mix designs - in conjunction with the Engineer if required.
- Production of laboratory, production/plant and/or trial mixes.
- Adjustments to the mix designs and reproduction of the required laboratory, production/plant and/or trial mixes.
- Construction and testing of trial sections and/or other trials as required.
- Submission of duplicate samples and the proposed mix designs to the Engineer for review and comment, and approval if so specified in the Contract Documentation.
- Verification of the mix designs, trials and/or trial sections before commencing with the permanent Works.

The Contractor's mix designs shall be submitted to the Engineer using the Employer's standard forms where they are provided, or in any other format which includes all the relevant information and which is acceptable to the Engineer.

A1.2.6 CONSTRUCTION VEHICLES AND EQUIPMENT

The Contractor shall submit a list of the construction vehicles and equipment to be used on the site of the Works to the Engineer for review before the commencement of the Works.

The Contractor shall ensure that all construction vehicles and equipment used on the site of the Works and on public roads shall comply with all current legislation and regulations.

The Contractor shall also ensure that all construction vehicles and any equipment that may travel on roads used by the public are:

- Suitable for their intended purpose.
- Maintained in good working order.
- Inspected daily by the operator or driver - the inspection records shall be kept in the vehicle or item of equipment.
- Equipped with the following:
 - A flashing amber LED light / light bar of an approved design. The flashing light / light bar shall be mounted so that it is clearly visible in daylight from all directions. They shall be switched on continuously while the vehicles are on site, are manoeuvring in or out of traffic or are travelling or parked alongside roads open to public traffic.
 - A warning sign with the wording CONSTRUCTION VEHICLE in retro-reflective Class 3 red letters at least 200mm high on a retroreflective Class 3 white background which shall be mounted in a visible position at the rear of every vehicle or any item of construction plant which may travel on roads used by the public.
 - An automatic acoustic reversing alarm.

The Contractor shall confirm to the Engineer in writing that all the construction vehicles and mobile equipment to be used on the site of the Works comply with all the legal and other specified requirements before any vehicles and construction equipment will be permitted to commence operating on the site of the Works.

A1.2.7 EXECUTION OF THE WORKS

A1.2.7.1 Programme of work

a) General

This Clause describes the requirements for the preparation, submittal, update and revision of the Contractor's programme. These requirements are in addition to, or expand upon, the requirements for programming the Works which are given in the Conditions of Contract or elsewhere in the Contract Documentation.

The Contractor's programme shall be used by the Contractor to plan and execute the Works. The programme will also be used by the Engineer to monitor progress and it may be used as the basis for the assessment of extensions of time and the effect of any delays on the progress of the Works.

The Contractor's original baseline programme shall be reviewed and updated monthly, or as required in the Contract Documentation, to ensure that the programme always reflects the actual progress of the Works.

Scheduling of work and monitoring of progress can be done to various degrees. Extensive scheduling has its benefits in controlling progress and in the evaluation of delay claims, but the amount of effort involved in this can be considerable and may not be required on all contracts, especially on relatively small Works. This specification makes provision for two schemes: Scheme 1 where the programme may be kept relatively simple, and Scheme 2 with more extensive requirements for complex or high value projects.

Whether a Scheme 1 or Scheme 2 programme is required will be indicated in the Contract Documentation. Scheme 1 will apply if nothing is indicated in the Contract Documentation. If only a Scheme 1 programme is indicated the Contractor shall still be able to incorporate some or all the requirements applicable to Scheme 2 in the programme if he so wishes.

b) Scheme 1

The Contractor's programme shall be in the form of a bar chart with logic links identifying critical activities forming the critical path. The Contractor is encouraged to prepare the programme using scheduling software but this is not a requirement.

All significant activities must be reflected on the programme. The degree to which these activities are broken down into sub-activities is left to the discretion of the Contractor, but it is pointed out that too little detail will impact on the degree to which the programme can be used to manage time on the project, and to assess the impact of any delays.

The equipment and labour resources which are compatible with the planned rates of production and activity durations should be allocated to all the major programmed activities.

c) Scheme 2

The initial / first programme to be submitted by the Contractor at the start of the contract, within the time limits specified in the Contract Documentation, shall include all the activities required for at least the first three months of work in detail, and need only show the major activities for the balance of the work. The Engineer will then comment on the Contractor's initial programme and the Contractor shall revise the programme if necessary.

Within six weeks of the commencement of the Works on site the Contractor shall submit a full programme which covers all the activities required to complete the full Works in the necessary detail (unless the initial programme already included all the work in detail). The Engineer will then comment on the Contractor's full programme and the Contractor shall revise the programme if necessary.

The initial and full programmes should be drawn up using the software specified in the Contract Documentation. If no such software is specified, the Contractor should use generally acceptable software intended for the creation of network diagrams and linked bar charts, and which can produce the schedules which may be required in the Contract Documentation. If required, a licenced copy of such software should be provided to the Engineer for the duration of the contract.

The full programme shall make provision for and show at least the following:

- Logic links identifying critical activities forming the critical path.
- The activities in all work packages including those by the Contractor's sub-contractors and suppliers, service owners, any subcontractors and suppliers directly employed by the Employer and others.
- The equipment resources required for each activity and which are compatible with the planned rate of production.
- The labour resources required for each activity and which are compatible with the planned rate of production.
- The earliest and latest start and finish dates for every activity in each work package. Activities shall include all scope activities and any activities or time durations expected in addition to scope activities.
- Access dates required on each phase or section of the Works.
- The earliest and latest start and finish dates for each phase or section of the Works, including dates when the Contractor plans to complete work to allow any other sub-contractors, suppliers or service owners the necessary access to do their work.
- Programme milestones and other key dates.
- Allowances for rain delays, holiday periods and the Contractor's pay weekends.
- Dates by which designs and drawings for the temporary and permanent Works and the mix designs which are to be produced by the Contractor will be submitted to the Engineer for comment and dates by which comments on such design work, drawings and mix designs from the Engineer will be required by the Contractor, allowing time for submittals, re-submittals and reviews.
- Dates by which samples of manufactured articles or materials to be produced by the Contractor will be submitted for approval by the Engineer and dates by which approval of such samples will be required by the Contractor, allowing time for submittals, re-submittals and reviews.
- Procurement periods and delivery dates for the major items of plant and materials to be incorporated into the Works.;
- Occupation dates and re-commissioning dates of utilities and services affected by the Works.
- Dates by which major work items will be ready for testing by the Engineer or the Employer.
- Details and dates of any information required from the Engineer or the Employer.
- The work contained in all defined provisional sums.
- Activities representing the likely work content of undefined provisional sums, complete with logic links but with durations set to zero (unless specified otherwise or until the scope of the work is defined).
- Commissioning periods.
- Provisions for float, time risk allowances, quality control procedures, health and safety requirements and any other requirements that may be set out in the Contract Documentation.

The main activities, and all activities where any delay is likely to lead to a delay in the completion of the Works, shall be resourced. The resourcing input should contain details of the Contractor's resource requirements in terms of manpower, gang sizes, tradesmen, production rates, items of construction equipment and materials and quantities of work allowed for in sufficient detail to explain the Contractor's assumed rates of production and activity durations.

Details of schedules to be provided with the programme may be stipulated in the Contract Documentation. Typical schedules that may be requested include, inter alia, equipment and labour resource deployment schedules, cash flow schedules and schedules of critical activities.

d) Updating and revising the programme

The Contractor shall submit an updated programme at the end of every month which indicates the current status of the Works. The Contractor shall show the updated programmed completion date on this updated programme, compared with the completion date on the previous update.

When using a Scheme 2 programme the Contractor shall provide with each monthly programme update a schedule that compares the current float values on all key activities with the float values on corresponding items on the programme of the previous month. Brief reasons for substantial deviations should be provided on the schedule. The Contractor shall also submit a written report giving more detail for differences in progress and describing what actions will be taken to make up for any lost time.

The Contractor shall revise the programme when instructed to do so by the Engineer in accordance with the requirements of the Conditions of Contract or when the Contractor is aware that the programme no longer reflects the way in which the Contractor plans to execute the remaining work. Failure to do so will compromise the extent to which the programme may be used to evaluate any delays and any extension of time that may be due.

The revised programme shall introduce changes to the production rates if the production rates being achieved on site differ notably from the programmed production rates. The revised programme should reflect any actions, and any changes to the equipment and labour resources, that the Contractor intends to implement to address slippage on the programme. Such actions could include the provision of additional resources, a change in the sequence of work, a change to the work methods, etc.

A1.2.7.2 Setting out of the Works and the protection of beacons

The Contractor shall check the condition of all reference and level beacons provided and shall satisfy himself that they have not been displaced and that they are all correct with respect to both their position and level. If beacons have been destroyed, displaced or damaged before the site is handed over to the Contractor, the Engineer will arrange to have new beacons installed, unless such beacons are declared non-essential. A beacon which has been displaced shall not be used unless its true position and level have been re-established and the new values verified by the Engineer.

The Contractor shall take care that property beacons, trigonometrical survey beacons or setting-out beacons are not displaced or destroyed without the consent of the Engineer. Property beacons and trigonometrical survey beacons that have been displaced or destroyed during construction activities shall be replaced by a registered land surveyor, who shall certify such replacement, all at the Contractor's cost.

In cases where the displacement of or damage to property beacons or trigonometrical-survey beacons is unavoidable, the Contractor shall notify the Engineer in good time so that he may arrange to have such beacons suitably referenced and reinstated.

Where a beacon is likely to be displaced during construction operations, the Contractor shall establish suitable reference beacons at locations where they will not be displaced during construction. No beacon shall be covered over, displaced or destroyed before accurate reference beacons have been established and details of the position and levels of such beacons have been submitted to and accepted by the Engineer. The Contractor's reference beacons shall be of an acceptable quality and durability sufficient to ensure that they remain in the correct position and level for the duration of the work for which they are required.

To ensure beyond all doubt that the complex elements of the road, such as traffic interchanges, structures and other important features are located correctly, the Contractor shall check all setting-out by a second method. The Engineer may at any time request the Contractor to submit proof that his setting-out has been satisfactorily carried out and checked.

To protect beacons, the boundary fences of the road reserve shall be splayed at corners to avoid the use of corner posts in the same position as property or trigonometrical survey beacons.

Accurate control of line and level shall be provided by the Contractor at all stages of construction. In respect of the road itself, control shall be provided at 20 m intervals or at such closer intervals as may be required by the Contractor to meet the specified tolerances or as may be directed by the Engineer for horizontal and vertical curves. Wherever necessary, but particularly on completion of the fill and the base layer, the Contractor shall re-establish stake-line pegs at sufficiently close intervals to determine accurately the position of the edges of the base layer, surfacing and any kerbing, guardrails, road markings and other road elements that must be accurately placed.

The checking of any surveys, setting out, lines or levels by the Engineer shall not relieve the Contractor of his responsibility for the correct survey and setting out and for the construction of the Works to the lines and levels specified in the Contract Documentation.

A1.2.7.3 Services

The specifications relating to the location, identification, protection of and/or moving and reinstating of existing services that may be affected by the construction of the Works are given in Clause A2.1.3.2 b), c) & d) of Chapter 2.

A1.2.7.4 Work on, over, under or adjacent to utilities

All work carried out on, over, under or adjacent to utilities shall be carried out strictly in accordance with the latest edition of the official specifications of the utility owner, a copy of which will normally be included in the Contract Documentation. Where no such copy is included in the Contract Documentation, or where the copy included in the Contract Documentation is amended or superseded by another, the Contractor shall obtain the latest edition from the utility owner, which shall be kept on the site, before any work of this nature is commenced.

The Contractor's attention is drawn particularly to the requirements contained in the Contract Documentation, or provided by the statutory authority, regarding the approval that must be obtained from the utility owner for:

- Issuing a work permit.
- Allowing occupation of its property.
- All particulars of programmed activities during such occupation.
- Approval of the Contractor's work and/or construction methods.
- The design and/or specifications of any temporary Works that may be required.
- All measures required to protect the utilities that may be affected by the construction of the Works.

A1.2.7.5 Use of explosives – compliance with legislation and regulations

The Contractor shall ensure that he complies fully with all current legislation and regulations pertaining to the manufacture, purchasing, transport, storage and use of explosives, including:

- The latest version of the Explosives Regulations R 1604 dated 08th September 1972 issued under the Explosives Act (Act No. 26 of 1956 as amended in R 2371 dated 14th December 1973 and in any further subsequent amendments that have been issued up until the start date of the Contract.
- The latest version of the Explosives Regulations R 109 dated 17th January 2003 issued under Section 43 of the Occupational Health and Safety Act (Act No. 85 of 1993) as amended in any amendments that have been issued up until the start date of the Contract.
- The latest version of the Explosives Act No. 15 of 2003 and as amended in any amendments that have been issued up until the start date of the Contract.
- The latest versions of all other applicable national, provincial or municipal legislation, regulations and by-laws.

Specifications for blasting shall be in accordance with the requirements in Section A12.10 of Chapter 12.

A1.2.8 WORKMANSHIP

The quality of the workmanship, products, elements and goods provided by the Contractor shall be controlled by a process control system executed by the Contractor as well as by a system of acceptance control executed by the Employer, the Engineer or any other appointed agent as specified below. This quality assurance process, including the liability for the payment of the testing required, is specified in Chapter 20 of this Standard Specification.

A1.2.8.1 Process quality control

The onus rests with the Contractor to produce work and products which comply with the characteristics and requirements of the specifications and drawings in all respects. The Contractor shall institute a quality management system and provide experienced engineers, technicians, foremen, inspectors and other technical staff, under the control of a designated quality manager, to give effect to and manage the quality management system.

Where any performance based specifications apply, the Contractor shall institute a quality management system that will ensure and demonstrate that the required performance standards have been met and, where applicable, will continue to be met for any period which has been specified in the Contract Documentation.

The quality management system shall outline the minimum requirements and actions to be taken during the construction of all elements of the Works and shall include monitoring of the various properties of the elements of the Works using either a fully ISO certified quality assurance system or an appropriate quality management system based on recognised sampling and testing principles.

For continuous concrete and asphalt production using mixing plants the Contractor shall augment the quality management system by the use of appropriate automated equipment capable of producing continuous measurements and data printouts for the relevant mix parameters such as mass of mix components, production and storage temperatures, moisture contents etc. during the mixing / production process. All the measurement information shall be kept for the duration of the Contract and the Defects Notification Period and it shall be made available to the Engineer when requested.

The Contractor shall carry out testing and measurement in accordance with the requirements specified in the Contractor's quality management system to confirm the conformance of the Works with all the relevant requirements and specifications.

Although it is not a requirement for the Contractor to conduct regular tests and measurements on commercially produced products bearing the SANS, or any other internationally recognised, specification for products such as cement, road-lime, paint, bitumen, steel pipes, sealants and bridge bearings etc. the quality of such materials and products shall nevertheless be checked on a regular basis in liaison with the Engineer. The costs for any such sampling, tests and measurements shall be borne by the Employer in the event of compliance with the requirements and specifications. In the event of non-compliance with the requirements and specifications the costs for any such sampling, tests and measurements and subsequent corrective or remedial actions shall be borne by the Contractor.

All measurements and test results shall be submitted, without delay, to the Engineer on the completion of each element of the Works. Should the sampling, testing and measurements for any end product be carried out by the accredited combined laboratory, or any other accredited laboratory or institution, and prove compliance with the specifications, the Engineer may accept these results for acceptance control purposes at the cost of the Employer.

In the event of method specifications being applicable for the construction of certain layers, products or elements, the Contractor shall follow the proposed methodology given in a method statement that has been commented on and/or accepted by the Engineer. Where applicable the methodology to be used and the acceptability of the work / product shall be demonstrated by means of an appropriate trial section carried out by the Contractor. Any subsequent deviation from the proposed methodology shall be submitted to the Engineer for comment prior to implementation.

All completed elements of the Works shall be submitted to the Engineer for written acceptance and the Contractor shall not cover up any completed work prior to such acceptance being issued. The Contractor shall plan, and make arrangements for, the submission of work for acceptance control in a manner which will afford the Engineer a reasonable and timeous opportunity for inspection, testing and measurement of the Works.

The Contractor shall agree all the process control sampling, testing, measurement and approval processes with the Engineer for each element of the Works before commencing work. Regardless of the acceptance of any materials or products based on the Contractor's process control the Contractor shall remain fully responsible for any defective material, product or plant/equipment used in the temporary and permanent Works.

A1.2.8.2 Acceptance quality control

Acceptance quality control shall be conducted by the Employer and/or the Engineer and it shall consist of visual inspections, sampling, testing and measurements in terms of the methods and procedures specified in Chapter 20 of this Standard Specification and/or in the Contract Documentation in order to ensure that the Contractor complies with all his obligations prior to the acceptance of and payment for the Works.

The properties, characteristics and workmanship for each product or completed element of the Works shall be assessed for acceptance as specified in Chapter 20. Other properties, characteristics and requirements not prescribed in Chapter 20 shall be assessed and judged in terms of the specified requirements, permissible deviations and tolerances specified in the other chapters.

In the event of elements constructed using method specifications, the Engineer shall regularly monitor and inspect the process visually and ensure that the work is constructed in accordance with the approved method statement as well as with any applicable industry norms, standards and best practices. The Engineer may, however, request any sampling, tests and measurements of the final product to ensure conformance to the design requirements. The costs for any such sampling, tests and measurements shall be borne by the Employer in the event of compliance with the requirements and specifications. In the event of non-compliance with the requirements and specifications the costs for any such tests shall be borne by the Contractor.

Regardless of the Employer's quality control acceptance of any materials or products the Contractor shall remain fully responsible for any defective material, product or plant/equipment used in the temporary and permanent Works.

A1.3 CONTRACTOR'S SITE ESTABLISHMENT AND GENERAL OBLIGATIONS PART A: SPECIFICATIONS**A1.3.1 SCOPE**

This Section covers the establishment of the Contractor's organization, construction camps and constructional plant and their removal on completion of the contract.

It also includes payment items to cover certain general obligations, risks and liabilities and general items of cost that are included in, but not covered directly by the payment items in the other chapters.

A1.3.2 DEFINITIONS

Construction camps - are all areas used for erecting offices, stores, workshops, testing facilities, plant parking areas, and equipment and material storage areas.

General Obligations - the Contractor's General Obligations shall include the following:

- Setting up, providing, insuring and maintaining the personnel, construction camps, staff accommodation, furniture, office equipment and stationery, other temporary structures, fencing and construction equipment on the site and their removal on completion of the contract.
- Providing transport to, from and on the Site of the Works for all permanent and temporary staff and local labour, including transporting local employees to and from their places of residence when or where necessary.
- Compliance with the requirements of the Conditions of Contract and with all the general requirements included in this Chapter 1.
- Compliance with all legislative and regulatory requirements.
- Assessing, dealing with and/or insuring all risks associated with the Contractor's General Obligations and with the construction, maintenance and protection of the Works.
- The protection and/or safeguarding of private property and livestock.
- The provision of security for all the Contractor's personnel, facilities and equipment on the Site of the Works, including quarries, borrow pits, stockpile areas and storage yards as well as for any traffic accommodation facilities and equipment that may be placed on the approaches to, or the exit from, the Site of the Works.
- All other general obligations, overhead costs, financing charges, insurance costs and all other general items which are not specifically included in, or covered by, this Standard Specification.
- The preparation and submission of all designs and drawings prepared by the Contractor for the temporary works or any alternative design proposals.

A1.3.3 GENERAL**A1.3.3.1 Construction camps**

The Contractor shall establish the construction camps either at the specific sites and borrow areas identified in the Contract Documentation or at locations chosen by the Contractor. The exact location of these facilities shall be subject to the approval of the Engineer and such approval will not be unreasonably withheld.

The Contractor shall make his own arrangements for the use of any property outside the road reserve for erection of the construction camp/s, as well as for the provision of adequate means of access, security and the installation and supply of water, electricity and telephone services required by the Contractor.

Before commencing with the construction of any camps the Contractor shall comply with all the requirements specified in Clauses A1.2.3.2 and/or A1.2.3.3.

If Employer-owned land can be made available for the use of the Contractor for the construction camps, the use of such land will not be treated as a lease but will form part of the contract. In this regard the Contractor shall complete the prescribed agreement and comply with all the conditions thereof as if it is part of the Contract. The availability of any Employer owned land will be indicated in the Contract Documentation.

On completion of the Works, all constructional plant, buildings, fencing and other temporary structures erected by the Contractor shall be removed and the construction camp site shall be restored to its original condition and left neat and tidy. The Contractor shall also comply with all the requirements related to the completion of the operations specified in Clause A1.2.3.2 and/or Clause A1.2.3.3.

A1.3.3.2 Housing

The Contractor shall not erect any housing or other accommodation facilities on the site in urban areas and shall make all the necessary arrangements for accommodation of his personnel and site staff off the site, unless otherwise stated in the Contract Documentation.

The Contractor shall not erect any housing or other accommodation facilities on the site before he has obtained the written permission of the Employer and, where applicable, the land owner and has complied fully with all applicable legislative and regulatory requirements.

A1.3.3.3 Maintenance of the Contractor's facilities

The Contractor shall maintain the construction camps and all the Contractor's other facilities in a clean, neat and tidy condition for the duration of the Contract. The Contractor shall also maintain all the access roads to the Contractor's site facilities including any publicly or privately owned roads that the Contractor is making use of. Depending on the initial condition of the access roads this may entail repairing any potholes and edge breaks of surfaced roads or the re-gravelling of the road and subsequently the regular watering, blading and rolling of the surface to maintain a firm surface without excessive corrugations and loose materials. The Contractor shall ensure that the access roads to the Contractor's facilities are always in a safe and passable condition for normal cars under all weather conditions.

A1.3.3.4 Contractor's own security arrangements

The Contractor shall provide all the security measures required for the Contractor's own facilities and equipment on the Site of the Works, including quarries, borrow pits, and for the traffic accommodation site facilities and equipment, as he deems necessary. The provision of security measures for the duration of the Works shall be included in the Contractor's General Obligations as defined in Clause A1.3.2.

A1.3.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

The Contractor shall be responsible for the design of the site facilities. All applicable legislative and regulatory requirements related to building standards and health and safety shall be complied with.

A1.3.5 MATERIALS

The Contractor shall be responsible for the selection and purchase of all materials required to construct the site facilities. All applicable legislative and regulatory requirements with regard to building standards and health and safety shall be complied with.

A1.3.6 CONSTRUCTION EQUIPMENT

Not applicable for Section A1.3.

A1.3.7 EXECUTION OF THE WORKS

All work required for the Contractor's site facilities and for the Contractor's site establishment of personnel, vehicles, plant and equipment shall be carried out in compliance with all applicable legislative and regulatory requirements and with the requirements of the Contractor's environmental management and health and safety plans.

A1.3.8 WORKMANSHIP

The Contractor shall control the quality of materials and workmanship used for the construction and fitting out of the construction camps to ensure that the applicable legislative and regulatory requirements related to building standards and to health and safety are adhered to.

A1.4 FACILITIES FOR THE ENGINEER PART A: SPECIFICATIONS**A1.4.1 SCOPE**

This Section covers the provision by the Contractor of facilities for the Engineer and the Engineer's staff. These facilities shall include the necessary site accommodation, laboratories and offices, all the necessary furnishings and services, as well as all the arrangements in connection with the property, buildings and/or land, on which the Engineer's facilities will be provided.

The specifications for the site accommodation and the site laboratory and office buildings, together with all the fittings and furnishing required, are specified in this section. If necessary, additional details and requirements will be specified in the Contract Documentation or provided by the Engineer.

A1.4.2 DEFINITIONS

Engineer's site facilities - the Engineer's site accommodation, laboratories and offices are temporary buildings provided on site, or existing buildings on or near the site. Together with the required water, sewage, telecommunication, internet and electricity services these shall be known as the Engineer's site facilities. (The Engineer's site facilities shall be provided by the Contractor for the duration of the Contract to house the Engineer's site personnel, accommodate all the materials testing equipment required to carry out the Engineer's acceptance control testing and to provide office space for the Engineer's site personnel.)

A1.4.3 GENERAL

Where not already provided in the Contract Documentation, the Engineer shall furnish the Contractor with full details, in writing, regarding the number, type, layouts and furnishing of all site accommodation, laboratories and offices required for the use of the Engineer's site personnel.

The Contractor shall not order or make any arrangements for the provision of any buildings, materials, equipment or fittings on the basis of what is specified or scheduled without written confirmation by the Engineer. No buildings shall be rented, purchased, erected, refurbished or altered without the Engineer's written approval of the exact position, layout and orientation of the buildings.

Buildings for staff accommodation, laboratories and offices may comprise one or more of the following:

- Rented existing permanent structures in residential, business, industrial or farming areas.
- Temporary structures erected on property rented by the Contractor or on property provided by the Employer.
- Mobile structures parked on property rented by the Contractor or on property provided by the Employer.
- Permanent structures provided by the Employer.

Existing permanent structures may require refurbishment and partitioning to suit the requirements of the Engineer.

All buildings provided for the Engineer's staff accommodation, laboratories and offices shall where possible be located in an area where landline and/or cellular telecommunication and internet connectivity is available. If any of these services are not available dedicated services to that effect shall be provided.

Unless otherwise specified in the Contract Documentation, or agreed to by the Employer, the buildings provided for the use of the Engineer's personnel shall be erected near the Contractor's construction camp. Should the Contractor decide to move the construction camp to a new site during the construction of the Works, the buildings erected for the use of the Engineer shall be moved to the new site and re-erected if required by the Engineer, or alternative buildings which meet the specified and the Engineer's requirements shall be provided by the Contractor. No additional costs related to moving the Engineer's site facilities, or providing new site facilities, shall be incurred by the Employer or by the Engineer and all such costs shall be borne by the Contractor.

The Contractor may not proceed with the permanent Works before the specified site accommodation, laboratory and office buildings required by the Engineer have been provided, serviced and furnished by the Contractor. All the site accommodation, laboratory and office buildings shall be provided as soon as possible after the Contractor has been given possession of the site of the Works and not later than six weeks after the Contract commencement date.

If any additional site facilities are required by the Engineer during the construction of the Works, the Engineer shall inform the Contractor of the additional requirements at least 30 calendar days before such additional facilities are required.

The Contractor shall be responsible for servicing the Engineer's site facilities and for maintaining the facilities in a serviceable condition for the duration of the contract.

The ownership of all offices, laboratories, housing, sanitary facilities, laboratory equipment, furniture, office equipment and other items provided by the Contractor shall revert to the Contractor when the Engineer confirms in writing that he no longer requires them. The Contractor shall then remove them from the site or terminate the rental lease for any rented buildings.

As specified in Clause A1.2.3.17 the Contractor shall provide adequate security measures to prevent unauthorised entry to the Engineer's offices, laboratories, site accommodation and any rented accommodation.

A1.5.5.3 Temporary road restraint systems

Where specified in the Contract Documentation or instructed by the Engineer, the Contractor shall provide, install, move and re-install and subsequently remove temporary road restraint systems, if so required for the construction of temporary deviations.

All work shall be carried out in accordance with the specifications given in Section A11.4 of Chapter 11.

A1.5.5.4 Temporary fencing and gates

Where specified in the Contract Documentation or instructed by the Engineer, the Contractor shall provide either new fencing and gates, or move and subsequently reinstate existing fencing and gates, if so required for the construction of temporary deviations.

All work shall be carried out in accordance with the specifications given in Section A11.5 of Chapter 11.

A1.5.5.5 Temporary road signs

Temporary road signs shall comply with the specifications given for road signs given in Section A11.6 of Chapter 11.

A1.5.5.6 Temporary road markings and road studs

Temporary road markings and road studs shall comply with the specifications given for permanent road markings and road studs given in Section A11.7 of Chapter 11.

A1.5.5.7 Traffic accommodation facilities and safety devices

All road signs, barriers, channelization devices, guardrails, reflectors and other traffic safety devices shall be manufactured with materials that comply with the specifications given in the latest current edition of Volume 2 of the SARTSM, or any applicable international design standards that may be given in the Contract Documentation, and in accordance with the specifications given in Sections A11.4.5 and A11.6. of Chapter 11 as well as any additional specifications that are given in the Contract Documentation.

A1.5.5.6 Maintenance of existing roads used as detours

Where specified in the Contract Documentation, all existing roads used as detours by public traffic, and/or by the Contractor's vehicles, for bypassing the Site of the Works shall be maintained by the Contractor in a good and safe trafficable condition for the entire period during which such roads are used as detours.

Maintenance of these roads used as detours shall include grass cutting, removal of rubbish, cleaning of all drains and culverts and repair of potholes and surface failures as instructed by the Engineer. Unless otherwise specified in the Contract Documentation the maintenance work shall also include the care and maintenance of all road markings, road signs, delineators and guardrails.

A1.5.7.7 Liaison with traffic authorities

The Contractor shall liaise with the relevant provincial and/or municipal traffic authority, and with the Employer's traffic management centre if applicable, at the start of the contract period and as often as required thereafter to keep them continually informed in advance about the expected Works being carried out and the detour and deviation and lane closure arrangements that will be in place.

A daily report covering the expected work and traffic control arrangements for the following day shall be submitted to the relevant traffic authorities or to the traffic management centre not later than 10h00.

For exceptional traffic accommodation impacts, such as lane closures in peak hours, short term contra flow conditions, lane closures over weekend peak periods etc., the relevant traffic authorities, and the Employer's traffic management centre if applicable, shall be informed seven days prior to the event.

The Contractor shall inform the relevant traffic authorities, and the Employer's traffic management centre if applicable, about all traffic related incidents as soon as he becomes aware of the incident. The Contractor's site agent and his traffic safety officer must always have the relevant telephone numbers and email addresses with them so that contact can be made as soon as any traffic related incidents occur.

The Contractor shall, in appropriate circumstances that have been agreed with the relevant provincial and/or municipal traffic authorities, be responsible for acquiring the services of a provincial or municipal traffic officer and traffic vehicle (equipped with a blue light) to assist in the accommodation of traffic. The traffic officer and traffic vehicle will be required when lanes are to be closed, or where directed by the Engineer.

If the road under construction forms part of an abnormal load route the Contractor shall liaise with the relevant provincial abnormal load office that issues permits to ensure that permits are not issued when horizontal and/or vertical restrictions do not allow passage of the abnormal load.

A1.5.7.8 Informing the road users

The Contractor shall on a continual basis, and at least one week prior to a major event, inform the road users of the intended road Works, construction period and accommodation of traffic arrangements through press releases in local and provincial newspapers and via local radio channels.

Any temporary road closures required for blasting operations, or for any other reason, shall also be advertised on sign boards erected in appropriate positions along the section of road to be closed at least fourteen calendar days prior to each closure.

A1.5.7.9 Lighting of construction access points during night work

Where work is required to be done during the night the Contractor shall make adequate provision for additional lighting to ensure that all vehicle and equipment entry and exit points are adequately lighted. The Contractor shall provide floodlights to ensure that a minimum 200 lux lighting level is provided at all these areas.

The floodlights must be mounted on masts at least 9m high to ensure that they illuminate the required areas without being directed into the vision of oncoming drivers.

A1.5.7.10 Construction of temporary deviations

a) General

Unless otherwise specified in the Contract Documentation, or instructed by the Engineer in writing, the construction of temporary deviations shall be done in conformance with the requirements and specifications given in this section as well as in other relevant chapters of this Standard Specification as follows:

- Clearing and grubbing – Chapter 1, Section A1.6
- Drainage – Chapter 3.
- Earthworks and pavement layers – Chapters 4 and 5.
- Asphalt surfacing – Chapter 9.
- Bituminous surfacing – Chapter 10.
- Ancillary road works – Chapter 11.

The proposed location and layout of all temporary deviations, including the signage required, shall be agreed with the Engineer before construction of the temporary deviation commences.

b) Drainage works for temporary deviations

The Contractor shall construct the necessary temporary drainage works such as side drains, catch-water drains, mitre drains, culverts, etc., to deal adequately with any storm water and surface water run-off.

Temporary culverts of the type and size specified by the Engineer shall be installed on existing drainage channels. Any suitable prefabricated culverts salvaged from an existing road or an abandoned temporary deviation may be re-used if they are in a good condition and are accepted by the Engineer.

All drainage works shall be maintained in a clean condition and in good working order.

Any flood damage caused to a temporary deviation shall be repaired by the Contractor as soon as the flood water has subsided. **c)**

Earthworks for temporary deviations

The Contractor shall perform the necessary clearing and grubbing, including the removal of all trees and stumps. The Contractor shall then shape and grade the temporary deviation and prepare the roadbed.

The Contractor shall make full use of all suitable material that can be obtained from alongside the temporary deviation, from side cuts or from the immediate vicinity for the construction of any fills that are required. If an adequate quantity of acceptable fill material cannot be obtained in this manner it shall be imported from other approved sources. Where necessary, cuttings shall be made to obtain additional fill material and/or to achieve a satisfactory vertical alignment.

The earthworks across stream crossings shall be constructed from rock fill or coarse material so as to limit, in so far as is possible, damage caused by flood water.

d) Earthworks and pavement layers for temporary deviations

The Contractor shall provide the fill and pavement layers required for the temporary deviations in accordance with the requirements specified in the Contract Documentation or as instructed by the Engineer.

The cross fall shall be maintained between 3 % and 4 % on gravel deviations and between 2 % and 3 % on surfaced deviations.

If existing gravel shoulders are to be used for the accommodation of traffic and they are unsafe and/or not wide enough, the shoulders shall be reconstructed. All grass and unsuitable material shall be bladed from the surface and, where necessary, roadbed preparation shall be done. Additional wearing course gravel material shall be imported from the road reserve or from borrow pits as required to provide a layer of wearing course gravel at least 150 mm thick after compaction. The gravel shall then be placed and compacted as specified in the Contract Documentation.

e) Surfacing of temporary deviations

The Contractor shall surface the temporary deviations in accordance with the requirements specified in the Contract Documentation or as instructed by the Engineer.

Unless otherwise specified in the Contract Documentation, or instructed by the Engineer, the surfaced width of a temporary deviation accommodating two-way traffic shall be 8,5 m to provide two 3,5 m wide traffic lanes with a 0,75 m wide surfaced shoulder on each side. A further 0.75 m wide gravel shoulder shall also be provided on each side to provide a minimum total roadway width of 10,0 m. Where temporary deviations

consist of two separate one-way lanes, the minimum surfaced width of each lane shall be 3,5 m. A further 0,5 m wide gravel or surfaced shoulder shall also be provided on each side to provide a minimum total roadway width of 4,5 m in each direction. **f) Maintenance of temporary deviations**

All temporary deviations shall be maintained by the Contractor in a safe trafficable condition at all times.

All potholes and surface failures shall be repaired as soon as possible. The Engineer may also instruct the Contractor to resurface the temporary deviation or existing road being used as a detour if it becomes necessary.

Whenever required by the Engineer, temporary gravel deviations shall be bladed by means of self-propelled road graders to provide a smooth riding surface free from corrugations. The Engineer may also instruct the Contractor to water the temporary gravel deviations to keep down dust or to facilitate the proper blading of the surface.

g) Removal of temporary deviations

After traffic is rerouted permanently onto the new road, and on the written instructions of the Engineer, the Contractor shall remove temporary deviations. All roadwork materials, drainage structures, temporary signage, barricades and guardrails etc. will be removed either to spoil or to temporary storage for re-use elsewhere in the Works.

All temporary signage and road markings on the approaches to the temporary deviations shall also be removed.

A1.5.7.11 Temporary traffic control facilities

a) General

The Contractor shall provide, erect and maintain the necessary temporary traffic-control facilities, which are comprised of traffic control devices, road signs, channelization devices, barricades, warning devices and road markings, in accordance with the specifications given in Chapter 13 of Volume 2 of the SARTSM, in this Section or as specified in the Contract Documentation. The details shown for spacing and placement of traffic control facilities may also be revised by the Engineer in writing where deemed necessary to accommodate local site geometry and traffic conditions.

The Contractor shall ensure that all the temporary traffic control facilities devices are present where required at all times and are always functioning properly.

Traffic control facilities no longer required at a particular site shall be moved and stored safely for re-use.

All traffic control facilities which are scratched, bent, broken or otherwise damaged by the Contractor's staff and/or vehicles, construction equipment or by any other road users to the point where the Engineer considers them to be no longer usable or compliant shall be replaced by the Contractor at his own cost if they were not:

- Carefully stored, handled or transported.
- Correctly attached to their support bases, poles or frames.
- Correctly erected or ballasted.
- Erected in the correct position and/or not maintained in their correct position which made them likely to be damaged by passing vehicles.

If, due to poor storage, handling, transportation or old age, the co-efficient of retro-reflection of any of the signs fall below 80% of the value specified in the current edition of SANS 1519-1 for the grade and colour of the material used, the sign shall be considered defective and it shall be replaced at the Contractor's own cost.

All correctly erected, ballasted and positioned temporary traffic control facilities which are damaged by public road users shall be replaced and paid for under the relevant payment item.

All lost or damaged items shall be replaced as soon as possible within a maximum period of two hours of the Contractor becoming aware of it or of receiving instructions from the Engineer.

A1.5.7.12 Traffic safety officer

The Contractor shall appoint a knowledgeable, experienced and conscientious person as his traffic safety officer who shall be responsible for the arrangements and maintenance of all accommodation of traffic measures required for the duration of the contract. The Contractor shall submit details of the person's qualifications, training and experience to the Engineer for comment before appointing him.

The traffic safety officer shall be able to communicate in the languages of the area and shall be a dedicated official who shall have no other responsibilities on site unless permitted otherwise on small projects in the Contract Documentation or by the Engineer.

The traffic safety officer shall be equipped with a dedicated vehicle and a cellular telephone and shall have sufficient labour and a Traffic Safety Vehicle, as specified in Clause A1.5.6.2, at his disposal 24 hours a day.

The traffic safety officer shall always have a direct line of communication with the police and traffic officers responsible for the area within limits of the contract and shall be responsible for maintaining liaison with them in accordance with the requirements given in Clause A1.5.7.7.

1. The replacement of any traffic control facilities that are stolen from the Site of the Works. (All traffic control facilities provided on the Site of the Works shall be covered by the Contractor's insurances or by the Contractor should he elect not to insure them.)

(iii) Items to be measured and paid for using items specified elsewhere in the specifications

For activities shown in Table C1.5-1 payment items specified in other Chapters or Sections of the specifications, where they relate to work under this Section, will be listed in the Pricing Schedule.

Table C1.5-1: Payment items from other Chapters or Sections

Activity	Section 1.5 reference	Section item reference

Identification, protection and relocation of existing services	A1.5.3.11	C2.1.1 & C2.1.2 of Chapter 2
Temporary deviations	A1.5.5.1	Chapters 1, 3, 4, 5, 9 & 10 - All relevant pay items as applicable
Temporary culverts	A1.5.5.2	C3.2.1 to C3.2.24 of Chapter 3 as applicable
Temporary road restraint systems	A1.5.5.3 & A1.5.6.1(a)	C11.4.1 to C11.4.15 of Chapter 11 as applicable
Temporary fencing and gates	A1.5.5.4	C11.5.1 to C11.5.10 of Chapter 11 as applicable
Temporary road signs and removal, storage, covering and re-erection of existing road signs	A1.5.5.5 & A1.5.6.1(c)	C11.6.1.8, C11.6.1.10, C11.6.1.12, C11.6.2, C11.6.3, C11.6.5, C11.6.6, C11.6.7 & C11.6.10 of Chapter 11 as applicable
Temporary road markings and road studs	A1.5.5.6	C11.7.1 to C11.7.10 of Chapter 11 as applicable

Item	Description	Unit
C1.5.5	Maintenance of temporary deviations	
C1.5.5.1	Grass cutting	hectare (ha)
C1.5.5.2	Drain cleaning	kilometre (km)
C1.5.5.3	Cleaning out culverts	cubic metre (m ³)
C1.5.5.4	Collection of rubbish / litter	kilometre (km)
C1.5.5.5	Base patching using crushed stone material stabilised with bitumen emulsion and cement	cubic metre (m ³)
C1.5.5.6	Base and/or surface patching using cold premixed asphalt	kilogram (kg)
C1.5.5.7	Base and/or surface patching using hot plant mixed asphalt	tonne (t)
C1.5.5.8	Replacement of damaged guardrails	metre (m)
C1.5.5.9	Grading of temporary deviations and existing roads used as detours	kilometre (km)
C1.5.5.10	Watering of temporary deviations and existing roads used as detours	litre (l)
C1.5.5.11	Other road maintenance work ordered by the Engineer	provisional sum
C1.5.5.12	Handling cost, profit and all other charges in respect of item C1.5.6.11	percentage (%)

A1.6 CLEARING AND GRUBBING PART A: SPECIFICATIONS

A1.6.1 SCOPE

This Section covers the clearing of the site and the grubbing necessary for construction of the Works. This includes the following:

- Clearing and grubbing in watercourses and for hydraulic structures.
- Removal of rubbish, unsuitable or waste material, weeds and other vegetation in urban road/street reserve areas.
- Clearing and grubbing of service trench and designated excavation areas.
- Clearing and grubbing of borrow pits and quarries.
- Clearing and grubbing of the road prism.
- Clearing outside the road prism to improve sight distances.
- Clearing and grubbing of fence lines and other ancillary work areas.
- Preparation of topsoil stockpile areas.
- Stockpiling of topsoil and windrowing of topsoil.

The clearing and grubbing of areas required for site offices, laboratories and the Engineer's site accommodation shall be included in the work required to erect these facilities.

A1.6.2 DEFINITIONS

Clearing - is the removal, loading and disposal of all trees (including designated and protected trees if approved for removal), grass, brush, shrubs, other vegetation, rubbish/litter, rocks and boulders of up to 0,15 m³ in size which are exposed or lying on the surface and all other unsuitable or waste material on or above ground level.

Clearing shall also include the removal of existing buildings, walls and other structures which encroach on or obstruct the Works and which can be broken down and removed with a medium sized bulldozer. (Breaking down of reinforced concrete shall be specified separately in the Contract Documentation if required.)

Removal of temporary works installed by the Contractor shall not be measured or paid for as clearing.

The removal, loading, transport, offloading and stacking (or disposal if specified in the Contract Documentation or by the Engineer) of existing fences, road signs, guardrails, kerbing, channelling etc. shall be carried out as specified in the relevant sections of this Standard Specification.

Designated trees - are indigenous trees or heritage trees that may not be removed without the approval of the relevant local authority.

Designated spoil areas - are spoil or dump sites identified by the Employer in the Contract Documentation or identified by the Engineer on site and those identified by the Contractor in the Contractor's materials management and utilisation plan, as prepared in accordance with the environmental regulations and the environmental management plan.

There are two types of designated spoil areas:

- Unsuitable material spoil areas identified on or near the site of the Works and which have been agreed to by the Engineer. In urban or peri-urban areas the use of the spoil areas shall be approved by the local municipal authority in writing before any general unsuitable material is deposited there.
- Hazardous waste spoil areas which shall be commercial or municipal waste sites that are registered to receive and dispose of hazardous waste material.

Grubbing - is the removal and loading of all stumps and roots in areas where clearing has been carried out and the Engineer has confirmed in writing that grubbing is also required. Grubbing also includes the removal and loading of all non-reinforced building foundations and floor slabs, buried rubbish and other unsuitable or waste material.

Hazardous waste material - material that is cleared and grubbed shall be classified as hazardous waste material if it falls into the hazardous waste categories identified in SANS 10228.

Protected trees - are trees as listed in the Schedule of Protected Trees given in the Government Gazette dated 8th September 2017 (or any later amendments) issued in terms of Clause 15.3 in Chapter 3, Part 3 of the National Forests Act No. 84 of 1988. In terms of this Act protected trees may not be pruned or removed without the permission of the Minister of Agriculture, Fisheries and Forestry.

Stockpile - is a pile of material pushed into a large heaped pile or off-loaded onto a heaped pile so that the material can be temporarily stored for later re-use in the Works. Where specified the material to be placed in a stockpile shall be placed in evenly spread layers of a specified layer thickness, up to the specified maximum height and to the specified shape.

Stockpile site - is a designated site that shall be prepared as specified in Chapter 4, Clause A4.1.7.3a).

Topsoil - is fertile, loamy soil obtained from areas with good soil coverage of natural vegetation, preferably grasses. It shall be free of deleterious matter, such as stiff/heavy clays, large stones, large roots, refuse, rubble and construction material or waste, which will adversely affect its suitability for the planting of grass.

Windrow - is a pile of material which has been excavated and pushed a relatively short distance to a prepared area alongside the borrow pit, quarry, cutting or roadbed area so that the material can be temporarily stored for re-use, usually close to where it is windrowed.

A1.6.7 EXECUTION OF THE WORKS

A1.6.7.1 Areas to be cleared and grubbed

The portions of the road or street reserve falling within the limits of the road prism or site limits as well as borrow areas shall be cleared and grubbed as specified in the Contract Documentation or as specified by the Engineer. Areas designated to be cleared and grubbed may also include existing water courses, inlets and outlets of hydraulic structures, sidewalks, service trenches, designated excavations as defined in Clause A4.2.2 of Chapter 4, fence lines and other ancillary road works which may fall outside the limits of the road prism. The Contractor shall note that the presence of subsurface and / or surface water may prohibit the use of conventional machines for this work and the contract rates should make allowance for alternative working methods and equipment where required.

Grubbing of part or all of the previously cleared areas may not always be necessary. Before commencing the grubbing operation, the Contractor shall ask for a written instruction from the Engineer to confirm the position and extent of the cleared area/s that also need to be grubbed. Only these areas so confirmed in writing shall be grubbed and measured for payment.

Clearing, and grubbing where necessary, of new fence lines shall be done over a 2,0 m wide strip, 1,0 m either side of the staked fence line, as described in Clause A11.5.7.3 of Chapter 11.

Clearing, and grubbing for new service trenches shall be carried out as specified in Clause A2.1.7.1e) of Chapter 2.

A1.6.7.2 Clearing

Clearing, as defined in Clause A1.6.2, shall be done with equipment which suits the type of material and terrain to be cleared and in a manner which will result in minimal loss of topsoil. The cleared material shall be separated into re-usable material, unsuitable material and hazardous waste and it shall be loaded and removed from the site immediately and transported to a designated stacking area, a designated spoil area or an approved hazardous waste site as appropriate.

All undesignated trees, together with those protected trees or designated (indigenous or heritage) trees where the required permission to remove them has been obtained, shall be cut down unless instructions have been given to retain any particular trees in the Contract Documentation or by the Engineer.

The Contractor shall take the necessary precautions to prevent damage to structures and other private or public property. If necessary, the trees shall be cut in sections from the top downwards.

A1.6.7.3 Conservation of vegetation

Prior to any clearing, any shrubs and trees encountered in the road reserve and borrow areas that have been designated for preservation in the Contract Documentation, or in the environmental approval process, shall be carefully removed, correctly stored and maintained in a temporary nursery until they are replanted within the road reserve as specified in Clause A11.8.7.5 of Chapter 11 or as specified by the Engineer.

A1.6.7.4 Grubbing

All stumps and roots, including matted roots, in the roadbed area shall be removed to a depth of at least 1,0 m below the cleared roadbed surface.

Outside the roadbed area only stumps and roots, including matted roots, exceeding 75 mm in diameter shall be removed to a depth of at least 75 mm below the original ground level. The grubbed material shall be loaded and removed from the site immediately and disposed of at a designated spoil area.

The foundations of any buildings or structures, buried rubbish, old rubbish tips, rubble or other unsuitable material shall be removed unless otherwise instructed by the Engineer. The building material and unsuitable or waste material shall be loaded and removed from the site immediately and disposed of at a designated spoil area.

Except in borrow areas, all cavities resulting from the grubbing shall be backfilled with approved material and compacted to a density of at least the density of the surrounding ground.

A1.7 LOADING AND HAULING PART A: SPECIFICATIONS**A1.7.1 SCOPE**

This Section covers the loading and hauling of construction materials on the site of the Works.

A1.7.2 DEFINITIONS

Hauling - is the moving of loaded construction material from the point of excavation, or from a stockpile or windrow, to the point of use on the site or to designated spoil areas. The hauling operation shall include the off-loading of the material at the point of use on site, at the temporary stockpiles or at the designated spoil sites as applicable.

Haul roads - are temporary roads constructed by the Contractor, or existing public or privately owned roads, or any part or section of the road under construction, used for the purposes of hauling construction materials or for carting material to spoil.

Loading - is the operation of picking up the material from an excavation, stockpile or windrow and placing it in a haul vehicle.

A1.7.3 GENERAL**A1.7.3.1 Measurement of haul distance**

The haul distance shall usually be measured from the centre of volume (centroid) of the excavation in the cutting (or part of a cutting), trench or borrow pit, or from the centre of the stockpile position where applicable, to the centroid of the fill (or part of a fill), to the mid-point along the road centreline of the section of the road layer where the material is placed, to the centre of the temporary stockpile position in a borrow pit, quarry or on site or to the centre of the designated spoil area where the material is off loaded as applicable. The haul distance will be measured to the nearest 0,1 km.

For those operations where the material is usually disposed of, and/or reused, near the source of the material the relevant pay item may state that the cost of hauling the material for the first 1,0 km shall be included in the contract rate for that pay item. For these operations the hauling of the material shall only be measured if the actual haul distance exceeds 1,0 km and the haul distance to be measured for payment shall be measured from a point starting 1,0 km from the centre of volume (centroid) of the excavation in the trench or borrow pit, or from the centre of the stockpile position where applicable, up to the centroid of the fill (or part of a fill), up to the mid-point along the road centreline of the section of the road layer where the material is placed or up to the centre of the designated spoil area where the material is off loaded as applicable. The haul distance will be measured to the nearest 0,1 km.

The haul distance shall be measured along the shortest route as instructed by the Engineer as being safe and practical. The haul distance shall include any distance that the haul vehicle must travel to make use of a safe turning point or the next off ramp before making the return trip. Should the Contractor choose to haul material over some other longer route, computations for payment shall nevertheless be based on the haul distance measured along the shortest route instructed by the Engineer.

A1.7.3.2 Haul and construction access roads

The construction, use and later closure / reinstatement of any haul roads and construction access roads that are required by the Contractor shall be carried out in accordance with the requirements given in Clause A4.1.7.1 of Chapter 4.

The requirements for the use of any existing public roads by the Contractor to haul material are given in Clause A4.1.7.1a) of Chapter 4.

The requirements for the use of haul roads not on existing public roads are given in Clause A1.2.3.2.

C1.7 LOADING AND HAULING PART C: MEASUREMENT AND PAYMENT**(i) Preamble**

The tendered rate for each item shall include full compensation for providing, operating, maintaining and decommissioning upon completion, of all the construction equipment, labour, tools, incidentals and supervision to carry out the activity or construct the works in the item, unless otherwise stated.

Any prime cost or provisional sums shall be paid in accordance with the provisions of the conditions of contract. The charge or mark-up tendered or allowed for is a percentage of the amount actually paid under the prime cost or provisional sum. This percentage shall cover all the Contractor's handling, supervision, profit and liability costs to provide the services in the prime cost or provisional sum item.

(ii) Items that will not be measured separately

The following required activities will not be measured or paid for separately and the Contractor shall include the cost of these activities in other pay items as already specified for the appropriate pay item or as deemed appropriate by the Contractor:

1. The loading and hauling of commercial materials from either Employer or Contractor identified suppliers/sources shall not be measured for payment.
2. The loading of materials on site will not be measured and paid for separately except for loading already stockpiled material and for loading material that has been placed in heaps or windrows where the relevant payment item in other Chapters specifically states that the loading will be paid for separately.
3. The hauling of materials on site will not be measured and paid for separately where the relevant payment item specifically states that the hauling operation is included in that payment item.
4. The hauling of materials on site over a localised distance of up to 1,0 km will not be measured and paid for separately where the relevant payment item specifically states that the initial haul of the material over a distance of up to 1,0 km is included in the pay item.

(iii) Items to be measured and paid for using items specified elsewhere in the specifications

There are no items mentioned in this section that are measured and paid for elsewhere in this Standard Specification.

(iv) Items specifically for this Section of the specifications

The following payment items will be inserted in the Pricing Schedule under the relevant payment section where loading and/or hauling of materials is applicable. The payment item shall commence with the relevant section number followed by / and then by the applicable loading and hauling payment item numbers given here.

Item	Description	Unit
C1.7.1	Loading	
C1.7.1.1	Loading from stockpile using machines and some hand labour where necessary	cubic metre (m ³)
C1.7.1.2	Loading from heaps or windrows using machines and/some hand labour where necessary	cubic metre (m ³)
C1.7.1.3	Loading by hand only from stockpile or heaps when labour enhancement work is specified or not possible to use machines	cubic metre (m ³) it is

Loading is generally considered to be part of the operation that produced the material which is being loaded, such as excavation, grubbing, cleaning, demolition etc., and it is therefore not usually measured separately for payment. Loading shall only be measured separately for payment for loading stockpiled material and for loading material that has been placed in heaps or windrows where the relevant payment item specifically states that the loading will be paid for separately.

The unit of measurement for items C1.7.1.1 to C1.7.1.3 shall be the cubic metre of material loaded into the hauling vehicles. These pay items shall only apply for those activities where the relevant pay item does not specify that the loading is included in the contract rate for that pay item.

The quantity of all soil and gravel materials loaded for hauling for use on the site of the Works shall be the compacted volume of material measured in its final position in the Works calculated using the dimensions given in the Contract Documentation or specified in writing by the Engineer.

The quantity of all materials loaded for hauling to temporary stockpile for later use in the Works, to borrow pits for backfilling purposes or for disposal at designated spoil areas shall be taken as 70% of the measured load volume of the haul vehicle being used to transport soil and gravel material and 50% of the measured load volume of the haul vehicle being used to transport hard material and/or boulders.

The contract rate for item C1.7.1.1 shall include full compensation for loading material from a stockpile and loading it into the hauling vehicles.

The contract rate for item C1.7.1.2 shall include full compensation for loading excavated material from heaps or windrows at the point of collection, including any windrowing and/or localised sorting / stockpiling that may be required, and loading it into the hauling vehicles.

The contract rate for item C1.7.1.3 shall include full compensation for loading excavated material at the point of collection on site or loading it from stockpile by hand and loading it by hand into the hauling vehicles. This item is only applicable when the Contractor has been instructed to load the material by hand in the Contract Documentation or by the Engineer to enhance the labour component of the Works or if it is not practical to use machines due to the restricted nature of the work.

Item	Description	Unit
C1.7.2	Hauling	
C1.7.2.1	Hauling material for use in the Works and off-loading it on the site of the Works:	
	(a) Soil, gravel, crushed stone and pavement layer material	cubic metre - kilometre (m ³ - km)
	(b) Boulders and hard material	cubic metre - kilometre (m ³ - km)
C1.7.2.2	Hauling material to spoil and off-loading it at a designated spoil or stockpile area:	
a)	Cleared and grubbed material (organic matter and all other unsuitable or waste material)	cubic metre - kilometre (m ³ - km)
b)	Soil and gravel material	cubic metre - kilometre (m ³ - km)
c)	Boulders, hard material and concrete	cubic metre - kilometre (m ³ - km)

The unit of measurement for items C1.7.2.1 and C1.7.2.2 shall be the cubic metre – kilometre (m³ - km) which is calculated as the product of the quantity of material loaded, as measured in items C1.7.1.1, C1.7.1.2 or C1.7.1.3, multiplied by the applicable haul distance which shall be calculated as defined in Clause A1.7.3.1.

These pay items shall only apply for those activities where the relevant pay item does not specify that all the hauling is included in the contract rate for that pay item.

The quantity of all soil and gravel materials hauled for use on the site of the Works shall be the compacted volume of material measured in its final position in the Works calculated using the dimensions given in the Contract Documentation or specified in writing by the Engineer.

The quantity of all materials hauled to temporary stockpile for later use in the Works, to borrow pits for backfilling purposes or to designated spoil areas shall be taken as 70 % of the measured load volume of the haul vehicle being used to transport soil and gravel material and 50 % of the measured load volume of the haul vehicle being used to transport hard material and boulders.

The quantity of all organic matter hauled to borrow pits or to designated spoil areas shall be taken as 50 % of the measured load volume of the haul vehicle being used.

The contract rate shall include full compensation for hauling the material and off-loading it at the required or designated position.

CHAPTER 2 : SERVICES

A2.1 GENERAL REQUIREMENTS AND TRENCHING FOR SERVICES PART A: SPECIFICATIONS

A2.1.1 SCOPE

Section A2.1 covers the general requirements applicable to civil construction work associated with the location, identification, protection, relocation and the installation of services in existing or new road reserves or servitudes as well as the protection and reinstatement of existing road infrastructure affected in the process of dealing with such services. This Section also covers the trenching requirements applicable to the installation of services in road reserves. Section A2.1 covers services installed as individual services as well as when they are to be installed as part of a larger construction contract. Chapter 2 does not cover stormwater and other drainage structures which are specified in Chapter 3.

A2.1.1.1 Installation of new services

The construction work associated with the installation of new (utility) services in road reserves including the installation of new dry services (ducts for cables for communications and electric power etc.) are covered in Section A2.2, the installation of new wet services (water supply and waste water (sewerage) pipelines etc.) are covered in Section A2.3 and the installation of street lighting, electric power and energy services (gas and fuel pipelines) as well as the installation of other new services as may be specified in the Contract Documentation are covered in Section A2.4.

A2.1.1.2 Location, identification, protection and relocation of existing services

Section A2.1 also covers the work associated with the location and identification of all existing services on the site and the protection and/or relocation of existing services. Existing services shall be located, identified and protected or relocated in accordance with the details shown on the drawings, provided in the Contract Documentation or as directed by the Engineer.

A2.1.1.3 General note

In certain SANS documents referred to in this section the term "*specified in the scope of work*" is used. For the purposes of this specification the term shall be deemed to mean "*specified in the Contract Documentation*".

A2.1.1.4 Applicable supporting specifications

Section A2.1 of Chapter 2 shall be used in conjunction with, amongst others, the following standards or specifications:

SANS 241-1	Drinking water Part 1: Microbiological, physical, aesthetic and chemical determinands
SANS 2001-DP1	Earthworks for buried pipelines and prefabricated culverts
SANS 51008	Mixing water for concrete – Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete

Where the documents referenced are undated the latest edition of the referenced document (including any amendments) shall apply. Where references are dated only the edition cited shall apply.

A2.1.2 DEFINITIONS

The following definitions shall apply to these specifications:

Affected Parties - all persons or organisations that may be affected by the construction work and shall include all Service Owners.

Backfill - approved compacted materials used to replace excavated materials from the top of the fill blanket or bedding up to the surrounding ground level or the bottom of the pavement layer works, whichever is the lowest.

Cables - power and auxiliary conductors including optical fibre cables for the transmission and distribution of electricity, communication signals and data signals.

Design - includes the collection of information, resolution of conflicts with all affected parties, detailing of service location or position and specifications and obtaining the written agreement of all affected parties.

Duct - an enclosed tubular or rectangular conduit for enclosing wires, pipes or cables for the purpose of providing structural or other protection for the wires, pipes or cables and/or allowing for their installation or replacement without re-excavation, jacking or boring.

Equipment - pipes, cables, poles, manholes, transformers and other components that are a necessary part of a service system or subsystem.

Footway (Footpath/Sidewalk/Walkway) - a formally constructed area or paved strip within a road reserve for the safe passage of pedestrians, animals and non-motorised transport. The terms footpath, sidewalk or walkway are also used with sidewalk generally used where the facility is contiguous to the carriageway/roadway. A footway excludes surfaced or unsurfaced road shoulders.

Known Existing Service - any existing service on site that is shown on the drawings, detailed in the Contract Documentation, indicated on the record (as-built) drawings or indicated in the wayleave information or which can be reasonably confirmed or inferred from visible features on site shall be defined as known existing services. All new or relocated services, once installed by either the Contractor or any other party, shall be also be defined as known existing services. All services located, identified and verified during any investigations for services on site shall be defined as known existing services as soon as their presence on site has been detected. Any service which has been temporarily taken out of service to allow for the execution of the works or which has been taken out of service, as a result of an event which necessitated the execution of the works, shall also be deemed to be a known existing service.

Non-motorised transport (NMT) - non-motorised transport or transport by any means other than a motor vehicle including, but not limited to, walking, cycling and animal-drawn vehicles and wheelchairs.

Pavement layers (Pavement layer works) - refer to Clause A4.1.2 of Chapter 4.

Pipe - a structural tubular product designed, tested, and manufactured for conveying liquids and gases under specific conditions.

Relocation - the removal of existing equipment and its re-installation in an alternative location. Such relocation may include the replacement of some, or all, of the existing equipment as part of the relocation process.

Replacement - the removal of existing equipment that has been damaged, or is worn, or obsolete, and installation of a similar or improved element of a service system or subsystem.

Reinstatement - the work necessary to replace, repair or otherwise restore all surfaces and features in a road reserve to the same or better condition as existed prior to any construction activities that affected the original condition.

Road - a street, road, or other public way, as well as bridges or other structures, including shoulders, and footways designated for the purpose of vehicular traffic and/or pedestrian and other non-motorised transport.

Road Authority - the authority responsible for a road in terms of the relevant national, provincial or municipal legislation.

Road (or Street) Furniture - a collective term for objects and pieces of equipment installed on streets and roads for various purposes. It includes, but is not limited to, guardrails, traffic barriers, bollards, traffic lights, road signs and street lighting.

Service(s) - the plant, equipment, conduits or other infrastructure installed for the generation, supply, distribution, transmission, transportation, storage or disposal of electricity, signals or data, liquids or gasses for the consumption, use or other benefit of others.

Service Owner - a private company, public authority, municipal council business unit, agency, directorate, or department etc. responsible for providing a service, including but not limited to gas, petroleum products, steam, chemicals, electric power, data, communications, water, sewerage, drainage or irrigation.

Sleeve - as for *Duct*.

Trenchless Methods - the methods of installing a pipe or sleeve under a road without disturbing the surrounding surface medium by using grade and alignment control equipment. Methods covered by this definition include, but are not limited to, pipe jacking, micro-tunneling, ramboring (RB) or directional drilling (DD) methods.

Verge - the area between the outer edge of the **Road Prism**, as defined in Clause A5.1.2 of Chapter 5, and the boundary of the road reserve.

A2.1.3 GENERAL

For the purposes of Clause A2.1.3 the definition of Services under Clause A2.1.2 shall be deemed to include any pipes, culverts or other infrastructure provided for surface or subsurface drainage purposes.

A2.1.3.1 Installation of new services

New services shall be installed in accordance with the details provided in the Contract Documentation or as directed by the Engineer and in accordance with the conditions and requirements of any applicable wayleaves or construction permits. Where sufficient details are not available for the Contractor to plan and carry out the work the Contractor shall, in writing, request that the Engineer provide any outstanding details.

When the investigation of the existing services as described in Clause A2.1.3.2 hereafter has been completed the Contractor shall inform the Engineer if the Contractor has become aware of any possible conflicts between the new proposed services and any known existing services.

A2.1.3.2 Location, identification, protection and relocation of existing services a) Existing as-built records

The Employer will, on the drawings or otherwise in the Contract Documentation, provide information regarding the location of all known existing services.

Although every care has been exercised in the compilation of the available as-built information, data, records and drawings for the known existing services, the Employer does not guarantee, or accept responsibility for, the accuracy or completeness of the information provided. The Contractor shall therefore locate, identify and verify all known existing services and at the same time investigate, locate, identify and report the existence of any other services not previously known to be present on site.

b) Location of existing services

Before any work can commence the Contractor shall verify the actual position of each known existing service and bring to the attention of the Engineer any previously unknown service that is not recorded in the existing as-built or wayleave records or indicated in the Contract Documentation.

The Contractor shall comply with the specified wayleave processes and conditions of the relevant road or service authorities including where such processes or conditions include a requirement to locate and verify the positions of services. If no other location and verification process is applicable the process specified hereafter shall apply.

Owing to the possible inaccuracy of the records of existing services the Contractor shall carefully check, determine and verify on the site the positions of all known existing services shown on the wayleaves, drawings or described in the Contract Documentation. This shall be done by visual inspections, using appropriate detection equipment with acceptable accuracy, and by making excavations to expose the position of the services at critical points. This shall also be done where no services are shown on the drawings or described in the Contract Documentation but where such services are nevertheless believed to be present or the possibility of their presence can reasonably be inferred or expected by an experienced and competent Contractor. Where indicated in the Contract Documentation services shall be detected by means of appropriate Ground Penetration Radar (GPR) or other specified equipment. The Contractor shall propose the nature and extent of the services investigation required and submit it to the Engineer for review and to obtain agreement on the use of any specialist services provided by other parties and on any other related payment matters.

The horizontal and vertical positions of all services detected shall be marked carefully, surveyed and then shown on the drawings together with appropriately recorded details of the service number, type and size.

The position of the existing services shall be checked and verified in advance of the construction works so that the Engineer is able to confirm or make the necessary arrangements for the protection, removal or relocation of the services before work has to commence in their vicinity. The lead times required to make the necessary arrangements for the protection, removal or relocation of services which the Contractor shall allow shall be as indicated in the Contract Documentation or as stated in any applicable wayleaves or construction permits or as confirmed by the Engineer and shall be as agreed with each affected service owner.

As soon as any service which has not been identified and located as described above is encountered on, under, over or within the site during excavation or any other construction activity during the progress of the works, it shall henceforth be deemed to be a known existing service and the aforesaid provisions pertaining to locating, verifying and recording its position shall apply. The Contractor shall notify the Engineer immediately when any such service is encountered or discovered on the site. The relevant service owner shall also be notified of any services verified on site that were not indicated on the original as-built records referred to in Clause A2.1.3.2a).

All the verified services will be defined as "known existing services" and the Contractor will be held responsible for any subsequent damage to them whether caused directly by the Contractor's operations or by the lack of proper protection. The Contractor shall take all reasonable precautions not to damage the services during a search. If a service is damaged during the course of its location, discovery or exposure, the Contractor will be reimbursed for the cost of making good such damage, unless it is established by the Engineer that the Contractor did not exercise reasonable diligence and care and that the damage was avoidable.

Payment for the location and verification of existing services will be made in accordance with the relevant payment items in Section C2.1. **c)**

Condition of existing services

The Contractor shall acknowledge that he has inspected and examined all known existing services and all existing services subsequently discovered on site and is satisfied that all such services were in an acceptable and serviceable state at the commencement of the works, or alternatively, upon verification thereof as contemplated in Clause A2.1.3.2b). The Contractor shall report all services that are damaged or not in an acceptable and serviceable state to the Engineer.

In the event of a dispute as to the acceptability and/or serviceability of an existing service at the commencement of the works or upon the verification of such a service, the Contractor shall prove to the satisfaction of the Engineer that the service in question was not in an acceptable and/or serviceable state at the commencement of the works or when located.

d) Protection of services*(i) Service owners*

Prior to commencing work, the Contractor shall confer with all service owners, authorities and departments concerned and obtain the necessary wayleaves, permits or permissions for both overhead and underground services affected by the works and shall satisfy himself that all the relevant information required to complete the contract has been obtained. Refer to Clause A2.1.3.8 in this regard.

The Contractor shall carry out the works with minimum interference to existing services. The Contractor shall co-operate with all the service owners, authorities and departments concerned and shall be responsible for timeously informing all service owners, authorities and departments as to the planned date for the stage of the construction which involves the laying and/or relaying of any particular services. The notice periods or lead times that the Contractor has to give each of the relevant service owners for them to be able to lay and/or relay any particular service shall be as indicated in the Contract Documentation or confirmed by the Engineer and shall be as agreed with each affected service owner.

The Contractor shall set out the lines and levels of kerbs, pipes, culverts and any other necessary features of the contract in order that service owners, authorities and departments are able to lay and/or relay services correctly.

The Contractor shall allow all reasonable access to any service owner, authority or department for the purpose of maintaining, laying and/or altering any services during the construction period as ordered by the Engineer and approved by the Employer.

(ii) Protection

During the course of the works all known existing services including traffic signals, water mains, sewers, electricity transmission and communication lines, cables, poles, pipes and ducts as well as any storm water or drainage infrastructure, whether in service or not, shall be protected, supported and maintained to the satisfaction of the service owner, authority or department concerned and the Engineer.

The Contractor shall take all reasonable precautions and shall exercise due care and diligence to locate and protect known existing services and to ensure that any interference with other underground or visible services are limited and controlled during any construction activities including trenching, during the installation of services or during the relocation of services. Where protective measures involve the construction of permanent work, the Contractor shall execute the work in accordance with the details shown or described in the Contract Documentation or in accordance with the Engineer's instructions, and payment shall be made under the relevant payment items. Hydrants under pressure, water main valve

Covers and manholes shall be kept unobstructed and accessible at all times if they are in service. The covers and frames of service manholes and catch pits will have to be adjusted where they are affected by the works.

The Contractor shall comply with the requirements of Clause A1.2.3.13 of Chapter 1 regarding work which involves blasting or the use of heavy vibratory or impact compaction equipment near known existing services.

Unless otherwise instructed by the Engineer, no services shall be left exposed after their exact position has been determined and all excavations carried out for the purpose of exposing underground services shall be promptly backfilled and compacted after surveying and recording is complete.

Services which are left exposed with good cause shall be suitably protected from damage and in such a manner as will eliminate any danger arising therefrom to the public and/or workmen, all in accordance with the requirements of the prevailing legislation and related regulations.

Where known existing services, which include new services that are being installed, are left exposed or are left partially bedded or backfilled, the Contractor shall provide adequate security measures to, as far as is reasonably possible, eliminate the risk of loss or damage due to theft or vandalism. The Contractor shall ensure that the bedding and backfilling for services is completed without any delay after a service has been laid to reduce the period that the services are exposed.

Survey beacons or reference pegs shall not be removed or disturbed. If such a need arises, the Engineer shall be advised so that the Engineer can determine what suitable action is to be taken.

(iii) Damage

The Contractor will be held responsible for any damage caused by him to known existing services, anywhere along the entire lengths of their routes, as may reasonably be deduced from the actual locations at which their positions were verified in accordance with Clause A2.1.3.2b), due cognisance being taken of such deviations in line and level which may reasonably be anticipated, unless the Contractor can prove that reasonable diligence and care had been exercised and that the damage was unavoidable despite all precautions. The Contractor will be not be held responsible for any damage caused if the position of a known existing service deviated by more than 1,0 m horizontally or 0,5 m vertically from the position as may reasonably have been determined after the location and verification of the service's position in accordance with Clause A2.1.3.2b).

In the event of damage to any services the Contractor shall immediately inform the Engineer, or when this is not possible, the relevant service owner, authority or department, and obtain instructions as to the necessary repairs or protective measures to be taken and as to who should carry out such repair or protection work. The Contractor shall take such immediate action as is necessary to prevent further damage or danger to life or property. In urgent cases, the Contractor shall take appropriate steps to mitigate damage to and interruption of the service. All known existing services of any nature whatsoever damaged as a result of the Contractor's operations shall be repaired and reinstated forthwith by the Contractor or by the service owner, authority or department concerned to the satisfaction of the Engineer and the relevant service owner, authority or department and the Contractor shall, subject to the provisions of the preceding paragraph of this Clause A2.1.3.2d)(iii), be liable for any related costs.

(iv) Relocation

Whenever services are encountered which interfere with the execution of the works, and which must be moved and relocated, the Contractor shall advise the Engineer, who will determine the extent of the work, if any, to be undertaken by the Contractor in moving, relocating and reinstating or protecting such services.

It shall be clearly understood that, in certain instances, existing services can be relocated only after the Contractor has advanced sufficiently on, or has completed, certain sections of the works included in the contract.

The Contractor shall work in close co-operation with all service owners, authorities or departments controlling services which have to be protected, moved or relocated. Details regarding the state of negotiations concluded between the Employer and the service owner prior to the commencement of the contract in respect of the time when either the service owner is prepared to start moving such services or when the Contractor is required to, or will be allowed to, start moving the services, and the duration of such operations, will either be stated in the Contract Documentation or be made available to the Contractor. Should the owners of services refuse to co-operate with the Contractor in a reasonable manner in connection with the protection or moving of services belonging to them, the Contractor shall refer the matter to the Engineer.

If the Contractor is not authorised to remove, relocate or replace services the Contractor shall give notice, in writing to the relevant service owner, that the services on the site will require removal or protection prior to works being carried out in the vicinity of such services. The Contractor shall advise the service owner of the number of services and their locations and the proposed dates when work will commence in the vicinity of each service.

The Contractor shall give notice as follows:

- Where the details of the services to be relocated are provided at the commencement of the contract the Contractor shall send the notice to the relevant service owners within fourteen days of the commencement of the contract.
- Where the need to relocate a service only becomes apparent after the location and verification of services has been completed as required by Clause A2.1.3.2b) the Contractor shall send the notice to the relevant service owners within fourteen days of the Engineer confirming that the service, as located or discovered, has to be relocated.

In addition to the above notice, the Contractor shall give the service owner a minimum of fourteen calendar days written notice (unless a longer period has been included in the service owner's wayleave or construction permit conditions in which case the longer period shall apply) of the intention to commence work in the vicinity of each relocated service. Upon completion of the work in the vicinity of each service, the Contractor shall notify the service owner, in writing, that work is complete.

Payment to service owners for the relocation of existing services or for any deposits or guarantees required by service owners for work near services will be made in accordance with the relevant payment items in Section C2.1. The Contractor is responsible for obtaining the relevant invoices when such payments are to be made and shall make any payments, due to the service owners, within seven (7) calendar days of receiving an instruction from the Engineer to proceed with such payments.

A2.1.3.3 Safety, Method Statements, safeguarding the works and accommodation of traffic a) Safety and Method Statements

All installation of services work shall comply with the health and safety requirements of Clause A1.2.3.6 of Chapter 1 and as specified in the Contract Documentation.

The Contractor shall prepare and submit to the Engineer for review and approval as required, the Method Statements required in terms of the relevant health and safety legislation, the specification or the Contract Documentation. Construction Method Statements shall include, but not be limited to, those indicated in Table A2.1.3-1.

Table A2.1.3-1: Method Statements

Section / Clause	Activity to be Covered by Method Statement
A2.1.3.1	Installation of all new services
A2.1.3.2b)	Location of existing services
A2.1.3.2d)	Protection of services
A2.1.3.4	Protection of existing road carriageways, footways, verges and other infrastructure
A2.1.7.1 excluding A2.1.7.1l) and A2.1.7.1r)	Trenching for services
A2.1.7.1l)	Timbering and shoring
A2.1.7.1r)	Dealing with water
A2.2.7	Installation of ducts
A2.3.7	Installation of sewers and water mains
A2.4.7	Installation of cables

b) Safeguarding the works

The Contractor shall ensure that the works, including but not limited to all excavations that are accessible to the public, are kept safe at all times in accordance with the requirements of the relevant legislation. Safety precautions shall include, but shall not be limited to, suitable barriers, barricades or fencing, the provision of watchmen and the provision of suitable lighting at night as accepted by the Engineer. Payment for the safeguarding of the works shall be in accordance with the relevant sections of the specification. **c) Accommodation of traffic**

Traffic accommodation during the installation of services shall comply with the requirements of Section A1.5 of Chapter 1 and shall be as specified in the Contract Documentation. All traffic accommodation measures shall be in accordance with the traffic accommodation plan for the works.

In addition to the accommodation of vehicular traffic the Contractor shall provide safe uncluttered thoroughfares for pedestrians and other NMT (as may be applicable) and also comply with any other specific access or accommodation requirements provided in the Contract Documentation.

A2.1.3.4 Protection of existing road carriageways, footways, verges and other infrastructure

Before construction equipment for services related work is allowed onto surfaced road carriageways or paved footways or verges, the Contractor shall submit, for acceptance by the Engineer, the proposals of how the Contractor intends operating construction equipment without causing damage to any of the existing surfaces. Protection proposals may 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 stabilising arms of excavators or cranes etc.;
- The placing of wooden blocks under the tined buckets of excavating equipment when fully lowered; and
- The use of loading equipment fitted with buckets without tines to remove dumped material to a minimum of 200 mm above any paved surface with the remaining 200 mm of material removed by means of hand work.

The Contractor shall adhere to the accepted proposals and will be held liable for repairing the damage caused by construction equipment or activities to any surfaced roads, footways or verges or kerbing etc. and restoring them to their original condition.

Before any construction commences the Contractor shall submit, for acceptance by the Engineer, the proposals regarding how the Contractor intends to work in the vicinity of any existing infrastructure or road furniture (such as traffic barriers, bollards, traffic lights, traffic signs, fencing, stays and struts for poles and gantries and street lighting) without causing damage to the existing infrastructure.

A2.1.3.5 Programming for services**a) Trenching and installation sequence**

Where services including ducts or pipes are to be installed at a level lower than the final level of any mass earthworks that have to be carried out for the purpose of constructing a structure or a road, the trenching for such services, ducts or pipes shall be carried out after the mass earthworks have been completed unless otherwise specified in the Contract Documentation or agreed by the Engineer. Refer to Clause C1.1.2.2d) of Chapter 1 in this regard.

Where services, ducts or pipes are to be installed across or along new roads that are under construction, such work shall be completed before the subbase layer is constructed.

b) Programme and delays

When the Contractor prepares the construction programme, the Contractor shall clearly indicate the proposed start and end dates for the moving of each known existing service or when a service owner will be required to start and conclude the moving of each service. Such scheduling shall include reasonable periods for all such activities and shall take in to account any applicable conditions stated in wayleaves or construction permits or as otherwise agreed with service owners. The Contractor shall update the construction programme, on at least a monthly basis, to reflect the actual progress on the scheduled service work activities. If the Contractor considers that the progress of the works is being affected by the failure of any service owner, authority or department to protect, lay, remove or relocate any service in time or in accordance with construction programme and that a delay in the completion of the work may result, the Contractor shall immediately notify the Engineer in writing. The Contractor shall take appropriate steps to accommodate or mitigate the effects of such delays irrespective of the cause of the delays. Should such delays make it

impossible to adhere to the programme of work, the Contractor shall, as agreed by the Engineer, suitably revise the programme in consultation with the Engineer so as to limit, in so far as is possible, the extent of any resultant damages or delays.

If the location of services process, described in Clause A2.1.3.2b), results in the identification of further existing services, the Contractor shall, as agreed by the Engineer, revise the construction programme to take account of any impact, as agreed with the service owner and the Engineer, the recently located services might have on the completion of the works.

The Contractor shall keep detailed records of all dealings with service owners so that, if required, it can be demonstrated that every effort had been made to timeously request and/or apply for the protection, removal or replacement of any services.

A2.1.3.6 Provision of record drawings and details

The Contractor, in addition to the records of the positions of known existing services, as determined in accordance with Clause A2.1.3.2b) above, shall ensure that the horizontal and vertical positions of all new and relocated services installed are accurately recorded and shown on the record drawings. All such drawings and records shall be delivered to the Engineer before the completion of the works. The position of the services shall be determined by a survey carried out by a suitably qualified surveyor. If so specified in the Contract Documentation the surveyor shall be registered as a Professional Surveyor, Technologist Surveyor or Technician Surveyor with the South African Council for Professional and Technical Surveyors (PLATO). The survey required to accurately record the position of the services may have to be carried out before any services are covered up. The position and levels of all manholes, valves, chambers, junction boxes, markers etc. shall be surveyed for the completion records.

A2.1.3.7 Construction supervision

The Contractor shall ensure that all work related to services is carried out, executed by and supervised by appropriately and sufficiently qualified and competent employees or agents.

A2.1.3.8 Liaison with affected parties

The provisions of Clause A1.2.3.22 of Chapter 1 shall apply to any wayleaves and/or construction or work permits required for all services related work.

A2.1.3.9 Limitations and restrictions

a) Work near other or existing services

No work using mechanical trenching equipment shall be undertaken closer than 1,0 m from any existing cable, pipe or duct without the explicit approval of the Engineer and the respective service owner.

Where any applicable wayleave conditions or construction or work permits include other working restrictions, limitations or conditions associated with particular services or other infrastructure they shall become applicable to all such work under the Contract and supersede the restriction stated in the paragraph above.

b) Maintaining accesses

The Contractor shall be responsible for maintaining accesses over trenches where applicable, in which regard the Contractor shall comply with the relevant requirements of Section A1.5 of Chapter 1.

c) Installation under special conditions

The following conditions are defined as special conditions for the installation of services and must be treated in accordance with the site or contract specific Contract Documentation, the wayleave conditions or any other relevant authority conditions as may be applicable in each case.

- Excavation within a radial distance of 500 mm from a power cable.
- Excavation requiring rock blasting.
- Placements requiring augering or horizontal directional drilling (HDD).
- Crossing of railway servitudes.
- Excavation adjacent to or crossing major road cuttings or embankments.
- Excavations near bridge abutments or footings.
- Work involving attachments to bridges or other structures.
- Concrete encasement of ducts in high risk areas.
- Installation of services in active clay conditions.
- Installation of services in areas where specific geotechnical conditions occur i.e. areas underlain by dolomites, collapsing soils or dispersive soils etc.

d) Other conditions

Trenching at the toe, crest or through cut or fill embankments shall be done such that the slope stability of the cut or fill embankment is not compromised.

e) Working widths

The Contractor shall always only occupy such areas as required to execute the specified services related work.

Where required by the Contract Documentation, once the setting out and pre-marking of the trench line has been completed, a corridor of a suitable maximum width, as agreed by the Engineer, shall be allowed for all trenching operations i.e. for all safety and environmental protection measures, accommodating workers and working space, as well as the safe placement of excavated material.

Where trenches are to be made in road reserves, servitudes or designated areas of specified width, the Contractor shall confine all his construction activities to within the limits of such reserves, servitudes and widths unless permission to encroach on to the adjacent property has been obtained, in writing in advance of any work, from any affected owner, lessee or occupier.

Any affected owner, lessee or occupier shall be afforded a reasonable time to remove any tall trees, shrubs or other plants as well as any improvements from a servitude should the affected party wish to do so. No trees or shrubs shall be removed by the Contractor without the written permission of the Engineer.

A2.1.3.10 Setting out of services works

The Contractor shall be responsible for the true and proper setting out of all work required for the installation of services and for the correctness of the position, levels, dimensions and alignment of all parts of such works and for the provision of all necessary instruments, equipment and labour in connection therewith.

The checking of any setting-out or of any line or level by the Engineer shall not relieve the Contractor of his responsibility for the correctness thereof. The Contractor shall rectify any error in the positions, levels dimensions or alignment of the works.

Refer to Clause A1.2.7.2 of Chapter 1 in this regard.

C2.1 GENERAL REQUIREMENTS AND TRENCHING FOR SERVICES PART C: MEASUREMENT AND PAYMENT**(i) Preamble**

The tendered rate for each pay item shall include full compensation for providing, operating, maintaining and decommissioning upon completion, of all the construction equipment, labour, tools, incidentals and supervision to carry out the activity or construct the works in the pay item as specified, unless otherwise stated.

Any prime cost or provisional sums shall be paid in accordance with the provisions of the conditions of contract. The charge or mark-up tendered or allowed for is a percentage of the amount actually paid under the prime cost or provisional sum. This percentage shall cover all the Contractor's handling, supervision, profit and liability costs to provide the services in the prime cost or provisional sum item.

The requirements of Section C1.1 of Chapter 1 shall apply.

Where pay item descriptions include any wording in brackets it is an indication that contract specific information is to be inserted in the Pricing Schedule included in the Contract Documentation.

(ii) Notes on measurement and pay items

1. Unless otherwise ordered or stated in the Contract Documentation, trench depths will be measured from the surface of the ground along the centre-line of the trench to the bottom of the specified bedding layer (as applicable). Where no bedding is required it shall be measured to the underside of the duct or pipe.
2. The ground surface will be that existing after any bulk earthworks have been carried out, i.e. the excavated surface or embankment surface, unless a different sequence of execution has been ordered.
3. Excavations will be measured as if taken out with vertical sides, regardless of whether they have been taken out with sloping sides.
4. The length used for trench computations will be the total through-length of a pipe or duct etc. from end to end and no deduction will be made for manholes or access chambers etc.
5. Wherever volumetric measurement is required, the volume will be computed from the depth determined as indicated in 1. and 2. above and using the authorised width (W) determined in accordance with the specification.
6. Where shoring is specified or ordered, the length of shoring measured for payment will be the length of the centre-line of the trench.

(iii) Items that will not be measured separately

The following activities, whether required to complete the specified work or not, will not be measured and paid for separately and the Contractor shall include the cost thereof in other pay items as the Contractor deems appropriate:

1. No separate payment will be made for backfilling excess excavations, disposing of surplus material etc. or any other contingent work, unless the work is specifically specified or ordered.
2. No separate payment will be made for setting out the works.
3. No separate payment will be made for the protection or repair as required of any existing or new road furniture, structures, buildings, infrastructure or services damaged by the Contractor's activities and for complying with all the requirements of Clause A2.1.3.4.
4. No additional payment shall be made, nor shall any claim for additional payment be considered, for any specified work in confined or restricted areas. Any additional costs associated with working in confined or restricted areas shall be deemed to be included in the standard applicable pay items.
5. No separate payment will be made for the loading of any materials.
6. No separate payment will be made for the hauling of any materials where the material is moved over a distance of less than and up to 1,0 km.
7. No separate payment will be made for transporting materials from commercial sources irrespective of the haul distance.
8. No separate payment will be made for the removal of any surplus material imported to complete the works.

(iv) Items to be measured and paid for using items specified elsewhere in the specifications

For activities in Table C2.1-1 pay items specified in other Chapters or Sections of the specifications, where they relate to work under this section, will be listed in the Pricing Schedule.

Table C2.1-1: Payment items from other Chapters or Sections

Activity	Section 2.1 reference	Section item reference
Traffic accommodation	A2.1.3.3c) & A2.1.3.9b)	Section C1.5 of Chapter 1 - All applicable items
The removal of large trees (girth exceeding 1,0 m) and the removal and conservation of topsoil	A2.1.7.1e)	Section C1.6 of Chapter 1 - All applicable items

Hauling materials	C2.1.6, C2.1.9, C2.1.11, C2.1.17 & C2.1.23	Section C1.7 of Chapter 1 - All applicable items
Borrow and spoil areas: - Opening and closing down - Excess overburden - Rehabilitation	C2.1.11, C2.1.17 & C2.1.23	Section C4.1 of Chapter 4 - All applicable items
Temporary stockpiling of excavated material	A 2.1.7.1f)	Section C4.1 of Chapter 4 - All applicable items
Segmented block and in situ concrete paving	A 2.1.7.2b)	Section C6.2 of Chapter 6 – All applicable items
Activity	Section 2.1 reference	Section item reference
Road markings	A 2.1.7.2c)	Section C11.7 of Chapter 11 - All applicable items 7
Placing of top soil and establishment of vegetation	A2.1.7.1e), A2.1.7.2d), C2.1.6 & C2.1.9	Section C11.8 of Chapter 11 - All applicable items
Trenchless methods	A2.1.7.5	Section C12.7 of Chapter 12 - All applicable items
Special concrete and steel structures	A 2.1.7.3	Chapter 13 - All applicable items

(v) Items specifically for this Section of the specification

Item	Description	Unit
C2.1.1	Location, identification, protection and relocation of existing services	
C2.1.1.1	Contractor's obligations	lump sum
C2.1.1.2	Permanent services relocation or protection work by others	prime cost (PC) sum
C2.1.1.3	Handling costs and profit in respect of item C2.1.1.2 above	percentage (%)
C2.1.1.4	Permanent services relocation or protection work by the Contractor	provisional sum
The lump sum tendered under item C2.1.1.1 shall be in full compensation for all the Contractor's obligations under Clauses A2.1.3.2, A2.1.3.3a), A2.1.3.3b) and A2.1.3.5 for the location, identification and protection of existing services and for safety and safeguarding and the programming for services.		

The prime-cost item C2.1.1.2 shall be paid for work done by others in accordance with the provisions of the conditions of contract for work ordered or agreed by the Engineer. The tendered percentage for item C2.1.1.3 is a percentage of the amount actually spent under the prime-cost item, which shall include full compensation for the handling, supervision and liability costs of the Contractor and the profit in connection with providing the specified service.

The provisional sum under item C2.1.1.4 shall be paid for work done by the Contractor accordance with the provisions of the conditions of contract for work ordered or agreed by the Engineer.

Item	Description	Unit
C2.1.2	Existing services location, detection and verification	
C2.1.2.1	Using specialist detection services (ground penetrating radar, radio detection etc.)	prime cost (PC) sum
C2.1.2.2	Handling costs and profit in respect of item C2.1.2.1 above	percentage (%)
C2.1.2.3	Survey to verify existing service positions	prime cost (PC) sum
C2.1.2.4	Handling costs and profit in respect of item C2.1.2.3 above	percentage (%)
C2.1.2.5	Using hand excavation to locate, expose and verify services	cubic metre (m ³)
The prime-cost item C2.1.2.1 will cover the costs of any specialist detection services used to locate, detect and verify existing services. The use of any specialist detection service providers shall be approved by the Engineer prior to their appointment.		

The prime-cost item C2.1.2.3 will cover the costs of any survey services used to determine, fix and record the positions of an existing service after it has been located. The use of any survey service providers shall be approved by the Engineer prior to their appointment.

The prime-cost items C2.1.2.1 and C2.1.2.3 shall be paid for in accordance with the provisions of the conditions of contract. The tendered percentage for items C2.1.2.2 and C2.1.2.4 shall be a percentage of the amount actually spent under the prime-cost item, which shall include full compensation for the handling, supervision and liability costs of the Contractor and the profit in connection with providing the specified service.

The unit of measurement for item C2.1.2.5 shall be a cubic metre of material excavated within the lengths and widths authorised by the Engineer and the depth required to expose the service. Excavation in excess of the authorised dimensions shall not be measured for payment.

The tendered rate for item C2.1.2.5 shall include full compensation for all excavation, backfilling, compacting to 90 % of MDD, disposing of any surplus excavated material, keeping the excavations safe, dealing with any surface or subsurface water, taking special care to ensure that services are not damaged in any way and any other operation necessary for completing the work. The tendered rate shall also include the transporting of surplus excavated material for a haul distance of 1,0 km. Any damage to a service caused by the Contractor's negligence shall be repaired at his

own cost, to the satisfaction of the owner of the service and the Engineer. No distinction will be made between the classes of material, neither will distinction be made between the various types of services to be exposed or the depths to which excavations are taken.

and paid for as trench excavations. Where saw-cutting of the excavation edge is required and/or ordered prior to excavation it will be measured and paid under the relevant items.

C2.1.7 Extra over items C2.1.6, C2.1.8 and C2.1.16 for excavating in:

C2.1.7.1	Hard material irrespective of depth	cubic metre (m ³)
C2.1.7.2	Stabilised material irrespective of depth	cubic metre (m ³)

The unit of measurement shall be the cubic metre of material excavated (irrespective of depth) and classified as hard material or as stabilised material, in accordance with the classification in Clauses A2.1.7.1i)(i) and A2.1.7.1i)(ii).

The tendered rates shall be paid over and above the rate tendered for excavation in respect of items C2.1.6, C2.1.8 and C2.1.16 and shall include 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	Description	Unit
C2.1.8	Excavations outside the normal trench profile	cubic metre (m³)

The unit of measurement shall be the cubic metre of material excavated, if necessary, using excavating equipment or by hand outside the normal trench profile as specified in Clause A2.1.7.1k).

The tendered rate shall include full compensation for excavating outside the normal trench profile, trimming the excavations, preparing the bottom of the excavation, separating any material unsuitable for backfill from selected backfill material, keeping excavations safe, dealing with any surface or subsurface water and for the temporary stockpiling of material unless otherwise specified in the Contract Documentation.

Item	Description	Unit
C2.1.9	Trench excavation using labour enhanced construction methods	

C2.1.9.1	Trenches up to 1,0 m wide (in soft material)	
(a)	Up to 1,0 m deep	cubic metre (m ³)
(b)	Over 1,0 m and up to 1,5 m deep	cubic metre (m ³)
C2.1.9.2	Trenches over 1,0 m and up to 2,0 m wide (in soft material)	
(a)	Up to 1,0 m deep	cubic metre (m ³)
(b)	Over 1,0 m and up to 1,5 m deep	cubic metre (m ³)
C2.1.9.3	Trenches up to 1,0 m wide (in intermediate material)	
(a)	Up to 1,0 m deep	cubic metre (m ³)
(b)	Over 1,0 m and up to 1,5 m deep	cubic metre (m ³)
C2.1.9.4	Trenches over 1,0 m and up to 2,0 m wide (in intermediate material)	
(a)	Up to 1,0 m deep	cubic metre (m ³)
(b)	Over 1,0 m and up to 1,5 m deep	cubic metre (m ³)

The unit of measurement shall be the cubic metre of soft or intermediate material, classified in accordance with Clause B2.1.7.1, excavated using labour enhanced construction methods and hand tools (picks and/or hand shovels) as instructed or authorised in writing by the Engineer in accordance with the provisions of Clauses A2.1.7.1j). Excavation will be classified according to the various depths and widths listed. The depth classification shall be in accordance with the actual depth of the trench for each length of trench excavated and not in accordance with the depth range in which material is situated before excavation i.e. for a section of trench which is up to 1,0 m wide and 1,3 m deep the total volume of excavation will be measured under item C2.1.9.1(b). For measurement purposes the width of a trench shall be determined from the authorised 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 duct or pipe.

The tendered rates shall include full compensation for setting out, 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 and stacking of any surfacing and paving material as applicable, for excavating the trench, preparing the bottom of the trench, separating topsoil, material unsuitable for backfill and selected backfill material, for safeguarding and keeping the excavations safe, which includes the provision, installation and later removal of temporary timbering, shoring and strutting, dealing with any surface or subsurface water and for the temporary stockpiling of material unless otherwise specified in the Contract Documentation. Excavations in bolsters i.e. tunnels less than 3,0 m in length will be measured and paid for as trench excavations. Where saw-cutting of the excavation edge is required and/or ordered prior to excavation it will be measured and paid under the relevant pay items. The tendered rates shall include full compensation for loading and transport by wheelbarrow if the material is disposed of or utilised within a

distance of 50 m of the point of excavation, or alternatively loading by hand onto transport vehicles for such disposal or utilisation elsewhere, within a haul limit of 1,0 km.

Item C2.1.9 shall be applicable where excavation by hand is required in terms of Clauses A2.1.3.9a) and A2.1.7.1j).

C2.1.10 Excavation in tunnels exceeding 3,0 m in length in:

C2.1.10.1 Soft material cubic metre (m³)

C2.1.10.2 Hard material cubic metre (m³)

The unit of measurement shall be the cubic metre of material excavated in tunnels exceeding 3,0 m in length in accordance with the authorised dimensions.

The tendered rates shall be in full compensation for excavating by hand or machine in tunnels through soft material or hard material, separating any material unsuitable for backfill from selected backfill material, keeping excavations safe, dealing with any surface or subsurface water, for supporting the roof if necessary, for compacting the floor of the tunnel if necessary, and for temporary stockpiling of material unless otherwise specified in the Contract Documentation.

This item shall apply only to tunnels exceeding 3,0 m and up to 10,0 m in length. Tunnels up to 3,0 m long i.e. bolsters, shall be paid as trench excavation.

Item	Description	Unit

C2.1.11 Backfilling of trenches

C2.1.11.1 Backfill compacted to 93 % (100 % for sand) of MDD (areas subject to traffic loads) using material:

(a)	From the excavated trench material	cubic metre (m ³)
(b)	From other excavations on site	cubic metre (m ³)
(c)	From approved borrow areas	cubic metre (m ³)
(d)	From sources provided by the Contractor	cubic metre (m ³)
(e)	From commercial sources (state material type)	cubic metre (m ³)

C2.1.11.2 Backfill compacted to 90 % (100 % for sand) of MDD or complying with the DCP requirements of Clause A2.1.8.2c) (areas not subject to traffic loads) using material:

(a)	From the excavated trench material	cubic metre (m ³)
(b)	From other excavations on site	cubic metre (m ³)
(c)	From approved borrow areas	cubic metre (m ³)
(d)	From sources provided by the Contractor	cubic metre (m ³)
(e)	From commercial sources (state material type)	cubic metre (m ³)

The unit of measurement for items C2.1.11.1 and C2.1.11.2 shall be the cubic metre of backfill material in place after compaction calculated from the specified or authorised trench excavation dimensions and placed above the fill blanket or bedding, as applicable. Backfill required for trenches excavated outside the specified or authorised dimensions will not be measured unless such excavation is authorised and measured under item C2.1.8.

The tendered rates shall be in full compensation for the backfilling of trenches including placing the material in the trench, watering and compacting the backfill to the specified minimum density using relative density or DCP compaction control as applicable.

The tendered rates for items C2.1.11.1(b), C2.1.11.1(c), C2.1.11.2(b) and C2.1.11.2(c) shall include full compensation for the additional cost of excavation in all materials, for loading the material from an excavation on site or from a borrow pit, for hauling the material within a haul limit of 1,0 km and for unloading the material for placement. The tendered rate for items C2.1.11.1(c) and C2.1.11.2(c) shall include full compensation for all operations at borrow pits not subject to any specified separate pay item.

The tendered rates for items C2.1.11.1(d), C2.1.11.1(e), C2.1.11.2(d) and C2.1.11.2(e) shall include full compensation for the payment of any royalties or charges for procuring and furnishing the material from sources provided by the Contractor or from commercial sources as well as for transporting the material over an unlimited haul distance.

Item	Description	Unit
C2.1.12	Backfilling additional excavations in trench floors due to poor founding conditions using:	
C2.1.12.1	Geotextile (state grade or class)	square metre (m ²)
C2.1.12.2	Concrete aggregate (37,5 mm aggregate size)	cubic metre (m ³)

cubic metre (m³)

The tendered rates for items C2.1.12.1, C2.1.12.2 and C2.1.12.3 shall include full compensation for procuring, furnishing and placing the geotextile, aggregate or concrete on the trench bottom including any mixing or compaction required.

Where the Engineer orders that selected backfill material or soil cement be used to backfill the trench bottom payment shall be made under items C2.1.11 and C2.1.13.

Item	Description	Unit
C2.1.13	Extra over item C2.1.11 for backfilling with soil cement or stabilised material	
C2.1.13.1	Backfilling trenches using soil cement using (state type of material i.e. G5, G7 or G8) material	cubic metre (m ³)
C2.1.13.2	Backfilling trenches using stabilised (state type of material i.e. G5, G7 or G8) material compacted to 93 % of MDD	cubic metre (m ³)
C2.1.13.3	Backfilling around poles using stabilised (state type of material i.e. G5, G7 or G8) material compacted to 95 % of MDD	cubic metre (m ³)
C2.1.13.4	Cement (state class of cement)	kilogram (kg)

The unit of measurement for item C2.1.13.1 shall be the cubic metre of soil cement material in place calculated from the specified or authorised trench excavation dimensions less the volume occupied by a duct, pipe, casing, pole or footing.

The unit of measurement for items C2.1.13.2 and C2.1.13.3 shall be the cubic metre of cement stabilised material in place after compaction calculated from the specified or authorised trench or hole excavation dimensions less the volume occupied by a duct, pipe, casing, pole or footing.

The unit of measurement for item C2.1.13.4 for the cement added to achieve the cement content, as instructed by the Engineer, in soil cement and stabilised material shall be the kilogram.

The tendered rate for item C2.1.13.1 shall include full compensation for the additional costs of procuring and furnishing the type of material specified and for mixing in the cement and placing and compacting the soil cement material as specified in Clause A2.1.7.1s(i). Payment for the backfill material mixed with the cement will be made under item C2.1.11.

The tendered rates for items C2.1.13.2 and C2.1.13.3 shall include full compensation for procuring and furnishing the type of material specified and for mixing in the cement and placing and compacting the stabilised material. Payment for the backfill material mixed with the cement will be made under item C2.1.11.

The tendered rate for item C2.1.13.4 shall include full compensation for procuring and furnishing the cement added to achieve the final cement content, as instructed by the Engineer, in soil cement or stabilised material.

Item	Description	Unit
C2.1.14	Extra over items C2.1.11, C2.1.12 and C2.1.13 for additional compaction of backfill	
C2.1.14.1	Compaction increased from 90 % of MDD to 93 % of MDD	cubic metre (m ³)
C2.1.14.2	Compaction increased from 93 % of MDD to 95 % of MDD	cubic metre (m ³)
C2.1.14.3	Compaction increased from 95 % of MDD to 98 % of MDD	cubic metre (m ³)

The unit of measurement shall be the cubic metre of material subjected to additional compaction, as ordered by the Engineer.

The tendered rates shall be paid as extra over the rates for items C2.1.11, C2.1.12 and C2.1.13 and shall include full compensation for the additional cost resulting from a higher compaction requirement for backfill ordered by the Engineer. Payment under this item will only be made where the Engineer has ordered, in writing, that a specified part or parts of the backfill be compacted to a higher minimum density than the standard specified under items C2.1.11, C2.1.12 and C2.1.13.

Item	Description	Unit
C2.1.15	Stone packing	
C2.1.15.1	In bolsters	cubic metre (m ³)
C2.1.15.2	In tunnels	cubic metre (m ³)

The unit of measurement shall be the cubic metre of stone packing constructed as specified in Clause A2.1.7.1o), determined from the authorised dimensions. The tendered rates shall include full compensation for procuring, furnishing and placing the stones and sand required, including all haul, and for hand packing the stones and filling the voids with sand as specified.

Item	Description	Unit
C2.1.16	Subsurface drains in trench bottoms (Contract Documentation reference or drawing number indicated)	metre (m)

The unit of measurement shall be the metre of subsoil drain constructed complete as specified or 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 geotextiles and pipes and the supply and placing of any drainage aggregate. The rate shall be subject to an extra overpayment under item C2.1.7 and shall also be subject to additional payment under item C2.1.17 for the removal disposal of any surplus or unsuitable excavated material to spoil sites provided either by the Employer or the Contractor.

Item	Description	Unit
C2.1.17	Removal and disposal of spoil material from trench excavations:	

C2.1.17.1 To spoil sites provided by the Employer as indicated in the Contract Documentation or as cubic metre (m³) instructed by the Engineer

C2.1.17.2 To spoil sites or dumping areas provided by the Contractor cubic metre (m³)

The unit of measurement shall be the cubic metre of material surplus to requirements or unsuitable for further use as backfill etc., calculated from the specified or authorised trench excavation dimensions, and which has to be spoiled as ordered by the Engineer.

The tendered rate for items C2.1.17.1 and C2.1.7.2 shall include full compensation for loading, off-loading and disposing of spoil material from trench excavations as specified including shaping and levelling off of any piles of spoil material. The tendered rate for item C2.1.17.1 shall also include full compensation for hauling the material up to the haul limit of 1,0 km. The tendered rate for item C2.1.7.2 shall also include full compensation for hauling the material over an unlimited distance, for providing the spoil site or dump area and the rate shall include any relevant payments to the affected land or dump site owners.

The tendered rates shall also include the provision of haul roads and the clearing up and finishing of haul roads, spoil sites and dumping areas on completion of the work. Where spoil is paid under pay item C2.1.17.1 the relevant pay items for finishing-off and rehabilitating borrow areas will apply.

Item	Description	Unit
C2.1.18	Timbering, strutting and shoring	
C2.1.18.1	Timbering, strutting and shoring left in excavations	square metre (m ²)

C2.1.18.2 Timbering, strutting and shoring opposite a structure or service (state reference in Contract metre (m) Documentation or indicate drawing number etc.)

Item C2.1.18.1 will only be applicable, as indicated in Clause A2.1.7.1)(ii), where the Engineer instructs that timbering, strutting and shoring be permanently left in place in excavations. The unit of measurement for item C2.1.18.1 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.

Item C2.1.18.2 will only be applicable, as indicated in Clause A2.1.7.1)(ii), where separate payment for timbering and shoring is indicated and described in the Contract Documentation. The unit of measurement for item C2.1.18.2 shall be the metre of trench shored opposite a structure or service as agreed by the Engineer. The length measured for payment will be that of the centre-line of the trench regardless of whether supports are placed on one or on both sides of the trench.

The tendered rate for item C2.1.18.1 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.

The tendered rate for item C2.1.18.2 shall include full compensation for the cost, for both sides of the trench if necessary, of the supply, placing, maintenance and removal of timbering and other support measures together with any cost that results from the inconvenience of working in the supported trench and the cost of any risks inherent in the operation.

Item	Description	Unit
C2.1.19	Dealing with water during services work	
C2.1.19.1	Dealing with surface water	lump sum
C2.1.19.2	Dealing with subsurface water	lump sum

The tendered sums for items C2.1.19.1 and C2.1.19.2 shall cover the cost for the provision, operation, maintaining and removal of all construction equipment and materials required to deal with any water anywhere on the site as required in terms of Clause A2.1.7.1r)(i).

The lump sum shall cover the cost of providing the necessary construction equipment or materials, or both, fully erected and operative on the site, and shall cover the cost of operating and maintaining pumps, well points, sheeting, close timbering, and other equipment, as applicable, for 24 hours a day, 7 days a week, throughout the period during which the facilities are required, and shall cover the cost of removing such goods and restoring the site to its original condition on completion of that part of the contract for which the temporary works were erected.

Two equal payments will be made under each subitem, the first after the Contractor has commenced with the services work and the second when all the services work has been completed.

Item	Description	Unit
C2.1.20	Specified temporary works to control water inflow (state reference in Contract Documentation or indicate drawing number etc.)	
C2.1.20.1	Provide equipment	lump sum
C2.1.20.2	Operate and maintain	day
C2.1.20.3	Remove equipment	lump sum

Item C2.1.20 will only be applicable, as indicated in Clause A2.1.7.1r)(ii), where separate payment for the control of water inflow is indicated in the Contract Documentation. The unit of measurement for item C2.1.20.2 shall be the 24 hour day.

The sums tendered for items C2.1.20.1 and C2.1.20.3 shall include full compensation for the provision and removal of equipment and shall cover the cost of providing the necessary equipment or materials or both, fully erected and operative on the site, and of removing such goods and restoring the site to its original condition on completion of that part of the contract for which the temporary works were erected.

The rate tendered for item C2.1.20.2 shall include full compensation for operation and maintenance and shall cover the cost of operating and maintaining the pumps, well points, sheeting, close timbering and other equipment, as applicable, for 24 hours per day, 7 days a week throughout the period during which, as agreed by the Engineer, the facilities are required.

Item	Description	Unit

C2.1.21 Supply and installation of sandbags in trenches

C2.1.21.1 Biodegradable bags (state bag size, material type and description) number of bags (No)

C2.1.21.2 Geofabric bags (state bag size, material type and description) number of bags (No)

The unit of measurement shall be the number of bags filled with soil installed in accordance with the Clause A2.1.7.1n). The tendered rates shall include full compensation for supplying the bags and suitable material to fill the bags, filling of the bags with soil and placing the bags as required and shall also include all associated transport costs. The tendered rates shall include full compensation for removing the bags when no longer required.

Item	Description	Unit

C2.1.22 Existing services that intersect or adjoin a trench

C2.1.22.1 Services that intersect a trench (angles between centre-lines in plan 45 ° to 90 °)

(a) State type and size of each intersecting service number (No)

(b) State type and size of each intersecting service number (No)

(c) State type and size of each intersecting service etc. number (No)

Services that adjoin a trench (parallel to or at an angle between

C2.1.22.2 centre-lines in plan of less than 45 °)

(a) State type and size of each adjoining service metre (m)

(b) State type and size of each adjoining service metre (m)

(c) State type and size of each adjoining service etc. metre (m)

The unit of measurement for item C2.1.22.1 shall be the number of underground services intersected by the trench excavated. Existing water pipes, sewers, stormwater pipes, concrete-lined channels and drains, box culverts, electric or other telecommunication cables, ducts, kerbs, channels, erf connections and various sizes of pipes and services that intersect a trench of specified width and require various degrees of care, whether or not their presence was known before they were uncovered, will be measured separately. The unit refers to one service, but services that are so grouped that they can be contained within a horizontal dimension of 300 mm measured at right angles to the axis of the services will be measured as one unit.

The unit of measurement for item C2.1.22.2 shall be the metre of trench excavated where there are adjoining services. In a case where a trench of specified width:

- Runs parallel to or at an angle (in plan) of less than 45 ° to an existing service, and
- Is such that the nearer side of the bottom of the trench lies at least partly between a vertical plane and a plane that lies at an angle of 45 ° below the horizontal, both planes passing through the axis of the service,

the length of service within the minimum base width of the trench, determined in accordance with Clause A2.1.7.1h), will be measured for payment under this item and the remaining length, the side of the trench which, as agreed by the Engineer, is rendered liable to collapse because of the existence of such service, will be measured for shoring.

The tendered rates for items C2.1.22.1 and C2.1.22.2 shall include full compensation for the additional cost of:

- Care in excavation necessitated by the presence of services adjacent to, in or across a trench;
- Protecting and maintaining such services in operation by means of temporary supports or shoring, as necessary;
- Delays and disruption of the progress of the work due to the existence of the services; and
- Repairs necessitated by damage caused by the Contractor.

Item C2.1.22 shall not be applicable where any services are to be removed and where payment will therefore be made under item C1.2.25.

Item	Description	Unit
C2.1.23	Reinstatement of trenches in existing surfaced roads using:	
C2.1.23.1	Selected material (state material type and source e.g. G7 or G8, commercial/borrow pits/etc. and layer thickness) compacted to (state minimum compaction) % of MDD	cubic metre (m ³)
C2.1.23.2	Subbase material (state material type and source e.g. G5 or G6, commercial/borrow pit etc. and layer thickness) compacted to (state minimum compaction) % of MDD	cubic metre (m ³)
C2.1.23.3	Stabilised subbase material (state material type and source e.g. C3 or C4, commercial/borrow pit etc. and layer thickness) using (state percentage and type of stabilising agent) compacted to (state minimum compaction) % of MDD	cubic metre (m ³)
C2.1.23.4	Base material (state material type and source e.g. G1 or G2, commercial/quarry etc. and layer thickness) compacted to (state minimum compaction either 102 % for G2 or 104 % for G1) % of MDD	cubic metre (m ³)
C2.1.23.5	Prime coat (state type of material and application rate)	square metre (m ²)
C2.1.23.6	Tack coat (state type of material and application rate)	square metre (m ²)

C2.1.23.7	Asphalt material (state asphalt type e.g. continuously graded, binder type, layer thickness and minimum density)	ton (t)
C2.1.23.8	Surface treatments (state surfacing type, binder type and application rate, aggregate size and application rate etc.)	square metre (m ²)

The unit of measurement for items C2.1.23.1, C2.1.23.2, C2.1.23.3 and C2.1.23.4 shall be the cubic metre of compacted pavement layer constructed during the reinstatement of existing surfaced roads. The unit of measurement for items C2.1.23.5 and C2.1.23.6 shall be the square metre of prime or tack coat placed during the reinstatement of existing surfaced roads. The unit of measurement for item C2.1.23.7 shall be the ton of compacted asphalt and the unit of measurement for item C2.1.23.8 shall be the square metre of surface treatment both placed during the reinstatement of existing surfaced roads. Items C2.1.23.1 to C2.1.23.8 will be measured in accordance with the authorised dimensions for the reinstatement area required. Any reinstatement required beyond the agreed or instructed dimensions owing to damage caused by the Contractor will not be measured for payment.

The tendered rates shall include full compensation for procuring, furnishing, placing, compacting and finishing all the materials including stabilising the layers as may be required and including full compensation for providing all labour and construction equipment, preparing the edges of the existing surfacing and protecting and maintaining the completed reinstatement as specified. The tendered rate shall also include full compensation for any temporary backfilling with excavated material and for compacting, maintaining and later removing the temporary material as specified in Clause A2.1.7.2b).

Where the materials are supplied from sources provided by the Contractor or from commercial sources the tendered rates shall include full compensation for the payment of any royalties or charges for procuring the material from sources provided by the Contractor or from commercial sources as well as for transporting the material over an unlimited haul distance. Where the materials are sourced from borrow pits or quarries provided by the Employer or other sources on site the tendered rates shall include full compensation for hauling the materials within the haul limit of 1,0 km, for unloading the material for placement and for all operations at borrow pits or quarries not subject to any specified separate pay item.

The backfill of the trench up to the bottom of the layers measured under item C2.1.23 will be paid for under items C2.1.11, C2.1.12, C2.1.13 and C2.1.14 as applicable.

Item	Description	Unit
C2.1.24	Saw-cutting before excavation	
C2.1.24.1	Saw-cutting asphalt to an average depth:	
(a)	Not exceeding 50 mm square metre (m ²)	
(b)	Exceeding 50 mm but not exceeding 100 mm square metre (m ²)	
(c)	Exceeding 100 mm but not exceeding 150 mm square metre (m ²)	
C2.1.24.2	Saw-cutting concrete to an average depth:	
(a)	Not exceeding 50 mm square metre (m ²)	
(b)	Exceeding 50 mm but not exceeding 100 mm square metre (m ²)	
(c)	Exceeding 100 mm but not exceeding 150 mm square metre (m ²)	
C2.1.24.3	Saw-cutting other materials (type of material to be specified) to an average depth:	
(a)	Not exceeding 50 mm square metre (m ²)	
(b)	Exceeding 50 mm but not exceeding 100 mm square metre (m ²)	
(c)	Exceeding 100 mm but not exceeding 150 mm square metre (m ²)	

The unit of measurement shall be the square metre of cut area, saw-cut before excavation in accordance with Clause A2.1.7.1d), calculated in accordance with the authorised length of cut and the average depth measured after excavation of the material.

The tendered rates for item C2.1.24 shall include full compensation for all construction equipment, tools, labour, supervision, materials, transport and for all incidentals for cutting the asphalt, concrete or other materials complete as specified and also for work in restricted areas.

Item	Description	Unit
C2.1.25	Removal of existing services:	
C2.1.25.1	State type and size of each service (duct, pipe or cable) removed	metre (m)
C2.1.25.2	State type and size of each service (duct, pipe or cable) removed	metre (m)
C2.1.25.3	Etc., insert additional items as required	metre (m)

The unit of measurement shall be the metre of existing service of each type removed.

The tendered rates for item C2.1.25 shall include full compensation for removing an existing service including dismantling the service, uplifting, loading, off-loading and storing the recovered material on site as agreed with the Engineer. The tendered rates shall include full compensation for removing all joints, specials, valves etc associated with the service removed.

The demolition of any structures and the excavation and backfill that may be associated with the removal of a service will be measured and paid separately.

Item	Description	Unit
C2.1.26	Disposal of existing service materials:	
C2.1.26.1	State type and size of each service (duct, pipe or cable) disposed of	metre (m)
C2.1.26.2	State type and size of each service (duct, pipe or cable) disposed of	metre (m)
C2.1.26.3	Etc., insert additional items as required	metre (m)

The unit of measurement shall be the metre of existing service material disposed of in accordance with Clause A2.1.7.6.

The tendered rate for item C2.1.26 shall include full compensation for disposing of existing service material including loading, removal from site, transporting the material over an unlimited haul distance and off-loading the material at the disposal site. The tendered rates shall include full compensation for disposing of all joints, specials, valves etc associated with the service, for any related disposal costs and for providing the Engineer with the disposal records. The tendered rates may be positive or negative as considered appropriate by the Contractor for each service type.

The removal of services will be measured and paid separately under item C2.1.25.

Item	Description	Unit
C2.1.27	Demolition of existing manholes, access chambers and other service structures consisting of:	
C2.1.27.1	Unreinforced concrete	cubic metre (m ³)
C2.1.27.2	Reinforced concrete	cubic metre (m ³)
C2.1.27.3	Masonry	cubic metre (m ³)

The unit of measurement shall be the cubic metre, measured prior to demolition, of concrete or masonry demolished and disposed of.

The tendered rate shall include full compensation for all labour and construction equipment and for all work necessary for, and incidental to, the demolition of the structures. The tendered rates shall include full compensation for the disposal of all rubble and material from the demolition at an approved disposal site including transporting the material over an unlimited haul distance to the disposal site.

For the purposes of this item reinforced concrete shall be taken to mean concrete which contains at least 0,2 % of steel by volume.

Excavation and backfilling will be measured and paid separately.

A2.4 ENERGY AND OTHER SERVICES PART A: SPECIFICATIONS

A2.4.1 SCOPE

Section A2.4 of Chapter 2 covers the civil construction work associated with the installation in road reserves of street lighting and electric power and other energy services (gas and fuel pipelines) and any other types of services (not dealt with elsewhere in Chapter 2) as specified in the Contract Documentation.

It should be noted that Section A2.4 of Chapter 2 only covers excavation and backfilling work for electric power and street lighting services. The section does not cover the supports (poles, struts, stays, pylons, gantries etc.) or the cables or other electric plant associated with such infrastructure which would be installed by specialist contractors or subcontractors with the appropriate skills, experience and equipment required to do such work.

Work on certain energy (gas and fuel pipelines and higher voltage (HV, EHV and UHV)) services, due to their nature, is specialised and therefore few standard specifications and conditions are considered to be applicable to such work. All energy services shall therefore be installed at the locations shown, and in accordance with, the specifications and details shown on the drawings or provided in the Contract Documentation or as directed by the Engineer.

The purpose of Section A2.4 is therefore partly to provide a structured framework for the Contract Documentation for civil construction work related to energy services or any other types of services not dealt with elsewhere in Chapter 2.

A2.4.1.1 Applicable supporting specifications

Section A2.4 of Chapter 2 shall be used in conjunction with, amongst others, the following standards or specifications:

SANS 4437-1	Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) Part 1: General
SANS 4437-2	Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) Part 2: Pipes
SANS 4437-3	Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) Part 3: Fittings
SANS 4437-5	Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) Part 5: Fitness for purpose of the system
SANS 10198-5	The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 5: Determination of thermal and electrical resistivity of soil
SANS 10198-8	The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 9: Cable laying and installation
SANS 10225	The design and construction of lighting masts

Where the documents referenced are undated the latest edition of the referenced document (including any amendments) shall apply. Where references are dated only the edition cited shall apply.

In certain SANS documents referred to in this section the term "*specified in the scope of work*" is used. For the purposes of this specification the term shall be deemed to mean "*specified in the Contract Documentation*".

A2.4.2 DEFINITIONS

The following definitions shall apply to these specifications:

Extra high voltage (EHV) - the set of nominal voltage levels that are used in power systems for bulk transmission of electricity in the range $220 \text{ kV} < U_n < 400 \text{ kV}$.

Fuel - see *Gas and Fuel*.

Gas and fuel - any hydrocarbon gas fuel transported by pipeline.

Gaseous fuel - fuel which is in a gaseous state at a temperature of 15°C and a pressure of 1 bar.

High voltage (HV) - the set of nominal voltage levels that are used in power systems for bulk transmission of electricity in the range $44 \text{ kV} < U_n < 220 \text{ kV}$.

Low voltage (LV) - the set of nominal voltage levels that are used for the distribution of electricity and whose upper limit is generally accepted to be an a.c. voltage of 1 000 V (or a d.c. voltage of 1 500 V). Note that in certain fields of technology, for example electric motors and mining, voltages up to and including 1 100 V are traditionally regarded as low voltage.

Medium voltage (MV) - the set of nominal voltages that lie above low voltage and below high voltage in the range $1 \text{ kV} < U_n < 44 \text{ kV}$.

Ultra-high voltage (UHV) - the set of nominal voltage levels that are used in power systems for bulk transmission of electricity in the range $U_n > 400 \text{ kV}$.

A2.4.3 GENERAL

The location, identification, protection and relocation of existing services, unknown or unrecorded services shall be managed in accordance with Clause A2.1.3.2.

A2.4.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

The requirements of Clause A2.1.4 shall be applicable.

A2.4.5 MATERIALS

A2.4.5.1 General

All materials for energy services or other types of services (not specified elsewhere in Chapter 2 or in this Section) shall be in accordance with the standards or specifications indicated in the Contract Documentation.

A2.4.5.2 Bedding for electric power cables

Only sandy clay or loam soil with an acceptable thermal resistivity (not exceeding $1.2 \text{ K}\cdot\text{m}/\text{W}$ determined in accordance with SANS 10198-5) shall be used for bedding for electric power cables. Sea or river sand, ash, chalk, peat, clinker or clayey soil shall not be used. The use of crusher dust/sand is acceptable. The maximum aggregate size for bedding material shall be 5,0 mm and, if required, bedding material shall be sieved to meet that requirement. Where no suitable bedding material is available on site, the Contractor shall import material from other sources and make all the necessary arrangements to do so.

A2.4.5.3 Backfill for electric power cables

Backfill for electric power cables, unless otherwise specified in the Contract Documentation, shall be a material that complies with the requirements of Clause A2.1.5.1.

A2.4.5.4 Electric power warning tape

All cables shall be covered with a continuous brightly coloured corrosion proof (PVC or PE) electrical warning tape. The tape shall have a minimum thickness of 0,8 mm and a minimum width of 150 mm. The tape shall be yellow, marked with the words "ELECTRIC CABLE / ELEKTRIESE KABEL" in red letters at least 70 mm in height. These markings shall not be more than 0,5 m apart.

A2.4.5.5 Electric power concrete slab protection

Where indicated in the Contract Documentation concrete protective slabs shall be installed on electric power cable bedding, approximately 100 mm above MV cables, and shall be a minimum 300 mm wide and 50 mm thick. The slabs shall be constructed of class C16/20-14 concrete. Each slab shall be reinforced with 8,0 mm diameter mild steel bars with at least two longitudinal bars per 300 mm wide slab and transverse bars at a maximum 200 mm spacing.

A2.4.5.6 Electric power cable markers

Unless otherwise indicated in the Contract Documentation cable markers shall consist of concrete blocks in the shape of truncated pyramids, approximately 300 mm high, 150 x 150 mm at the top and 250 x 250 mm at the bottom. Recessed letters, a minimum of 50 mm high, shall be cast into the tops of the blocks with the wording "ELECTRIC CABLE" as well as direction arrows and the cable voltage rating.

A2.4.5.7 Polyethylene pipes for gaseous fuels

Unless otherwise indicated in the Contract Documentation when polyethylene pipes are used for the supply of gaseous fuels they shall comply with the requirements of SANS 4437-1, 4437-2, 4437-3 and 4437-5.

A2.4.6 CONSTRUCTION EQUIPMENT

A2.4.6.1 General

All equipment for the construction of energy services or other types of services (not dealt with elsewhere in Chapter 2) shall be in accordance with the standards or specifications indicated in the Contract Documentation.

A2.4.6.2 Other requirements

The specified requirements in Clause A2.1.6 shall apply to construction equipment used for the installation of energy services.

A2.4.7 EXECUTION OF THE WORKS

A2.4.7.1 General

All construction of energy services or other types of services (not dealt with elsewhere in Chapter 2), unless specified otherwise in Section A2.4, shall be in accordance with the standards or specifications indicated in the Contract Documentation.

Except as indicated in Clause A2.4.7.2 the requirements of Clause A2.1.7 shall apply mutatis mutandis to the installation of electric power cables.

Electric cable installation shall comply with the requirements of SANS 10198-8.

The specialist electrical or communications contractor or subcontractor shall be attendance during all critical trenching, bedding, backfilling or compaction activities.

A2.4.7.2 Trenching for electric power cables

a) Excavation

Trenches shall be excavated in straight sections as shown on the drawings or as instructed by the Engineer and shall be excavated to the dimensions indicated in this specification. The bottom of the trench shall have smooth contours and shall have no sharp dips or rises which may cause tensile forces in the cable during backfilling. Where levels are not specified the level of the bottom of the trench shall follow the contours of the final ground level. Where the excavation is in excess of the required depth the excavation shall be backfilled and compacted with approved material to the required depth. Prior to cable laying the trench shall be inspected thoroughly and all objects likely to cause damage to the cables during or after laying shall be removed.

Where ground conditions are likely to reduce the maximum current carrying capacities of cables or adversely affect cable insulation or where the cables are likely to be subjected to chemical or other damage or electrolytic action e.g. soil drenched with hydrocarbon based solvents such as oil, the Engineer shall be notified before installing the cables so that the Engineer can issue any necessary instructions.

b) Trench dimensions

(i) Trench width

The width for cable trenches shall be as specified in the Contract Documentation.

The minimum trench width for cables shall be 450 mm. The specified width shall apply to the total trench depth. The width shall be increased where more cables are installed to allow for the spacings stipulated in Clause A2.4.7.2b)(iii) with the minimum trench width allowing for a working space on each side of the cables measured between the centre of the outside cables and the side of the trench. Unless otherwise indicated in the Contract Documentation the working space width shall be 200 mm.

Where trenches change direction or where cable slack is to be accommodated, the Contractor shall ensure that the requirements of the relevant specification regarding the bending radii of cables are met when determining trench widths.

Excavations in excess of the 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.

(ii) Trench Depth

Trench depths shall be determined in accordance with cable laying depths and bedding thickness.

Unless otherwise indicated in the Contract Documentation cables shall be installed at the following minimum depths below final ground level:

Table A2.4.7-1: Minimum telecommunication and electric power cable depths

Cable Type	Minimum Installation Depth
Telecommunication cables	600 mm
Low voltage (LV) services cables	800 mm
Low voltage (LV) feeder cables	800 mm
Medium voltage (up to 11 kV)	1000 mm

Medium voltage (greater than 11 kV)	1200 mm
Other voltages and cable types	In accordance with the Contract Documentation
All voltages and cable types where, due to security reasons, concrete bedding or other protection is specified	1000 mm

All cable depth measurements shall be made to the top of the cable when laid directly in ground or to the top of the duct or sleeve where these are provided. The above depths shall apply to the top layer where cables are installed in layers. The Contractor may only deviate from the above depths provided prior authority in writing has been obtained from the Engineer. In the event that the minimum depths cannot be achieved the cables shall be protected with a suitable concrete covering.

The depth of cable ducts or pipes beneath railway lines or roads shall be not less than 1,1 m below the formation or road level as applicable.

Trenches shall be excavated to a total depth which take into account the bedding thickness requirements indicated in Clause A2.4.7.3.

(iii) Cable spacing

Cables installed in the same trench shall be laid parallel to each other with the following minimum spacings between cables (for the purposes of the list below MV refers to voltages up to 11kV).

Table A2.4.7-2: Minimum electric power cable spacings

Cable Type	Minimum Cable Spacing
LV/LV	2 cable diameters (minimum 25 mm)
LV/MV	150 mm
MV/MV	200 mm
LV/MV/PILOT	1 cable diameter

Where MV and LV cables have to be installed in the same trench, both shall be laid at a depth of 800 mm and then covered with 200 mm of bedding material. The bedding shall then be placed and compacted and the trench then backfilled and compacted layer by layer.

Cables for telephones, communication systems and other low voltage systems (less than 50V) shall be separated from power cables by at least 1,0 m horizontally. All control or pilot cables without a lead sheath and steel armouring shall be laid at least 300 mm from power cables.

Cables shall not be installed on top of each other unless separating layers are specified. The minimum spacing between layers shall be 200 mm. Where cables are to be installed on top of each other the work shall be done in accordance with the details provided in the Contract Documentation.

Cable laying shall be planned so that as far as possible cables do not cross each other. Where crossing is unavoidable, a vertical separation of not less than 150 mm shall be provided for cables of the same voltage and of 300 mm for cables of differing voltage.

A2.4.7.3 Bedding for electric power cables

The bottom of the trench shall be filled across the full width with a layer of bedding material and levelled off. After cable laying a further layer of bedding shall be placed above the cable. The bedding under joints shall be fully consolidated to prevent subsequent settling.

Normal bedding thicknesses for electric cables shall be as follows (unless otherwise stated the dimension indicated is the bedding thickness required above and below the cable(s)):

Table A2.4.7-3: Bedding thickness for electric power cables

Cable Type	Minimum Bedding Thickness
MV and LV cables in soft earth	75 mm
MV cables in other conditions (gravel / hard rock)	150 mm
LV kiosk feeder cables in other conditions (gravel / hard rock)	150 mm
LV service connection cables in other conditions (gravel / hard rock)	150 mm (above) 100 mm (below)

Refer to Clause A2.4.7.7 where security risks dictate the use of concrete bedding.

A2.4.7.4 Backfilling for Electric Power Cables

The Contractor shall not commence with the backfilling of trenches without prior notification to the Engineer so that the cable installation may be inspected. Such an inspection will not be unreasonably delayed. Should the Contractor fail to give a timeous notification, the trenches shall be re-opened at the Contractor's cost.

All loose stones or any other materials likely to cause damage to cables shall be removed from trenches or from any excavated material that may be used for backfill, before backfilling commences.

Backfilling of trenches shall be in layers not exceeding 150 mm thick. Compaction of backfill shall achieve the following field densities:

- In areas not subject to vehicular traffic loads 90 % of MDD
- In areas subject to vehicular traffic loads 93 % of MDD

Backfilling across grassed or landscaped areas may be in layers of 300 mm thickness. Removal and replacement of plants, shrubs, grass, etc. including care until growth is re-established, may be required. After completion of the work the route of the trench shall be neatly finished off and cleared. All stones bigger than 25 mm, as well as all loose organic material and rubble, shall be removed.

Where trenches cross a road carriageway and/or footways the reinstatement of the pavement layers and surfacing shall be in accordance with the requirements of Clause A2.1.7.2.

A2.4.7.5 Electric power cable warning tape

All cables shall be covered with an electrical warning tape. The tape/s shall cover all the cables installed in a trench. Where two tapes are laid side by side they shall overlap by at least 20 mm. The warning tapes shall be installed 400 mm above the upper cable in a trench.

A2.4.7.6 Electric power cable concrete slab protection

Where the minimum installation depths cannot be achieved due to the crossing of other services and the service cannot be crossed underneath cables must be protected by additional slabs in accordance with SANS 10198-8.

Where cables cross other services such as water pipes and sewage pipes or where it is possible that the cable may be damaged as a result of excavation by others, the cable shall be protected by means of reinforced concrete slabs.

The slabs shall protect the cable for a distance of 1,0 m on either side of the crossing or vulnerable area.

The slabs shall be installed 150 mm above the cables to be protected.

A2.4.7.7 Electric power cable concrete bedding

Cables installed in a road reserve, where the risk of cable theft is considered to be significant, shall, if specified in the Contract Documentation, be encased in class C16/20-20 concrete. The bottom of the trench must be filled with a 150 mm thick concrete layer, the cable installed while the concrete is still wet, and then the cable covered with a further 150 mm thick concrete layer. The concrete must extend all the way to inside the pole or kiosk where the cables terminate.

A2.4.7.8 Electric power cable markers

Cable markers shall, if specified in the Contract Documentation, be provided along cable routes. Cable markers, where specified, shall be installed on the surface along the underground routes and shall project 35 mm above normal ground level unless the projected markers could be a hazard to pedestrian or other traffic in which case they shall be installed flush with the surface. Cable markers shall be installed at the beginning and end of a cable run (e.g. where a cable enters a substation or building), at all changes of direction, above all joints, above cable duct entries and exits and at intervals not exceeding 50 m along the cable route. The position of cable markers shall be indicated on the record drawings.

A2.4.7.9 Steel supporting structures

Steel supporting structures for lighting and other energy services, such as lighting masts on concrete median barriers shall be carried out in accordance with the requirements of the Contract Documentation and in accordance with the applicable sections of this standard specification. All work shall adhere to the specified levels, alignments and tolerances.

A2.4.7.10 Overhead power lines

Overhead power lines shall be constructed in accordance with the requirements of SANS 10280 and SANS 10280-1.

A2.4.7.11 Polyethylene pipes for gaseous fuels

Unless indicated otherwise in the Contract Documentation or indicated on the drawings polyethylene pipes for gaseous fuels shall be installed in accordance with the requirements of ISO/TS 10839.

A2.4.8 WORKMANSHIP

The requirements of Clause A1.2.8 of Chapter 1 shall apply to the process and acceptance quality control for all services work dealt with in Section A2.4.

The Engineer may, at his discretion, elect to use some of the Contractor's process control test results if the Engineer is satisfied that the Contractor's process control requirements are acceptable for acceptance quality control purposes.

The requirements of Clause A1.2.3.14 of Chapter 1 shall apply to any remedial work required where any work or material does not comply with the specified requirements.

A2.4.8.1 General

The quality of materials and workmanship for energy services or other types of services (not dealt with elsewhere in Chapter 2) shall be in accordance with the standards or specifications indicated in the Contract Documentation.

A2.4.8.2 Tolerances

The excavation, backfilling and bedding for the installation of cables shall be controlled in line and level to ensure that the cable/s installed meet all statutory or specified cable depth, cover and clearance requirements.

CHAPTER 3: DRAINAGE

A3.1 DRAINS PART A: SPECIFICATIONS

A3.1.1 SCOPE

Drainage under this Section covers mainly open drains as well as subsoil drains and their associated works. This Section covers the work required for adequate surface, subsurface and piped drainage to ensure that the road and ancillary structures drain freely and without damage or risk to infrastructure and road users. It covers all work, both rehabilitation and new work, in connection with the excavation and construction of open drains, channels, subsoil drainage and banks and dykes at the locations and to the sizes, shapes, grades and dimensions as shown on the drawings, or as specified by the Engineer.

It also covers the cleaning of existing open drains, as well as the test flushing of existing and new subsoil drains and the repairing of existing subsoil drainage. In particular circumstances this work may be executed outside the road reserve.

Also covered is the clearing of existing culverts, including the removal of all materials which have accumulated in and around inlet and outlet structures and in the barrels of the culverts, which is likely to adversely affect the operation of the drainage system.

Excluded are the lining of any drains such as with concrete, stone pitching, vegetation, synthetic and alternative materials and wired mesh, which are covered under Section A11.1 of Chapter 11.

A3.1.2 DEFINITIONS

No specific definitions.

A3.1.3 GENERAL

No specific items.

A3.1.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

None applicable unless specific specifications have been accepted as proposed by the Contractor or included into the Contract Documentation.

A3.1.5 MATERIALS

A3.1.5.1 General material specifications

The material specifications are the required specifications for the materials as provided, placed and/or processed in final position for the drainage elements.

It is the Contractor's responsibility to ensure that the materials delivered and utilised for the drainage elements shall meet the specified requirements.

Materials removed under this Section from existing works, except where excavated materials are specified to be reused or disposed of, or except where provision has been made in Part C for their reuse or specific disposal, shall be deemed to be the property of the Contractor.

A3.1.5.2 Subsoil Drainage Materials

a) Pipes

The pipes for subsoil drainage systems to be used shall be either unplasticised PVC (U-PVC) pipes or high-density polyethylene (HDPE) pressure pipes with smooth inner bore and internal diameters as indicated on the drawings or in the Contract Documentation. Pipes shall have the specified internal diameter, which shall be not less than 100 mm (except for composite subsoil drainage systems), and shall be one of the following types:

- U-PVC pipes complying with SANS 791 for solid wall pipes (category-heavy duty) or SANS 1601 for structured wall pipes (stiffness class 350), which may be slotted or perforated for drainage in-flow as specified. The carrier portions of pipes shall not be slotted or perforated.
- HDPE pipes to be used with aggregate filled subsoil drains systems shall be slotted or perforated for groundwater in-flow as specified. HDPE pipes shall have a ring stiffness >450 kPa and slotted / perforated with 30 % solid invert and of twin wall construction, with a smooth inner bore and ribbed outer wall. The carrier portions of pipes shall not be slotted or perforated.

The size of perforations in perforated pipes shall in all cases be 8,0 mm in diameter $\pm 1,5$ mm and the number of perforations per meter shall not be less than 26 for 100 mm diameter pipes and 52 for 150 mm diameter pipes. Perforations shall be spaced in two rows for 100 mm pipes and as shown on the drawings for 150 mm pipes.

Slotted pipes shall have a nominal slot width of 8,0 mm $\pm 1,5$ mm. The arrangement of slots shall be 240 degrees of the circumference with the flow channel invert of 120 degrees. The total slot area shall not be less than that required for perforated pipes.

- Pipes for geocomposite fin type subsoil drainage systems may be HDPE, extruded into an open lattice wall structure with a wall thickness of minimum of 5,0 mm. Of the circumference area, 70 % shall consist of an open structure, and the remaining 30 % being the invert, shall be solid. Openings in the mesh structure shall be greater than 5,0 mm but less than 12 mm in size. Alternatively, U-PVC or HDPE pipes as specified above for aggregate filled drains may be used. The water infiltration capacity of the all types of pipes under a 200 mm static head shall not be less than 20 litres per second per metre pipe length (l/s/m) for 65 mm diameter pipes; not less than 55l/s/m for 100 mm diameter pipes and not less than 80l/s/m for 150 mm diameter pipes.

All slotted or perforated pipes shall retain 30 % of the pipe invert for conveyance of drainage and the top of the pipes shall externally carry a longitudinal marker line to ensure that pipes are correctly placed during construction.

Pipes without slots or perforations required for conveying ground water from the subsoil drainage proper, to the point of discharge, shall be UPVC or HDPE pipes of the types specified.

Pipes must be stored in a shaded area without exposure to direct sunlight, and stacked according to supplier's instructions. **b)**

Natural and crushed permeable material

Natural permeable filter materials for subsoil drainage shall consist of sand and/or crushed stone of suitable grading. Natural permeable materials shall conform to the following requirements:

Sand used for natural permeable material shall be clean, hard sand obtained from approved sources. The sand shall comply with the requirements of SANS 1083, Table 1: Sand, and shall be either coarse, medium or fine grade as specified. The nominal maximum particle size for the various grades shall be as shown in Table A3.1.5-1, and all sand shall be clean with not more than 5 % of the material passing through the 0,075 mm sieve.

Table A3.1.5-1: Natural permeable materials: Sand

Grade	Nominal maximum particle size (mm)
Coarse	5
Medium Fine	2
	0,2

Crushed stone used for natural permeable material shall comply with the requirements given in SANS 1083: Table 3: Stone for Concrete, and shall be either be fine (14 mm nominal size) or coarse (20 mm nominal size) as specified. Crushed stone shall be clean with not more than 5,0 % of the material passing through the 0,075 mm sieve.

When no suitable sand and/or crushed stone is available from borrow pits or designated quarries, the Engineer may require that it be procured from commercial sources.

c) Geotextiles

Should the use of geotextiles be specified in subsoil drainage systems, or as filter separation blankets, or for any other purposes, it shall comply with the requirements as specified in Section A12.11 of Chapter 12.

(i) Testing

The Contractor shall, at his own cost, submit a certificate by an approved laboratory to prove compliance with specified tests as stated in Chapter 20. Alternatively, verifiable testing by the supplier may be submitted for approval to the Engineer.

The tests to be carried out on geotextiles relate to the material and the method of manufacture and are mainly to ascertain that the correct grade and type of geo-textile is supplied, and that the material is equivalent in quality to that specified for use in the works. This includes geotextile qualities regarding soil retention; permeability; clogging; durability and strength. Compatibility testing can be done for filtration using the ASTM D5101 - Measuring the Soil-Geotextile System Clogging Potential by the Gradient Ratio. **d) Polymer film sheeting**

Plastic for subsoil drainage systems to be used shall be polymer film type sheeting of 150 to 250 micron (0,15 to 0,25 mm) thickness, complying with SANS 952-1.

A3.1.5.3 Geocomposite drainage systems (fin type drains)

Geo-composite in-plane drains (fin type drains) shall consist of a drainage core connected to a drainage pipe, all of which shall be enclosed in a geotextile as specified, required to fully enclose the drainage core.

The drainage core shall act as a flow net and shall include the physical characteristics as listed in Table A3.1.5-2.

Table A3.1.5-2: Physical characteristics of fin type geo-composite drain

Properties		Units	Core	Test Method
Polymer Type			HDPE	
Mass	(minimum)	g/m ²	500	SANS-9864/ISO 9864
Thickness	(minimum under 2 kPa)	mm	4,0	SANS 9863-1/ISO 9863-1
Tensile Strength	(minimum machine & across)	kN	5,0	SANS 1525/ISO 10319
Minimum Discharge Capacity of Fin type Geo-composite drain				
Discharge Capacity	(under 50 kPa)	l/s/m ²	>0,1	ISO 12958

The geotextile shall comply with the properties in Section A12.11 of Chapter 12. The Engineer shall specify the grade and type of geotextile required to fully enclose the drainage core.

a) Mesh-structured pipe component of geo-composite drain.

The drainage pipe used for this purpose shall meet the following requirements:

Pipes for in-plane subsoil drainage systems shall have an internal diameter of 65 or 100 mm, as specified. The pipe shall be manufactured from High Density polyethylene (HDPE) with a solid 5,0 mm wall thickness. It shall be extruded in an open lattice wall structure, with 70 % of the diameter consisting of open area and a 30 % solid area along the invert. Perforations in the open structure of the pipe shall be greater than 5,0 mm but less than 12 mm.

The infiltration capacity of the pipe, without geotextile, under a 200 mm static head shall not be less than the following:

- For 65mm ID pipe = 20 litres per metre per second
- For 100mm ID pipe = 55 litres per metre per second

b) Geo-composite strip drains or prefabricated vertical drains (wick drains):

Geo-composite strip drains shall consist of a drainage core enclosed in geotextile.

The drainage core shall act as a flow net and combined with the geotextile shall include the physical characteristics as listed in Table A3.1.5-3.

Table A3.1.5-3: Physical characteristics of the geo-composite strip drain

Properties			Units	Composite Strip Drain			Test Method
Drain Width			mm	100	250	330	
Manufacture		Geotextile	As specified in Clause A3.1.5.2c)(i)				
		Core	HDPE				
Mass		Core	g/m²	80	200	220	SANS 9864 / ISO 9864
Thickness	Geotextile & Core	Minimum under 250kPa	mm	4,5	4,5	4,5	
Minimum Discharge Capacity Of Geo-composite strip drain							
Discharge Capacity		under 20kPa	l/s	0,1	0,07	0,10	ISO 12958 / ASTM D4716
		under 50kPa	l/s	0,05	0,06	0,09	
		under 250kPa	l/s	0,02	0,03	0,04	

c) Geo-composite Panel Drains

Geo-composite panel drains shall consist of a rigid corrugated plastic core of a flat pipe configuration with a well-defined invert enclosed in a geotextile and shall be classified according to the following minimum requirements as listed in Table A3.1.5-4.

Table A3.1.5-4: Physical characteristics of the geo-composite panel drain

Properties		Units	Geo-composite Panel Drain			Test Method
Drain Depth		mm	170	315	450	ASTM D2122
Drain Width		mm	>40			
Slot Size		mm	2,8 x 30			
Compressive Strength		kPa	>200			ASTM D2412:11 Mod
Manufacture	Geotextile	As specified in A3.1.5.2c)(i)				
	Core	HDPE				
Geotextile						
Minimum Through Flow	Under 100mm head	l/s/m²	230			AS3706.9-12
Minimum Tensile Strength	Machine	kN/m	9,5			AS3706.2-12
Minimum Trapezoidal Tear		N	300			AS3706.3-12
Pore Size	O95W	µm	110			AS3706.7-14

Geo-composite panel drain						
Minimum Discharge Capacity(vertical)	Under 200kPa at 0,01 gradient	l/s	0,35*	0,65	0,95	ASTM D4716:14

A3.1.5.4 Concrete

All concrete work shall be carried out in accordance with the requirements in Section A13.4 of Chapter 13 of these specifications, read together with the provisions of this Section. Cement shall comply with SANS 50197-1 for CEM I or CEM II with a strength class of 32.5 or greater, and a rate of strength gain of N or greater.

Unless the Contractor obtains the concrete from a commercial concrete supplier, the Contractor shall be responsible for providing suitable materials, determining the mix proportions and manufacturing the concrete of the required quality to comply with SANS 50206.

The mix design shall be based upon obtaining an average concrete compressive strength sufficiently above the specified characteristic compressive strength so that, considering the expected variability of the concrete and test procedures, no more than 5,0 % of strength tests will be expected to fall below the specified characteristic compressive strength.

Where concrete is supplied by a commercial source outside the direct control of the Engineer, the concrete supplier shall ensure compliance with the requirements of SANS50206 (SANS878), and the Contractor shall take full responsibility to implement acceptance control testing in accordance with the specification.

All concrete mixed on the site of works shall be weigh-batched unless the Contractor can demonstrate to the Engineer that his method of proportioning the concrete ingredients consistently produces uniform concrete, which meets the strength requirements.

Concrete shall be properly mixed to a uniform consistency. The total period between the times that the cement is placed into the mix until mixing starts shall not exceed 15 minutes.

Concrete shall be so transported to its final position that segregation or loss of any of the ingredients or contamination will be prevented and that the mix is of the required workability at the point and time of placing. It shall be protected against rain, heat, direct sunlight and/or evaporation by means of covers. No additional water may be added in transit or where delivered or placed.

Once the casting of concrete has begun, it shall be carried out in a continuous process between construction joints. Concrete shall be placed within 60 minutes from the start of mixing. This time may be extended by the Engineer where a retarding admixture has been used. All excavations and other contact surfaces of an absorbent nature such as timber formwork shall be damp but no standing water shall be permitted to remain on these surfaces. The formwork shall be clean on the inside.

A3.1.5.5 Mesh for subsoil drain outlets

Where specified on the drawings, the outlets of subsoil drains shall be covered by mesh built into the outlets or other material as specified. Galvanized woven wire mesh shall comply with the requirements of SANS 675.

A3.1.6 CONSTRUCTION EQUIPMENT

The Contractor shall submit his plant and equipment list for excavating, stockpiling, if specified, loading, hauling and any temporary works as part of his method statement to perform the different elements of the drainage works.

A3.1.7 EXECUTION OF THE WORKS

A3.1.7.1 Classification of Materials

All excavations for open drains and subsoil drainage systems shall be excavated in the position and to the required dimensions. Overbreak in width or depth, unless specified by the Engineer, shall be filled and compacted by the Contractor and shall not be measurable for payment.

All excavations under this Chapter shall be classified as follows for payment purposes:

Hard material: Material which cannot be excavated except by drilling and blasting, or with the use of pneumatic tools or mechanical breakers, and

Boulders exceeding 0,1 m³; where more than 40 % by volume of any material consists of boulders, each exceeding 0,1 m³ in size, the volume of material so defined shall be classified as hard material

Existing stabilised road Existing layer material which has been stabilised (irrespective of stabilising agent) and requires careful cutting layers: and excavation without damage to surrounding existing road layers, by whichever method.

Soft material: All material not classified as hard material or existing stabilised road layers shall be classified as soft material.

A3.1.7.2 Open Drains

Open-drain excavation shall involve the excavation of open drains and channels, including channels to direct the course of water flow, all as detailed in the Contract Documentation or as directed by the Engineer.

The classification criteria for establishing the type of drain excavation is set out in Table 3.1.7-1.

Table A3.1.7-1: Open drain excavation classification criteria

Drain	Trapezoidal shape / channel	V-shaped	Trapezoidal shape / channel	V-shape	Road prism drains
Bottom width	< 4,0 m	n/a	≥ 4,0 m	n/a	All new or

Side-slope (steepest side-slope is the determining slope)	not applicable (n/a)	Steeper than 1v : 4h (v=vertical; h=horizontal)	n/a	Flatter than 1v : 4h	existing drains within the road prism namely median drains, side drains and drains on cut or fill slopes.
Top width	n/a	≤ 5,0 m	n/a	> 5,0m	
Classification criteria	Bottom width only	Steepest sideslope or top width	Bottom width only	Steepest sideslope or top width	
Drain classification for excavation	Open drain excavation Chapter 3	Open drain excavation Chapter 3	Designated excavation Chapter 4 compliant material		Shape, trim and/or clean Chapter 5
			Excavation to spoil Chapter 5		

Where clearing and/or grubbing is required for new open drains to be constructed, it shall be executed as specified in Section A1.6 of Chapter 1.

Open drains shall be constructed within 5 % true to line, grade and cross-section and shall be so maintained for the duration of the contract. Open drains shall at all points be graded to flow in the direction of intended flow without low points where water may pond.

Care shall be taken to avoid excavation below the required grades for the open drains and any excavation carried out below the required grade shall be backfilled with material of minimum G7 quality and compacted to at least 93 % of MDD by the Contractor at no cost to the Employer.

Material resulting from the excavations for open drains shall be used in the construction of fills, banks and dykes, or for other purposes, or shall be disposed of to spoil, all as specified by the Engineer.

In respect of material resulting from open-drain excavation and not taken to spoil but used elsewhere in the construction of the works, payment will be made for open drain excavation as well as for any item of temporary or permanent construction built from such material. Material from open drain excavation, which is taken to spoil will be paid for as open-drain excavation only. Where specified by the Engineer that existing open drains, but excluding new open drains constructed by the Contractor, shall be cleared and, where necessary, shaped by removing the sediment and trimming the floors and side slopes, the specified requirements for constructing new open drains shall apply similarly to clearing and shaping existing open drains.

Any concrete, stone pitched or wire mesh enclosed lining of open drains shall be done in accordance with the requirements of Clause A11.1.5 of Chapter 11.

The Contractor shall remove all materials that will adversely affect the performance of the constructed drainage, including all silt, sediment, driftwood, vegetation, debris and rubble that have accumulated in and around the culvert inlet and outlet structures and in the culvert barrels. Unless such work forms part of specified work to rehabilitate or clear existing drains, no payment shall be made for such work, as it shall be deemed to form part of normal finishing and trimming operations. All materials resulting from the clearing operations shall be disposed of at specified locations. The clearing shall preferably be done with hand tools in order to prevent damage to existing drainage and other structures.

All structures damaged by the Contractor shall be repaired and made good at no cost to the Employer, all as instructed by the Engineer.

Measurement and payment in respect of the clearing and shaping of existing open drains, as classified in Table A3.1.7-1 shall be made under the relevant items in Sections C3.1, C4.2 of Chapter 4 and C5.2 of Chapter 5.

A3.1.7.3 Banks and Dykes

Where specified by the Engineer that clearing and/or grubbing is required for new banks and dykes to be constructed, it shall be executed as specified in Section A1.6 of Chapter 1.

Mitre banks, catchwater banks and dykes shall be constructed of approved soil or gravel obtained from cut and/or open drain excavation or, if no suitable material can be obtained from those sources, from suitable approved alternative sources, and be placed in such a way that the water will flow in a shaped open drain or on the natural ground and against the bank. Where open drains with bank/dyke are constructed as combination, excavation and fill shall be measured and paid for separately.

The banks and dykes shall be properly compacted to 93 % of MDD in layers not exceeding 150 mm.

The appearance of the completed mitre bank shall present an even, tight surface.

If so specified, mitre banks facing shall be constructed of hand packed stone pitching as detailed in Clause A11.1.7 of Chapter 11.

A3.1.7.4 Subsoil drainage

a) Construction of subsoil drainage systems

(i) With natural permeable material

Trenches required for subsoil drainage systems shall be excavated to the dimensions and gradients shown on the drawings or as specified by the Engineer, neatly trimmed to line and level. In case of deeper excavations, or excavations in unstable or saturated ground, the Contractor shall take all necessary steps to assure the safety of such excavations and to ensure that specified lines and levels are complied with. Such steps may entail the provision of temporary shoring or battering of side slopes. All such steps shall be deemed to be included in the tendered rates for excavations.

A layer of natural permeable material of the grade and thickness as shown on the drawings shall be placed on the bottom of the trench and be lightly tamped and finished to the required gradient.

Pipes of the type and size specified shall then be firmly bedded on the natural permeable material, true to line and level, and be coupled in accordance with the pipe manufacturer's requirements. Thereafter the trench shall be backfilled with the specified natural permeable material to such height above the pipes as shown on the drawings or as specified by the Engineer. The natural permeable material shall be lightly compacted and trimmed to the required level. Further layers of finer specified natural permeable material shall then be placed, in layers not exceeding 300 mm in thickness at a time lightly compacted and finished to an even surface, as specified by the Engineer. The remainder of the trench, if any, shall be backfilled with approved impermeable material and as specified by the Engineer, in layers not exceeding 150 mm, and compacted to at least the same density as the surrounding material. The trench shall be specially protected against the ingress of water until the impermeable layer has been completed. The width of the backfill as measured for payment shall not exceed the specified width of the trench.

The total thickness of each type of natural permeable material shall be carefully controlled for thickness and level, using suitable spacers where required. When successive layers are placed, the lower layer shall not be walked on and, as far as possible, shall not be disturbed. Care shall be taken to prevent the contamination of natural permeable material during construction of the subsoil drainage system and all natural permeable material contaminated by soil or silt shall be removed and replaced by the Contractor at his own cost.

Perforated and slotted pipes shall be joined by means of couplings, the provision and installation of which shall be deemed to be covered under the rates for the pipes. Perforated pipes shall be laid with perforations either at the top or bottom as specified on the drawings, specifications or specified by the Engineer.

The higher end of each subsoil drainage pipe shall be sealed off with a loose concrete cap of class C20/25-20 concrete, as shown on the drawings and at the lower end, the pipe shall be built into a concrete head wall providing a positive outlet, or it shall be connected to structures for stormwater pipes or concrete culverts. The complete system, together with head walls, shall be constructed in one process starting at the lower end. No continuous section of subsoil drain shall be longer than 80m long and cleaning eyes constructed in accordance with the details shown on the drawings shall be spaced at a maximum spacing of 80m.

Any section of a subsoil drainage system constructed of pipes without perforations or slots shall be backfilled with impermeable backfill material as described herein. Where suitable, the excavated material may be used for backfilling.

(ii) With polymer film lining to trenches for subsoil drainage systems

Where shown on the drawings or specified by the Engineer, trenches for subsoil drainage systems shall be lined with approved polymer film sheeting 0,15 mm or 0,25 mm thick as shown on the drawings or specified in the Contract Documentation. The polymer film sheet shall cover the bottom of the trench and shall extend upwards on both sides for as far as may be specified by the Engineer in each particular case, in order to form a waterproof channel. At joints the polymer film sheeting shall be heat-welded together or lapped by a minimum of 200 mm. Lapping shall be in direction of the flow of water.

Pipes of the type and size specified shall be installed as specified, true to level and grade, and be coupled in accordance with requirements.

When backfilling the trench with the specified natural permeable material, care shall be taken not to displace or damage the polymer film lining in any way. The use of plastics other than polymer film will be considered, provided that the material is proven to the Engineer to be of equal or better quality.

(iii) With geotextiles

Where specified that geotextiles shall be used for lining in subsoil drainage systems, it shall be procured, furnished and installed as specified and shown on the drawings. The lining shall not be displaced or damaged in any way when the trench is being filled with the specified natural permeable material. The geotextile shall be lapped both longitudinally and transversely by at least 300 mm or as specified by the manufacturers. The longitudinal lap shall be positioned on top of the box forming the drain and shall be stitched together with plastic/galvanised wire or strong synthetic thread at one metre intervals. The transverse lap shall be in the direction of flow.

Pipes of the type and size specified shall be installed as specified, true to line and grade, and be coupled in accordance with the pipe manufacturer's requirements.

(iv) With composite in-plane drainage systems

Wherever specified, composite in-plane drainage systems shall be constructed in accordance with the details shown on the drawings and in accordance with the manufacturer's requirements. The elements of the system shall be assembled above ground in manageable lengths, and all exposed surfaces shall be sealed with an approved geo-fibre seal. The trench sides shall be vertical, and the composite in-plane system shall be installed against the side through which the subsoil flow is expected. The trench shall then be backfilled with natural permeable sand, which shall be saturated with water after placement, up to the prescribed level. The upper part of the trench shall be backfilled with impermeable material, which shall be compacted to the density of the surrounding material, in layers not exceeding 100 mm in thickness.

(v) With alternative drainage systems

Alternative drainage systems, where relevant, shall be specified and detailed in the Contract Documentation.

(vi) Proving of pipes in subsoil drainage systems

The laying of slotted/perforated pipes supplied in coils shall be subject to providing a method statement which includes proving during installation, to ensure that the invert is accurately installed.

On completion of the pipe laying and prior to backfilling over pipes, all pipe joints shall be surveyed as proof of their installation to line and grade. After backfilling, the pipes shall be proved by pulling through a cylindrical cleaning brush followed by a wooden mandrill $\pm$ 400 mm long and 5,0 mm in diameter less than the bore of the pipe. Proving of installed pipes shall not be paid for separately and the cost thereof shall be deemed to be included in the rate tendered for laying the pipe. **b) Test flushing**

Final acceptance of longitudinal subsoil drains constructed by the contractor will be subject to satisfactory test flushing after completion and installation of the rodding eye inlets. Flushing tests shall be carried out in the presence of the Engineer's representative by flushing the drain and metering the outflow to ensure the drain is clear of blockage. Should blockages be apparent the Contractor shall locate and clear the obstruction and repeat the test.

Proving of the lack of obstructions may also be undertaken by camera equipment inserted into the subsoil drains should this be specified by the Engineer.

A3.1.7.5 Manholes, outlet structures and cleaning eyes

Outlet structures and cleaning eyes for subsoil drainage systems shall be constructed in accordance with the details shown on the drawings and/or indicated in the Contract Documentation. Manholes for subsurface drains shall be constructed as detailed and measured under Section A3.3.

The end of each subsoil outlet shall be marked with a suitable visible marker clearly indicating the position of each subsoil outlet structure in accordance with the details on the drawings or as specified by the Engineer.

A3.1.7.6 As-Built Drawings

The Contractor shall furnish the Engineer with a detailed set of relevant drawings verifying and recording the subsoil drainage systems as installed. Such records shall include accurate coordinates of all starting points, bends, cleaning eyes, manholes, junctions and outlet structures, including the depth below surface level at each such point.

A3.1.8 WORKMANSHIP

The Contractor shall determine the required frequency of testing and conduct sufficient tests on the sourced material for each type of material, in order to ensure that the quality of materials produced will meet the specified requirements for the particular layer for which it will be used.

The Engineer shall carry out quality control testing and may, at his discretion, elect to use the Contractor's test results if he is satisfied that the Contractor's process control requirements are acceptable for quality control purposes.

Any work or materials which do not comply with the specified requirements, shall be removed and replaced with work or materials which comply with the requirements or, if the Engineer so agrees, shall be repaired so that it shall comply with the specified requirements after having been repaired.

C3.1 DRAINS PART C: MEASUREMENT AND PAYMENT

(i) Preamble

The tendered rate for each item shall include full compensation for providing, maintaining and decommissioning upon completion, of all the plant, equipment, labour, tools, incidentals and supervision to carry out the activity or construct the works in the item, unless otherwise stated.

Any prime cost or provisional sums shall be paid in accordance with the provisions of the conditions of contract. The charge or mark-up tendered or allowed for is a percentage of the amount actually paid under the prime cost or provisional sum. This percentage shall cover all the Contractor's handling, supervision, profit and liability costs to provide the services in the prime cost or provisional sum item.

The requirements of Section C1.1 of Chapter 1 shall apply.

Where pay item descriptions include any wording in brackets it is an indication that contract specific information is to be inserted in the Pricing Schedule included in the Contract Documentation.

(ii) Notes on measurement and pay Items

1. Unless otherwise ordered or stated in the Contract Documentation, open drains, subsoil drains and trenches will be measured from the surface of the ground along the centre-line of the trench to the bottom of the specified bedding layer (as applicable).
2. The ground surface will be that existing after any bulk earthworks have been carried out, i.e. the excavated surface or embankment surface, unless a different sequence of execution has been ordered.
3. Excavations will be measured as if taken out with vertical sides, regardless of whether they have been taken out with sloping sides.
4. Wherever volumetric measurement is required, the volume will be computed from the depth determined as indicated in 1. and 2. above and using the authorised width (W) determined in accordance with the specification.
5. Where shoring is specified or ordered, the length of shoring measured for payment will be the length of the centre-line of the open drain or trench.

(iii) Items that will not be measured separately

The following activities, whether required to complete the specified work or not, will not be measured and paid for separately and the Contractor shall include the cost thereof in other pay items as he deems appropriate:

1. No separate payment will be made for backfilling excess excavations, disposing of surplus material etc. or any other contingent work, unless the work is specifically specified or ordered.
2. No separate payment will be made for setting out the works.
3. No separate payment will be made for the protection or repair as required of any existing or new road furniture, structures, buildings, infrastructure or services damaged by the Contractor's activities.
4. No additional payment shall be made, nor shall any claim for additional payment be considered, for any specified work in confined or restricted areas. Any additional costs associated with working in confined or restricted areas shall be deemed to be included in the standard applicable pay items.
5. No separate payment will be made for the loading of any materials.
6. No separate payment will be made for the hauling of any materials where the material is moved over a distance of less than, and up to 1,0 km.
7. No separate payment will be made for transporting materials from commercial sources irrespective of the haul distance.
8. No separate payment will be made for the removal or any surplus material imported to complete the works.
9. For all Works performed, precautionary measures required in terms of the Occupational Health and Safety Act (Act 85 of 1993) and the latest amendments thereof as well as the latest Construction Regulations shall be deemed included in the rates tendered for the relevant products.

(iv) Items to be measured and paid for using items specified elsewhere in the specifications

The following items of work, when specified, shall be carried out, measured and paid for in accordance with the appropriate Sections of the specifications.

Table C3.1-1: Payment items from other Chapters or Sections

Activity	Section 3.1 reference	Section item reference
Open drain excavation	A3.1.7.2	C4.2.5 & C4.2.12 of Chapter 4 C5.1.2 & C5.2.9 of Chapter 5
Clearing and grubbing	A3.1.7.2; A3.1.7.3	C1.6 of Chapter 1 - All applicable items

(v) Items specifically for this Section of the specifications

Item	Description	Unit
C3.1.1	Excavation for open drains:	

C3.1.1.1	Excavating all material situated within the following depth ranges below the surface level using conventional methods:	
(a)	0 m to 1,5 m	cubic metre (m ³)
(b)	Exceeding 1,5 m and up to 3,0 m	cubic metre (m ³)
(c)	Etc, in increments of 1,5 m	cubic metre (m ³)
C3.1.1.2	Extra over sub-item C3.1.1.1 for excavation in hard and boulder material, irrespective of depth	cubic metre (m ³)
C3.1.1.3	Extra over sub-item C3.1.1.1 for excavation in stabilised existing road layers, irrespective of depth	cubic metre (m ³)
C3.1.1.4	Excavating soft material situated 0 m to 1,5 m below the surface level using labour enhanced construction methods	cubic metre (m ³)
C3.1.1.5	Excavating intermediate material situated 0 m to 1,5 m below the surface level using labour enhanced construction methods	cubic metre (m ³)

The unit of measurement shall be the cubic metre of material excavated in accordance with the authorised dimensions, measured in place before excavation. Only excavation for open drains as defined in Clause A3.1.7.2 shall be measured.

Irrespective of the total depth of the excavation, the quantity of material in each depth range shall be measured and paid for separately.

Excavations shall be done using conventional construction methods and/or labour enhanced construction methods as specified.

Payment made for either hard, boulder or stabilised existing road layers shall only be measured for the one applicable extra over category.

The tendered rates shall include full compensation for the excavation of the material to the required dimensions, lines, levels and grades, the trimming of the open drain and the loading and disposal/utilisation of the material as directed, including haul of 1,0 km when using conventional construction methods.

Loading and hauling, where applicable, including a haul of 1,0 km, shall be measured and paid under Section C1.7 of Chapter 1. Where the excavation of material is specified by means of labour enhanced construction methods, the tendered rates shall include loading and transport by wheelbarrow if the material is disposed of or utilised within a radius of 50 m, alternatively loading by hand onto transport vehicles for such disposal or utilisation elsewhere, within a haul distance of 1,0 km.

For payment purposes a distinction shall be made between materials as classified according to Clause A3.1.7.1 under Classification of Materials.

Item	Description	Unit
C3.1.2	Clearing, shaping and disposal of accumulated sediment in existing unlined open drains	
C3.1.2.1	Using conventional methods	cubic metre (m ³)
C3.1.2.2	Using labour enhanced construction methods	cubic metre (m ³)

The unit of measurement shall be a cubic metre of sediment, including accumulated existing cut slope rubble and vegetation, removed measured in place before removal. Where such measurement is impractical or impossible, as decided by the Engineer, quantity measurement shall be determined as 70 % of volume measured in haulage vehicles.

Excavations shall be done using conventional construction methods and/or labour enhanced construction methods as specified.

The tendered rate shall include full compensation for excavating the material, protecting the existing drainage structures, trimming the floors and sides of the open drains and loading and disposing of material as prescribed.

Loading and hauling, where applicable, including a haul of 1,0 km, shall be measured and paid under Section C1.7 of Chapter 1. Where the clearing and shaping of existing unlined open drains is specified by means of labour enhanced construction methods, the tendered rates shall include loading and transport by wheelbarrow if the material is disposed of or utilised within a radius of 50 m, alternatively loading by hand onto transport vehicles for such disposal or utilisation elsewhere, within a haul distance of 1,0 km.

The clearing of existing lined side drains will be measured and paid for under item C3.1.3.

Item	Description	Unit
C3.1.3	Excavation, clearing and disposal of accumulated sediment in existing lined drains and drainage systems	
C3.1.3.1	Using conventional methods (up to 1,5 m):	
(a)	Manholes and inlet and outlet structures	cubic metre (m ³)
(b)	Culvert barrels	cubic metre (m ³)
(c)	Concrete or other lined side drains	cubic metre (m ³)
C3.1.3.2	Using conventional methods (in excess of 1,5 m):	
(a)	Manholes and inlet and outlet structures	cubic metre (m ³)

(b) Culvert barrels cubic metre (m³)

(c) Concrete or other lined side drains cubic metre (m³) C3.1.3.3 Using labour enhanced construction methods:

(a) Manholes and inlet and outlet structures cubic metre (m³)

(b) Culvert barrels cubic metre (m³)

(c) Concrete or other lined side drains cubic metre (m³)

The unit of measurement shall be the cubic metre of material excavated and removed, measured in place before excavation. Where such measurement is impractical or impossible, as decided by the Engineer, quantity measurement shall be determined as 70 % of volume measured in haulage vehicles.

Excavation for the clearing of existing lined drains and drainage systems up to a depth of 1,5 m shall be done using conventional construction methods and/or labour enhanced construction methods as specified and measured. Excavation in excess of 1,5 m depth shall be paid for under item C3.1.3.2.

The tendered rate shall include full compensation for excavating the material, protecting the existing linings or drainage systems, dealing with any surface or subsurface water, and loading and disposing of the excavated material.

Loading and hauling, where applicable, including a haul of 1,0 km, shall be measured and paid under Section C1.7 of Chapter 1. Where the clearing of existing lined drains and drainage systems is specified by means of labour enhanced construction methods, the tendered rates shall include loading and transport by wheelbarrow if the material is disposed of or utilised within a radius of 50 m, alternatively loading by hand onto transport vehicles for such disposal or utilisation elsewhere, within a haul distance of 1,0 km.

Item	Description	Unit
C3.1.4	Excavation and disposal of material for subsoil drainage systems:	
C3.1.4.1	Excavating in all material situated within the following depth ranges below the surface:	
(a)	0 m to 1,5 m	cubic metre (m ³)
(b)	Exceeding 1,5 m and up to 3,0 m	cubic metre (m ³)
(c)	Etc, in increments of 1,5 m	cubic metre (m ³)
C3.1.4.2	Excavating soft material situated within 0 m to 1,5 m below the surface level using labour enhanced construction methods	cubic metre (m ³)
C3.1.4.3	Excavating intermediate material situated within 0 m to 1,5 m below the surface level using labour enhanced construction methods	cubic metre (m ³)
C3.1.4.4	Extra over sub-item C3.1.4.1 for excavation in hard and boulder material, irrespective of depth	cubic metre (m ³)
C3.1.4.5	Extra over sub-item C3.1.4.1 for excavation through stabilised existing road layers	cubic metre (m ³)
C3.1.4.6	Excavation and disposal of material for composite in-plane fin-drain type drainage systems using a trenching machine:	
(a)	Trench width of and depth of.....	metre (m)
(b)	Etc for width of and depth of.....	metre (m)

The unit of measurement for items C3.1.4.1 to C3.1.4.5 shall be the cubic metre of material excavated in accordance with the authorised dimensions, measured in place before excavation. Irrespective of the total depth of the excavation, the quantity of material per classification in each depth range shall be measured and paid for separately.

Excavations shall be done using conventional construction methods and/or labour enhanced construction methods as specified and measured.

The tendered rates shall include full compensation for the excavation of the material to the required dimensions, lines, levels and grades, all temporary shoring and strutting, and the loading and disposing of the excavated material.

Loading and hauling, where applicable, including a haul of 1,0 km, shall be measured and paid under Section C1.7 of Chapter 1. For payment purposes a distinction shall be made between materials as classified according to Clauses A3.1.7.1 and B3.1.7.2 under Classification of Materials.

Item C3.1.4.6 for excavation for composite in-plane fin-drain type drainage systems using a trenching machine shall be to the required width and depth indicated. The unit of measurement shall be the linear metre of trenching excavated. No distinction shall be made between soft material and stabilised layers of existing road layers. Hard material shall not be required to be excavated by trenching machine.

Loading and hauling, where applicable, including a haul of 1,0 km, shall be measured and paid under Section C1.7 of Chapter 1. Where excavation is specified by means of labour enhanced construction methods, the tendered rates shall include loading and transport by wheelbarrow if the material is disposed of or utilised within a radius of 50 m, alternatively loading by hand onto transport vehicles for such disposal or utilisation elsewhere, within a haul distance of 1,0 km.

Where subsoil drainage systems are adjacent to structures such as culverts, that part of the excavation for subsoil drainage systems, which can be made by widening the excavation for the structure, shall only be measured and paid for under excavation for such structure, and not under excavation for the subsoil drainage systems.

Item	Description	Unit

C3.1.5 Impermeable backfilling to subsoil drainage systems

C3.1.5.1	Un-stabilised natural gravel obtained from approved sources on the site	cubic metre (m ³)
C3.1.5.2	G5 material obtained from commercial sources	cubic metre (m ³)

C3.1.5.3 Extra over items C3.1.5.1 and C3.1.5.2 for stabilisation with 4,0 % CEM II (32.5) cement cubic metre (m³)
The unit of measurement shall be the cubic metre of completed backfill, measured in place in the subsoil drainage systems and shall be calculated in accordance with the authorised dimensions.

The tendered rate for item C3.1.5.1 shall include full compensation for procuring, furnishing, placing and compacting the backfilling.

Loading and hauling, where applicable, including a haul of 1,0 km, shall be measured and paid under Section C1.7 of Chapter 1.

The tendered rate for item C3.1.5.2 shall include full compensation for procuring, furnishing and transporting G5 material from commercial suppliers, including the cost of transporting the material to the site irrespective of haul distance, and placing the materials as specified.

The tendered extra over rate for item C3.1.5.3 shall include full compensation for all additional costs for procuring, furnishing, mixing and placing the cement stabilised backfill.

Item	Description	Unit
C3.1.6	Construction of banks and dykes:	
C3.1.6.1	Banks and dykes using conventional methods	cubic metre (m ³)
C3.1.6.2	Banks and dykes using labour enhanced construction methods	cubic metre (m ³)

The unit of measurement shall be the cubic metre of material, measured in place in the banks or dykes, and calculated in accordance with the authorised dimensions. Where open drain with bank/dyke combinations are constructed, excavation shall be measured and paid under item C3.1.1.

The tendered rate shall include full compensation for procuring, furnishing, placing, watering, compacting, shaping and trimming the material in the banks and dykes.

Loading and hauling, where applicable, including a haul of 1,0 km, shall be measured and paid under Section C1.7 of Chapter 1. Where excavation is specified by means of labour enhanced construction methods, the tendered rates shall include loading and transport by wheelbarrow if the material is disposed of or utilised within a radius of 50 m, alternatively loading by hand onto transport vehicles for such disposal or utilisation elsewhere, within a haul distance of 1,0 km.

Item	Description	Unit
C3.1.7	Natural permeable material in subsoil drainage systems (approved crushed stone):	
C3.1.7.1	Crushed stone obtained from approved sources on the site (state grade and size)	cubic metre (m ³)
C3.1.7.2	Crushed stone obtained from commercial sources (state grade)	cubic metre (m ³)

The unit of measurement for item C3.1.7.1 shall be the cubic metre of approved crushed stone in place in the drains, calculated in accordance with the authorised dimensions. The volume occupied by the pipes shall be deducted when calculating the volume of the natural permeable material.

The tendered rate shall include full compensation for procuring, furnishing and placing the material as specified.

Loading and hauling, where applicable, including a haul of 1,0 km, shall be measured and paid under Section C1.7 of Chapter 1.

For payment purposes a distinction shall be made between the different grades of approved crushed stone.

The unit of measurement for item C3.1.7.2 shall be the cubic metre of crushed stone in place in the drains, calculated in accordance with the authorised dimensions. The volume occupied by the pipes shall be deducted when calculating the volume of the natural permeable material.

The tendered rate shall include full compensation for procuring, furnishing and transporting approved crushed stone from commercial suppliers, including the cost of transporting the material to the site irrespective of haul distance, and placing the materials as specified.

For payment purposes a distinction shall be made between the different grades of approved crushed stone.

Item	Description	Unit
C3.1.8	Natural permeable material in subsoil drainage systems (approved natural sand):	
C3.1.8.1	Natural sand obtained from approved sources (state grade & source)	cubic metre (m ³)
C3.1.8.2	Natural sand from commercial sources (state grade)	cubic metre (m ³)

The unit of measurement for item C3.1.8.1 shall be the cubic metre of approved sand in place in the drains, calculated in accordance with the authorised dimensions. The volume occupied by the pipes shall be deducted when calculating the volume of the permeable material.

The tendered rate shall include full compensation for procuring, furnishing and placing the sand as specified.

Loading and hauling, where applicable, including a haul of 1,0 km, shall be measured and paid under Section C1.7 of Chapter 1.

For payment purposes a distinction shall be made between the different grades of sand.

The unit of measurement for item C3.1.8.2 shall be the cubic metre of sand in place in the drains, calculated in accordance with the authorised dimensions. The volume occupied by the pipes shall be deducted when calculating the volume of the permeable material.

The tendered rate shall include full compensation for procuring, furnishing and transporting approved sand from commercial suppliers, including the cost of transporting the material to the site irrespective of distance, and placing the material as specified.

For payment purposes a distinction shall be made between the different grades of sand.

Item	Description	Unit

C3.1.9 Pipes in subsoil drainage systems:

C3.1.9.1 U-PVC pipes and fittings, normal duty, complete with couplings (state size and whether or metre (m) not perforated or slotted)

The unit of measurement for pipes shall be the metre of pipe, measured in place along its centreline, including the length of fittings.

The tendered rate shall include full compensation for procuring, furnishing, laying and jointing the pipes and fittings as specified.

Item	Description	Unit

C3.1.10 Polymer film sheeting or similar approved material, for lining subsoil drainage systems:

C3.1.10.1	0,15 mm thick	square metre (m ²)

C3.1.10.2	0,25 mm thick	square metre (m ²)

The unit of measurement shall be the square metre of polymer film sheeting installed, measured net from the specified dimensions.

The tendered rate shall include full compensation for procuring, supplying, cutting, overlapping, jointing, placing and protecting the sheeting as specified, as well as for wastage.

Item	Description	Unit

C3.1.11 Geotextiles (indicate type, grade, etc.)

square metre (m²)

The unit of measurement shall be the square metre of geotextile supplied and installed as specified in Section A12.11 of Chapter 12.

The tendered rate shall include full compensation for furnishing, procuring, cutting, overlapping, jointing, placing and protecting the geotextile as specified, as well as for wastage.

Item	Description	Unit

C3.1.12 Composite drainage systems

C3.1.12.1	In-plane drainage systems (state size, type of core and type grade, etc. of geotextile)	metre (m)

C3.1.12.2	Vertical subsoil strip drainage systems (state size, type of core and type grade, etc. of geotextile)	metre (m)

C3.1.12.3	Panel drainage systems (state size, type of core and type grade, etc. of geotextile)	metre (m)

C3.1.12.4	Alternative drainage systems as detailed in Contract Documentation (state size, type and other details)	metre (m)

The unit of measurement shall be the metre of composite or alternative drainage system as specified, measured in place along the centre line of the system.

The tendered rate shall include full compensation for procuring, furnishing, assembling, installing and jointing the composite or alternative drainage system, including perforated or other types of drainage core, complete as specified.

Item	Description	Unit

C3.1.13 Concrete outlet structures, manhole boxes, junction boxes and cleaning eyes for subsoil drainage systems:

C3.1.13.1	Outlet structures (specify each type and drawing reference)	number (No)

C3.1.13.2	Inspection boxes (specify each type and drawing reference)	number (No)

C3.1.13.3	Junction boxes (specify each type and drawing reference)	number (No)

C3.1.13.4	Cleaning eyes (specify each type and drawing reference)	number (No)

The unit of measurement shall be the number of outlet structures, manhole boxes, junction boxes and cleaning eyes for subsoil drainage systems constructed in accordance with the details on the drawings and the Engineer's instructions.

The tendered rates shall include full compensation for all excavation, backfilling, compacting to 93 % of MDD, disposing of surplus excavated material, keeping the excavations safe, dealing with any surface or subsurface water, procuring and furnishing all materials, providing, erecting and removing formwork, mixing, transporting, placing and curing the concrete, and all labour and constructional plant required for constructing the concrete outlet structures, subsoil drain inspection boxes, subsoil junction boxes and cleaning eyes, complete as specified.

The tendered rate shall also include full compensation for procuring and finishing the galvanised woven wire mesh, cutting, waste, installing the wire mesh at outlets and keeping the wire mesh in the pipe openings clean for the duration of the contract period.

Item	Description	Unit
C3.1.14	Caps for subsoil drain pipes:	
C3.1.14.1	Concrete caps	number (No)
C3.1.14.2	Cast metal iron caps	number (No)
C3.1.14.3	Other (Glass fibre reinforced, PVC etc.) (specify)	number (No)

The unit of measurement shall be the number of caps supplied as specified, and the tendered rate shall include full compensation for supplying and installing the caps.

Item	Description	Unit
C3.1.15	Repairing or replacing existing drainage systems	Provisional sum

The provisional sum given for repairing or replacing existing drainage systems shall be expended in terms of the general conditions of contract, for unmeasured work to be undertaken as described in the Contract Documentation.

Item	Description	Unit
C3.1.16	Loading and hauling of material in excess of 1,0 km	cubic metre-kilometre (m³-km)

The measurement and payment for hauling material referred to in items C3.1.1, C3.1.2, C3.1.3, C3.1.4, C3.1.5, C3.1.6, C3.1.7, C3.1.8, C3.1.17 and C3.1.18, if any, shall be in accordance with Section C1.7 of Chapter 1.

Item	Description	Unit
C3.1.17	Backfilling existing eroded side drains	cubic metre (m³)

The unit of measurement shall be the cubic metre of approved granular material placed and compacted to 93 % of MDD, measured in place after compaction. Where such measurement is impractical or impossible, as decided by the Engineer, quantity measurement shall be determined as 70 % of the loose volume of imported material.

The tendered rate shall include full compensation for procuring, furnishing, transporting, placing and compacting the granular material and including haul of 1,0 km. Where trimming or benching of the side drains and disposal of resulting material is required, it shall be measured and paid under item C3.1.3.

Item	Description	Unit
C3.1.18	Backfilling of drains with selected material compacted to 93 % of MDD prior to construction of concrete lining and/or stone pitched lining	cubic metre (m³)

The unit of measurement shall be the cubic metre of compacted material and the quantity shall be calculated from the authorised dimensions given on the drawings or as specified by the Engineer.

The tendered rate shall include full compensation for procuring, as if from soft excavation or borrowpits, breaking down, placing and compacting the material in 150 mm layers, transporting of the material transport over a haul of 1,0 km as well as for shaping the top surface in accordance with the drawings.

Item	Description	Unit
C3.1.19	Exposing of existing subsoil drains	cubic metre (m³)

The unit of measurement shall be the cubic metre of material removed to expose the drain for the purposes of refurbishment existing drains. This item shall not be applicable in cases where complete substitution or replacement of existing drains is specified.

The tendered rate shall include full compensation for all labour and tools required for removing the material. The re-instatement of the drain elements, as may be specified, shall be paid for under the relevant items for constructing a new drain.

Item	Description	Unit
C3.1.20	Breaking into existing drainage structures and install subsoil drain pipe	number (No)

The unit of measurement shall be the number of subsoil drain pipes built into existing drainage structures in accordance with the details on the drawings or as specified by the Engineer.

The tendered rates shall include full compensation for supplying all labour, constructional plant and materials required, for all excavation, breaking into existing drainage structures, building pipes into the newly formed accesses, sealing around the pipes and making the joints watertight, breaking out existing benching and channeling where required and reconstructing them complete with granolithic rendering to suit the new pipe arrangement, backfilling and compacting to 93 % of MDD, transporting (including all haulage) and disposing of all surplus excavated material and debris to approved dumping sites provided by the Contractor, and dealing with the flows in the existing structures.

No distinction will be made between different types of structures, or diameters of subsoil drain pipes.

Item	Description	Unit
C3.1.21	Clearing of existing subsoil drains	

C3.1.21.1 Cleaning rod, brush and flushing

metre (m)

C3.1.21.2 Hydro jetting

metre (m)

The unit of measurement for clearing of existing subsoil drains shall be the metre of drain cleared with a sewer cleaning rod and brush, thorough flushing and mandrill testing.

The unit of measurement for hydro jetting will include the establishment on site, hydro jetting and vacuuming of specified drains at various locations on site.

The tendered rate shall include full compensation for all labour, equipment, tools, water and transport required for clearing existing subsoil drains and for disposal of the cleared material to approved sites.

Item	Description	Unit
C3.1.22	Test flushing of subsoil drain pipe systems	number (No)

The unit of measurement shall be the number of tests satisfactorily completed on newly installed or unblocked sections of drain system, irrespective of its length. No payment will be made for tests, which have to be repeated due to blocked pipes or faulty workmanship.

The tendered rate shall include full compensation for the provision of a water tanker, water, equipment and labour necessary to carry out the tests, complete as specified.

Item	Description	Unit
C3.1.23	Subsoil drain outlet marker (type or drawing specified)	number (No)

The unit of measurement is the number of subsoil outlet markers installed in accordance with the details on the drawings.

The tendered rate shall include full compensation for procuring and furnishing the subsoil drain outlet marker and installation in accordance with the details on the drawing.

Item	Description	Unit
C3.1.24	Submission of as built drawings by the Contractor	Provisional sum

The provisional sum given for the Contractor to provide the Engineer with as built drawings pertaining to all subsoil drains on the site. The drawings must contain the location, co-ordinates of in- and outlets, length and depth and must be provided to the Engineer prior to the site hand over.

A3.2 CULVERTS PART A: SPECIFICATIONS

A3.2.1 SCOPE

Drainage under this Section covers mainly culverts and conduits and their associated works in water courses or from natural or shaped areas, but may also cover drainage of road or bridge surfaces. This Section covers work in connection with the construction of in situ constructed and prefabricated culverts and other closed conduits to provide such drainage, together with inlet and outlet structures, manholes and other appurtenant structures. Different Road Authorities may differentiate between minor culverts, lesser culverts or major culverts. Major culverts are covered in Chapters 13 and 14.

The replacing and/or lengthening of existing culverts, modification of and repairs to existing drainage structures and catch pits as well as sleeving or lining, partly or fully, of the insides of existing culverts are also included in this Section.

A3.2.2 DEFINITIONS

Culvert: is a structure other than a bridge which provides an opening under the carriageway or median for drainage or other purposes.

Major Culvert: is a cellular structure with dimensions less than those defining a bridge but with any clear span length (as measured horizontally at the soffit perpendicular to the faces of its supports) equal to or larger than 2,1 m, or diameter equal to or larger than 2,1 m, or a culvert with a total cross-sectional opening equal to or larger than 5,0 m². (TMH19)

Minor Culvert: all culverts smaller than that defined as a Major Culvert are classified as lesser culverts. (TMH19)

A3.2.3 GENERAL

The attention of the Contractor is drawn to the requirement that information given on the drawings, longitudinal sections or drainage schedules may have to be verified and reviewed to suit actual site conditions and therefore the Contractor shall only construct these culverts after the Engineer has amended or verified the information on the drawings based on detail surveys taken on site.

Prefabricated units shall be ordered by the Contractor from actual measurements of lengths determined on site and not from lengths stated in the drainage schedules or from the schedule of quantities.

All existing stormwater culverts, which are to be extended, shall be inspected on site and any defects reported to the Engineer prior to extensions being constructed. Likewise, existing and new culverts are to be inspected for possible damage after completion of layerworks over the culverts.

A3.2.3.1 Types of culverts

For the purposes of this specification, the term "culverts" shall mean culverts constructed from-

- a) Reinforced concrete floors and roofs and reinforced concrete walls, hereinafter referred to as "rectangular concrete culverts". The reinforced concrete floors and/or roofs may be either cast in situ or prefabricated units constructed elsewhere;
- b) Reinforced concrete floors and roofs and reinforced brickwork walls, hereinafter referred to as "rectangular brickwork culverts". The reinforced concrete floors and/or roofs may be either cast in situ or prefabricated units constructed elsewhere;
- c) Prefabricated reinforced concrete pipes with circular sections, hereinafter referred to as "concrete pipe culverts";
- d) Prefabricated reinforced concrete culverts other than pipe culverts hereinafter referred to as "prefabricated portal culverts", generally of combined wall and roof prefabrication. The reinforced floors may be either cast in situ or prefabricated units constructed elsewhere. These culverts are generally of rectangular construction;
- e) Prefabricated corrugated metal pipes and pipe arches, hereinafter referred to as "metal culverts".
- f) U-PVC pipes with circular section, hereinafter referred to as "U-PVC culverts"
- g) Other types of culverts not included above, if required, shall be specified in the Contract Documentation.

A3.2.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

None applicable unless specific specifications have been accepted as proposed by the Contractor or included into the Contract Documentation.

A3.2.5 MATERIALS

A3.2.5.1 General material specifications

The material specifications are the required specifications for the materials as placed and/or processed in its final position.

It is the Contractor's responsibility to ensure that the materials delivered to the site shall meet these specified requirements.

Prior to the manufacture of any prefabricated units by the Contractor's manufacturer, the manufacturer shall submit his Quality Plan to the Engineer to verify that all prefabricated units will be manufactured in full compliance with the relevant SANS requirements. No prefabricated units shall be ordered until the Engineer has satisfied himself that the proposed units have been or will be manufactured to the required specifications and tolerances as well as the load bearing requirements. In particular the manufacturer shall check each prefabricated portal culvert unit for steel cover compliance, and random checking of units shall not be accepted. The Engineer's representative may visit the factory at any stage to ascertain adherence to the quality plan. Should the manufacturer fail to adhere to their Quality Plan the Engineer may exercise the right to reject the use of products from the manufacturer concerned. No claim from the Contractor for any resultant cost or delay due to such rejection, and due to procurement from a new manufacturer, shall be entertained.

Materials removed under this Section from existing works, except where excavated materials are specified to be reused or disposed of, or except where provision has been made in Part C for their reuse or specific disposal, shall be deemed to be the property of the Contractor.

A3.2.5.2 Culvert materials

a) In situ concrete

All concrete work shall be carried out in accordance with the requirements of Section A13.4 of Chapter 13 of these specifications, read together with the provisions of Clause A3.1.5.4.

b) Prefabricated portal culverts and prefabricated in/outlet, floor and roof slabs units

The prefabricated units shall comply with the requirements of SANS 986.

For durability requirements, all durability testing shall be done in accordance with Clause A20.1.5 for testing and Clause A20.1.7 for assessment in Chapter 20 and shall fall within the severe category. For units within the 5,0 km zone from the coast the very severe category shall be used and increased cover shall be as specified by the Engineer.

Portal and rectangular prefabricated units shall be transported and handled with sufficient care to prevent stressing, cracking or damage to the unrestrained elements of the units. Cracks or damage shall constitute adequate reason for rejection by the Engineer or required confirmation by the manufacturer of their serviceability.

All broken, bent, chipped, cracked, dented, corroded or otherwise damaged or substandard units shall be repaired to the Engineer's specification or, where this is not acceptable or does not comply to the SANS specification, they shall be removed and replaced with undamaged units, at the Contractor's cost.

Slab units which are thinner than the specified thickness, or which may exhibit signs of substandard work shall be removed and replaced with units which conform to the specifications.

c) Prefabricated concrete pipe culvert units

Prefabricated concrete pipe culvert units shall comply with the requirements of SANS 677. Pipes with ogee joints shall be provided, unless otherwise specified.

All broken, bent, chipped, cracked, dented, corroded or otherwise damaged or substandard units shall be repaired to the Engineer's specification or, where this is not acceptable or does not comply with the relevant SANS specification, they shall be removed and replaced with undamaged units, at the Contractor's cost.

d) Brickwork

Bricks shall be engineering bricks conforming to the requirements of SANS 227. Bricks may be manufactured on site or elsewhere. The limit for water absorption in the 24 hour immersion test shall be 8 % maximum. All bricks shall be unbroken, except where required as closers.

e) Plaster

Plaster shall consist of one part of CEM I class 32.5 cement to four parts of approved fine sand, and shall conform to the requirements of SANS 2001.

f) Manhole covers, grid inlets, frames, etc.

Manhole covers and frames, grid inlets and accessories of metal, or non metal composition shall be supplied and/or manufactured in accordance with the details shown on the drawings and be of the size and type indicated. Frames, grid inlets and covers which are of project specific requirements shall be manufactured and installed as indicated on the drawings, and all steel elements shall be galvanised in accordance with SANS 121. Frames, grids/gratings covers and accessories of cast iron, synthetic or composite materials shall comply with the requirements of SANS 558, SANS 1115, or SANS 50124 and be of the strength class, size and type specified,

Before fixing cast iron manhole covers and frames, they shall be dipped in an approved preservative and gratings and frames painted with two coats of bituminous paint.

g) Corrugated metal culvert units

Corrugated metal culverts shall either be supplied fully assembled; or as unassembled nestable arch or circular segments, in which case they shall be assembled in accordance with the manufacturers specifications. The manufacturer's specifications shall be provided to the Engineer prior to the start of any assembly.

Metal culverts shall be supplied with inlet and outlet ends finished by one of the following two methods, whichever is shown on the drawings or has been specified:

Where no concrete inlet and outlet structures but only beveled pipe ends are required, inlet and outlet units shall be beveled to suit the skew angle of the culverts and the side slope of the fill and pavement. Such beveled units shall be machined and shall receive full corrosion protection treatment after such machining.

Where in situ 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 provided with anchor bolts projecting radially around the edge as shown on the drawings for bonding the metal culvert into the concrete inlet and outlet structures.

The Contractor shall not store any nestable culvert units on the site in such a manner that moisture can accumulate between the contact faces of the nested units, as this may adversely affect the spelter coating and render the units liable to rejection. Any units damaged by corrosion shall, if not rejected, be repaired by cleaning all affected areas and applying at least two coats of an approved zinc-rich epoxy primer which complies with the requirements of SANS 926, in accordance with the manufacturer's instructions, or as directed by the Engineer.

Uneven joints, distorted shapes, deviations from a straight centre line, irregular or diagonally ruptured sides, loose rivets, rivets not in line or irregularly spaced, poorly finished rivet heads, illegible trade marks, or a lack of rigidity.

h) Protective coating for metal culverts

Metal culverts shall have a protection coating as specified in the Contract Documentation or indicated on the drawings, and may be of galvanized, aluminized or polymer coatings to the specified thickness. Where soil or water conditions are likely to cause excessive corrosion of metal culverts, the Engineer may prescribe that prefabricated units be protected by the application of a mastic asphalt protective coating. The coating shall be applied to either the inside, the outside or to both sides of the metal culvert units as may be directed by the Engineer.

The mastic asphalt shall contain fibres and filler and shall be supplied as a spray or brush-grade material as prescribed.

The surfaces to be protected shall be cleaned to remove all moisture, dirt, all, paint, grease, alkalis, rust, mill scale or other deleterious matter.

The material shall be thoroughly mixed until all fibres and filler are uniformly distributed.

Spray-grade mastic shall be applied by means of an airless gun and shall be of a suitable consistency without the addition of a harmful amount of thinners.

Brush-grade mastic shall be applied with an ordinary roofing brush, with the second coat being applied at right angles to the first coat.

The final film thickness measured on the crest of corrugations shall be a minimum of 1,3 mm or such other thickness as may be specified.

Care shall be taken not to damage the protective coating, and all damage to the coating shall be repaired before the culvert is put to use. **i)**

U-PVC culverts

U-PVC culverts shall comply to the requirements of SANS 791 for solid wall pipes (category-heavy duty), and shall have socketed ends should joining be required.

j) Alternative culvert materials

Alternate culvert materials, if any, shall be specified and detailed in the Contract Documentation.

A3.2.5.3 Skewed ends

Where culverts are to be constructed at a skew angle, the prefabricated culvert units at the inlet and outlet of the culvert shall be supplied with skew ends by the manufacturer, if required. The cutting of skew ends on the site shall not be allowed.

Prefabricated portal and rectangular culverts placed on a skew shall be constructed with cast in-situ skewed ends as shown on the drawings. Insitu skew ends are to be constructed simultaneously with the wingwalls and headwalls.

A3.2.5.4 Prefabricated energy dissipaters in outlet structures

Where shown on the drawings, the Contractor shall supply and install in the outlet structures, prefabricated reinforced concrete energy dissipaters of class C25/30-20 concrete with dimensions as shown on the drawings. All concrete work shall comply with the requirements of Section A13.4 of Chapter 13.

A3.2.5.5 Fine granular material

Wherever the use of fine granular material is specified in this section for the bedding of the prefabricated concrete floor slabs of the culverts, it shall mean sand or other cohesionless material, all of which shall pass through a 7,0 mm sieve and not more than 10 % of which shall pass through a 0,15 mm sieve.

A3.2.5.6 Materials at joints

Joint filler and joint sealing material shall comply with the requirements of Section A13.7 of Chapter 13.

A3.2.6 CONSTRUCTION EQUIPMENT

The Contractor shall submit his plant and equipment list for excavating, stockpiling if specified, loading and hauling and compaction, erection and installation, as part of his method statement to perform the different elements of the drainage works specified in Section A3.2.

A3.2.7.7 Laying and bedding of prefabricated culverts

a) Concrete pipe culverts

Prefabricated concrete pipe culverts shall be laid on Class A, B, C or D bedding as shown on the drawings or as specified. The pipe ends shall be laid hard up against each other so as to obtain tight joints. Ogee pipes shall be laid with their spigot ends pointing downstream. The joints shall be sealed on the outside with two layers of bitumen-impregnated grade 3 geotextile as specified in Section A12.11 of Chapter 12.

The insides of the culverts shall be smooth and without any displaced joints. All pipes shall be laid true to line and level.

(i) Class A bedding

The pipe shall be laid with its bottom part on a C20/25-20 concrete bedding cradle of specified thickness below the lower part of the pipe, which concrete shall extend upwards on both sides of the pipe to a specified portion of its height, as shown on the drawings.

Before concreting, the pipes shall be supported on suitably shaped cradles at the correct level. No longitudinal construction joints on the horizontal plane will be permitted.

(ii) Class B and Class C beddings

The pipe shall be laid on a bedding cradle of compacted selected granular material as specified. The bedding shall extend upwards on both sides of the pipe to a specified portion of its height, as shown on the drawings. Grooves for thickened pipe ends, if applicable, shall be formed in the bedding cradle for pipe sockets and couplings, to ensure that each pipe is fully supported throughout the length of its barrel on the bedding cradle.

(iii) Class D bedding

The pipe shall be laid on the in situ material in the excavation bottom after the bottom has been hand trimmed to support the pipe along the entire length of its barrel in accordance with the details shown on the drawings. Wherever necessary, the in situ material shall first be stabilised in accordance with the details shown on the drawings or as prescribed by the Engineer. Grooves for thickened pipe ends, if applicable, shall be formed in the trench bottom for pipe sockets and couplings, to ensure that each pipe is fully supported throughout the length of its barrel on the bedding cradle.

(iv) Rock foundation

Where rock, shale or other hard material is encountered on the bottom of excavations, the installation of pipes on Class B bedding shall proceed as follows:

The material below the pipe shall be excavated and replaced with a bed of sand or approved gravel or soil to a depth as shown on the drawings or prescribed by the Engineer. Such material shall be classed as backfill for purposes of payment.

The backfill material shall be watered and compacted to provide a firm earth foundation. Class B bedding shall then be prepared as described in Clause A3.2.7.7a)(ii).

(v) Concrete casing

Where shown on the drawings or specified by the Engineer, pipes shall be fully encased in concrete according to class and dimensions as shown on the drawings or as ordered by the Engineer. Supports shall be provided close to the pipe ends to support the pipes during the placing of concrete. The concrete shall be so placed as to fill all spaces below and around the pipe completely. Poker vibrators shall be used for this purpose. Concrete casing shall be cast in one continuous operation until completed. **b) Prefabricated portal culverts**

(i) Cast in situ floor slabs

Cast in situ floor slabs shall be constructed to the dimensions and at the locations as shown on the drawings or as may be prescribed by the Engineer. They shall be reinforced with steel reinforcement as detailed on the drawings. Joints of the types detailed on the drawings shall be formed in the floor slabs, as well as between the floor slabs and the inlet and outlet structures. Where specified by the Engineer a screed layer shall be cast to the specified dimensions and details, prior to casting the floor slab.

In accordance with the drawings, transverse construction joints are required in cast in situ concrete invert slabs for portal culverts. In addition, longitudinal construction joints as shown on the drawings between the invert slabs of each the barrels of multiple culverts are required. Allowance for Class F1 surface finish and soft board in these joints is made in the schedule of quantities. No payment shall be made for formwork on the outside edges of invert slabs (closest to the excavated face).

(ii) Prefabricated floor slabs

A layer of fine-grained material at least 75 mm thick shall be placed on the bottom of the excavation or backfilled bedding, leveled, compacted and trimmed to line and grade, to form a bed to receive the prefabricated slabs.

The slabs shall be carefully placed on the prepared bed, true to line and grade, and so bedded that they will be uniformly supported over their whole area on the bedding.

(iii) Placing the portal portions of culverts

The portal portions of portal and rectangular culverts shall be placed accurately and symmetrically on the floor slabs, with a thin layer of mortar of one part of CEM I class 32.5 cement and six parts of sand between the contact surfaces to ensure a firm and uniform support.

The units shall be butted end to end with butt joints, which joints (both horizontally and vertically) shall be covered externally with two layers of grade 3 geotextile as specified in Section A12.11 of Chapter 12, pre-impregnated with a bituminous emulsion, or a similar approved material. The strip of geotextile shall be at least 150 mm wide and placed symmetrically over the joint. The units shall first be treated with a primer of 60 % bitumen emulsion over the width of the strip of geotextile.

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 concrete up to the level of the top of the culvert.

c) Metal culverts

The excavation shall be trimmed to the shape of the invert of the culvert and a bed of fine granular material not less than 75 mm thick shall be placed, compacted and shaped to enable the culverts to be bedded as shown on the drawings.

Where rock is encountered, the depth of excavation shall extend to a depth of at least 200 mm below the invert of the culvert, and shall be filled with granular material as before.

The culverts shall be assembled and installed in accordance with the manufacturer's recommendations as specified by the Engineer. Where these specifications are inconsistent with the manufacturer's recommendations, these specifications shall have preference. Anchor bolts shall be installed at the ends of metal pipe culverts in accordance with the manufacturer's instructions to bond them into inlet and outlet head walls, which head walls shall be constructed as soon as possible after installation of the culverts.

No concrete bedding or casing shall be used in the installation of metal culverts.

Where prescribed, the inner invert of metal culverts with diameters or spans exceeding 1 500 mm which are laid on steep grades shall be protected with a layer of concrete with dimensions and class as shown on the drawings.

A3.2.7.8 Extension of existing culverts

Where an existing portal or rectangular culvert requires extension, the new section shall be constructed at the same grade and, where it joins the existing structure, at the same level as the existing structure.

Any sections of existing wing walls, approach slabs and head walls, which may obstruct any new work, shall be demolished and removed. Existing culvert ends shall not be damaged, but should damage occur, the repair work shall be done before the placement of any fresh concrete or construction of the new culverts. Loose material shall be removed and joint faces thoroughly cleaned to the satisfaction of the Engineer.

Joining shall be done in accordance with Clause A3.2.7.13. After completion of the extension of a culvert, new approach slabs, head walls, wing walls, catchpits, etc, shall be constructed in accordance with the drawings and Clause A3.2.7.11.

A3.2.7.9 Construction of culverts in half widths in existing roads

If necessary for accommodation of traffic or for any other reasons, or if so specified by the Engineer, culverts shall be constructed in half widths.

Unless otherwise prescribed, the downstream section shall be constructed first. The end of the excavation adjoining the traffic lane shall be properly supported and shored up to prevent displacement or collapse from occurring. The necessary warning signs and barriers shall be erected in accordance with the requirements of Section A1.5 of Chapter 1. No such work may be commenced with before safety barriers and traffic signs have been erected.

Where the culvert is constructed in an existing road and it has been so prescribed by the Engineer, each of the pavement layers at least shall be benched and recompacted during backfilling. The depth of benching shall equal the respective layer thicknesses, and the width shall be at least 150 mm.

A3.2.7.10 Backfilling of culverts

After the culverts have been constructed as described in Clauses A3.2.7.6 and A3.2.7.7, backfilling shall be carried out as follows:

No backfilling of a brickwork or in situ concrete structure may be done for a period of at least 7 days after the structure has been completed, unless otherwise specified or directed by the Engineer. No backfilling of a brickwork structure may be done until the roof slab has been installed.

The material used for the backfilling of those portions of culverts subject to traffic loads shall be selected material of at least subbase quality or such other lower quality as may be permitted by the Engineer. Where the excavated material is not of adequate quality, selected material shall be imported for this purpose. The Contractor shall, in advance, ascertain from the Engineer as to which portions will require selected-quality material for backfilling.

Backfilling alongside and over all culverts shall be placed at optimum moisture content 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 93 % of MDD.

Backfilling shall be carried out simultaneously and equally on both sides of a culvert to prevent unequal lateral forces from occurring.

Whenever specified or as may be specified by the Engineer, a wet or a stiff mixture of soil cement in lieu of a compacted gravel placed between the side of the culvert and the excavation up to the top of the culvert shall be used.

The wet mixture of soil cement shall consist of an approved soil or gravel mixed with 5,0 % of CEM II class 32.5 cement and only sufficient water to give a consistency that will permit the soil cement to be placed with vibrators, so that all voids between the culverts and the sides of excavations and between culverts in the case of multi-barrel culverts will be properly filled. A stiff mixture of soil cement shall contain 3,0 % of CEM II class 32.5 cement and just sufficient water for it to be placed and compacted like ordinary backfill material. The height to which the soil cement backfill shall be taken shall be as prescribed by the Engineer or shown on the drawings, and any remaining backfill shall be carried out as described above with selected material.

The material used for soil cement shall preferably be a sandy material but may contain larger particles up to 38 mm, and it shall not have a plasticity index exceeding 10. Detrimental percentages of silt or clay shall be avoided, and where the excavated material is not of adequate quality, the material shall be obtained from an approved source.

The soil cement shall be mixed on the site with suitable concrete mixers, and the water and cement contents shall be carefully controlled. Should the Contractor provide adequate quality control mechanisms for hand mixing, the Engineer may approve alternative mixing methods. The material shall be placed and then thoroughly compacted so that all voids are filled as described above. At culvert ends stones shall be packed to prevent the soil cement from flowing beyond the required limits.

All imported and backfill material shall be subject to the load and haul provisions specified in Section A1.7 of Chapter 1.

B3.2.7.2 Classes of Excavation

Where excavation is done using labour enhanced construction methods, the Engineer shall classify excavated materials as either soft or intermediate for payment purposes in terms of Table B3.2.7-1 or, if the Contractor does not agree with the classification, in terms of Table B3.2.7-2. The decision of the Engineer regarding the classification of the excavated materials shall then be final and binding, subject to the provisions of the conditions of contract.

No hard material shall be measured under labour enhanced construction methods. **Table**

B3.2.7-1: Classification of Excavated Materials

Materials Classification	Description
Soft	Material which can be excavated by means of a suitable shovel with or without the use of a pick or other hand-swung tool.
Intermediate	Material which is difficult to excavate by hand even with the aid of a crowbar and requires the assistance of pneumatic tools for economic removal.

Table B3.2.7-2: Classification of Materials in Terms of Consistency and Shear Strength

Materials Classification	Consistency		Number of DCP blows to penetrate 100 mm ^{*1}	
	Granular soil	Cohesive soil	Granular soil	Cohesive soil ^{*2}
Soft	Very loose to dense	Very soft to stiff	≤ 15	≤ 8
Intermediate	Very dense	Very stiff	>15	>8
*1 Only applicable to materials comprising not more than 10 % gravel of size less than 10 mm and materials containing no cobbles or isolated small boulders.				
*2 Classification depends on the moisture content of the cohesive material.				

B3.2.8 WORKMANSHIP

The provisions of Part A shall apply.

Items to be measured and paid for using items specified elsewhere in the specifications

The following items of work, when specified, shall be carried out, measured and paid for in accordance with the appropriate Sections of the specifications.

Table C3.2-1: Payment items from other Chapters or Sections

Activity	Section 3.2 reference	Section item reference
Clearing and grubbing	A3.2.7.1; A3.2.7.12	C1.6 of Chapter 1 - All applicable items
Loading and hauling	A3.2.7.5; A3.2.7.10	C1.7 of Chapter 1 - All applicable items

(iv) Items specifically for this Section of the specifications

Item	Description	Unit
C3.2.1	Excavation for culvert structures:	
C3.2.1.1	Excavating in all material situated within the following depth ranges below the surface level:	
(a)	0 m to 1,5 m	cubic metre (m ³)
(b)	Exceeding 1,5 m and up to 3,0 m	cubic metre (m ³)

(c)	Etc, in increments of 1,5 m	cubic metre (m ³)
C3.2.1.2	Excavating soft material 0 m to 1,5 m below the surface level using labour enhanced construction methods, or instructed by hand under Clause A3.2.7.2d):	cubic metre (m ³)
C3.2.1.3	Excavating intermediate material 0 m to 1,5 m below the surface level using labour enhanced construction methods, or instructed by hand under Clause A3.2.7.2d):	cubic metre (m ³)
C3.2.1.4	Extra over sub-item C3.2.1.1 for excavation in hard or boulder material, irrespective of depth	cubic metre (m ³)
C3.2.1.5	Extra over sub-item C3.2.1.1 for excavation in stabilised existing road layers, irrespective of depth	cubic metre (m ³)

The unit of measurement shall be the cubic metre of material excavated within the specified widths over the lengths and depths authorised by the Engineer in each case, measured in place before excavation. Excavation in excess of the widths specified or authorised by the Engineer shall not be measured for payment.

When measuring excavation for the removal of existing culverts, the volume occupied by the culvert shall not be subtracted from the calculated volume of excavation.

In the case of manholes, catchpits and inlet and outlet structures, the dimensions for determining the volume of excavation shall be the neat outside dimensions of the structure, plus an allowance of 0,5 m of working space around the structure.

Payment made for either hard; boulder or stabilised existing road layers shall only be measured for the one applicable extra over category.

The tendered rates shall include full compensation for all excavation, temporary timbering, shoring and strutting, for preparing the bottom of the excavation for the culvert beds, the disposal of excavated material unsuitable for backfilling, keeping excavations safe, dealing with any surface or subsurface water, and for any other operations necessary for completing the work as specified.

Irrespective of the total depth of the excavation, the quantity of material in each depth range shall be measured and paid for separately.

Excavation shall be done using conventional construction methods and/or labour enhanced construction methods as specified and measured.

The tendered rates shall include full compensation for the excavation of the material to the required dimensions, lines, levels and grades, the trimming of the bottom of the excavation and the loading and disposal/utilisation of the materials directed, including haul of 1,0 km when using conventional construction methods.

Loading and hauling, where applicable, including a haul of 1,0 km, shall be measured and paid under Section C1.7 of Chapter 1. Where the excavation of material is specified by means of labour enhanced construction methods, the tendered rates shall include loading and transport by wheelbarrow if the material is disposed of or utilised within a radius of 50 m, alternatively loading by hand onto transport vehicles for such disposal or utilisation elsewhere, within a haul distance of 1,0 km.

Variations will be dealt with in accordance with C1.1.4 of Chapter 1.

Item	Description	Unit
C3.2.3	Concrete pipe culverts:	
C3.2.3.1	On Class A bedding (type and diameter indicated)	metre (m)
C3.2.3.2	On Class B bedding (type and diameter indicated)	metre (m)
C3.2.3.3	On Class C bedding (type and diameter indicated)	metre (m)
C3.2.3.4	On Class D bedding (type and diameter indicated)	metre (m)
C3.2.3.5	Provision of skew ends of pipe culvert (type and diameter indicated)	number (No)
The unit of measurement for concrete pipe culverts shall be the metre of culvert laid as shown on the drawings or ordered by the Engineer. The length shall be measured along the soffit centre of the culvert or along each barrel for multiple barrel units. The unit of measurement for the skew ends of culverts shall be the number of skew end units provided; in- and outlets and multiple barrels shall be measured separately. The tendered rate shall include for all costs to provide the skew end unit from the manufacturer to the specified length and skew including all wastage.		

The tendered rates shall include full compensation for providing, testing, loading, transporting and unloading the culverts, for providing and placing all specified bedding but excluding concrete bedding, and for the installation, laying and jointing of the culverts, as specified.

Where a half-length pipe unit is required, i.e. a pipe unit of which the length is equal to half the standard length, and provided that such half-length pipe units are normally supplied by the manufacturers, the actual length of such half-length pipe unit will be measured for payment, and no additional compensation will be paid in respect of such half-length pipe unit.

For the purposes of payment, differentiation shall be made between the various types and sizes of culverts and between the culverts placed on A, B, C and D Classes of bedding as well as the different size skew ends requirements.

Item	Description	Unit
C3.2.4	Metal and U-PVC culverts:	
C3.2.4.1	Size, wall thickness and type indicated	metre (m)
C3.2.4.2	Provision of skew or bevelled ends for metal culverts	number (No)

C3.2.4.3	Anchor bolts (size and type indicated)	number (No)
C3.2.4.4	Protective coating to metal culverts (culvert size; inside/outside/ both sides; coating type & thickness indicated)	metre (m)

The unit of measurement for metal culverts and protective coating shall be the metre of culvert laid as shown on the drawings or ordered by the Engineer. The unit of measurement for the skew/bevelled ends of culverts shall be the number of skew/bevelled end units provided; in- and outlets and multiple barrels shall be measured separately. In the case of a metal or U-PVC pipe, the culvert length shall be measured along the pipe centreline. In the case of a metal pipe arch, the culvert length shall be measured along the bottom/invert of the pipe arch. In all cases the length of bevelled and/or skew ends shall be included.

The tendered rates shall include full compensation for providing, testing, loading, transporting and off-loading the culverts, for providing and placing fine-grained material where required for the installation of culverts, and for installing, laying and jointing the culverts as specified. For the purposes of payment, a differentiation shall be made between the various types and sizes of culverts and also between culverts with differing wall thicknesses.

Payment shall be made separately for the provision of bevelled and/or skew ends for metal culverts, and the tendered rate shall include full compensation for all work in connection with the provision of specified ends. U-PVC culverts may be cut to skew ends, but no additional payment will be made for cutting skew ends.

The tendered rate per anchor bolt shall include full compensation for procuring, providing and installing the bolts.

Item	Description	Unit

The unit of measurement shall be the number of each type of accessory delivered and installed. Accessories shall only be measured and paid where such items are not included in unit prices for complete structures such as under item C3.2.15

The tendered rates shall include full compensation for procuring, furnishing and installing the accessories as specified.

Item	Description	Unit
C3.2.20	Anchors for pipes (description)	number (No)

The unit of measurement shall be the complete anchor installed, including straps, bolts, etc, but excluding any concrete work, which shall be measured under item C3.2.7.

The tendered rate shall include full compensation for procuring, providing and installing the anchors.

Item	Description	Unit
C3.2.21	Prefabricated reinforced-concrete skew end units for concrete culverts constructed at a skew angle (type and dimensions of unit and class of bedding indicated)	number (No)

The unit of measurement shall be the number of each type and size of prefabricated reinforced-concrete skew end unit provided and installed, irrespective of the angle of skew.

The tendered rates shall include full compensation for providing, testing, loading and unloading the units, constructing the prescribed class of bedding, and for installing, laying and joining the units, complete as specified and in accordance with the details shown on the drawings.

Item	Description	Unit
C3.2.22	Cutting of concrete pipes (diameter indicated)	number (No)

The unit of measurement shall be the number of pipes that have been cut on the instruction by the Engineer. The tendered rate shall be fill compensation for the cutting, by means of mechanical saw (angle grinder) and finishing off the pipes for the specific angle of skew at which the pipes must be laid.

Cutting of the pipes shall only be paid for if the headwall or the wingwalls are at such a skew angle in respect to the centre line of the pipes that cutting is required and where non-standard lengths are required. The maximum skew angle at which pipes are allowed to be cut shall be 30 degrees and the maximum length of pipe measured along the shortest side, shall be 1,5 m.

C3.2.23 Breaking into existing drainage structures and building in pipes or culverts of the number (No) following size (pipe diameter and/or culvert size to be stated)

The unit of measurement is the number of each type and size of existing drainage structure that is being modified as shown on the drawings or as specified by the Engineer.

The tendered rates shall include full compensation for providing all labour, constructional plant and materials required, for all excavation, breaking into existing drainage structures, building into the newly formed accesses, sealing around the edges and making the joints watertight, breaking out existing benching and channelling where required and reconstructing them complete with granolithic rendering to suit the new drainage arrangement, backfilling and compacting to at least 93 % of MDD and dealing with the flows in the existing structures.

Item	Description	Unit
C3.2.24	Compaction of bedding for inlets, outlets, manholes and catchpits:	
C3.2.24.1	Preparation and compaction of in situ bedding material to 90 % of MDD (depth indicated)	cubic metre (m³)
C3.2.24.2	Extra-over sub-item C3.2.24.1 for compaction to 93 % of MDD (depth indicated)	cubic metre (m³)

The unit of measurement shall be the cubic metre of material ripped and compacted as specified.

The tendered rate shall include full compensation for the ripping of the in situ material to the specified width and depth, wetting the material to such an extent that the density can be achieved.

Item	Description	Unit
C3.2.25	Painting of exposed steel bars with two coats of zinc rich primer (Type specified)	litre (ℓ)

The unit of measurement shall be the litre of primer used as specified

The tendered rate shall include full compensation for cleaning the exposed steel as specified and providing and applying the primer in accordance with the manufacturer's specifications.

Item	Description	Unit
C3.2.26	Repair with cementitious mortar or concrete (Class) to (description)	litre (ℓ)

The tendered rate shall be as specified under item C14.4.1 of Chapter 14. Payment for larger concrete extensions shall be made under item C3.2.7.

The unit of measurement is the litre of epoxy mortar measured in place, of specified type used for the repair of specified concrete defects, including curing.

The tendered rate shall be as specified under item C14.4.2 of Chapter 14.

D3.2 CULVERTS PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

D3.2.1 SCOPE

D3.2.3 PERFORMANCE GUARANTEE REQUIREMENTS

D3.2.4 FUNCTIONAL PERFORMANCE ASSESSMENTS

D3.2.5 VISUALLY ASSESSED PROPERTIES

D3.2.6 INSTRUMENTALLY ASSESSED PROPERTIES

D3.2.7 EVALUATION FOR ACCEPTANCE

D3.2.8 ADDITIONAL PROCEDURES TO BE ADOPTED IN THE EVENT OF FAILURE

D3.2.9 NOTIFICATION OF REMEDIAL WORK

D3.2.10 REMEDIAL WORKS

No specific items in this Section.

Where applicable, details must be provided in the Contract Documentation.

3.3 CONCRETE KERBING AND CHANNELING, ASPHALT BERMS, CHUTES, DOWNPIPES, AS WELL AS CONCRETE, STONE PITCHED AND GABION LININGS FOR OPEN DRAINS

A3.3 CONCRETE KERBING AND CHANNELING, ASPHALT BERMS, CHUTES, DOWNPIPES, AS WELL AS CONCRETE, STONE PITCHED AND GABION LININGS FOR OPEN DRAINS

PART A: SPECIFICATIONS

A3.3.1 SCOPE

Drainage under this Section mainly covers the drainage of road and bridge surfaces into open structures or conduits. Drainage may transfer into culverts or conduits or to natural or formed drainage channels. This Section covers work in connection with the construction of concrete kerbing and its channeling, asphalt berms, kerb inlets, chutes, downpipes, and linings for open drains constructed from concrete, stone pitching, gabions, mattresses or alternative materials at the locations and to the details as shown on the drawings or specified by the Engineer. This Section also covers the replacement of damaged kerbing, channeling, asphalt berms, and lining of all types of construction.

A3.3.2 DEFINITIONS

No specific definitions.

A3.3.3 GENERAL

A3.3.3.1 Types of structures

Kerbing shall include barrier kerbs, mountable and semi-mountable types. All these elements may be prefabricated on site or elsewhere or constructed in a continuous operation using slipforms. Kerb inlets shall generally be cast in situ concrete.

Channeling may be cast in situ concrete, prefabricated units, slipform construction, stone pitched or gabion lined.

Chutes may be prefabricated units, cast in situ concrete, stone pitched or gabion lined.

Lining of open channels may be cast in situ concrete or stone pitched or gabions, except that side slabs may be precast on site or elsewhere.

Downpipes shall be prefabricated elements, of concrete, steel or U-PVC or HDPE.

Asphalt berms may be cast in situ in moulds or constructed by means of a suitable machine.

A3.3.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

None applicable unless specific specifications have been accepted as proposed by the Contractor or included into the Contract Documentation.

A3.3.5 MATERIALS

A3.3.5.1 General material specifications

The material specifications are the required specifications for the materials as placed and/or processed in its final position on the road.

It is the Contractor's responsibility to ensure that the materials delivered to the road shall meet these specified requirements. All precast and manufactured elements are to be tested for strength and durability.

Materials removed under this Section from existing works, except where excavated materials are specified to be reused or disposed of, or except where provision has been made in Part C for their reuse or specific disposal, shall be deemed to be the property of the Contractor.

A3.3.5.2 Drainage structure materials

a) Concrete

All concrete work shall be carried out in accordance with the requirements of Section A13.4 of Chapter 13 of these specifications, read together with the provisions of Clause A3.1.5.4.

b) Cement

Cement shall comply with SANS 50197-1 for CEM I or CEM II with a strength class of 32,5 or greater, and a rate of strength gain N or greater. **c)**

Kerbing and channeling

Prefabricated kerbing and channeling shall be manufactured on site or elsewhere and shall comply with the requirements of SANS 927. Cast in situ kerbing and channeling shall be of the class of concrete indicated.

d) Joint sealant

Two-part cold applied polysulphide sealing compound shall conform to the requirements of BS 4254.

Polyurethane-based joint sealants shall comply with the requirements of SANS1077.

Silicone-based joint sealants shall comply with the requirements SANS 1305 unless otherwise indicated in the Contract Documentation. **e)**

Bedding material

Concrete as bedding or backing material, in shall be a class C16/20-20 cast in situ concrete.

Alternative bedding shall consist of crushed stone, cinders, slag, sand or other approved porous material with a maximum particle size of 14 mm.

f) Asphalt berms

Asphalt berms shall be bedded on completed surfacing layers or primed base layers. Asphalt shall be a continuously graded fine or medium mix, as specified, with aggregate grading as specified in Table A9.1.5-5 of Chapter 9 and mix properties as specified in Table A9.1.3-2 of Chapter 9. **g) Stone**

Stone for pitching shall be sound, tough and durable, with 80 % of stones more than 150 mm in minimum dimension, with smaller pieces or spalls may be used for filling spaces between the larger stones. The shapes of the rocks or stones shall be so as to form a stable protective layer of the required thickness. Rounded boulders shall not be used on slopes steeper than 2:1 unless cement grouted. **h) Sand for concrete**

Sand for concrete, cement slurry and cement mortar shall comply with the requirements of SANS 1083. **i)**

Gabions and mattresses

The materials used for the construction of gabions and mattresses which may include rock, PVC-coated and/or galvanized wire and wire mesh shall comply with the requirements of Section A12.6 of Chapter 12.

j) Geotextiles

Geotextiles shall be of the grade and type specified in the schedule of quantities or Contract Documentation, and shall comply with the requirements of Section A12.11 of Chapter 12.

k) U-PVC pipes

U-PVC pipes shall comply to the requirements of SANS 791 for solid wall pipes (category-heavy duty), and shall have socketed ends should joining be required.

l) Bituminous binders

Should a prime coat be required, it shall conform to the specifications of the prime for the base layer.

The bond coat shall consist of a stable grade bituminous emulsion diluted to have 30 % net bitumen content

The bituminous binder to be used in the specified mix shall be a bitumen emulsion and conform to the specifications in Clause A9.1.5.2 of Chapter 9.

- **CHAPTER 4: EARTHWORKS AND PAVEMENT LAYERS: MATERIALS**
- **4.1 BORROW MATERIALS**

CONTENTS PART A: SPECIFICATIONS A4.1.1 SCOPE A4.1.2 DEFINITIONS A4.1.3 GENERAL A4.1.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS A4.1.5 MATERIALS A4.1.6 CONSTRUCTION EQUIPMENT A4.1.7 EXECUTION OF THE WORKS A4.1.8 WORKMANSHIP

PART B: LABOUR ENHANCEMENT PART C: MEASUREMENT AND PAYMENT PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

A4.1 BORROW MATERIALS

PART A: SPECIFICATIONS

A4.1.1 SCOPE

This Section covers the work requirements for sourcing natural or crushed compliant materials that can be used for the construction of earthworks and road pavement layers from borrow pits and quarries that are developed and operated to supply materials for a specific road construction project or projects. It contains the following specifications:

- Definitions applicable for Chapters 4 and 5.
- Responsibilities and duties of the Employer and the Contractor in providing geotechnical information, and information on the preparation of management and utilisation plans for the borrow pits and quarries.

- The material specifications for the earthworks and road pavement layers.
- The requirements for the control, excavation, selection of material, and closure of borrow pits and quarries, as well as definitions for the different classes of excavation.
- Producing of the road construction materials by crushing and/or screening.
- The preparation of stockpile sites and the stockpiling of materials.

Operations at quarries of commercial suppliers to produce commercial materials are excluded from the requirements in this Section A4.1, except for the material specifications in Clause A4.1.5.

Specifications for aggregate to be used in subsoil drains, asphalt, seals, gabions and concrete are not included in this Chapter 4 but are included in the relevant Chapters where these works are specified.

The sourcing of materials from road cuttings, box cuts and designated excavations, from existing roads, from commercial sources, and the use of alternative materials are covered in the other Sections of this Chapter 4.

Chapter 5 – Earthworks and Pavement layers: Construction, covers the construction of the road pavement layers.

SANS test methods published by the South African Bureau of Standards (SABS) are listed in Chapter 20.

• **A4.1.2 DEFINITIONS**

The relevant definitions in Chapter 1 shall also be applicable to this section. Additional definitions for this Section are listed below.

Borrow or sourced material - any road construction material obtained from borrow pits and quarries which is compliant for the construction of earthworks and road pavement layers. The purpose of a borrow pit or quarry is to borrow or source or procure the material, or to win the material as defined in the South African Minerals and Petroleum Act. Borrowing or sourcing material from borrow pits and quarries requires statutory authorisation and approval in South Africa.

Borrow pit area or quarry area - an area clearly defined by physical boundaries, that delineate the overall area within which the sourced material is to be excavated, stockpiled and produced.

Borrow pit - the excavated area within the borrow pit area from which road construction materials such as soil, gravel, cobbles and boulders, and to a lesser extent hard rock, are obtained.

Crushed stone type G1 base layer - a crushed stone base layer is the uppermost (top) structural layer of a road pavement that consists of type G1 crushed stone which:

- Is continuously graded;
- Consists of minus 37,5 mm crushed aggregate of high durability equal to that of the parent rock, low permeability because of the continuous grading at maximum particle interlock, and low moisture sensitivity as the material is non-cohesive;
- Is compacted to a high percentage of Apparent Density; and
- Is slush-compacted to refusal or maximum particle interlock.

Deleterious minerals - minerals, when present in the natural untreated material, that are detrimental to the road pavement layers. The most common undesirable minerals that are known to have deleterious effects in the earthworks or road pavement layers are sulfide, soluble salts and mica:

- **Sulfide** is a compound of sulfur. When exposed to air and water, the sulfide decomposes easily. Oxidation leads to the development of sulfate salts and sulfuric acid that result in acidic materials. The sulfuric acid and sulfate salts can destroy cementitious stabilising agents, and the salts can cause blistering and cracking of a pavement.

Golden-coloured iron pyrite, also known as “fools gold”, is the most common sulfide mineral and is usually present in gold and copper mine rocks. However, it can also occur in normal rock quarries in most other rocks. If it can be seen with the naked eye or a hand lens it is potentially troublesome. However, in some materials it can't be seen and other indicators such as a dark grey or black colour in a quartzite, and white, yellow or brown staining, are indicative of sulfide in the rock.

- **Soluble salts** are salts that dissolve easily in water and are sufficiently soluble to cause deleterious physical or chemical effects. Salts that generally occur in such quantities to affect the road materials are sodium chloride and sulfates.

Soluble salts can be encountered in the roadbed, the earthworks and in any of the road pavement layer materials. The dissolved salt migrates upwards through the earthworks and road pavement layers, and is precipitated at the contact between the base layer and the surfacing. The salt then causes the disruption of the bond between the base layer and the surfacing, and blisters develop. This generally results in the failure of the surfacing.

- **Mica** of which the most striking features are its platy structure and elasticity. In this respect muscovite, the “light” or “white” mica, is the most troublesome. The deleterious properties of mica only manifest themselves when the minerals are separated from the rock, that is when it occurs in a loose state in weathered rock, gravel or soil (also known as free mica). The springy action of free mica, especially muscovite, affects the compaction so that low densities and strengths are achieved. The mica plates may also prevent filling the voids in the material, resulting in a high void ratio and a high water demand. Biotite, the “dark” or “black” mica is not as elastic as muscovite and tends to break more easily into smaller pieces during construction. Fewer problems are experienced with biotite. Material derived from granite, gneiss, mica schist, phyllite and some sandstones usually contain mica.

Drainage layer - the drainage layer is constructed over a wet roadbed or in the lower fill layers to provide a stable roadbed, or to intercept water or moisture to prevent it from rising into the road prism and/or the road pavement layers.

Earthworks - all operations involved in sourcing, excavating and removing, spoil of non-compliant material, processing, hauling, importing, depositing and placing, shaping and compacting of compliant soil, gravel, cobbles, boulders and rock. The structure resulting from these operations may comprise a pioneer layer or a roadbed of in situ material, and fill layers. The earthwork layers form the foundation for the subsequent road pavement layers that are constructed on top of the earthworks.

Fill layers - fill is that portion of the earthworks that is positioned above the pioneer layer or roadbed, and on which the road pavement layers are to be constructed. Fill layers can either be sand fill, normal fill, coarse fill or rock fill materials:

- **Sand fill material** comprises of non-plastic sand with more than 95 % passing through the 5,0 mm sieve, and which can be compacted to a measurable density.
- **Normal fill material** consists of sand, gravel, gravel with cobbles or alternative materials (refer to Section A4.5) with a maximum particle size up to 200 mm in the fill and which can be compacted to a measurable density.
- **Coarse fill material** comprises gravel with cobbles, boulders, lumps of hard material or alternative materials with a maximum particle size up to 500 mm, or a maximum particle size so that the material in the fill layer can be compacted to the specified density by the construction equipment, whichever is the lesser. The strength of coarse fill material does not rely on mechanical interlock of the coarse particles. Coarse fill is constructed by compaction to a measurable density or according to a compaction specification of the number of roller-passes of applicable compaction equipment.
- **Rock fill material** consists predominantly of blasted or crushed angular rock with fine material filling the voids between the rock particles to form a dense layer with minimum voids between the rocks. Rock fill may be constructed with a geotextile separation layer between the rock fill and subsequent layers to prevent loss of material into the rock fill. The stability of rock fill results from the mechanical interlock of the rock particles and not from the compaction of the finer material. The compacted density of a rock fill cannot be measured.

Low volume roads - low volume roads have a maximum traffic class ES 1, that is a total of 1,0 million 80 kN single axles over 20 years..

Macadam layer - a macadam layer is a type of base layer. It consists of a single graded coarse aggregate with a filler material in the voids between the coarse aggregate.

Material control personnel - the personnel for the control of material sourcing and stockpile operations shall be:

- A materials manager who shall be an experienced engineering geologist or engineer, a qualified senior materials technician or an experienced senior general foreman.
- An excavation controller who shall be a materials technician or a general foreman.
- A stockpile controller who shall be an assistant materials technician or a junior foreman.

Material depth - the depth below the finished level of the road to which the material characteristics have a significant effect on the pavement behaviour. Below this depth the strength and density of the material are assumed to have a negligible effect on the pavement, except when conditions may arise in the subgrade that require special treatment, such as expansive materials, materials with collapsible or compressible structures, voids or potential sinkholes, mining subsidence, slope instability, non-uniform support or the presence of deleterious minerals.

Maximum dry density (MDD) - the maximum dry density of soils and gravels is the density at the peak of the compaction curve at optimum moisture content (OMC) as determined in accordance with test methods SANS 3001-GR30 for natural materials and SANS 3001-GR31 for stabilised materials.

M&U Plan - a management and utilisation plan of operations for material sources to ensure that it is worked in a sustainable and sensitive manner, that negative environmental impacts are prevented, material sourcing is optimized and that costs are minimized.

Overburden - overburden is the material immediately beneath the topsoil, if any, and above the specifically sourced material in the borrow pit, the quarry or in the cutting. Overburden is normally not compliant for use in the construction of earthworks and pavement layers but may prove compliant in appurtenant works such as banks (earth berms), for covering of organic material and for rehabilitation of the borrow pit or quarry.

Particle size classification - the particle size classification hereunder commonly applies for uncrushed natural material used in road construction.

Clay has a particle size smaller than 0,002 mm. It has a soapy or greasy feel when rubbed on the palm of the hand with water. Clay is shiny when wet and stains the hands. Clay materials are plastic when wet, and coherent when dry.

Silt has a particle size larger than 0,002 mm and smaller than 0,075 mm. Silt particles are barely felt when rubbed with water on the palm of the hand. It has a chalky feel on teeth and when dry, rubs off the hands. The individual particles cannot be seen, not even with a hand lens.

Sand is a natural untreated material that consists of particles larger than 0,075 mm and smaller than 5,0 mm but may contain a small amount of silt and/or clay:

- Fine sand has a particle size generally between 0,075 mm and 0,3 mm. The particles are not visible to the naked eye and are just visible under a hand lens.
- Medium sand has a particle size generally between 0,3 mm and 0,6 mm. The particles are clearly visible under a hand lens and just visible to the naked eye.
- Coarse sand has a particle size generally between 0,6 mm and 5,0 mm. The individual particles are clearly visible to the naked eye.

Gravel is naturally occurring coarser material from weathered rock that consists mostly of rock fragments between 5,0 mm and 63 mm in size, together with smaller varying amounts of silt, sand and/or clay.

Pebbles, cobbles and boulders are natural occurring rounded stones. Pebbles are between 5,0 mm and 63 mm in size, cobbles are larger than 63 mm and up to 200 mm, while boulders are larger than 200 mm. Core stones and floaters are large individual boulders floating within the residual soil, or lying loose on the surface when the soil has been eroded.

Rock fragments or lumps of hard material are pieces of rock, and can be of any size and shape.

For crushed material the fraction smaller than 5,0 mm is referred to as the fine aggregate or crusher dust, while the coarse aggregate comprises material 5,0 mm and larger.

Pavement layers - the road pavement layers comprise the base, shoulder, subbase and selected layers. Collectively the pavement layers are the road pavement or pavement structure.

- **Base layer** - A layer of material constituting the uppermost (top) structural layer of a road constructed on top of other strata or layers, and on which the surfacing will be placed. Where the shoulders of a road are surfaced and constructed with the same material as that of the base layer, the definition for a shoulder layer shall then not be applicable as the base layer also forms the shoulder.
- **Shoulder layer** - The uppermost gravel unsurfaced or unsealed pavement layer lying between the outside edge of the base layer and the shoulder breakpoint. For roads and streets with kerbing edge restraints, the shoulder layer shall be the backfill behind the kerbing. In this instance the shoulder layer is referred to as the sidewalk layer.
- **Subbase layer** - The layer of material on top of the selected layers, or in the absence of selected layers on the fill, below the base, shoulder and gravel wearing course layers, or below an asphalt base layer, paving blocks or a concrete pavement.
- **Selected layer** - The lower layer or layers of the pavement below the subbase layer(s) which is constructed immediately on top of the fill, or in the absence of fill, directly on top of the roadbed.

Pioneer layer - an initial layer constructed with or without a geotextile on a soft and/or wet roadbed to provide a stable working platform for the construction of subsequent layers.

Quarry - the excavated area within the quarry area where rock material is sourced that requires drilling and blasting.

Soil and gravel - in road construction materials that have a large proportion of fine material in comparison to the coarser material are commonly referred to as "soil(s)". Materials which comprise predominantly of coarser particles with a smaller amount of finer material occurring between the larger particles, and which have good strength due to particle interlock, are described as "gravel(s)". The grading modulus (as defined in TRH 14) of gravel generally exceeds 1,5.

Soil constants - the soil constants of a material comprise:

- The Atterberg Liquid Limit (LL), Plastic Limit (PL), and Shrinkage Limit (SL).
- The Plasticity Index (PI).
- The Linear Shrinkage (LS) and the Linear Shrinkage Modulus ($LSM = LS \times \% \text{ passing the } 0,425 \text{ mm sieve}$).

Spoil material - Spoil material is excavated material that is not compliant for use anywhere in the works or is material which is surplus to the requirements of the contract. Spoil material shall therefore be placed in borrow pits or quarries at completion or disposed of in approved spoil sites.

Stockpile area – A prepared area designated or used for the temporary stockpiling of material until used elsewhere or placed back in the borrow pit or quarry.

Unsuitable material – This is material in or below the roadbed of a quality that would be detrimental to the performance of the completed road, and that must be removed. Unsuitable material can be stable or unstable.

- **Stable material** – This is material which have inadequate bearing strength, active (heaving) clay, material with excessive quantity of unwanted material, and the like. Stable material can be removed or excavated efficiently by means of conventional road construction equipment such as bulldozers, road graders, road scrapers, tractor-loader-backhoes (TLBs) or excavators. Stable material may be taken to spoil, or to stockpile for future use depending on the material properties.
- **Unstable material** – This is material which cannot be removed or excavated efficiently by means of bulldozers, road graders, road scrapers, TLBs, or excavators. The material is unstable by virtue of being soaked, such as being located in marsh or swamp conditions, and cannot provide a stable working platform for the construction of subsequent layers. Unstable material is normally left in place and covered with a pioneer layer but can also be removed to spoil.

Wearing course - the gravel layer constituting the uppermost (top) layer of an unsealed road. The wearing course is not considered part of the structural layers (the base and other layers). The purpose of the wearing course is to provide a maintainable road surface which is skid resistant, dust-free and impermeable to moisture as far as possible.

Weinert N-value - is a climatic numerical value, which has become known as the N-value. It is calculated by multiplying 12 times the computed evaporation of the warmest month, mostly January in Southern Africa, divided by the mean annual precipitation. Four N-values are important:

- Where N is more than 10, no significant weathering profile develops, and only a thin layer of coarse gravel can generally be obtained from the disintegrating rock.
- Where N is between 10 and 5, disintegration or the physical breakdown of all rocks is the predominant form of weathering, and a deeper weathering profile is usually present.
- Where N is between 5 and 2, decomposition or chemical weathering or more specifically, the alteration of minerals, becomes the predominant form of weathering of crystalline rocks. The clay component is less expansive kaolinite when derived from an acid crystalline rock, and highly expansive montmorillonite when derived from a basic crystalline rock.
- When N drops below 2, decomposed basic crystalline rocks are still expansive. Decomposed acid crystalline rocks may become expansive as montmorillonite may have developed from the little biotite and amphibole present.

• **A4.1.3 GENERAL**

• **A4.1.3.1 Employer identified borrow pits and quarries**

Borrow materials shall be obtained from sources listed and described in the Contract Documentation for which the required statutory authorisation and approvals have been obtained by the Employer to source the materials.

The geotechnical information provided for the borrow pits and the quarries reflects the results of site investigations including the excavation of trial pits and/or drilling, and laboratory tests conducted by or on behalf of the Employer. This information is indicative of, but not confirmation of, the sufficiency in quantity and quality of the material. The provision of this information shall not in any way be construed as limiting the obtaining of material from the borrow pit or quarry areas and/or to the depth of working shown on the drawings. However, borrow pits and quarries shall not be extended beyond the limits shown on the drawings without prior written approval by the authority that authorised the use of the borrow pit or quarry.

The decision as to which material sources the Contractor shall use at any time shall rest with the Employer or the Engineer. The Contractor shall, at any stage of the work, use the approved source of supply that is the most compliant with regard to the quality and quantities of the various types of available materials and the ultimate cost of the works to the Employer. The Employer shall also have the right at any stage during the construction period to identify new borrow pits and quarries, and to have them approved by the relevant authority.

The Contractor shall be instructed by the Employer and/or the Engineer as to the applicable usage of materials, always employing the best economic alternative (lowest construction cost in terms of tendered rates) after taking cognizance of the following:

- Haulage distance,
- Hardness of the material, and
- Overburden removal and re-use for rehabilitation of the borrow pit.

The Contractor shall not use borrow material for any purpose other than for the execution of the contract. Material shall not be disposed of, whether processed or not, either by sale or donation to any person without the written authorisation of the Employer.

On completion of the construction works, the Employer or his agent shall apply for a borrow pit or quarry closure certificate. The application shall consist of the required reports compiled by or on behalf of the Employer, and the closure plan compiled by the Contractor.

• **A4.1.3.2 Contractor identified borrow pits and quarries**

Should the Contractor during construction want to propose compliant alternative or additional borrow pits or quarries to those contained in the Contract Documentation, the Engineer's consent shall first be obtained prior to finalising the arrangements for the Contractor identified source. Information to be provided shall be the reasons for the alternative or additional borrow pit or quarry, the cost and time implications, quality and quantity of compliant material and any other information that the Engineer may require.

After obtaining the Engineer's initial consent, the Contractor shall proceed with a detailed investigation of the borrow pit or quarry that comprises the following activities:

- Negotiations with the landowner or legal occupant of the property about acquiring the land, compensation and conditions for entering the property, operations at the borrow pit or quarry, and for shaping and finishing after the material has been removed. Proof must be submitted that successful negotiations have been conducted with all the affected parties, and the landowner or legal occupant.
- An invasive geotechnical investigation of trial pitting, drilling as required, and sampling must be carried out for the intended use by an approved geotechnical engineer, engineering geologist or an experienced road material specialist. The laboratory to be appointed to carry out the material testing shall also be approved by the Engineer. All field work and laboratory testing shall be carried out under the supervision of the Engineer. The scope and findings of the geotechnical investigation, material test results, quality and quantity of the compliant material, and conditions for excavating and operating the borrow pit or quarry shall be submitted in a report to the Engineer.
- A topographical survey of the entire borrow pit or quarry area with cadastral information shown, as well as the surveyed positions of trial pits and boreholes.
- Obtaining the required statutory authorisation and approvals by the appropriate authorities.

The Engineer shall approve or reject the use of the alternative or additional borrow pit and/or quarry, after the results of the detailed investigation have been received.

Where the Tenderer, during the tender stage, wishes to base the tender on alternative material source(s) to those contained in the Contract Documentation, the alternative material source(s) shall be considered as an alternative design, for which the Engineer's consent shall be obtained prior to tender closure. The Engineer shall then inform the Tenderer which information of the listed activities of the detailed investigation must be submitted with the tender, and which activities can be carried out later during construction.

Where the Contract Documentation specifies that the Contractor must identify compliant borrow pits and / or quarries, the same procedure and requirements apply as for alternative or additional borrow pits or quarries.

The Contractor can also propose for consideration the procurement of compliant commercial materials, should they prove to be economically viable.

The Contractor shall be responsible for all costs relating to the negotiations and compensation, the geotechnical investigation and to obtain the statutory approvals of any alternative or additional source.

The Engineer's approval of the Contractor identified material source shall in no way relieve the Contractor of the responsibility for the quantity and quality of the compliant material in the source. The Engineer can at any time halt operations at the source when the material is no longer compliant for its intended use.

After acceptance by the Employer and the Engineer of the Contractor's identified source of material, the Engineer shall have full control of the use of the material. The Engineer shall have authority to give instructions for excavation, producing, stockpiling, finishing and all other construction issues.

• **A4.1.3.3 Negotiations with landowners or legal occupants of land**

For Employer identified borrow pits, quarries, and temporary haul and access roads, the acquisition of the land and/or the removal of the material and compensation in respect of the land, material, royalties and/or loss of crops to which the landowner or legal occupant may be entitled, will be negotiated and paid for by the Employer. When compensation is not made directly by the Employer, payment shall be made by the Contractor through a provisional sum in the Pricing Schedule.

The Contractor will be provided with proof of the successful negotiations and compensation, if applicable, of the Employer identified borrow pits, quarries and temporary haul and access roads. The Contractor shall include the proof of the negotiations and compensation in the M&U plan.

The Contractor shall notify the landowner or legal occupant both verbally and in writing at least 14 calendar days before entering upon or occupying the property. The Engineer shall be provided with a copy of such notice, together with acknowledgement of receipt by the landowner or legal occupant. The Contractor shall not enter the property without the approval of the landowner or legal occupant.

On completion of the borrow pit or quarry operations and after the shaping and finishing activities have been carried out, the Contractor shall obtain from the landowner or legal occupant a written statement confirming that:

- The Contractor has fulfilled all obligations under any written agreement, and
- The landowner or legal occupant is satisfied that the borrow pit, quarry and/or temporary haul and access roads have been properly restored and are in a satisfactory condition.

All such statements shall be signed by the Contractor and the landowner or legal occupant, dated and delivered to the Engineer.

• **A4.1.3.4 Contractor prepared plans for borrow materials**

Based on the information provided in the Contract Documentation, the Contractor shall prepare and submit a Management and Utilisation (M&U) plan for every borrow pit and quarry, whether it be a source identified by the Employer or by the Contractor. The M&U plan shall at least show and include the following:

- The position of a satellite office and camp site, ablution facilities, refuse disposal facilities and workshops as applicable;
- The curriculum vitae of the proposed materials manager, excavation and stockpile controllers as applicable;
- Drainage measures to keep the excavations dry and prevent water ponding;
- Demarcation of the areas for stockpiling of topsoil, overburden and the various earthworks and pavement layer materials;
- Sequence and operation of the borrow pit or quarry for sourcing the material, after the further supplementary exploration described in Clause A4.1.7.2c);
- Method statements and risk assessments for sourcing the material and for operating the borrow pit or quarry;
- The testing protocol of the applicable tests and the frequency of testing;
- Method statements for the blasting of hard material, details for the safe storage and transport of explosives, and the process for obtaining blasting permits in terms of the requirements of these Specifications;
- When blasting within the vicinity of buildings or structures, measures to comply with the relevant Act and Regulations pertaining to the utilisation of explosives, as specified in Clause A1.2.7.5 of Chapter 1, proposals for the examination and recording of the condition of the buildings and structures as specified in Clause A1.2.3.13 of Chapter 1 and compliance with the specifications given in Clause A12.10.7.2 of Chapter 12;
- The positioning of crushers, screens and other plant for crushing and screening of materials;
- Proposed details of a closure plan at completion, including the shaping, finishing and rehabilitation of the borrow pit or quarry side slopes and floor;
- Measures to comply with the conditions of the statutory environmental and mining approvals for the borrow pit or quarry;
- Measures to comply with the safety regulations and obligations in terms of the relevant Health and Safety Act and Regulations; and
- Procedures for regular monitoring, auditing and reporting.

M&U plans need only to be submitted during the course of the construction. However, no operations (including clearing and grubbing) at a borrow pit or a quarry shall commence until the Contractor's M&U plan for that material source has been reviewed and accepted by the Engineer. The Engineer shall respond within one week after receiving an M&U plan.

The M&U plan shall be reviewed after removing of the topsoil and overburden, and revised if the sequence of excavation, type and quality of material or any other issue requires a different operation than detailed in the original M&U plan.

Rock fill that is deficient in fine material can be used in the works, provided that after placing the rock fill and during the compaction, concrete or plaster sand or non-parent (not from the same source as the rock) sandy material, is spread uniformly over the surface of the rock fill and vibrated or worked into and between the rocks to fill the voids. The grading of the sand shall be such that all material passes the 5,0 mm sieve and not more than 15 % shall pass the 0,075 mm sieve.

A strength requirement such as the CBR is not required for rock fill material.

• **A4.1.5.6 Requirements for types G7 to G9 materials for the pavement layers**

Gravel-soil types G7 to G9 materials shall be classified according to the requirements in Table A4.1.5-3.

Table A4.1.5-3: Requirements for types G7 to G9 materials

Property		Type of material		
		G7	G8	G9
DESCRIPTION OF MATERIAL		Soil, gravel with cobbles, boulders and lumps of hard material that may require crushing or grid rolling, or alternative materials.	Soil, gravel, or alternative materials.	
MAXIMUM PARTICLE SIZE		(i) Uncrushed material: Twothirds of the compacted layer thickness. (ii) Crushed material: 100 mm.	Two-thirds of the compacted layer thickness.	
GRADING MODULUS (GM)		0,75 – 2,7.		
SOIL CONSTANTS ON THE P0,425 FRACTION (= % passing the 0,425 mm sieve)	All materials except calcrete	PI ≤ (3xGM) + 10.		
	Calcrete	PI ≤ 20.		
STRENGTH (CBR at % of MDD)		CBR ≥ 15 % at 93 %. ⁽¹⁾	CBR ≥ 10 % at 93 %.	CBR ≥ 7 % at 93 %.
SWELL AT 100 % OF MDD		Swell ≤ 1,5 %.		
DURABILITY		No requirement, except when mudstone or shale is used in the selected layer. Requirements then as specified in Clause A4.1.5.16.		
DELETERIOUS MINERALS		Specified in Clause A4.1.5.17.		

Note:

⁽¹⁾ The minimum CBR requirement shall be increased to 18 % at 93 % of MDD for an otherwise compliant G7 material that requires modification such as lime treatment or mechanical modification to bring the CBR within specification.

• **A4.1.5.7 Requirements for types G4 to G6 materials for the pavement layers**

Gravel, natural occurring or modified or processed, types G4 to G6 materials shall be classified according to the requirements in the Table A4.1.5-4.

Table A4.1.5-4: Requirements for types G4 to G6 materials

Property	Type of material				
	G4A	G4B	G5A	G5B	G6
DESCRIPTION OF MATERIAL	Medium to hard rock, or boulders that require multistage crushing and screening.	1. Gravel with pebbles and small cobbles, or gravel with larger cobbles, boulders and lumps of hard material, or soft rock that require single- or two-stage crushing, or grid rolling.	Medium to hard rock, or boulders that require multistage crushing and screening.	1. Gravel with pebbles and small cobbles, or gravel with larger cobbles, boulders and lumps of hard material, or soft rock that require single- or two-	Gravel with cobbles, or alternative materials.

		2. Pedogenic materials that require dozer ripping.		stage crushing, or grid rolling. 2. Pedogenic materials that require dozer ripping.	
MAXIMUM PARTICLE SIZE	50 mm.	1. In a base layer: 50 mm. 2. In a stabilised subbase layer: 63 mm. 3. In all other pavement layers: Two-thirds of the compacted layer thickness, or 100 mm whichever is the smaller.	50 mm.	1. In a base layer: 50 mm. 2. In a stabilised subbase layer: 63 mm. 3. In all other pavement layers: Two-thirds of the compacted layer thickness, or 100 mm whichever is the smaller.	
FLAKINESS INDEX	Flakiness Index $\leq$ 35 on all individual fractions above 14 mm.	None specified.	Flakiness Index $\leq$ 35 on all individual fractions above 14 mm.	None specified.	
FRACTURED FACES	None specified.	Gravels and boulders that are crushed: at least 50 % by mass of the material retained on each of the 5 mm and larger sieves shall have at least one fractured face.	None specified.	Gravels and boulders that are crushed: at least 50 % by mass of the material retained on each of the 5 mm and larger sieves shall have at least one fractured face.	None specified.
GRADING ENVELOPE	Sieve size (mm)	Percentage passing sieve, by mass	None specified.	Percentage passing sieve, by mass	None specified.
	50	100		100	
	37,5	85 – 100		85 – 100	
	20	61 – 91		61 – 91	
	14	48 – 82		48 – 82	
	5	31 – 66		31 – 66	
	2	20 – 50		20 – 50	
	0,425	10 – 30		10 – 30	
	0,075	5 – 15		5 – 15	
GRADING MODULUS (GM)	None specified	1,75 (base) / 1,5 (subbase) – 2,5.	None specified	1,75 (base) / 1,5 (subbase) – 2,5.	
SOIL CONSTANTS ON THE P _{0,425} FRACTION ⁽¹⁾ (= % passing the 0.425 mm sieve)	(a) All materials except calcrete: LL $\leq$ 25. PI $\leq$ 6. LS $\leq$ 3 %. (b) Calcrete: LL $\square$ 30. PI $\square$ 8. LSM $\square$ 170.		(a) All materials except calcrete: LL $\leq$ 30. PI $\leq$ 10. LS $\leq$ 5 %. (b) Calcrete: LL $\square$ 45. PI $\square$ 15. LS $\square$ 6 %. LSM $\square$ 320.		(a) All materials except calcrete: PI $\leq$ 2GM + 10. LS $\leq$ 7 %. (b) Calcrete: LL $\leq$ 45. PI $\leq$ 15. LS $\square$ 6 %, or LSM $\leq$ 320, whichever is the more stringent requirement.
STRENGTH (CBR at % of MDD)	CBR $\geq$ 80 % at 100 %.		CBR $\geq$ 45 % at 95 %. Except In the dry western parts of Southern Africa (Weinert N $\geq$ 10) and		CBR $\geq$ 25 % at 95 %.

		when the E80s < 3 million, then the subbase CBR ≥ 25 % at 95 % provided that the base thickness ≥ 150 mm.	
SWELL AT 100 % OF MDD	Swell $\leq 0,2$ %.	Swell $\leq 0,5$ %.	Swell $\leq 0,5$ %.
DURABILITY	Specified in Clause A4.1.5.16.		
DELETERIOUS MINERALS	Specified in Clause A4.1.5.17.		

Note:

⁽¹⁾ The LS and the LSM shall be the primary soil constants for acceptance control of calcrete, and the PI for all other materials.

- A4.1.5.13 Drainage layer material**

- a) Drainage blanket layer material**

Material for a drainage blanket layer comprising coarse material shall comply with the gradation requirements in Table A4.1.5-13.

- Table A4.1.5-13: Gradation of material for a drainage blanket layer**

Sieve size (mm)	Percentage passing sieve, by mass
50	100
37,5	74 – 100
28	56 – 98
14	42 – 69
5	25 – 37
2	15 – 20
0,425	4 – 9
0,075	0 – 4

- b) Sand filter material**

Sand for filter material in the fill layers shall be clean, durable sand and shall comply with the gradation requirements in Table A4.1.5-14.

- Table A4.1.5-14: Gradation of sand filter material**

Sieve size (mm)	Percentage passing sieve, by mass	
	Natural sand	Crusher sand
5	90 – 100	
0,150	5 – 25	
0,075	0 – 5	0 – 10

- A4.1.7 EXECUTION OF THE WORKS**

- A4.1.7.1 Haul and access roads**

- a) Existing roads and streets**

The Contractor will be entitled to use existing public roads and municipal streets, subject to any constraint on axle load legislated or imposed by the road authority. The Contractor shall be acquainted with any restrictions about the road width, overhead clearance at structures and services, and maximum allowable axle loads.

Where the surfacing of a road or street to be used for hauling is already in a visual poor condition or when it is expected that it will deteriorate considerably during the hauling, the Contractor in conjunction with the Engineer shall conduct a visual assessment and compile a photographic record of the road or street's condition for record purposes before hauling any construction material over the road or street.

The Contractor shall handle all claims by the road authority regarding any damage caused by the Contractor's vehicles and/or equipment.

The Contractor will not be required to maintain existing roads and streets belonging to other authorities that is used to haul material or for construction access, except for damage caused by negligence on the Contractor's part or by overloading of the Contractor's vehicles. Where the condition of the existing routes is so poor that it results in inefficient haul of the material or in unavoidable deterioration of the roads, the Contractor shall request the authority to implement suitable and effective maintenance actions. The Contractor shall refer any maintenance proposals to be conducted by the Contractor, to the Employer for a decision when the responsible road authority cannot or will not carry out the requested maintenance.

The Contractor shall keep records comprising counts and categories, of construction vehicles using the public roads and streets.

• **b) Temporary new roads on acquired land and over private property**

The Employer or its agents may acquire land, or register a servitude, or conclude arrangements with the landowner or legal occupant of the land for the construction of temporary haul and access roads over a property.

Where the Employer or its agents have not made any arrangements for the new roads, the Contractor shall then engage with the landowner or legal occupant to construct and maintain temporary unproclaimed haul and access roads over the private property. Existing tracks shall be used as far as possible for haul roads. The Employer shall approve any costs relating to the Contractor's arrangements prior to concluding an agreement with the landowner or legal occupant.

.

• **b) Classes of excavation**

The excavation of borrow material shall be classified as follows:

• (i) Soft excavation

Soft excavation class is excavation of material that can be efficiently removed by the reference construction equipment specified in the Contract Documentation, without prior breaking down.

Very dense granular or sand material and stiff to very stiff cohesive clay material, which can still be removed by the reference construction equipment without prior breaking up as specified for hard material but that do not comply with the definition of efficient removal of the equipment, shall also be classed as soft excavation.

In the absence of any construction equipment specified to reference the efficient removal of the material, a hydraulic crawler excavator in good mechanical order with nett horsepower (flywheel power) generally between 180 kW and 225 kW, also known as a 30 ton excavator, and equipped with a heavy duty bucket shall be the reference construction equipment. A minimum continuous production rate of 160 m³/h of the excavated material will be taken as the benchmark for the excavator's capacity and efficiency.

• (ii) Boulder excavation class A

Where material contains in excess of 40 % by volume of boulders, core stones, floaters and lumps of hard material larger than 200 mm but volume less than 20 m³ in size, in a matrix of soft material, then the full volume excavated shall be classed as boulder excavation class A.

Excavation in dolomite formations other than solid dolomite shall also be classed as boulder excavation class A if the formations contain in excess of 40 % by volume of lumps of hard dolomite larger than 200 mm but volume less than 20 m³ in size, in a matrix of softer material or smaller lumps of hard dolomite.

Excavation of fissured or fractured rock shall not be classed as boulder excavation but as soft or hard excavation according to the nature of the material.

• (iii) Boulder excavation class B

Where material contains 40 % or less by volume of boulders, core stones, floaters and lumps of hard material larger than 200 mm but volume less than 20 m³ in a matrix of soft material, then the volume of the individual boulders, core stones, floaters and lumps of hard material shall be classed as boulder excavation class B.

The volume of the rest of the material shall be classed as soft excavation.

• (iv) Hard excavation

Hard excavation is excavation of material, excluding boulder excavation that is classed separately, which cannot be removed efficiently by the reference construction equipment specified in the Contract Documentation, and that will require other means of breaking down before removal by one of or a combination of the following:

- Drilling and blasting.
- Ripping with a bulldozer.
- An excavator fitted with a hydraulic percussion hammer or fitted with a ripper.
- Hand operated pneumatic or electro-mechanical equipment such as jackhammers or pavement breakers.
- Drilling and injecting non-explosive, expansive, silent rock-breaking cracking products.

Excavation of individual large boulders, core stones and lumps of hard material in excess of 20 m³ shall also be classed as hard excavation.

The Contractor shall be at liberty to use any method and construction equipment for excavating any class of material, but the chosen method or construction equipment to excavate the material shall not dictate the classification of the material.

Before any excavation commences the Engineer and the Contractor shall agree on the applicable classes of excavation, based on a visual inspection, any geotechnical information issued with the Contract Documentation and the supplementary explorations as in Clause A4.1.7.2c).

Agreement shall also be reached on the method of measurement to be used for boulder excavation or blasted rock prior to the commencement of the excavation.

In the event of a disagreement between the Engineer and the Contractor, the Contractor shall if instructed, make available such reference construction equipment as specified at no cost to the Employer, in order to determine whether or not the material can be efficiently removed. The decision of the Engineer as to the classification shall thereafter be final and binding, subject to the relevant provisions of the Contract Documentation.

The Contractor shall immediately inform the Engineer if and when the nature of the material being excavated changes to such an extent that a new classification for further excavation is warranted. Failure to inform the Engineer of any possible change in the class of excavation before the material is excavated, shall entitle the Engineer to classify and measure such excavation as deemed appropriate. **c) Supplementary exploration**

When agreed to by the Engineer and the Contractor, the Contractor in the presence of the Engineer, shall conduct further investigations to obtain information for the M&U plan of a borrow pit and of a quarry. In doing so the Contractor shall:

- Recommend and request additional trial pits and/or drilling to substantiate the material properties tested during the exploration at the design stage,
- Determine the extent of the clearing and grubbing,
- Determine the thickness of the topsoil,
- Determine the thickness of the overburden, and quality for use in appurtenant works,
- Determine the thickness, quality and quantity of compliant material for earthworks and pavement layers,
- Assess the class(es) of excavation for proposing to the Engineer,
- Determine the sufficiency of the available material compared to the mass haul or information in the Contract Documentation,
- Recommend proposals to supplement any material shortage, and • Determine any other input required for the Contractor's M&U plan.

• **d) Clearing and grubbing**

The borrow pit or quarry from where material is to be sourced shall be cleared and grubbed as specified in Section A1.6 of Chapter 1.

Borrow pits and quarries shall be cleared and grubbed 2,0 m wider than the excavated area or to 2,0 m beyond the outer edge of temporary drainage banks and dykes, as applicable. Material obtained from clearing and grubbing of an area, provided it is not hazardous material, shall be removed to temporary stockpile within the borrow pit or quarry area. Upon closure, it can be placed within the borrow pit or quarry and covered up. The burning of material on the site of the works shall not be permitted.

Where the total thickness of the topsoil and the overburden is more than 1,0 m, all trees and tree stumps including mattered roots shall be removed to a depth of at least 1,0 m below the cleared surface. Where the total thickness is less than 1,0 m a separate grubbing operation is not required and the tree stumps can be removed together with the overburden, unless otherwise instructed by the Engineer.

Individual boulders, core stones, floaters or lumps of hard material which are exposed or lying on the surface and that cannot be removed by the construction equipment used in the clearing and grubbing operation, shall be separated (pushed aside) and left in the borrow pit, or shall be broken down and then removed to spoil or to the road if suitable after breaking down or to a crushing plant for crushing. Breaking down or crushing of the material shall be approved or instructed by the Engineer.

• **e) Removal and conservation of the topsoil**

After the clearing and grubbing of an area, the topsoil shall be excavated and stockpiled as specified in Section A1.6 of Chapter 1, for later rehabilitation of the borrow pit or quarry. It shall be stockpiled in a designated area as indicated on the borrow pit or quarry plan. **f) Removal of the overburden**

No removal of overburden or any further borrow pit/quarry operations shall commence until agreement has been reached with the Engineer in regard to the thickness, the extent, use and quantity of the overburden. Overburden less than 200 mm thick shall be removed with the topsoil and not separately.

Overburden shall be moved to beyond the outer limits of the borrow pit or quarry excavation. This operation shall not be regarded as temporary stockpiling. The Engineer's approval must be obtained for removing and stockpiling of overburden that cannot be moved to beyond the limits of the borrow pit or quarry excavation, or for overburden that is to be used in the works. Overburden shall be kept in a weed-free condition during the construction.

• **l) Use of the borrow material**

The results of laboratory tests, trial pits and borehole drilling of materials carried out during the design stage are included in the Contract Documentation. The results and other information give a preliminary indication as to the purpose for which and where the material shall be used. The Engineer shall give final instructions during construction regarding the use of the borrow material.

Coarse rock encountered shall be utilised for the construction of the lower layers of fills high enough to accommodate thick layers, or, where so required, shall be conserved and used as directed for constructing the sides of embankments or for serving as protection against embankment or channel erosion.

The Engineer may order that particular materials in the borrow pits and quarries be selected for a specific purpose. Where selection is ordered, the method of excavation and the programme of work shall be so arranged as to avoid double handling. When ordered by the Engineer, the better class fill material shall be selected for use in the top layer of the fills and in the lower layers of high fills.

Any surplus or non-compliant material resulting from the excavation shall be disposed of as directed by the Engineer.

The Engineer shall have full control over the use of all borrow pit and quarry materials. The Engineer shall have the right to decide which borrow pit or quarry the Contractor shall operate from at any particular stage of the work, and to deviate from any previous programme of material source at no additional cost to the Employer.

The Contractor shall plan the operations and particularly the excavation-to-fill operations in such a manner that all borrow material be used to the best advantage of the Employer. This means that no material shall be unnecessarily spoiled, borrowed, stockpiled or hauled. The Contractor shall neither borrow nor spoil any material without the Engineer's approval and without proving to the Engineer that this is necessary and that it is the most economical method of constructing the works.

• **m) Closing of the borrow pits and quarries**

The operations and requirements for shaping, finishing, rehabilitation and closure of the borrow pits and quarries after the removal of the road construction material is completed, are contained in the borrow pit and quarry plans approved by the control authority and shall be complied with.

In the absence of any specified conditions in the borrow pit or quarry approvals, or elsewhere in the Contract Documentation, the following minimum requirements shall be complied with:

- All gravel and soil material in the borrow pit and quarry areas outside the borrow pit or quarry, whether spoil from the road construction operations, excess stockpiled material, any material from the stockpile fill platform, oversize material left in the borrow pit, material from temporary banks and material resulting from clearing and grubbing operations shall be placed in the floor of the borrow pit or quarry. The material shall be spread evenly and the floor shall be shaped to prevent standing water,
- Material placed in the floor of the borrow pit or quarry incapable of supporting natural vegetation shall be covered with soft material or topsoil,
- Remaining portions of in situ soft material in the floor shall be scarified along the contours so that undue erosion is avoided. Hard material in the floor shall be left intact,
- The floor of the borrow pit or quarry shall generally not be vegetated, unless required in the statutory authorisation or instructed by the Engineer,
- All infrastructure and foundations for buildings and the crushing plants shall be demolished and removed and the surface covered, • All foreign materials shall be removed,
- Domestic or other waste and rubbish shall not be disposed of in the borrow pit or quarry but shall be removed from the site,
- Hazardous material as specified in Clause A4.5.5.5 shall not be spoiled or buried in the borrow pit or quarry,
- Soil contaminated with oil or grease or fuel or other hydrocarbons shall not be disposed of in the borrow pit or quarry excavation but shall be removed from the site,
- Existing banks and dykes shall be reconstructed if required, or new banks and dykes shall be constructed to divert surface water from or around the excavation. Stormwater shall also not be concentrated on the property of an adjoining landowner or legal occupant,
- The excavation shall be self-draining or where this is not possible the control authority's approval shall be obtained,
- Unless otherwise specified in the Contract Documentation and/or environmental and mining approval documents, large boulders or remaining in situ hard material can be left to protrude from the slopes or faces of the excavation,
- The slopes (sides or batters) within soft excavation shall be shaped not steeper than 1 vertical to 3 horizontal,
- All loose and unstable material shall be removed from the faces of excavation in boulder or hard material,
- The finished surfaces in soft material that will be topsoiled shall not have any loose stones larger than 100 mm,
- The soft material embankments shall receive a 75 mm to 150 mm thick topsoil layer, and shall be vegetated when measured in the Pricing Schedule, and
- The entire borrow pit or quarry area shall be fenced along with appropriate access control signage and with a locked gate for access if required, except if the area is not accessible by the public, there are no slopes steeper than 1 vertical to 3 horizontal in the hard material areas and the Engineer, the landowner or legal occupant and the relevant authority agree in writing that it is safe to leave the borrow pit or quarry area unfenced.

• **A4.1.7.3 Stockpiles**
• **a) Preparation of the stockpile site**

Stockpile sites shall be prepared in positions as indicated on the borrow pit or quarry plans, or at positions agreed to and indicated on the M&U plans.

Before any stockpiling may be done the area shall be cleared and grubbed as specified in Section A1.6 of Chapter 1. The area to be cleared and grubbed shall be 2,0 m wider than the footprint of the stockpile or to 2,0 m beyond the outer edge of temporary banks and dykes, as applicable. Topsoil and overburden material can remain in place, except when it has insufficient bearing strength for the height of the stockpiled material or where a platform of fill material must be constructed. The topsoil shall then be removed and stockpiled in an area that will not be affected by construction activities nor impede the natural flow of water. The stockpiled topsoil and its immediate surrounds shall be kept free of all undesirable vegetation.

Trees and tree stumps shall be removed to 75 mm below the cleared surface.

Stockpile areas shall be constructed with a minimum slope of 2 % to ensure proper drainage. The surface (floor) shall be scarified to a depth of 150 mm, watered, and compacted to a minimum density of 90 % of MDD. Further instructions will be given for the treatment of soft in situ material with low bearing strength, in accordance with the roadbed treatments specified in Section A5.1 of Chapter 5.

On steep sloping landforms, a platform shall be constructed so that the cross fall does not exceed 5 %. The platform shall be constructed of fill material in layers compacted to a minimum density of 90 % of MDD. The compacted surface for stockpiling shall be firm and clean of loose material.

Stockpile areas shall be large enough to allow the different types of material to be stockpiled without overlapping or exceeding the limits of the borrow pit or quarry area or indicated stockpile area.

The Contractor shall ensure that stockpiled material is not washed away during rain. Temporary banks must be constructed on the high side of stockpiles to divert surface water. Care must also be taken to prevent water from damming up against the stockpiles. On the lower side of the stockpile material, temporary banks with stormwater outlets shall be constructed to contain any stockpile material that is washed down during rain.

The Contractor shall only commence the stockpiling activities after the areas have been prepared and approved by the Engineer.

b) Stockpiling of the material

The material shall be off-loaded and spread uniformly in layers in the stockpile. Segregation of the material during the handling shall be avoided.

The different material stockpiles shall be sign posted according to the material type and intended use.

Where different types of excavated or commercial materials are placed in the same stockpile for mixing later on the road for the mechanical modification of pavement layer material, the materials shall be placed in lift heights of less than one metre. The different materials shall be placed in layers in every lift, in thicknesses of the same proportion as in the final material mix determined by testing.

The height of stockpiles that consists of different layered materials shall not exceed 3,0 m to enable efficient mixing of the materials during loading to the road. Stockpiles that consist of uniform materials can be built higher depending on the capacity of the loading equipment, unless restrictions are placed on the height in the environmental or other approvals.

Special attention shall be given to the stockpiling of crushed stone material for a base layer. It shall always be placed in stockpiles after crushing.

The material shall be dumped and levelled in the stockpile so that any segregated material from the processing operation is blended again. However, extensive working of the crushed stone material in the stockpile shall be prevented to avoid segregation. The side slopes of the stockpile shall be visually assessed for areas or layers of obvious fine or coarse material that is indicative of segregation.

The lower 100 mm of stockpiled material shall not be loaded for construction to avoid contamination with the floor or platform material of the stockpile.

The Contractor shall carry out the following duties at every stockpile:

- Ensure that the stockpile site has been prepared correctly and that all banks and dykes are in place before stockpiling commences,
- Ensure that the material is placed at the correct designated stockpile,
- Manage the correct proportional placing of different materials in the specified lift heights if applicable,
- Ensure that the specified stockpile heights are not exceeded,
- Ensure that the stockpile slopes are safe and not prone to excessive segregation at the edge,
- Regularly inspect and maintain the stormwater banks and dykes,
- Ensure that material washed from the stockpile is contained,
- Control the safe movement of construction equipment, vehicles and personnel on the stockpile site,
- Comply with all the conditions of the borrow pit and quarry approvals by the control authority and in the Contract Documentation, and
- Comply with the requirements of the relevant legislation relating to OHS, Mining and Construction.

When specified in the Contract Documentation, the Contractor shall have a stockpile controller at every stockpile site to conduct and manage the above duties. The requirements for the stockpile controller, whether the person must be an assistant materials technician or a junior foreman and whether the controller is to be present full time or only part time during the stockpiling, as well as the controller's required qualifications and experience, shall then also be specified.

c) Reinstatement of the stockpile site

After the stockpiled material has been removed, the site shall be reinstated as closely as possible to its original condition.

In the absence of any specified conditions in the borrow pit or quarry approvals, or elsewhere in the Contract Documentation the following minimum requirements shall be complied with:

- All surplus stockpiled material shall be removed and disposed of,
- Material used to construct a fill platform and the temporary banks shall be removed and disposed of, unless the Contractor is instructed to leave the banks in place to prevent future erosion,
- The stockpile floor shall be graded to the original natural contours,
- The stockpile floor shall be ripped 100 mm deep to break all compacted in situ material, and

- The stockpile site shall be lightly scarified to promote growth of natural vegetation or shall be covered with a 75 mm to 150 mm thick topsoil layer and vegetated when required in the statutory approvals.

4.2 CUT MATERIALS

A4.2 CUT MATERIALS PART A: SPECIFICATIONS

A4.2.1 SCOPE

This Section covers the work requirements for sourcing natural or crushed materials that can be used for the construction of earthworks and road pavement layers from:

- New cuttings.
- The widening of, or altering the side slopes of, or cutting of benches into existing cuttings.
- Box cuts for new roads and from box cuts for the widening of existing roads.
- Designated excavations.

Chapter 5 – Earthworks and Pavement layers: Construction, covers the construction of the road layers.

Specialised cutting slope protection measures are covered in Section 12.9 of Chapter 12.

A4.2.2 DEFINITIONS

The relevant definitions in Chapter 1 and Clause A4.1.2 shall also be applicable to this Section. Revised or additional definitions for this Section are listed below.

Cuttings - are shallow or deep excavations made in the in situ material required for the construction of the road within the road reserve where the road level results in a cutting slope or batter to be constructed and finished. Further or additional excavations, also referred to as under cuts, below the road pavement layers to remove unsuitable stable material in the same excavation operation within the cutting shall be deemed part of the cutting excavation.

Box cuts - are shallow excavations made in the in situ material required for the construction of the road pavement layers below the natural ground level. Additional or further excavations, also referred to as under cuts, below the pavement layers to remove unsuitable stable material in the same excavation operation within the box cut shall be deemed part of the box cut excavation. Box cuts are backfilled with the pavement layer, fill or with other compliant material. Unlike cuttings and designated excavations, box cuts do not have side slopes that must be finished.

Cut material - any material excavated from cuttings, box cuts or designated excavations.

Designated excavations - are excavations for open drains and channels, canals including channels to direct the course of water flow, that can yield compliant material for use in the works. The excavation criteria for open drains and channels to be classified as designated excavations are provided in Table A3.1.7.2-1 of Chapter 3.

A4.2.3 GENERAL

A4.2.3.1 Employer requirements

The geotechnical information provided for the cuttings, box cuts and designated excavations reflects the results of site investigations including the excavation of trial pits and/or drilling, and laboratory tests conducted by or on behalf of the Employer. This information is indicative of, but not confirmation of, the sufficiency in quantity and quality of the material.

The Contractor shall use materials strictly in accordance with the requirements in the Contract Documentation and as instructed by the Engineer. The Contractor shall ensure that compliant materials are not unnecessarily contaminated with non-compliant material and that cut materials are not wasted.

All cuttings, and designated excavations where appropriate, must be surveyed and correctly staked before any cut operations commence to ensure that the designated cut lines and slopes are adhered to.

The Contractor shall be instructed as to the applicable usage of the material supply always employing the best economic alternative (lowest construction cost in terms of tendered rates) taking cognizance of the following:

- Quality of material,
- Haulage distance,
- Hardness of the material, and
- Overburden removal and use.

The Contractor shall not use cut material for any purpose other than the execution of this contract. Material shall not be disposed of, whether processed or not, either by sale or donation to any person without the written authorisation of the Employer.

A4.2.3.2 Contractor prepared plans for cuttings

The Contractor shall prepare and submit a Management and Utilisation (M&U) plan of operations for every cutting where the quantity of cut material will exceed 5 000 m³. Only a representative M&U plan can be submitted for cuttings between 5 000 m³ and 10 000 m³ where the cuttings have significantly similar material classes and excavation methods. Box cuts and designated excavations do not require M&U plans.

The M&U plan for the cutting shall at least show and include the following:

- The curriculum vitae of the proposed materials manager, excavation and stockpile controllers as applicable;
- The survey methods to stake the cut lines and slopes;
- Demarcation of the areas for stockpiling of topsoil, overburden and the various fill and pavement layer materials as required;
- Sequence and working of the cutting for sourcing the material;
- The testing protocol of the applicable tests and the frequency of testing;
- A method statement and risk assessment for sourcing the material;
- Method statements for the blasting of hard material, details for the safe storage and transport of explosives and the process for obtaining blasting permits in terms of the requirements specified in Section A12.10 of Chapter 12;
- When blasting within the vicinity of buildings or structures, measures to comply with the relevant Act and Regulations pertaining to the utilisation of explosives, as specified in Clause A1.2.7.5 of Chapter 1, proposals for the examination and recording of the condition of the buildings and structures in Clause A1.2.3.13 of Chapter 1 and compliance with the specifications given in Clause A12.10.7.2 of Chapter 12;
- The finishing and stabilising of the cut slopes;
- The positioning of crushers, screens and other plant for crushing and screening of materials;
- Measures to comply with the conditions of the statutory road environmental approval;
- Measures to comply with safety regulations and obligations in terms of the relevant Health and Safety Acts and Regulations; and
- Procedures for regular monitoring, auditing and reporting.

M&U plans need only to be submitted during the course of the construction. However, no operations at a cutting including clearing and grubbing, shall commence until the Contractor's M&U plan for that cutting has been reviewed and accepted by the Engineer. The Engineer shall respond within one week after receiving an M&U plan.

A4.2.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

Not required for Section A4.2.

A4.2.5 MATERIALS

A4.2.5.1 General

The specifications given in Clause A4.1.5 shall also apply to cut materials and are the required specifications for the cut material as finally processed and constructed on the road.

A4.2.5.2 Quality of materials

It is the Contractor's responsibility to ensure that the cut material including all operations such as excavation, loading, hauling, producing and stockpiling as applicable will comply with the material specifications, subject to the relevant provisions of the Contract Documentation.

Monitoring the quality and quantity of the cut materials produced for the construction on the road shall be the responsibility of the Contractor.

Based on a visual inspection by the Engineer and on the results of material tests as deemed appropriate, the Engineer shall have the right to declare the material non-compliant for use at any time before construction on the road or stockpiling as applicable. The Contractor shall then submit proposals for acceptance by the Engineer to rectify or replace the non-compliant material. Acceptance control testing of materials by the Engineer shall only be carried out during or after construction on the road, or of the material in the stockpile as applicable.

A4.2.6 CONSTRUCTION EQUIPMENT

Construction equipment to source the cut materials shall comply with the requirements of Clause A1.2.6 of Chapter 1.

4.3 EXISTING ROAD MATERIALS

PART B: LABOUR ENHANCEMENT PART C: MEASUREMENT AND PAYMENT PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

A4.3 EXISTING ROAD MATERIALS PART A: SPECIFICATIONS

A4.3.1 SCOPE

This Section covers the work requirements for sourcing of existing road construction materials that are:

- Obtained from reclaiming or from the reconstruction of existing road fills, pavement layers and asphalt materials.
- Used to reconstruct the same road they are obtained from or used on another road project.

This Section also covers the removal of existing concrete pavements and paving blocks from the road, and of materials in urban areas such as road edging, services structures, and paved sidewalk materials.

Chapter 5 – Earthworks and Pavement layers: Construction, covers the construction of the road layers.

• **A4.3.2 DEFINITIONS**

The relevant definitions in Chapter 1 and Clause A4.1.2 shall also be applicable to this Section. Additional definitions for this Section are listed below.

Cemented material - also referred to as bound material, is existing stabilised or treated road layer material that can only be removed by milling, or by pulverising prior to excavation by using conventional road construction equipment.

Milling - a process to break down (pulverise) and remove, all or part of bituminous surfacing layers (seals and asphalt), and/or pavement layers by a milling machine.

Reclaimed road materials - are obtained by breaking up and excavating material in controlled separate layers from the existing earthworks and pavement layers and bituminous surfacing layers, producing compliant material by crushing and/or stockpiling it if required, and then hauling or moving it for use elsewhere on the same road, or on another road project or for other construction purposes.

Reconstructed road materials - are existing layer and bituminous surfacing materials that are scarified or pulverised (broken down) by ripping or broken down by a recycling machine and then subsequently processed in situ, for the construction of reconstructed road pavement layers.

• **A4.3.3 GENERAL**

• **A4.3.3.1 Employer identified existing road materials**

The road layer information provided in the Contract Documentation for the existing layers reflects the results of trial pits and laboratory tests conducted by or on behalf of the Employer. This information is indicative of the type of road layer materials and layer thicknesses. The provision of this information shall not in any way be construed as defining or limiting the extent and thickness of materials nor the quality to be obtained from the existing road.

The use of existing road materials shall be specified in the Contract Documentation. These materials could be re-used on their own or mixed and blended with additional imported material or used with material from underlying layers or a combination of the above in order to increase the new layer thickness, or improve the material properties, or a combination of both requirements for the intended use of the material in the road.

• **A4.3.3.2 Contractor identified materials**

Should the Contractor wish to propose alternative reclaiming or recycling methods, or use different materials or different proportions of materials, then a method statement shall be provided by the Contractor. The method statement shall be supported by sufficient test results and shall confirm that the Contractor's proposal will meet the Employer's requirements. When accepted, the Contractor's alternative methods and/or identified materials shall then be handled as an alternative in terms of the conditions of contract.

A4.3.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

Not required for Section A4.3.

• **A4.3.5 MATERIALS**

• **A4.3.5.1 Reclaimed and reconstructed gravel and crushed stone materials**

The specifications given in Clause A4.1.5 for the materials shall also apply to reclaimed and reconstructed gravel and crushed stone materials.

The material requirements for stabilised materials are given in Table A4.4.5-2, and for bitumen stabilised materials in Table A4.4.5-3.

These material specifications are the required specifications for the reclaimed or reconstructed material finally processed and constructed on the road. The Contractor may be instructed to modify or blend reclaimed or reconstructed material by the addition of some imported material and/or treatment agents in order to produce a material that complies with the specified material properties.

• **A4.3.5.2 Reclaimed asphalt material**

Asphalt material from existing surfacing or base layers may be removed to spoil or reclaimed for use.

Reclaimed asphalt from a surfacing and/or base layer may be used in the construction of earthworks, new pavement layers, recycled pavement layers or placed on the road shoulders. It may also be used as reclaimed asphalt in new asphalt layers, or for a wearing course of an unsealed road. The Contract Documentation shall specify where and in what mix proportions, if any, the reclaimed asphalt shall be used.

• **A4.3.5.3 Bituminous seal surfacings**

Thin bituminous seal surfacings shall be processed together with the underlying layer during reconstruction, or shall be removed by blading or milled off before being taken to spoil, or shall be treated as reclaimed material if compliant for further use as specified in the Contract Documentation or instructed by the Engineer.

• **A4.3.5.4 Quality of materials**

It is the Contractor's responsibility to ensure that the processed reclaimed or reconstructed materials resulting from all operations such as milling, pulverising, excavating, stockpiling, loading and hauling operations as applicable shall comply with the required material specifications, subject to the relevant provisions of the Contract Documentation.

• **A4.3.6 CONSTRUCTION EQUIPMENT**

A4.3.6.1 General

Construction equipment to source the existing road materials shall comply with the requirements of Clause A1.2.6 of Chapter 1.

• **A4.3.6.2 Milling machine**

The milling machine shall be capable of milling out either bituminous surfacing layers or unstabilised/stabilised pavement layer materials, or a combination of both simultaneously, to the depth specified in the Contract Documentation or as instructed by the Engineer.

The direction and speed of the milling machine and the speed of rotation of the milling drum shall be adjustable to deliver the required material properties. The machine shall be capable of making a neat vertical cut at the outer edges when milling. The Contractor shall inspect the milling machine's cutting tools, also known as picks, regularly and replace them as required whenever uneven or ineffective milling occurs, or when the gradation of the milled material is adversely affected.

The milling machine shall be equipped with a self-loading conveyor belt which can be easily removed and installed, and adjusted for slope and direction.

• **A4.3.6.3 Construction equipment for breaking down and excavation**

The type of construction equipment to be used for the breaking down and excavation of existing pavement layers shall be determined by the size and depth of the pavement section to be excavated, taking into consideration that the work is sometimes carried out in restricted areas confined to only the demarcated areas of the pavement layers to be broken up.

• **A4.3.7 EXECUTION OF THE WORKS**

• **A4.3.7.1 Reconstructed layers**

The construction of reconstructed layers, including the breaking down and/or pulverising of the layers and then reconstructing it with or without modification, is covered in Section 5.5 of Chapter 5.

• **A4.3.7.2 Supplementary exploration**

The Contractor, in the presence of the Engineer, shall conduct further investigations to confirm the quality, thickness, properties and quantity of the material of the existing road layers, that have been identified for reclaiming or reconstruction in the Contract Documentation.

Where it is intended to separately remove the asphalt layers in the existing pavement, investigations shall be carried out to determine the following:

- Potential quantity of the asphalt available for reclaiming,
- The haul distance to the nearest asphalt mixing plant with recycling capability,
- Locating a suitable area for stockpiling the reclaimed asphalt to suit the future recycling on other projects if applicable, •
- Basic asphalt mix types in the existing pavement,
- Uniformity of the asphalt in the existing pavement layers,
- Visual condition of the pavement, and
- Ownership of the reclaimed asphalt.

Samples of asphalt layers shall be taken by at least 150 mm diameter cores or by using a small milling machine. The asphalt material shall be examined to establish:

- The thickness of each asphalt layer found in the core or in the excavation side face,
- The asphalt mix types in single or multiple layers,
- The presence of surfacing seals, particularly those containing highly modified binders,
- The presence of coal tar that can normally be detected by its pungent odour, and that will classify the material as hazardous and non-compliant for use as reclaimed asphalt,
- The presence of geosynthetic or other types of asphalt reinforcement interlayers, and
- For signs of stripping of the binder from the aggregate.

Trial pits in the road layers, or coring in cemented layers shall be made to depths as instructed by the Engineer. Sufficient trial pits or coring shall be made so that uniform material sections can be identified.

• **A4.3.7.3 Classes of excavation for reclaimed material**

The classes of excavation of reclaimed material shall be classed according to the type of material being reclaimed, namely:

- Asphalt material, including bituminous surfacing seals thicker than 30 mm.
- Crushed stone and macadam materials.
- Cemented (chemically stabilised) material.
- Natural gravel and sand materials in the pavement layers and earthworks.
- Coarse and rock fill materials.

The removal of road material not excavated in controlled layers shall be classed as for box cuts and designated excavations in terms of Clause A4.2.7.1b) in Section 4.2.

• **A4.3.7.4 Milling**

Before milling may be commenced, the surface of the existing road shall be cleaned of all vegetation, dirt, recent fuel spillage, road studs and any other foreign material.

Where the milled material is to be re-used in road pavement layers, the Contractor shall execute trial milling on the various materials to be milled. Trial milling shall consist of milling one strip not longer than 40 m. Trial milling shall not be required for material that is to be milled to spoil or re-used for general filling purposes. During the trial milling, the Contractor shall vary the speed of the milling machine, the speed of rotation of the milling drum and the milling depth, to select the desired optimum milling operation parameters to provide the required material quality and to prove that the milling machine is fit for purpose. The Engineer shall instruct the depth of milling the layer(s) after the trial milling.

Care shall be exercised to avoid damage to any concrete elements such as bridge expansion joints and joint nosings, manholes, kerbing, kerb inlets and any other roadside furniture during the milling and the excavation. Damage caused to any element forming part of the permanent works shall be repaired at no cost to the Employer.

The floor of a milled excavation shall have an even texture without any loose local areas. Loose areas shall be remedied as specified in the Contract Documentation or as instructed by the Engineer.

The floor of a milled excavation shall be tested in the longitudinal direction with a 3,0 m straight-edge, and in other directions with a straight-edge of such length as fits between the longitudinal sides of the excavation. The surface of the milled area shall not deviate by more than 7,0 mm from the bottom edge of the straight-edge.

• **A4.3.7.5 Safety at milled excavations**

Milled excavations shall not be trafficked unless it is necessary to temporarily accommodate traffic. When shallow milled excavations need to be opened to traffic then all loose material shall first be removed, and all longitudinal and transverse joints caused by the milling excavation shall be tapered where the difference in level between the floor of the milled excavation and the existing road surface exceeds 25 mm. Transverse joints shall be tapered at a slope of 1,0 mm vertical to 20,0 mm horizontal. Longitudinal joints shall be tapered at a slope of 1,0 mm vertical to 5,0 mm horizontal. The tapers shall either be formed by cutting back the joint edges to the specified slope or by constructing a suitable asphalt wedge, which shall be bonded to the cleaned joint with a bituminous bond coat.

• **A4.3.7.6 Removal of asphalt material**

Reclaimed asphalt material shall be removed separately from the existing road, either by excavating and breaking down the asphalt material into blocks using conventional road building equipment, or by milling off the asphalt material.

Where only part of the asphalt is to be milled off, the area to be milled shall be demarcated and the milling depth shall be specified. Milling shall not exceed the demarcated width by more than 50 mm or the specified depth by more than 5,0 mm.

Where the asphalt consists of layers of various mixes or grades, the results of the supplementary investigation will assist in deciding on the most appropriate milling strategy, namely whether to mill different asphalt layers separately (split milling), or to mill multiple asphalt layers together, or selective milling of non-compliant layers that must be discarded.

Contamination of the asphalt with underlying material, or unwanted damage to the underlying layer, during milling shall be avoided. The Contractor shall adjust and carefully control the depth of milling to prevent this by full time monitoring of the milled floor behind the milling machine.

Where the material is contaminated by the actions of the Contractor, it shall be replaced with other approved material at no cost to the Employer.

• **A4.3.7.7 Excavation of crushed stone, macadam, cemented and gravel materials**

The existing pavement material shall be ripped or pulverised to the specified depth and then excavated using conventional road building equipment or by milling. The underlying layers shall not be damaged. Different types of material in consecutive layers may not be mixed unless required, and the Contractor shall adjust the depth of ripping, pulverising or milling in accordance with the thickness of the layer. Continuous adjustment will be required to suit any variations in the thickness of the pavement layer. Where unauthorised mixing occurs or where the material is contaminated in any other way by the actions of the Contractor, it shall be replaced with other approved material at no cost to the Employer.

Where a layer or layers required to be excavated over part of the road width only, the limit of the work shall be clearly demarcated and shall not be exceeded by more than 100 mm. Saw-cutting along the demarcated setting out line prior to excavation is obligatory, except where the material is removed by milling.

Excavation outside the demarcated limits shall be repaired by the Contractor at no cost to the Employer.

When specified in the Contract Documentation, the Contractor shall have an excavation controller to manage the selection and excavation of the pavement materials. The requirements for the excavation controller, namely whether the person shall be a materials technician or a general foreman, the controller's required qualifications and experience, and whether the controller is to be present full time or only part time at the excavation of the reclaimed pavement materials, shall then also be specified.

- **A4.3.7.8 Removal of existing concrete**

The thickness of existing concrete road pavements or paving shall be established by core drilling prior to removal. Sidewalk or driveway concrete pavements do not need to be cored.

The existing concrete shall be removed by one of two methods:

- The break-up method, or
 - The lift-out method.

The break-up method comprises breaking of the concrete with hand operated pneumatic or electro-mechanical equipment such as jackhammers or pavement breakers, or high energy impact compaction rollers, and removing it with a front end loader or a tractor-loader-backhoe (TLB) or by labour enhanced methods. Breaking out may be assisted by additional intermediate saw-cuts. In road pavements the breaking operation shall commence from the centre of the concrete pavement towards the boundary saw cuts to eliminate damage to any adjoining slabs. Care shall be taken with this method to avoid damage to the subbase if it is not to be reclaimed or recycled.

The lift-out method requires lifting hooks to be attached to the saw-cut slab and heavy lifting plant to lift out the concrete. Alternatively, the slab may be sawn into smaller pieces so that it can be lifted out by a front end loader or TLB. Although this method is less likely to damage the subbase and adjacent slabs, the Contractor is required to dispose of large slabs of concrete.

Where concrete is to be removed over part of the road width only, the limit of the work shall be clearly demarcated. Saw-cutting along the demarcated setting out line is obligatory. Removal of existing concrete outside the demarcated limits shall be repaired by the Contractor at no cost to the Employer.

- **A4.3.7.9 Removal of existing paving blocks**

Existing paving blocks shall be lifted and used as specified in the Contract Documentation and/or instructed by the Engineer. Paving blocks that are to be handed to a property or landowner or are to be stockpiled for re-use shall be lifted by hand only. Paving blocks removed to spoil can be lifted by construction equipment.

Where paving blocks are to be handed to a property or landowner, the Contractor shall mark paving blocks that are broken or chipped and indicate them to the property or landowner prior to lifting of the blocks. The blocks shall be neatly stacked in a location agreed with the owner.

Paving blocks marked or instructed by the Engineer for re-use or other purposes, shall be removed to stockpile, and then neatly stacked.

Paving blocks that must be handed to a property or landowner, or that will be stockpiled for re-use, shall be cleaned of dirt, soil, concrete spillage and the like.

The bedding sand shall be removed after lifting of the paving blocks.

- **A4.3.7.10 Removal of the existing road edging**

Existing road edging, such as in situ concrete kerbing and edge beams, precast kerbing, kerb inlets (catchpits), grid inlets and so forth, shall be demolished and removed to spoil at an approved spoil site provided by the Contractor, or shall be stockpiled and stacked for re-use as instructed by the Engineer.

- **A4.3.7.11 Saw-cutting**

When specified or instructed that existing pavement layers are to be saw-cut, the equipment shall be capable of saw-cutting the pavement layers in a single operation without fragmenting the material, and in straight lines. The depth of saw-cutting shall be specified in the Contract Documentation or instructed by the Engineer. Requirements for saw-cutting and the construction of joints between existing and new layers are specified in Clause A5.3.3.7 of Chapter 5.

- **A4.3.7.12 Stockpiling of material**

Should the reclaimed material have to be stockpiled, the requirements for stockpiles in Clause A4.1.7.3 shall apply. Stockpile sites shall be large enough to allow the placing of different types of material without the stockpiles overlapping.

- **a) Preparation of the stockpile site**

Stockpile sites shall be prepared in accordance with the requirements of Clause A4.1.7.3a).

When specified in the Contract Documentation or instructed by the Engineer, the floor for the reclaimed asphalt stockpile site shall be stabilised to a depth of 150 mm.

- **b) Stockpiling of the material**

Different types of material shall be stockpiled separately. When instructed by the Engineer, the Contractor shall remove the reclaimed asphalt material obtained from split milling to separate stockpiles.

Stockpiles of unprocessed reclaimed asphalt shall be ramp shaped and lifted in layers. When flattening the tipped material, it shall not be pushed over the edge to cause segregation. Stockpiles of unprocessed reclaimed asphalt shall not be covered, except when instructed by the Engineer.

Additional stockpiling requirements for reclaimed asphalt and for stockpiling of pavement layer materials are listed in Clause A5.5.5.2 of Chapter 5.

• **A4.3.7.13 Spoil of material**

Material from the milling and/or excavations of existing road materials that is non-compliant for the earthworks and pavement layers or material that is not required for further use shall be loaded and hauled directly to approved spoil sites.

Paving blocks, and road edging not suitable for further use or that are not required in future construction shall be loaded and hauled to approved spoil sites. Services structures, and asphalt and concrete material on sidewalks in urban areas shall also be spoiled.

Spoil sites are to be identified by the Employer or by the Contractor.

• **A4.3.8 WORKMANSHIP**

The material properties of the existing road layers shall always be verified by drilling of cores or by additional trial pits in the road and by subsequent laboratory testing, before any milling and/or excavation is carried out. The depths of the core drilling and trial pits and applicable laboratory tests shall be determined by the intended use of the material in the existing road, whether the material is to be reclaimed or recycled.

Testing shall be more comprehensive for recycling of layers. The effects of patching and repairs, the variable thickness of layers and the variable addition of new material may result in the fluctuation of material properties. The impact of the fluctuation of these properties must be properly managed.

For the recycling of asphalt and/or bound (stabilised) materials, slabs of the materials shall be removed from the road trial pits and then crushed manually or with a small laboratory crusher to simulate the material produced by the recycler.

Agreement shall be reached with the Engineer on the testing, protocol of the applicable tests and frequency of process control testing on the existing road materials, to ensure that the quality of the materials meets the specified requirements for the particular layer for which it will be used.

Measurement, testing, and evaluation of all individual components and constructed products shall be in accordance with the methods prescribed in this Section or in Chapter 20 as relevant.

C4.3.3 Removal of bituminous seal surfacing (thickness not exceeding 30 mm) square metre (m²)

The unit of measurement shall be the square metre of seal surfacing removed separately.

The quantity shall be measured from the authorised dimensions.

The tendered rate shall include full compensation for blading or milling off the existing seal surfacing, and for loading and hauling the material to spoil sites identified by the Contractor.

All haul costs shall be included in the tendered rate of item C4.3.3.

The removal of a bituminous seal surfacing together with the underlying base layer shall not be measured in this item, but the cost shall be included with the excavation of the base layer under items C4.3.9 and C4.3.10 respectively.

Item	Description	Unit
•		
ranges		
	C4.3.4 Saw-cutting existing materials within the following average depth	
C4.3.4.1	Asphalt material:	
(a)	Up to 50 mm metre (m)	
(b)	Exceeding 50 mm and up to 100 mm metre (m)	
(c)	Etc, in 50 mm increments	
C4.3.4.2	Crushed stone and gravel material:	
(a)	Up to 100 mm metre (m)	
(b)	Exceeding 100 mm and up to 200 mm metre (m)	
(c)	Etc, in 100 mm increments	
	C4.3.4.3 Cemented material:	
(a)	Up to 100 mm metre (m)	
(b)	Exceeding 100 mm and up to 200 mm metre (m)	
(c)	Etc, in 100 mm increments	
	C4.3.4.4 Concrete material:	

- (a) Up to 50 mm metre (m)
- (b) Exceeding 50 mm and up to 100 mm metre (m)
- (c) Etc, in 50 mm increments

The unit of measurement shall be the metre of saw-cut. The length in each depth range shall be measured and paid separately.

The quantities shall be measured from the authorised length of saw-cut, and the depth specified or instructed by the Engineer.

The tendered rates shall include full compensation for saw-cutting the material.

Where asphalt and the underlying layer(s) are both to be saw-cut and the asphalt is less than 50 mm thick, separate measurement and payment shall not be made for the asphalt saw-cutting in item C4.3.4.1. The asphalt thickness shall then be added to the thickness of the material in items C4.3.4.2 and/or C4.3.4.3 as applicable.

Item	Description	Unit
C4.3.5	Providing the milling machine on the site	
C4.3.5.1	Small milling machine with a cutting width of 1,2 m or smaller	number (No)
C4.3.5.2	Large milling machine with a cutting width exceeding 1,2 m	number (No)

The unit of measurement shall be the number of milling machines provided on the site, or the number of times a milling machine is brought onto the site where it had to be removed temporarily with prior approval. De-establishment and subsequent re-establishment shall also only be measured if undertaken with prior approval.

The tendered rates shall include full compensation for establishment and for de-establishment of the milling machine.

Payment for returning the machine to the site after removal shall be made only where the removal was in accordance with the Contractor's approved programme of work and not for any other reason. Payment shall not be made for replacing any defective plant.

Payment shall also not be made for moving the milling machine around on the site.

Item	Description	Unit
C4.3.6	Milling and removal of existing asphalt layers with an average milling depth (Contractor takes ownership)	
C4.3.6.1	Not exceeding 50 mm	cubic metre (m ³)
C4.3.6.2	Exceeding 50 mm but not exceeding 100 mm	cubic metre (m ³)
C4.3.6.3	Exceeding 100 mm	cubic metre (m ³)

Item	Description	Unit
C4.3.7	Milling and removal of existing asphalt layers with an average milling depth (Employer takes ownership)	
C4.3.7.1	Not exceeding 50 mm	cubic metre (m ³)
C4.3.7.2	Exceeding 50 mm but not exceeding 100 mm	cubic metre (m ³)
C4.3.7.3	Exceeding 100 mm	cubic metre (m ³)

The unit of measurement for items C4.3.6 and C4.3.7 shall be the cubic metre of material milled from the existing pavement.

The quantities shall be computed in accordance with the authorised dimensions of the excavation.

When instructed, split milling and removal of the different existing asphalt layers shall be measured individually.

The tendered rates for item C4.3.6 shall include full compensation for demarcating the excavation, for milling (excavating) the material, for loading and hauling to a site identified by the Contractor, and for spoil or re-use by the Contractor. All haul costs shall be included in the tendered rates of item C4.3.6.

The tendered rates for item C4.3.7 shall include full compensation for demarcating the excavation, for milling, loading, hauling and off-loading the material at a site designated by the Employer. Haul shall be measured from the point where the material is loaded to where it is off-loaded.

Trial milling shall be measured and paid for under items C4.3.6 or C4.3.7, and no separate payment shall be made for it.

Item	Description	Unit
C4.3.8	Excavating material by milling	
C4.3.8.1	Crushed stone material	cubic metre (m ³)
C4.3.8.2	Cemented material	cubic metre (m ³)

C4.3.8.3 Natural gravel material cubic metre (m³)
The unit of measurement shall be the cubic metre of milled material.

The quantities shall be measured in place on the existing road before the excavation commences.

The tendered rates shall include full compensation for milling out and loading the material.

Trial milling shall be measured and paid for under item C4.3.8, and no separate payment shall be made for it.

Item	Description	Unit
C4.3.9	Excavating material by using conventional road construction equipment	
C4.3.9.1	Asphalt material	cubic metre (m ³)
C4.3.9.2	Crushed stone and macadam materials	cubic metre (m ³)
C4.3.9.3	Cemented material	cubic metre (m ³)
C4.3.9.4	Natural gravel and sand materials	cubic metre (m ³)
C4.3.9.5	Coarse fill and rock fill	cubic metre (m ³)

The unit of measurement shall be the cubic metre of excavated material, by using conventional road building equipment.

The quantities shall be measured in place on the existing road before the excavation commenced.

The tendered rates shall include full compensation for excavating and loading the material.

The tendered rate for cemented material shall include for ripping or pulverising the material prior to excavating.

Item	Description	Unit
C4.3.10	Excavating material by using labour enhanced methods of construction	
C4.3.10.1	Asphalt material	cubic metre (m ³)
C4.3.10.2	Crushed stone and macadam materials	cubic metre (m ³)
C4.3.10.3	Cemented material	cubic metre (m ³)
C4.3.10.4	Natural gravel and sand materials	cubic metre (m ³)

The unit of measurement shall be the cubic metre of excavated material, by using labour enhanced methods of construction.

The quantities shall be measured in place on the existing road before the excavation commenced.

The tendered rates shall include full compensation for excavating and loading the material.

Item	Description	Unit
•	C4.3.11 Breaking down a stabilised layer by using conventional road construction equipment	cubic metre (m³)

The unit of measurement shall be the cubic metre of stabilised material that is broken down, by using conventional road building equipment.

The quantities shall be measured in place on the existing road, from thickness measurements determined by drilling cores or in trial pits.

The tendered rate shall include full compensation for all equipment, labour and supervision to break the stabilised layer. No distinction shall be made between ripping the material with a grader, or pulverising the material with a recycler or rotary machine.

Measurement and payment in this item shall only be made when the existing material is used in a side-cut to new pavement layer operation. For excavating the existing material and then remove it to stockpile or to spoil, measurement of item C4.3.9 shall apply that includes the breaking down by ripping or pulverising.

Item	Description	Unit
•	C4.3.12 Removing of existing concrete material within the following average depth ranges	
C4.3.12.1	The break-up method:	
(a)	Not exceeding 150 mm	cubic metre (m ³)
(b)	Exceeding 150 mm but not exceeding 250 mm	cubic metre (m ³)
C4.3.12.2	The break-up method using labour enhanced methods of construction:	
(a)	Not exceeding 75 mm	cubic metre (m ³)

- (b) Exceeding 75 mm but not exceeding 200 mm cubic metre (m³)

C4.3.12.3 The lift-out method:

- (a) Not exceeding 150 mm cubic metre (m³)
- (b) Exceeding 150 mm but not exceeding 250 mm cubic metre (m³)

The unit of measurement shall be the cubic metre of concrete removed.

The quantity shall be measured in place on the road or in the sidewalk before the concrete is broken up or lifted.

The tendered rates shall include full compensation for drilling of cores, and for removing and loading the concrete.

Item	Description	Unit
•	C4.3.13 Lifting of existing paving blocks (specify the type or size and thickness)	

C4.3.13.1	Using construction equipment	square metre (m ²)

C4.3.13.2	Using labour enhanced methods of construction	square metre (m ²)

The unit of measurement shall be the area of paving blocks lifted.

The quantities shall be measured in place on the road or in the sidewalk before the blocks are lifted.

The tendered rates shall include full compensation for lifting the paving blocks and for removing the bedding sand.

Distinction shall be made between the construction methods used.

Item	Description	Unit
•	C4.3.14 Removing of existing road edging and services structures	

C4.3.14.1 Removing of existing road edging using construction equipment:

(a) Kerbing and edge beams:

- (i) In situ concrete kerbing and edge beams cubic metre (m³)
- (ii) Precast concrete kerbing (specify type or figure number) metre (m)
- (iii) Precast concrete kerbing (specify type or figure number) and situ concrete channel metre (m) (specify dimensions)

- (b) Kerb inlets number (No)
- (c) Grid inlets number (No)
- (d) Etc., for other services structures number (No)

C4.3.14.2 Removing of existing road edging using labour enhanced methods of construction:

(a) Kerbing and edge beams:

- (i) In situ concrete kerbing and edge beams cubic metre (m³)
- (ii) Precast concrete kerbing (specify type or figure number) metre (m)
- (iii) Precast concrete kerbing (specify type or figure number) and situ concrete channel metre (m) (specify dimensions)

- (b) Kerb inlets number (No)
- (c) Grid inlets number (No)
- (d) Etc., for other services structures number (No)

The unit of measurement for items C4.3.14.1(a)(i) and C4.3.14.2(a)(i) shall be the cubic metre of concrete removed.

The unit of measurement for items C4.3.13.1(a)(ii) and (iii) and C4.3.14.2(a)(ii) and (iii) shall be the metre of precast kerbing removed. For items C4.3.14.1(a)(iii) and C4.3.14.2(a)(iii) the length of in situ concrete channel shall not be measured separately.

The unit of measurement for items C4.3.14.1(b) and (c) and C4.3.14.2(b), (c) and (d) shall be the number of inlets.

The quantities shall be measured in place on the road before the items are removed.

The tendered rates shall include full compensation for excavation, breaking down and removing the edging.

Distinction shall be made between the construction methods used.

Item	Description	Unit
C4.3.15	Stockpiling of road layer materials	
C4.3.15.1	Asphalt material	cubic metre (m ³)
C4.3.15.2	Crushed stone material	cubic metre (m ³)
C4.3.15.3	Cemented material	cubic metre (m ³)
C4.3.15.4	Natural gravel material	cubic metre (m ³)
C4.3.15.5	Concrete pavements	cubic metre (m ³)

The unit of measurement shall be the cubic metre of material stockpiled.

The quantities shall be measured in place on the road before excavation commenced.

The tendered rates shall include full compensation for hauling the first 1,0 km of milled or excavated material to the stockpile, and for spreading and maintaining the material in the stockpile.

Haul shall be measured starting 1,0 km from the centre point where the material is loaded to where it is off-loaded.

Item	Description	Unit
C4.3.16	Stacking paving blocks and road edging	
C4.3.16.1	Paving blocks (specify type or size and thickness)	number (No)
C4.3.16.2	Precast concrete kerbing (specify type or figure number and length of sections)	number (No)
C4.3.16.3	Precast kerb inlets	number (No)
C4.3.16.4	Precast manholes	number (No)

The unit of measurement shall be the number of units that are neatly stacked at the approved stockpile site.

The quantities shall be measured in the stockpile (stack).

The tendered rates shall include full compensation for cleaning the paving blocks or road edging items, for loading and hauling to the stockpile (stacking) site or to a position as indicated by the land or property owner, for off-loading and stacking.

Any haul costs shall be included in the tendered rates of item C4.3.16.

Item	Description	Unit
C4.3.17	Excavate non-compliant or excess pavement layer material to spoil in sites designated by the Employer, material consisting of	
C4.3.17.1	Asphalt material	cubic metre (m ³)
C4.3.17.2	Crushed stone, macadam, gravel and sand material	cubic metre (m ³)
C4.3.17.3	Cemented material	cubic metre (m ³)
C4.3.17.4	Concrete material	cubic metre (m ³)

The unit of measurement shall be the cubic metre of material spoiled.

The quantity shall be measured in place on the road before excavation commenced. Where this method of quantification is not feasible or where the quality of material is only identified after it has been excavated, the Engineer may approve that the quantity be taken as equal to 70 % of the loose volume of the material in the haul vehicles be used to transport asphalt, crushed stone, macadam, gravel, sand and cemented materials, and in the case of concrete materials to 50 % of the loose volume of material in the haul vehicles.

The tendered rates shall include full compensation for breaking down the material, excavating, and for disposing the material, including shaping and levelling-off any heaps of spoil material.

Haul shall be measured from the point where the material is loaded to where it is off-loaded.

Item	Description	Unit

C4.3.18 Excavate non-compliant or excess pavement layer material to spoil in sites designated by the Contractor, material consisting of

C4.3.18.1	Asphalt material	cubic metre (m ³)
C4.3.18.2	Crushed stone, macadam, gravel and sand material	cubic metre (m ³)
C4.3.18.3	Cemented material	cubic metre (m ³)
C4.3.18.4	Concrete material	cubic metre (m ³)

The unit of measurement shall be the cubic metre of material spoiled.

The quantity shall be measured in place on the road before excavation commenced. Where this method of quantification is not feasible or where the quality of material is only identified after it has been excavated, the Engineer may approve that the quantity be taken as equal to 70 % of the loose volume of the material in the haul vehicles.

The tendered rates shall include full compensation for negotiations with the land owner or legal occupant of the property or of the spoil site, for breaking down the various materials, excavating, loading and hauling the material to the spoil sites irrespective of the haul distance, for off-loading and disposing the material, and for finishing the spoil site and obtaining the approval of the property or spoil site owner, if applicable.

The tendered rate shall also include the cost of spoiling at a municipal site, if applicable.

All haul costs shall be included in the tendered rates of item C4.3.18.

Item	Description	Unit
C4.3.19	Spoiling of paving blocks and road edging in spoil sites designated by the Employer	
C4.3.19.1	Paving blocks	cubic meter (m ³)
C4.3.19.2	Precast and in situ concrete kerbing, edge beams and channels at precast kerbing	cubic metre (m ³)
C4.3.19.3	Kerb and grid inlets, and other services structures	number (No)

The unit of measurement shall be the cubic metre of material spoiled.

The quantities shall be taken as equal to 70 % of the loose volume in the haul vehicles.

The tendered rates shall include full compensation for loading the materials, and for disposing the materials. The tendered rates shall also include the cost of spoiling at a municipal site, if applicable.

Haul shall be measured from the point where the material is loaded to where it is off-loaded.

Item	Description	Unit
C4.3.20	Spoiling of paving blocks and road edging in spoil sites designated by the Contractor	
C4.3.20.1	Paving blocks	cubic meter (m ³)
C4.3.20.2	Precast and in situ concrete kerbing, edge beams and channels at precast kerbing	cubic metre (m ³)
C4.3.20.3	Kerb and grid inlets, and other services structures	number (No)

The unit of measurement shall be the cubic metre of material spoiled.

The quantities shall be taken as equal to 70 % of the loose volume in the haul vehicles. The tendered rates shall include full compensation for loading the materials, for hauling to the spoil site irrespective of the haul distance, and for off-loading and disposing the materials.

The tendered rates shall also include the cost of spoiling at a municipal site, if applicable.

All haul costs shall be included in the tendered rates of item C4.3.20.

4.4 COMMERCIAL MATERIALS

PART B: LABOUR ENHANCEMENT PART C: MEASUREMENT AND PAYMENT PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

• A4.4 COMMERCIAL MATERIALS PART A: SPECIFICATIONS

• A4.4.1 SCOPE

This Section covers:

- The provision of natural or crushed materials for a specific road construction project or projects that are procured from commercial and other private sources. It includes information on the requirements for providing the commercial materials for earthworks and road pavement layers as an alternative to sourcing these materials from borrow pits, from quarries, from cuttings, box cuts and designated excavations or from existing roads.
- The provision of commercial agents and additives that are added or worked into the available materials or road pavement layers to enhance, improve or alter their properties so that the materials then comply with the specified quality and strength requirements. Commercial agents and additives comprise traditional stabilising agents, non-traditional stabilising or soil treatment agents, and dust palliatives. The selection (design) process to determine the optimum quantity of cementitious and bituminous stabilising agents is also covered in this Section.

Chapter 5 – Earthworks and Pavement layers: Construction, covers the construction of the road layers.

SANS test methods published by Standards South Africa (a subdivision of the SABS) are listed in Chapter 20. The Sabita Guideline TG2 can also be consulted for tests on bitumen stabilised materials.

• A4.4.2 DEFINITIONS

The relevant definitions in Chapter 1 and Clause A4.1.2 shall also be applicable to this Section. Additional definitions for this Section are listed below.

Commercial materials - are natural gravel, sand or crushed rock materials:

- Sourced from commercial suppliers. These materials are sold by commercial suppliers and are generally crushed materials acquired from quarry operations or from stockpiles of non-ore containing material excavated during mining operations and shall already comply with the gradation and other material requirements, or
- Sourced from private or other non-commercial suppliers identified by the Employer or the Contractor, or material from the Employer's or Contractor's own sources. These materials are usually natural materials available in excavations or stockpiles, and the primary objective for excavating the material is/was not for road construction purposes. It is distinguished from material sourced from borrow pits and quarries in Section 4.1, in that the excavation or sourcing does not require a mining right or a mining permit in terms of South African legislation, although other legislative approvals may be required. Commercial materials from private or other non-commercial suppliers or from the Employer's own sources may require removal or breaking down of oversize material, screening, crushing or crushing and screening.

Dust palliatives - are products applied to the surface of a wearing course of an unsealed road or worked into the layer to reduce the dust and loss of fines.

Non-traditional stabilising or soil treatment agents - non-traditional stabilisation or soil treatment agents can be:

- Sulfonated petroleum products (SPPs), also known as ionic soil stabilisers.
- Polymers, essentially plastic materials derived from acrylic polymers and commonly used as household glues.
- Nano-technology products that utilise processes at the molecular level within bitumen to improve the material properties.

Non-traditional stabilising or soil treatment agents are sometimes also referred to as proprietary stabilising agents.

Stabilisation - is the treatment of natural or crushed material to enhance the strength (load bearing capacity) and stiffness, and/or to make the material more water resistant to improve the durability. Marginal non-compliant material can also be made compliant for use after stabilisation. Stabilisation of material may take place by means of mechanical modification, also referred to as granular stabilisation (for example material blending), chemical (for example mainly modification or modification and cementation), electrical (for example ion exchange), or material improvement (for example using bitumen emulsion or foamed bitumen).

Traditional stabilising agents - these are agents that have generally been used through the years to stabilise materials, and are classified as:

- Cementitious stabilising agents (cement and lime), also referred to as stabilisers.
- Bituminous stabilising agents (added as an emulsion or in a foamed state).

- **A4.4.3 GENERAL**

- **A4.4.3.1 Employer identified commercial materials**

- **a) Materials from commercial suppliers**

The Employer may identify and include test results of compliant materials from commercial suppliers in the Contract Documentation. However, the Contractor shall still be responsible for sourcing the material and for ensuring the sufficiency in quantity and quality of the material intended for use in the contract.

The Employer will usually not conclude any arrangements with these commercial suppliers, and the Contractor shall enter into negotiations with them and conclude contracts for the price, payments, rate of supply and the like.

Once the Contractor has chosen one or more of the commercial suppliers identified by the Employer, further dealings with the supplier and procuring the material shall be undertaken by the Contractor.

- **b) Materials from private or non-commercial suppliers**

The sources and results of any material testing of materials from private or non-commercial suppliers that have been identified by the Employer, will be included in the Contract Documentation. This information is indicative as to the sufficiency in quality and quantity of the material.

The Contract Documentation shall also specify the arrangements made with the suppliers and specifically those that the Contractor must comply with, and any further negotiations that the Contractor shall conclude.

- **c) Materials from the Employer's own sources**

The material is free issued to the Contractor, unless otherwise stated in the Contract Documentation when any conditions of the Employer shall then also be specified.

The results of any material testing will also be included in the Contract Documentation.

- **A4.4.3.2 Contractor identified suppliers or sources**

When no commercial sources are identified by the Employer in the Contract Documentation or if so instructed, the Contractor shall identify compliant material sources. The Contractor can also identify compliant commercial or private / non-commercial material sources, or material from the Contractor's own sources, other than those identified by the Employer for utilisation in the works as an alternative material source.

Proof of the approvals and authorisation by the appropriate authorities for the commercial or private / non-commercial sources identified by the Contractor, as applicable, shall be provided by the Contractor.

The Contractor shall be responsible for all contractual and legal matters pertaining to ordering, loading, delivering and paying for materials obtained from the Contractor identified commercial or private / non-commercial suppliers.

The Contractor shall also ensure compliance by the suppliers of commercial or private / non-commercial materials that the necessary negotiations have been concluded with other interested and affected parties, as well as any land acquisitions, royalty payments and any special conditions imposed by these parties. If required, the Contractor shall submit proof or confirmation of all approvals and agreements before delivering any commercial materials to the site.

When the Contractor is responsible to procure commercial materials, test results of the natural material as prescribed shall be submitted to the Engineer to assess. The Engineer shall then declare the material fit for use before it can be sourced.

When the materials are proposed by the Contractor as an alternative material source to those identified by the Employer, the Contractor shall arrange for the required testing to prove the compliance of the natural material properties and for the design of the stabilised material as applicable at no cost to the Employer. The type and amount of stabiliser required shall be determined in accordance with the testing protocol in Clause A4.4.7. The test results, along with a proposal regarding the stabiliser type and stabiliser content, and the financial benefit for the Employer shall be submitted for review to the Engineer and acceptance before the material is sourced.

- **A4.4.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS**

Should the Contractor wish to use, or to propose alternative commercial materials to those available from the designated borrow pits or quarries provided under Section 4.1, then sufficient laboratory test results must be provided to confirm that the Contractor's proposed commercial materials comply with the specified material properties.

The dust palliative shall be subject to a performance based system. Particulars of the system are given in Part D of this Section.

- **A4.4.5 MATERIALS**

- **A4.4.5.1 Earthworks and pavement layer materials**

The specifications for a pioneer layer, fill material and crushed stone for earthworks given in Clause A4.1.5 shall also apply to commercial materials. These material specifications are the required specifications for the commercial material finally processed and constructed on the road.

Test results from representative samples recently processed shall be submitted for review by the Engineer. The Engineer shall declare the sourced or produced material fit for use before construction on the road may commence.

When specified in the Contract Documentation, material procured from commercial suppliers shall be stockpiled separately at the supplier when it cannot be used immediately after producing. The Contract Documentation may then also specify that the stockpile be fenced and sign posted as belonging to the Employer.

• **A4.4.5.2 Traditional cementitious stabilising agents**

The traditional cementitious stabilising agents for chemical stabilisation shall be either one or more of the agents listed hereunder.

a) Cement

Cement, also known as common cement, shall comply with the requirements of SANS 50197. Only extended common cement with a strength class of 32.5N shall be used.

The following common cements shall not be used for stabilisation:

- CEM I due to rapid setting.
- CEM III/B, III/C and V/B due to a low clinker content.
- High early strength cements, affixed by the symbol "R", except where early strength is required for trafficking and compaction is completed within the field working time established during the stabilisation design.

Masonry cement, even if it complies with the requirements of SANS 50413, shall also not be used for stabilisation.

Proprietary cement blends that do not necessarily comply with SANS 50197 will be considered by the Engineer as stabilising agent, provided it has a proven record of being used and the requirements in Table A4.4.5-2 are complied with. **b) Lime**

Road lime for the treatment of road materials can be calcium lime, magnesium lime or dolomitic lime. Lime shall comply with the requirements of SANS 824. All lime used for road stabilisation shall be slaked lime, also known as hydrated lime. Unslaked lime, also known as quicklime, and agricultural lime shall not be used.

• **c) Blending of cement with GGBS or PFA**

The practise of site blending of cement with ground granulated blast furnace slag (GGBS) or pulverised fly ash (PFA) is not necessary, and has been eliminated by the availability of the extended cements classified by SANS 50197.

• **A4.4.5.3 Traditional bituminous stabilising agents**

• **a) Bitumen**

Bitumen used as a stabilisation agent for bitumen stabilised material (BSM) shall be one of the following products and shall comply with the applicable standards:

- Penetration grade bitumen: SANS 4001-BT1 (for BSM – foam).
- Anionic road emulsion: SANS 4001-BT3 (for BSM – emulsion). • Cationic road emulsion: SANS 4001-BT4 (for BSM – emulsion).

• (i) Bitumen emulsion

Bitumen emulsion shall usually be slow set, stable grade anionic emulsion.

Cationic bitumen emulsion is generally more compatible with acidic aggregates having high silica content and low alkali content such as quartzite, granite, sandstone, rhyolite, syenite and felsite.

• (ii) Foamed bitumen

Foamed bitumen shall be produced by injecting a limited amount of water (typically between 2 % and 4 % by mass of the bitumen) into a 70/100 penetration-grade bitumen, which has been pre-heated to a temperature of 170 °C to 180 °C. The minimum foaming characteristics (in terms of expansion ratio and half-life) shall be as specified in Table A4.4.5-1.

• **Table A4.4.5-1: Foaming characteristic limits (minimum values)**

Aggregate temperature (°C)	15 – 25	> 25
Bitumen temperature (°C)	160 - 190	
Expansion Ratio (times)	10	8
Half-Life, $T_{1/2}$ (seconds)	8	6

• **b) Active fillers**

Fillers, also referred to as active fillers, such as hydrated lime or cement are introduced into the material requiring to be bitumen stabilised depending on the outcome of the laboratory mix design.

Cement, preferably CEM II 32.5N, and hydrated lime shall comply with the requirements of Clauses A4.4.5.2a) and A4.4.5.2b) above respectively.

A4.4.5.4 Non-traditional stabilising or soil treatment agents

The use of non-traditional stabilising or soil treatment agents may be specified in the Contract Documentation. Details of the product, its method and rate of application, construction method statement and any applicable curing measures, measurement and payment shall then be provided.

Should the Contractor propose the use of a non-traditional stabilising or soil treatment agent, either as an alternative to the specified product or to enhance the properties of any material, it shall only be considered when the following information is submitted for review by the Engineer:

- Details of the type of agent and basis material,
- A cost comparison that shows it to be economically viable compared to traditional stabilising or soil treatment agents,
- Test results show that the non-traditional agent is effective in achieving the specified material properties for the applicable layer,
- The product is accredited by a recognised body, such as Agrément South Africa, or project details of previous successful use of the product with the specific project test results, references and contact details are submitted, and
- The application specifications from the supplier, a method statement describing the application and processing of the stabiliser, and an equipment list to apply the agent and for the construction of the layer.

A4.4.5.5 Chemically stabilised materials

The material requirements for the different classes of chemically stabilised materials to achieve cementation are given in Table A4.4.5-2.

Table A4.4.5-2: Requirements for cemented chemically stabilised materials

Classification		C2	C3	C4
Type of material before stabilisation		At least G4A quality	At least G5B quality	At least G6 quality
Maximum particle size		50 mm	Base 50 mm, Subbase 63 mm	
PI after stabilisation		Non-plastic	Basic crystalline material: NP	
			Other materials: 6	
UCS (Unconfined Compression Strength) (MPa) at 100 % of MDD ⁽¹⁾	Min	3,0	1,5	0,75
	Max	5,0	3.0	
ITS (Indirect Tensile Strength) (kPa) at 100 % of MDD	Min	300	250	200
	Max	600	500(2)	450(2) (350)(3)
WDD (Wet/Dry Durability) (mass loss maximum)		10 %	20 %	30 %

Notes:

- ⁽¹⁾ It is more important that the ITS requirements be met than the UCS requirement, as the ITS affects both the structural behaviour of the layer and limits the potential of the material to degrade should the durability decreases in time.
- ⁽²⁾ Maximum ITS values for a subbase can be exceeded when subbase under a sound G1 crushed stone base layer or block paving.
- ⁽³⁾ ITS in brackets applies for a stabilised base layer.

The UCS and ITS requirements in Table A4.4.5-2 are determined at the standard 7-day curing, and not at the 24-hour rapid or accelerated curing testing. The 7-day cured strengths shall always be taken as the reference requirements, as the rapid curing may give a higher strength. Should rapid curing be done during the construction, both tests shall be done in parallel and a calibration factor derived for that material with that specific stabiliser. The rapid testing can then be used for acceptance control provided that regular calibration checks are made against the 7-day cured strengths to ensure that nothing has changed significantly. When significant variations are found in the relationship between the results of the two types of test, then all further test samples that are rapid cured shall have duplicate samples that are tested by the standard full 7-day acceptance test until a reliable, stable calibration factor has been re-established.

A4.4.5.8 Quality of materials

It is the Contractor's responsibility to ensure that the commercial materials including the procuring, loading, hauling, and/or further stockpiling if applicable, shall comply with the material specifications.

Any approval or consent given previously for the use of any commercial material may be cancelled, if the material quality has altered so that it does not comply with the specifications anymore.

- **A4.4.6 CONSTRUCTION EQUIPMENT**

For materials obtained from commercial suppliers, an equipment list does not have to be submitted.

For materials sourced from private or non-commercial suppliers or from the Contractor's own resources, the requirements in Clause A1.2.6 of Chapter 1 shall be applicable for the construction equipment.

- **A4.4.7 EXECUTION OF THE WORKS**

- **A4.4.7.1 Selection (design) of the stabilising agent content**

- **a) Purpose of the selection process**

The purpose of selecting the stabilisation content is to find the optimum combination of gravel or crushed material and stabilising agent that will provide the required strength and durability to ensure adequate structural capacity of the layer but not excessive for the design life of the road. This requires that the correct type and quantity of stabilising agent are determined.

- **b) Sampling of materials**

For determining the positions of sampling and trial pits and during the taking of samples, it shall always be remembered that material properties can vary. Crushed aggregate, and more so gravels which are partly weathered, have properties that can vary considerably as a result of the effect of chemical reactions (hydration, hydrolysis and so forth), physical processes (leaching, saturation and so forth) and the effect of the environment (depth, water flows, temperatures and so forth). Adequate sampling shall always be carried out to ensure that representative test results are obtained. Samples shall also be taken from the point of availability of the material earmarked for stabilisation (generally in stockpile).

- **c) Cementitious stabilising agent for chemical stabilisation**

The Engineer, in consultation with the Contractor, will carry out the process to select the cementitious stabilising agent in an agreed to laboratory.

The Contractor shall provide the laboratory with an adequate quantity of the natural material and stabilising agent for the laboratory to use in the testing procedures. The stabilisation design testing may take up to 8 weeks to conclude. The Contractor shall identify the material for stabilisation timeously to prevent delays to the contract.

The cementitious stabilising agent selection process for stabilisation shall be undertaken in a four-step sequence.

Step 1: Determine the compliance of the natural material.

The natural or untreated material shall be tested for compliance. Refer Table A4.4.5-2 in this Section and Tables A4.1.5-3, A4.1.5-4 and A4.1.5-5 in Section A4.1. The material may have to be processed by crushing, screening or crushing and screening, blended with other materials or pre-treated with lime or another stabilising agent if required, to meet the specifications of the material before stabilisation testing commences. The material shall also be tested for deleterious minerals, especially for sulfates, for compliance with the requirements in Section 4.1 Clause A4.1.5.17.

Sugar has also deleterious effects on cement that may affect stabilisation in sugarcane farming areas. The presence of sugar in material in these areas must be tested in accordance with SANS 5833.

Step 2: Determine the Initial Consumption of Stabiliser (ICS) of the material.

The pH shall be tested of samples prepared at varying stabiliser contents. The stabiliser content in percentage at which the pH reading does not increase by more than 0,1 % compared to the next reading, shall be taken as the ICS of the material.

Step 3: Determine the compliance of the stabilised material.

Samples of the material and stabilising agent shall then be prepared at stabiliser contents of 1,0 %; 1,5 %; 2,0 % and 2,5 % more than the ICS percentage identified in Step 2. The PI, UCS and ITS of all samples shall be tested at 7-day curing and evaluated against the requirements in Table A4.4.5-2. Samples cured at 24-hour rapid curing shall also be prepared and tested the same time for comparison with the 7-day curing results, should the results of the rapid curing be used for the construction quality control.

If it is not possible to fully comply with both the UCS and ITS specified requirements, then compliance with the ITS requirement takes precedence.

The selected stabilising agent and content, increased to represent the construction method, will then be chosen that meet the requirements for PI and ITS in Table A4.4.5-2.

When required by the Engineer, the addition of more stabilising agent to allow for variations in material properties and stabiliser distribution shall be assessed during the construction of the trial section specified in Chapter 5.

Step 4: Determine the durability of the stabilised material, the effect of the test curing period on the ITS, and the field working time.

The Engineer shall indicate the stabiliser content(s) for the tests below, but it shall generally be carried out at the content chosen in Step 3 and at a stabiliser content of 0,5 % higher.

- **(i) Durability of the stabilised briquettes**

For durability the wet/dry brushing test shall be done. Should the wet/dry durability (WDD) requirement in Table A4.4.5-2 be met, the Engineer shall then confirm the stabilising agent and the application rate. Should the wet/dry durability requirement not be met, the test shall be

repeated with higher contents of stabilising agent until the durability specification is met, or other types of stabilising agent shall be considered and the design steps repeated.

Stabilisation on the road may be permitted by the Engineer before the results of the wet/dry durability test are available, but only where historical results of the durability tests on material from the same source have complied with the specification.

- (ii) ITS correlation between 7-day and 24 hr curing times

Parallel testing shall be carried out to establish for quality assurance testing the correlation between the ITS values at 7-day curing at the temperature of the standard test, and of the rapid curing test of 24 hours at elevated temperature, on material with the same stabiliser content.

- (iii) Field working time

This test procedure for the field working time gives an indication of the maximum time for completion of the stabilised layer after commencement of the addition of the stabilising agent to the material. The working time shall be assessed by testing the ITS at rapid curing at increasing standing periods after the stabilising agent is mixed with the material. The field working time limit is then where the specified ITS requirement can still be achieved. The specified working time for construction stabilisation shall not exceed the construction time limitations specified in Section 5.4 of Chapter 5.

- **d) Bituminous stabilising agent for material improvement**

The Engineer, in consultation with the Contractor, will carry out the process to select the bituminous stabilising agent in an agreed to laboratory.

The requirements for the various test results hereunder are specified in Table A4.4.5-3. The Contractor shall provide the laboratory with a sufficient quantity of the bituminous stabilising agent and active fillers for use in the various testing procedures.

The stabilising agent selection process of BSMs shall be undertaken in a three-step sequence as below. (Note: a more extensive explanation and description is given in the Sabita Guideline TG2).

Step 1: Determine the compliance of the natural material.

The selection process starts by testing whether the natural material to be treated is compliant for treating with bitumen and, if not, to ascertain the producing of the material by crushing, screening or crushing and screening, and if pre-treatment is required, with a cementitious stabilising agent or blending with other materials to make it compliant. For the material requirements refer Table A4.4.5-3 in this Section and Tables A4.1.5-4 and A4.1.5-5 in Section A4.1.

Step 2: Determine the effect of active filler and the optimal binder content.

ITS tests are carried out to determine the effect of adding an active filler in conjunction with the bituminous stabilising agent. Three samples are normally tested, all with the same application of bituminous stabilising agent. Following the relevant test procedure, no active filler is added to the first sample, 1 % (by mass) cement is added to the second sample and 1 % (by mass) hydrated lime is added to the third sample. (Additional samples may be treated with other active fillers or a greater mass of filler if required.) Six ITS specimens are manufactured from each of the three (or more) treated samples. After curing, half the ITS specimens are soaked in water for 24 hours before testing to determine the ITS_{WET} values. The ITS_{DRY} values are obtained from the unsoaked ITS specimens.

The active filler in the mix that achieves the highest ITS_{WET} value is selected as the preferred active filler and is applied to the mixes used to manufacture specimens for all further tests.

(Note. When there is a significant increase in the ITS_{DRY} value of specimens treated with and without active filler, the ITS test procedure is repeated with a reduced application rate of 0,75 % active filler.)

Similar to the procedure to select the optimal filler content, ITS tests are carried out to determine the effect of adding different amounts of bituminous stabilising agent to samples all treated with the same amount of active filler. The ITS_{DRY} and ITS_{WET} values achieved are plotted against the respective amounts of stabilising agent on a graph, and the amount of agent that yields the ITS values specified for the required BSM classification is selected as the optimum.

Step 3: Evaluate the shear properties.

A large sample is prepared by adding active filler and bituminous stabilising agent at the application rates determined in Steps 1 and 2. Ten 150 mm diameter x 300 mm high specimens are manufactured and cured. Monotonic triaxial tests are then carried out on eight of the specimens (2 each at 4 different confining pressures) to determine the shear properties (the internal friction angle and cohesion) as well as the retained cohesion (determined from tests on the remaining two samples after soaking in water for 24 hours).

- **A4.4.7.2 Storage of stabilising agents on site**

- **a) Cement provided in pockets**

Cement delivered in pockets can be kept at the road on pallets or on a raised platform for no longer than two weeks. The pockets shall always be protected from the ingress of any moisture with a waterproof tarpaulin or plastic cover not less than 1,0 mm thick.

For longer storage periods, the cement bags shall be stored in a shed. The requirements for the shed and for storing are:

- Storage sheds shall be watertight and of solid construction.
- The floor shall be waterproof and covered with plastic sheets not less than 1,0 mm thick.
- The pockets shall be stored on the delivery pallets, which must be stacked closely together (to reduce the circulation of air) and away from any outside walls.
- Pockets shall be stored in such a way that older pockets are used first.
- Vertical stacking of loose pockets shall not exceed 12 pockets high.
- Doors and windows shall be kept shut.

The permitted shelf life of cement stored in a shed is 6 months inland and 3 months in coastal areas. Cement which has been properly stored in an approved shed as specified above for longer than these periods, or at the road side for more than two weeks, shall not be used in the stabilisation works.

- **b) Lime**

Lime can be kept at the road for up to six months on pallets or on a raised platform. The pockets shall always be protected from the ingress of any moisture with a waterproof tarpaulin or a plastic cover not less than 1,0 mm thick.

c) Bitumen
The maximum storage temperatures for penetration grade bitumens are given in Table A9.1.7.1 of Chapter 9. Binders stored in a heated condition shall be kept in a container with a securely fitting lid and the circulatory system that is functioning properly. The container shall be provided with a build-in thermometer. Binders which have been heated above the maximum allowed temperatures shall not be used and shall be removed from the site.

Bitumen emulsion shall be stored at ambient temperature in storage tanks fitted with a circulating pump system, which will enable the stored bitumen emulsion to be properly circulated in the static tank, especially when no bitumen emulsion has been drawn or added for a period of 2 to 3 consecutive days. The supplier shall be contacted for the maximum storage period.

- **d) Placing on the road**

Pockets of stabilising agents shall only be placed immediately before the mixing and compaction operations are carried out, and after the gridlines have been marked out on the surface to ensure the correct application rate. Where this is not practical and approved by the Engineer, then pockets shall not be left on the road for longer than one day after placing the pockets prior to spreading the agent, as it may absorb moisture from the underlying layer or be damaged during other construction activities.

When the pockets of stabilising agents are placed on the road during periods of wet weather and get wet before the agent is spread and mixed into the layer, then the agent shall be removed to spoil and replaced with new dry agent at no cost to the Employer.

Where a pocket is broken on the road and mixing and compaction are not done within the specified time, the agent in the broken pocket shall be removed to spoil and replaced with new dry agent at no cost to the Employer.

When the stabilising agent is delivered to site in bulk tankers then the agent may only be dispensed onto the road immediately before the mixing and compaction operations are carried out.

- **A4.4.8 WORKMANSHIP**

The Engineer and the Contractor shall determine and agree on the testing protocol and frequency of the applicable process control tests required for the commercial materials, to ensure that the quality of the materials meets the specified requirements for the particular layer for which it will be used.

The stabilised material and designs shall always be tested and evaluated by constructing and testing of a trial section. After the type and quantity of stabiliser have been finalised, the Contractor shall further take full responsibility for compliance of the constructed stabilised layer with the requirements.

Measurement, testing, and evaluation of all individual components and constructed products shall be in accordance with the methods prescribed in this Section or in Chapter 20 as relevant.

CHAPTER 5: EARTHWORKS AND PAVEMENT LAYERS:

CONSTRUCTION 5.1 ROADBED

A5.1 ROADBED PART A: SPECIFICATIONS

A5.1.1 SCOPE

This Section covers the work requirements for normal roadbed treatment. This is all work in connection with the preparation and compaction of the roadbed, the removal to spoil of material not approved for use in the roadbed and for the replacement of the spoiled roadbed material. Normal roadbed treatment includes dealing with collapsible subgrades, unsuitable material and clay.

Specialist roadbed treatment shall be dealt with in accord with Clause A5.1.3.3.

The following Sections contain relevant specifications for Section A5.1:

- Section A1.2 of Chapter 1 – General requirements and provisions
- Section A1.5 of Chapter 1 – Accommodation of traffic
- Section A1.6 of Chapter 1 – Clearing and Grubbing
- Chapter 4 – Earthworks and pavement layers: Materials
- Section A12.3 of Chapter 12 – Ground improvement
- Section A12.10 of Chapter 12 – Hard excavation by blasting

A5.1.2 DEFINITIONS

The relevant definitions elsewhere in the standard specifications are applicable. Additional definitions for this Section follow.

Batter - a slope inclined upwards or downwards between the outer edge of a constructed platform area and the outer edge of a second constructed platform area located above or below the first constructed platform. The slope gradient shall be as indicated in the Contract Documentation.

Clay activity - clays are either inactive, normal or active. The activity of clay (A) is measured by the ratio of the plasticity index (PI) to the percentage passing the 2µm ($P_{0,002}$) sieve opening.

- A clay is active when ($A > 1,25$)
- A clay is normal when ($0,75 < A < 1,25$)
- A clay is inactive when ($A < 0,75$)

Potential expansiveness of clay is also dealt with in TRH9 (van der Merwe method).

Collapsing soil or sand - a soil with a collapsible grain structure. It is a soil which can withstand relatively large imposed stresses with small settlements at a low in-situ moisture content but exhibits a decrease in volume and associated additional settlement with no increase in the applied loading if wetting up occurs. The change in volume is associated with a change in soil structure (the collapse of the grain structure).

Collapse settlement - is the term applied to the additional settlement which occurs due to the wetting up of a partially saturated collapsible soil under load. This collapsing soil phenomenon shall not be confused with consolidation or compaction, since no water is dissipated from the soil, but the collapsing soil absorbs water and progressively loses strength.

Normal roadbed treatment - normal roadbed treatment is treatment that does not need to be designed by specialist geotechnical engineers nor does it need to be constructed using specialist geotechnical construction equipment.

Roadbed - the constructed, treated or improved natural in place material on which the fill or the pavement layers is constructed directly. The roadbed is constructed prior to the construction of the fill or pavement layers.

Road prism – is the area disturbed during previous or new road construction. The road prism extends between the top of slopes where in cut and between the bottom or toe of slopes where in fill. Where the road cross section is in cut and fill, the road prism shall extend between the top of the cut slope and the bottom or toe of the fill slope. Additionally, the road prism shall include the median width and all side drains when the nearest edge of the side drain is located within 0,5 m of the top of the cut slope or located within 0,5 m of the bottom or toe of the fill slope.

Roller-pass (conventional roller) - an area will be taken to have received one roller-pass when a roller has passed over the area once. Additional passes made as a result of nominal overlapping of at least 200 mm so as to ensure full coverage of the area, shall not be taken into account.

Roller-pass (high-energy impact compactor or roller HEIC) - an area will be taken to have received one roller-pass when an HEIC has passed over the area twice. Additional passes made as a result of nominal overlapping of at least 200 mm so as to ensure full coverage of the area shall not be taken into account.

Note: *With the continued enhancement of HEIC compaction technology this definition may need to be adjusted or augmented to suit the compaction equipment. Any adjusted definition shall be included in the Contract Documentation.*

Side-cut or benching - the excavation of material to form benches or steps. Suitable excavated material is bladed or placed directly by excavator or dozer into the final position of the material. The material is used for the construction of a roadbed fill, a fill widening or a backfill behind a retaining structure without it having to be loaded and hauled to the place of final use. Material excavated in this manner is termed side-cut or benching to fill.

Subgrade - the completed earthworks within the road prism before the construction of the pavement layers. This comprises the treated in-situ material of the roadbed and the fill material.

A5.1.3 GENERAL

A5.1.3.1 Roadbed material investigation

The geotechnical information provided in the Contract Documentation for the roadbed reports the results of site investigations including the excavation of test pits and/or drilling, and laboratory tests conducted by or on behalf of the Employer. This provides information as to the quality of the roadbed material and the type of roadbed treatment required.

If not already specified in the Contract Documentation, the Engineer shall instruct the Contractor regarding the different types of normal roadbed treatment or ground improvement, required in terms of Section A5.1 and Section A12.3 of Chapter 12. Normal roadbed treatment excludes specialist roadbed treatment listed in Clause A5.1.3.3.

The Engineer shall give final instructions regarding any additional investigation and testing requirements and the treatment of the roadbed materials prior to the commencement of the programmed roadbed construction period. If any undocumented roadbed conditions are found during construction, the Engineer shall be notified immediately so that any further instructions that may be required, can be issued.

The road prism must be surveyed and correctly staked before any roadbed related operations commence to ensure that the correct extent of roadbed is demarcated for treatment.

A5.1.3.2 Roadbed construction

The Contractor shall take due cognizance when programming roadbed construction as to whether the work may be able to be carried out as fullwidth construction or if the work may only be able to be done as partial-width construction or carried out under other restrictive conditions.

Clauses C1.1.3.2 and A1.2.3.23 of Chapter 1 are applicable for roadbed construction that takes place as partial-width construction or takes place under restrictive conditions.

A5.1.3.3 Ground improvement or specialist roadbed treatment

Roadbed ground improvement requiring specialist geotechnical input is dealt with in Section A12.3 of Chapter 12. The various types of ground improvement specified for the roadbed are:

- Geotechnical grouting,
- Jet grouting,
- Compaction grouting,
- Dynamic compaction,
- Rapid impact compaction,
- Vibro-compaction,
- Underpinning,
- Preloading and monitoring, and
- Geosynthetics

A5.1.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

Not required for Section A5.1.

A5.1.5 MATERIALS

A5.1.5.1 Remove unwanted material

Prior to construction or treatment of the roadbed, the in-situ roadbed material shall not contain any of the following materials listed hereunder. These unwanted materials shall be removed to a designated spoil site.

- Organic materials, grass and shrubs;
- Wood chippings, tree bark and roots;
- Plastic (bags, polystyrene and so forth);
- Refuse or other non-compliant material;
- Free asbestos; or
- Any of the hazardous material as listed in Clause A4.5.5.5 of Chapter 4.

A5.1.5.2 Topsoil

Topsoil shall be obtained from wherever suitable topsoil material occurs within the road prism ahead of the roadbed construction and within the road reserve as detailed in the Contract Documentation and as specified in Clause A1.6.7.6 of Chapter 1.

A5.1.5.3 Collapsing soil material

The following types of material exhibit a collapsible structure and may form part of the roadbed in some areas as detailed in the Contract Documentation:

- Certain types of Kalahari sands, other aeolian sands and transported sands.
- Some alluvial and sedimentary soils.

Features most commonly associated with collapsible soils include:

- An open soil structure;
- A high void ratio ('void ratio' is the ratio of 'volume of voids to the volume of solids');
- A low dry density;
- A high porosity;
- Geologically young or recently altered deposit; • Low inter-particle bond strength.

Table A5.1.5-1 provides an indication of the collapse potential of a soil in terms of key soil properties.

Table A5.1.5-1: Soil property collapse potential (CP) indicators

Soil Property	CP indicators
Maximum dry density / MDD (kg/m ³)	< 1600
% passing 2,0 mm and retained on 0,075 mm sieve opening	> 60 %
% passing 0,075 mm sieve opening	< 20 %
In place relative density as % of MDD	< 85 %

Where required an inspection pit shall be dug and the material sampled. An undisturbed sample for carrying out a single oedometer test shall be taken. The single oedometer test, also known as the collapse potential (CP) test, shall be performed to assess collapse potential. Table A5.1.5-2 summarises the potential for collapse in terms of the single oedometer test result. The undisturbed sample for the oedometer test shall be taken at a depth of between 0,8 m and 1,0 m below the material depth detailed in Table A4.1.5-2 of Section A4.1 of Chapter 4.

Table A5.1.5-2: Potential for collapse

Test result range for the single oedometer test	Collapse Potential
0 – 1 %	No potential
1 % – 5 %	Moderate potential
5 % - 10 %	Definite potential
10 % - 20 %	Severe potential
> 20 %	Very severe potential

Some collapsing soils exhibit two separate optimum moisture content (OMC) values with two separate maximum dry densities. The collapsibility of these soils is very sensitive to small increases or decreases in compaction moisture content.

A5.1.5.4 Spoil material

The roadbed may contain material that is unsuitable for use because the quality of the material is unacceptable. This material shall be excavated, loaded and hauled to designated spoil sites as instructed by the Engineer. When designated spoil sites are not available temporary spoil stockpiles may be permitted with the prior consent of the Engineer.

The material so removed shall be replaced with fill material or pioneer layer material as instructed by the Engineer.

A5.1.5.5 Pioneer layer material

The properties of material for a pioneer layer are specified in Clause A4.1.5.3 of Chapter 4.

A5.1.5.6 Geosynthetic materials

Reference shall be made to Section A12.11 Geosynthetics of Chapter 12, for the specification, application and types of geosynthetic material to be used for a specific application.

A5.1.6 CONSTRUCTION EQUIPMENT

Construction equipment to carry out roadbed treatment shall comply with the requirements of Clause A1.2.6 of Chapter 1.

High energy impact compactors (HEIC) shall be equipped with functioning continuous impact response metering and GPS when specified in the Contract Documentation.

A5.1.7 EXECUTION OF THE WORKS

A5.1.7.1 Clearing and grubbing

The entire roadbed shall be cleared and grubbed as specified in Section A1.6 of Chapter 1 ahead of any topsoil being removed. Any hazardous material uncovered, shall be disposed of in terms of Clause A1.6.7.7 of Chapter 1.

The clearing and cutting of trees is specified in Section A1.6 of Chapter 1.

The road prism shall be cleared and grubbed 2,0 m wider than the road prism width. Material obtained from clearing and grubbing shall be removed to a temporary stockpile site within the road reserve or removed from site as detailed in the Contract Documentation.

The burning of material on the site of the works shall not be permitted.

Areas within an existing road prism will normally not require clearing and grubbing.

The removal of buildings and structures is specified in Section A1.6 of Chapter 1 and the removal of materials generally found in urban areas such as kerbs, road-edging, utility structures and paved sidewalks are specified in Section A4.3 of Chapter 4.

A5.1.7.2 Removal and conservation of topsoil from roadbed

After clearing and grubbing, topsoil shall be excavated and stockpiled as specified in Section A1.6 of Chapter 1, but only after the Engineer has confirmed that the removal of topsoil and the stockpiling thereof, is required.

The topsoil shall be excavated and stockpiled for later top-soiling of the fill and cut slopes. The requirements of Section A1.6 of Chapter 1 for the removal of topsoil shall be complied with.

A stockpile site shall be prepared at the designated area prior to removing any of the required topsoil in accordance with the provisions of Clause A4.1.7.3 of Chapter 4.

Topsoil shall be stockpiled in separate loose heaps not exceeding 2.0 m in height, unless specified otherwise in the Contract Documentation. The haul trucks shall not be driven over the top soil material and any compaction of the topsoil shall not be permitted.

A5.1.7.3 Normal roadbed treatment a) Construction overview

The method of processing and compacting the roadbed and fill material as part of normal roadbed treatment, or the class of compaction, shall be specified in the Contract Documentation or be instructed by the Engineer in advance.

The classification of material as hard material or in the case of LEC, intermediate material, to compensate the Contractor for the cost of excavation thereof, shall not be taken into consideration for any additional compensation when used in the compacted fill.

When the roadbed to be treated is located on a slope that is steeper than 1 (one) vertical to 10 (ten) horizontal, the roadbed treatment shall be benched as specified in Clause A5.2.7.3 and in the Contract Documentation. The minimum depth of the specified roadbed treatment shall be complied with for the full extent of the treatment.

Ground improvement roadbed treatment is not normal roadbed treatment, but specialist roadbed treatment and is specified in Chapter 12. **b)**

Removal of unsuitable roadbed material

Any roadbed material which is of unsuitable quality shall be removed to spoil to such widths and depths as instructed by the Engineer. The unsuitable material shall be disposed of as detailed in the Contract Documentation or as instructed by the Engineer. The excavated roadbed material shall then be replaced with approved, imported fill material, compacted to the specified density.

The Engineer may instruct that material that is unsuitable due to being unstable be removed and replaced with approved material. The Contractor shall implement adequate temporary drainage measures as per instruction from the Engineer, ahead of the removal to spoil of the unstable material. The instruction by the Engineer must clearly state the depth of the material to be removed, contain an assessment in respect of the stability of the material and ensure that suitable construction equipment is available.

After completion of the removal of any unstable material to the specified line and depth in accordance with the Engineer's instructions, it may still be necessary to remove some stable material. This material will also be classified as 'unstable' material, for measurement and payment purposes only, if the thickness of the stable material to be removed is less than 200 mm. If the thickness to be removed exceeds 200 mm then the stable material will remain classified as stable material taken to spoil.

c) Percentage of maximum dry density (MDD)

Any section of the roadbed material that is classified as being suitable for use in-situ, but the material fails to meet density requirements, shall be scarified, watered and compacted to the depth and to the percentage of MDD specified in the Contract Documentation. In the absence of a specified depth, the depth of roadbed treatment shall be 150 mm. If necessary, roadbed material may have to be scarified and temporarily bladed to windrow to allow for compaction in layers in order to achieve the specified compaction density throughout the specified depth of treatment.

Where any additional material has to be imported to make up the required level and layer thickness, and where the thickness of the layer of imported material would be less than the specified layer thickness after compaction, then the roadbed material shall first be scarified. The additional imported material shall then be placed, blended with the scarified roadbed material and compacted to the full specified depth of that roadbed layer. **d) Roller-pass compaction**

Where the percentage compaction cannot be satisfactorily determined by way of testing the in-situ density due to the nature of the material, the Engineer shall instruct that the material be compacted by a specified number of passes. The number of passes shall be carried out by a single type of roller or by a combination of various types of rollers. The Engineer shall issue instructions regarding the required number of passes for each type of roller being used.

A trial section shall be constructed to determine the best type of rollers or combination of rollers and the required number of roller-passes for each roller being used.

The Contractor shall use one, or a combination of any, of the following rollers:

- Grid roller;
- Impact roller;
- Pad-foot vibratory roller;
- Smooth drum vibratory roller;
- Pneumatic roller;
- High energy impact compactor (HEIC); or • Any other suitable roller.

This roller-pass compaction shall normally be carried out at the in-situ moisture content. No rigid control of the moisture content will be exercised during compaction. The Contractor shall nevertheless prove to the Engineer that every possible endeavour is being made to take advantage of favourable soil-moisture conditions and to carry out such roller-pass compaction in so far as is possible during periods when the roadbed is neither excessively dry nor excessively wet.

The Contractor shall consult the Engineer as to when conditions are favourable for compaction and where such compaction shall be done at any particular time. The Engineer shall instruct and then compensate the Contractor to water the roadbed when the roller-pass compaction cannot be programmed to be carried out at a time when acceptable moisture conditions exist.

e) Compaction of collapsible soil

(i) General

The type of treatment of any portion of the roadbed that has a collapsible soil structure shall be specified in the Contract Documentation.

(ii) Soil collapse construction

The measurable criteria to confirm that soil collapse has taken place, such as percentage of MDD, the in-situ measured CBR (by DCP), the amount of collapse settlement and so forth, shall be specified in the Contract Documentation.

(iii) Non wetting-up roadbed collapse

The non wetting-up collapsible roadbed material;

- The material can be compacted in-situ using conventional rollers and/or HEIC rollers. The soil shall be collapsed at the insitu moisture content.
- The material to be collapsed can alternatively be temporarily excavated to stockpile and then imported from the stockpile in controlled compacted layers.

A trial section shall monitor and establish all or some of the following criteria as specified in the Contract Documentation.

- The existing in-situ DCP-determined CBR strength (pre-construction);
- Confirm the compaction equipment or combination of compaction equipment required;
- A correlation between settlement, density and DCP-determined CBR strength for compaction control;
- The minimum required number of compaction passes to ensure collapse settlement;
- The moisture content and the percentage of MDD; and
- The DCP-determined CBR (post-construction) at the depth specified.

(iv) Wetting-up roadbed collapse

The wetting-up and compaction of a roadbed trial section for the collapse thereof shall be divided into construction phases:

- Determine the pre-construction moisture contents and then after each controlled addition of water.
- All moisture contents are to be determined along the length and the full collapse depth of the trial section. This is to establish and verify uniform moisture sections for collapse treatment;

The trial section shall monitor and establish all or some of the following criteria as specified in the Contract Documentation:

- The existing in-situ DCP-determined CBR strength at different depths (pre-construction);
- Determine the moisture contents and DCP-determined CBR strengths after completion of each wetting and compaction cycle during the construction of the trial section;
- Establish the amount of vertical settlement or collapse by taking sufficient levels before, after completion of each wettingup/compaction phase and after the completed construction of the trial section for each uniform moisture section.
- The minimum required number of compaction passes, compaction equipment and moisture content required to ensure compliance with the specified collapse settlement and/or the required DCP-determined CBR, post-construction. **f)**

Hard material

Where detailed in the Contract Documentation, or as instructed by the Engineer, the roadbed shall be treated in-situ by breaking up formations of hard materials in order to achieve a uniform standard of compaction and to improve the subsurface drainage ahead of the fill or the road pavement layers.

Treatment in-situ shall consist of ripping the roadbed, or drilling and blasting the roadbed using explosives, or drilling and splitting the roadbed using non-explosive, expansive, rock-breaking products. The depth of ripping or drilling shall increase uniformly from the centre of the roadbed to the edges, on cambered sections of road.

(i) In-situ treatment by ripping

Unless indicated otherwise in the Contract Documentation, or instructed by the Engineer, the depth of ripping in the centre of the roadbed shall not be less than 300 mm and at the edges of the roadbed not less than 500 mm.

On super elevation sections or cross-fall sections the in-situ treatment shall have a cross-fall parallel to the pavement cross-fall and a uniform minimum depth of 400 mm.

Shales and mudstones shall also be treated in-situ as described above or removed to the required depth if so specified in the Contract Documentation.

After ripping, the hard roadbed material shall be broken down by rolling until the maximum dimension of any material fragment does not exceed 200 mm. The material shall then be compacted by means of a specified number of passes by a selected type of roller or by a combination of various rollers.

(ii) In-situ treatment by drilling and rock breaking

Unless indicated otherwise in the Contract Documentation, or instructed by the Engineer, the depth of drilling and rock breaking shall not be less than 700 mm at the centre of the roadbed and not less than 1000 mm at the edges of the roadbed.

On super elevation sections or cross-fall sections, the in-situ treatment shall have a cross-fall parallel to the pavement cross-fall with a minimum depth of 850 mm.

After drilling and rock breaking, the hard roadbed material shall be broken down by rolling until the maximum dimension of any material fragment does not exceed 200 mm. The material shall then be compacted as specified by means of a number of rollerpasses using a selected type of roller or a combination of various rollers. The Contractor shall determine the drilling pattern to ensure that the amount of breaking down required during compaction is less than 5 %.

Any surplus material resulting from bulking after in-situ treatment, shall be removed and disposed of or utilized elsewhere as directed by the Engineer.

g) Inactive clay and normal clay

Inactive clays and normal clays in the roadbed that heave or settle during a three roller-pass trial compaction shall be treated using one of the following three methods, as specified in the Contract Documentation.

A trial section shall be constructed of the specified roadbed treatment, to clearly establish the construction technique to be applied as well as to confirm the correct construction equipment and the required number of roller-passes required.

The trial section shall also clearly establish the visual and/or laboratory testing to be done. Upon completion of the trial section the Engineer shall instruct the Contractor regarding the type and amount of testing.

(i) Material modification

The in-situ roadbed material shall be shaped to line and level. A layer of approved material, thickness as specified in the Contract Documentation, shall be imported and spread out across the top of the pre-shaped roadbed.

The imported layer shall be thoroughly blended with the inactive/normal clay to the depth as specified in the Contract Documentation using appropriate construction equipment and then compacted to comply with the specified MDD or to comply with the specified number of roller-passes and compaction requirement.

(ii) Lime modification

The in-situ roadbed material shall be shaped to line and level. The amount of road lime shall be as specified in the Contract Documentation. This amount shall not be less than 2 % by weight. The road lime shall then be evenly spread over the shaped roadbed. Laboratory testing prior to construction shall establish the required lime content and the ideal maturing period to achieve a maximum reduction of the plasticity index (PI). The Engineer shall then instruct the Contractor accordingly.

The lime shall be mixed in-situ into the roadbed material to the specified depth in the Contract Documentation or as instructed by the Engineer using a suitable rotovator or recycling machine or by making use of other appropriate construction equipment such as a motor grader and plough. The thickness of mixing should be limited to a maximum of 200 mm. Adjacent mixing strips shall be overlapped by at least 150 mm to avoid any material not being treated.

During initial mixing and pulverisation, it may be necessary to add water when the in-situ material is below OMC, in order to ensure that the lime modifies the material.

Following each mixing pass the material shall be trimmed and lightly compacted using single roller-pass compaction or as instructed by the Engineer, with a smooth wheeled roller or pneumatic tyre roller or other suitable roller as determined during the construction of a trial section, in order to ensure the correct processing depth throughout the operation. Once initial mixing and the addition of water is complete, the material shall be trimmed and lightly compacted with two roller-passes and then left for a maturing period which shall be between 24 hours and 72 hours as determined by the laboratory.

Following the maturing period, re-mixing and the final moisture content adjustment shall take place. The moisture content should be as close as possible to the OMC for the material. The roadbed material shall then be compacted to either the specified MDD or to the specified roller-pass compaction requirement.

(iii) Removal of material

The clay material shall be removed and replaced with approved material to a maximum depth of 450 mm as specified in the Contract Documentation. The approved material shall be compacted to the specified MDD. **h) Active clay**

Treatment of active clays shall be by means of Alternative 1 or by means of Alternative 2 hereunder. The method to be used shall be as specified in the Contract Documentation or as instructed by the Engineer.

(i) Alternative 1 - Roadbed construction using lime

Laboratory testing prior to construction shall confirm the required lime content and the ideal maturing period in terms of the maximum reduction of the plasticity index (PI).

A trial section shall then be constructed to clearly establish the construction technique to be applied as well as to confirm the correct construction equipment to be used and the required number of roller-passes.

The in-situ material shall be shaped to line and level for the section of roadbed with active clay and the roadbed shall then be processed in 3 phases as specified below.

- Phase 1 Mix first 50 % of lime

The section of in-situ roadbed with active clay shall be ripped to a depth of 250 mm or to a depth as specified in the Contract Documentation and 50 % of the required total road lime content, as determined by the laboratory testing, shall then be mixed in to the full depth using a rotovator or a recycling machine. Due to the nature of active clay the use of a motor grader and/or plough will not achieve the required degree of mixing when used on their own. During this mixing process the Contractor shall ensure that all the clods of clay are broken down. If necessary, a pad foot roller can also be used to help break up the clay clods.

After the mixing and breaking down process has been completed, water must be added if required, to ensure that the moisture content shall be close to 50 % of the optimum moisture content. The layer shall then be sealed with a single roller-pass compaction using the appropriate roller as established during the construction of a trial section.

- Phase 2 Maturing period

The treated roadbed clay material shall then be left for at least 48 hours or any longer period as determined by the laboratory to allow the first amount of lime to react with the material to make the material more workable.

- Phase 3 Mix balance of lime and compact

After the maturing period, spread the remaining 50 % of the lime, rip the 250 mm thick roadbed layer and mix in the lime using a rotovator, a recycling machine or a grader and plough as determined during the construction of a trial section.

After this mixing process has been completed water must be added to ensure that the moisture content shall be close to 50 % of the optimum moisture content. The roadbed material shall then be compacted as specified in the Contract Documentation or as instructed by the Engineer after construction of a trial section.

During the final compaction process the roadbed layer shall be shaped to the correct design levels and camber or cross-fall to ensure that the compacted surface is able to drain. No low spots shall exist where water can be trapped beneath the fill on top of the compacted and treated active clay roadbed material.

(ii) Alternative 2 - Roadbed construction by removal of active clay

The heaving clay in the roadbed shall be removed down to the bottom of the clay layer, or to a minimum depth of 750 mm below natural ground level, or to a depth as specified in the Contract Documentation. The material shall be loaded, hauled and then offloaded at a designated spoil site.

The removed material shall be replaced with compliant material and be compacted to the specified percentage of MDD as per the Contract Documentation.

Moisture content fluctuations for both alternatives within the road prism must be restricted. This shall be achieved by constructing a flattened side batter such as 1 (vertical):3 (horizontal), or by placing and compacting additional clay material adjacent to the standard road side batter as detailed in the Contract Documentation.

i) Construction of a pioneer layer

Where fill is to be constructed across water-logged or soft clayey ground, that exhibits excessive movement under normal compaction equipment and haulage trucks (unstable material), and such conditions preclude the effective compaction of the bottom fill layers, or the effective removal of the material to spoil, a pioneer layer shall be constructed directly over this material as detailed in the Contract Documentation or as instructed by the Engineer. The pioneer layer shall be constructed by dumping successive loads of material compliant with Clause A4.1.5.3 of Chapter 4 and spreading the material uniformly to a thickness which is just sufficient to provide a stable working platform for constructing the subsequent fill layers.

Appropriate light hauling equipment shall be used and end-tipping shall be employed for placing the material. The layer shall be compacted by using suitable compaction equipment without the water-logged roadbed material being overstressed. Pioneer layers shall not require compaction to a controlled density.

Upon completion of the construction of the pioneer layer, the construction of a levelling course layer with an average compacted thickness of 200 mm shall normally be required to be constructed to line and level, using compliant fill material. The compacted density of the layer shall be as instructed by the Engineer, but no more than a density of 90 % MDD.

A5.1.7.4 Special drainage measures, dewatering

Any waterlogged roadbed, such as saturated material overlying less pervious strata, shall first be drained by the installation of all permanent surface and/or subsoil drainage detailed in the Contract Documentation or as directed by the Engineer, before any other construction may commence on these sections.

A5.1.7.5 Dolomitic roadbed treatment

In dolomitic areas the roadbed treatment by the construction of a soil raft, or by any other appropriate treatment measure, shall be specified in the Contract Documentation by a geotechnical Engineer.

A5.1.8 WORKMANSHIP

A5.1.8.1 Inspection of the works

The Engineer shall do routine inspections and conduct routine tests to determine whether the quality of material and workmanship provided, complies with the requirements of the Contract Documentation.

A5.1.8.2 Compaction requirements

Compaction compliance shall be determined as follows:

- The in-situ measured density of the roadbed treatment complies with the specification when the results of at least 75 % of the in-situ density tests, located as per the Contract Documentation of any lot, are equal to or exceed the specified values and no single density is more than 5 percentage points below the specified value.
- The roller-pass roadbed treatment complies with the specification when the agreed number of roller-passes have been observed and recorded as being the same as that of the accepted trial section.
- The roadbed treatment of collapsing soils complies with the specification when the compaction of the collapsing soils is verified to yield the same agreed results as obtained in the accepted trial section.
- The hard material roadbed treatment complies with the specification when the depth of blasting or ripping is confirmed as being in accordance with the specification and the layer has been monitored and confirmed as being fully functional in terms of sub-surface drainage.
- There are no compaction density requirements for the pioneer layer. The pioneer layer complies with the requirements of the specifications when movement or heaving of the pioneer layer under the load of conventional compaction equipment or of loaded haulage trucks has ceased.

- The in-situ measured density of the levelling layer is compliant when results of at least 75 % of the in-situ density tests, located as per the Contract Documentation, of any lot, are equal to or exceed the specified values and no single density is more than 6 percentage points below the specified value.

A5.1.8.3 Construction tolerances

The roadbed shall be constructed to the dimensional tolerances specified below. **a)**

Levels

The level tolerances shall be as follows for the top of the roadbed.

In cases where the in-situ treatment of the roadbed supports a fill of more than 500 mm thick, the levels of the top of the treated roadbed shall not be subject to any level tolerances other than that the roadbed shall at no point encroach more than 200 mm into the fill.

In cases where the in-situ treatment of the roadbed is beneath a fill of less than 500 mm thick, the levels of the top of the treated roadbed shall at no point encroach more than 50 mm into the fill.

In cases where the in-situ treatment of the roadbed is in a cutting, irrespective of the type of material in the roadbed, and the pavement layers are constructed directly on top of the treated roadbed, the treated roadbed shall be subject to the following tolerances as applied to the specified design levels:

$$H_{90} = \pm 25 \text{ mm}$$

$$H_{\max} = \pm 35 \text{ mm}$$

b) Width

The horizontal measurement taken from the centre line of the road to the edge of the roadbed treatment shall nowhere be 250 mm more than the specified dimension when measured at roadbed level and nowhere should it be less than the specified dimension.

(vi) Determining the quantities

Before carrying out any construction work in connection with clearing and grubbing and the removal of topsoil, the Contractor, shall at no cost to the Employer, take cross-sections at a maximum spacing of 20 m so as to determine the original ground line.

After completion of the topsoil removal the Contractor, shall at no cost to the Employer, take cross-sections at a maximum spacing of 20 m so as to determine the new ground line and subsequently the quantities of topsoil removed ahead of the commencement of the roadbed treatment.

After completion of the roadbed treatment the Contractor, shall at no cost to the Employer, take cross-sections at a maximum spacing of 20 m so as to determine the final roadbed levels and subsequently the quantities of any roadbed levelling operations, if any, ahead of the cut to fill operations commencing.

The Engineer shall take control measurements to determine the accuracy and adequacy of the cross-sections, and shall instruct the Contractor to correct any out of tolerance work and to take such additional measurements and cross-sections as may be deemed necessary. Such cross-sections shall be taken before any cut or fill work is done.

Where the Contractor proceeds with further construction work before the Contractor and the Engineer have reached agreement on the accuracy and adequacy of the cross-sections, the Engineer's decision regarding the cross-sections to be used shall be final and binding on the Contractor.

(vii) Material from commercial sources

Where specified in the Contract Documentation, material from commercial sources shall be used for the construction of roadbed treatment. In such cases the items listed below shall be applicable, except that the tendered rates shall also include full compensation for all transport costs as no load and haul shall be measured for commercial material.

(viii) Payment items specifically for this Section of the specifications

Item	Description	Unit
C5.1.1	Roadbed construction and compaction	
C5.1.1.1	Compaction of in-situ material to 90 % of MDD	cubic metre (m ³)
C5.1.1.2	Compaction of in-situ material to 93 % of MDD	cubic metre (m ³)
C5.1.1.3	Compaction of imported material to 90 % of MDD	cubic metre (m ³)
C5.1.1.4	Compaction of imported material to 93 % of MDD	cubic metre (m ³)
C5.1.1.5	Compaction of in-situ sand roadbed to 95 % of MDD	cubic metre (m ³)
C5.1.1.6	Compaction of in-situ sand roadbed to 100 % of MDD	cubic metre (m ³)

The unit of measurement shall be the cubic metre of roadbed material prepared and compacted as specified. The quantity of the in-situ material shall be computed in accordance with the authorised dimensions of the completed layers. The quantity of imported material shall be measured in the haul vehicles, by taking the volume of the imported material to be the equivalent of 70 % of the loose volume in the haul vehicles.

The tendered rates for items C5.1.1.1, C5.1.1.2, C5.1.1.5 and C5.1.1.6 shall include full compensation for shaping, scarifying, mixing of in-situ material and preparing and compacting the material to the specified MDD.

The tendered rates for items C5.1.1.3 and C5.1.1.4 shall include full compensation for shaping, scarifying with in-situ material where required and mixing of the imported material or the in-situ/imported material blend, then preparing and compacting the material to the specified MDD.

The tendered rates for items C5.1.1.3 and C5.1.1.4 shall include for loading and off-loading the imported material. The haul of the imported material shall be measured from the point of loading until the point of off-loading as per Section A1.7 of Chapter 1.

All material that requires being imported for the construction of the roadbed, to replace spoil material measured under item C5.1.2, or to replace unsuitable material measured under C5.1.3, except the levelling layer which shall be paid under item C5.1.12, shall be measured and paid for under this item C5.1.1.

Item	Description	Unit	C5.1.2	Excavate material to spoil sites designated by the Employer
C5.1.2.1	Excavate material to spoil from roadbed construction, material obtained from:			
(a)	Soft excavation	cubic metre (m ³)		
(b)	Boulder excavation Class A	cubic metre (m ³)		
(c)	Boulder excavation Class B	cubic metre (m ³)		
(d)	Hard excavation (other than by blasting)	cubic metre (m ³)		
(e)	Hard excavation (by blasting)	cubic metre (m ³)		
C5.1.2.2	Excavate material to spoil from roadbed construction, using labour enhancement, material obtained from:			
(a)	Soft excavation	cubic metre (m ³)		
(b)	Intermediate excavation	cubic metre (m ³)		

The unit of measurement shall be the cubic metre of material measured in its original position in cut and computed by the method of average end areas from levelled cross-sections taken as specified.

Where measurement by cross-sections is considered by the Engineer to be impractical, cut to spoil may be measured in the haul vehicles, by taking the in situ volume of the material to be the equivalent of 70 % of the loose volume in the haul vehicles.

For payment purposes a distinction shall be made between using conventional construction methods and using labour enhancement.

The tendered rates of item C5.1.2.1 shall include full compensation for excavating and loading from the road prism and roadbed the material in the different classes of excavation. Haul shall be measured and paid for from the point of loading to the point of off-loading.

The tendered rates of item C5.1.2.2 shall include full compensation for using labour enhancement for excavating and loading from the road prism and roadbed in the different classes of excavation. Haul shall be measured and paid for from the point of loading to the point of off-loading.

The excavation of hard material by blasting shall exclude the cost of blasting which shall be measured and paid for under item C12.10.1 in Section C12.10 of Chapter 12.

Item	Description	Unit	C5.1.3 Excavate material to spoil sites designated by the Contractor

C5.1.3.1 Excavate material to spoil from roadbed construction, material obtained from:

(a)	Soft excavation	cubic metre (m ³)	
(b)	Boulder excavation Class A	cubic metre (m ³)	
(c)	Boulder excavation Class B	cubic metre (m ³)	
(d)	Hard excavation (other than by blasting)		cubic metre (m ³)
(e)	Hard excavation (by blasting)	cubic metre (m ³)	

C5.1.3.2 Excavate material to spoil from roadbed construction, using labour enhancement, material obtained from:

(a)	Soft excavation	cubic metre (m ³)	
(b)	Intermediate excavation	cubic metre (m ³)	

The unit of measurement shall be the cubic metre of material measured in its original position in cut and computed by the method of average end areas from levelled cross-sections taken as specified.

Where measurement by cross-sections is considered by the Engineer to be impractical, cut to spoil may be measured in the haul vehicles, by taking the in situ volume of the material to be the equivalent of 70 % of the loose volume in the haul vehicles.

For payment purposes a distinction shall be made between using conventional construction methods and using labour enhancement.

The tendered rates of item C5.1.2.1 shall include full compensation for excavating and loading from the road prism and roadbed the material in the different classes of excavation. All haul costs shall be included in the tendered rates for item C5.1.3..

The tendered rates of item C5.1.2.2 shall include full compensation for using labour enhancement for excavating and loading from the road prism and roadbed in the different classes of excavation. All haul costs shall be included in the tendered rates for item C5.1.3..

The excavation of hard material by blasting shall exclude the cost of blasting which shall be measured and paid for under item C12.10.1 in Section C12.10 of Chapter 12.

Item	Description	Unit

C5.1.4 Removal of unsuitable material to spoil

C5.1.4.1 In layer thicknesses of 200 mm and less

(a)	Stable material	cubic metre (m ³)	
(b)	Unstable material	cubic metre (m ³)	

C5.1.4.2 In layer thicknesses exceeding 200 mm

(a)	Stable material	cubic metre (m ³)	
(b)	Unstable material	cubic metre (m ³)	

The unit of measurement shall be the cubic metre of unsuitable material removed by the Contractor to spoil in accordance with the Engineer's instructions, and it shall be the in-situ volume of the material calculated in accordance with the authorised dimensions. Where the use of authorised dimensions proves to be unsatisfactory, then the unit of measurement shall be 70 % of the loose volume measured in the haul trucks.

The tendered rates shall include full compensation for excavating and loading the material from the road prism and roadbed in the different classes of excavation.

Hauling shall be measured and paid for from the point of loading to the point of off-loading as per Section C1.7 of Chapter 1.

The removal of unsuitable stable material in cuttings is measured and paid for under item C4.2.7 of Chapter 4.

Item	Description	Unit
C5.1.5	In-situ treatment of roadbed in hard material	
C5.1.5.1	In-situ treatment by ripping	cubic metre (m ³)
C5.1.5.2	In-situ treatment by drilling and blasting	cubic metre (m ³)
C5.1.5.3	In-situ treatment by drilling and splitting the material using non-explosive, rock-breaking products	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 authorised dimensions of the in-situ treatment.

The tendered rates for items C5.1.5.1 and C5.1.5.2 shall include full compensation for ripping or for drilling and blasting, shaping, scarifying, sizing, mixing of in-situ and imported material if required, processing and compacting the material as specified. Payment shall distinguish between in-situ treatment by ripping only and in-situ treatment by drilling and blasting.

The excavation of hard material by blasting for item C5.1.5.2 shall exclude the cost of blasting which shall be measured and paid for under item C12.10.1 in Section C12.10 of Chapter 12.

The tendered rates for item C5.1.5.3 shall include full compensation for drilling the holes, procurement of the rock-breaking product(s), charging the drilled holes and splitting the material. The tendered rates shall also include for shaping, scarifying, sizing, mixing of in-situ and imported material if required, processing and compacting the material as specified.

All imported material shall be measured and paid for under Section C5.2.

No separate payment shall be made for oversize or surplus material excavated to spoil as a result of this treatment.

Surplus material shall be measured and paid under item C5.1.1 if used in the roadbed.

Item	Description	Unit
C5.1.6	Roller-pass compaction	
C5.1.6.1	Grid rollers	square metre (m ²)
C5.1.6.2	Pad foot vibratory rollers	square metre (m ²)
C5.1.6.3	Smooth drum vibratory rollers	square metre (m ²)
C5.1.6.4	Other vibratory rollers. Specify.....	square metre (m ²)
C5.1.6.5	Impact rollers	square metre (m ²)
C5.1.6.6	Pneumatic rollers	square metre (m ²)
C5.1.6.7	High energy impact compactor/roller (HEIC)	square metre (m ²)
C5.1.6.8	Other rollers. Specify.....	square metre (m ²)

The unit of measurement shall be the square metre of roadbed compacted in accordance with the specification for a single roller-pass. The quantity will be measured in accordance with the authorised dimensions of the area to receive single roller-pass compaction.

The area to be roller-pass treated will be adjusted to be commensurate with the number of roller-pass treatments instructed. The authorised area will be doubled when two roller-pass compaction is specified or trebled when three roller-pass compaction is specified in the Contract Documentation, or instructed by the Engineer, and so forth.

The tendered rates shall include full compensation for shaping, providing the rollers, keeping the rollers operational and ready for when soilmoisture conditions are favourable, and for compacting the roadbed with the specified number of roller-passes.

The Contractor shall base the tendered rates on a single, one direction pass for each specified type, size and weight of roller. The area covered by the nominal roller overlap width required to ensure full coverage of the area being compacted shall not be measured for additional payment. If the rollers available on site are different types, sizes and weights than those specified in the Contract Documentation, then revised rates which take into account the percentage increased or reduced compaction effort per roller-pass, shall be agreed with the Contractor based on the same percentage increase or decrease.

The unit of measurement for the addition of water shall be the kilolitre of water applied as required.

The tendered rates for the addition of water to achieve the required compaction shall include full compensation for the supply, delivery and application of the water when required.

Item	Description	Unit
C5.1.7	Construction of a roadbed trial section	
C5.1.7.1	Non wetting-up collapsing soil trial section at in-situ moisture content using conventional rollers and/or HEIC	cubic metre (m ³)
C5.1.7.2	Non wetting-up collapsing soil trial section by excavating the soil to stockpile and then importing the soil from the stockpile to controlled compacted layers	cubic metre (m ³)
C5.1.7.3	Wetting-up collapsing soil trial section	cubic metre (m ³)

C5.1.7.4	Inactive and normal clay	
(a)	By material modification	cubic metre (m ³)
(b)	By lime modification	cubic metre (m ³)
(c)	By removal of material	cubic metre (m ³)
C5.1.7.5	Active clay	
(a)	Roadbed construction using lime	cubic metre (m ³)
(b)	Roadbed construction by removal of active clay	cubic metre (m ³)

C5.1.7.6 Roller-pass compaction. cubic metre (m³)

The unit of measurement for a trial section shall be the cubic metre of material processed during construction of the trial section according to the authorised dimensions as specified in the Contract Documentation measured along the centre line of the road. A total length of at least 150 m of trial section and no more than 200 m will be measured for payment as a trial section.

The authorised depth and width of the trial sections including item C5.1.7.1 (the depth of compaction) and item C5.1.7.3 (the depth of wetting-up) shall be representative of what will ultimately be constructed as per the Contract Documentation.

The tendered rates for item C5.1.7.4(a) shall include full compensation to mechanically modify the material as specified in Clause A5.4.7.2 with the type of material and ratios of material as specified in the Contract Documentation.

The tendered rates for item C5.1.7.4(c) shall include full compensation for excavating and loading from the road prism and roadbed the inactive/normal clay material. Haul shall be measured and paid for from the point of loading to the point of off-loading.

The tendered rates shall include full compensation for setting out the trial section, preparing and providing the programme of work for the specific trial section and preparing the existing roadbed surface where required.

The tendered rates shall include full compensation for the application of water, in the case of items C5.1.7.3, C5.1.7.4, C5.1.7.5 and C5.1.7.6, all laboratory testing and for the full documentation of the construction techniques to produce a trial section that is compliant with the requirements specified in the Contract Documentation.

The addition of lime for construction of the trial sections shall be measured and paid for under Section C5.4.

Item	Description	Unit
C5.1.8	Construction of the roadbed in collapsing soil	
C5.1.8.1	Non wetting-up collapsing soil roadbed construction at in-situ moisture content using conventional cubic metre (m ³) rollers	
C5.1.8.2	Non wetting-up collapsing soil roadbed construction at in-situ moisture content using HEIC	cubic metre (m ³)
C5.1.8.3	Non wetting-up collapsing soil roadbed construction by excavating the soil to stockpile and then cubic metre (m ³) importing from the stockpile to controlled compacted layers	
C5.1.8.4	Wetting-up collapsing soil roadbed construction	kilo litre (kl)

C5.1.8.5 Water for wetting-up collapsing soil roadbed construction kilo-litre (kl)

The unit of measurement for items C5.1.8.1, C5.1.8.2, C5.1.8.3 and C5.1.8.4 shall be a cubic metre of collapsing soil material constructed according to the authorised dimensions in the Contract Documentation, measured in-situ prior to the commencement of any construction.

The tendered rates shall include full compensation for setting out the collapsing soil material sections, for preparing and providing the construction programme for the roadbed construction and preparing the existing roadbed surface where required.

The tendered rates shall include full compensation for construction of the roadbed treatment all in terms of the Contract Documentation and/or in terms of the relevant compliant trial section constructed as per item C5.1.7. The tendered rates shall include full compensation for all labour, construction plant including conventional rollers (C5.1.8.1) or HEIC (C5.1.8.2), equipment and incidentals required to carry out the construction of the roadbed in collapsing soil material as specified.

The unit of measurement for item C5.1.8.4 shall be a kilolitre of water used to wet-up the collapsing soil.

The tendered rates for item C5.1.8.4 shall include full compensation for the provision and application of water for the construction of item C5.1.8.3, applied as per the compliant trial section under item C5.1.7.3.

Item	Description	Unit
C5.1.9	Construction of roadbed comprising normal and inactive clay	
C5.1.9.1	By material modification	cubic metre (m ³)
C5.1.9.2	By lime modification	cubic metre (m ³)
C5.1.9.3	By removal of material	cubic metre (m ³)

The unit of measurement shall be a cubic metre of inactive clay material constructed according to the authorised dimensions in the Contract Documentation and down to a depth of 200 mm for both items C5.1.9.1 and C5.1.9.2.

The tendered rates shall include full compensation for setting out each inactive clay section and preparing the existing roadbed surface where required. The tendered rates for C5.1.9.1 shall also include for loading the material.

The tendered rates for items C5.1.9.1 and C5.1.9.2 shall also include full compensation for construction of the roadbed treatment of inactive clay by material modification or lime modification, respectively, as specified. The tendered rates for each item shall also include full compensation for all labour, construction plant, equipment and incidentals required to carry out the construction of the roadbed by material modification or lime modification as specified.

The hauling of compliant fill material shall be measured and paid for from the point of loading to the point of off-loading as per Section A1.7 of Chapter 1.

The production of the compliant material is measured and paid for under Sections C4.1 and/or C4.2 of Chapter 4.

The procurement and mixing of the lime is specified and measured in Section A4.4 of Chapter 4 and Section C5.4 respectively.

Item	Description	Unit
C5.1.10	Construction of roadbed comprising active clay	
C5.1.10.1	Roadbed construction using lime	cubic metre (m ³)
C5.1.10.2	Roadbed construction by removal of active clay	cubic metre (m ³)

The unit of measurement shall be a cubic metre of active clay material constructed according to the authorised dimensions in the Contract Documentation.

The depth of treatment for item C5.1.10.1 shall be 200 mm unless otherwise instructed in the Contract Documentation or by the Engineer. The depth of treatment for item C5.1.10.2 is the depth indicated in the Contract Documentation up to a limit of 750 mm unless instructed otherwise in the Contract Documentation or by the Engineer.

The procurement and mixing of the lime for item C5.1.10.1 is specified and measured in Section A4.4 of Chapter 4 and Section C5.4 respectively.

The tendered rates shall include full compensation for setting out each active clay section and preparing the existing roadbed surface as specified.

The tendered rates for item C5.1.10.1 shall also include full compensation for construction of the roadbed treatment of active clay using lime modification as specified.

The tendered rates for C5.1.10.2 shall also include for loading and off-loading the active clay. The hauling of the active clay material shall be measured and paid for from the point of loading to the point of off-loading as per Section A1.7 of Chapter 1.

The tendered rates for each item shall also include full compensation for all labour, construction plant, equipment and incidentals required to carry out the construction of the roadbed as specified.

Item	Description	Unit
C5.1.11	Construction of roadbed comprising a pioneer layer	cubic metre (m³)

The unit of measurement shall be a cubic metre of pioneer layer material constructed in the authorised areas specified in the Contract Documentation or as instructed by the Engineer.

The compacted volume of the pioneer layer of material shall be taken as equal to 70 % of the loose volume of material in the hauling vehicles.

The tendered rate for the construction of the roadbed treatment using a pioneer layer over water-logged or soft clayey ground as per the Contract Documentation shall include full compensation for all labour, construction plant, equipment and incidentals required to carry out the construction of the roadbed using a pioneer layer as specified.

The loading and hauling of compliant pioneer material for the roadbed construction is measured and paid for as specified in Section A1.7 of Chapter 1.

The production of the compliant pioneer material is measured and paid for under Sections C4.1 and/or C4.2 of Chapter 4.

Item	Description	Unit
C5.1.12	Excavation for benches	
C5.1.12.1	Excavation for benches	
(a)	Side-cut to fill in soft material	cubic metre (m ³)
(b)	Side-cut to spoil in soft material	cubic metre (m ³)
C5.1.12.2	Excavation for benches using labour enhancement	
(a)	Side-cut to fill	
(i)	Soft material	cubic metre (m ³)
(ii)	Intermediate material	cubic metre (m ³)
(b)	Side-cut to spoil	
(i)	Soft material	cubic metre (m ³)
(ii)	Intermediate material	cubic metre (m ³)

The unit of measurement shall be the cubic metre of material measured in its original position in cut and computed by the method of average end areas from levelled cross-sections taken as specified. The cross-sections shall be taken prior to excavating the cut for the benches.

Excavations shall be done using conventional construction and/or labour enhancement as specified and measured.

The tendered rates for excavating of benches under item C5.1.12.1 shall include full compensation for excavating from the road prism and roadbed in the class of excavation indicated. The rate shall also include full compensation for moving, by bull-dozers or excavating and loading the fill material a maximum of 1,0 km into its final location in the fill or for excavation, loading, off-loading and disposing of the spoil material at designated spoil sites up to a maximum of 1.0km, as instructed by the Engineer, including shaping and levelling-off any piles of spoil material.

The tendered rates for excavating of benches under item C5.1.12.2 using labour enhancement, shall include full compensation for excavating from the road prism and roadbed in the class of excavation indicated, loading the fill material, off-loading and disposing of the spoil material at designated spoil sites, as instructed by the Engineer, including shaping and levelling-off any piles of spoil material. The tendered rates shall include wheelbarrow transport over a haul distance of 100 m.

Hauling beyond 1,0 km when using conventional construction plant and 100 m using labour enhancement, shall be measured and paid for under Section C1.7 of Chapter 1.

Construction of the fill is measured and paid for under Section C5.2.

Construction of the cut, exposed benched area, shall be measured and paid under the appropriate item in Section C5.1.

For payment purposes a distinction shall be made between materials as classified above.

Item	Description	Unit
C5.1.13	Construction of a levelling layer	
C5.1.13.1	Over roadbed treatment in hard material compacted to 90 % MDD	cubic metre (m ³)
C5.1.13.2	Over a constructed pioneer layer compacted to 90 % MDD	cubic metre (m ³)

The unit of measurement shall be the cubic metre of material measured in its final position and computed by the method of average end areas from levelled cross-sections taken as specified. The cross-sections shall be taken prior to the importation of the levelling layer and after completion of the levelling layer.

When measurement by cross-sections is considered impractical the Contract Documentation may specify that the volume of the levelling layer can be computed as 70 % of the loose volume in the haul trucks.

The tendered rates shall include full compensation for the construction of the levelling layer of varying thickness, with an average thickness of 200 mm and shall also include for all labour, construction plant, equipment and incidentals required to carry out the construction of the roadbed using a levelling layer as specified as well as compaction to the specified MDD.

The production of the compliant levelling layer material is measured and paid for under Sections C4.1 and/or C4.2 of Chapter 4.

Loading and hauling of the compliant material for the levelling layer is measured and paid for in Section C1.7 of Chapter 1 and is measured from the point of loading to the point of off-loading as per Section A1.7 of Chapter 1.

5.2 FILL

CONTENTS

PART A: SPECIFICATIONS

- A5.2.1 SCOPE
- A5.2.2 DEFINITIONS
- A5.2.3 GENERAL
- A5.2.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS
- A5.2.5 MATERIALS
- A5.2.6 CONSTRUCTION EQUIPMENT
- A5.2.7 EXECUTION OF THE WORKS
- A5.2.8 WORKMANSHIP

PART B: LABOUR ENHANCEMENT

PART C: MEASUREMENT AND PAYMENT

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

A5.2 FILL PART A: SPECIFICATIONS

A5.2.1 SCOPE

This Section covers the work requirements for off-loading and the subsequent processing of compliant fill material.

The work requirement for loading and hauling the fill material is specified in Section A1.7 of Chapter 1.

The fill material is produced as specified in the relevant Sections of Chapter 4.

A5.2.2 DEFINITIONS

The relevant definitions in the standard specifications are applicable. Additional definitions for this Section are included here.

Haul material - any construction material that is hauled between the point of loading, or the point of collection and the point of off-loading. Construction material may include all borrow, cut and reclaimed materials produced as specified in Sections A4.1, A4.2 and A4.3 of Chapter 4 and all spoil, and unsuitable material. Material obtained from commercial sources or from alternative sources, as specified in Sections A4.4 and A4.5 of Chapter 4, shall not be classified as haul material.

A5.2.3 GENERAL

A5.2.3.1 Fill dimensions and shape

The dimensions of fills shall be in accordance with the road design reflected in the typical cross-sections and other details contained in the Contract Documentation.

The Contract Documentation shall contain relevant details regarding the following:

- the required slope/batter of each fill,
- geometric layout details of each fill at interchanges and intersections,
- the proposed use of material for each fill,
- the method and classification of compaction for the fills as per Clause A5.2.3.4.
- any physical restrictions or material conditions that may affect the construction of the fill, and
- the proposed sequence of fill construction along the length of the project.

During compaction, the fill layer shall be maintained to the required shape and cross-section.

The compacted fill layers shall be adequately drained and shaped to prevent water from standing on the fill layers or scouring the completed work.

A5.2.3.2 Fill adjacent to existing fill

Where existing fills are widened, or where new fills are to be constructed adjacent to existing fills such as to construct an additional carriageway along with a median, the existing fill side slopes shall be benched in accordance with the details provided in the Contract Documentation.

A5.2.3.3 Fill layer thickness

The layer thickness used for the construction of the fills is dictated by the type and grading of the fill material and the compaction equipment being used. Fill layer thicknesses specified in the Contract Documentation are based on the expected material type and on the use of typical compaction equipment.

Fill layers shall be placed in successive layers at the same slopes and cross-fall as the final road surface. The construction of wedge-shaped fill layers shall be restricted to the bottom layers of high fills where this may be unavoidable due to changes in the road cross fall and super elevation or where the tapering out of the fill occurs. Benching shall be carried in terms of the specification in Clause A5.2.7.3 to avoid wedge-shaped fill layers. Where a new fill layer is constructed on an existing or already constructed fill and the new layer will be less than 100 mm in compacted thickness, the existing fill shall be scarified to such a depth as will give a compacted layer thickness of not less than 150 mm of the new plus scarified material together.

During the initial construction of fill layers or of a trial fill section, if so instructed by the Engineer, the Contractor shall confirm the construction layer thicknesses and the type of compaction equipment to be employed and shall then submit the method of compaction to the Engineer for review and acceptance.

The compacted fill thickness shall be as follows for the different types of compliant fill material used unless specified otherwise in the Contract Documentation or instructed by the Engineer after reviewing the Contractor's compaction process and equipment. **a) Sand**

Sand fill material may be compacted in layer thicknesses not exceeding 400 mm subject to the construction of a compliant trial section. The trial section shall be constructed as part of the fill, at no additional cost to the Employer other than the cost of the actual constructed fill. **b) Normal fill**

Normal fill material shall be compacted in layers not exceeding 200 mm after compaction. **c)**

Coarse fill

Coarse fill shall be compacted in layers not exceeding 500 mm after compaction. **d)**

Rock fill

The maximum compacted thickness of a rock fill layer shall not exceed 750 mm.

A5.2.3.4 Fill compaction classification

The classification of material as hard material or intermediate material in the case of labour enhancement, to compensate the Contractor for the cost of excavation thereof, shall not be taken into consideration for any additional compensation in respect of the classification of the same material when used in the compacted fill.

The method of processing and compacting the fill material shall be classified as specified hereafter. **a)**

MDD compaction

Wherever a density requirement in respect of a fill layer is specified in the Contract Documentation in terms of a percentage of MDD, the Contractor may employ any type of compaction equipment to achieve such density over the full, as-specified, depth of the layer. The compaction equipment employed shall be adequate and suitable for the purpose and shall not create lamination layers or shear cracks.

The Contractor shall restrict the size of the compaction equipment being used, if necessary, in order to ensure that no part of the already completed works, any underlying structures, adjacent buildings or underground services are damaged during the compaction process.

(i) Sand fill

Sand fill material with properties as specified in Clause A4.1.5.4 of Chapter 4 shall be subject to a minimum percentage compaction of MDD. This sand shall be compacted to 100 % of MDD, unless specified otherwise in the Contract Documentation.

Notwithstanding this compaction criteria, the compactability of the sand fill material shall be assessed and then confirmed by means of the construction of an appropriate trial section or trial sections. The Contractor's selected compaction process shall form part of the submitted Management and Utilisation (M&U) plan.

(ii) Normal fill and coarse fill

Normal fill and coarse fill material shall both be subject to a minimum percentage compaction of MDD. The compaction density shall normally be either 90 % of MDD or 93 % of MDD as specified in the Contract Documentation.

(iii) Fill widening

Unless specified otherwise in the Contract Documentation the fill material placed in a fill widening shall be benched as specified in Clause A5.2.7.3 and compacted to 93 % MDD irrespective of the depth of the embankment fill, to avoid or minimise differential settlement.

Where it is not possible to achieve 93 % MDD at the roadbed level, the Engineer shall instruct alternative roadbed compaction or treatment.

(iv) Roller-pass compaction

When the bottom layer of a fill is compacted on top of soft or marshy ground, over a synthetic fibre membrane, the compaction shall be carried out by roller-pass compaction in accordance with Section A5.1.

When the nature of the fill material is such that the degree of compaction cannot be satisfactorily controlled by testing the compaction density, such as for a coarse fill or for a rock-fill, the compaction shall be carried out by roller-pass compaction in accordance with Section A5.1.

The number of roller-passes, the combination of compaction equipment required and the fill layer thickness shall be confirmed by means of the construction of a trial section in each case.

A5.2.5 MATERIALS

A5.2.5.1 Material specification

The material specifications for use in the construction of fills are given in Section A4.1 of Chapter 4 in the following clauses:

- Clause A 4.1.2 Definitions for Sand fill, Normal fill, Coarse fill and Rock fill material under sub-heading Fill layers

- Clause A4.1.5.4 Sand, normal and coarse fill material in the earthworks
- Clause A4.1.5.5 Rock fill material in the earthworks layers
- Clause A4.1.5.9 Sand in fill and pavement layers of sealed low volume roads
- Clause A4.1.5.13 Drainage layer material

Material excavated for the construction of infrastructure such as open drains, subsoil drains, culverts, bridge foundations and other structures, shall, if compliant and instructed by the Engineer, be used for the construction of fills.

A5.2.5.2 Use of fill material

The different types of fill material that can be used as fill material are defined in Clause A4.1.2 of Chapter 4. The specific use of each type of fill material is specified hereafter:

- Only normal fill material shall be used at a depth less than 150 mm below the top of the fill, unless specified otherwise.
- Only normal fill or coarse fill shall be used to construct a fill widening unless specified otherwise.
- Coarse fill material shall only be used up to a depth of 150 mm below the top of fill, unless specified otherwise.
- Rock fill material shall only be used up to a depth of 300 mm below the top of fill, unless specified otherwise.
- The fill material to be used in high fills as per Clause A5.2.7.9 shall be specified in the Contract Documentation.

A5.2.5.3 Unsuitable fill material

When the Contractor renders compliant fill material unsuitable for use due to inappropriate handling and/or processing methods, then such material shall be removed from the road and disposed of at a designated spoil site at no cost to the Employer. The replacement of the non-compliant fill material shall also be at no cost to the Employer.

Where there is a nett surplus of cut material for use as fill, the Contractor may be reimbursed for the removal to spoil of the now non-compliant material as if taken directly from the cut. A surplus of cut material for fill implies that the surplus has to be disposed of in any event. The Contractor shall not be reimbursed for any costs for the replacement of the material, irrespective of the source of the replacement material.

All unsuitable fill material, whether designated unsuitable in the Contract Documentation or rendered unsuitable by the Contractor, must be broken down sufficiently for convenient loading and transporting to the designated spoil area. Sufficient material shall be broken down to a maximum size of 500 mm with a view to effectively trimming the designated spoil areas.

A5.2.5.4 Wet fill material

The Contractor shall take measures to prevent fill material on the road becoming excessively wet as a result of rain, groundwater or storm run-off water. These measures shall form part of the Management and Utilisation (M&U) plan.

When these measures to keep the material dry and/or to dry it out have been taken and it remains too wet, the Engineer shall declare the material to be unsuitable. If the material declared unsuitable has already been placed on the road, the Engineer shall instruct that it be removed and replaced with alternative compliant material at no cost to the Employer.

A5.2.6 CONSTRUCTION EQUIPMENT

Construction equipment to carry out the construction of fill efficiently shall comply with the requirements of Clause A1.2.6 of Chapter 1.

A5.2.7 EXECUTION OF THE WORKS

A5.2.7.1 Compaction of fill material

Material used for the construction of a fill layer, from borrowpits or from cuttings, shall be prepared and used as set out in Clauses A4.1.7 and A4.2.7 of Chapter 4 respectively, during the excavation, placement and compaction thereof.

After fill material in borrow pits and cuttings has been broken down to the maximum size specified in Clauses A4.1.7 and A4.2.7 of Chapter 4 and then spread on the road, the oversize in excess of 5 % by volume shall be further broken down by means of suitable equipment such as a grid roller or a pad-foot roller.

In many cases breaking down oversize material by the normal compaction process may prove adequate, and no special effort should be necessary for breaking down the material, but, in the case of hard material, the engineer may require that the material be broken down by light grid-rolling. The degree to which the breaking down occurs shall then serve as the norm for what may be required with regard to alternative breaking down methods. For the purposes of these specifications light grid-rolling is defined as follows:

- The material shall be spread in a layer, the uncompacted thickness of which shall be approximately the average maximum fragment size, but with a minimum uncompacted thickness of 200 mm. It shall then be rolled by means of at least two complete roller-passes per 200 mm uncompacted layer thickness, by a grid roller with a mass of not less than 13,5 tons, travelling at a speed of at least 12 km/h whether towed or self-propelled. Should the uncompacted layer thickness be in excess of 200 mm, the roller-passes shall be increased pro rata.

Compensation for the light grid-rolling process to break down oversize material shall be regarded as being included in the pay item for providing, processing and compacting the material. Even when fill material is instructed to be compacted by means of a certain number of roller-passes, the two passes for breaking down the material will not be measured for payment.

Material that contains in excess of 5 % by volume of oversize material shall not be hauled to the road for use in sidewalks and in shoulder widenings.

Where any fill material contains less than 5 % by volume of oversize material, the oversize material shall be broken down by means of appropriate compaction equipment such as a grid roller or a pad-foot roller, or shall be bladed out of the layer or be removed from the layer by hand.

Compaction shall be carried out in a series of continuous operations covering the full width of the layer concerned. The length of any section of a layer being compacted shall normally not be less than 150 m nor more than what can be properly compacted during the available working period with the available equipment. The Contractor shall reduce the length of any fill layer compacted in any single operation if the specified compaction of such a layer is not being achieved.

The types and/or combination of compaction equipment to be used and the amount of rolling to be done shall be such as to ensure that specified densities or the required number of roller-passes are obtained without damage being done to the lower fill layers or underlying structures.

All holes, depressions or ruts shall be filled with compacted material and any lamination layers that may develop in the layer shall be removed or processed again to a minimum compacted depth of 150 mm.

A5.2.7.2 Fill drainage and protection

a) Road prism drainage

During fill construction, the road prism shall be kept well-drained and protected at all times by the Contractor.

The Contractor shall construct all permanent drains as soon as possible, as well as sufficient additional temporary drains as may be necessary to protect the road prism.

The provision of temporary drainage works shall include providing open channels, cut-off banks and the provision of and operation of temporary pumps and such other equipment as may be necessary for adequately protecting, draining and dewatering the works and the temporary works. This temporary provision will be in addition to any permanent drainage works specified and installed, and in addition to any temporary drainage works specifically paid for separately as in the case of diversions.

Throughout the construction of the works these permanent and temporary drainage provisions shall be maintained in good working order. **b) Fill layers drainage**

Material spread over the road shall be spread with a cross slope at or greater than the slope of the final road surface and, if not directly compacted, it shall receive at least one complete roller-pass compaction with a flat-wheel roller in order to allow the water to run off rather than penetrate the uncompacted spread material. Precautions shall be taken to ensure that water does not dam up against material heaps, windrows, or any spread material or collect in low spots where it can form a pond and soak into the completed fill material.

Where fill material, despite proper precautionary measures, on account of its in-situ moisture content, is too wet to comply with the requirements with regard to moisture content during compaction, the Contractor shall dry out the material until it is suitable for compaction. Where wet in-situ conditions exist the Contractor shall, where possible, plan the construction programme so that material with a high natural moisture content will be excavated, placed and compacted during the dry season and not in the wet season.

The Contractor shall decide on the best method to dry wet material.

c) Fill protection

All completed fill layer work shall be protected and maintained until the following layer is constructed. Maintenance shall include immediate repairs to any damage or defects which may occur and shall be repeated as often as may be necessary to keep the layer continuously intact and in a good condition.

Ruts and potholes developing in the fills after completion shall be repaired, and damaged portions of the fills shall be reshaped and re-compacted at no cost to the Employer. Material shall not be spread on a constructed fill layer that is above its optimum compaction moisture content which can result in damage being caused to the layer during compaction of a subsequent layer.

All windrows shall be cut away or removed immediately after construction work to prevent the concentrated flow of water on completed fill layers. Cut-off berms or banks shall be constructed when and where required to prevent the erosion of fill slopes.

All cut and fill slopes shall be maintained by the Contractor until the road has been certified as being finally completed. All erosion and flood damage to slopes shall be promptly repaired.

Side drains discharging water from cuts and all other drains shall be so constructed as to avoid damage to the fills by erosion during the period before completion of the construction of the final drainage design.

A5.2.7.3 Benching for fill construction

Where the natural cross fall of the treated roadbed exceeds 1 vertical to 10 horizontal (1:10), the new fill shall be bonded to the roadbed by construction of benches.

The dimensions of the benches shall be as detailed in the Contract Documentation. The excavated material to create the benches shall be used directly for the construction of fill or taken to spoil as per the details in the Contract Documentation or as instructed by the Engineer.

The depth and width of benches cut into hard material may normally be smaller than those in soft material. Where benches are cut into hard material, the toe of the fill shall preferably also be constructed from rock material, and the benches shall be at least as deep as the largest rocks or boulders in the fill material. Benches in hard material shall be excavated to slope slightly inwards and the benched floor must have a broken and roughened or serrated surface so as to obtain a good bond between the surface of the bench and the fill material compacted on top of it.

The benches may be constructed in accord with Method A or Method B. The benching per Method A does not extend beyond the extremity of the road prism. The benching per Method B extends beyond the extremity of the road prism. All suitable and excess material obtained from the excavations for benching shall, in so far as is possible, be re-used for constructing the fills. **a) Method A**

This method requires the cut of the first bench in the roadbed to be of adequate width to accommodate normal-width self-propelled construction equipment. The widths of successive benches shall be determined by the width of the fill at the elevation of the next bench.

The width of benches shall decrease gradually up to the stage where the fills in any case are wide enough for accommodating normal-width selfpropelled construction equipment.

b) Method B

This method does not require the benching at the toe of the fill to be cut back adequately for accommodating normal-width construction equipment. The bench width shall be less than the normal-width for construction equipment and requires the fills then constructed to be so much wider (beyond the toe of the fill) as may be necessary for accommodating such equipment up to the height where the fill is sufficiently wide for construction equipment.

The Contract Documentation shall detail the width of the lowest bench to be cut beneath the new fill and the entire benching detail.

The position of the narrow first bench at the toe of the fill shall be accurately set out.

In the case of Method B benching construction, the Engineer may instruct that any excess width constructed adjacent to the toe of the fill should be removed to fill.

A5.2.7.4 Widening of fills

Where existing fills are to be widened, the fill slopes and the roadbed onto which the new fills are to be constructed shall be cleared and grubbed, as detailed in the Contract Documentation.

Where existing fills, or fills already constructed under the current project, are required to be widened or flattened, it shall be done by way of bench construction in accord with Clause A5.2.7.3 and as per the details in the Contract Documentation. The Contractor shall submit proposals for each fill widening or fill flattening less than 10 000 m³ not already included in the M&U plan, to the Engineer, for review before proceeding with such work.

Benches of not more than 500 mm vertical depth shall be cut into an existing fill. In the case of fills of less than 1.0 m height, and in the upper metre of any fill, the benches shall have a vertical depth equal to the actual individual fill layer thickness specified for constructing the widening. When the side slope of the existing fill contains any uncompacted material, the benches shall extend 'sideways' in a horizontal plane for a distance of at least 1m into the properly compacted portion of the original fill material or as per the details specified in the Contract Documentation.

All suitable material derived from cutting the benches shall be used in the construction of the widened section of the fill. Unsuitable material shall be removed to a designated spoil site as instructed by the Engineer or as per the Contract Documentation. Benches shall be compacted at the same time as the fill widening during the construction of the fill.

Where the existing fill consists of normal fill or coarse fill the widened section shall consist of normal fill or coarse fill respectively unless specified differently in the Contract Documentation.

A5.2.8 WORKMANSHIP

A5.2.8.1 Inspection of the works

The Engineer shall do routine inspections and conduct routine tests to determine whether the quality of material and workmanship provided, complies with the requirements of the Contract Documentation.

The Engineer shall do specific inspections of completed layers prior to the next layer being imported and specifically to determine whether the layer is still intact and after a rainfall to determine whether the layer has become saturated due to poor provision for temporary drainage.

A5.2.8.2 Material quality and compaction requirements

The quality of fill materials shall comply with the requirements of Chapter 4 prior to the material being transported to the site.

The compaction of fill materials shall comply with the requirements specified in Clause A5.2.3.4 and summarised in Table A5.2.8-1.

Table A5.2.8-1: Summary of material requirements and layer thickness

Material description or use	Type of compaction	Individual layer thickness (t)	Compaction (% of MDD)
Sand Fill	MDD	$t < 400 \text{ mm}$	100 % as per Clause A5.2.3.4
Normal fill	MDD	$t < 200 \text{ mm}$	90 % or 93 % as per the Contract documentation
Coarse fill	MDD	$t < 500 \text{ mm}$	90 % or 93 % as per the Contract Documentation
Rock fill	Formula	$T < 750 \text{ mm}$	Formula as per Clause A5.2.7.6
Fill widening (only normal or coarse fill material to be used)	MDD	$200 \text{ mm} < t < 500 \text{ mm}$	93 % for entire height of fill
Fill over soft or marshy terrain using compliant fill material as instructed by the Engineer	Roller-pass	Determine by trial section	Determine number of roller-passes by trial section

The in-situ measured density of the fill layer being tested complies with the compaction requirements when the results of at least 75 % of the insitu density tests of any lot, located as per the Contract Documentation, are equal to or exceed the specified value and no single density is more than 3 percentage points below the specified value.

Fill materials treated by providing roller-pass compaction shall be compliant when the agreed number of passes as determined during the construction of a trial section, or as specified in the Contract Documentation, or as instructed by the Engineer have been observed and recorded as being the correct quantity.

A5.2.8.3 Construction tolerances

The work specified in this Section shall be constructed to the following dimensional tolerances. **a)**

Levels

The level tolerances shall be as follows for fill, but shall apply only to the top layer of the fill:

$$H_{90} = \pm 25 \text{ mm}$$

$$H_{\text{max}} = \pm 35 \text{ mm}$$

b) Width

(i) Normal fill and coarse fill

The horizontal measurement taken from the centre line of the road to the side of the fill, shall nowhere be 125 mm less or 250 mm more than the specified dimension when measured at any level.

(ii) Rock fill

The horizontal measurement taken from the centre line of the road to the side of the fill, shall nowhere be 250 mm less or 1 000 mm more than the specified dimension when measured at any elevation. **c) Fill batters or slopes**

The construction tolerances specified in Clause A5.2.7.13b) shall be complied with.

5.3 ROAD PAVEMENT LAYERS

A5.3 ROAD PAVEMENT LAYERS PART A: SPECIFICATIONS

A5.3.1 SCOPE

This Section covers the work requirements for loading at the point of supply, the hauling and off-loading at the point of use, the spreading, mixing, watering and levelling and the compaction and finishing of pavement layer material required for the construction of the road pavement layers.

This Section also covers the work requirements for the loading of pavement layer material at the point of supply, the haulage to a central mixing plant to add and mix water and stabilising agent with the pavement material, hauling the mixed material to a paver at the point of use and then the construction of the pavement layer by paving, compacting and finishing the layer. This operation is known as plant-mixed, paver-laid (PMPL) pavement layer construction.

Material for the road pavement layers is produced as specified in the relevant Sections of Chapter 4.

The addition and mixing of stabilising agents either as an integral part of the PMPL process or for some of the conventionally placed road pavement layers that require treatment and/or stabilisation is specified in Section A5.4.

The reconstruction of existing road pavement layers is specified in Section A5.5.

A5.3.2 DEFINITIONS

The relevant definitions elsewhere in the standard specification are applicable. Additional definitions for this Section are included here.

Single-operation - a single-operation is the amount of work that can normally be carried out during the course of a single work shift using the applicable construction equipment.

A5.3.3 GENERAL

A5.3.3.1 Sources of material

The sourcing of material shall take place as specified in Chapter 4.

Material shall be obtained from approved sources such as borrow areas, cuts, stockpiles or reclaimed road materials from existing road pavement layers. Reclaimed road material shall be processed as specified in Section A4.3 of Chapter 4 to produce a material compliant with the material properties specified in Chapter 4 for the particular intended use of the material, as specified in the Contract Documentation.

Material may also be obtained from compliant commercial and alternative material sources as detailed in the Contract Documentation.

Crushed stone material shall be obtained from approved sources such as quarries, commercial sources and approved cuttings.

A5.3.3.2 Use of material

The Contract Documentation shall detail the proposed layers for which the different materials are suitable, including the proposed use of commercial materials and alternative materials.

Notwithstanding the proposed use of the various sources of materials given in the contract document the Contractor shall ensure that all material used for the pavement layers complies with the relevant material quality as specified in Chapter 4.

A5.3.3.3 Requirements prior to the construction of any pavement layer

The first pavement layer shall not be constructed until the following construction work has been completed:

- Construction of the fill must be completed;
- Construction of the cut must be completed;
- Construction of the roadbed through a cutting in soft or hard material, must be completed;
- All over-built material on fill slopes must be removed.

The finishing of cutting slopes shall be completed prior to the construction of a subbase layer.

Before any material for a pavement layer is off-loaded onto the road for the subsequent construction of that pavement layer, the Contractor shall obtain approval of the underlying layer from the Engineer. Immediately prior to off-loading any pavement material onto the underlying layer the Contractor shall recheck the underlying layer to establish whether there is any localised damage or localised defects in the underlying layer, and if so, these shall first be rectified. Wet spots in the underlying layer are dealt with as specified in Clause A5.3.3.8.

A pavement layer shall only be constructed once the underlying layer meets all the specified requirements and has been approved.

In a new cutting, or in a completed box cut, the underlying floor layer needs to be processed and constructed as roadbed preparation. The specific roadbed preparation shall be as specified in the Contract Documentation or as instructed by the Engineer and shall take place as specified in Section 5.1. This roadbed preparation shall be constructed before the construction of the first pavement layer takes place on the constructed and approved roadbed preparation.

Where the in-situ material properties prove to be compliant with those for the first selected layer, the Contract Documentation or the Engineer may specify that the in-situ material shall be processed and constructed as per the requirements for a selected layer without any prior roadbed preparation being required.

A5.3.3.4 Compaction of pavement layer material

All material used for the construction of pavement layers shall be mixed with water to the required compaction moisture content prior to being processed and compacted to the specified thickness, level and density. The material shall be compliant with the material requirements for each specific layer.

Compaction shall be carried out in a series of continuous processing and compacting operations covering the full width of the layer concerned. The length of any section of a layer being compacted shall not be more than what can be properly compacted with the available equipment in a single-operation or shorter period when specified in the Contract Documentation.

The Contractor shall reduce the length of any layer compacted in any single-operation, and/or change the compaction process and/or change the number of, or type of, equipment being used, if the specified thickness, level or density of the layer is not being achieved.

The type of compaction equipment used and the amount of rolling done shall be such as to ensure that the specified density, or the specified number of roller-passes, is obtained without damage being done to any of the underlying layers due to breakdown or settlement of the underlying layer.

The compacted layer shall be completed to the required density, thickness, levels, shape and cross-section specified in the Contract Documentation and within the tolerances specified in this Section. All oversize material, lamination layers and any excess material shall be removed from the compacted surface before any further pavement layers or surfacing is carried out.

A5.3.3.5 Existing or newly constructed infrastructure

During the construction of pavement layers, all existing or newly constructed drainage infrastructure such as concrete edging, kerbing and channelling, sidewalks, lined drains, manhole covers, kerb inlets and gratings shall not be displaced or damaged.

Furthermore, no damage shall be caused to any existing or newly constructed structures such as culverts, bridges and buildings or any roadside furniture such as road signs, guardrails, streetlights, fencing, service pipes and cables during the construction of pavement layers.

Where necessary small hand-operated compaction equipment shall be used to ensure that the specified compaction is achieved immediately adjacent to drainage infrastructure, structures and roadside furniture.

Any items damaged during construction shall be replaced or repaired immediately by the Contractor, at no cost to the Employer.

A5.3.3.6 Tie-ins at existing bituminous surfaces

At junctions with existing bituminous surfaces, the existing surfacing and layer work near the tie-in shall be cut back in a neat, straight line so as to ensure that the compacted thickness of the new base layer all the way up to the tie-in point, is not less than 150 mm.

A5.3.3.7 Joints between pavement layers

a) Location of joints

Pavement construction joints, or overnight stops, in each successive layer of the pavement, shall be staggered and never be directly above the construction joint in the underlying layer.

The final manifestation of a longitudinal joint in the asphalt surfacing shall coincide with a road marking line (lane or shoulder) or with the middle of a traffic lane as detailed in the Contract Documentation. Under no circumstances shall the longitudinal joint in the pavement base layer or in the asphalt layer be located along a traffic wheel path.

Longitudinally, the joint between new and existing asphalt surfacing layers shall be off-set at least 100 mm from the longitudinal construction joint between the pavement base layers.

Transversely, the joint between new and existing asphalt surfacing layers shall be off-set at least 500 mm from the transverse construction joint between the pavement base layers.

b) Longitudinal joints

A longitudinal joint shall be formed between existing pavement layers that are to remain intact and the adjacent widened pavement layers or the adjacent pavement layers to be reconstructed.

The construction of longitudinal joints shall commence with a saw-cut through the existing surfacing and through each bound layer (G1 and/or G2), any stabilised layer to the depth as detailed in the Contract Documentation. After each layer has been saw-cut, the layer material on the widening side of the saw-cut or on the reconstruction side of the saw-cut, shall be removed to sufficiently expose the layer below so that the next saw-cut through the bound or stabilised layer beneath can be made. The position of the next saw-cut shall be at least 150 mm away from the first saw-cut, and further away from the pavement layers that are to remain intact. This procedure shall be repeated until all the layers to be removed have been saw-cut.

Ultimately the longitudinal joint shall comprise a series of steps that are 150 mm wide and vertically the depth of each layer unless specified otherwise in the Contract Documentation. The saw-cut prevents adjacent intact layers from being damaged during the material processing or reconstruction and prevents a longitudinal crack developing immediately above the widening or reprocessing location. **c) Transverse joints**

A transverse joint is required between pavement layers when the road pavement length is extended or between two new sections of pavement layer construction. A transverse joint so formed shall be perpendicular to the road centreline and the step width shall be 500 mm per reconstructed layer. The number of 500 mm wide steps cut into the existing road pavement layers or between two new sections will be the same as the number of constructed pavement layers unless specified otherwise in the Contract Documentation.

When upper pavement layers are bladed or milled to windrow or taken to stockpile in order to expose the underlying layer that requires reconstruction, a transverse joint shall be constructed in the same manner as specified for the longitudinal joints, with each step being 500 mm wide per layer that is reconstructed or extended. The process of stepping back by 500 mm, doing the saw-cut and trimming up to the saw-cut, ahead of the next layer, shall continue until the base layer has been constructed.

Where use of a recycler is made to reconstruct a pavement layer in-situ, the transverse joint may be constructed using the recycler, without the use of saw-cutting equipment, as instructed by the Engineer or as specified in the Contract Documentation.

A5.3.3.8 Pavement layer drainage

Each compacted and completed pavement layer shall be adequately drained to prevent water from standing on or along the completed work. Windrows shall be removed immediately after construction to facilitate the drainage of water off the surface and to prevent scouring of the completed work. On steep grades the Contractor may need to provide temporary berms to divert the water off the road surface at regular intervals.

No material for a subsequent layer may be placed if the underlying pavement layer has been softened by moisture. The underlying pavement layer must first be allowed to dry out until the moisture content in the layer is below the optimum compaction moisture content. Any scouring of the pavement layer surface caused by storm water shall be repaired and the repairs approved by the Engineer before any material for the subsequent layer is placed.

If the underlying pavement layer cannot be adequately dried out or the water related damage cannot be satisfactorily repaired the affected layer shall be broken up and reprocessed at no cost to the Employer.

Where pavement layers are replaced over a section of the road width, or where pavement layers are widened and the permeability of the new layer is not the same as the adjacent existing layer, then subsoil drainage shall be installed along and below this interface as detailed and specified in the Contract Documentation.

A5.3.3.9 Pavement layer protection and maintenance

The Contractor shall protect and maintain the completed pavement layers at no cost to the Employer until the next layer or the surfacing has been constructed and thereafter until the works have been taken over by the Employer.

Maintenance shall include the closing off of the constructed pavement layers to all public traffic (except traffic for property access along the route by owners/tenants) and construction traffic except the vehicles hauling in the next layer of construction material and the immediate repair of any damage done to the layer or of any defects in the layer. Repairs shall be carried out as instructed by the Engineer. The Contractor shall ensure that an even and uniform surface is restored after completion of the repair work.

The base layer shall be primed as soon after construction as possible once the base layer has dried out sufficiently to a point where the moisture content, measured at any depth within the base layer, is below 50 % of the optimum moisture content for the material. No public or construction traffic shall be permitted on the completed base layer either before priming the layer or on the primed layer.

A5.3.3.10 Bound macadam (BM) layer protection and maintenance

The Contractor shall protect and maintain the completed bound macadam (BM) layer at no cost to the Employer until the next layer or the surfacing has been constructed and thereafter until the works have been taken over by the Employer. Maintenance shall include the immediate repair of any damage to the layer or of defects in the BM layer and shall be repeated as often as necessary. Repairs shall be carried out so as to ensure that an even and uniform surface is restored after completion of the repair work.

No public traffic (except traffic for property access along the route by owners/tenants) or construction traffic other than the prime distributor and the surfacing equipment shall be allowed on any completed BM layer.

A5.3.3.11 Water for pavement layers

Water for the construction of pavement layers shall comply with the requirements of Clause A4.1.5.18 of Chapter 4.

A5.3.3.12 Contractor prepared plans for the construction of pavement layers

The Contractor shall prepare and submit a management and utilization (M&U) plan for the construction of each individual pavement layer to ensure that it is worked in a sustainable and sensitive manner, that the environmental impact is minimised, material use and haulage are optimised and that costs are minimised.

The M&U plan shall at least take cognizance of the following and provide detail of the following as appropriate:

- The survey methods to be used to set out and control the levels and width of the pavement layers for each layer,
- A method statement and programme for the construction of each of the pavement layers from loading at the source of supply up to the completion of each layer,
- Risk assessment for ensuring the material can be taken to and used directly on the road to minimize any additional stockpiling on site,
- A method statement of how the pavement layers material will be prevented from sustaining storm water damage and from becoming excessively wet,
- A method statement for the construction of trial sections where specified or where requested by the Contractor and especially for stabilised layers, crushed stone layers and macadam layers,
- A method statement of how oversize material will be dealt with,
- A method statement of how work will be carried out in restricted areas,
- Measures to comply with the general and specific conditions of the road environmental management plan,
- Measures to comply with safety regulations and obligations in terms of the relevant Health and Safety Acts and Regulations,,
- The full quality and process control testing detail for the applicable materials tests along with the frequency and quantity of such testing for each constructed section of each layer type to ensure full compliance of the constructed layer in terms of compaction density and material quality,
- The full quality and process control testing, frequency and quantity of tests, for stabilised layers, visually and tests in the laboratory, and
- Procedures for regular monitoring, auditing and reporting.

M&U plans need to be submitted during the course of construction. The Contractor's construction programme shall set out by when each M&U plan will be submitted for review. The construction of a particular layer shall only commence once the Contractor's M-&U plan for that layer has been reviewed and accepted by the Engineer. The Engineer shall respond within one week after receiving an M&U plan.

A5.3.4 DESIGN BY THE CONTRACTOR/PERFORMANCE BASED SYSTEMS

The Contractor shall be permitted to submit an alternative pavement design as part of a performance based system.

A5.3.4.1 Catalogue pavement design

An alternative pavement design based on approved catalogue designs may be submitted when the average annual daily traffic (AADT) is less than 5 000. A 15-year pavement design life shall be required.

A5.3.4.2 Mechanistic pavement design

An alternative pavement design based on a mechanistic design process, may be submitted when the project details meet the following criteria; **a)**

AADT between 5 000 and 50 000

A 20-year pavement design life is required, and a full Life Cycle Cost Analysis shall be required for the alternative pavement design. **b)**

AADT in excess of 50 000

A 25-year pavement design life is required, and a full Life Cycle Cost Analysis shall be required for the alternative pavement design.

A5.3.4.3 Other pavement design methods

An alternative pavement design may also be submitted, based on other accepted pavement design methods such as AASHTO, DCP, Empirical or any other, when the project details meet the criteria of Clause A5.3.4.2.

A5.3.5 MATERIALS

A5.3.5.1 Material information

The required material properties for each individual pavement layer for a specific pavement design shall be clearly specified in the Contract Documentation.

The Contract Documentation shall specify which types of materials are to be used for a PMPL layer.

Any anticipated mechanical modification of material shall be stated in the Contract Documentation.

A5.3.5.2 Pavement layer thickness and compaction requirements

a) Pavement layer thickness requirements

The compacted pavement layer thickness shall be as specified in the Contract Documentation.

The thickness tolerances specified in Clause A5.3.8.4b) shall apply.

b) Gravel and soil pavement layer compaction requirements (G4B to G9 material)

The minimum compacted dry density of a gravel or soil pavement layer shall be as specified in Table A5.3.5-1 unless specified otherwise in the Contract Documentation.

Table A5.3.5-1: Minimum compaction densities for gravel and soil pavement layers

Layer	Compaction as % of maximum dry density (MDD)
Lower selected layer	93 %
Upper selected layer	95 % for gravel layers
	100 % for sand layers (97 % when specified in Contract Documentation)
Wearing course layer	95 %
Shoulder layer	95 %
Lower subbase layer	95 % for unstabilised layers
	95 % for chemically stabilised layers
	100 % for sand layers
Upper subbase layer	97 % for unstabilised layers
	95 % for chemically stabilised layers
	100 % for sand layers
Base layer	100 % for unstabilised layers
	97 % for chemically stabilised layers

In restricted areas the compacted dry density of the individual pavement layers shall also comply with the requirements given in Table A5.3.5-1 unless specified otherwise in the Contract Documentation.

c) Crushed stone pavement layer compaction requirements (G1 to G4A and G5A materials)

The minimum compacted dry density of a crushed stone pavement layer shall be as specified in Table A5.3.5-2 unless specified otherwise in the Contract Documentation.

Table A5.3.5-2: Minimum compaction densities for crushed stone pavement layers

Layer	Compaction as % Maximum Dry Density (MDD) or as % Bulk Density (BD) or as % Apparent Density (AD)
G4A and G5A lower subbase layer	95 % of MDD for unstabilised layers
	95 % of MDD for chemically stabilised layers
G3, G4A and G5A upper subbase layer	97 % of MDD for unstabilised layers
	97 % of MDD for chemically stabilised layers
G3 and G4A base layer	98 % to 100 % of MDD (for G3 and G4A) or 85 % of BD for G3 only
G2 base layer	88 % of BD for Road category C and D (TRH 4, Table 1) 86 % of AD for Road category A and B (TRH 4, Table 1)
G1 base layer	86 % of AD for Road category C and D (TRH 4, Table 1 for road categories) 88 % of AD for Road category A and B (TRH 4, Table 1 for road categories)
PMPL pavement layer (lean mix concrete)	Cube crushing strength as specified in Contract Documentation. No density requirement.

The density of the compacted crushed stone base layers (G1 and G2 layers only) shall be tested to the full depth of the layer using a nuclear gauge.

In restricted areas the in-situ dry density of the crushed stone subbase and base layers shall also comply with the requirements given in Table A5.3.5-2 unless specified otherwise in the Contract Documentation.

d) Bound macadam (BM) layer

The minimum in-situ density of a BM layer shall be within the range as specified in Table A5.3.5-3. The Contract Documentation shall specify the actual applicable apparent density along with the construction method and the type of BM.

Either the dry-bound or wet-bound construction method can be used to construct the BM rock matrix.

Table A5.3.5-3: Minimum compaction density for BM pavement layers

Layer	Compaction density as % of apparent density (AD)
Bound macadam (BM) layer – dry-bound	84 % to 86 %
Bound macadam (BM) layer – water-bound	88 % to 90 %

After the construction of the BM rock matrix to the required compaction density the subsequent treatment of the compacted BM layer can vary and shall be specified in the Contract Documentation or instructed by the Engineer.

A5.3.5.3 Bound macadam layers

There are various BM layers that can be constructed, each with different material usage and different methods of construction.

The Contract Documentation shall specify which BM shall be constructed.

Table A5.3.5-4 describes the different BM layers.

Table A5.3.5-4: Different BM pavement layers

BM layer description	Key layer characteristics
Dry-bound macadam (DBM)	Single size rock matrix, usually 63 mm, filled with dry fine filler aggregate using compaction equipment only. Smooth swept surface.

Water-bound macadam (WBM)	A DBM slushed afterwards by saturating the filled rock matrix, usually 63 mm, and rolling with a steel drum roller. Where the climate does not allow the fine filler aggregate to dry sufficiently, it may be washed into the coarse aggregate. Smooth swept surface.
Partially penetrated macadam (PPM)	Construct a DBM or WBM. Broom away excess aggregate fines and some of the fine filler aggregate in the exposed open voids. Rough swept surface. Apply slurry which will therefore only penetrate partially.
Slurry-bound macadam (SBM)	Construct a PM followed by the application of a slurry using a crusher-sand/sand with emulsion. All voids to be completely filled with the emulsion slurry
Composite macadam (CM)	Construct the lower portion of the layer as a DBM or WBM. Construct the upper portion of layer of SBM using 50 mm or 37,5 mm aggregate. See Table A4.1.5-8.

A5.3.6 CONSTRUCTION EQUIPMENT

Construction equipment to carry out the construction of the pavement layers shall comply with the requirements of Clause A1.2.6 of Chapter 1.

A5.3.7 EXECUTION OF THE WORKS

A5.3.7.1 Controlling pavement layer thickness

a) Placing and spreading layer material

All material placed in position before compaction shall be spread evenly over the entire surface of each layer to be compacted and the quantity of material spread shall be such that each layer will comply with the requirements for thickness as specified in the Contract Documentation, when measured after compaction.

The Contractor shall ensure that segregation of the material into finer and coarser fractions does not occur during any of the stockpiling, loading, hauling, spreading and subsequent mixing operations.

b) Minimum pavement layer thickness in transition areas

Where the thickness of an existing gravel layer needs to be supplemented and the thickness of the added material after compaction will be less than 100 mm, the existing layer shall be scarified to a depth that will give a combined compacted layer thickness of at least 150 mm after compacting the loosened existing material and the added material as one layer unless specified otherwise in the Contract Documentation.

Where the thickness of an existing crushed stone subbase or base layer needs to be supplemented then the entire existing subbase or base layer shall be scarified and blended with the added material. The blended material forms a composite layer and it shall be compacted as a single layer if the compacted layer thickness will be less than 175 mm. The layer shall be compacted in two equal thickness layers when the final compacted layer thickness will exceed 175 mm unless the Contractor has demonstrated in a trial section that a thicker layer can be compacted successfully.

A5.3.7.2 Combining materials

The specific material requiring to be combined shall be specified in the Contract Documentation or the material shall be combined as instructed by the Engineer.

a) Combining materials from various sources in stockpile

Materials from various sources requiring mixing and that cannot be taken directly to the point of use, shall be stockpiled and subsequently loaded as specified in Clauses A4.1.7.2g) and A4.1.7.3b) of Chapter 4.

b) Combining recovered material

Recovered material from windrows, from stockpile floor areas, from oversize material, or from any area where there is an excess of material shall be combined and re-used. Screening, or crushing and screening, of the recovered material or combining it with some new material may also be required to comply with the material specifications of the layer for which it is subsequently to be used.

A5.3.7.3 Construction of gravel pavement layers

a) Construction

All material to be used for the construction of gravel pavement layers shall be checked at the source of supply for compliance with the material properties specified in Chapter 4 before being loaded and hauled to the point of use or to the central mixing plant for a PMPL pavement layer.

Oversize material up to a maximum of 5 % by compacted volume may be hauled to the point of use on the road where it shall be broken down by using appropriate compaction rollers. The remaining oversize material shall then be bladed out of the layer or removed by hand on the road. Where this material is hauled to a central mixing plant for a PMPL pavement layer, the material shall be screened and the oversize then loaded and hauled to a spoil site or to a crusher, for further processing.

Material containing more than 5% by volume of oversize material shall not be hauled to the point of use on the road unless it can be demonstrated that the oversize material can be broken down on the road and the Engineer has provided an instruction for this work to take place.

When longitudinal construction joints are necessary, they shall be constructed in the positions detailed in the Contract Documentation.

Care shall be taken during the loading, hauling and dumping operations to prevent segregation of the material.

b) Breaking down pavement layer oversize material

Oversize material transported to the point of use as per Clause A5.3.7.3a) or oversize material already at the point of use, shall be broken down. The Contractor may employ any preferred methods and equipment to break down the material. However the effectiveness of the Contractors method shall be assessed against normal grid rolling, to establish the norm for the degree of breaking down to be attained by any alternative method.

Normal grid rolling shall be instructed by the Engineer and shall mean the following.

- (i) The material shall be placed or bladed to the one side of the road to provide working space for breaking-down the material.
- (ii) A portion of the material shall be spread in a thin layer on a compacted surface to promote effective breaking-down of the material, and to a width which the grid roller shall be able to cover in a single pass.
- (iii) The grid roller, which shall proceed at a speed of at least 12 km/h and shall have a minimum mass of 13,5 tons, shall do four complete roller passes over the material.
- (iv) Any material that is still oversize shall be removed and taken to a designated spoil site or to a crushing plant to be crushed (v) The broken-down material shall be placed in a windrow to the opposite side of the material still to be broken-down (vi) Repeat steps (ii) to (v), then place the second windrow next to the first windrow and mix the two windrows. (vii) Repeat steps (ii) to (vi) until all the material that needs to be broken down has been treated.

If normal grid rolling does not break down the material acceptably, the Engineer shall instruct either additional normal grid rolling, or crushing and screening to take place. Additional grid rolling means a repeat of the normal grid rolling detailed in points (i) to (vii) above. **c) With grader and conventional equipment**

Before the pavement layer material is compacted, it shall first be thoroughly mixed by grader and disc plough, so as to obtain an even mix of the pavement material. The fine and coarse material shall be mixed evenly throughout the layer in the transverse, vertical and longitudinal direction.

Unless the material is already too wet, additional water shall be sprayed evenly over the spread pavement layer material using a water tanker. **d)**

With grader and specialised equipment

Before the pavement layer material is compacted, it shall first be thoroughly mixed using equipment such as a recycler so as to obtain an even mix of the pavement material. The fine and coarse material shall be mixed evenly throughout the layer in the transverse, vertical and longitudinal direction.

To ensure thorough mixing in a transverse direction when using a recycler, cross-mixing of the material may sometimes be required.

Unless the material is already too wet, additional water shall be sprayed evenly over the spread pavement layer material by the recycler during the final mixing pass.

The addition of water and mixing of the material can all take place simultaneously when a recycler is used. **e) Moisture**

control

The requirements of this clause e) are applicable to both clauses c) and d) above.

All additional water shall be uniformly mixed into the material to bring it to a moisture content to suit the specific compaction equipment used. When adding water, allowance shall be made for the loss of any water due to evaporation during the mixing and compaction operations which may occur under hot and/or windy weather conditions.

If the moisture content of the material is in excess of the compaction moisture content required to achieve the specified compaction density the wet material shall be replaced with dry material or processing shall cease and the material left to dry out until the required compaction moisture content has been reached. During compaction the material shall not display any signs of still being too wet, such as pumping or movement. The pavement layer material shall be compacted to the correct layer thickness and density as specified.

f) With paver and other equipment

Before the pavement layer material is compacted the mixture shall be spread and placed by a mechanical paver on the underlying layer to the required width and to a thickness and levels which are compliant with the tolerances specified in Clause A5.3.8 after final compaction. Segregation of the materials shall be prevented and the layer shall be free from pockets of coarse or fine materials.

Immediately prior to paving the material, the underlying layer shall be dampened and kept damp (not wet) until the layer is paved.

A5.3.7.4 Processing coarse gravel subbase or base layer

Coarse gravel containing mostly non-plastic or slightly plastic soil fines and used in the construction of a gravel subbase or base layer, shall require slushing and rolling in addition to the specified compaction, in order to obtain a firm, well-knit surface.

After being processed and compacted, the layer may require to be well watered by the Contractor over short sections at a time and then slushed and rolled with pneumatic and/or vibratory compactors. Watering and rolling shall continue over a section until excess fines have been brought to the surface of the layer. Such excess fines shall be uniformly spread over the entire surface of the layer by means of stiff mechanical or hand brooms.

Watering, rolling and brooming shall continue until all surface areas deficient in fines have been corrected. All excess fines shall then be broomed off the surface of the layer without loosening the surface texture of the completed layer.

A5.3.7.5 Construction of gravel shoulder

Shoulder material shall be spread, watered, processed and compacted in accordance with the specifications for a pavement layer.

Where the gravel shoulder layer is to be constructed with the same gravel material as for the base layer, it shall be constructed simultaneously with the base layer.

Where a base is to be constructed with different gravel or with crushed stone material, the shoulders shall first be constructed and then neatly cut to the required line and level to provide lateral support for the edges of the new base layer material while it is being compacted. Care shall be taken not to contaminate the base material with the shoulder material. The Contractor shall ensure that the subbase layer and the base material that has not yet been compacted is adequately drained at all times by means of temporary drainage channels or pipes passing through the gravel shoulder layer.

Where an asphalt base layer is to be constructed, the shoulders shall be constructed after the completion of the asphalt base layer.

C5.3 ROAD PAVEMENT LAYERS PART C: MEASUREMENT AND PAYMENT

(i) Preamble

The tendered rate for each item shall include full compensation for providing, maintaining and decommissioning upon completion, of all the constructional plant, equipment, labour, tools, incidentals and supervision to carry out the activity or construct the works in the item, unless otherwise stated.

Any prime cost or provisional sums shall be paid in accordance with the provisions of the conditions of contract. The charge or mark-up tendered or allowed for is a percentage of the amount actually paid under the prime cost or provisional sum. This percentage shall cover all the Contractor's handling, supervision, profit and liability costs to provide the services in the prime cost or provisional sum item.

The requirements of Section C1.1 of Chapter 1 shall apply.

Where pay item descriptions include any wording in brackets it is an indication that contract specific information is to be inserted in the Pricing Schedule included in the Contract Documentation.

(ii) Items that will not be measured separately

The following required activities will not be measured or paid for separately and the Contractor shall include the cost thereof in other items as deemed appropriate:

1. All surveying, setting out and level control required for the construction of the pavement layers.
2. Drainage and protection of the pavement layers from all damage that may occur for any reason until the Employer has taken over the works.
3. Protection of all existing or new kerbs, channels, sidewalks, lined drains, catch pits, kerb inlets, gratings, culverts, bridges, structures, buildings, road signs, guard rails, street lights, fencing, service pipes or cables and any other items adjacent to, over or under the road that could be damaged by the Contractor's vehicles, construction equipment, or by public traffic being accommodated on or alongside the pavement layers, during the construction of the pavement layers, until the Employer has taken over the works.
4. Compaction immediately adjacent to existing or new kerbs, channels, sidewalks, lined drains, catch pits, kerb inlets, gratings, culverts, bridges, structures, buildings, road signs, guard rails, street lights, fencing, service pipes or cables etc. using hand operated compaction equipment.
5. Repair of all damage to the pavement layers and any new or existing structures, buildings, road furniture and services that may occur for any reason before, during or after the construction of the pavement layers up until the Employer has taken over the works.
6. Provision of additional material in excess of the compacted volume of the layers calculated using the layer dimensions given in the Contract Documentation for whatever reason including additional material required for the correct placing, mixing, levelling and compaction of the layers.
7. Removal of additional material required for the correct mixing and working of the layers and left in windrow or on the sides of the road.
8. Breaking down and removal of oversize material up to 5 % of the compacted layer volume. Payment will only be made to remove any oversize material in excess of 5 % of the compacted layer volume that cannot be broken down on the road when instructed by the Engineer.
9. Loading and hauling of commercial pavement material identified by the Employer or by the Contractor.
10. Loading and hauling of alternative material identified by the Contractor.
11. Construction of tie-in joints to new or existing road layers or surfacing.

(iii) Items to be measured and paid for using payment items specified elsewhere in the specifications

For activities in Table C5.3-1 payment items specified in other Chapters or Sections of the specification, where they relate to work under this Section, will be listed in the Pricing Schedule.

Table C5.3-1: Payment items from other Chapters or Sections

Activity	Section 5.3 reference	Section item reference
Loading and hauling	A5.3.1	Section C1.7 of Chapter 1 – All applicable items
Stabilisation	A5.3.1	Section C5.4 of Chapter 5 – All applicable items
Subsoil drainage	A5.3.3.8	Section C3.1 of Chapter 3 – All applicable items
Asphalt base layer	A5.3.7.5	Section C9.1 of Chapter 9 – All applicable items
Bound macadam surfacing	A5.3.7.10g)	C10.1.2 of Chapter 10
Construction of edge constraints for BM	A5.3.7.10a)	Section C11.1 of Chapter 11 – All applicable items
Priming	A5.3.3.9 / 10	Chapter 10 – All applicable items
Screening material	A5.4.7.2d)	Section C4.1 of Chapter 4 – All applicable items

Emulsion slurry	Table A5.3.5-4	Section C10.1 of Chapter 10 – All applicable items

(iv) **Items specifically for this Section of the specifications**

Item	Description	Unit
C5.3.1	Compiling and implementing M&U plans for the construction of all the pavement layers	number (no)

The unit of measurement shall be the number of compiled M&U plans for the construction of the pavement layers.

Usually only one plan shall be required for each of the layers unless specified otherwise in the Contract Documentation.

The tendered rate shall include full compensation for gathering all information and compiling the plan(s) and for ensuring the implementation of the plan(s) during the construction of the pavement layers.

Item	Description	Unit
C5.3.2	Construction of pavement layers	

C5.3.2.1 Construction of layers using conventional construction methods:

	(a)	Lower selected subgrade layer (layer thickness indicated) compacted to 93 % of MDD	cubic metre (m ³)
	(b)	Lower selected subgrade layer (layer thickness indicated) compacted to 95 % of MDD	cubic metre (m ³)
	(c)	Upper selected subgrade layer (layer thickness indicated) compacted to 95 % of MDD	cubic metre (m ³)
	(d)	Upper selected subgrade layer (layer thickness indicated) compacted to 97 % of MDD	cubic metre (m ³)
	(e)	Sand layer (layer thickness indicated) compacted to 97 % of MDD	cubic metre (m ³)
	(f)	Sand layer (layer thickness indicated) compacted to 100 % of MDD	cubic metre (m ³)
	(g)	Gravel wearing course layer (layer thickness indicated) compacted to 95 % of MDD	cubic metre (m ³)
	(h)	Gravel shoulder layer (layer thickness indicated) compacted to 95 % of MDD	cubic metre (m ³)
MDD	(i)	Lower subbase gravel layer (unstabilised) (layer thickness indicated) compacted to 95 % of	cubic metre (m ³)
	(j)	Lower subbase gravel layer (chemically stabilised) (layer thickness indicated) compacted to cubic metre (m ³) 95 % of MDD	
MDD	(k)	Upper subbase gravel layer (unstabilised), (layer thickness indicated) compacted to 97 % of	cubic metre (m ³)
	(l)	Upper subbase gravel layer (chemically stabilised), (layer thickness indicated) compacted to cubic metre (m ³) 95 % of MDD	
	(m)	Gravel base layer (unstabilised), (layer thickness indicated) compacted to 100 % of MDD	cubic metre (m ³)
MDD	(n)	Gravel base layer (chemically stabilised), (layer thickness indicated) compacted to 97 % of	cubic metre (m ³)
MDD	(o)	G5B crushed rock/boulder subbase layer (layer thickness indicated) compacted to 97 % of	cubic metre (m ³)
	(p)	G5B crushed rock/boulder base layer (layer thickness indicated) compacted to 100 % of MDD	cubic metre (m ³)
MDD	(q)	G5A crushed rock/boulder subbase layer (layer thickness indicated) compacted to 97 % of	cubic metre (m ³)
	(r)	G5A crushed rock/boulder base layer (layer thickness indicated) compacted to 100 % of MDD	cubic metre (m ³)
	(s)	G4A crushed rock/boulder lower subbase layer (unstabilised or chemically stabilised) (layer cubic metre (m ³) thickness indicated) compacted to 95 % of MDD	
	(t)	G4A crushed rock/boulder upper subbase layer (unstabilised or chemically stabilised) (layer cubic metre (m ³) thickness indicated) compacted to 97 % of MDD	
	(u)	G4A crushed rock/boulder subbase layer compacted to 97 % of MDD	cubic metre (m ³)
	(v)	G3 crushed stone subbase layer (unstabilised or chemically stabilised) (layer thickness cubic metre (m ³) indicated) compacted to 97 % of MDD	
	(w)	G3 crushed stone base layer (layer thickness indicated) compacted to 85 % of BD	cubic metre (m ³)
	(x)	G2 crushed stone base layer (layer thickness indicated) compacted to 88 % of BD	cubic metre (m ³)
	(y)	G2 crushed stone base layer (layer thickness indicated) compacted to 88 % of AD	cubic metre (m ³)
	(z)	G1 crushed stone base layer (layer thickness indicated) compacted to 86 % of AD	cubic metre (m ³)
	(aa)	G1 crushed stone base layer (layer thickness indicated) compacted to 88 % of AD	cubic metre (m ³)
	(bb)	Bound macadam layer (layer thickness indicated) compacted to 90 % of AD	cubic metre (m ³)

(cc) PMPL wet lean-mix concrete layer (Cube crushing strength and layer thickness indicated) cubic metre (m³)

C5.3.2.2 Construction of layers using labour enhancement:

(a)	Lower selected subgrade layer (layer thickness indicated) compacted to 93 % of MDD	cubic metre (m ³)
(b)	Upper selected subgrade layer (layer thickness indicated) compacted to 95 % of MDD	cubic metre (m ³)
(c)	Sand layer (layer thickness indicated) compacted to 97 % of MDD	cubic metre (m ³)
(d)	Sand layer (layer thickness indicated) compacted to 100 % of MDD	cubic metre (m ³)
(e)	Gravel wearing course layer (layer thickness indicated) compacted to 95 % of MDD	cubic metre (m ³)
(f)	Gravel shoulder layer (layer thickness indicated) compacted to 95 % of MDD	cubic metre (m ³)
(g)	Lower gravel subbase layer (layer thickness indicated) compacted to 95 % of MDD	cubic metre (m ³)
(h)	Upper gravel subbase layer (layer thickness indicated) compacted to 97 % of MDD	cubic metre (m ³)
(i)	Gravel base layer (layer thickness indicated) compacted to 98 % of MDD	cubic metre (m ³)
(j)	Gravel base layer (layer thickness indicated) compacted to 100 % of MDD	cubic metre (m ³)
(k)	Bound macadam layer (layer thickness indicated) compacted to 90 % of AD	cubic metre (m ³)
(l)	Soil cement or soilcrete (layer thickness indicated) wet mixture as per clause A4.1.5.14	cubic metre (m ³)
(m)	Soil cement or soilcrete (layer thickness indicated) stiff mixture as per clause A4.1.5.14	cubic metre (m ³)
(n)	Emulsion treated base material (G1 or G2 material and layer thickness indicated) as per clause A4.1.5.15	cubic metre (m ³)

The unit of measurement shall be the cubic metre of material in the compacted layer, calculated using the layer work dimensions given in the Contract Documentation.

The tendered rates shall include full compensation for spreading the material, for breaking down oversize gravel material using one normal grid rolling operation or an equivalent operation, for removal of up to 5 % of the compacted layer volume of oversize material that cannot be broken down, for adding water for compaction purposes, for mixing, for levelling, for compacting to the specified density, for slush-compaction of G1 material layers or other layer that may be specified to receive slush-compaction and for finishing the layers in accordance with the specifications and the Contract Documentation. The tendered rates shall also include for the removal of all material in the windrow after the compaction of the layer has been completed.

Measurement and payment for loading the layer work material from borrow pits, quarries, cuttings, reclaimed material from existing roads and alternative materials identified by the Employer, transporting and then off-loading the material at the point of use is made under items C1.7.1 and C1.7.2 of Chapter 1.

The haul of the imported material shall be measured from the point of loading/collection to the point of off-loading as per Section A1.7 of Chapter 1.

A distinction shall be made between construction using conventional construction methods and labour enhancement.

Item	Description	Unit
C5.3.3	Construction of crushed stone base supplied by the Employer	cubic metre (m³)

This item is for crushed stone base constructed from type G1 or G2 material supplied from the Employer's stockpile (state location of stockpile) at R..... per ton (layer thickness indicated) and compacted to 88 % AD or 86% AD respectively as specified in the Contract Documentation.

The unit of measurement shall be the cubic metre of completed crushed-stone base in-situ and compacted to the specified density. The quantity shall be calculated from the net authorised dimensions of the layer as shown on the drawings or prescribed by the engineer. No adjustments shall be made to the net specified dimensions for level and thickness tolerances, overbuilding and/or other wastage.

The tendered rate shall include compensation for the purchase of the material from the Employer at R.....per ton, weighing on the calibrated weighbridge, furnishing and placing all materials, including crusher fines for correcting the grading of the crushed-stone and hauling the material to the point of use, rolling slushing and correcting the layers, and for testing, protecting and maintaining the work all as specified.

Item	Description	Unit
C5.3.4	Deductions for G1 crushed stone base material supplied by the Employer	ton (t)

The unit of measurement shall be the ton of material supplied by the Employer.

The value of material supplied by the Employer and to be deducted from payments due to the contractor, shall be determined as the sum of audited weighbridge documentation and delivery notes.

Item	Description	Unit
C5.3.5	Breaking down oversize gravel layer material on the road	
C5.3.5.1	By additional normal grid rolling as per clause A5.3.7.3b)	square metre-pass (m ² -pass)
C5.3.5.2	By tamping roller	square metre-pass (m ² -pass)
C5.3.5.3	By pad foot vibratory roller	square metre-pass (m ² -pass)
C5.3.5.4	By vibratory roller	square metre-pass (m ² -pass)

C5.3.5.5 By any other roller type

square metre-pass (m²-pass)

The unit of measurement shall be the square metre-pass calculated by multiplying the layer surface area covered by the agreed number of rollerpasses used to break down the material satisfactorily.

The tendered rate for each square metre-pass instructed by the Engineer shall include full compensation for all supervision, labour, equipment, fuel, materials, work and incidentals necessary for completing the work. The same rates shall be applicable should there be a reduction in the number of roller-passes for a specific type of roller.

The tendered rate shall include full compensation for supplying the roller and removing the roller after completion of the breaking down process.

The items shall differentiate between the different types of rollers used.

Item	Description	Unit
C5.3.6	Removal of oversize material	cubic metre (m³)

The unit of measurement shall be the cubic metre of oversize material which cannot be broken down on the road and is removed for re-crushing or removed to spoil as instructed by the Engineer in excess of the 5 % of the compacted layer volume of oversize material included in the rates tendered for item C5.3.2.

The volume measured for payment shall be taken as 70 % of the loose volume in excess of 5 % of the measured volume of the layer as measured in the haul vehicles.

The tendered rate shall include full compensation for removing the oversize material from the pavement layers, loading it into the hauling vehicles and off-loading it at the point of disposal.

The haul of the oversize material in excess of 5 % by volume per layer shall be measured from the point of loading/collection to the point of offloading as per Section A1.7 of Chapter 1.

Item	Description	Unit
C5.3.7	Recombining recovered material	cubic metre (m³)

The unit of measurement shall be the cubic metre of the recombined material added to and mixed into the pavement layer as specified in Clause A5.3.7.2. The volume measured for payment shall be taken as 70 % of the loose volume of recovered material as measured in the haul vehicles.

The tendered rate shall include full compensation for mixing the recombined recovered material binder into the layer to form one homogeneous layer.

Payment for the construction operations required to process and compact the recombined layer will be paid for under item C5.3.2 and other relevant items

The haul of the recovered material shall be measured from the point of loading/collection to the point of off-loading as per Section A1.7 of Chapter 1.

Item	Description	Unit
C5.3.8	Processing of coarse gravel subbase or base layers	cubic metre (m³)

The unit of measurement shall be the cubic metre of material in the compacted layer calculated using the layer work dimensions given in the Contract Documentation.

The tendered rate shall include full compensation for carrying out the processing and finishing work for a coarse layer as specified in Clause A5.3.7.4.

Item	Description	Unit
C5.3.9	Construction of a trial section	

C5.3.9.1 Construction of a trial section using conventional methods of construction

(a)	Stabilised gravel layer (layer thickness indicated) trial section	cubic metre (m ³)
(b)	Crushed stone subbase layer (layer thickness indicated) trial section	cubic metre (m ³)
(c)	Crushed stone base layer (layer thickness indicated) trial section	cubic metre (m ³)
(d)	PMPL layer (layer thickness indicated) trial section	cubic metre (m ³)
(e)	Bound macadam layer (layer thickness indicated) trial section	cubic metre (m ³)
(f)	Any other	cubic metre (m ³)

C5.3.9.2 Construction of a trial section using labour enhancement methods

(a)	Stabilised gravel layer (layer thickness indicated) trial section	cubic metre (m ³)
(b)	Gravel base layer (layer thickness indicated) trial section	cubic metre (m ³)
(c)	Bound macadam layer (layer thickness indicated) trial section	cubic metre (m ³)
(d)	Any other	cubic metre (m ³)

The unit of measurement shall be the cubic metre of layer trial section constructed, tested and accepted. The quantity shall be calculated based on the authorised dimensions of the trial section layer.

The tendered rate shall include full compensation for providing all the material and constructing the particular layer for the trial section as specified. The tendered rate shall also include for any costs associated with a delay up to a maximum of ten working days, to allow for testing between completion of the trial section and the acceptance thereof.

A distinction shall be made between construction using conventional construction and labour enhancement.

Item	Description	Unit
C5.3.10	Removal of a completed trial section	
C5.3.10.1	Stabilised layer	cubic metre (m ³)
C5.3.10.2	PMPL layer	cubic metre (m ³)
C5.3.10.3	Crushed stone layer	cubic metre (m ³)

The unit of measurement shall be the cubic metre of compliant trial section layer removed to a designated site when instructed by the Engineer. The tendered rates shall include full compensation for breaking up the trial section layer and for loading the broken up layer material..

The haul of the material to the designated site as instructed by the Engineer and off-loading the material shall be measured from the point of loading/collection at the trial section to the point of off-loading as per Section A1.7 of Chapter 1.

The removal to spoil of a non-compliant trial section layer shall be done by the Contractor at no cost to the Employer.

Item	Description	Unit
C5.3.11	Riding quality measurements	
C5.3.11.1	Using a 3,0 m straight edge	kilometre (km)
C5.3.11.2	Using a rolling straight edge	kilometre (km)
C5.3.11.3	Using an inertial profilometer	kilometre (km)

The unit of measurement shall be the kilometre of riding quality measurements taken in each wheel path, measured along the wheel path as specified in Clause A5.3.8.5.

The tendered rates shall include full compensation for the cost of all traffic accommodation arrangements required, for several possible establishments and de-establishments of testing equipment, for the measurement of the riding quality with the specified instrument and the processing, analysis and interpretation of the riding quality measurements.

Item	Description	Unit
C5.3.12	Surface regularity payment adjustments	Provisional Sum (Prov Sum)

The unit of measurement shall be the cumulative monetary value of each 100 m section of the completed base layer as measured and paid under item C5.3.2, multiplied by the applicable payment adjustment factor obtained from Table A5.3.8-6.

5.4 STABILISATION

A5.4 STABILISATION PART A: SPECIFICATIONS

A5.4.1 SCOPE

This Section covers the work requirements for the treatment of the material properties of natural roadbed, fill layers or pavement layers and crushed material by stabilisation, all in terms of the definition of Stabilisation in Clause A4.4.2 of Chapter 4.

A5.4.2 DEFINITIONS

The relevant definitions in the standard specifications are applicable. Additional definitions for this Section are included here.

Mechanical modification - mechanical modification, also referred to as granular stabilisation, is a form of stabilisation as defined in Clause A4.4.2 of Chapter 4. Mechanical modification of a pavement layer involves the addition and mixing together of various materials from different sources to produce a uniformly mixed material that is compliant with the properties required for the pavement layer for which the modified material is being used.

Lamination layer - a term used to describe the layer formed when a compacted layer delaminates and forms loose and unbonded layers on top of the layer when incorrect compaction techniques are used. A colloquial term, biscuit layer, is also used for the lamination layers.

Breaking of emulsion - this term describes the process that occurs when the suspended bitumen in the emulsion separates from the water and the water evaporates, leaving behind bitumen. It is also referred to as the setting of the emulsion.

Filler a filler is a commercially available product. A filler is often a cementitious agent. The quantity added is sufficient to result in improvement of the properties of the material it is added to, but insufficient to result in the stabilisation of the material should the filler have been added in isolation.

A5.4.3 GENERAL

A5.4.3.1 Stabilisation agents

The type and quantity of cementitious or bituminous stabilisation agent to be used for each layer of material shall be determined as described in Clauses A4.4.7.1c) and A4.4.7.1d) of Chapter 4.

The different types of cementitious and stabilisation agents are specified in Clauses A4.4.5.2, A4.4.5.3 and A4.4.5.4 respectively of Chapter 4.

Should a non-traditional stabilising or soil treatment agent be proposed by the Contractor, it will only be considered if the requested details specified in Clause 4.4.5.4 of Chapter 4 are provided.

A5.4.3.2 Work in restricted areas

Work in restricted areas is specified in Clauses A1.1.3.2 and A1.2.3.23 of Chapter 1.

Where pavement layers are to be treated or stabilised in restricted areas such as widenings, no cementitious or bituminous agent may be spread or mixed beyond the required width. The Contractor shall not be permitted to mix the material being stabilised on an adjacent paved surface.

Where restricted areas are such that mixing in the restricted area is impractical and mixing on adjacent surfaces is not permitted, mixing shall be done in a central mixing plant. In the case of small quantities, suitable portable concrete mixers may be used.

Treatment and stabilisation of layer work materials in restricted areas shall not be measured separately for payment unless specified otherwise in the Contract Documentation.

A5.4.3.3 Construction limitations

The Contractor shall programme all construction work to take into account all the construction limitations which are applicable to soil treatment and stabilisation work.

a) Size of area

The cementitious and/or bituminous agent shall only be applied to a surface area the size of which will permit all processing, watering, compacting and finishing to be completed within the time periods specified in Table A5.4.3-1.

b) Processing time

The construction methods and programme of the Contractor shall take into account and ensure compliance with the processing times specified in Table A5.4.3-1.

Table A5.4.3-1: Construction time limitations for treatment and stabilisation⁽¹⁾

Chemical agent	Maximum continuous period allowed from the time the application of the chemical agent onto the top of the layer commences up until the completion of the stabilisation process
Material modification	
Lime	10 hours. The treated layer shall subsequently remain undisturbed for 24 hours.
Material cementation	
Cement blends	6 hours until the completion of the compacted layer
Lime	10 hours until the completion of the compacted layer
Material improvement	
Bitumen emulsion	12 hours until the completion of the compacted layer
Bitumen emulsion with cement	8 hours until the completion of the compacted layer
Foamed bitumen with or without cement	10 hours until the completion of the layer
PMPL stabilised crushed stone material	
Cement blends	1 hour until the commencement of compaction plus 4 hours until the completion of the compacted layer.
Wet lean-mix concrete	150 minutes until the completion of the compacted/vibrated layer (reference temperature = 20°C This time shall be reduced by 30 minutes for every 5°C that the mix temperature exceeds 20°C

Note (1): The construction time limitations shall not exceed the field working time established during the stabilisation design in Clause A4.4.7.1 of Chapter 4.

c) Trial section approval and testing time

The construction programme and methods of the Contractor shall take into account and ensure compliance with the limitations applicable to the construction, testing and acceptance of the trial section/s as specified.

d) Weather restrictions

No stabilisation shall be done during windy conditions, wind speed more than 15 km/h (4 m/s), wet weather and cold weather when the air temperature is below 3°C or with falling air temperatures, 7°C and falling.

No stabilisation work shall be commenced if the surface temperature of a compacted stabilised layer may fall below 1°C during the first three (3) days after stabilisation. The Contractor shall take the necessary precautions and the construction programme for the stabilisation work shall take the actual and predicted weather conditions into account.

All stabilised layers damaged by rain, frost or by the formation of ice in the layer shall be removed and replaced by the Contractor at no cost to the Employer.

e) Traffic limitations

No vehicles or construction equipment except that used for mixing the stabilising agent into the layer shall be allowed to travel over the spread stabilising agent.

No traffic or construction equipment except that required for curing or priming shall be allowed to travel over the compacted stabilised layer during the specified curing period as per Clause A5.4.7.6, unless specified otherwise in the Contract Documentation.

A5.4.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

Not required for Section A5.4.

A5.4.5 MATERIALS

A5.4.5.1 General

For chemically stabilised layers the natural material or the reclaimed road material, even if previously stabilised, shall comply with the requirements of Table A4.4.5-2 in Chapter 4.

For bitumen stabilised layers the natural material or the reclaimed road material, even if previously stabilised, shall comply with the requirements in Table A4.4.5-3 in Chapter 4.

All commercial materials proposed for use by the Contractor or as specified in the Contract Documentation to be stabilised, shall comply with the requirements of Table A4.4.5-2 or Table A4.4.5-3 in Chapter 4 as applicable.

A5.4.5.2 Material for modification or pretreatment

Material with non-compliant properties, such as the grading, plasticity index and/or CBR strength, that are not compliant for direct use in a stabilised layer, shall first be mechanically modified and/or chemically pretreated as specified in the Contract Documentation or as instructed by the Engineer.

The materials to be modified shall be identified in the Contract Documentation or by the Engineer during construction and shall be modified to produce compliant material before any chemical stabilisation is carried out.

a) Mechanical pretreatment of material before stabilisation

Material requiring mechanical modification to improve the grading and/or moderate the plasticity index and/or to increase the CBR strength, in order for the material to be compliant before stabilisation shall first be prepared and/or treated as specified in Section A5.3.

The mechanically modified compliant material shall then be stabilised with the type and amount of stabilising agent specified in the Contract Documentation or as instructed by the Engineer.

b) Cementitious pretreatment of material before stabilisation

Material requiring modification to reduce the plasticity index in order for the material to be compliant for subsequent stabilisation, shall first be pretreated.

The chemically pretreated, modified and now compliant material shall then be stabilised with the type and amount of cementitious stabilising agent determined as specified in the Contract Documentation or as instructed by the Engineer.

A5.4.5.3 Cementitious stabilising agents

The Contract Documentation shall specify the type of cementitious agent to be used for the specific gravel or crushed stone material being chemically pretreated or stabilised. These nominal contents shall then be verified or adjusted based on the laboratory test results and/or after the construction of a trial section.

A5.4.5.4 Bituminous stabilising agents

The Contract Documentation shall specify the type of bituminous agent to be used for the project for the specific gravel or crushed stone material being stabilised. These nominal contents shall then be verified or adjusted, based on the laboratory test results and/or after the construction of a trial section.

A5.4.5.5 Water for stabilisation

Water for the construction of stabilised layers shall comply with the requirements of Clause A4.1.5.18 of Chapter 4.

A5.4.6 CONSTRUCTION EQUIPMENT

Construction equipment to carry out the stabilisation or modification of layer work material shall comply with the requirements of Clause A1.2.6 of Chapter 1.

When either a rotary mixer or a recycler is used to mix in the stabilising agent and process the layer, this construction equipment must be capable of adding variable but precise amounts of water, and then mixing and placing the material in a single pass in conformance with the design grades and cross falls.

Where specified in the Contract Documentation, the watering for the curing of compacted stabilised layers shall be done by side-spraying tankers travelling off the layer.

A5.4.7 EXECUTION OF THE WORKS

A5.4.7.1 Construction of a trial section

The Contractor shall demonstrate by constructing one or more of the following trial sections that the equipment and procedure to be used will result in the construction of layers in accordance with the specifications. The required trial section(s) shall be in accord with the pricing schedule.

- A trial section for the chemical modification or stabilisation of a layer of material processed on the road shall be constructed in accordance with the relevant requirements of Clauses A5.3.7.12 and A5.4.7 and/or as specified in the Contract Documentation.
- A trial section for the bituminous stabilisation of a layer of material processed on the road shall be constructed in accordance with the requirements of Clauses A5.3.7 and A5.5.7 and/or as specified in the Contract Documentation.
- A trial section for the cementitious stabilisation of PMPL materials shall be constructed in accordance with the requirements of Clause A5.3.7 and/or as specified in the Contract Documentation.

To allow sufficient time to test and assess all aspects of a trial section(s) and to determine the final content of stabilising agent required, the Contractor shall programme to start stabilisation work for the works no sooner than 10 working days after completion of the trial section.

Should the Contractor make any alterations to the methods, processes, equipment or materials used, or if the Contractor is unable to consistently comply with the specifications due to variations in the in-situ material, or for any other reason, further trial sections shall be constructed for assessment before continuing with the construction of the permanent works as instructed by the Engineer.

In the event of a trial section not being accepted due to non-compliance, the Contractor shall remove the trial section and construct a new trial section at no cost to the Employer. The trial section shall be paid for separately only when it complies with all the requirements of these specifications and has been accepted. Once acceptance of the trial section has been obtained, the mixing process and construction equipment shall remain unaltered unless instructed otherwise by the Engineer.

A5.4.7.2 Mechanical modification of pavement layer material

The specific layer material requiring to be mechanically modified shall be specified in the Contract Documentation or instructed by the Engineer.

When two or perhaps three different pavement layer materials need to be blended in order to provide a compliant composite material the proportion of each material type shall be specified based on the test results obtained from site blending trials.

a) Mixing materials from various sources in-situ

This Clause for mixing materials from various sources shall only apply when the smallest component of the materials mixture exceeds 20 % of the total mass of the mixture.

The material from the coarsest material source shall be placed onto the road at the point of use and spread in a layer of uniform thickness after which it shall be lightly rolled with a steel-wheeled roller. The material from the second and possibly third material source shall then be placed on top of the spread layer and then evenly spread on top in a layer of uniform thickness. After spreading each subsequent layer, each layer shall be lightly rolled with a steel-wheeled roller. After evenly spreading the different materials on top of each other, the materials shall be thoroughly mixed together, broken down if required and then spread evenly again to the required thickness.

The Contractor shall take care to avoid segregation from occurring during the mixing and spreading processes. The grading of the mixed material shall then be tested at random locations as instructed by the Engineer and further mixing shall be required if grading tests indicate that the material is not mixed sufficiently.

The finally mixed material shall also be tested for compliance with the specification of all the material properties for use in the specific layer. **b)**

Modifying material in-situ by the addition of a soil binder

When the smallest component is less or equal to 20 % of the total mass of the mixture then the process shall be regarded as the addition of a soil binder. The addition of the soil binder may be required to modify the grading or to reduce the plasticity index.

The material to be modified shall be placed onto the road at the point of use and evenly spread in a layer of uniform thickness after which it shall be lightly rolled with a steel-wheeled roller. The specified soil binder material shall then be placed on top of the evenly spread material and then evenly spread in a layer of uniform thickness over the first layer of spread material. The soil binder and material shall be thoroughly mixed together, broken down if required and then spread evenly to the required thickness.

The grading and plasticity index of the mixed material shall then be tested at random locations as instructed by the Engineer and the modified material shall be tested for compliance with the specification for use in the specific layer.

A5.4.7.3 Chemical pretreatment and stabilisation

The material to be stabilised or pretreated shall be prepared and placed as specified in Section A5.3. The surface of the prepared layer shall then be lightly watered until it is damp and given at least one pass with a flat wheel or steel tyre roller.

a) Applying the cementitious agent mechanically

After the layer of material has been prepared, the cementitious agent shall be spread uniformly over the full area of the layer by means of an approved type of mechanical bulk spreader at the prescribed rate of application in a continuous process.

When the mechanical application of the cementitious agent is clearly uneven in places it shall be evenly respread using squeegees where required so that it is uniformly spread over the entire surface to be stabilised before mixing may commence.

A recycler may be used to mechanically apply the cementitious agent through an on-board automatic dispensing system. Adjacent cuts of the recycler shall overlap by at least 150 mm. Over application of either moisture or cementitious agent in the overlap shall not exceed 10 % of the average requirement for the layer.

b) Applying the cementitious agent by hand

When spreading of the cementitious agent is done by hand, pockets or bags of cementitious agent shall be accurately packed out and spaced at equal intervals across the full area of the section to be stabilised so that the specified rate of application will be achieved. Spreading shall only commence once it has been confirmed by the Engineer that the correct quantity of cementitious agent has been placed on the layer by physically counting the number of pockets and checking the spacing of the pockets.

The even spreading of the hand spaced and packed cementitious agent may further be done by hand using squeegees, provided that the wind speed is less than 15 km/h (4 m/s). Irrespective of the spreading method used the cementitious agent shall be uniformly spread over the entire surface to be treated.

c) Mixing in the cementitious agent using conventional equipment

Immediately after the cementitious agent has been evenly spread, it shall be mixed with the layer material for the full depth of treatment. The completed layer underneath shall not be damaged, nor shall the cementitious agent be mixed below the required depth. Mixing shall be continued until a homogeneous mix of the material and the cementitious agent has been achieved over the full area and depth of the material being pretreated or stabilised.

Mixing shall be done using a combination of a grader, disc harrow and/or rotary mixer or by using a recycler, working over the full area and depth of the layer by means of successive passes of the construction equipment as applicable. When a recycler is used in isolation, cross-mixing is often inadequate and additional mixing plant shall then be utilised in conjunction with the recycler to ensure thorough cross-mixing. Mixing may also be done in a central batch-mixing plant if the Contractor so chooses.

After completion of the mixing process the mixed material shall be spread and shaped.

If the material is being pretreated, the shaped layer shall be given at least one pass with a flat wheel or steel tyre roller and left undisturbed for the time period as specified in Table A5.4.3-1. After the specified time period, the chemically modified layer may then be stabilised in accordance with Section A5.4 if the material is now compliant for stabilisation or processed and compacted as an unstabilised layer in accordance with Section A5.3.

d) Watering and mixing in of water for stabilisation using conventional equipment

Moisture content tests shall be done the day before the stabilising agent is to be added to the material in order to determine the amount of water that must be added to bring the moisture content up to the required compaction moisture content. If there is any rain after the moisture content test samples were collected additional tests shall be done.

Immediately after the cementitious agent for stabilisation has been properly mixed with the material, the required amount of compaction water shall be added incrementally. Each application of water shall be thoroughly mixed with the material before more water is added so as to avoid a concentration of water near the surface or the flow of water across the surface of the layer.

The Contractor shall ensure that a satisfactory and even moisture distribution is achieved over the full depth, width and length of the section being stabilised and shall ensure that no portion of the work gets excessively wet after the cementitious stabilising agent has been added. Any portion of the work that becomes too wet after the stabilising agent has been added and before the mixture has been compacted, due to poor construction control or disregard for the specified weather limitations or for any other specified requirement that has not been complied with, shall be rejected. Such portions shall be allowed to dry out to the required moisture content and shall then be scarified, re-stabilised using additional agent, compacted and finished off in accordance with the specification, all at no cost to the Employer.

The water supply and watering equipment shall be adequate and sufficient to ensure that all the water required shall be added and mixed with the material within a short enough period to enable compaction and finishing to be completed within the period specified in Table A5.4.3-1.

The moisture content of the material during compaction shall never exceed 80 % of the saturation moisture content of the natural material without a stabilising agent.

The moisture content at the specified saturation degree (Sr) shall be determined as follows:

$$W_v = S_r \{X_w/X_d - 1000/G_s\}$$

W_v = moisture content of the specified degree of saturation (%)

X_w = density of water (kg/m³)

X_d = dry field density of the material (kg/m³)

G_s = apparent density of the material (kg/m³)

S_r = specified degree of saturation (%).

e) Applying and mixing in the cementitious agent using a recycler

When the cementitious agent is applied by hand the requirements of Clause A5.4.7.2b) remain applicable.

The requirements of proper moisture control specified in Clause A5.4.7.2d) remain applicable.

The recycler shall be capable of applying the agent and mixing to the required depth in a single pass. The recycler shall be equipped with an onboard automatic spraying system that can accurately apply a specific metered quantity of water over the full width of the milling drum. Electronic sensors shall be fitted to maintain the milling/mixing depth within a tolerance of 5,0 mm.

The speed of rotation of the milling drum and the forward speed of the machine shall be adjustable to obtain a material that is evenly mixed with the cementitious agent. The outer edges of the recycler cut shall be vertical and the floor of the cut shall be clean and to the lines specified in the Contract Documentation. The width of application shall be the same as the cut-width of the recycler.

The recycler shall be required to simultaneously add the required amount of water and mix the cementitious agent to produce an approved uniform mix.

f) Compaction of a chemically stabilised layer

Section A5.3 shall apply to the compaction of chemically stabilised layers.

During the compaction process the Contractor shall ensure that no lamination layers or biscuit layers are formed within the compacted layer. Final rolling shall be done with equipment that will give a smooth surface finish which conforms to the surface tolerances specified. Low spots on the surface of a chemically stabilised layer may not be filled after compaction.

When a recycler has been used to mix the layer material Contractor shall ensure that the mixed material between the wheel paths of the recycler is compacted to at least the same density as the material in the wheel paths, before commencing with the cutting of levels.

The minimum compaction requirements shall be as specified for the particular layer. Sufficient compaction equipment shall be employed on each layer to ensure that, from the time when the stabilising agent is first mixed into the layer, the mixing process, watering, compacting, shaping and final finishing will be completed within the time periods specified in Table A5.4.3-1.

A5.4.7.4 Bituminous stabilisation

a) In-situ mixing for stabilisation

The material to be stabilised with bitumen shall be prepared and placed as specified in Section A5.3.

(i) Addition of the cementitious agent

If a cementitious agent is specified as part of the bituminous stabilisation process then it shall be evenly spread over the layer surface (Clause A5.4.7.2) before the bitumen stabilisation process commences.

When using standard construction equipment such as a grader along with a plough / rotovator, the Contractor shall pre-mix the cementitious agent into the layer as specified (Clause A5.4.7.2) before the compaction moisture and the bituminous stabilising agent is added and mixed in.

When using a recycler, the cementitious agent shall be mixed in at the same time as the compaction moisture and the bituminous stabilising agent is being added.

(ii) Heating and diluting the bituminous stabilising agent

The bituminous stabilising agent shall be heated to the required temperature as specified by the supplier.

If dilution of the bitumen emulsion stabilising agent with water is required, only potable water shall be used. The water shall be added gradually during constant stirring or circulation of the emulsion by means of pumps to prevent the emulsion from separating or breaking.

(iii) Apply and mix in the bituminous stabilising agent

The bituminous stabilising agent (foamed bitumen or bitumen emulsion) may be applied and mixed into the material using an approved in-situ recycling machine as specified in Section A5.5.

When a bituminous emulsion stabilising agent is being used it can be applied using a calibrated spray tanker with a spray bar, followed immediately behind ahead of it being mixed into the material using a grader and a rotovator.

The quantity of material being stabilised with a bituminous stabilising agent must be restricted to the amount that can be properly mixed with the available equipment before the bitumen emulsion breaks.

b) Remote mixing for stabilisation

Where in-situ mixing and stabilisation is not possible due to a confined working area or inadequate turning space for the construction equipment, then remote off-site mixing may take place.

(i) Remote site and material preparation

An appropriate site shall be prepared in accord with Section A4.1 of Chapter 4 in the same way a stockpile site is specified to be prepared.

Place and spread the material on the prepared remote site to a thickness of approximately 300 mm. Place and spread the cementitious agent as specified in Clause A5.4.7.2 and proceed to mix using appropriate construction equipment such as a grader, or an articulated loader, or a rotovator.

(ii) Adding the bituminous stabilising agent

Apply the bituminous stabilising agent, heated and/or diluted as specified, using a hand sprayer and then mix the material further.

Once the material has been thoroughly mixed it shall be loaded, hauled, placed and then processed at its point of use, as specified in Sections A5.3 and A5.4.

A5.4.7.6 Finishing at joints

This Clause A5.4.7.6 relates specifically to the construction of joints when the material is stabilised and is in addition to the specification in Clause A5.3.3.7.

Where existing works and new works are joined the material shall be mixed with the stabilising agent and compacted without causing any permeable or loose patches along the longitudinal or transverse construction joints.

Any completed portion of a stabilised layer adjacent to new work, which is used as a turn-around area by equipment in constructing the adjoining section, shall be provided with a protective cover of soil or gravel of at least 100 mm thick over a sufficient length to prevent damage to the completed work.

When the adjoining section is being finished, such cover shall be removed to permit the construction of a smooth vertical joint at the junction of the completed and adjoining section. Material 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.

The junctions of sections shall be finished so as to obtain an even and well-compacted joint and so as not to cause damage to the adjacent parts of any other sections.

A5.4.8 WORKMANSHIP

A5.4.8.1 Inspection of the works

The Engineer shall do routine inspections and conduct routine tests to determine whether the quality of material and workmanship provided, complies with the requirements of the Contract Documentation.

Any stabilised layers with lamination layers such as biscuit layers, as identified visually and/or by the hollow sound caused when a heavy chain is dragged over the stabilised layer, shall be rejected.

The material in the rejected sections of the completed layer shall be ripped and removed and replaced with new material. The new material shall then be stabilised and compacted according to the specifications prior to the construction of any subsequent layers.

Alternatively, the material in the rejected sections can be recycled in-situ with an additional quantity of stabilising agent as determined by testing and instructed by the Engineer. In-situ recycling will only be permitted provided that the properties of the recycled material are compliant with the specified requirements for that layer of material.

All remedial work shall be carried out at no cost to the Employer.

A5.4.8.2 Material properties

The test results and measurements of the material quality, compaction density, stabiliser content and the engineering properties of the stabilised layers shall be assessed in accordance with the provisions of Chapter 20.

A5.4.8.3 Quality/process control

It shall be the responsibility of the Contractor to ensure that the Engineer has been informed in writing of the daily testing requirements. The material testing can then be properly co-ordinated and completed timeously.

Sample preparation and testing for checking and approving the properties of chemically stabilised material shall be done as per the approved SANS test methods.

Sample preparation and testing for checking and approving the properties of bituminous stabilised material shall be done as specified in Section A5.5.

The stabilised material sampled from the layer for the compaction of MDD briquettes shall be prepared according to SANS 3001-GR50 and compacted according to SANS 3001-GR31.

A5.4.8.4 Tolerances

a) Rates of application

(i) Chemical stabilisation

The average rate of application of a cementitious stabilising agent when applied by mechanical bulk spreading equipment and measured by the canvas patch method shall be within 5 % of the specified rate of application over any section not exceeding 1,0 km in length. No single measurement shall deviate by more than 20 % from the specified rate.

When hand placed and spread, or spotted, stabilising agents shall be spread exactly to the specified rate of application.

The rate of application of the cementitious stabilising agents added to the material in a central mixing plant shall be controlled by means of weighing the stabilising agent before it is introduced into the mixing plant.

(ii) Bituminous stabilisation

The rate of application of the bituminous stabilising agent shall be within 5 % of the specified rate in the Contract Documentation. **b) Uniformity of cementitious stabilisation**

The quantity of cementitious binder in the mixed material as determined during sampling and testing as specified in Chapter 20, shall be within the limits specified in the statistical judgement plan described in Chapter 20 using the following formula; (S_n / X_n) where;

S_n = the standard deviation of stabiliser

X_n = the average stabiliser content

Where required by the Engineer, the Contractor shall determine the mix uniformity of chemically stabilised layers by means of indirect tensile strength tests, using SANS 3001-GR54. Samples for the determination of the uniformity of the mix shall be taken immediately after the material has been mixed with the water and stabiliser and spread, but before the layer is compacted. The Contractor shall therefore make the necessary arrangements timeously and allow for the time to collect the samples.

As described in Chapter 20, test results shall be adjusted to make allowance for the presence in the material being stabilised of minerals, which affect the test results. The above requirements for uniformity of mix shall be applied only on condition that the variation in these adjustments falls within the limits specified in Chapter 20. The coefficient of variation may not exceed 0,3 or 30 % for material mixed in-situ, and 0,2 or 20 % for material mixed in a central mixing plant.

or the specific layer being treated.

Item	Description	Unit
C5.4.5	Cementitious stabilisation agents for pavement layers	

C5.4.5.1 Addition of cementitious stabilisation agents (specify agent separately) for pavement layers

(a)	Cement (for pavement layer)	ton (t)
(b)	And so forth for other agents (for pavement layers)	ton (t)

C5.4.5.2 Addition of cementitious stabilisation agents (specify agent separately) for pavement layers and spreading the agent using bags and labour enhancement methods.

(a)	Cement (for pavement layer)	ton (t)
(b)	And so forth for other agents (for pavement layers)	ton (t)

The unit of measurement shall be the ton of cementitious stabilising agent spread and mixed into the prepared layer material in-situ.

The tendered rates shall include full compensation for the supply and delivery of the agent to the point of use. The tendered rates shall also include for spreading the specified amount of cementitious stabilising agent, and all materials, supervision, labour, equipment, tools and incidentals necessary for completing the specified work. The layer thickness can be varied by up to 20 mm and the rate for this work shall remain applicable.

A distinction shall be made between spreading the cementitious soil stabilisation agents by mechanical bulk spreaders or using labour enhancement methods.

C5.4.6 Addition of cementitious stabilisation agents (specify agent separately) for a PMPL layer

C5.4.6.1	Cement	ton (t)
C5.4.6.2	And so forth for other agents	ton (t)

The unit of measurement shall be the ton of cementitious stabilising agent mixed into the material at a central mixing plant at the specified application rate.

The tendered rates shall include full compensation for delivery of the agent from storage to the mixing plant and introducing the specified amount of cementitious agent and water into the mixing plant for the PMPL layer and all materials, supervision, labour, equipment, tools and incidentals necessary for completing the specified work. No distinction shall be made in respect of the type of cementitious stabilisation agent used, the time for completion or the specific layer being produced whether that is a wet lean-mix concrete or a chemically stabilised crushed stone material.

Item	Description	Unit
C5.4.7	Bituminous stabilisation of pavement layers	cubic metres (m³)

C5.4.7.1 Bituminous stabilisation (layer thickness indicated) of pavement layers (layer to be indicated) litres (ℓ)

C5.4.7.2 Bituminous stabilisation (layer thickness indicated) of pavement layers (layer to be indicated) using labour enhanced methods of construction litres (ℓ)

The unit of measurement shall be the cubic metre of stabilised material, the quantity of which shall be determined in accordance with the authorised dimensions of the bituminous stabilised compacted layer.

The tendered rates for bituminous stabilisation shall include full compensation for watering and compacting the surface of the placed material prior to spreading the stabilising agent, for mixing the specified amount of stabilisation agent and material and shall include full compensation for all incidentals. No distinction shall be made with regard to the type of bituminous stabiliser used, the time for completion, and the particular layer to be stabilised with bitumen. The tendered rate shall apply to any combination thereof.

The layer thickness can be varied by up to 20 mm, and the rate for this cementitious stabilisation work shall remain applicable.

A distinction shall be made between spreading the cementitious soil stabilisation agents by mechanical bulk spreaders or using labour enhancement methods.

Item	Description	Unit
C5.4.8	Bituminous stabilisation agent (specify agents separately)	

C5.4.8.1 60 % anionic emulsion litres (ℓ)

C5.4.8.2 60 % cationic emulsion litres (ℓ)

C5.4.8.3 Foamed bitumen litres (ℓ)

C5.4.8.4 Any other litres (ℓ)

The unit of measurement shall be the litre of bituminous stabilising agent mixed into the road layer at the specified application rate. For bitumen emulsion this shall be the litre of 60 % emulsion mixed into the material. For foamed bitumen this shall be the litre of bitumen that is foamed.

For bitumen emulsion stabilisation the tendered rates shall include full compensation for diluting and introducing the specified amount of stabilisation agent at the point of use, and shall include full compensation for all incidentals. No distinction shall be made in regard to the type of bituminous stabiliser used, the method of application, the time for completion, and the particular layer to be stabilised with bitumen and the tendered rates shall apply to any combination thereof. The layer thickness can be varied by up to 20 mm, and the rate for this bituminous stabilisation work shall remain applicable.

For foamed bitumen, the rate shall also include for foaming the bitumen on the recycler, including the water and any other additive that may be required to achieve the minimum foaming characteristics and for injecting the foamed bitumen into the material being processed

The tendered rates shall also include full compensation for heating and the transfer into tankers of the bitumen. It shall also include for coupling to the recycling train, for all transport on site, for any re-heating required, for all wastage and for strict adherence to all safety measures required when handling warm or hot bitumen.

Item	Description	Unit

C5.4.9 Filler for bituminous stabilisation

C5.4.9.1	Filler for bituminous stabilisation (specify agents separately)	ton (t)

C5.4.9.2	Filler for bituminous stabilisation spreading the agent or filler using labour enhanced methods of construction (specify agents separately)	ton (t)

The unit of measurement shall be the ton of cementitious agent mixed into the road layer at the specified application rate.

The tendered rates shall include full compensation for the supply and the blending of the specified amount of filler with the bituminous stabilisation process and all materials, supervision, labour, equipment, tools and incidentals necessary for completing the specified work. No distinction will be made in respect of the type of filler used, the time for completion or the specific layer being treated.

A distinction shall be made between spreading the filler by mechanical bulk spreaders and using labour enhancement methods.

C5.4.10 Provision and application of water for curing kilolitre (kℓ)

The unit of measurement shall be the kilolitre of water provided and applied for curing a chemically stabilised layer.

The tendered rate shall include full compensation for furnishing, transporting and applying the water.

Item	Description	Unit

C5.4.11 Curing by covering with the subsequent layer square metre (m²)

The unit of measurement shall be the square metre of chemically stabilised pavement layer being cured by covering it with the subsequent layer. The quantity will be determined by the plan area of the authorised dimensions of the layer being cured

The tendered rate shall include full compensation for incidentals in respect of applying the subsequent layer for curing as specified, including the cost of regularly supplying and applying water.

Item	Description	Unit

C5.4.12 Curing with a membrane (type of material to be specified)

C5.4.12.1	Cut back bitumen	litre (ℓ)

C5.4.12.2	Inverted bitumen emulsion	litre (ℓ)

C5.4.12.3	Spray grade emulsion	litre (ℓ)

C5.4.12.4	Curing compound for PMPL layers	litre (ℓ)

The unit of measurement shall be the litre of curing material measured at spraying temperature and sprayed as specified.

The tendered rates shall include full compensation for supplying the material, preparation of the surface before applying the curing membrane, applying the membrane material and maintaining the surface as specified.

Item	Description	Unit

C5.4.13 Trial section for a PMPL layer (specify width) square metre (m²)

The unit of measurement for the trial section of the plant-mixed paver-laid pavement layer shall be the square metre of trial section of the specified width as specified in the Contract Documentation measured along the centre line of the road. A total length of at least 250m of trial section and no more than 350 m will be measured for payment as a trial section.

The tendered rate shall include full compensation for supplying, introducing and mixing the cementitious stabilising agent at the specified rate at the mixing plant for the construction of the trial section.

Item	Description	Unit

C5.4.14 Trial section for a chemically stabilised layer cubic metre (m³)

The unit of measurement for the trial section of a chemically stabilised pavement layer shall be the cubic metre of trial section as per the authorised dimensions. A total length of at least 150 m of trial section and no more than 200 m will be measured for payment as a trial section.

The tendered rate shall include full compensation for placing spreading and mixing the stabilising agent at the specified application rate during the construction of the trial section.

Item	Description	Unit

C5.4.15	Trial section for a bituminously stabilised layer (specify width)	square metre (m²)

The unit of measurement for the trial section of a bituminously stabilised pavement layer shall be the square metre of trial section of the specified width as specified in the Contract Documentation measured along the centre line of the road. A total length of at least 250 m of trial section and no more than 350 m will be measured for payment as a trial section.

The tendered rate shall include full compensation for placing spreading and mixing the bituminous stabilising agent and filler at the specified application rate during the construction of the trial section.

Item	Description	Unit
C5.4.16	Mechanical modification	cubic metre (m³)

The unit of measurement shall be the cubic metre of material in the compacted layer which has been mechanically modified as per Clause A5.4.7.2a) calculated using the layer work dimensions given in the Contract Documentation.

The tendered rate shall include full compensation for mixing all the different materials together to form one homogeneous layer as per Clause A5.4.7.2.

Payment for the construction operations required to process and compact the modified layer shall be made under item C5.3.2.

Item	Description	Unit
C5.4.17	Addition of a soil binder	cubic metre (m³)

5.5 RECONSTRUCTION OF PAVEMENT LAYERS

A5.5 RECONSTRUCTION OF PAVEMENT LAYERS

PART A: SPECIFICATIONS

A5.5.1 SCOPE

This Section covers the work requirements for the reconstruction of existing road pavement layers. This comprises patching and in-situ reconstruction.

A5.5.1.1 Patching

Patching covers the work requirements for the patching of existing pavement layers, and in exceptional cases patching fills and the roadbed, with the purpose of repairing local failures. Patching involves excavating the existing failed sections to the specified depth and area, removing the excavated material and reconstructing the excavated fills and pavement layers with the specified material.

Patching specified in this Section A5.5 is applicable when the project scope of works is predominantly the reconstruction of Pavement Layers.

Patching specified in Section A8.8 is applicable when the project scope of works is predominantly the construction of Asphalt Layers.

This scope also covers the work requirements for the repair of edge breaks.

Resurfacing the repaired failed area does not form part of this scope and is provided for in Chapters 8 and 9.

A5.5.1.2 In-situ reconstruction

In-situ reconstruction covers the work requirements for the process using either conventional construction equipment exclusively or a customdesigned recycling machine (recycler) along with some conventional construction equipment, to reconstruct pavement layers.

A5.5.2 DEFINITIONS

The relevant definitions in the standard specification are applicable. Additional definitions for this Section are included here.

Conventional equipment - this is equipment that is normally used for the construction of the Works. This equipment excludes equipment specifically designed and used for in-situ reconstruction works and/or for the recycling of materials.

Cross-mixing - this is the mixing of layer materials horizontally across a layer width when the material properties of the layer are not the same throughout the width and the depth of the layer. Cross-mixing cannot be carried out using a recycler.

Edge break - an edge break is a defect in which the outer edge of the wearing course and part of the underlying pavement layer (asphalt or crushed stone or gravel) is broken and/or worn away resulting in an irregular road edge line with an average defect width of 250 mm or less. Edge breaks wider than 250 mm are defined as patching.

In-situ - this means in the actual original or final location without moving the material elsewhere.

Patching - means the repair of failures in fill and/or pavement layers when the failed width is less than 1,0 m or the failed length is less than 25 m or the failed area is less than 100 m². Patching does not include the pretreatment of a surfacing, or the repair/patching of surfacing defects, or the rehabilitation of a concrete pavement which is covered in Chapters 8 (pretreatment), 8 (surface defects) or 7 (repair of concrete).

Reconstruction - this is the reconstruction of existing pavement layer material (in-situ or reclaimed material) with or without stabilisation. Reconstruction in several construction phases can be accomplished using conventional construction equipment to reclaim and reconstruct layer work material or in a single construction phase using a recycler along with some conventional construction equipment to achieve the reclaiming and reconstruction of layer work material.

Rehabilitation - this is the restoration of an existing deteriorated or failed road pavement either to the original constructed condition or to a better condition. The restoration of the road pavement can take place by patching, by layer reconstruction, by adding layers or a combination of the aforementioned as specified in the Contract Documentation.

Recording pass - this is the roller-pass when the roller's compactometer readings are recorded, cross-referenced to a location and compared with the specified layer density requirements. A recording pass is only made on the second roller-pass over the same area. A recording pass comprises two passes with the roller.

Slushing - the process of wetting the surface of a compacted layer accompanied by rolling with a smooth-drum roller and/or a pneumatic tyre roller to generate saturated fine material or slush, on the upper surface of the compacted layer.

Uniform pavement section - a uniform pavement section has pavement layers with similar layer materials, similar layer properties, similar layer thicknesses and similar deflection responses (when available) throughout the section. Uniform pavement sections shall be clearly identified in the Contract Documentation.

CHAPTER 6: CONCRETE LAYERS

6.1 PAVER LAID CONCRETE LAYERS

CONTENTS

PART A: SPECIFICATIONS

A6.1.1 SCOPE

A6.1.2 DEFINITIONS

A6.1.3 GENERAL

A6.1.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

A6.1.5 MATERIALS

A6.1.6 CONSTRUCTION EQUIPMENT

A6.1.7 EXECUTION OF THE WORKS

A6.1.8 WORKMANSHIP

PART B: LABOUR ENHANCEMENT

PART C: MEASUREMENT AND PAYMENT

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

A6.1 PAVER LAID CONCRETE LAYERS

PART A: SPECIFICATIONS

A6.1.1 SCOPE

This Section covers all the material requirements and work pertaining to the construction of mechanically paver laid concrete layers on new supporting layers or existing concrete or asphalt layers and include, inter-alia, the following pavement types:

- Jointed concrete pavement (JCP- Plain) – with or without dowels, for new construction or overlays
- Continuously reinforced concrete (CRCP) for new construction or overlays

It includes, inter alia, the specifications for materials, manufacture and construction requirements as relevant to the specific pavement as prescribed.

This Chapter does not apply to the repair and or rehabilitation of concrete pavements, which is covered in Chapter 7: Maintenance and Repair of Concrete Layers. The construction of concrete pavements utilising labour based methods or relatively small or isolated sections of concrete pavement are covered in Part B of this Chapter.

A6.1.2 DEFINITIONS

Jointed Concrete Pavement (Plain JCP) - concrete pavements that contain sufficient joints to control all expected natural cracks. All necessary cracking occurs at joints and not elsewhere in the slab. However, there may be load transfer devices (e.g. dowel bars) at transverse joints and deformed steel bars (e.g. tie bars) at longitudinal joints, which are not considered as reinforcement.

Continuously Reinforced Concrete Pavement (CRCP) - concrete pavements that include continuous longitudinal reinforcement steel typically between 0,50 and 0,70 % of the cross-sectional area of the pavement slab. They also typically include transverse reinforcing consisting of individual bars placed at approximately 1,0 m intervals or as specified in the Contract Documentation.

Aggregate - granular material of natural, manufactured or recycled origin used in the manufacture of concrete products to the specific grade/class as defined in these specifications and the latest published version of SANS 1083, or as may be otherwise specifically specified in the Contract Documentation:

- Course aggregate – all aggregate > 5,0 mm as further defined in the latest SANS 1083 specification for the specific class of aggregate and nominal maximum aggregate size as required.
- Nominal maximum particle size (NMPS) – designated as one sieve size larger than the largest sieve to retain a minimum of 15 % of the aggregate particles.
- Fine aggregate – all aggregate fractions ≤ 5,0 mm and which shall consist of clean material derived from crushing competent parent rock, or naturally occurring sand conforming to SANS 1083 and any further specified requirements listed herein.

Cement - as defined in SANS 50197-1 for the various classes as listed.

Cement extenders or supplementary cementitious materials - the following as defined in the relevant SANS documents:

- Ground Granulated Blast Furnace Slag: As defined in SANS 55167-1
- Fly Ash: As defined in SANS 50450-1

Characteristic compressive strength - characteristic strength of concrete is the compressive cylinder or cube strength below which no more than 5 % of the test results in a statistical population shall fall, tested as specified in SANS 3001-CO 1 and 2.

Valid test result (F_{cu}) - a valid test result, for the purpose of evaluating compressive strength, shall comprise of the arithmetic mean of three cube or cylinder specimens where the difference between the highest and lowest result does not exceed 15 % of the arithmetic mean of the specimens.

Water: cementitious binder ratio - the ratio of the total water content to total cementitious binder content by mass in the mixed concrete.

A6.1.3 GENERAL

A6.1.3.1 Quality Plan

Prior to commencing with any permanent works, the Contractor shall submit a Quality Plan, for review and acceptance by the Engineer, detailing all checks and hold points relating to construction of the specified product. All work shall be completed in accordance with accepted Plan, with any deviations resubmitted to the Engineer for evaluation and acceptance prior to implementation thereof.

A6.1.3.2 Trial sections

Where so provided for in the pricing schedule, the Contractor shall construct a trial section for each pavement type specified. The location and area of the trials in an area that simulates the permanent work condition shall be as directed by the Engineer. The purpose of the trial is for the Contractor to demonstrate that the equipment, processes and intended concrete mix that he proposes to use will enable him to construct the particular concrete layer in accordance with all the specified requirements. Evaluation and monitoring of the trial section shall include all items listed in the South African Pavement Engineering Manual (SAPEM), Chapter 12 Appendix, Table 19: Concrete Pavement Trial Section Checklist. The Contractor shall calibrate the equipment and refine the mix design and construction process at his own cost.

The Contractor may, unless advised of any deficiencies in the trial section, proceed with the construction of the pavement ten days after the completion of the trial section or such earlier time as the Engineer may determine. In the event of deficiencies in the trial section, the Engineer may order the Contractor to construct a further trial section, which shall again be regarded as the initial trial section with no additional cost. The Contractor may then proceed with the construction of the pavement ten days after the satisfactory completion and acceptance of the second or subsequent trial section.

If the Contractor should make any alterations in the methods, processes, equipment or materials used and approved, or if he is unable to comply consistently with the specifications, the Engineer may require that a new trial section be constructed, at the Contractor's cost, before allowing the Contractor to continue with any permanent work. The intention of this clause is to avoid any experimentation by the Contractor on the permanent work.

The trial sections shall be laid where indicated by the Engineer. The Contractor shall prepare the surface on which to lay the trial section and shall also, if required, remove the trial section after completion and restore the surface on which it was constructed, all at the Contractor's cost.

Provision is made for payment of the first approved trial section of any particular mix type, but subsequent trial sections that may be required for the same mix type shall be at the Contractor's own cost. Payment will be made for the specified area of each approved first trial section for any particular mix type.

A6.1.3.3 Weather limitations

a) Responsibility for protection

The Contractor shall be responsible for the quality and strength of the concrete placed and for its protection. Any concrete damaged by adverse weather, such as, any combination of high or low ambient temperature, low humidity, wind, rain and hail, shall be removed and replaced at the Contractor's expense.

b) Protection against rain or hail

No concrete shall be placed during rainy weather. For the concrete to be properly protected against rain and hail before it has sufficiently hardened, the Contractor shall have available at all times frame-mounted waterproof covers for protecting the surface of the unhardened concrete. In addition, when slip-form pavers are used, the Contractor shall also provide acceptable emergency protection for the slab edges. When rain appears to be imminent, all paving operations shall cease and the Contractor shall take the necessary steps to protect the unhardened concrete. The Contractor shall be responsible for the repair of any damage to the concrete, texturing or the curing compound that may occur. **c) Cold-weather paving**

All reasonable precautions shall be taken to prevent the temperature of the pavement concrete from falling below 5°C during the first 48 hours after casting. When prevailing temperatures are low, or when cold weather is forecast and there is a danger that the temperature of the freshly constructed concrete pavement will fall below the prescribed limits the Contractor shall either cease all pavement operations, or he may be permitted to proceed, provided that the Engineer is satisfied that adequate protective measures are available and will be taken to ensure that the temperature of the pavement will be maintained above 5°C for the period stated.

d) Hot-weather paving

When paving is done 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 place the concrete at the coolest temperature practicable. Paving operations shall cease when the concrete temperature as discharged at the paver exceeds 32°C.

e) Hot and windy weather paving

Unless appropriate and adequate protection measures to the plastic concrete are provided, all production of concrete and paving operations shall cease when the prevailing evaporation rate, as determined in accordance with the nomograph given in Clause A 20.1.5.15 of Chapter 20 exceeds 1,0 kg/m²/hr.

Provision has been made in the Pricing Schedule in Chapter 1 for the establishment of a portable weather station to be located in the immediate vicinity of the paving site and positioned at 1,0 m above the level of the pavement being constructed. During paving operations the Contractor shall provide the Engineer with all the relevant data as recorded by the weather station.

A6.1.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

A6.1.4.1 General

The Contractor shall be responsible for providing suitable materials as prescribed in Clause A6.1.5, determining the mix proportions, and manufacturing the concrete of the required quality and consistency.

The specifications prescribed for materials to be used for concrete shall not limit the Contractor's responsibility to design and manufacture concrete which complies with the requirements of these specifications. If the Contractor finds it necessary to work to more stringent tolerances than those specified, or that the aggregates have to be further processed in any way (e.g., by washing or sieving) to permit, or to facilitate, paving operations,

all costs resulting therefrom shall be for the Contractor's account. However, if the Contractor is of the opinion that the requirements of the specifications regarding the materials to be used will prevent him from manufacturing concrete of the required quality, he shall submit the necessary supporting evidence to the Engineer. If such evidence is acceptable to the Engineer, he may amend certain requirements of the materials specification.

A6.1.4.2 Design requirements

a) Water-cement ratio

The water-cement ratio shall not exceed 0,53.

b) Minimum cement content

The total cementitious content of the mix shall be not less than 320 kg/m³.

c) Specified strength

The relationship between the 28-day cube compressive and the 28-day flexural of the concrete shall be established by laboratory tests.

The specified compressive strength shall be the highest of the following four values:

- (i) 35 MPa at 28 days; or
- (ii) 0,85 f_{c1} where f_{c1} is the 28-day compressive strength corresponding to a 28-day flexural strength of 4,5 MPa.
- (iii) 0,85 f_{c2} , where f_{c2} is the 28-day compressive strength corresponding to a water: cement ratio of 0,53.
- (iv) 0,85 f_{c3} , where f_{c3} is the 28-day compressive strength corresponding to a cement content of 320 kg/m³.

Where f_{c1} , f_{c2} and f_{c3} shall be the 28-day compressive strengths determined from laboratory mixes as prescribed in Clause A6.1.4.3. **d)**

Workability of the concrete

The mix proportions and consistency of the concrete mix shall be such that, with the equipment in use, the concrete can be adequately transported, discharged, and fully consolidated without excessive bleeding or segregation of the components. The concrete consistency shall be appropriate to the type of paving equipment used, the haul, the weather and the site conditions. Where consistency is measured by way of a slump test in accordance with SANS 3001-CO1-3, the slump shall not deviate by more than 20 mm from the optimum value for mixes with a target slump of 35 mm or greater.

Where the required consistency of the concrete is such that the desired slump is less than 35 mm, the consistency of the concrete shall be determined by means of the Vebe test in accordance with SANS 3001-CO1-4. **e) Air content**

Where an air-entraining agent is prescribed in the Contract Documentation, the total air content in the freshly mixed concrete shall be $M \pm 1\%$, where M is the target value within the limits of 2 % to 4 %. Tests shall be conducted in accordance with SANS 3001- CO1-8.

A6.1.4.3 Design procedure

a) General

The proportions of cement and aggregate required for producing concrete which complies with the requirements of these specifications shall be determined by means of laboratory tests on concrete manufactured from the cement, coarse and fine aggregates, admixtures (if any) and water proposed for use in the works.

b) Preliminary tests

At least thirty days prior to the construction of the trial pavement, as specified in Clause A6.1.3.2, the Contractor shall submit to the Engineer samples of all the components of the concrete he proposes to use, together with a report by an approved testing laboratory showing the mix proportions proposed for each combination of material sources for the concrete. The report shall also include the following:

- (i) The results of tests on the specified properties of all components.
- (ii) The relationship between the 28-day compressive strength and flexural strength of the concrete at each of at least three water cement ratios namely 0,48; 0,53 and 0,58.
- (iii) The effect of the particular admixture (if any) proposed by the Contractor in regard to variations in admixtures, air content (if air entraining), concrete setting and sawing times.
- (iv) The effect of at least three water contents on concrete consistency.

In determining the relationship between compressive and flexural strength, the tests shall be based on not less than six compressive-strength specimens and six flexural-strength specimens for each water-cement ratio. All tests shall be conducted in accordance with the methods in SANS 3001 CO1, SANS 3001 CO2 and SANS 3001 CO3 as relevant.

c) Changes in the mix proportions or the materials

- (i) If during the progress of the work the requirements set out in Clause A6.1.4.2 are not being met by concrete manufactured from the materials or material mix proportions as approved, the Contractor shall immediately cease producing such concrete and shall effect such changes to the mix proportions and/or materials as may be necessary in order to meet those requirements.
- (ii) If during the progress of the work the Contractor wishes to use materials or mix proportions other than those originally approved, or if the materials from the sources originally approved change with regard to any properties, he shall, before proceeding with further work, submit adequate evidence to the Engineer that the new materials or combination of materials will produce concrete which complies with the requirements of Clause A6.1.4.2 and shall not bring about any detrimental changes in the properties of the concrete.
- (iii) Any such changes made shall be at the Contractor's expense, and no extra payment shall be allowed for reason of such changes.
- (iv) Where concrete is required to be placed, vibrated or finished with hand equipment for any specific reason, the requirements of Clause A6.1.4.2 shall remain applicable irrespective of the size of the concrete panel or concrete patch placed. The mix proportions, however, shall be

adjusted to promote hand placing, vibrating and finishing, but only if the Contractor has produced written proof to the Engineer that the requirements of Clause A6.1.4.2 cannot be complied with under the specific circumstances.

d) Changes in requirements

The Engineer shall have the power, at any time during the progress of the work, to order changes in the requirements set out in Clause A6.1.4.2. In such cases the Contractor shall be compensated in accordance with the terms of the contract for the additional cost of materials or additional handling, placing and/or other costs, if any, resulting from such changes. If such changes result in savings, the Engineer shall recover such savings from the Contractor.

e) Mix designs

The mix design requirements as specified in Clause A1.2.5.2 will also apply. Testing for mix designs shall be performed by laboratories accredited by SANAS for the relevant tests.

A6.1.5 MATERIALS

A6.1.5.1 Cementitious materials

The cementitious materials used for concrete shall comply with the following standards:

- Cement shall comply with SANS 50197-1 (EN 197-1) with a strength class of 32,5 or greater, and a rate of strength gain N or greater. Cement shall hold valid certification in the form of a Letter of Authority issued as certified approval pursuant to the Compulsory Specification for cement published by Government Notice R.544. Masonry cement shall not be used. The cement type and class incorporated in the mix shall be appropriate to the type of pavement to be constructed and the placing, finishing and saw cutting constraints envisaged.
- Ground Granulated Blast Furnace Slag - SANS 55167-1
- Fly ash - SANS 50450-1

Blends of cement complying with SANS 50197-1 and supplementary cementitious materials complying with the above standards may be used subject to a maximum of 20 % of the total cementitious content.

In order to promote resource sustainability principles, cement shall have a maximum average carbon dioxide emission value of 925 kg CO₂e per ton, determined in accordance with the World Business Council for Sustainable Development Greenhouse Gas Protocol.

All cementitious materials shall be protected from moisture until used, and there shall be sufficient facilities to ensure that the cementitious materials to be used in the work are kept separate from each other and from other cementitious materials.

Where cementitious materials are stored in a silo, the silo must be emptied before using the silo for a different cementitious material. Blended cements with a percentage of SCM differing by more than 2 % shall be considered different cementitious materials.

The cementitious binder shall comprise either cement, complying with SANS 50197-1, or an approved site blend of such cement and supplementary cementitious materials that take appropriate cognisance of environmental conditions, durability and strength requirements. The site blending of cement with supplementary cementitious materials shall only be conducted on the basis of an acceptable quality assurance system approved by the Engineer.

A6.1.5.2 Water

Water for washing aggregates, mixing concrete, and curing shall comply with relevant requirements specified in SANS 51008.

A6.1.5.3 Aggregates for concrete

a) General

Aggregates shall not contain any deleterious quantities of organic material, particularly pieces of timber, grass or similar matter as assessed by visual inspection, which will cause unacceptable surface defects when they float to the top of fresh concrete during vibration. Aggregates shall comply with the requirements of SANS 1083 for concrete but subject to the following:

The average 28 day drying shrinkage of 3 concrete samples made from each of the required three concrete mixtures for preparing the compressive strength and flexural strength samples in accordance with Clause A6.1.4.3 shall not exceed 0,040 %. Drying-shrinkage tests shall be conducted in accordance with SANS 3001-CO2-7. Where the drying shrinkage exceeds the specified maximum value, either alternative aggregates shall be used, further investigations undertaken, or evidence shall be produced with a view to confirming the suitability of the aggregates proposed for use. The historical behaviour of the aggregate in concrete may serve as a recommendation in such cases if accepted by the Engineer. **b)**

Alkali-aggregate reaction

Where there is any risk of a particular combination of aggregate and cement giving rise to a harmful alkali-aggregate reaction, the proposed combination shall be tested in accordance with SANS 6245 (SANS3001- AG 46). Where the result indicates such potential reaction, the aggregate, shall be replaced so that an acceptable combination may be obtained.

c) Coarse aggregate

(i) Hardness

When tested in accordance with SANS 3001 No AG10, the 10 % FACT value shall comply with the following requirements:

10 % FACT Dry - 210 kN minimum: Wet – 160 kN minimum.

(ii) Flakiness Index

The flakiness index of the coarse aggregate, as determined in accordance with SANS 3001 – AG4 shall not exceed 35.

(iii) *Nominal Maximum Particle Size (NMPS)*

The maximum nominal particle sizes of the coarse aggregate fraction in the mix shall be as follows:

- Slab thickness >175 mm: 37,5 mm, plus one or more of the following 20,0 mm, 14,0 mm and 10,0 mm.
- Slab thickness >150 mm < 175 mm: 28,0 mm (Where recommended by an approved laboratory and approved by the Engineer, smaller sizes of aggregate, nominal 20,0 and/or 14,0 mm sizes shall be provided).
- Slab thickness >100 mm <150 mm: 20 mm (Where recommended by an approved laboratory and approved by the Engineer, smaller sizes of aggregate, nominal 14,00 and/or 10,0 mm sizes, shall be provided).
- Slab thickness <100 mm: 14,0 mm (Where recommended by an approved laboratory and approved by the Engineer, smaller sizes of aggregate, nominal 10,0 mm and/or 7,1 mm shall be provided).

d) Fine aggregate

The fine aggregate shall be either a natural or crusher-produced sand or a blend of natural and crusher sands. Where a mixture is used, and the quantity passing through each of the 0,150 mm and 0,075 mm sieves shall not exceed the relevant interpolated values for the approved blend. Where required by the Engineer the fine aggregate shall contain more than 20 % quartz by mass.

The acid insolubility of the fine aggregate, or fine aggregate blend, as determined in accordance with SANS 642, shall exceed 40 %.

The fineness modulus (FM), as determined in accordance with SANS 3001 AG-1 and PR-5, FM of the fine aggregate (or mixtures thereof) shall not deviate from the approved fine aggregate component (or mixtures thereof) by more than 0,20.

e) Additional requirements for aggregates

Where instructed by the Engineer, aggregates shall be checked and shall be free of the following deleterious substances:

- (i) Tests for the presence of sugar shall be determined in accordance with SANS 3001-AG-30 (SANS 5833) and shall be free from the presence of sugar;
- (ii) Tests for soluble deleterious impurities shall be conducted in accordance with SANS 3001-AG-31 (SANS 5834) and shall have minimum compressive strength of 85 % of the reference;
- (iii) Test for the presence of material of low density shall be determined in accordance with SANS 3001-AG-?? (SANS 5837) and shall have maximum 0,5 % by mass;
- (iv) Tests for soluble salts shall be determined in accordance with SANS 3001-AG-40 (SANS 5849) and shall have maximum 0,5 % by mass;
- (v) Tests for water soluble sulfates shall be determined in accordance with SANS 3001-AG-31 (SANS 5850-1) and shall have maximum 0,2 % SO₃ by mass; and
- (vi) Tests for the presence of shell material shall be determined in accordance with SANS 3001-AG-35 (SANS 5840) and shall be maximum 5 % by mass.

A6.1.5.4 Admixtures to concrete

No admixtures shall be used without the written permission of the Engineer. The admixtures proposed for use shall be assessed during the mix design process and construction of the trial section.

All admixtures for concrete shall comply with the requirements of SANS 50934 (EN 934), ASTM C494 or AASHTO M194. Admixtures shall be approved by the Engineer and be compatible with the exposure environment and cementitious binder composition. Admixtures shall have no deleterious effects on the steel or concrete, and shall not contain any chlorides, nitrates, sulphides or sulphites, which may be detrimental. Admixtures shall generally be supplied in liquid form and accurately dispensed by a mechanical dosing unit in a manner appropriate to the method batching e.g. dry versus wet batching. Unless extraordinary circumstances dictate otherwise, under no circumstances shall a mixture be dispensed directly onto the mix components. Where extraordinary circumstance does exist, other methods of feeding into the concrete mixture shall be agreed with the Engineer. Where specified, air entraining agents may alternatively comply with the requirements of SANS 50934 (EN 934), ASTM C260 or AASHTO M154.

Where combinations of two or more admixtures are utilised, they shall be tested for compatibility. The total amount of admixtures shall not exceed the maximum dosage recommended by the admixture producer and also shall not exceed 5 % by mass of the total cementitious binder, unless the influence of the higher dosage of admixture on the performance and durability of the concrete is established and taken into account.

If the total quantity of liquid admixture equals or exceeds 3 litres per cubic metre of concrete, the admixture quantity shall be included in the water content of the concrete mixture when calculating the water: cementitious binder ratio.

The alkali content (Na₂O-equivalent) of all admixtures shall form part of the calculation of the alkali content of concrete in order to limit the degree of reactivity as specified in Clause A13.4.7.2a) of Chapter 13.

Where so specifically specified, or proposed by the Contractor, any chemical or air-entraining admixtures used shall comply with the requirements of SANS 50934 Parts 1 to 6 and shall be of an approved type and brand. In addition, admixtures shall be subject to such tests as may be prescribed by the Engineer, carried out at an approved testing laboratory at the Contractor's expense to determine the effect of the admixture on the concrete mix including early strength development. Admixtures containing calcium chloride shall not be used.

Admixture properties shall be uniform throughout their use in the work and stored and dispensed in liquid form.

If more than one admixture is used, the admixtures must be compatible with each other such that the desirable effects of all the admixtures used are realized.

Admixtures shall be utilised in compliance with the manufacturer's written instructions. The instructions shall include a statement that the admixture is compatible with the types and quantities of cementitious material intended for use.

If the use of admixtures is not specified, the dosage thereof shall be as recommended by the admixture manufacturer to achieve any enhanced fresh or final concrete characteristics required.

A6.1.5.5 Reinforcing steel, tie-bars and dowels

a) Dimensions

The dimensions for reinforcing steel, tie-bars and dowels shall be as indicated on the drawings and Contract Documentation. **b)**

Reinforcing steel and tie bars

Reinforcing steel and tie-bars shall comply with the requirements of SABS 920. Tie-bars shall be deformed mild-steel bars or deformed high-yield steel, except that any tie-bars intended to be bent and subsequently straightened shall be hot-rolled deformed mild-steel bars. The use of plate type tie bars shall be approved by the Engineer.

c) Welded steel fabric

Welded steel fabric shall comply with the requirements of SABS 1024.

d) Dowel bars at transverse joints

Dowel bars shall be mild-steel bars having a smooth, circular section produced on a Kocksblock to ¼ DIN tolerance of the DIN 1013 specification. Dowel bars shall be straight and free from irregularities and without any burred ends, and shall have their sliding ends sawn and bevelled. Cropping of dowels shall not be permitted. The free or un-bonded end of the dowel shall be coated with a bond-breaking coating, as directed by the Engineer, to prevent the concrete from adhering to it. The coating or sheath shall cover at least two-thirds of the dowel length. The bond-breaking coating shall be an approved synthetic material applied at a thickness of 0,5 mm in accordance with the manufacturer's recommendations. The sheath shall be a tough polyethylene material with an average thickness of 1,0 mm ± 0,2 mm.

The use of alternative plate dowels shall be approved by the Engineer.

A6.1.5.6 Curing compound

The curing compound used shall be a white-pigmented resin-based curing compound containing no water and which complies with the requirements of ASTM C 309, except that the water loss requirement be substituted with the efficiency-index as determined in accordance with BS 7542. The efficiency-index shall exceed 90 % at an application rate of 0, 2 l/m². A recent certificate not older than 3 months from an approved testing laboratory shall be submitted, certifying that the curing compound complies with the specifications. Further testing shall be conducted at regular intervals.

The curing compound shall be capable of hardening within 30 minutes of having been applied and of being sprayed onto a wet surface without loss of stability, change in colour or becoming less efficacious. This characteristic shall also be confirmed by the approved testing laboratory.

A6.1.5.7 Materials for joints

a) Joint filler for expansion joints

Joint filler for expansion joints shall be manufactured from a closed-cell polyethylene and the filler strips shall be provided with tear-off cover strip. The joint filler shall comply with the requirements of AASHTO M 153, and the particular type used shall be subject to the Engineer's approval. Joint filler for isolation joints shall be pre-formed expansion joint filler for concrete (bituminous type) complying with ASTM D 994. **b) Silicone**

sealant

Unless specifically approved by the Engineer, the joint sealant shall be silicone specifically formulated for use on concrete.

(i) Sealant

The silicone sealant shall be a one-component material with low-modulus properties. The use of acid cure sealants shall not be permitted. Silicone joint sealant must be compatible with the surface it is applied to and have properties shown in the Table A6.1.51:

Table A6.1.5-1: Silicone joint sealant

Property	Test method	Specification
Tensile stress, 150 % elongation, 7-day cure at 25°C ± 2°C and from 45 % to 55 % Relative Humidity	ASTM D 412 (Die C)	0,31 MPa max
Flow at 25°C ± 2°C with 15 % slope channel A	ASTM C 639	must not flow from channel
Extrusion rate through 3.18mm opening at 0.62 MPa at Material temperature - 18°C	ASTM C 603	min 75 g/min
Extrusion rate through 3.18mm opening at 0.62 MPa at Material temperature 38°C	ASTM C 603	max 250 g/min
Relative density /Specific gravity	ASTM D 792 Method A	1.01 to 1.51
Durometer hardness, at -18°C, Shore A, cured 7 days at 25°C ± 2°C	ASTM C 661	10 to 25
Ozone and UV resistance, after 5,000 hours	ASTM C 793	no chalking, cracking or bond loss
Tack-free at 25°C ± 2°C and 45 % to 55% Relative Humidity	ASTM C 679	less than 75 minutes
Elongation, 7 day cure at 25°C ± 2°C and 45 % to 55 % Relative Humidity	ASTM D 412 (Die C)	500 % min.

Set to Touch, at 25°C ± 2°C and 45 % to 55 % Relative Humidity	ASTM D 1640	Less than 75 minutes
Shelf Life, from date of shipment	--	6 months min.
Bond, to concrete mortar-concrete briquettes, air cured 7 days at 25°C ± 2°C	AASHTO T 132	0,34 MPa min
Movement capability and adhesion, 100 % extension at 18°C after, air cured 7 days at 25°C ± 2°C, and followed by 7 days in water at 25°C ± 2°C	ASTM C 719	no adhesive or cohesive failure after 5 cycles
Colour		Grey

The Contractor shall submit a certificate, less than six months old, from an approved testing laboratory, certifying that the sealant conforms to all the specified requirements.

The silicone sealant shall be applied by means of pumping the sealant from a storage container by means of compressed air powered pumping equipment and applied to the joint slot by means of nozzles designed to ensure that the slot is filled with sealant as indicated on the drawings. Application of the sealant into the joint slot by hand shall not be permitted.

(ii) *Silicone sealant applied in terms of a Product Performance Guarantee System*

Sealant installed in accordance with the above shall be in accordance and be assessed in terms of Part D of these specifications

(iii) *Additional materials for silicone sealant*

Backer rods shall comply with ASTM D 5249, Type 1. The backer rod diameter shall be at least 25 % greater than the saw cut joint width. Backer rod material shall be expanded, cross-linked, closed-cell polyethylene foam.

The sealant shall be supported by a bond breaker backing strip, and, unless otherwise recommended by the manufacturer and approved by the Engineer, the faces of the joint groove shall first be treated with an appropriate primer.

Supporting and priming materials shall be compatible with adjacent materials or surfaces in contact with the materials and shall be in accordance with the recommendations by the manufacturer and subject to approval by the Engineer. Any primer used shall form a barrier layer between the silicone and the concrete.

(iv) *Materials for cleaning, repairing and resealing of existing joints and cracks*

Materials used for cleaning existing joints and for repairing and sealing or resealing joints and cracks shall comply with the provisions of the Contract Documentation. Cleaning agents shall be such that they will not stain the concrete or cause the existing bituminous or other material to soak into the concrete.

c) Liquid sealant for joints between concrete or asphalt pavement

The liquid sealant used in joints between concrete and asphalt pavement shall be of the hot-poured type and shall comply with the requirements of US Federal Specification SS-S-1401, or any other type as may be approved by the Engineer.

A6.1.6.7 Applicator for curing compound membrane

The Contractor shall provide equipment for applying curing compound that is self-propelled and capable of uniformly applying the curing compound at the specified rate. The equipment shall be capable of continuously stirring the curing compound by effective mechanical means to keep the pigmentation in suspension. The curing compound shall be thoroughly atomized during the spraying operation so that the finished surface appearance of the fresh concrete will not be marred. The entire surface of the pavement shall be covered by a single pass of the machine and, with slip-form type paving, shall also include the vertical exposed faces. Spray nozzles shall be equipped with appropriate wind guards to ensure uniform application.

Hand operated power-spray equipment may be used to apply curing compound to areas where it is impracticable to operate the self-propelled equipment.

A6.1.6.8 Equipment for paving small or narrow areas

For minor roads, variable width areas, other than mainline, ramps, and shoulders, the Engineer will not require the full slipform paver as specified for the standard run of paving. In such instances the Contractor shall utilise appropriate hand equipment and construction methods as prescribed in Part B of this Chapter in order to achieve the desired final product as specified. The Contractor shall provide a comprehensive method statement and quality plan to the Engineer for approval prior to commencing with any such work.

A6.1.7 EXECUTION OF THE WORKS

A6.1.7.1 Preparing the underlying layers

a) General

The underlying layers shall be constructed in accordance with the relevant standard specifications, and any additional relevant Contract Documentation as may be prescribed, up to the level of the underside of the concrete slab. The surface of the layer directly below the concrete should not be smooth, loose or show signs of lamination.

The Contractor shall note the provisions of Chapter 1 in regard to the use of construction tolerances for successive pavement layers and shall make provision in his prices for any additional concrete which may be necessary in respect of irregularities in the layer underlying the concrete pavement.

b) Applying the prime or bond coat

Unless otherwise specified in the Contract Documentation, a bituminous prime coat shall be applied to the completed cementitious stabilised subbase layer in accordance with the requirements of Chapter 8: Pre-treatment and Repair of existing Layers. Where the underlying subbase layer consists of asphalt, a bituminous bond coat shall be applied in accordance with the relevant requirements of Chapter 9: Asphalt Layers. The nominal application of 0,3 l/m² net bitumen shall be applicable in each instance. Before any pavement concrete is placed, the prime or bond coat shall be cured and shall be checked. Any areas having deficient or poor application, or where damaged, shall be repaired as directed by the Engineer. The coated surface shall then be thoroughly cleaned and shall be dry before any reinforcing steel, tie bars, dowels or concrete may be placed.

c) Wetting the subbase

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 the road ahead of the paver so as to ensure that the subbase will still be damp when the concrete is placed. No puddles of water or deleterious matter shall be left on the road.

A6.1.7.2 Batching and mixing of concrete

a) General

Concrete may be batched at a dedicated mixing plant on site, or supplied by a commercial ready mix facility. In either instance the concrete shall conform to the requirements as listed in Clause A6.1.6.2 Concrete Batching Plants. All constituent materials shall be stored and handled so that their properties do not change, for example due to climate conditions, intermingling or contamination, and that their conformity with the respective standard is maintained.

b) Cement and supplementary cementitious materials

Cement and supplementary cementitious materials stored on the site shall be kept separately under cover which provides adequate protection against moisture and other factors which may promote deterioration of the cement or supplementary cementitious material.

Cement and supplementary cementitious material may only be used if stored and maintained at a temperature less than 45°C. In hot weather concreting conditions, the cement and supplementary cementitious material storage facilities shall be painted with white high solar reflectance paint and insulated to reduce any temperature rise in the stored cement or supplementary cementitious material.

Cement or supplementary cementitious material supplied in bags shall be closely and neatly stacked, separately to a height not exceeding 12 bags and arranged so that they will not be in contact with the ground, the floor or the walls, and can be used in the order in which they were delivered to the site.

Cement or supplementary cementitious material supplied in bulk shall be stored separately in waterproof containers so designed as to prevent any dead spots from forming, and the cement or supplementary cementitious material drawn for use shall be measured by mass.

Cement shall not be kept in storage for longer than 8 weeks without the Engineer's permission, and different brands or types of the same brand of cement or supplementary cementitious material shall be stored separately.

c) Aggregates

Aggregates of different nominal sizes, sources or types shall be stored separately. Intermixing of different materials and contamination by foreign matter shall be avoided. Aggregates exposed to a chloride (XS) environment (refer Table A13.4.7-2 of Chapter 13) shall be covered to protect them from salt contamination. Sufficient quantity of fine aggregate shall be stockpiled on site and handled in a manner that ensures the thorough mixing of the various deliveries in order to achieve a stable fineness modulus within the specified limits.

In hot weather concreting conditions, both the coarse- and fine-aggregate stockpiles shall be shaded from the sun. When the ambient temperature reaches and at all times when it exceeds 30°C, only the coarse aggregate shall be sprayed with water to assist cooling by evaporation. Water shall be delivered by means of an approved water droplet sprayer system. The Contractor shall ensure adequate drainage of the aggregate stockpile area.

Where concrete is batched on site, the aggregates shall be stored in bins with a minimum 150 mm thick concrete floor constructed below the aggregate stockpile to prevent contamination during the storage and handling the aggregate. The floor slab shall be appropriately sloped to facilitate drainage of the stockpile area. A 3,0 m wide concrete apron slab shall be constructed around the entrance and outer edge of the aggregate stockpile area and sloped for drainage away from the main stockpile area. The aggregates shall be tipped on the concrete apron slab to prevent contamination during the process of tipping and hoisting the aggregate. **d) Water**

In hot weather concreting conditions, the sides and tops of water tanks for mixing water, including pipework leading to and from tanks, shall be insulated.

e) Storage capacity

The storage capacity provided and the quantity of material stored, whether cement, supplementary cementitious materials, aggregates, admixture or water, shall be sufficient to ensure that no interruptions to the progress of the work will be occasioned by any lack of materials. **f)**

Deteriorated material

Deteriorated or contaminated or otherwise damaged non-conforming material shall not be used in concrete. Such material shall be removed from the site without delay.

g) Proportioning the components (i)

Cementitious binder

Where cementitious binder is supplied in standard bags, the bags shall be assumed to contain 50 kg for batching purposes. Cementitious binder taken from bulk storage containers and from partly used bags shall be batched by mass, accurate to within 2 % of the required mass.

(ii) Water

The mixing water for each batch shall be measured, either by mass or by volume, accurate to within 2 % of the required quantity. The quantity of water added to the mix shall be adjusted to make allowance for any moisture in the aggregates.

(iii) Aggregates

All aggregates for concrete shall be measured separately by mass, except as otherwise provided in this Clause, accurate to within 3 % of the required quantity.

(iv) Admixture

Admixtures shall generally be supplied in liquid form and accurately dispensed by a mechanical dosing unit, into solution with the mixing water, except where the admixture cannot be dispersed homogeneously into the mixing water. Unless extraordinary circumstances dictate otherwise, under no circumstances shall admixtures be dispensed on to dry mix components. Where such extraordinary circumstances do exist, in such cases, other methods of feeding into the concrete mixture shall be agreed with the Engineer.

All admixtures shall be dispensed in quantities accurate to within 2 % by mass of the desired quantity. The mechanical dosing unit shall be checked daily for accuracy using a nominal dispensing volume, typically 2 litres, or as recommended by the dosing unit manufacturer or admixture supplier. At least once a week, the dosing unit shall be checked for accuracy using the full dispensing volume suited to the concrete mixing procedures employed on site, typically for 6 cubic metre concrete batch mixed by a standard mixing truck and proportionally for other standard batch volumes. **h) Mixing the concrete**

(i) General

Mixing the material for concrete shall be conducted by an experienced operator. Unless otherwise authorised, mixing shall be carried out in a mechanical mass batch-mixer of an approved type which will be capable of producing a uniform distribution of ingredients throughout the batch.

(ii) Charging the mixer

The sequence of charging the ingredients shall be subject to approval by the Engineer, and, unless otherwise instructed, the same sequence of charging the ingredients shall be maintained. Fibres, pigments and colouring agents shall be added to the mix in a manner that ensures that they are uniformly dispersed in the mix.

The volume of the mixed material by batch shall not exceed the volume recommended by the manufacturer of the mixer.

(iii) Mixing and discharging

The period of mixing shall be measured from the time when all the materials are in the drum until the commencement of discharge.

The mixing period for the materials shall be at least 90 seconds and may be reduced only if the Engineer is satisfied that the reduced mixing time will produce concrete with the same strength and uniformity as concrete mixed for minimum 90 seconds. The reduced mixing time, however, shall be not less than 50 seconds or the manufacturer's recommended mixing time, whichever is the longer. A suitable timing device shall be attached to the mixer to ensure that the minimum mixing time for the materials has been complied with.

The first batch to be run when starting with a clean mixer, shall contain only 75 % of the required quantity of coarse aggregate to make provision for coating the mixer drum. Refer Clause A13.4.7.12g) of Chapter 13 for a similar provision for richer concrete mix placed at horizontal construction joints.

Discharge shall be so carried out that no segregation of the materials will occur in the mix. The mixer shall be emptied completely before it is recharged with fresh materials.

(iv) Maintaining and cleaning the mixer

If the mixer has stopped running for a period in excess of 30 minutes, it shall be thoroughly cleaned out with 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.

Before any concrete is mixed, the inner surfaces of the mixer shall be cleaned and all hardened concrete shall be removed. Worn or bent blades and paddles shall be replaced.

i) Transporting the concrete

Concrete shall be so transported to its final position that segregation or loss of any of the ingredients, or contamination, will be prevented, and that the mix is of the required workability at the point and time of placing.

The Contractor will be permitted to use appropriate truck mixers which agitate previously mixed concrete in transit.

The fresh concrete shall be protected against rain, heat, direct sunlight and/or evaporation by means of covers on all open vehicles. No additional water may be added in transit or where delivered.

The time lapse from the moment when the cement and aggregate are intermingled up to the time of placing and compacting the concrete shall not exceed 60 minutes when concrete is transported in truck agitators, and shall not exceed 45 minutes in mild weather, or 30 minutes when the concrete temperature is 30°C or higher, when transported in ordinary trucks.

A6.1.7.3 Placing, Compacting and Finishing Concrete

a) General requirements for both side-form and slip-form paving

(i) Maintaining continuity during placing

The Contractor shall make adequate advance arrangements for preventing delay in delivering and placing the concrete. An interval of more than thirty minutes between the placing of any two consecutive batches or loads of concrete shall constitute sufficient reason for the Engineer to have the paving operations stopped, and the Contractor shall, then at his own expense, make a construction joint in the concrete already placed, at the location and of the type directed by the Engineer. Paving operations shall be continuous, and the rate of paving shall be adjusted to suit the rate of delivery of the concrete.

(ii) Time for placing and compacting

The placing, compacting and finishing of the concrete shall be carried out as quickly as possible, and the operations shall be so arranged that, in any transverse section of the pavement, the concrete shall be fully compacted and finished within 2,5 hours of having been mixed. 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 beforehand by the Contractor, the placing of concrete pavement shall cease in good time so that the finishing operation can still be completed during daylight hours.

(iii) Compacting

The concrete shall be fully compacted by means of approved equipment and shall be free from honeycombing and planes of weakness. The average amount of air voids in concrete cores shall not exceed 1,5% when measured by the visual assessment method described in SANS 5865 (SANS 3001-CO3-5).

Over-vibration resulting in segregation, surface laitance, or leakage (or any combination of these) shall not be acceptable.

No paving in the downhill direction will be allowed if tearing of the concrete occurs. The Contractor shall take the necessary measures to the satisfaction of the Engineer to prevent tearing of the concrete, for example by carrying out the paving in the uphill direction.

(iv) Width of placing

The width of concrete pavement strip to be placed in a single uninterrupted operation shall be as agreed with the Engineer so that longitudinal construction joints do not, as far as practical, fall within the wheel paths of the relevant lanes.

(v) Placing of tie bars

Tie-bars shall be placed as indicated on the drawings and shall be placed at right angles to joints. Tie-bars shall be free from paint, grease or other matter which may affect bonding with the concrete.

At longitudinal construction joints the one half of each tie-bar shall be supported on the subbase by means of suitable stools, while the other half shall project into the adjacent lane through the side forms. The arrangement and spacing and fixing of the tie bars and stools shall be such that they shall be supported in position without deflection or displacement when a dead load of 100 kg is applied or during placement and compaction of the concrete. Mild steel tie-bars at longitudinal joints may be bent parallel to the edge of the first lane constructed and later on straightened into its final position before the concrete of the adjacent lane is placed. The method of fixing and supporting the tie-bars shall be approved by the Engineer. Where tie-bars are bent and later straightened due to traffic accommodation constraints, any damage to the concrete shall be made good by the Contractor.

At longitudinal weakened-plane hinge joints the bars shall be firmly supported in position by steel supporting devices fixed to the subbase. If the paver or other paving equipment is equipped with a device for placing tie-bars into the plastic concrete, such device may be used only after it has been demonstrated that the tie-bars will be located in their correct positions after the slab has been compacted and finished.

(vi) Placing of dowel bars

Dowel bars shall be installed at locations as indicated on the drawings. Dowels shall be fixed rigidly both in horizontal and vertical alignment parallel to the centre line of the road and the surface of the slab, by robust supporting frames or cradles which do not project within 150 mm of the joint and are left permanently in place. The frames shall be fixed to the subbase so that they will be stable and remain undisturbed during paving operations. The free end of the dowel shall not be tack-welded to the frame but shall be held in position by soft binding wire. Dowels may be mechanically inserted, in which case no frames will be required for securing the dowels, provided that conclusive evidence is submitted that the proposed method is an accepted method and has already been used successfully. Dowel alignment shall be accurate to within the tolerance given in Clause A6.1.8.

(vii) Placing of continuous reinforcing steel in continuously reinforced concrete pavement

The continuous steel reinforcement shall be free from dirt, oil, paint, grease or other organic materials, which may adversely affect or reduce the bond with the concrete. Loose surface rust caused by lengthy storage shall be removed.

The arrangement and spacing and fixing of the chairs or stools shall be such that the reinforcing shall be supported in position without deflection or displacement when a dead load of 100 kg is applied or during placement and compaction of the concrete. The chairs shall be so supported as to prevent them overturning on the subbase when the paving train passes over them.

(viii) Placing of steel mesh in jointed concrete pavement

The reinforcing concrete welded mesh detail shall be as indicated on the drawings. The steel shall be free from dirt, oil, paint, grease or other organic materials which may adversely affect or reduce the bond with the concrete. Loose surface rust caused by lengthy storage shall be removed. The steel mesh sheets shall be handled with care so that they remain reasonably flat and free from

distortions. The sheets shall be free from kinks or bends that will prevent them from being properly assembled and installed. The arrangement and spacing and fixing of the chairs or stools shall be such that the reinforcing shall be supported in position without deflection or displacement during placement and compaction of the concrete. The reinforcement shall not straddle intended joints.

(ix) Burlap drag finish

This texture shall be obtained by first applying a burlap-drag, as specified in Clause A6.1.6.5, as a finish to the concrete surface. The first pass of the burlap drag shall be made as soon as construction operations permit and before the wet sheen has disappeared from the surface. Burlap dragging shall be repeated until a gritty and uniform texture having the required finish and depth of texture has been obtained.

Every morning the burlap drag shall be wetted and shall be kept moist throughout the day. At the end of each day's production the burlap mats shall be cleaned or discarded and replaced with new burlap if cleaning is not possible.

(x) Surface texturing

After completing the burlap finish described above, the pavement surface shall be further textured by means of a broom finish or grooving comb as stated in the Contract Documentation. The grooving comb shall be as specified in Clause A6.1.6.6. The direction of the texturing shall be at right angles to the longitudinal axis of the pavement. Surface texturing shall extend over the full width of the pavement.

The surface texture shall be applied and completed before the concrete is so hard that the surface will be torn and coarse aggregate unduly loosened during texturing. When measured with a suitable depth gauge, the grooves shall be not less than 2,0 mm and not more than 4,0 mm in depth.

After the concrete has hardened, all loose particles generated by the cutting of the grooves shall be broomed off the surface with stiff hand brooms or mechanically-operated rotary brooms.

The Engineer may permit the use of texturing equipment other than the grooving comb, provided that it produces a texture similar to that produced by the metal tines.

Texturing the surface with hand-held brooms or combs shall be allowed only where the pavement is so small or irregular, or the site is so restricted as to make the use of the texturing machine impracticable, or in cases of mechanical breakdown of the texturing machine, in which case it may be used for the required texturing of concrete already placed. The brush or comb to be used then shall be of the same type and width used in the machine. In order to ensure straight grooves the comb shall be operated against a straight-edge placed at right angles to the pavement centre line. The same requirements regarding groove dimensions or texture depth as for machine-texturing shall apply.

(xi) Curing

Immediately after the completion of texturing, a white-pigmented curing compound complying with the requirements of Clause A6.1.5.6, and in accordance with the direction of the manufacturer, shall be applied.

In the case of slip-form paving, the exposed surfaces, including the sides of the slab, shall be treated immediately after the required texturing of the surface has been effected. In the case of side-form paving the surface shall be treated immediately after the texturing has been completed and the sides of the panels after the side formwork has been removed.

The curing compound shall be sprayed onto the surface at a rate of 0,35 l/m² or as directed by the Engineer by means of a mechanical distributor capable of producing a fine fog-type of spray which will not damage the surface of the concrete. The curing compound shall be applied in two layers with the distributor moving in opposite directions for the two applications. Coverage shall be uniform over the entire surface and the rate of application of the curing compound shall be carefully controlled.

During spraying operations the curing compound shall be continuously stirred mechanically to keep the pigmentation in suspension. The spray nozzles shall be adequately protected against wind.

After shutting off the spray nozzles, no dripping of curing compound on the concrete surface may occur. If necessary, the Contractor shall provide drip pans suspended below the nozzles to prevent dripping of the curing compound onto the pavement.

The curing membrane shall be maintained intact for at least seven days after the concrete has been placed. Any damage to the curing membrane shall be repaired by hand-spraying the affected areas.

Areas inaccessible to the mechanical distributor such as odd shaped areas, those with varying widths or shapes or the sides of the slabs after removal of the form work, shall be sprayed with curing compound by means of approved hand spraying equipment, at the specified rate of application.

b) Side-form paving

(i) Side form set up

The side forms shall be accurately set to line and grade and in such a manner that they rest firmly, throughout their entire length, upon the subgrade surface. The forms shall be connected neatly and tightly, and braced in order to resist the pressure of the equipment operating on the forms. The Contractor shall obtain the Engineer's approval of the alignment and grade of all forms immediately prior to the placing of concrete.

Any voids between the established grade of the form line and the layer on which it is supported shall be caulked with a stiff mortar consisting of one part of rapid-hardening cement and 3 parts of sand by volume and finished vertically on the inside. The mortar shall have hardened sufficiently before any concrete may be cast against it. The rails, side-forms and running surface shall be kept clean in front of the wheels of all paving equipment.

As an exception, when placing forms on a cement-treated or asphalt subbase layer, the Contractor may use wedging, provided that the wedging system used adequately supports the forms without causing detrimental deflection under the weight of the paving equipment.

A sufficient number of forms shall be available on site at all times to ensure that at least 150 m of formwork can be accurately set and maintained true to line and grade in advance of the point where concrete is being placed. Sufficient forms shall also be provided so that it is not necessary to remove them less than 12 hours after placing the concrete. All forms shall be thoroughly cleaned and treated with an approved releasing agent prior to reuse.

(ii) Placing and spreading the concrete

The concrete shall be spread uniformly by means of a purpose-made mechanical hopper spreader running on rails and capable of spreading the concrete uniformly to a specified level and to a uniform un-compacted density over the entire surface of the slab. The machines shall be capable of being rapidly adjusted for changes in slab thickness or cross-fall.

(iii) Compaction

The concrete shall be fully compacted by vibration or by a combination of mechanical surface vibration, internal vibration and tamping. The power supply to the vibrators shall cut out automatically as soon as the compaction equipment stops moving. Suitable internal vibrators shall be used against the side-forms and at joint assemblies to ensure compaction throughout the pavement layer.

(iv) Final finishing

The surface of the concrete shall be finished smooth and true to grade and level by means of an initial finishing machine equipped with a transverse or oblique oscillating beam. The final finish of the surface of the slab shall be carried out by a machine which incorporates twin oblique oscillating finishing beams. The beams in the case of both machines shall be readily adjustable for both height and tilt, and the leading beam shall be vibrated. The beam shall be supported on a carriage with two wheels on either side, at least 3,5 m apart in the longitudinal direction. The oscillating beams shall be of rectangular section, spanning the full width of the slab and each weighing not less than 170 kg/m.

Hand-finishing of the concrete surface shall be reduced to the absolute minimum and shall be used only to correct minor imperfections and marks on the surface. Before the concrete starts setting, all pavement edges, and the edges of joints, shall be rounded off to the prescribed radius.

After finishing, the Contractor shall test the concrete surface with a straight-edge of at least 3,0 m in length. Irregularities indicated by the straight-edge shall be removed with a long-handled hand-operated scraping straight-edge of at least 3,0 m length. A gangplank shall be used when walking on the concrete.

Before the concrete starts setting, all pavement edges, and the edges of joints, shall be rounded off to the required radius.

(v) Constructing the pavement in more than one contiguous strip

Where concrete is placed adjacent to an existing pavement, that part of the paving equipment running on the existing pavement shall have flanged wheels on flat-bottom section rails weighing not less than 15 kg/m or by replacing the flanged wheels on that side of the machines by smooth flangeless wheels. Before the paving operation commences the surface regularity of the existing pavement shall comply with Clause A6.1.8 and be thoroughly cleaned and brushed to remove all extraneous materials. The wheels shall run at a distance of not less than 300 mm from the edge of the pavement to prevent the pavement edge from spalling or cracking.

No equipment or construction traffic shall be permitted on the completed pavement until the concrete is strong enough to prevent damage from occurring, but in any case not earlier than 14 days after the construction of the slab.

Where visible cracks occur or any other damage is done to the pavement, further work involving the paver shall be suspended immediately. The Contractor shall repair all damage at his own cost.

(vi) Removal of side forms

Side-forms shall not be removed before the concrete has hardened sufficiently to prevent damage being done to the sides and loosening of tie-bars or dowels, if any, and not earlier than 12 hours after the completion of the construction of the slab. The sideforms shall also be removed timeously to permit the sawing of transverse joints up to the edges of the concrete slab. Projecting tie-bars and/or the concrete shall not be damaged during removal of the side-forms. **c) Slip-form paving**

(i) Placing and spreading

The paver shall include a spreader box or auger capable of distributing the delivered concrete evenly to the specified level and to a uniform un-compacted density over the entire surface of the slab. The machines shall be capable of being rapidly adjusted for changes in slab thickness or cross-fall requirements.

(ii) Compaction

The slip-form paver shall compact the concrete over the full paved width by means of internal vibration only, or by a combination of internal and surface vibration. The vibration shall be variable with a maximum energy output of at least 2,5 kN per metre width of slab per 300 mm depth for a laying speed of up to 1,5 m per minute or pro rata for higher speeds.

(iii) Finishing

The level and grades of the surface shall be automatically controlled within the prescribed tolerances by means of a sensing device running on guide wires or a suitable 3D string-less system as approved. The consistency of the concrete shall be so controlled that the edge slump will not exceed the tolerance specified in Clause A6.1.8. If approved by the Engineer, metal side-forms of sufficient thickness and stability may be used to maintain the proper shape and line.

After the concrete layer has been completed by the finishing devices incorporated in the slip-form paving equipment, the surface of the concrete shall be checked by means of a straight-edge of not less than 3,0 m in length. High spots indicated by the straightedge shall be removed by hand floats.

After the final finishing and texturing of the concrete, but before curing, the pavement edges shall be rounded manually to the prescribed radius.

(iv) *Constructing the concrete pavement in more than one contiguous strip*

Except for the wheels, which shall, in the case of slip-form pavers, be replaced with rubber cushioned crawler tracks, the provisions of Clause A6.1.8 shall apply when concrete is being placed in more than one contiguous strip.

(v) *Track support*

The Contractor shall at his own cost ensure that adequate track support is provided to suit the needs of the slip-form paver, either by extending the upper pavement layers or by providing alternative support layers.

d) Placing, compacting and finishing with hand equipment

Where the slabs are too small or irregular, or the site is so restricted as to render the use of the methods described in Part A of this Chapter impracticable, concrete shall be placed, compacted and finished in accordance with Part B of this Chapter.

A6.1.7.4 Joint forming

a) Construction joints

Construction joints shall be made only in accordance with the details and in the positions shown on the drawings or determined by the Engineer. Where the pavement is constructed in more than one strip, longitudinal construction joints shall be constructed, and where edge slump in excess of 6,0 mm occurs with slip-form paving, the sides of the pavement shall be supported by an approved method.

Transverse construction joints shall be formed at the end of a day's work or where necessary on account of any unavoidable suspension of work.

The upper edges of the pavement shall be rounded off or chamfered at a construction joint as shown on the drawings. Where sealing of the construction joint is required, the groove may be sawn only after seven days' curing of the concrete.

b) Weakened-plain longitudinal hinge joints

Hinge joints shall be sawn where the pavement is constructed in widths of two or more lanes at a time. Sawing shall be done at an appropriate time, dependant on the cement type used and ambient temperatures to prevent longitudinal cracking from occurring, but not later than 24 hours after concrete placing.

The widths and depths of the groove and the joint filler shall be in accordance with the drawings. The width tolerances for hinge joints shall be as prescribed out in Clause A6.1.8.

Deformed steel tie bars shall be installed where indicated on the drawings.

c) Weakened-plain transverse contraction joints

Transverse contraction joints shall initially be sawn as specified in Clause A6.1.7.4e) and shall not exceed 3,0 mm in width. The grooves shall be sawn to the depth shown on the drawings. The exact time and sequence of sawing shall be determined by the Contractor, bearing in mind the risk of excessive ravelling and spalling with early sawing, and the risk of cracking with delayed sawing, but shall not later than 24 hours after the concrete has been placed.

When the pavement is constructed in more than one strip, the transverse joints opposite those which have opened in the adjacent pavement shall be sawn within the first 24 hours. The Contractor may initially omit up to two consecutive planned contraction joints and shall saw such joints within 48 hours of the concrete having been placed, but before uncontrolled cracking takes place.

All transverse joints shall initially be sawn to the full depth as indicated, and not more than 3,0 mm wide. In sealed joints the top portion of the groove shall be reamed out to the specified final width and depth not sooner than 7 days after the initial sawing.

Joints shall be sealed in accordance with the details shown on the drawings or as specified in the Contract Documentation. **d)**

Expansion joints

Expansion joints shall be constructed in accordance with the details shown on the drawings. The joint filler shall comply with the requirements of Clause A6.1.5.7 and holes for the dowels shall be accurately drilled. The filler for each joint shall be supplied in a single piece for the full depth and width required for the joint unless otherwise authorised by the Engineer. Where the use of more than one piece is authorised for a joint, the abutting ends shall be securely fastened, and held accurately in shape, by stapling or by another suitable method acceptable to the Engineer.

The joint filler together with the sealing groove shall completely separate adjacent slabs. Any loose-fitting dowel bars and any spaces between the subbase and the filler shall be caulked with joint-filler material after the joint has been assembled.

If expansion joints incorporate dowels, the dowels shall be encased at one end in a close-fitting cap. The cap shall be placed on the free half of each dowel which half shall be coated as late as possible before concreting, with a bond-breaking coating or sleeve which complies with the requirements of Clause A6.1.5.5d).

The sealing groove in the upper portion of the expansion joints shall be sealed with a preformed neoprene compression seal or any other appropriate sealant prescribed or approved.

e) Sawing of joints

The Contractor shall be responsible for determining the optimum time for the sawing of joints. This shall depend on the strength gain characteristics of the cementitious products incorporated in the concrete mix, the hardness of the aggregate and weather conditions at the time of placing. The Contractor shall use the type of blade and equipment best suited to the hardness of the concrete, type of aggregate and the site conditions in order to prevent uncontrolled cracking and any spalling adjacent to the joint being sawn.

Sufficient standby power saws shall be held available by the Contractor, ready for use, at all times when concrete is being placed in the pavement. Immediately after sawing, the joint grooves shall be washed out with a jet of clean water to remove all fine material which shall be appropriately disposed of at an approved site. The joints shall then be sealed temporarily by means of an approved material, flush with the permanent surface. No traffic of any kind shall be allowed on the pavement until all the joints have been permanently sealed.

f) Opening to traffic

No vehicle with an axle load exceeding 20 kN shall be permitted to travel over the completed surface within 14 days after it has been completed, or such longer period as may be directed by the Engineer.

A6.1.7.5 Joint sealing

Joints shall be permanently sealed before the pavement is opened to any traffic.

a) Silicone sealant

(i) Materials

The silicone sealant and appurtenant materials shall be as specified in Clause A6.1.5.7b). The dimensions and positions of the sealant and appurtenant materials shall be as shown on the drawings, as specified in the Contract Documentation, or as approved by the Engineer.

(ii) Installation

Just prior to sealing, the joint grooves shall be reamed to their prescribed final dimensions and shall then be cleaned by means of a high pressure jet of water over the full depth of the joints to remove all fine matter and to produce dust-free joint grooves. Immediately before the supporting material is supplied, the grooves shall be dried by means of oil-free compressed air at a pressure of 700 kPa. Compressors shall be equipped with an apparatus which removes water and oil from the compressed air. Where a primer is required, it shall be applied before the supporting materials are installed.

After the joints have been finally cleaned and the primer (if any) has been applied, a supporting backing cord shall be installed by means of an approved rolling tool in the prescribed positions. Where the joints are dirty, wet or moist, the supporting material shall be removed, the joints cleaned and dried, and fresh material applied.

The procedure(s) to be followed by the Contractor to prevent the sealant from being spilt onto the concrete pavement shall be subject to approval by the Engineer. The silicone sealant shall be pumped continuously directly into the joints with a suitable pneumatically driven pump. Sealing shall be done from the upper surface of the supporting material. Immediately after installation and before a skin appears, the surface of the sealant shall be worked to compact the sealant and to press it against the sides of the joint so as to ensure that the prescribed clearance under the road surface is obtained. As an alternative to separate installation and finishing of the sealant, an approved injection nozzle incorporating a finishing apparatus may be used, in which case only closed-cell polyethylene may be used as supporting material. Further directions supplied by the manufacturer shall be strictly complied with, particularly with regard to temperatures for application, opening to traffic, and safety aspects. No traffic shall be permitted to pass over a sealed joint before the sealant is able to withstand the penetration of foreign matter.

The top surface of the sealant shall not be less than 5,0 mm and not more than 7,0 mm below the paved surface. All surplus sealant and other foreign matter shall be removed from the concrete pavement surface in accordance with the directions of the manufacturer of the sealant.

b) Liquid sealant for joints between concrete and asphalt pavements

These joints shall be sealed with a hot-poured joint-sealing compound as specified in Clause A6.1.5.7c). Prior to application, the joints shall be clean and free from water. Curing compound adhering to joint walls shall be removed by sandblasting 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 at least 700 kPa immediately before the sealing operation. The sealant shall be applied in accordance with the manufacturer's instructions, particularly in regard to the temperature of application, which shall be strictly controlled.

A6.2 SEGMENTAL BLOCK PAVING LAYERS

PART A: SPECIFICATIONS

A6.2.1 SCOPE

This Section covers the furnishing of materials and the construction of segmental block paving for roads.

A6.2.2 DEFINITIONS

Segmental block paving – a system of individual shaped blocks arranged to form a continuous hard-wearing and durable surface overlay.

A6.2.3 GENERAL

Not applicable to this Section.

A6.2.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

Where it is specified in the Contract Documentation that the blocks shall be manufactured in a dedicated on-site facility by the Contractor, all the requirements as listed in SANS 1058 for the specific class of block specified shall be applicable.

A6.2.5 MATERIALS

A6.2.5.1 Paving blocks

Concrete paving blocks shall comply with the requirements of SABS 1058. The block shall be of the class, type and thickness specified in the Contract Documentation. The surface texture and colour of all blocks shall be uniform.

A6.2.5.2 Bedding sand

Bedding sand shall not contain any silt, clay or other deleterious impurities. The sand shall comply with the following grading requirements in Table A6.2.5-1.

Table A6.2.5-1: Grading requirements for bedding sand

Sieve size (mm)	Percentage passing by mass
7,1	100
5,0	95 – 100
2,0	80 – 100
1,0	50 – 85
0,600	25 – 60
0,300	10 – 30
0,150	5 – 15
0,075	0 - 10

A6.2.5.3 Jointing sand

100 % of the sand used to fill the joints between the concrete blocks shall pass through a 1,0 mm sieve and between 10 % and 15 % of it shall pass through a 0,075 mm sieve.

A6.2.5.4 Concrete beams, kerbs and channelling

Cast in situ concrete edge beams or intermediate beams shall be constructed in accordance with the provisions of Chapter 13: Structures, as relevant. Prefabricated kerbing and channelling shall comply with the requirements of Section A3.3 or Section B3.3 of Chapter 3 as specified in the Contract Documentation.

A6.2.5.5 Herbicide and ant poison

The herbicide and ant poison shall be environmentally friendly and shall be subject to the Engineer's approval.

A6.2.6 CONSTRUCTION EQUIPMENT

A suitable vibrating-plate compactor shall be supplied operating at a frequency of 65 Hz to 100 Hz and a low amplitude. Its plate surface shall be 0,2 m² to 0,4 m² and it shall develop a centrifugal force of 7 kN to 16 kN..

A6.2.7 EXECUTION OF THE WORKS

A6.2.7.1 Preparing the underlying layers

The underlying pavement layer/s shall be as specified in the Contract Documentation. The underlying pavement layers shall be constructed and prepared in accordance with the requirements for the relevant pavement layers in Chapters 4 and 5 of these specifications, or as may be specifically otherwise prescribed in the Contract Documentation. Where specified by the Engineer the prepared surface shall be treated with approved herbicide and ant poison before the layer of sand for bedding is placed.

A6.2.7.2 Concrete edge and intermediate beams

Cast in situ or prefabricated concrete edge beams or intermediate beams shall be constructed on the underlying pavement layer in accordance with the details shown on the drawings. No paving blocks shall be laid before the edge and intermediate beams have developed sufficient strength to withstand the construction forces.

A6.2.7.3 Bedding sand

A layer of bedding sand complying with the requirements of Clause A6.2.5.2 shall be placed on top of the prepared surface of the underlying pavement layer. It shall be accurately levelled to an un-compacted thickness of 25 mm ($\pm$ 5,0 mm), or as specified, so that the concrete paving blocks will have the correct level after compaction. The bedding sand shall be placed immediately before the concrete paving blocks are laid and shall be allowed to dry out to permit upward creep during compaction. The sand shall not be compacted before the blocks have been laid.

A6.2.7.4 Laying of the blocks

The blocks shall be laid in the pattern shown on the drawings or as directed by the Engineer. Unbroken blocks shall be laid first and the filler pieces afterwards. Filler pieces shall be neatly sawn or hewn to fit exactly into the space to be filled. Any space of which the size is less than 25 % of the size of an unbroken block, shall be filled with 35 MPa concrete. The size of the joints between blocks shall be between 2,0 mm and 4,0 mm, and the top faces of the blocks shall be flush.

After the paving blocks have been laid, the pavement shall be compacted by two passes of a suitable vibrating-plate compactor operating at a frequency of 65 Hz to 100 Hz and a low amplitude.

After compaction of the pavement as described above, jointing sand shall be spread and brushed into the joints until the joints have been properly filled. Any surplus sand shall then be broomed off and the pavement shall then be subjected to two further passes by the plate vibrator. Jointing sand shall not be hosed into the joints. The block paving shall be inspected after 2 months, and the joints shall be resanded where required.

A6.2.8 WORKMANSHIP

A6.2.8.1 Construction tolerances

The completed concrete block paving shall comply with the following construction tolerances: a)

Line of pattern

- (i) Maximum deviation from a 3,0 m straight edge: 3,0 mm
- (ii) Maximum deviation from a 20 m straight line: 10 mm
- b) Vertical deviation from a 3,0 m straight edge
 - (i) At the edge beams: 3,0 mm
 - (ii) Elsewhere: 3,0 mm
- c) Differences in the surface levels of adjacent units: 2,0 mm

CHAPTER 9: ASPHALT LAYERS

9.1 ASPHALT LAYERS

CONTENTS

PART A: SPECIFICATIONS

A9.1.1 SCOPE

A9.1.2 DEFINITIONS

A9.1.3 GENERAL

A9.1.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

A9.1.5 MATERIALS

A9.1.6 CONSTRUCTION EQUIPMENT

A9.1.7 EXECUTION OF THE WORKS

A9.1.8 WORKMANSHIP

PART B: LABOUR ENHANCEMENT

PART C: MEASUREMENT AND PAYMENT

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

A9.1 ASPHALT LAYERS

PART A: SPECIFICATIONS

A9.1.1 SCOPE

This Chapter covers the following work:

All work in connection with the construction of asphalt base and surfacing layers in accordance with current good practice and any other specific work as may be prescribed. It includes the:

- Design of the specified mix type, procuring and furnishing of aggregate, active fillers and bituminous binder, mixing at a central mixing plant, transport, placement and compaction of the product.
- Widening of asphalt bases and surfacing, placing of asphalt in restricted areas and placing asphalt reinforcing where specified
- Recycling of asphalt by reprocessing reclaimed asphaltic materials, adding new aggregate, bituminous binders and rejuvenating agents to obtain an asphalt mix which will comply in all respects with the standard final product requirements for a particular mix as specified.
- General provisions and requirements of Chapter 9 shall apply throughout to recycled asphalt, except where explicitly specified otherwise in the Contract Documentation.

Asphalt layers constructed utilising certified products with, or without, extended performance guarantees, are covered in Part D of this Chapter.

A9.1.2 DEFINITIONS

Asphalt mix types - a mixture of aggregate, with or without active filler, and an appropriate bituminous binder proportioned in such a manner as to produce a final product conforming to all the relevant mix, and or, performance properties as specified. Asphalt mixes are classified into two fundamental mix types and may incorporate either standard, homogenous modified or non-homogenous (bitumen-rubber) bitumen.

a) **Sand skeletal mixes** - where the loads on the layer are carried by a continuous matrix of the finer aggregate fraction. There is no meaningful contact between the individual coarse aggregate particles and only provide bulk while not compromising the continuity of the finer fraction. Examples include:

- Semi-gap graded asphalt (AS), as further defined in Sabita Manual 35; Design and Use of Asphalt in Road Pavements
- Gap-graded asphalt (AG), as further defined in Sabita Manual 35; Design and Use of Asphalt in Road Pavements
- Fine/medium continuously graded asphalt mixes (AC), as further defined in Sabita Manual 35; Design and Use of Asphalt in Road Pavements
- Bitumen-rubber gap-graded (BRAGG), as further defined in Sabita Manual 19; Guidelines for the design, manufacture and construction of bitumen rubber asphalt wearing courses

b) **Stone skeletal mixes** - where a continuous matrix (skeleton) of coarse aggregates carries the imposed loads. In dense mixes the spaces between the coarse aggregate fractions are filled by the finer aggregate fractions to an extent that assures that the skeleton is not dilated, and contact between the coarser aggregate particles is maintained. In porous mixes, the spaces between the coarse aggregates are void. Examples include:

- Coarse continuously graded (AC), as further defined in Sabita Manual 35; Design and Use of Asphalt in Road Pavements - Stone mastic (SMA), as further defined in Sabita Manual 35; Design and Use of Asphalt in Road Pavements - Ultra-thin friction course (UTFC)
- High modulus base (EME), as further defined in Sabita Manual 33; Design Procedure for High Modulus Asphalt (EME)
- Porous (AP), as further defined in Sabita Manual 17; Design of Porous Asphalt Mixes
- Bitumen-rubber gap graded (BRAGG), as further defined in Sabita Manual 19; Guidelines for the Design, Manufacture and Construction of Bitumen-Rubber Asphalt Surfacing.
- Bitumen-rubber open graded (BRAOG), as further defined in Sabita Manual 17; Design of Porous Asphalt Mixes - Proprietary mixes, such as UTFC, which have been independently certified as fit-for-purpose.

The particular mix type, and or, any additional requirements, shall be as specified in the Contract Documentation.

Asphalt mixes - produced by any of the methods below:

- Hot mix asphalt (HMA) – asphalt produced in the traditional manner at mixing and placing temperatures appropriate to the inherent rheological properties of the binder incorporated.
- Warm mix asphalt (WMA) – as per a standard hot mix asphalt type and requirements, with the exception that an appropriate agent is introduced to enable mixing and placement of the specific product at reduced temperatures.
- Cold mix asphalt (CA) – asphalt, generally including a proprietary agent that has been pre-mixed in a mixing plant, packaged and stored for future applications at ambient temperatures. The specific mix, performance and application requirements of such mixes are not prescribed in this Chapter but shall be as specified in Chapter 8, or in the Contract Documentation. Cold mix products may also be prescribed as being fit for purpose for specific applications as certified by an approved independent certification agency.
- Recycled asphalt – as per any standard asphalt mix type, with the exception that a proportion of the mix, as may be prescribed or otherwise, shall consist of asphalt reclaimed from existing layers and appropriately processed and included in the mixture together with an approved rejuvenating agent if required.
- Certified asphalt mixes - asphalt mixes, such as UTFC or cold-mix products that have been certified as being fit for purpose for the required functional, and or, structural properties as required. Such Certification Agency may be Agrément SA, or any other accredited facility, as approved by the Employer. Such products may be constructed with, or without, extended performance guarantees, and shall be constructed as prescribed in Part D, or any other Chapter of these specifications.

Aggregate - granular material of natural, manufactured or recycled origin used in the manufacture of asphaltic products to the specific grade/class as defined in these specifications and the latest published version of SANS 1083, or as may be specifically specified in the Contract Documentation:

- Course aggregate – all aggregate > 5,0 mm as further defined in the latest SANS 1083 specification for the specific class of aggregate and nominal maximum particle size as specified.

- Nominal maximum particle size (NMPS) – designated as one sieve size larger than the largest sieve to retain a minimum of 15 percent of the aggregate particles as defined in SANS 1083.
- Fine aggregate – all aggregate fractions $\leq 5,0 \text{ mm} > 0,075 \text{ mm}$ and which may consist of clean material derived from crushing competent parent rock, or naturally occurring sand conforming to good practice and any further specified requirements.
- Filler – material predominantly $< 0,075 \text{ mm}$ which may consist of natural rock flour, extracted bag-house fines, or a manufactured active filler such as hydrated lime or cement.
- Reclaimed asphalt (RA) – asphalt that has been appropriately milled off existing pavement layers, as well as asphalt discarded at the mixing plant that is crushed, screened and tested in accordance with the requirements contained in the latest version of TRH 21: Use of Reclaimed Asphalt in the Production of Asphalt.

Bitumen - a black viscous mixture of hydrocarbons obtained as a residue from crude oil distillation and processed according to specific grade requirements.

Cellulose fibre - a constituent, either loose or in pellet form, introduced at manufacturing stage to prevent drain-down of the binder during storage, transporting and placing of mixes such as Stone Mix Asphalt (SMA).

Bond coat - an appropriate bituminous product applied to an existing surface, (prime, spray seal, asphalt, or concrete pavement surface), in order to ensure adequate bonding with the underlying substrate layer.

Prime coat - an appropriate low viscosity bituminous product applied in a single application for the purposes of sealing and protecting the surface of granular or cemented base layers. The general requirements relevant to these products are covered in Chapter 8 of this document.

A9.1.3 GENERAL

A9.1.3.1 Nominal mix proportions and application rates

- a) Mix composition. The mix proportions of bituminous binder, combined aggregates and filler for the various mix types, as well as bond coat and rolled-in chip applications, as listed in Tables A9.1.3-1 to A9.1.3-3 below, are nominal, and shall only be used for tendering purposes. The proportions actually used shall be as determined during the mix design, trial section and assessment requirements as specified in Clause A9.1.3.3. Any approved variation to these nominal mix proportions, and or, application rates shall be subject to an adjustment in payment, calculated in accordance with Clause C1.1.4 of Chapter 1 and relevant to the applicable variation rates tendered for each component as listed under Measurement and Payment.

Table A9.1.3-1: Nominal Mix Proportions of Stone Skeletal Mixes for Tender Purposes

MIX TYPE	High Modulus Base (EME)		Continuous graded base and surfacing: conventional and homogenous modified bitumen			Stone Mastic Asphalt (SMA)		Continuous graded surfacing: Bitumen-rubber:		Gap graded surfacing: Bitumen-rubber:		Mixes containing reclaimed asphalt
Nominal maximum particle size (mm)	20	14	20	14	10	14	10	20,0	14,0	20,0	14,0	Refer to Note* 2 below and Contract Documentation
Aggregate (%)	93,0	92,0	94,0	93,5	93,0	92,5	92,0	92,0	91,5	91,5	91,0	
Bitumen (type and grade according to Contract Documentation) (%)	6,0	7,0	5,0	5,5	6,0	6,5	7,0	7,0	7,5	7,5	8,0	
Active filler*1 (%)	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	
Cellulose fibre (%)	N/A	N/A	N/A	N/A	N/A	0,5	0,5	N/A	N/A	N/A	N/A	

*Note 1: Active filler for tender purposes shall be hydrated lime

*Note 2: The nominal proportions for mixes containing reclaimed asphalt shall be as specified in the Contract Documentation dependent on the percentage of reclaimed asphalt or binder replacement limits specified or permitted. If no such amendments are specified, the standard nominal mix proportions tabled above shall apply.

Table A9.1.3-2: Nominal Mix Proportions of Sand Skeletal Mixes for Tender Purposes

MIX TYPE	Continuous graded base and surfacing: standard and homogenous modified bitumen			Gap and semi-gap mixes using standard and homogenous modified bitumen		Mixes containing reclaimed asphalt
Nominal maximum particle size (mm)	20	14	10	14	10	Refer to Note* 2 below and Contract Documentation

Aggregate (%)	94,0	93,5	93,0	92,5	92,0
Bitumen (type and grade according to Contract Documentation) (%)	5,0	5,5	6,0	6,5	7,0
Active filler*1 (%)	1,0	1,0	1,0	1,0	1,0

*Note 1: Active filler for tender purposes shall be hydrated lime

*Note 2: The nominal proportions for mixes containing reclaimed asphalt shall be as specified in the Contract Documentation dependent on the percentage of reclaimed asphalt specified or permitted. If no such amendments are specified, the standard nominal mix proportions tabled above shall apply.

b) Bond coat and rolled-in chippings. The nominal application rates for tender purposes for asphalt bond coats and rolled-in chippings shall be as tabled below.

Table A9.1.3-3: Nominal application rates for bond coats and rolled-in chippings

Product	Nominal application rate	Bitumen %	Filler*1 (%)
Bond coat			
(a) Pavement	0,55 l/m ²		
(b) Bridge decks	0,40 l/m ²		
Rolled in chippings			
20 mm	8 Kg/m ²	1,5	1,0
14 mm	6 Kg/m ²	1,7	1,0
10 mm	4 Kg/m ²	2,0	1,0

*Note 1: Active filler for tender purposes shall be hydrated lime

The nominal rates for tender purposes for the bond coat are based on 30 % stable grade emulsion. Nominal application rates for other bond coat products shall be as specified in the Contract Documentation.

The actual application rate for rolled-in chippings shall be as determined and approved by the Engineer based on the relative density of the aggregate and the target texture depth to be achieved.

A9.1.3.2 Quality Plan

Prior to commencing with any permanent works, the Contractor shall submit a Quality Plan, for acceptance by the Engineer, detailing all checks and hold points relating to construction of the specified product.

A9.1.3.3 Trial sections

Where so provided for under Measurement and Payment, the Contractor shall construct a trial section for each layer, and relevant mix type, specified. The purpose of the trial is for the Contractor to demonstrate that the equipment and processes that he proposes to use will enable him to construct the particular asphalt layer in accordance with all the specified requirements. Evaluation and monitoring of the trial section shall include all items listed in the South African Pavement Engineering Manual (SAPEM) Chapter 12, Table 11 and Chapter 12: Appendix – Asphalt Trial Section Check List.

The Contractor shall calibrate the equipment and refine the mix design and construction process at his own cost.

The Engineer may require that up to 3 different binder contents be incorporated in one such trial section to verify the laboratory, and or, plant design phase and its behavior/properties at the specified layer thickness being constructed.

The Contractor shall only commence with construction of the permanent work when such a trial section has been satisfactorily constructed and complies with all the specified requirements.

If the Contractor should make any alterations in the methods, processes, equipment or materials used and approved, or if he is unable to comply consistently with the specifications, the Engineer may require that a new trial section be constructed, at the Contractor's cost, before allowing the Contractor to continue with any permanent work. The intention of this clause is to avoid any experimentation by the Contractor on the permanent work.

The trial sections shall be laid where indicated by the Engineer. The Contractor shall prepare the surface on which to lay the trial section and shall also, if required, remove the trial section after completion and restore the surface on which it was constructed, all at the Contractor's cost.

Provision is made for payment of the first approved trial section of any particular mix type, but subsequent trial sections that may be required for the same mix type shall be at the Contractor's own cost. Payment will be made for the specified area of each approved first trial section for any particular mix type.

A9.1.3.4 Weather limitations

Asphalt may be mixed and placed only under favorable weather conditions and shall not be mixed or placed when rain is imminent or during misty or wet conditions. The following wind and temperature conditions shall be applicable:

- 6°C and temperatures are rising with an allowable wind velocity of less than 25 km/h
- 10 °C with an allowable wind velocity of less than 55 km/h for layers paved > 30 mm thick
- 10 °C with an allowable wind velocity of less than 25 km/h for layers ≤ 30 mm thick

With falling air temperature, paving shall cease when the air temperature reaches 6 °C regardless of the wind velocity, and may not be restarted before the temperature is definitely rising.

Where specifically ordered by the Engineer for emergency safety or traffic accommodation reasons, paving operations shall comply with the recommendations listed in: Sabita Manual 22: Hot Mix Paving in Adverse Weather.

The mixing and placing of asphalt shall not be permitted under the following conditions:

- The moisture content of the aggregate affects the uniformity of mix temperature
- Free water is present on the working surface, or if
- The moisture content of the upper 50 mm of a granular base layer exceeds 50 % of the optimum moisture content, as determined by the Engineer.

Immediately after a rainy spell on an existing partly cracked and/or highly permeable surfacing and/or primed base resulting in the trapping of moisture in the pavement structure. In such case the base shall be allowed to dry out to meet the above moisture content requirements prior to placing the asphalt layer.

A9.1.3.5 Surface requirements

Immediately before applying the specified bond coat the surface shall be broomed and cleaned of all loose or deleterious material before commencing with any paving. Where the prime coat (if any) has been damaged, it shall be repaired by hand brushing or spraying priming material over the damaged portions, which shall be allowed to cure prior to commencing paving. Where the surfacing is to be constructed on bridge decks, the concrete deck shall be thoroughly cleaned by washing and brushing to remove all loose material and curing compound and then allowed to dry prior to application of the specified bond coat.

The base or the subbase, as the case may be, (after the prime coat has been applied), shall be checked for smoothness and accuracy of grade, elevation, cross section as well as any visible damage. Any portion of the base or subbase layer not complying with the specified requirements shall be corrected with asphalt at the Contractor's own expense, until the specified requirements are met. The Engineer may however, in his sole discretion, allow minor surface irregularities to remain, provided that the final asphalt layer conforms to the requirements of the specification.

The asphalt used for the correction of the base or subbase, shall be the same mixture as specified for the surfacing, or as directed by the Engineer. The maximum size of aggregate used in the mix shall be dictated by the maximum required thickness of the correction layer in each case.

Notwithstanding these provisions, the Engineer reserves the right to order the removal and reconstruction of the layer, or of portions of the layer not complying with the specified requirements instead of allowing the correction of substandard work with asphalt material.

The prime coat shall be dry before further bond coats or layers are applied. No work shall commence with the application of the bond coat and/or the paving without the approval of the Engineer.

A9.1.4 DESIGN BY THE CONTRACTOR

A9.1.4.1 Mix designs

The fundamental mix type, stone or sand skeletal, as well as the associated sub-group and design level requirements, shall be as specified in the Contract Documentation. The asphalt design shall be reported on the latest version of the D3 Design form (Asphalt Mix Design) as listed in Appendix A of the South African Pavement Engineering Manual (SAPEM) published by the South African National Roads Agency SOC Ltd (SANRAL). Updated version of the D3 Design Form should be used. No asphalt layers shall be constructed unless the specified, or other appropriate and accepted, mix design process has been carried out by the Contractor and submitted to the Engineer on the above form for assessment and approval.

A9.1.4.2 Mix design requirements

Unless otherwise specifically approved, the mix design methodology to be followed, appropriate mix volumetric properties, as well as all other relevant performance property criteria, shall conform to the relevant listed requirements as contained in the latest published version, at the time of tender, of the appropriate Sabita Manuals, for the following specific mix types as listed.

- Stone skeletal mixes:
 - Continuous graded mixes: The latest version of Sabita Manual 35; Design and Use of Asphalt in Road Pavements. The design processes may consist of up to four levels as appropriate for the mix type as specified and relevant to the expected performance demands/risks. The level of design required shall be as stated in the Contract Documentation. The final mix proportions and properties shall conform to the requirements as tabled in Sabita Manual 35 for the specific mix type and design level prescribed.
 - Stone mastic asphalt (SMA) mixes: The latest version of Sabita Manual 35, Appendix B
 - High Modulus Asphalt (EME) mixes: The latest version of Sabita Manual 33: Design Procedure for High Modulus Asphalt (EME) for the specific class prescribed.
 - Gap and continuously graded asphalt mixes incorporating bitumen-rubber: The latest version of Sabita Manual 19: Guidelines for the Design, Manufacture and Construction of Bitumen-Rubber Asphalt Surfacing.
 - Porous asphalt mixes: The latest version of Sabita Manual 17: Design of Porous Asphalt Mixes.
- Sand skeletal mixes
 - Continuous, semi-gap and gap graded mixes: The latest version of Sabita Manual 35
 - Continuous and gap graded mixes incorporating bitumen-rubber: The latest version of Sabita Manual 19: Guidelines for the Design, Manufacture and Construction of Bitumen-Rubber Asphalt Surfacing.
- Any other specific mix types shall be designed in accordance with the Contract Documentation requirements.
- Independently certified as being fit for the intended purpose, such as Agrément SA, or any other independent certification authority as approved by the Engineer.

In all instances the mix properties shall conform to the latest requirements as listed in the relevant publications above for the mix type, class and design level specified.

The following shall, in all instances, be indicated in the Contract Documentation:

- Mix type (stone or sand skeletal mix)
- Specific mix type within the above categories
- Level of design required, as appropriate for the specific mix type specified

- Nominal maximum particle size (NMPS) of the aggregate
- Binder type
- Nominal layer thickness

Where the incorporation of warm mix asphalt technology has been prescribed in the Contract Documentation, provision has been made in Part C: Measurement and Payment, for any extra over/under rate as may be applicable. WMA technology may be used provided that the performance criteria of HMA is met and the only change is the mixing and placement temperature ranges.

Asphalt designed and constructed under performance based systems with, or without, extended guarantee periods shall be treated as prescribed in Part D of these specifications, or as otherwise stated in the Contract Documentation.

Before any asphalt is placed on the road, the Engineer shall review and accept the mix design. In the case of performance based specifications, the Engineer reserves the right to have any proposed asphalt mix design independently verified. The approval process shall be as follows:

- The Contractor shall prepare and submit a proposed laboratory design mix with test results at four different binder contents. The design mix shall be submitted on the prescribed design form D3 with all relevant testing completed.
- Samples of all proposed components shall be submitted together with the laboratory design mix results to enable the Engineer to carry out check design testing if required. The above design and its components shall be submitted to the Engineer at least two weeks before it is intended to commence with any asphalt production.
- After initial approval is obtained for the laboratory design mix, a plant mix at varying binder contents, approximately 0,3 % above and below the expected target binder content. The quantity of asphalt at each point shall not be less than 20 tons. The purpose of the plant mix is for the Contractor to prove that the laboratory design mix can be produced successfully and meets all the specified mix properties. The Engineer may conduct any necessary confirmation testing on the plant mixes. The plant mixes shall not be placed on the road. During the production of the plant mix, the Engineer shall be afforded the opportunity to inspect the asphalt plant.
- After the plant mix is approved, permission shall be given for laying a trial section at varying binder contents in accordance with the requirements of Clause A9.1.3.3 of these specifications. The Engineer may require that the mix be further assessed by any additional test methods, the cost of which will be borne by the Employer. Mass production of asphalt shall only commence after approval of the trial section, which shall be given within a maximum of ten calendar days.
- Final grading and mix proportions will be approved by the Engineer after three days of full production.

A9.1.4.3 Changes to mix components

The Engineer shall instruct the Contractor at any time to halt his paving process and to review the whole, or part, of the above process should:

- the specified asphalt mix properties not be met • a consistent asphalt mix is not being produced.
- a change of any aggregate properties is identified

A9.1.4.4 Mix design period

As different design methodologies or levels have minimum time periods for completion, assessment and approval, the Contractor shall ensure that he commences the specified design processes for the specific mix type and design level timeously to ensure that there are no delays to his construction program. The minimum time that shall be allowed for in the construction program is:

Sabita Manual 35: Level 1: 6 weeks

Sabita Manual 35: Level 2: 10 weeks

Sabita Manual 35: Level 3: 12 weeks

Sabita Manual 17 (Porous asphalt): 8 weeks

Sabita Manual 19 (Bitumen-rubber mixes): 8 weeks

Sabita Manual 33 (EME): 12 weeks

The Engineer may permit the commencement of construction of asphalt layers prior to the full asphalt mix design protocols, as specified, being submitted for formal acceptance. In such instances the Contractor shall prove that historical mix design data obtained by an accredited testing laboratory meets all the specified mix design properties, and that the relative properties of the current individual mix constituents to be incorporated are essentially similar to those utilised at the time of the original design. Any such concession shall, however, not absolve the Contractor of any obligations with respect to submitting a current valid mix design for evaluation and acceptance, and constructing asphalt layers that conform in all respects to the specified requirements.

A9.1.4.5 Cost of designs

Provision has been made under Measurement and Payment for the costs associated with producing, for each mix, and or, binder type specified, a single laboratory mix design followed by plant mix verification confirming conformance to the particular design method and product properties specified. Any changes to individual components, or properties of a mix, even after initial acceptance has been given, shall require that a new mix design process be undertaken, with any extension of time and cost implications for re-design and trial section at the cost of the Contractor.

If, however the Engineer issues an instruction to change any component, or mix type, for whatever reason, the Contractor shall, in such instances be entitled to claim the cost for additional designs and time at the relevant rates tendered and as approved by the Engineer.

A9.1.5 MATERIALS

A9.1.5.1 General

The Contractor shall, as often as necessary, and in accordance with his approved quality plan, test and control the materials produced by himself, or any materials received by him from suppliers, to ensure that the materials are uniform and always comply with the specified requirements. Refer to the latest version of Sabita Manual 5: Guidelines for the manufacture and construction of hot mix asphalt.

Sufficient aggregate and bituminous binder for a minimum of 3 days production shall be separately stockpiled/stored and tested for conformance and uniformity prior to use. The test results shall be made available to the Engineer on request.

A9.1.5.2 Bituminous binders for asphalt mixes

The binder type to be used in a specified mix shall be as prescribed in the Contract Documentation. The specific properties relating to each binder type/class are not specified here but shall conform to the relevant requirements/ product properties as listed in the latest version of the appropriate publications below, or as may be specifically stated in the Contract Documentation.

- Penetration grade: Conventional bitumen of standard grades and properties as specified in SANS 4001-BT1
- Performance grade: As specified in SATS 3208 – which covers standard bitumen or modified bitumen
- Homogenous modified binders: Penetration grade bitumen modified with appropriate polymers to achieve the specific class and relevant properties as listed in the latest version of Technical Guideline (TG1) - (Modified Binders for Road Construction) as published by the SABITA or Performance Grade as specified in the Contract Documentation.
- Non-homogeneous modified binders (bitumen-rubber): A blend of penetration grade bitumen, rubber crumbs and any extender oils to achieve the specific class/grade and relevant properties as listed in the latest version of TG1 (Modified Binders for Road Construction –as published by SABITA) or Performance Grade as specified in the Contract Documentation.
- Bitumen emulsion: A mixture of normal penetration grade bitumen which has been suitably emulsified with water to achieve the specific class/grade as specified. The relevant requirements and properties pertaining to a specific class/grade shall be as listed in SANS BT4001BT4 to BT6.
- Modified bitumen emulsion: A mixture of conventional bitumen and appropriate polymer that has been suitably emulsified with water to achieve the specific class/grade and properties as listed in the latest version of Technical Guideline TG1 (Modified Binders for Road

Construction) as published by the SABITA

Notwithstanding initial conformance of any modified bituminous binder property as may be specified, such products shall be blended, transported, stored and utilized in accordance with all the accepted best practice guidelines/requirements as published in the latest versions of the SA Asphalt Academy and/or, South African Bitumen Association Guideline documents as relevant for that particular product.

If the Engineer suspects that bitumen or asphalt has been overheated, he may order that the bitumen, or the bitumen recovered from the asphalt, be subjected to the n-Heptane-Xylene (Spot Test) as described in AASHTO-T102. Recovery of the binder from the mixed asphalt for use in the Spot Test shall be carried out in accordance with SANS 3001-AS25. Any bitumen having an n-Heptane-Xylene equivalent in excess of 36, or in excess of the manufacturers test result on the dispatched stock, shall be considered to have been overheated and shall be rejected unless proven otherwise.

A9.1.5.3 Bitumen bond coat

Unless otherwise specified in the Contract Documentation, the bond coat shall consist of a stable grade bituminous emulsion diluted to have a 30 % net bitumen content. The use of polymer modified emulsions, or any other product as may be certified as fit for the specific purpose, shall be as specified in Part D of these specifications or in the Contract Documentation.

A9.1.5.4 Aggregates

a) Aggregate properties

Aggregate shall consist of hard material derived from the crushing of solid rock or boulders. Coarse and fine aggregate shall be clean and free from decomposed materials, vegetable matter or any other deleterious substances, and shall meet the requirements listed in Table A9.1.5-1 below unless otherwise specifically stated in the Contract Documentation. All aggregates shall be handled and stockpiled in a manner that will prevent contamination, segregation or degradation.

Asphalt mixes shall be manufactured using individual single size coarse aggregates fractions and crushed fine aggregates complying with the latest version of SANS 1083 and appropriately blended to conform to the target grading as determined by the selected design methodology. The use of natural sands shall only be permitted if approved by the Engineer and shall be limited to a maximum of 7 % by mass for continuously graded mixes. For stone mastic asphalt mixes all aggregate fractions in excess of 2,0 mm shall consist of individual nominal single size fractions.

Once the target grading has been fixed for each individual fraction, the allowable tolerances shall not exceed that specified in SANS 1083. The Contractor shall note that commercial suppliers may not be able to consistently supply all the required single size aggregate, in which instance additional on-site screening may be required, for which no additional payment shall be made. The use of run of crusher type materials shall not be permitted.

Table A9.1.5-1: Aggregate properties

Property	Test	Standard	Product	Criteria
Hardness / Toughness	Fines aggregate crushing test: 10% FACT (kN)	SANS 3001-AG10	Sand skeletal mixes	≥ 160
			Stone skeletal mixes	≥ 210
	Aggregate crushing value (ACV)	SANS 3001-AG10	Sand skeletal mixes	≤ 25
			Stone skeletal mixes	≤ 21
Soundness	Magnesium sulphate soundness (%)	SANS 5839 SANS 3001-AG12	All	≤ 21
				12 - 20
Durability	Methylene blue adsorption indicator	SANS 6243	All	≤ 5 > 5: additional testing and analysis needed

Particle shape and texture	Flakiness index	SANS 3001- AG4	20 mm and 14 mm aggregate 10 mm and 7,1 mm aggregate Rolled in chippings	$\leq 25^{*1}$ ≤ 30 ≤ 20
	Polished stone value (PSV)	SANS 3001-AG11	Coarse aggregate for surfacing	$\geq 50^{*2}$
	Fractured faces	ASTM 5821	Sand skeletal mixes Stone skeletal mixes and rolled in chippings	At least 50 % of all particles should have three fractured faces At least 95 % of all particles should have 3 fractured faces
Water absorption	% by mass	SANS 3001-AG20	Coarse aggregate (>5,0 mm)	$\leq 1,0$
		SANS 3001- AG21	Fine aggregate (< 5,0 mm)	$\leq 1,5$
Binder absorption	% by mass	SANS 3001 – AS11	Coarse and fine aggregate	$\leq 0,5$
Cleanliness	Sand equivalency test	SANS 3001-AG5	Total fines fraction	≥ 50
	Clay lumps and friable Particles (%)	ASTM C142-97	Coarse and fine aggregate	$\leq 1,0$

¹ For certain types of mixes, e.g. UTFC, a maximum flakiness index of 20 may be required

² If approved by the Engineer, a limiting value of 45 may be accepted with due regard to material availability, traffic, road geometry and expected climatic conditions.

b) Coarse aggregate grading

(i) The coarse aggregate component of any asphalt mix shall comprise of nominal single aggregate sizes conforming to the specific aggregate grading class and appropriately blended in the mixing plant. The blend shall be relevant to the mix type and layer thickness specified. The nominal maximum particle size (NMPS) utilised in any mix shall not exceed the maximum limits listed in Table A9.5.1-2 below.

Table A9.1.5-2 NMPS versus nominal layer thickness requirements

NMPS [mm]	Minimum layer thickness (mm)	
	Absolute minimum	Preferred minimum
7,1	20	25
10	30	35
14	45	50
20	80	90
28	110	120

(ii) Coarse aggregate grading class

Unless otherwise specifically permitted, the coarse aggregate components of any asphalt mix shall comply with the grading limits tabled in Table A9.1.5.-3 below for the relevant grading class and NMPS as listed. The grading class applicable to the relevant mix type shall be as follows:

Grading class 1:

- Continuously graded: stone skeletal
- High modulus asphalt (EME)
- Gap graded: stone skeletal mixes
- Ultra-thin friction courses (UTFC)
- Stone mastic asphalt (SMA)
- Porous asphalt

Grading class 2:

- Continuously graded: sand skeletal
- Semi-gap: sand skeletal mixes
- Gap graded: sand skeletal mixes

Table A9.1.5-3: Grading limits for nominal single size coarse aggregate

	Nominal maximum particle size (NMPS) (mm)

	28,0		20,0		14,0		10,0		7,1		5,0	
Grading grade	1	2	1	2	1	2	1	2	1	2	1	2
Sieve size (mm)	Percentage passing sieve size by mass											
37,5	100	100	-	-	-	-	-	-	-	-	-	-
28,0	85-100	85-100	100	100	-	-	-	-	-	-	-	-
20,0	0-20	0-35	85-100	85-100	100	100	-	-	-	-	-	-
14,0	0-5	0-5	0-20	0-35	85-100	85-100	100	100				
10,0			0-5	0-5	0-20	0-35	85-100	85-100	100	100		
7,1					0-5	0-5	0-20	0-35	85-100	85-100	100	100
5,0							0-5	0-5	0-20	0-35	85-100	85-100

Once the target grading has been fixed for each individual coarse aggregate fraction, the allowable tolerances shall not exceed 10 % of that agreed for the target grading for each specific nominal maximum aggregate particle size. The Contractor shall note that commercial suppliers may not be able to consistently supply all the required nominal single size aggregate to the specified tolerances. In such instances additional on-site screening may be necessary, for which no additional payment shall be made. The use of run of crusher type materials shall not be permitted. **c) Fine aggregate grading**

If approved by the Engineer, and if the specified mix properties are met, the fine aggregate component may contain natural fines not obtained from the parent rock being crushed, on condition that such added material does not exceed 7,0 % by mass, unless otherwise specified in the Contract Documentation. The added fines shall have a liquid limit not exceeding 25 % and a PI not exceeding 4. The Contractor shall submit full details regarding the exact quantity and nature of such fine aggregate, before such permission will be considered. In the event of such added material being natural sand, its impact on final mix properties shall be assessed from laboratory briquettes and cores obtained in the trial section. The addition of natural fines shall only be by means of a separate plant cold-feed bin.

Table A9.1.5-4: Fine aggregate grading limits for relevant mix type

Grading Grade	Grade 1	Grade 2	Stockpile Tolerance
	Percentage passing by mass		
Sieve Size (mm)	Class 1 Percent Passing	Class 2 Percent Passing	
	Stone skeletal mixes as defined	Sand skeletal mixes as defined	
7,1	100	85 - 100	5 %
5	90 - 100	70 - 90	5 %
2	65 - 90	45 - 70	5 %
1	45 - 70	28 - 50	5 %
0,6	30 - 50	19 - 34	5 %
0,3	18 - 30	12 - 25	4 %
0,15	10 - 21	7 - 18	3 %
0,075	5 - 15	5 - 15	2 %

When determined in accordance with SANS 3001-AG1, the Fineness Modulus (FM) of both the crushed and natural fine aggregates shall not deviate by greater than 0,2 from that determined on the fine aggregate incorporated in the approved design mix.

d) Combined aggregate grading

The combined grading selected shall be relevant to the mix type and design level as specified and shall be determined by means of the specified mix design methodology prescribed in Clause A9.1.4.2 and shall be appropriately optimised to ensure conformance to all the specified mix properties as relevant.

Continuously graded sand skeletal asphalt mixes shall be designed in accordance with the method listed in Sabita Manual 35: Design of Hot Mix Asphalt, and the grading shall fall within the control points listed in Table A9.1.5-5 for the specified nominal maximum particle size (NMPS) of aggregate as prescribed. Notwithstanding these control point limits, during the design process, the grading of the mix shall be optimised utilising appropriate means, such as the "Bailey" Method as outlined in Appendix A of Sabita Manual 35 to ensure that the specified volumetric and performance properties of the final mix, as specified, are optimised in all respects.

Table A9.1.5-5: Aggregate grading control points for a continuously graded sand skeletal mix (Sabita Manual 35)

% passing sieve size by mass	Sieve size (mm)	Nominal Maximum Particle Size (NMPS)			
		28.0	20.0	14.0	10.0
	37,5	100			
	28	80 - 100	100		
	20	< 85	80 - 100	100	
	14		< 85	80 - 100	100
	10			< 85	80 - 100
	7,1				< 85
	5				
	2	19 - 45	23 - 40	28 - 58	32 - 67
	1				
	0,600				
	0,300				
	0,150				
	0,075	4,0 – 7,0	4,0 – 8,0	4- 10	4 - 10

The grading control points shown in Table A9.1.5-5 shall be considered as a guideline only and not a specification grading envelope.

Where the use of reclaimed asphalt has been prescribed, the reclaimed asphalt shall be crushed, screened, stockpiled, protected, tested and utilised in accordance with the requirements contained in the latest version of Sabita Manual 36: Use of Reclaimed Asphalt in the Production of Asphalt.

For open and gap graded mixes the proposed grading for the combined aggregate in the mix shall be as specified in the Contract Documentation or if not specified, then the guidelines in Manual 35 and the applicable Sabita Manuals shall apply, e.g. Manual 17 for open graded mixes, Manual 19 for bitumen rubber mixes and Manual 33 for EME. Stone skeletal mixes and SMA shall follow the guidelines in Manual 35.

The grading of the combined aggregate, including any filler added, in an accepted mix design shall be designated as the target grading. Allowable tolerances from such an approved target grading during production shall be as specified in Clause A9.1.8.5. **e) Rolled in chippings grading**

The grading requirements for rolled in chippings shall be as listed in Table A9.1.5-6. **Table A9.1.5-6:**

Grading limits for rolled-in chippings

Sieve size (mm)	Percentage passing sieve size by mass by mass		
	20,0 mm	14,0 mm	10,0 mm
20,0	100	-	-
14,0	0 – 20	100	
10,0	0 – 5	0 – 20	100
7,1	0 – 1	0 – 5	0 – 20
0,425	0,5 max	0,5 max	0,5 max

A9.1.5.5 Fillers

Should the grading of the combined aggregates for asphalt mixes show a deficiency in fines, an approved filler may be used to improve the grading. With the exception of stone mastic asphalt, in no instance shall more than 2 % by mass of active filler be used in a mix. Inert filler such as rock dust used to improve a grading shall not be subject to this limitation. No payment will be made for any filler added to improve the grading. The Engineer may order the use of any active filler to improve the adhesion properties of the aggregate. Active filler shall consist of hydrated lime, ordinary Portland cement, Portland blast furnace cement, fly-ash or a mixture of any of the above materials. Individual materials shall comply with the requirements of the relevant SANS or other specifications for such material. Active fillers shall be used in the order in which they have been received.

A nominal active filler content of 1 % by mass is included for tender purposes and shall be included in the mix unless otherwise specified. For tender purposes the active filler shall be hydrated lime or as per the Contract Documentation. If no active filler is added, the cost of the nominal 1 % filler shall be deducted

from the unit rate, at the variation rate tendered. The Contract Documentation must consider the use of adhesion promoters and alternative active fillers and as such should be measured separately in the schedule of quantities. The actual active filler and adhesion promoters will be determined by the mix design and paid for under the variation items. **Table A9.1.5-7: Filler requirements**

Type of filler/origin	Property	Limit	Test method
Active filler: Hydrated lime Portland cement	Grading: % passing 0,075 mm Bulk density in toluene Voids in compacted filler Methylene blue test	70 minimum 0,5 – 0,9 g/ml 0,3 – 0,5 % 5 maximum	SANS 3001-AG1 BS 812 BS 812 SANS 6243
Non- Active filler: Fly ash	As above for active fillers	As above	
Baghouse fines	Refer Contract Documentation		
Limestone dust	Refer Contract Documentation		

A9.1.5.6 Fibres

A nominal cellulose fibre content has been allowed for in stone mastic mixes. The Contractor shall prove that the fibre he intends using has the proven ability to prevent any drain down of the bitumen in the mix during transportation and placing without compromising the in-place mix properties.

A9.1.5.7 Bitumen rejuvenators

Where the use of reclaimed asphalt is permitted or prescribed, the percentage, and existing binder properties, of such material incorporated into the final mix as well as the limits of binder replacement shall dictate whether a bitumen rejuvenating agent is required to be added, or not. No specific product, or quantity thereof, is prescribed. The Contractor shall however follow the generally accepted good practice guidelines contained in latest version of Sabita Manual 36: Use of Reclaimed Asphalt in the Production of Asphalt. The Contractor shall provide the Engineer with sufficient proof that the product intended for use has a proven capability of producing a final bitumen product meeting all the requirement of the binder type specified, and that the final asphalt mix meets all the relevant properties as specified. No additional payment shall be made for including these products, the cost of which shall be deemed to be included in the relevant unit rates tendered for the specified constructed asphalt layers.

A9.1.5.8 Mix properties

The properties of the mix shall be relevant to the mix type and design level prescribed in the Contract Documentation. In all instances the specific mix properties shall conform to the latest requirements, as relevant for the mix type and required Design Level, as published in the following Manuals as listed below:

a) Stone skeletal mixes

- Continuously graded: Sabita Manual 35: Design and Use of Asphalt in Road Pavements.
- High modulus base (EME): Sabita Manual 33: Design of High Modulus Asphalt Bases (EME)
- Bitumen Rubber mixes: Sabita Manual 19: Design of Bitumen Rubber Wearing Courses
- SMA: Sabita Manual 35: Design and Use of Asphalt in Road Pavements – Appendix B - Porous Asphalt: Sabita Manual 17: Design of Porous Asphalt Mixes

b) Sand skeletal mixes

- Continuously graded: Sabita Manual 35: Design and Use of Asphalt in Road Pavements.
- Semi-gap graded: Continuously graded: Sabita Manual 35: Design and Use of Asphalt in Road Pavements.
- Gap graded: Sabita Manual 35: Design and Use of Asphalt in Road Pavements.
- Residential applications: Sabita Manual 35: Design and Use of Asphalt in Road Pavements and Sabita Manual 27: Design of Asphalt Wearing Courses on Residential Streets

A9.1.5.9 Asphalt reinforcing

Asphalt reinforcing shall be of the type specified in the Contract Documentation and shall be obtained from an approved manufacturer.

Where the use of reinforcing for asphalt has been specified, the Contractor shall, at least 3 months before the material is to be used, submit samples of the type he intends to use, together with complete specifications of the material, as well as the manufacturer's instructions for use, to the Engineer for approval. In general, the product shall be installed according with the best practice guidelines contained in the latest version of Technical Guideline (TG) 3, as published by the SABITA. Where the material does not carry the SABS mark, or the mark of another acknowledged authority, the Engineer may instruct the Contractor to have the material tested by an approved laboratory and to submit the results.

A9.1.6 CONSTRUCTION EQUIPMENT

A9.1.6.1 General

Where asphalt for the project is sourced from a mobile asphalt plant, the Contractor must obtain assurance in writing that the establishment and operation of such mobile asphalt plant is in accordance with the National Environmental Management Act: Air Quality Act 2004 (Act No 39 of 2004) and the National Environmental Management Act, 1998. These items to also be included in the regular site audit protocol to ensure ongoing compliance.

All plant shall be so designed and operated as to produce a mixture complying with the requirements of this specification. The plant and equipment used shall be of adequate rated capacity and be in good working order. Obsolete or worn-out plant shall not be permitted on site. Mobile plant with hydraulic or petroleum product oil leaks shall be immediately repaired or removed from site.

Prior to the start of the work the Contractor shall supply the Engineer, on request, with copies of the manufacturer's handbooks and copies of check lists prepared in terms of ISO 9002, where applicable, pertaining to the mixing and paving plants, containing details of the correct settings and adjustments of the plant.

Any alteration which has been, or is being effected to any constructional plant, and which does not comply with the specifications of the manufacturer, shall be brought to the notice of the Engineer.

A9.1.6.2 Mixing plant

Asphalt shall be mixed by means of an approved mixing plant of proven suitability for producing a mixture complying with all the requirements of the specifications.

The heating system of the binder storage tanks shall be so designed that the binder will not be degraded during storing, heating and production. A circulating system for the binder shall be provided which shall be of adequate size to ensure the proper and continuous circulation between storage tanks and mixer during the entire operating period.

Binder storage tanks shall be fitted with thermometers designed to provide a continuous record of the temperature of the binder in the tank. Copies of these records shall be supplied to the Engineer on a daily basis.

The binder content of the mix shall be controlled within the tolerances specified, either by weighing or by volumetric measurements. The system shall be controlled by the cold feeding of each aggregate fraction, and filler, by mass, by means of a load cell or other devices regulating the feed automatically. Suitable dust collecting equipment shall be fitted to prevent pollution of the atmosphere in accordance with the provisions of the latest laws and relevant regulations.

Where more than 10 % (drum mixers) or 15 % (batch mixes) of reclaimed asphalt is to be utilised in the mix, the mixing plant shall be of such a design and configuration as to produce a recycled mix containing the prescribed, or selected, percentage of reclaimed asphalt without any premature ageing of the mix occurring. In general, the requirements for appropriate mixing plants to be used for recycling shall be as recommended in the latest version of Sabita Manual 36: Use of Reclaimed Asphalt in the Production of Asphalt.

A9.1.6.3 Paver

The mixture shall be laid by an approved type of self-propelled mechanical spreader and finisher fitted with automatic electronic screeds, capable of paving to the required widths, thickness, profile, camber or cross-fall without causing segregation, dragging, tearing, or other surface defects. Where leveling beams on multiple skids or sliding beams are used they shall be at least 12,0 m long, or as specified in the Contract Documentation.

A9.1.6.4 Chip spreader

The chip spreader shall straddle the full width being paved and shall be used for spreading the rolled in chippings. Such a mechanical spreader shall be self-propelled and be able to follow immediately behind the paver.

When coated chippings are spread by hand in restricted areas, special care shall be taken to prevent bunching of the chippings.

A9.1.6.5 Rollers

Compaction shall be done by means of approved flat steel-wheeled, vibratory or pneumatic-tyre rollers. The frequency as well as the amplitude of vibratory rollers shall be adjustable. Vibratory rollers shall be used only where there is no danger of damage being done to the asphalt, and to the smoothness of the layer, bridge decks, or other layers. It will be indicated in the Contract Documentation whether any vibratory compaction equipment may be used on bridge decks, and what the constraining parameters will be. The rollers shall be self-propelled and in good working condition, free from back lash, and without any oil leaks. Rollers shall be equipped with adjustable scrapers to keep the drums clean and with efficient, fully functioning means of keeping the wheels wet to prevent mixes from sticking to the rollers. Approved release agents may be used on roller wheels but the use of petroleum products for this purpose shall not be permitted. The mass and tyre pressures shall be such so as to ensure compaction complying with the specifications for surface finish and compaction.

The required type, and number, of rollers to be utilized shall be appropriate to the mix type being paved and rate of paving which shall be as determined during the trial section. The Contractor shall take adequate precautions to eliminate any pick-up of the paved mat. For open-graded asphalt and/or stone-mastic asphalt, only flat steel-wheeled rollers shall be used.

A9.1.6.6 Binder distributors

The bituminous binder bond coat shall be applied either by means of a "self-tacking" paver or by an approved binder distributor as follows:

Comply with SANS 3001-BT20 and shall be covered by a valid certificate of compliance with SANS 3001-BT20, not older than 12 months, issued by an accredited testing organisation;

Not have any fuel, oil or binder leaks;

Have a straight and clean spray bar, 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 spray bar and the height adjusted to the correct level so as to obtain the required overlapping. The uneven application of binder shall be unacceptable;

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;

Be fitted with a suitable cut-off spray-head (end nozzles) or fishplates to prevent over spraying onto gravel shoulders or staining of concrete elements on the edge of the surfacing of the road.

Be capable of spraying the binder at the specified applications rates and to the satisfaction of the Engineer. The pump of the distributor shall be capable of delivering the binder at the spray bar nozzles at the correct pressure to obtain the specified application rates, irrespective of the viscosity properties of the prescribed binder and the number of nozzles open.

Fitted with a suitable valve or other access gate for taking of samples of the binder for testing purposes.

Hand sprayers, other than in restricted areas, shall only be permitted if so approved by the Engineer.

A9.1.6.7 Vehicles

The asphalt shall be transported from the mixing plant to the spreader in tip trucks that are in good condition having no oil leaks. They shall have tight, clean smooth beds and sides that have been treated to prevent adhesion of the mixture to the truck bodies. A thin film of soapy water, vegetable oil or approved release agents may be used to prevent adhesion but petroleum products shall not be used for this purpose. The truck bins shall be designed to tip asphalt into the paver's hopper without spillage.

To minimize temperature loss, all vehicles used for transporting asphalt to the site shall be fitted with appropriate bin covers. Where the expected transport, and or, storage time of the asphalt is expected to exceed one hour in the truck, the use of thermal asphalt covers (canvas covers not acceptable) shall be obligatory.

A9.1.6.8 Material transfer vehicle

Where so specified, and provision thereof is included under Measurement and Payment, asphalt shall be transferred from the haul trucks into the paver hopper by means of a materials storage and transfer vehicle and no material shall be tipped directly from the truck into the paver with the exception of paving in restricted areas.

The materials storage and transfer vehicle shall be capable of storing and transferring the asphalt from truck to paver to ensure continuous paving. It shall contain an anti-segregation auger that remixes the asphalt just prior to delivery to the paver hopper in order to ensure a mix of uniform temperature.

A9.1.6.9 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 calibrated mass-measuring device for measuring the mass of asphalt being delivered. The device shall be provided with a means of electronically recording and printing the type of mix, the mass, the time and the date. The printed data shall be submitted to the Engineer.

A9.1.6.10 Milling machine

Where so required and scheduled, the Contractor shall provide a suitably sized milling machine to mill off existing asphalt on bridge decks and or to mill an appropriate keyway at the approaches to bridge structures. The size of the milling machine shall be such as to allow milling adjacent to bridge nosings and any joints without damaging them.

A9.1.7.3 Storing the asphalt mix

Mixing shall not be allowed to take place more than four hours before paving begins unless provision has been made for storage in approved silos which are capable of maintaining the temperature of the mix uniform throughout. Storage will not be permitted for a period longer than 8 hours after mixing, unless otherwise approved by the Engineer. Open-graded mixes and stone-mastic asphalt shall not be stored or mixed ahead of paving operations but shall be laid directly following mixing.

A9.1.7.4 Transporting of asphalt

The mixture shall be transported from the mixing plant to the works in trucks complying with the requirements of Clause A9.1.6.7. Deliveries shall be made so that paving and rolling of all the mixtures prepared for a day's production, can be completed during daylight hours, unless artificial lighting, as approved by the Engineer, is provided. Any asphalt that has become cold or wet due to rain, or any other cause, shall be rejected. Hauling over asphalt that has not cooled to ambient temperature shall not be permitted.

A9.1.7.5 Bond coat

In all instances, unless otherwise, specified, a bond coat shall be applied to the surface to be paved. Concrete curbing and channeling, as well as any other adjacent structure or completed pavement shall be protected against staining by bitumen being sprayed or asphalt being placed. Where any bitumen is to be sprayed, all such work shall be completely covered with polyethylene sheeting at least 0,25 mm thick, specially reinforced paper, or other approved material adequately secured to prevent the sheeting from lifting during windy conditions. Any permanent work stained by bitumen shall be broken down and replaced, unless all such bitumen is completely removed so as not to show any stains. Painting over stained work is strictly prohibited.

Unless otherwise specified in the Contract Documentation, the bond coat shall consist of a stable-grade bituminous emulsion, diluted to have a 30 % net bitumen content, and shall be applied at a nominal rate of 0,55 (l/m²), or as directed by the Engineer. For bridge decks the bond coat shall be applied to the surface at a nominal rate of 0,4 (l/m²). The bond coat shall not be applied more than 24 hours before the paving is to commence and shall be fully cured prior to paving.

Before a new layer is placed adjacent to an existing layer, except in the case of open-graded or stone mastic mixes, the cut edge of the existing layer shall be hand painted with a bond coat of bituminous material of the same type used for the substrate bond coat. The bond coat shall fully coat the vertical face of the joint.

The use of hand-operated equipment for the application of bond coats, other than in restricted areas, shall be at the sole discretion of the Engineer, and his approval shall be timeously obtained.

A9.1.7.6 Placing the asphalt

The mixture shall be delivered to the paver in such a manner that the paving will be as continuous as possible with minimal stopping. Any lengthy delay in supply resulting in the asphalt mat cooling to below the appropriate compaction temperatures shall require that a construction joint be formed prior to recommencing with the paving operation.

The temperature of the mixture shall be controlled by measuring in a random pattern in the truck immediately before emptying and shall not be more than 10°C below the minimum mixing temperature, or above the maximum mixing temperature specified in Table A9.1.7-1. The adjustment of the screed, tamping bars. Feed- screws, hopper feed, etc., shall be checked frequently to ensure uniform spreading of the mix. If segregation or tearing occurs, the paving operations shall immediately be suspended until the cause is determined and corrected.

The addition or removal of material behind the paver shall not be allowed and the paver shall be capable of spreading the mixture to the levels that will provide the specified compacted thickness

Only minimal hand-working of the gap graded asphalt shall be permitted after discharge from the paver and before rolling and shall only be carried out with wooden spreaders. Workmen shall not be permitted to walk on un-compacted open graded asphalt.

Unless otherwise approved, paving shall commence at the bottom of the grades and the lower edges of super-elevated curves where the grades are steeper than 5 %.

Paving widths shall be so planned that longitudinal joints do not coincide with joints in lower layers of asphalt base, paver laid crushed stone bases or within the wheel paths of a lane.

Continuity of placing is especially important for open graded asphalt. Cutting of longitudinal joints shall be avoided when paving open-graded asphalt but where cutting is essential, only saw cutting shall be permitted. The existing layer edge shall be heated by approved means in order to ensure adequate longitudinal bonding of the asphalt between the two lanes.

Unless otherwise specified in the Contract Documentation the paver shall be equipped to provide automatic control of levels and cross section.

The mixer capacity and the operating speed of the paver shall be so coordinated so as to ensure continuous laying and thus avoid intermittent stopping of the paver.

Paving shall cease when rain starts falling or when the surfaces to be paved are visibly wet.

In all cases, including leveling courses, the paver shall be provided with approved skid beams with electronically controlled equipment that can ensure a constant cross-fall and can even out local irregularities.

Asphalt shall be placed in restricted areas with the aid of smaller specially equipped pavers, hand tools or other approved equipment. All the requirements with respect to temperature, mix composition, uniformity, in-place properties etc. shall remain applicable but layer thickness and control shall be such that the requirements for compaction and surface tolerances can still be achieved.

A9.1.7.7 Compaction

The compaction requirements for each mix type shall be in accordance with the requirements listed in the relevant Sabita Manuals as listed in Clause A9.4.2 for the specific mix type prescribed. The sequence of rollers used in compaction shall be at the discretion of the Contractor provided that the completed pavement shall meet the required compaction, profile, and surface texture as specified. The paved layer shall be compacted as soon as possible after it has been laid by a combination of vibratory, static steel-wheeled and or pneumatic-tyre rollers in a sequence determined and approved during the laying of trial sections. Rolling shall commence, and be continued, only for so long as it is effective and does not have any detrimental effect.

Only steel-wheel rollers (non-vibratory) shall be permitted for the compaction of stone mastic asphalt as well as semi-open and open-graded mixtures, although rubber tyre rollers may be on standby if required. During rolling the roller wheels shall be kept moist with only sufficient water or an approved release agent to avoid picking up the material. The use of petroleum products or excesses of releasing agents (soap) to prevent pick-up shall not be permitted. The use of vibratory rollers shall not be permitted on bridge decks.

Rolling shall commence from the edges of the paved mat and progress towards the center. On areas of super elevated curves, or where the cross-fall exceeds 2 %, rolling shall commence on the low side and progress to the higher side, uniformly lapping each preceding track. During breakdown-rolling the rollers shall move at a slow but uniform speed (not to exceed 5,0 km/h) with the drive roller nearest the paver, unless otherwise specified on account of steep gradients.

Except for mixtures using warm mix asphalt technology, no movement of the asphalt layer shall occur under steel wheel rollers once the asphalt temperature has dropped to below 100°C.

For thin layer asphalt (less than 30 mm) the compaction requirements shall be in accordance with the method statement as assessed and approved in the accepted trial sections.

For open graded (Porous) asphalt the degree of compaction can be controlled indirectly by means of in-situ permeability tests calibrated during the trial section and by visual evaluation of the aggregate to prevent crushing.

The Contractor shall utilize an appropriate and calibrated nuclear gauge for process control during compaction operations. Notwithstanding this requirement, the acceptance control carried out to determine compaction shall still be based on cores taken from the compacted layer where the layer thickness is appropriate.

A9.1.7.8 Applying rolled-in chippings

The size of pre-coated chippings used shall be as specified in the Contract Documentation. Unless specifically approved by the Engineer, the chippings shall be laid by a mechanical spreader that straddles the paved width and follows immediately behind the paver. The chippings shall be spread to give a uniform texture free from clusters and open patches. Unless otherwise specified in the Contract Documentation, the final surface texture shall not be less than 0,8 mm and shall be demonstrated as being achievable in the trial section, as described in Clause A9.1.3.3. Measurement of texture depth shall be in accordance SANS 3001-BT11, or by means of instrumentally measurements as described and specified in Clause A20.1.5.5 of Chapter 20 "Tests on pavements".

In restricted areas the Contractor may use hand tools for spreading chippings, in which instance the rate of application and requirements for evenness of the spread chippings shall remain applicable.

A9.1.7.9 Cutting of joints

All joints between adjacent sections of the work shall be formed by cutting back the edges of the paved layer in a straight line, either parallel or at right angles to the centerline, by a minimum of the width of the layer thickness being paved. Joints shall be neat and shall have the same texture and compaction level as the adjacent asphalt layer.

All joints shall be delineated by means of chalk lines prior to cutting. For sand skeleton mixes, such as semi-gap and fine continuously graded mixes, a cutting wheel may be utilized only if the layer is less than 50 mm in thickness and was paved within 24 hours. For all other mix types, layers in excess of 50mm, or that have been left for longer than 24 hours, the joints shall be formed either by means of saw cutting, using carborandum blades, or by an appropriate milling machine. All material emanating from preparing the joint shall be removed and transported to an approved site for possible recycling or other appropriate use or disposal. No payment for any such removed asphalt shall be made.

On completion of preparing the joint, the adjacent surface shall be inspected to ascertain that there has been no damage caused to the adjacent layer. Any identified damage shall be appropriately repaired prior to commencement of paving any adjacent asphalt layer.

Whenever the paving operation ceases due to lack of supply of mix, and the temperature of the mat has reduced to below the appropriate compaction temperature, the Contractor shall form a proper transverse construction joint as specified.

Unless otherwise provided for, joints in the final layer of the surfacing shall correspond with the intended lane markings. Joints in lower layers shall be offset by not less than 150 mm from either side of the edges of any underlying substrate joint.

The allowable tolerances for joints shall be as specified in Clause A9.1.8.3.

A9.1.7.10 Treatment of joints for traffic accommodation

Where it is necessary to accommodate public traffic during paving operations and the difference in level between the new work and the existing road surface exceeds 25 mm, joints shall be treated as follows:

Transverse steps at the end of a day's work shall be tapered off at a slope of 1 vertical to 20 horizontal (1:20) to tie in with the existing surface. The tapered section shall be removed before surfacing is recommenced and a joint formed in accordance with Clause A9.1.7.7.

Longitudinal joints exposed to traffic shall be provided with a taper of compacted asphalt layer over the full length of the exposed joint. The width of the taper shall be at least 5 times the layer thickness. The tapered section shall be removed before surfacing is recommenced and a joint formed in accordance with Clause A9.1.7.7.

All costs involved in the provision and removal of these temporary ramps shall be deemed to be included in the rates tendered for the relevant asphalt pay item.

A9.1.7.11 Surfacing of bridge decks

The type and nominal thickness of the surfacing shall be as specified in the Contract Documentation.

Before commencing with the construction of the surfacing, the actual levels of the bridge deck shall be determined by means of accurate leveling. The levels and grades to which the surfacing is to be constructed shall be as shown on the drawings or as indicated by the Engineer. If the levels of the concrete deck, as constructed by the Contractor deviate by more than the specified tolerances from the specified levels, he shall construct a leveling layer at his own cost. The nominal mean maximum particle size of the aggregate in the leveling layer shall be 10 mm.

A9.1.7.12 Asphalt temperature before opening to traffic

Newly paved asphalt shall not be opened to traffic until its surface temperature, as measured using a digital thermometer, has decreased to 50°C or less.

A9.1.8 WORKMANSHIP

The onus shall be on the Contractor to consistently construct all elements conforming to the specifications and within allowable tolerances. The Engineer shall continuously monitor the quality and consistency of work produced by means of visual inspection as well as by appropriate testing and evaluation of results.

Measurement, testing, and evaluation of all individual components and constructed products shall be in accordance with the methods prescribed in this Chapter or in Chapter 20 as relevant.

A9.1.8.1 Dimensional tolerances – new construction

The completed sections of asphalt base and surfacing shall comply with the requirements for grade, width, thickness and cross section as stated below.

a) Level and grade

The level tolerances shall be as follows:

H90 ± 15 mm

Hmax ± 20 mm

Deviation from the specified longitudinal grade due to deviations from the specified levels shall not exceed the values given in Table A9.1.8-1. **Table A9.1.8-1: Maximum Deviation from Specified Grade**

Length of deviation of grade (m)	Maximum variation from specified grade (%)
2	0,354
5	0,224
10	0,158
20	0,112
30	0,091

In the case of surfacing bridge decks, the difference in level between the new asphalt and any existing adjacent bridge joint or nosing shall not exceed 3,0 mm

b) Width

The average width of both asphalt base and surfacing 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 by more than 15 mm for both asphalt base and asphalt surfacing layers. **c) Thickness**

The thickness tolerances shall be as listed in Table A9.1.8-2.

Table A9.1.8-2: Thickness Tolerances

Allowable Tolerances	Asphalt Base (mm)	Asphalt Surfacing (mm)
D 90	15	5
D Maximum	20	8
D Average	5	2

Thickness shall be determined from carefully controlled levels taken before and after construction in exactly the same position and/or from cores drilled from the completed layer.

d) Cross section

When tested with a 3,0 m straight edge laid at right angles to the road centerline the surface shall not deviate from the bottom of the straight-edge by more than 6,0 mm for freeways and more than 10 mm for other roads.

At any transverse section the difference in level between any two points shall not vary from that computed from the cross section shown on the drawings by more than 15 mm for freeways and 20 mm for other roads.

A9.1.8.2 Dimensional tolerances – overlays

Where asphalt is being placed for the purposes of rehabilitation or overlays, the following requirements shall be applicable, as relevant:

- a) When the overlay is constructed to specified levels on a layer that has also been constructed or milled to specified levels by the Contractor, all the tolerance requirements of Clause A9.1.8.1 shall be applicable.
- b) When the overlay is constructed to specified levels on an existing layer, or on a layer which has been constructed or milled by the Contractor, but which has not been constructed, or milled, to specified levels, all the tolerance requirements of Clause A9.1.8.1 shall be applicable, except for Clause A9.1.8.1c), which relates to thickness.
- c) When the overlay is not constructed to specified levels, the following tolerances shall apply:

The outer edges of the overlay shall nowhere be more than 15 mm inside or outside the lines shown on the drawings, or existing surface, and shall be parallel to the road centre line.

The minimum thickness shall be the specified nominal thickness.

The maximum thickness shall be the specified nominal thickness + 10 mm.

In the case of surfacing bridge decks, the difference in level between the new asphalt and any existing adjacent bridge joint or nosing shall not exceed 3,0 mm

A9.1.8.3 Construction joints

All joints shall be cut back by at least the minimum of the layer thickness constructed. When measured with a 3,0 m straight edge at 10 m intervals longitudinally, and at 1,0 m intervals transversely, the level of the outer edge of the layer constructed shall not deviate by more than 2,0 mm from the level plane on 80 % of the measurements. In no instance shall the difference in level differ by more than 4,0 mm on base layers and 3,0 mm on surfacing layers. If these requirements are not met, the Contractor shall recut the joints, at his cost, in order to meet this specification.

A9.1.8.4 Surface regularity

a) Measured using inertial laser profilometers

For the lanes and surfaced shoulders wider than 2,0 m of the through road as well as interchange ramps and cross roads, the roughness of the surfacing will be determined by using an inertial laser profilometer as specified in Chapter 20, and capable of producing a Class 1 vertical measurement resolution, and a Class 3 longitudinal sampling distance as defined in ASTM standard (E950-09).

Surface shoulders less than 2,0 m wide, will be assessed according to measurements obtained from the adjacent trafficked lane.

The inertial laser profilometer shall be used to record the longitudinal profile in both wheel tracks (which shall be 1,75 m apart) of each traffic lane or shoulder wider than 2,0 m, as determined according to the final line markings that will be applied after construction. Should the two tracks not be measured simultaneously during the same pass, then procedures shall be implemented to ensure that the longitudinal profile data recorded for the two wheel tracks are at the same longitudinal profile data recorded for the two wheel tracks are at the same longitudinal location on the road.

The measured longitudinal profiles will then be processed using the Quarter-Car simulation model with parameter values as defined in ASTM standard (E1170-97) for Ride Meter-Vehicle Mounted. The simulated suspension mentioned will then be linearly accumulated and divided by the length to yield 100 m IRI (International Roughness Index) values in units of mm/m or m/km for each wheel track. The last 50 m, and the joining first 50 m of adjacent sections will be evaluated as a 100 m section in the direction of vehicle travel. For each measured lane the left and the right 100m IRI values from the three runs will then be averaged to produce the Average IRI as follows:

Run1 IRI_{100m Ave} = (100m IRI Left wheel track + 100m IRI Right wheel track) / 2

Run2 IRI_{100m Ave} = (100m IRI Left wheel track + 100m IRI Right wheel track) / 2

Run3 IRI_{100m Ave} = (100m IRI Left wheel track + 100m IRI Right wheel track) / 2

Average IRI_{100m} = (Run1 IRI 100m Ave + Run2 IRI 100m Ave + Run3 IRI 100m Ave) / 3

The Average IRI_{100m} values is then evaluated and judged according to Table A9.1.8-3 to determine whether the 100m section needs corrective work or payment adjustments.

The applicable Full Payment Bracket in Table A9.1.8-1 (Where value = 1.000) for the measured lanes and shoulders will be determined as follows:

Calculate the applicable Target IRI_{100m Ave} for full payment as follows: Target IRI_{100m Ave} = greater of 1.05 or [IRI_{100m Ave} * {1-(NAT/100)}]

Where:

IRI_{b Ave} = Average IRI_{100m} before the construction of the asphalt surfacing as determined from:

The Average IRI_{100m}, as calculated from the network roughness measurements performed by Employer not more than 12 months prior to commencement of the contract, or

The Average IRI_{100m} as calculated from the measurements performed as part of the assessment of the base as per Clause A5.3.8.5c) of Chapter 5 for granular bases.

NAT = Total New Asphalt Surface Thickness (measured in mm) applied over a section as part of this contract. For example, should 40 mm AC be applied followed by 18 mm UTFC, then NAT = 58 mm.

Using the Target IRI_{100m Ave} calculated under 1 above, find the matching Target IRI_{100m Ave} range in the first column of Table A9.1.8-3 into which the value fits. Then read horizontally to the relevant Payment Bracket column in which the unit value (1.000) appears, as indicated by the highlighted cells in the Table. The values in this column shall then be applied as the payment adjustment factors for the contract or section. For example, should the Target IRI_{100m Ave} be 1.33, then the Payment Bracket will be No 4.

Should the Total New Asphalt Thickness (NAT) vary over the contract length, then a Payment Bracket will need to be calculated for each of these uniform NAT sections.

Any adjustment in the payment for asphalt surfacing will be made by multiplying the full payment value for each 100 m section, (for all the relevant payment items for this work) by the payment adjustment factor derived from Table A9.1.8-3. The payment adjustment shall apply to the total asphalt layer width placed during a single pass by the paver over the 100 m sections in question.

Surfaced shoulders less than 2,0 m wide will be assumed to have the same roughness measurements as the adjacent lane and the quantity of material in the shoulder shall be added to the quantity of material of the adjacent lane for determination of the payment adjustment factor.

On sections where the Average IRI_{100m} is worse than the cut-off value listed in Table A9.1.8-3 the section is rejected and corrective work shall be necessary.

CHAPTER 10: SURFACE TREATMENTS

10.1 GENERAL REQUIREMENTS FOR SURFACE TREATMENTS

CONTENTS

PART A:	SPECIFICATIONS
A10.1.1	SCOPE
A10.1.2	DEFINITIONS
A10.1.3	GENERAL
A10.1.4	DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS
A10.1.5	MATERIALS
A10.1.6	CONSTRUCTION EQUIPMENT
A10.1.7	EXECUTION OF THE WORKS
A10.1.8	WORKMANSHIP
PART B:	LABOUR ENHANCEMENT
PART C:	MEASUREMENT AND PAYMENT
PART D:	GUARANTEES AND COMPLIANCE CERTIFICATES

A10.1 GENERAL REQUIREMENTS FOR SURFACE TREATMENTS PART A: SPECIFICATIONS

A10.1.1 SCOPE

This Chapter covers all the material requirements and work in connection with the construction of surface treatments incorporating single seals, multiple stone seals, sand seals, Cape seals, graded aggregate seals, slurry seals and microsurfacing.

A10.1.2 DEFINITIONS

Surface treatments - encompass thin bituminous surfacings applied as wearing courses for new construction or as reseals.

Bitumen - is a dark brown to black viscous liquid or solid, consisting essentially of hydrocarbons and their derivatives. It is soluble in trichloroethylene, is substantially non-volatile, and softens gradually when heated. Bitumen is obtained by refining petroleum crude oil.

Penetration grade bitumen - is manufactured by straight-run distillation of crude oil or by blending two or more base components (one hard, such as 40/50 pen, and the other soft, such as 150/200 pen). Penetration grade bitumen is used either as a primary binder (70/100 pen for surface seal work in South Africa) or as a base bitumen for the manufacture of cut back bitumen, modified binders or bitumen emulsions.

Bitumen emulsions - are two-phase systems consisting of a dispersion of bitumen droplets in water which contains an emulsifier. The emulsifiers are added to assist in the formation of the emulsion, to render it stable, and to modify its properties. Different grades of emulsion are manufactured to allow slower and

faster curing e.g. stable grade (Slow setting) is required for labour intensive work and manufacturing of conventional slurries. Spray grade (Rapid setting) emulsions are preferred for spray sealing. The terms cationic and anionic derive from the electrical charges on the bitumen globules. The positively charged cationic emulsions are preferred for construction of sprayed seals due to superior adhesive properties with the mostly negatively charged aggregate used for seal work in South Africa.

Cutback bitumens - are blends of penetration grade bitumen and slow, medium or rapid curing solvents. The choice of solvent determines the rate at which the bitumen will "set up" or cure when exposed to air. A rapid-curing (RC) solvent will evaporate more quickly than a medium-curing (MC) solvent, which in turn will cure more rapidly than a slow-curing (SC) solvent. The viscosity of the cutback bitumen is determined by the proportion of solvent added. MC-30 used for prime coats has a high percentage of medium curing solvent (45 %) with a very low viscosity. MC-3000 used for sprayed seal work has approximately 12 % solvent allowing application at low road surface temperature.

Modified binders - modification is achieved by the introduction of polymers, crumb rubber, aliphatic synthetic wax or naturally occurring hydrocarbons to a penetration grade bitumen. Modified binders for seal work are classified into:

- Hot homogeneous modified binder S-E1 and S-E2 for spray sealing and C-E1 for crack sealing (refer properties in TG1)
- Cold homogeneous modified binder SC-E1 and SC-E2 for spray sealing and CC-E1 for crack sealing
- Hot non-homogeneous modified binder S-R1 and S-R2 for spray sealing and C-R1 and C-R2 for crack sealing

Aggregate for seal work consists mainly of crushed rock with specified hardness, durability, polishing resistance, adhesion to bitumen and falling within selected grading envelopes. Screened natural gravels and sand as well as crushed slag, separated from metals during the smelting or refining of ore, are also used with success for specific seal types.

Sprayed seals - are constructed by spraying bituminous binder, spreading of aggregate and rolling. For purpose of this document sprayed seals are divided into sand/ grit seals, single stone seals (including single stone and sand blinding layer), Multiple stone seals (Double or triple stone seals) and Graded aggregate seals e.g. Otta seals.

Combination seals - are defined as seal types consisting of at least two components of different character e.g. Cape seals (Single stone seal with one or two layers of slurry) and Slurry-bound Macadam seals.

Slurry - is a homogeneous mixture consisting of fine aggregate (normally crusher dust), or where required to satisfy grading requirements and permitted, a blend of crusher dust and a limited percentage approved natural sand, stable grade bitumen emulsion (anionic or cationic) or a polymer modified stable grade emulsion, active filler (usually cement or lime), water, additive to retard the setting rate of rapid setting slurry) and Polymer (in case of microsurfacings).

Tack coat - is defined as the first application of binder for a sprayed seal or a Cape seal

Penetration coat - is defined as the second application of binder on a multiple stone seal

The **term cover spray** - refers to the application of a diluted emulsion as a final binder application on single or double seals or before application of the slurry, in case of Cape seals.

The term **fog spray or rejuvenation spray** - is used for the application of anionic emulsion, diluted anionic emulsion or invert emulsion rejuvenator for purposes of adding additional binder to the seal or rejuvenating the seal at a later stage of the seal life. Specifications for this type of treatment are provided in Chapter 8.

A10.1.3 GENERAL

A10.1.3.1 Requirements pertaining to all surface treatments

Adequate advance notice shall be given to the Engineer before the Contractor proceeds with any seal work. This notice shall include the program containing exact dates and sections to be sealed as well as the stockpile/s which will be used for each section.

Seal work shall not commence until a design has been submitted for each section and approved by the Engineer.

The areas to be sealed shall be cleaned of all dust, dirt, dung, oil or any other foreign matter that may be deleterious to the seal. Sealing work shall not commence until the Engineer has approved all preparatory works ordered on that section of road.

Unless otherwise agreed by the Engineer and subject to the outcome of a trial section, the Contractor shall programme all spraying to cease each working day at 15:00.

The Contractor shall comply with the requirements of Chapter 1 regarding traffic over completed layers

Wherever reference is made to distance the measurements for length shall be taken as actual lengths measured along the road centreline.

All quantities of sprayed binder and variations shall be measured at spray temperature of the applied binder.

A10.1.3.2 Weather limitations

The following general limitations shall apply:

- Whenever the temperature of the road surface falls below the specified temperature for the binder to be applied or will probably fall below the required temperature before spraying the binder, no binder shall be sprayed;
- No bituminous work shall be done during foggy or rainy weather and, when a cold wind is blowing, the above temperatures as specified in the sub-sections below, shall be increased by 3°C to 6°C.
- When strong winds (more than 30 km/h) are blowing which are likely to interfere with the proper execution of the work, no sealing, especially spraying of binder, shall be done;
- No sealing shall be done when rain or cold temperature is imminent;
- No sealing shall be done when the surface of the layer is visibly wet, i.e. more than damp;
- No sealing shall be done after sunset

Only emulsion products, MC3000 and cutback S-E1 binder shall be permitted during the embargo period stated in the Contract Documentation. Special formulated winter grade binders shall only be allowed if provision is made in the Contract Documentation.

The minimum road-surface rising temperatures at which the spraying of the different types and grades of binder shall be allowed are specified in Table A10.1.3-1.

Table A10.1.3-1: Minimum road-surface rising temperature

Bituminous binder type	Minimum road surface rising temperature
70/100 penetration-grade	25°C
MC 3000	10°C
Cationic emulsion	10°C
Anionic emulsion	10°C
S-E1	25°C
S-E2	25°C
S-R1	25°C
S-R2	25°C
SC-E1	10°C
SC-E2	10°C
S-E1 cut back with 4.5% MC30	23°C
S-E1 cut back with 9.0% MC30	21°C
Any special formulated binder not defined above	As specified in the Contract Documentation

Conventional slurry shall not be applied at an air temperature of less than 7°C when temperatures are rising or less than 13°C when temperatures are dropping.

During hot weather slurry operations shall be suspended when aggregate is being displaced by the spreader box or squeegees.

Rapid setting slurry or microsurfacing shall be sufficiently versatile to be laid in air temperatures of 4°C to 40°C as well as capable of being laid under damp conditions. When the breaking process accelerates to such an extent that it renders the product unworkable to attain the required end result, no further work shall be done until adjustments to the composition of the product have been proven through trial sections and approval by the Engineer.

A10.1.3.3 Areas inaccessible to mechanical equipment

a) Bituminous binder application

Each area that is to be sealed shall be screened off by means of fibre-reinforced paper, so that only the area to which the binder is to be applied will be exposed.

Bituminous binders shall be applied at the rate specified in the Contract Documentation by means of a binder distributor. Hand-spray or light appropriate equipment may be used only with the written approval of the Engineer and then only in accordance with approved methods under the strict supervision of experienced personnel and with equipment suitable for performing the work in accordance with specified requirements.

The application of binders shall be controlled to ensure that the specified application rates are obtained. **b)**

Aggregate

The aggregate shall be of the same size as the aggregate in the existing surrounding seal and shall be spread by hand. **c)**

Rolling and brooming

Each layer of the seal shall be rolled with the most effective rollers that can be used in the area in question and thereafter the excess aggregate shall be swept off the surface with hand brooms

d) Grit or slurry application

The Engineer may require Grit or a texture slurry to be applied to areas subjected to traffic turning actions. The slurry and application thereof shall comply with the requirements of Section A8.3 of Chapter 8. Grit shall conform to specifications in Clause A10.1.5.14. The Engineer may order precoating of the Grit and application of diluted cationic emulsion before spreading the Grit.

A10.1.3.4 Protection of kerbs, channels, etc.

Kerbs, channels, manholes, guard rails, bridge railings and any other structures, adjoining seals to be constructed, shall be protected from soiling. The Contractor shall replace at his own cost any items that have been soiled.

A10.1.3.5 Moisture content

No seal shall be placed immediately after a rainy spell on an existing partly cracked and /or highly permeable surfacing resulting in the trapping of moisture in the pavement structure. A minimum delay of 24 hours shall apply.

Seal work shall not be permitted on new granular base layers of type G1, G2 or G3 if the moisture content in the upper 50 mm exceeds 50 % of the optimum moisture content as determined in accordance with SANS 3001 No GR30.

Seal work shall not be permitted on new granular base layers of type G4 or G5, if the moisture content in the upper 50 mm exceeds 60 % of the optimum moisture content as determined in accordance with SANS 3001 No GR30.

These limitations shall apply even if the layer has been previously primed.

A10.1.3.6 Pretreatment

New base layers shall be pre-treated if the volumetric macro texture depth varies with more than 40 % or if the macro texture exceeds the guideline values for different seal types as published in SABITA Manual 40.

Existing roads that require resealing shall, if so specified in the Contract Documentation, be given a pretreatment in accordance with one or more of the methods described in Chapter 8.

The following curing periods shall apply to the various treatments listed, prior to applying to seal/reseal unless otherwise specified in Contract Documentation:

Texture treatment using fine slurries.....	6 weeks
Coarse slurry, rapid setting slurry or microsurfacing applied as screed or rut filling	12 weeks
Crack sealing	2 weeks
Asphalt patches for pavement repair	6 weeks
Bitumen treated granular materials.....	4 weeks
Untreated granular and cement stabilised materials	2 weeks

The Engineer may reduce the specified curing period for slurry, microsurfacing and asphalt application, based on a representative corrected ball penetration (SANS 3001-BT10), at the expected operating road surface temperature (Refer SABITA Manual 40) of less than 2,0 mm.

A10.1.3.7 Demarcation of working area

The Contractor shall demarcate the area to be sealed by means of setting out string lines along each edge of the specified seal area. The intervals for setting out horizontal curves shall be as agreed with the Engineer.

Before the tack coat and first application of aggregate may be applied, the centreline of the road shall be demarcated by means of a clearly visible fibre rope, pegged down with nails driven into the existing surface or primed base at intervals of 15 m on straight sections and 3,0 m apart on curves. The demarcating rope shall be removed prior to the application of the tack coat and aggregate on the adjacent lane.

A10.1.3.8 Dust control

Any temporary deviations and construction roads shall be kept watered and damp during all sealing operations and all dust shall be removed from surfaces before any binder, aggregate or slurry is applied.

The supply and application of water on temporary deviations will be paid for separately as specified in Clause A1.5.7.10 of Chapter 1 but payment for watering the haul and construction roads shall be included in the unit rates tendered for the various types of seals used.

A10.1.3.9 Spray joints

a) Transverse joints

In order to prevent overlapping at junctions of separate binder applications the previous work along the joint shall be covered with removable reinforced paper for a sufficient distance back from the joint to ensure that the sprayer is operating at the required speed 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.

b) Longitudinal joints

Longitudinal joints shall be constructed meeting the following requirements:

- Unless specified differently in the Contract Documentation, the spraying of adjacent strips shall overlap by 200 mm i.e. 100 mm of 2/3 application and 100 mm of 1/3 application
- The string line on the joint shall demarcate the area sprayed at full application and 2/3 application
- No turning of the end nozzles or use of fish plates shall be allowed at longitudinal joints
- Aggregate shall only be applied on the area with full triple overlap binder application
- No longitudinal joints are allowed in the wheel tracks
- All aggregate applied on the 2/3 and 1/3 binder application shall be broomed back or chipped off in a neat straight line before the adjoining spray
- All stone-loss shall be made good by the Contractor at no additional cost

A10.1.3.10 Traffic limitations

Traffic shall not be allowed:

- On a single seal or double seal prior to application of the cover spray, if designed with a cover spray
- On the first layer of aggregate of a double seal, second layer of a triple seal (split application double seal) or Cape seal (single seal with slurry)
- On non-completed longitudinal joints

Stop/go positions shall not be allowed at steep grades.

Speed restriction of maximum 60 km/h shall be enforced for at least 24 hours after opening to traffic or for such time as determined by the Engineer. The Contractor shall not allow any construction equipment which is likely to cause damage, over the completed seal.

A10.1.3.11 Opening to traffic

The road shall not be opened to traffic until sufficient adhesion has developed between the binder and aggregate, cover sprays, fog sprays and rejuvenation sprays have lost its tackiness or in the case of slurry seals, the slurry has cured completely.

When non-fluxed binders are applied and cold temperatures are expected, the road shall only be opened to traffic when the surface temperature increases above 20°C.

During the specified embargo period, and unless MC3000 has been used, the road shall only be opened to traffic when the road surface temperature increases above 20°C. Closures are required for the first three days after sealing when the road surface temperature falls below 20°C

When rain is imminent, the road shall only be opened to traffic once the surface is dry.

The Contractor shall erect and maintain the necessary temporary traffic-control signs in accordance with the requirements in the Contract Documentation and the latest version of the South African Road Traffic Signs Manual.

Where a double application of slurry has been specified in case of single seals with slurry, the Contractor shall open the road to traffic before the second layer of slurry is applied.

Where road widths allow, traffic shall be directed through placement of delineators to compact the full width of the applied seal.

A10.1.3.12 Trial sections

Before the Contractor commences with the construction of any seal work he shall demonstrate that the equipment and processes he proposes to use will enable him to construct the seal in accordance with the specified requirements.

At the commencement of the surfacing operation, a 200 m lane section shall be considered as a trial. After completion of each phase of the seal on this 200 m section, the Engineer will review and then approve/reject the work method. If approval is granted for a specific operation i.e. application of tack coat, aggregate, fog or slurry, the Contractor shall proceed with that approved operation and document the approved method statement, which shall include aggregate spread rates, the timing, type, sequence and number of roller passes, as well as the approved strategy for opening to traffic.

Trial sections for sand seals and Grit seals, using emulsion, shall specifically be designed to evaluate the appropriate timing of aggregate application to prevent wave forming as well as the sequence and timing of rollers to prevent pick up.

Should the Contractor at any stage fail to deliver an accepted product, as adjusted, he shall rectify the problems at his own cost, demonstrate with a further trial section that he can carry out the operation successfully and revise the method statement. No specific payment shall be made for conducting these additional trials.

A10.1.3.13 Maintenance

The Contractor shall maintain the bituminous surface until the work is finally accepted by the Employer, after the specified Defects Notification Period. Any damage related to design, materials and workmanship or any defects which may develop before the issue of the Performance Certificate, fair wear and tear and 3rd party mechanical damage excepted, shall be corrected by the Contractor at his own cost.

Treatment of defects shall be carried out in accordance with Chapter 8.

Penalties in accordance with Part D of this Chapter shall apply, when applicable.

A10.1.3.14 Nominal rates of application for tender purposes

The nominal rates of application provided in these specifications are for tendering purposes only and will not necessarily be used in construction. Application rates for all bituminous binders shall be specified at spraying temperature.

All binders, aggregates and slurry used in the various types of seals shall be applied at the rates of application as approved by the Engineer after:

- Measurement of the existing surface characteristics
- Testing of the materials proposed for use
- Aggregate spread rate determination on site
- Construction and evaluation of a trial section
- Documentation of the method statement and approval thereof

a) Single seals

The nominal rates of application given in Table A10.1.3-2 shall be used for tendering purposes only.

The actual application rate shall be as approved by the Engineer after assessing the Contractor's design proposals.

Table A10.1.3-2: Nominal binder application rates for single seals

Nominal size of aggregate mm	Nominal rates of binder application for tack coat (l/m ²)				Nominal aggregate spread rate (m ² per m ³)	
	Conventional bitumen and emulsion. (Residual cold bitumen)	Homogeneous modified emulsion. (Residual cold binder)	Hot applied homogeneous modified bitumen at spray temperature.	Hot applied non-homogeneous modified binders at spray temperature	Aggregate spread rate for conventional and homogeneous modified binders	Aggregate spread rate for non-homogeneous modified binders
20	1,6	1,6	1,9	2,7	70	65

14	1,4	1,4	1,7	2,1	100	90
10	1,0	1,0	1,2	1,6	140	130
7,1	0,75	0,75	0,9	1,1	200	
5	0,6	0,6	0,7		250	

b) Multiple stone seals

The nominal rates of application given in Tables A10.1.3-3 and A10.1.3-4 shall be for the purposes of tendering only and the actual rates of application shall be approved by the Engineer.

The use of cut-back bitumen in the tack coat will only be permitted under special circumstances and if so specified in the Contract Documentation.

Table A10.1.3-3: Nominal rates of first application of binder and aggregate for multiple stone seals

Nominal size of aggregate mm	Nominal rates of binder application for tack coat (l/m ²)				Nominal aggregate spread rate (m ² per m ³)	
	Conventional bitumen and emulsion. (Residual cold bitumen)	Homogeneous modified emulsion. (Residual cold binder)	Hot applied homogeneous modified bitumen at spray temperature	Hot applied non-homogeneous modified binders at spray temperature	Aggregate spread rate for conventional and homogeneous modified binders	Aggregate spread rate for non-homogeneous modified binders
20	1,2	1,2	1,3	2,0	75	65
14	0,9	0,9	1,0	1,8	110	90
10	0,7	0,7	0,8	NA	150	130

Table A10.1.3-4: Nominal rates of application for second binder and final aggregate

Nominal size of aggregate mm	Nominal rates of binder application for penetration coat (l/m ²)				Nominal aggregate spread rate (m ² per m ³)	
	Conventional bitumen and emulsion. (Residual cold bitumen)	Homogeneous modified emulsion. (Residual cold binder)	Hot applied homogeneous modified bitumen at spray temperature	Hot applied non-homogeneous modified binders at spray temperature	Aggregate spread rate for conventional and homogeneous modified binders	Aggregate spread rate for non-homogeneous modified binders
10	1,0	1,0	1,2	1,8	165	140
7,1	0,8	0,8		-	170	
7,1 (1st layer)*	n/a	n/a		-	250	
7,1 (2nd layer)*	1	1	1,1	-	150	
5	0,6	0,6	0,9	-	230	

*Split application 20/7 double seal

Residual cold binder is defined as the net binder (bitumen, polymers and additives) cold at a temperature of 20°C. The hot applied binder is calculated by multiplying the residual cold bitumen by the "Cold to hot" conversion factors published in TRH3.

c) Nominal binder application and aggregate spread rates for sand and grit seals

The nominal rates of application given in Table A10.1.3-5 shall be for the purposes of tendering only and the actual rates of application shall be as approved by the Engineer.

Table A10.1.3-5: Nominal binder and aggregate application rates for sand and Grit seals

Seal Type	Hot applied 70/100 Pen bitumen at spray temperature.	Hot applied MC3000 at spray temperature.	Hot applied Emulsion at spray temperature.	Aggregate spread rate (m ² per m ³)
Grit precoated		1,1	1,1	200
Grit unprecoated		1,2	1,3	200
Sand	1,0	1,2	1,3	180

d) Nominal binder application and aggregate spread rates for Cape seals (Single seal component)

The nominal rates of binder and aggregate application provided in Table A10.1.3-6 shall apply for tender purposes only.

Table A10.1.3-6: Nominal application for binder and single sized aggregate application in Cape seals

Nominal size of aggregate (mm)	Conventional bitumen and emulsion. (Residual cold bitumen)	Homogeneous modified emulsion. (Residual cold binder)	Hot applied homogeneous modified bitumen at spray temperature.	Aggregate spread rate for conventional and homogeneous modified binders
20	1,2	1,2	1,5	75
14	0,9	0,9	1,2	110
10	0,65	0,65	0,8	150

Residual cold binder is defined as the net binder (bitumen, polymers and additives) cold at a temperature of 20°C. The hot applied binder is calculated by multiplying the residual cold binder by the "Cold to hot" conversion factors published in TRH3.

e) Nominal binder application and aggregate spread rates for Cape seals (Slurry component)

The following proportions per cubic metre of slurry shall apply for tendering purposes only:

(i) First or only slurry application

Slurry aggregate (saturated volume)	1,0 m ³
Stable-grade emulsion at mixing temperature	230 l
Cement	16,5kg ³
Water.....	210 l

(ii) Second slurry application

Slurry aggregate (saturated volume)	1,0 m ³
Stable-grade emulsion at mixing temperature	260 l
Cement	16,5kg ³
Water.....	200 l

The following spread rate of slurry (saturated aggregate volume) shall apply for tender purposes only: **Table**

A10.1.3-7: Nominal spread rate of slurry for Cape seals

Nominal size of aggregate (mm)	First layer of slurry (m ² per m ³)	Second layer of slurry (m ² per m ³)
20	140	185
14	150	
1	180	

f) Nominal binder application spread rates for Slurry-bound Macadams

The nominal rates of aggregate and slurry application provided in Table A10.1.3-8 shall apply for tender purposes only

Table A10.1.3-8: Nominal application rates of aggregate and Slurry for Slurry-bound Macadam

Layer Thickness (mm)	Nominal size of aggregate (mm)	Aggregate spread rate rate (m ² /m ³)	Slurry Spread rate (m ² /m ³)
25	14	40	16
30	14	33	13
30	20		
40	20	25	10
50	20		
50	28	20	10

The following proportions per cubic metre of slurry shall apply for tendering purposes only:

Slurry aggregate (saturated volume)	1,0 m ³
Stable-grade emulsion at mixing temperature	230 l
Cement.....	0,01m ³
Water.....	200 l

g) Cover sprays

The nominal hot application rate of a diluted emulsion cover spray (50/50) as specified, shall for tender purposes be 0,8 l/m². **h)**

Slurry

The nominal rate for a void filling coat of diluted 60 % anionic stable-grade emulsion (50/50), before application of the slurry, for tender purposes, shall be 0,8 l/m².

The nominal binder content of the slurry (60 % anionic stable-grade emulsion), for tender purposes shall be taken as 235 l/m³.

The nominal active filler content of the slurry, for tender purposes shall be taken as 16,5 kg/m³.

The nominal rate of slurry application is dependent on the thickness and shall be specified in the Contract Documentation. **i)**

Microsurfacing

The nominal binder content (emulsion) for tender purposes shall be taken as 180 l/m³.

The nominal rate of microsurfacing application is dependent on the thickness and shall be as specified in the Contract Documentation.

A10.1.3.16 Precoating fluid

For tender purposes the nominal quantity of precoating fluid for the relevant nominal aggregate sizes is specified in Table A10.1.3-9.

The nominal application rates as provided in Table A10.1.3-9 are for tender purposes only and must be verified in the site laboratory, with upward adjustment in case of precoating on stockpile by hand or front-end loader. **Table A10.1.3-9: Nominal rates for precoating fluid**

Nominal aggregate size (mm)	Nominal precoating application on stockpile or by hand rate (l/m ³)	Nominal precoating application plant precoating rate (l/m ³)
20	12	10
14	14	12
10	16	14
7,1	18	16
5 or Grit	20	18

If required, an adhesion agent approved by the Engineer shall be added to the precoating fluid at a rate of 0,5 % of the volume of precoating fluid.

A10.1.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS A10.1.4.1 SCOPE

This Section covers the requirements of surface treatments when the selection and design of the surfacing seal is executed by the Contractor in accordance with the Contract Documentation or when the Contractor's alternative is accepted.

A10.1.4.2 Performance period

A performance period of two years after issuing of the Taking-over certificate, or any other period as specified in the Contract Documentation, shall apply.

A10.1.4.3 Contractor's obligation before tendering

a) Condition assessment

Condition assessments of the road shall be carried out by the Engineer or Employer prior to tendering and the following information supplied to tenderers:

- Visual defect assessment according to TMH9 (Part A and B) per 100 m lane section
- Rutting according to TMH13 in each wheel track (Average per 10 m)
- Macro texture in wheel tracks according to TMH13 (Average per 10 m)
- Macro texture in-between wheel tracks according to TMH13 (Average per 10 m)
- Position, size and condition of existing patches

In addition to the condition assessment, the Contractor / Tenderer should also be obliged to recognise:

- Traffic loading and volumes
- Climatic conditions
- Up- and downgrades along the road
- Traffic accommodation requirements

all of which would impact on his design and construction activities.

b) Achievable specifications

When, in the opinion of the Contractor, the properties of the proposed materials do not adhere to the specifications set in this chapter and/or the prescribed performance over the specified period cannot be met, a set of achievable specifications shall be submitted as part of the tender or, if an alternative is proposed, to the Engineer for evaluation.

A10.1.4.4 General Specifications

a) Quality and Workmanship

Specifications regarding workmanship as defined in the relevant clauses in Part A of this Chapter, for each specific seal type, shall apply.

Prior to commencing with construction, the Contractor shall submit to the Engineer a Quality Management Plan detailing the tests and processes that will be followed during construction of the surfacing seal.

b) Material properties

(i) Aggregate

Aggregate properties shall be in accordance with the specifications for each individual seal type as stated in the relevant section of this chapter. *(ii) Binder*

Binder properties shall be in accordance with the specifications for each individual seal type as stated in the relevant section of this chapter.

Should a proprietary product be used, the relevant properties of the selected product, not meeting the generic specifications shall be stated as well as the achievable specifications.

c) Performance Specifications

Performance specifications are provided in D10.1.

d) Remedial work

Requirements for remedial work are provided in D10.1.10.

A10.1.5 MATERIALS

A10.1.5.1 Conventional Bituminous Binders for seal work

Unless Performance Grade binder specifications SANS 4001 BT – 10 are specified in the Contract Documentation, conventional bituminous binders shall comply with the following specifications:

- Penetration-grade bitumen complying with SANS 4001-BT1 • Cut-back bitumen complying with SANS 4001 – BT2:
- Anionic bitumen emulsion complying with SANS 4001 – BT3
- Cationic bitumen emulsion complying with SANS 4001 – BT4

A10.1.5.2 Polymer Modified Bituminous Binders for seal work

a) Non-homogeneous (heterogeneous) modified binders (summer grade)

The bitumen-rubber binder shall comply with the requirements as set out in the latest publication of TG1.:

The Contractor shall provide the Engineer with time versus temperature relationships in regard to the above properties of his specific product before work may start, in order to determine the final process and the acceptance limits.

If a supplier uses a diluent, an ageing test shall be required in which the binder is placed in an oven for 5 hours at 150°C, after which time it shall comply with the above specifications.

The Contractor shall provide the performance record for three recent projects of the materials he intends to use in order to prove the successful use of the materials. The Information shall include mean values obtained for the prescribed tests as well as any relevant comments. This information shall be submitted at design stage.

b) Non-homogeneous modified binders (winter grade)

If non-homogenous modified binders (winter grade) are required, they shall comply with the requirements in the Contract Documentation. **c)**

Homogeneous cold applied modified binders

(i) Base Bitumen

The cationic emulsion shall be manufactured from bitumen complying with the requirements of SANS 4001-BT1:2012.

(ii) Polymer

The Contractor shall indicate, in the relative pay item in the Pricing Schedule, the type of polymer to be used in the blend.

(iii) Polymer modified emulsion blend

All blending shall be done at the factory. The modified binder for this project shall be specified in the Contract Documentation be as one of binder Class SC-E1 or SC-E2, with the range of binder content and with a "(t)" added to indicate if no fluxing agent or volatile solvent is allowed in the binder) and shall comply with the requirements of the latest publication of TG1.

The recovery binder residue shall be obtained using either the rotary vacuum evaporation or simple evaporation method. If there is any discrepancy in the test results, then the results on recovered binder obtained from the rotary vacuum evaporation method shall be binding.

The use of a volatile solvent flux added to the bitumen shall not be permitted unless approved by the Engineer.

d) Homogeneous hot-applied modified binders (summer grades)

(i) Base Bitumen

The base bitumen or blends thereof, shall comply with the requirements of SANS 4001-BT1 or, if specified in the Contract Documentation, with the PG binder specifications as prescribed in Chapter 9. In addition, the chemical composition of the bitumen shall be such as to permit blending with the proposed polymer to form a stable product.

(ii) Polymer

The type and percentage of polymer to be blended with the bitumen is not prescribed, however the Contractor shall indicate, in the relevant pay item in the Pricing Schedule, the type of polymer to be utilised.

(iii) Polymer modified blend

The polymer modified bitumen shall be blended at the factory.

The polymer modified bitumen to be used on this project shall conform to a binder Class S-E1 or S-E2 and shall comply with the requirements of the latest publication of TG1.

The binder for the day's production shall be tested on site to determine the softening point before any seal work is commenced with. As a control, a hand-held spindle viscometer shall be used to monitor the viscosity of the binder at the spray temperature.

No claim for delays due to this requirement shall be considered.

e) Homogeneous hot-applied modified binders (winter grade)

The cutting back of the S-E1 binder shall only be allowed when specified in the Contract Documentation.

The percentage of cut back using MC30 shall be 4,5 % during the start and end of winter, with a maximum of 9 % during the coldest periods in the middle of winter.

A10.1.5.3 Bituminous binders for cover sprays

Undiluted or diluted cationic spray grade emulsion shall be used as cover sprays on single or multiple stone seals in accordance with the Contract Documentation.

Unless specified differently in the Contract Documentation, diluted cationic spray grade or anionic stable-grade emulsion (50/50) shall be used as cover sprays on Cape seals (single plus slurry seals).

A10.1.5.4 Bituminous binders for slurry seals

The following shall be used:

- Cover spray, if specified in the Contract Documentation, using diluted 60 % anionic stable-grade emulsion (50/50) in accordance with Clause A8.2.3.2 of Chapter 8.
- Slurry seal: 60 % anionic stable-grade emulsion.

A10.1.5.5 Bituminous binders for microsurfacing overlays

The binder shall be a quickset cationic bitumen emulsion, modified with an elastomer and conforming to AC-E2 specifications as given in the latest publication of TG1. The emulsion must be specially formulated to allow for a time of between 90 and 240 seconds when mixed with the selected aggregate, to ensure sufficient setting time of the mix during placing.

A10.1.5.6 Water for diluting emulsions

Water used for the dilution of emulsions on site shall be suitable potable water, and each source of water used shall be tested for compatibility with the emulsion before it is added to the bulk emulsion.

A10.1.5.7 Precoating fluid

Precoating fluid shall be manufactured from petroleum-based products. The use of tar based precoating fluids shall not be permitted.

If required, an adhesion agent approved by the Engineer shall be added to the precoating fluid at a rate of 0,5 % of the volume of precoating fluid.

A10.1.5.8 Cutting back of bitumen in a dedicated plant

The cutting back of bitumen shall only be allowed when specified in the **Contract Documentation**. The cutting back of bitumen shall be done with MC30 in accordance with SABITA: Guide for the control of HSE hazards associated with the field production of medium curing cutback bitumen. MC30 shall comply with the requirements of SANS 4001 – BT2.

The temperature of the bitumen, when the MC30 is introduced shall not be higher than 140°C.

A10.1.5.9 Heating and storing of bituminous binders

a) Conventional binders

The allowed temperature ranges between which bituminous binders are stored or heated for application shall be as given in SANS 4001_BT1.

Binders stored in a heated condition shall be kept in a container with a securely fitting lid and the circulatory system of which is functioning properly. The container shall be provided with a built-in thermometer.

Binders which have been heated above the maximum allowed temperatures shall not be used and shall be removed from the site. Every effort shall be made to maintain the binder temperature for spraying to within 5°C of the recommended temperature.

For seals the temperature limits for 70/100 penetration grade bitumen, cut back with the indicated amounts of MC-30 in parts per 100 parts of bitumen by volume as described in Clause A10.1.5.9, shall be as set out in Table A10.1.5-1 to prevent degradation of the bitumen.

Table A10.1.5-1: Temperature/time limits for conventional binders cut back to specific proportions

Quantity of MC-30 added (parts per 100 parts of bitumen by volume)	Temperature limits	
	Lower limit °C	Upper limit °C
0	150	175
6	146	163
11	138	154
17	132	149
<u>22</u>	<u>125</u>	<u>143</u>

b) Non-homogeneous (heterogenous) modified binders (summer grade)

After completion of the bitumen-rubber reaction, the handling of the binder shall be in accordance with the latest published TG1. **c)**

Non-homogeneous modified binders (winter grade)

The Contractor shall comply with the requirements specified in the Contract Documentation with regard to the storage, heating and spraying temperatures. **d)**

Homogeneous cold applied modified binders

Modified bitumen emulsions may be stored at ambient temperature for long periods, provided that some circulation/mixing takes place from time to time. The spraying temperatures of these emulsions are the same as for conventional bitumen emulsions.

The requirements for short term handling, storage and application of these binders shall be in accordance with the latest published TG1. **e)**

Homogeneous hot-applied modified binders (summer grade)

Excessive temperature over extended periods will degrade all modified bitumen and negatively affect the enhanced properties of these binders.

The temperature limits for the storage and spraying of modified hot-applied binders shall be in accordance with the latest published TG1

Modified binders stored in a heated condition shall be kept in a container having a properly functioning circulation system and a securely fitting lid. **f)**

Homogeneous hot-applied modified binders (winter grade)

When S-E1 is cut back with MC30, the supplier shall provide temperature-viscosity relationships for the different percentages of MC30 addition and recommendations regarding spray temperatures.

g) Bituminous binders for Cape seals

The type of bituminous binder for the tack coat shall be specified in the Contract Documentation and shall conform to the specifications in Clause

A10.1.5.1. No volatile solvents are allowed in the tack coat binder.

Cover spray for Cape seals (single seal plus slurry) shall conform to the specifications in Clause A10.1.5.1.

A10.1.5.10 Single sized aggregate

The aggregate for single, multiple and the first layer of Cape seals shall consist of approved crushed stone of the specified grade and size and shall comply with the following requirements in regard to grading, hardness and shape and durability. **a) Grading**

The grade or grades of aggregate to be used must be specified in the Contract Documentation. Table A10.1.5-2 serves as a broad guideline for selection of the aggregate grade appropriate for the expected traffic volume. **Table A10.1.5-2: Aggregate grade**

Traffic (AADT)	Less than 300	300 - 3000	More than 3000
Relevant Aggregate Grade	C	B	A

The grading shall comply with the requirements set out in Table A10.1.5-3 for grades A, B or C.

Table A10.1.5-3: Single-sized crushed aggregate grades A, B and C

Sieve size (mm)	Grade	Percentage by mass passing				
		Nominal size (mm)				
		20	14	10	7	5
37.5	A & B					
28		100				
20		85 - 100	100			
14		0 - 35*	85 - 100	100		
10		0 - 5**	0 - 35*	85 - 100	100	
7,1			0 - 5**	0 - 35*	85 - 100	100
5				0 - 5**	0 - 35*	85 - 100
3.35						0 - 35*

2.0					0 – 5**	0 – 5**
	C	Grading shall comply with the requirements for grades 1 and 2 with the following exceptions: *0 – 50, **0 – 10,				
Fines content passing 0,425 mm sieve	A	0.5	0.5	0.5	0.5	1.0
	B	1.5	1.5	1.5	1.5	2.5
	C	2.0	2.0	2.0	3.0	3.5
Dust content: Material passing at 0,075 mm sieve (max)	A	0.2	0.2	0.2	0.5	0.5
	B	0.5	0.5	0.5	1.0	1.0
	C	1.5	1.5	1.5	1.5	1.5

Note: When determined on aggregate before treatment e.g. precoating

b) Hardness

When tested in accordance with SANS 3001 No AG10, the 10 % FACT value shall comply with the requirements in Table A10.1.5-4.

Table A10.1.5-4: Hardness

Relevant Aggregate Grade	C	B	A
Dry 10 % FACT [kN] (min)	130	180	210
Wet 10 % FACT [kN] (min)	100	135	160

c) Polishing stone value

Unless specified differently in the Contract Documentation, the polishing stone value, measured according to SANS 3001-AG11 shall comply with the requirements in Table A10.1.5-5.

Table A10.1.5-5: Polishing stone value

Relevant Aggregate Grade	C	B	A
Aggregate position in seal			
Exposed aggregate	48	49	50
Underlying aggregate	45	47	48

Underlying aggregate refers to the first aggregate layer of a double seal.

d) Shape

The maximum flakiness index, when tested in accordance with SANS 3001- AG4, shall comply with the requirements in Table A10.1.5-6.

Table A10.1.5-6: Flakiness

Relevant Aggregate Grade	C	B	A
20 mm nominal size	30	30	25
14 mm nominal size	30	30	25
10 mm nominal size	35	35	30
7,1 mm nominal size	35	35	30

Ninety-five (95 %) percent of the particles shall have at least three fractured faces. The Average Least Dimension (ALD) of the relevant nominal aggregate sizes, measured according to SANS-AG2 and 3, shall comply with the requirements of Table A10.1.5-7.

Table A10.1.5-7: Average least dimension

Relevant Aggregate Grade	C	B	A

Nominal Aggregate Size (mm)			
20	10,8	12	12
14	7,4	8	8
10 single	5	5,5	5,5
10 second layer	NA	5	5

e) Durability

Grade A aggregate used in seals shall show a durability index of less than 4 as determined by the test method specified in Section A20.1 of Chapter 20.

Should the durability index be higher, additional testing according to current best practice shall be conducted and the results submitted to the Engineer for evaluation.

A10.1.5.11 Aggregate for blinding single seals

The aggregate used for blinding a single seal shall consist of crushed aggregate or river sand complying with Table A10.1.5-9.

The aggregate shall be clean, hard and free from clay, silt or other deleterious matter.

A10.1.5.12 Aggregate for Sand and Grit seals

The grading for sand and Grit seals shall comply with the requirements set out in Tables A10.1.5-8 and A10.1.5-9. **Table**

A10.1.5-8: Sand

Sieve size (mm)	Percentage passing by mass
7,1	100
0,300	0 - 15
0,150	0 - 2
Sand Equivalent [%] (min)	35
Plasticity Index: Non-Plastic	

Table A10.1.5-9: Grit

Sieve size (mm)	Percentage passing by mass
5	100
2	0 - 100
1	0 - 50
0,600	0 - 20
0,300	0 - 10
0,150	0 - 5
0,075	0 - 2
Sand Equivalent [%] (min)	35

A10.1.5.13 Aggregate for Graded Aggregate seals

The grading and material property requirements for Graded aggregate seals shall comply with the requirements set out in the Contract Documentation.

A10.1.5.14 Precoating of Hydrophilic aggregates

Where hydrophilic or other aggregates which may cause problems are encountered, the stone chips shall be precoated, as described below. **a)**

General

No precoating shall be applied where conventional and modified emulsion binders are used unless specified in the Contract Documentation. **b)**

Plant precoating

Where plant precoating is specified, the requirements for the end product and environmental specifications shall be in accordance with the Contract Documentation. Adjustments to the nominal quantity of precoating fluid as indicated in Table A10.1.3-9 might be required to ensure that the final product is uniformly coated.

c) Precoating of aggregate stockpiles

The untreated stockpile of aggregate shall be thoroughly sprayed with water, which shall be allowed to drain off. The damp aggregate shall then be loaded into the bucket of a front-end loader with known capacity and a nominal quantity of an approved precoating fluid shall be sprayed evenly over the aggregate by means of a watering can.

The mixture of aggregate and precoating fluid shall then be dumped on a site prepared as specified in Clause A10.1.5.17. This process shall be repeated until a stockpile of approximately 15 m³ to 20 m³ has been built up.

This stockpile shall then be turned over with the front-end loader until the aggregate is uniformly coated with the precoating fluid. Three complete turnings of the stockpile will probably be required. Adjustments to the nominal quantity of precoating fluid as indicated in Table A10.1.3-9 might be required to ensure that the final product is uniformly coated.

The time between the precoating and the placing of the aggregate shall not exceed two weeks.

A10.1.5.15 Aggregate management

a) Stockpiles

The Contractor shall heed the environmental requirements of Section A1.2 of Chapter 1, as well as the Contract Documentation, in the preparation, operation and closure of stockpile sites. The positions for stockpiling of aggregate and the proposed operation methods shall be approved by the Engineer before delivery of the aggregate can commence.

Sites for the stockpiling of aggregates shall be located, prepared and maintained in such a manner that:

No grass, mud, dirt or other deleterious material will be included when the aggregates are loaded for use.

They are not exposed to excessive contamination with dust arising from traffic on the road or access roads. Where necessary, temporary deviations and access roads in the immediate proximity shall be watered or sealed

No dirt is conveyed by vehicle wheels onto the areas to be sealed or resealed whilst aggregate is being transported to or from the stockpiles.

Stockpiles shall always be covered with tarpaulins or similar protective coverings

Aggregates contaminated to the extent that it contains more than the allowable percentage of material passing through the 0.425mm sieve and 0.075mm sieve shall not be used for sealing.

b) Removal of excess aggregate

After application of the seal all loose stones swept off the road surface are to be heaped either in the drain or gravel shoulder, whichever is applicable, and removed in one operation. Under no circumstances shall the excess stone be swept over embankments. No sweepings are to be left on site for more than 24 hours.

A10.1.5.16 Geosynthetic membranes for seal work

The geosynthetic shall be a non-woven geofabric, double needle punched with properties as specified in Table A10.1.5-10.

Table A10.1.5-10: Specifications for geosynthetic membranes

Property	Unit	Requirement	Test Method
Nominal mass	g/m ²	130	SANS 9864/ISO 9864
Thickness	mm	1,2	SANS 9863/ISO 9863
Tensile strength (min)	kN/m	7	SANS 1525/ISO 10319
Elongation at break	%	40 - 60	SANS 1525/ISO 10319
Penetration load (CBR)	kN	1.5	SANS 12236/ISO 12236
Puncture resistance (DART)	mm	30	SANS 13433/ISO 13433
Tear strength (Min)	N	215	ASTM D4533
Grab strength (Min)	N	400	ASTM D4632
Melting point	°C	>165	ASTM D276
Bitumen retention	l/m ²	>1,0	ASTM D6140

A10.1.5.17 Aggregate and fillers for slurry seals

a) Aggregate

The aggregate for slurry seals shall be an approved crusher sand obtained from a parent rock having a 10 % FACT value (dry) of at least 150 or a mixture of such crusher sand and an approved clean natural sand, where the mixture does not contain more than 25 % of natural sand. The aggregate shall be clean, tough, durable, and angular in shape and shall comply with the grading requirements given in Table A10.1.5-11 for the slurry and the grade or type of aggregate specified. Aggregate for the particular application shall be specified in the Contract Documentation.

Table A10.1.5-11: Grading limits of aggregate for slurry seals

Sieve size (mm)	Percentage passing sieve, by mass	
	Fine slurry	Coarse slurry

	Fine Grade	Medium grade	Coarse grade	Type 1	Type 2
14					100
10				100	85 – 100
7,1		100	100	85 – 100	70 – 90
5	100	82 - 100	70 – 90	70 – 90	60 – 80
2	90 - 100	56 – 95	45 – 70	45 – 70	40 – 60
1	65 - 95	37 – 75	28 – 50	25 – 45	25 – 45
0.600	42 - 72	22 – 50	19 – 34	15 – 30	15 – 30
0.300	23 - 48	15 – 37	12 – 25	10 – 20	10 – 20
0.150	10 - 27	7 – 20	7 – 18	6 – 15	6 – 15
0.075	1 – 15	4 – 15	2 – 8	4 – 10	4 – 10

The sand equivalent determined in accordance with SANS 3001 - AG5, shall be at least 35.

The immersion index of briquettes made with slurry aggregate and 70/100 penetration-grade bitumen at the specified net bitumen content for the slurry shall be not less than 75 when tested in accordance with Chapter 20.

In addition, unless otherwise specified, for rapid setting slurries the supplier shall assess the compatibility of the binder offered with aggregates from suitable sources nearest to the site prior to tender closure.

The slurry for Cape seals shall conform to the specifications in Table A10.1.5-11 for Fine Slurry, Fine or Medium as specified for each coat in the Contract Documentation.

b) Filler for slurry

Ordinary portland cement and portland blast-furnace cement (PBFC) shall be SANS 50197 certified. Road lime shall be SANS 824 certified (Lime for Soil Stabilisation).

Only one of the above materials shall be used throughout in order to prevent undesirable colour differences in the surface.

A10.1.5.18 Aggregate for Microsurfacing

The aggregate shall consist of a continuously graded crusher dust, conforming to the specifications in Table A10.1.5-12.

Table A10.1.5-12: Aggregate grading limits for rapid setting slurries and microsurfacing

Sieve Size (mm)	Type II Percent Passing	Type III Percent Passing	Stockpile Tolerance
	Overlay or Rut fill (up to 12 mm)	Rut fill (more than 12 mm)	
10	100	100	
7,1	100	85 - 100	5%
5	90 - 100	70 - 90	5%
2	65 - 90	45 - 70	5%
1	45 - 70	28 - 50	5%
0.6	30 - 50	19 - 34	5%
0.3	18 - 30	12 - 25	4%
0.15	10 - 21	7 - 18	3%
0.075	5 - 15	5 - 15	2%

A10.1.6 CONSTRUCTION EQUIPMENT

The following equipment shall be available and in good working order:

A10.1.6.1 Binder distributor

The binder distributor used for distributing the bituminous binders shall-

- Comply with SANS 3001-BT20 and shall be covered by a valid certificate of compliance with SANS 3001-BT20, *not older than 12 months*,

issued by an accredited testing organisation

- Not have any fuel, oil 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 the height adjusted to the correct level so as to obtain the required overlapping. The uneven application of binder shall be unacceptable.
- Have its sieve undamaged and clean;
- Be under the direct control of an operator approved by the Engineer on the grounds of a CV with experience and list of contracts completed with references, in writing or a certificate of competence signed by a representative of a road authority;
- Be fitted with a suitable cut-off spray-head (end nozzles) or fishplates to prevent over spraying onto gravel shoulders or staining of concrete elements on the edge of the surfacing of the road.
- Be capable of spraying the binder at the specified applications rates. The pump of the distributor shall be capable of delivering the binder at the spray bar nozzles at the correct pressure to obtain the specified application rates, irrespective of the viscosity properties of the prescribed binder and the number of nozzles open.
- Fitted with a suitable valve or other access gate for taking of samples of the binder for testing purposes.

The binder distributor, pumps and nozzles, used for non-homogeneous modified binder shall be adapted to spray the rubber modified binder satisfactorily. The Contractor shall provide proof by way of a test on the site that the binder distributor has sufficient reserve power to maintain the required constant speed up the steepest incline to which spray has to be applied and to obtain a uniform distribution of the binder.

The transverse distribution of the spray bar shall be field-verified by means of SANS 3001-BT24. Measurements of transverse distribution ('Bucket test') for a binder distributor. The maximum permissible tolerance permitted between the troughs (excluding the outer 300 mm) is dependent on the viscosity of the binder type being applied and shall be as follows:

- All emulsions, cutback and penetration grade bitumens – 5 %
- Hot homogeneous modified bitumens – 7 %
- Non-homogeneous binders (bitumen rubber) – 10 %

The spray bar shall be of such design as to allow for any adjustments to be made in order to meet the above tolerances. This procedure shall be carried out each time the distributor is first established on site and once a week thereafter or when a problem with transverse distribution is suspected. The distributor shall thus have a set of troughs available in order to allow the execution of the test. For limited quantities of spray-work, the Engineer may accept the results of a recently completed distribution test that has been recorded and approved by an independent supervisor on the distributor's test log book.

The transverse distribution of spray flairs shall be field verified according to SANS 3001-BT24 and Clause A20.1.5.9 of Chapter 20. The maximum permissible tolerance permitted for each trough from the average of the nine troughs is 10 %.

A10.1.6.2 Chip spreaders

The chip spreaders shall be capable of spreading stone of the specified size uniformly and shall be capable of adjustment to permit variation of the rate of application within the specified tolerances and uniform spreading in both the transverse and longitudinal directions.

The chip spreader shall be capable of delivering a proper and uniform transverse distribution of chips across the width of application. The chip distribution shall be tested by means of canvas patches, each 1,0 m by 1,0 m and placed side by side over the full width of application. The mass of chips spread onto each individual canvas patch shall not deviate by more than 10 % from the spread rate determined as part of the trial section and recorded in the approved method statement.

At least two chip spreaders shall be provided on site, one of which shall be self-propelled.

In cases where the sprayed width exceeds the maximum spread width of the chip spreader, an additional chip spreader shall be provided to apply aggregate on the remaining strip within twenty seconds of the first chip spreader.

Spreaders which are not self-propelled shall be of a type that can be attached quickly to the rear of trucks and operated while backed over the aggregate being spread.

A non-self-propelled chip spreader may only be used in the event:

- of a breakdown of the self-propelled chip spreader during a pull, and shall be limited to the completion of that pull. No further application of binder shall be permitted until such time as the self-propelled chip spreader is repaired or replaced.
- of spreading Class 3 aggregate, Graded aggregate, Sand- or Grit seals and Slurry-bound Macadam seals.

A10.1.6.3 Rollers

a) General

Sufficient operational rollers of each of the following types shall be available on the works to maintain the required tempo of work.

- Pneumatic tyred rollers (minimum two)
- Rubber-soled steel wheel rollers (as and when specified in the Contract Documentation)
- Light steel wheeled rollers of 2 – 4 tons (minimum two)

- Heavy steel wheel rollers of 5 – 12 tons (as and when specified in the Contract Documentation)

The timing, sequence of rolling and number of passes for each seal type shall be in accordance with the approved method statements following completion of the trial sections.

No seal work shall continue if the required rollers are not on site or not in an operational condition. **b)**

Pneumatic-tyred rollers

Pneumatic-tyred rollers shall be of a self-propelled type equipped with smooth flat profile pneumatic tyres of uniform size and diameter. The mass of the roller shall not be less than 2 ton per wheel.

The rollers shall be equipped with suitable devices for keeping the wheels wet and clean with water or non-petroleum-based products 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 shall be in accordance with the manufacturer's recommendations. Individual tyre pressures shall not differ by more than 35 kPa from one another.

In case of sealing more than 12 000 m² per day, using hot binder, at least three pneumatic-tyred rollers are required. **c)**

Rubber-soled steel-wheeled rollers

Rubber-soled steel-wheeled rollers shall be self-propelled and have a mass of between 6 and 8 tons. It shall be equipped with suitable devices for cleaning and moistening the wheels using water or non-petroleum-based products. The wheels of the roller shall be so arranged as to give one or two complete coverage by one passage of the roller, over a width equal to the rolling width of the roller. **d)**

Steel-wheeled rollers

Steel-wheeled rollers shall be self-propelled tandem rollers of between 2 and 4 tons mass and shall be equipped with suitable devices for cleaning and moistening the wheels using water or non-petroleum-based products. Heavier rollers shall only be permitted when specified in the Contract Documentation and tested for excessive crushing during construction of the trial section. No steel-wheeled rollers shall be used on the final aggregate layer without the consent of the Engineer, unless a cover spray will be applied after brooming the surface.

A10.1.6.4 Water sprinkler

The water sprinkler shall have efficient spray equipment, capable of spraying a uniform film of water over the whole area to be primed.

A10.1.6.5 Rotary broom

The rotary broom shall be height adjustable self-propelled or a towed type supplied together with a suitable pneumatic-tyred towing vehicle. The minimum bristle length allowed shall be 70 % of the initial length.

A10.1.6.6 Drag broom

A triangular or "Z-shaped" drag broom shall be provided together with a suitable pneumatic-tyred towing vehicle and capable of being ballasted to distribute the specified seal aggregate size.

A10.1.6.7 Miscellaneous equipment

Sufficient equipment for handling and hauling aggregate, binder and slurry, and blending units for non-homogeneous modified binders, shall be provided to ensure prompt and continuous placing and application of bituminous materials as specified. The Contractor shall have available all the necessary ancillary equipment, which shall include hand brooms, mat or reinforced paper for joints, string, nails and hand tools to carry out the work efficiently.

Suitable protective clothing shall be worn at all times.

Suitable fire-fighting equipment for dealing with fires shall be available on site, together with suitable first aid equipment for dealing with injuries and evacuation transport in case of bitumen burns. (Refer to Sabita Manual 8: Bitumen Safety Handbook.)

The Engineer shall be entitled to request reserve plant should there be any doubt as to the efficiency or capability of the equipment provided.

A10.1.6.8 Batch mixer for slurry

A mixer shall be provided in a good working order capable of producing a uniform slurry of the constituent materials. All the constituents of the slurry shall be accurately proportioned and due care and attention shall be given to the sequence in which the ingredients are introduced into the mixer and to the period of mixing. Volume batching will only be permitted with the written approval of the Engineer. Mixing shall be continued until the materials in each batch are thoroughly blended.

A10.1.6.9 Mass-measuring device for large batch mixers

Where payment per ton is specified, the Contractor shall provide and install suitable gauged mass-measuring device on the site. The device shall be provided with a printer for printing the mass, the time and date. The printed data shall be submitted to the Engineer on a daily basis.

A10.1.6.10 Loader for aggregate

A loader, or equivalent capacity labour force where so required in the Contract Documentation, compatible with the needs and capacity of the trucks or mixer, in the case of slurry, unit shall be available at the stockpiling site.

A10.1.6.11 Continuous slurry machine

Aggregate and filler contained in separate bins shall be fed through metering devices at controlled rates to the mixer. Water and bitumen emulsion contained in separate tanks shall similarly be pumped to the mixer at controlled rates through precise metering devices to enable the various constituents to be combined continuously to the selected or prescribed formulation. The mixing of the slurry shall be at a suitable rate adjusted to ensure complete blending of the ingredients and uniformity of mix before depositing into the spreader box.

The spreader box shall be so constructed as to distribute the weight onto metal skids in such a way that no damage shall be done to the surface when the box is in operation.

Soft rubber belting shall be attached to the framework in such a manner as to prevent slurry from being spilt past the sides of the spreader box when the box is in operation.

The spreader box shall be capable of spreading a uniform application of the slurry in adjustable widths from 1,5 m to 4,0 m, at specified rates, and it shall have efficient mechanical means of adjusting the rates and widths of application specified.

The mixing and application of microsurfacing shall be done by a mixer designed to provide a rapid mixing time, and sufficient agitation within the spreading system to prevent segregation or premature hardening. The appropriate workability measured by the flow (Consistency test: ASTM 3910) shall be verified during the first application and recorded as part of a method statement.

A10.1.6.12 Spreader box for slurry

If the use of a spreader box has been permitted in the Contract Documentation, the type of spreader box used for spreading the slurry shall be submitted to the Engineer, in advance, for approval. The spreader box for rapid setting slurry shall be of a proven and approved type, fitted with a proven and approved device to ensure sufficient agitation within the spreader system.

A10.1.7 EXECUTION OF THE WORKS

A10.1.7.1 Single Seals

a) Preparation

All specifications as stated in Clause A10.1.3 shall be met.

b) Application of tack coat and aggregate

The actual rates of application of binder and aggregate to be used during the construction shall be determined after measurement and evaluation of the existing surface and testing of the aggregate properties the Contractor proposes to use for the seal. The designs shall be submitted to the Engineer for approval prior to any sealing being carried out.

Bituminous binders shall be applied by means of a binder distributor, unless otherwise approved.

If a choice can be exercised areas inaccessible to mechanical equipment shall preferably be restricted to areas that are not subjected to traffic.

A bituminous tack coat consisting of the type and grade of binder specified in these specifications or in the Contract Documentation for each type of bituminous sea, shall be uniformly sprayed on the properly cleaned and prepared base or existing surface over the full specified width of the seal.

Where the tank of the binder distributor could become empty during spraying against inclines, the spraying shall be done while the binder distributor is moving uphill. Should the Engineer be of the opinion that the Contractor is unable to place the sealant over the full specified width in one movement the Contractor shall execute the spraying and the distribution of the aggregate in strips.

Immediately after the binder has been sprayed it shall be covered with clean, dry or precoated aggregate of the size specified in these specifications under each of the appropriate sections for each type of seal. The only exception is the spread of sand or Grit after application of an emulsion. In this case the emulsion must start to break before application of the aggregate to prevent wave forming.

The aggregate shall be applied uniformly by means of self-propelled chip spreaders, unless otherwise specified. The spreading of the chips shall be done as closely as possible behind the distributor. The chip spreader shall be so operated that the tack coat shall be covered with aggregate before the wheels of the chip spreader or truck pass over the uncovered tack coat

The quantity of bitumen sprayed in any single spray operation shall be governed by:

- The quantity of available aggregate. The number of trucks available shall be sufficient to ensure the continuous application of stone behind the distributor.
- Available roller capacity at normal operating speed. In case of hot penetration grade and hot modified binder, at least one roller pass is required within 5 minutes after application of the binder

Areas with varying or narrowing widths on which binder distributors can be used shall be screened off by means of fibre-reinforced paper, so that only the area to which the binder is to be applied, will be exposed. The binder shall then be applied at the specified rate with a binder distributor. Immediately thereafter the fibre-reinforced paper shall be removed, the aggregate shall be applied and the seal shall be completed.

Where hot binders are used, all the aggregate shall be applied immediately but not more than 2 minutes after the application of the tack coat. **c)**

Application in case of geosynthetic membrane

Following compliance with all relevant specifications in Clause A10.1.3, a tack coat of cationic 65 % bitumen emulsion (without solvents) or SC-E1(t) shall be applied at a spray rate of 0,8l/m² by means of a hand applicator or distributor. The geosynthetic shall then be applied to the wet tack coat by hand or a suitable mechanical applicator and rolled with a suitable roller to ensure satisfactory bonding between the geosynthetic and the road surface. All wrinkles shall be smoothed out.

The nominal rate of the binder for the single seal shall be as specified in the Contract Documentation. **d)**

Initial rolling of aggregate

Immediately after the aggregate has been applied on any hot binder, rolling shall be commenced.

In the case of emulsions, immediate rolling by means of self-propelled 2-4 ton steel wheel rollers shall be only permitted if excessive crushing of aggregate does not occur and if another layer of binder will be applied. Pneumatic-tyred rolling shall be delayed until the emulsion has been allowed to break sufficiently to firmly secure the aggregate. Rolling shall be postponed if there is excessive pick-up of aggregate on the tyres of the pneumatic type roller.

Rollers shall operate parallel to the centre line of the road from the shoulders inwards towards the crown of the road until the entire surface has been covered at least four times with the wheels of the roller.

The process (sequence, timing and roller passes) for each seal type shall be finalised during construction of a trial section and documented in a method statement.

e) Broom drag and final rolling of aggregate

After the bituminous binder has set-up sufficiently to prevent any aggregate from being dislodged, and if directed by the Engineer, the surface shall be slowly dragged with a broom drag to ensure even distribution of the aggregate. If there are areas which are deficient in stone chips, additional material shall be added by hand to leave a single layer of chips lying shoulder to shoulder after rolling and traffic compaction.

The Contractor shall provide a back-chipping team, together with a pneumatic-tyred roller, of sufficient capacity to ensure that back-chipping and rolling of aggregate shall be completed within thirty minutes after initial application of the aggregate.

It is essential to ensure that only one layer of aggregate is applied and every care shall be taken to avoid over-application of aggregate.

After completing the spreading of the aggregate, the surface shall be rolled with a self-propelled pneumatic-tyred roller with a minimum load of 2,0 t per wheel for a minimum of four coverages. Except in the case of single seals, constructed without a cover spray, final rolling after brooming off loose aggregate, shall then be done with a steel-wheeled roller with a mass of 2-4 tons working parallel to the centre line of the road from the shoulders towards the crown of the road, until every portion of the surface concerned has been covered by at least four passes of the roller. If excessive crushing occurs under the rollers, such rolling shall be stopped regardless of the number of passes completed by the roller.

All aggregate contaminated by fuel, oil or grease shall be removed and replaced with clean aggregate.

The process for each seal type shall be finalised during construction of a trial section and documented in a method statement.

All loose aggregate shall be broomed off the surface with a rotary broom or hard brooms before opening to traffic.

The finished surface shall be well-knit and have a uniform appearance free of roller-lyre marks. **f)**

Cover spray

When required by the Contract Documentation or if so directed by the Engineer in writing, a cover spray of diluted cationic spray grade emulsion shall be applied to the surface of the aggregate by means of a pressure distributor at the rate and dilution specified in the Contract Documentation or as directed by the Engineer.

g) Blinding

If required in the Contract Documentation or as may be directed by the Engineer, a light blinding layer of washed natural or crusher sand, conforming to Clause A10.1.5.11 shall be applied by the Contractor to prevent aggregate from being picked up by traffic. The blinding layer shall be spread evenly over the full indicated surface.

A10.1.7.2 Multiple stone seals

a) Preparation

All specifications as stated in Clause A10.1.3 shall be met.

b) Application of tack coat and first layer of aggregate

The binder of the type and grade and the aggregate of the size and grade specified in the schedule of quantities and according to the design approved by the Engineer, shall be applied as specified in Clause A10.1.7.1b).

c) Application in case of geosynthetic membrane

Following compliance with all relevant specifications in Clause A10.1.3, a tack coat of cationic 65 % bitumen emulsion (without solvents) or SC-E1(t) shall be applied at a spray rate of 0,8l/m² by means of a hand applicator or distributor. The geosynthetic shall then be applied to the wet tack coat by hand or a suitable mechanical applicator and rolled with a suitable roller to ensure satisfactory bonding between the geosynthetic and the road surface. All wrinkles shall be smoothed out.

The nominal rate of the binder for the seal shall be as specified in the Contract Documentation. **d)**

Initial rolling

Initial rolling shall be carried out as specified in Clause A10.1.7.1d).

e) Broom drag and final rolling of aggregate

Dragging and final rolling of aggregate shall be carried out as specified in Clause A10.1.7.1e).

f) Second application of bituminous binder and aggregate

The second bituminous binder shall be applied and followed by the second layer of aggregate of the size specified, in accordance with the approved method statement.

Where hot binders are used, all the aggregate shall be applied immediately but not more than 2 minutes after the application of the tack coat.

The second application of binder shall preferably take place within 48 hours of the application of the tack coat.

Where a 20 mm + double 7,1 mm split application seal is to be constructed, the application of the 7,1 mm aggregate shall be carried out in two separate operations. The first application of the 7,1 mm aggregate shall be placed before application of the second binder application, at the application rate determined during construction of the trial section and then slowly dragged with a drag broom to ensure an even distribution. **g) Initial rolling of second and final layer**

Initial rolling of the second layer of aggregate, or final layer in case of the 20 mm and double 7,1 mm split application seal, shall be carried out as specified in Clause A10.1.7.1d) or as per approved method statement

h) Broom drag and final rolling of second layer

Dragging and final rolling of the second layer of aggregate shall be carried out as specified in Clause A10.1.7.1e) or as per approved method statement. **i)**

Cover spray

When required by the Contract Documentation or if so directed by the Engineer in writing, a cover spray of diluted SC-E1 or diluted cationic spray grade emulsion shall be applied to the surface of the aggregate by means of a pressure distributor at the rate and dilution specified in the Contract Documentation or as directed by the Engineer.

A10.1.7.5 Slurry Seals

a) Application of slurry

Material which is not properly mixed or in which the emulsion shows signs of having broken during mixing shall not be applied to the road.

In order to achieve the required workability, the slurry consistency when measured in accordance with ASTM D3910 section 6.1 shall be within the ranges of the target flow stated in Table A10.1.7-1 or the adjusted ranges, approved by the Engineer, after construction of the trial section. **Table A10.1.7-1: Slurry consistency requirements**

Application	Target Flow
Slurry bound macadam	60 mm
Hand application of slurry for texture treatment or Cape seals	30 - 40 mm
Slurry overlay	20 - 30 mm
Micro surfacing	10 - 20 mm

Binder layer		Binder	Specified hot application rate	Applied rate	% out	Adjustment factor %	Acceptance	Weighted adjustment	Variation (R/I) tendered	Cost of binder (R/I)	%Cost of layer
First application (tack coat)		Hot: S-R1	2.00	2.20	10.00	79.80	Conditional	46.49	6.00	12	58.25
Second application (penetration coat)		Hot: S-E1	1.30	1.20	7.69	91.61	Conditional	28.91	5.00	6.5	31.55
Cover spray		Diluted Cat 65	1.00	1.10							
% Emulsion in dilution	70	Cold: Cat 65	0.7	0.77	10.00	79.80	Conditional	8.13	3.00	2.1	10.19
							% Payment	83.53		20.60	
							Tendered price/m ²	62.00			
							Payment /m ²	51.79			

The weighted adjusted payment factor in the case of multiple binder applications could directly be calculated using the following equation:

$$P_w = P_1 \left(\frac{C_1}{(C_1 + C_2 + C_3)} \right) + P_2 \left(\frac{C_2}{(C_1 + C_2 + C_3)} \right) + P_3 \left(\frac{C_3}{(C_1 + C_2 + C_3)} \right)$$

Where

Pw	=	Weighted adjusted payment factor
P1	=	Payment adjustment factor for the tack coat
P2	=	Payment adjustment factor for the penetration coat
P3	=	Payment adjustment factor for the emulsion component of the cover spray
C1	=	Cost of the tack coat, calculated by multiplying the specified hot application rate with the tendered variation for the binder
C2	=	Cost of the penetration coat, calculated by multiplying the specified hot application rate with the tendered variation for the binder
C3	=	Cost of the cover spray,

calculated by multiplying the specified application rate with the tendered variation for the emulsion

In the case of graded aggregate seals and sand seals the engineer may accept, an application of binder sprayed above the allowable tolerance subject to the contractor, at his own cost, applying and rolling any additional sand/aggregate necessary as a result of such over application.

The tendered rate shall include full compensation inter alia, for furnishing all materials, marking the centreline, spraying of binder spreading of aggregate, rolling, removing of dust or deleterious material, supplying of water and spraying of haul roads and construction roads, trimming the edges of the completed surface, and all other incidentals necessary for completing the work as specified

Item	Description	Unit
C10.1.9	Bituminous binder variations:	
C10.1.9.1	70/100 Penetration grade bitumen	litre (ℓ)
C10.1.9.2	60 % Stable-grade emulsion	litre (ℓ)
C10.1.9.3	Cationic Stable grade emulsion ((indicate bitumen content)	litre (ℓ)
C10.1.9.4	Cationic Spray-grade emulsion (indicate bitumen content)	litre (ℓ)
C10.1.9.5	Homogeneous modified binder (indicate type and bitumen content) cold applied	litre (ℓ)
C10.1.9.6	Non-homogeneous modified binder (indicate class S-R1 or S-R2)	litre (ℓ)
C10.1.9.7	Homogeneous modified binder (indicate type) hot applied	litre (ℓ)
C10.1.9.8	Homogeneous modified binder S-E1 with 4,5% MC30	litre (ℓ)
C10.1.9.9	Homogeneous modified binder S-E1 with 9% MC30	litre (ℓ)
C10.1.9.10	MC-3000 cut-back bitumen	litre (ℓ)
C10.1.9.11	Precoating fluid (state type)	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 (except for diluted emulsions, where the variation is calculated in terms of the emulsion before dilution)

Where MC30 is used to cut back the penetration-grade bitumen, the rate for MC-30 variation shall include full compensation for providing the MC-30 and mixing it with the bituminous binder.

Item	Description	Unit
C10.1.10	Aggregate variation (state grade):	
C10.1.10.1	5,0 mm aggregate	cubic metre (m³)
C10.1.10.2	7,1 mm aggregate	cubic metre (m³)
C10.1.10.3	10 mm aggregate	cubic metre (m³)
C10.1.10.4	14 mm aggregate	cubic metre (m³)
C10.1.10.5	20 mm aggregate	cubic metre (m³)
C10.1.10.6	Sand	cubic metre (m³)
C10.1.10.7	Grit	cubic metre (m³)

The unit of measurement for aggregate in respect of an increase or a decrease in the rates of application determined during the trial sections and contained in the approved method statement, shall be the cubic metre of aggregate.

Item	Description	Unit
C10.1.11	Application of cover spray:	
C10.1.11.1	60 % Anionic Stable-grade emulsion	litre (ℓ)
C10.1.11.2	60 % Diluted Anionic stable-grade emulsion (indicate dilution in % emulsion/%water)	litre (ℓ)
C10.1.11.3	Diluted Cationic spray-grade emulsion (indicate % bitumen and dilution in % emulsion/%water)	litre (ℓ)
C10.1.11.4	Diluted SC-E1 (indicate % bitumen and dilution in % emulsion/%water)	litre (ℓ)

This pay item shall only apply when an additional cover spray is ordered by the Engineer. Cover sprays included as part of the seal design shall be deemed to be included in the total rate for the pay item of the specific seal.

The nominal rates for cover sprays seals indicated in Clause A10.1.3.15 shall apply.

The unit of measurement shall be the litre of undiluted/diluted emulsion as specified, measured at spraying temperature.

The tendered rate shall include full compensation for furnishing the material and applying the cover spray as instructed.

Item	Description	Unit
C10.1.12	Application of cover spray by hand:	
C10.1.12.1	60% Anionic Stable-grade emulsion	litre (ℓ)
C10.1.12.2	60% Diluted Anionic Stable-grade emulsion (indicate dilution in % emulsion/%water)	litre (ℓ)
C10.1.12.3	Diluted Cationic Spray-grade emulsion (indicate % bitumen and dilution in % emulsion/%water)	litre (ℓ)
C10.1.12.4	Diluted SC-E1 (indicate % bitumen and dilution in % emulsion/%water)	litre (ℓ)

This pay item shall only apply when an additional cover spray is ordered by the Engineer. Cover sprays specified as part of the seal are included in the pay item of the specific seal.

The nominal rates for cover sprays seals indicated in Clause A10.1.3.15 shall apply.

The unit of measurement shall be the litre of diluted/undiluted emulsion as specified, measured at spraying temperature.

The tendered rate shall include full compensation for furnishing the material and applying the cover spray as instructed.

Item	Description	Unit
C10.1.13	Precoating of aggregate using a dedicated plant	
C10.1.13.1	Product containing low flashpoint solvent (indicate precoating fluid)	litre (ℓ)
C10.1.13.2	Product containing no low flashpoint solvent (indicate precoating fluid)	litre (ℓ)

Item	Description	Unit
C10.1.14	Precoating of aggregate using a frontend loader	
C10.1.14.1	Product containing low flashpoint solvent (indicate precoating fluid)	litre (ℓ)
C10.1.14.2	Product containing no low flashpoint solvent (indicate precoating fluid)	litre (ℓ)

Item	Description	Unit
C10.1.15	Precoating of aggregate by hand	
C10.1.15.1	Product containing low flashpoint solvent (indicate precoating fluid)	litre (ℓ)
C10.1.15.2	Product containing no low flashpoint solvent (indicate precoating fluid)	litre (ℓ)

The unit of measurement for the precoating of aggregate shall be the litres of precoating fluid for treatment of the specified aggregate in accordance with

Unit

C10.1.27	Provision of Performance Guarantee in respect of the Surfacing	Lump sum

The tendered rate shall include the provision of a bank guarantee in respect of the Surfacing, for an amount equal to 10 % of the contract value, valid for a period of two (2) years from Completion. The terms and conditions applicable to the release of the guarantee shall be as described under Clause D10.1.7. The guarantee shall be valid for two years, after the issuing of the Completion Certificate.

The performance guarantee as required shall be delivered to the Employer by the successful Contractor before signing of the contract with the applicable date of commencement of validity of the guarantee stated to be from the Completion Certificate and its estimated date.

The guarantee shall be prepared to the format provided in the Contract Documentation. The terms of the conditions applicable to the release of the performance guarantee shall be as described under Clause D10.1.3.

The tendered lump sum shall not be subject to Contract Price Adjustment and shall become payable once the Contractor has submitted and the Employer has accepted the guarantee.

D10.1.7 EVALUATION FOR ACCEPTANCE

The following procedures shall be followed by the Engineer to determine the acceptance of the surfacing or to determine whether remedial work is required on it. These procedures shall be followed as appropriate after each of the assessments.

D10.1.7.1 Assessment on completion of the works

An assessment shall be done on completion of the Works and the Contractor shall repair all defects recorded.

The first 50% of the Retention Money will be released subject to the further requirements of sub-clause 14.9 of the FIDIC Conditions of Contract.

D10.1.7.2 Assessment one year after completion in performance period

Should all parameters meet the full Acceptance Criteria at the end of the Defects Notification Period, the Engineer shall issue a report to the Employer and notify the Contractor accordingly. The balance of the Retention Money will be released.

Should the full Acceptance Criteria not be met, the Engineer shall advise the Contractor of such defects as may be evident and may, in consultation with the Employer, either:

- a) Instruct the Contractor to undertake immediate remedial work.
- b) Grant a concession to allow the remedial work to be held in abeyance until further notices are issued by the Engineer.
- c) Notwithstanding the concessions that may be granted under b) above, the Contractor may elect to attend to and defects immediately.

D10.1.7.3 Assessment two (2) years after completion in performance period

Should all parameters meet the full Acceptance Criteria two years after completion, the Engineer shall issue a report to the Employer and notify the Contractor accordingly and the Performance Guarantee shall be released to the Contractor. The Contract shall then be complete and the Contractor shall then have no further liability for the performance of the works, except for unfulfilled obligations as provided for under clause 11.10 of the FIDIC Conditions of Contract.

Should the full Acceptance Criteria not be met, the Engineer shall advise the Contractor of such defects as may be evident and may, in consultation with the Employer, either:

- a) Instruct the Contractor to undertake remedial work in accordance with Clauses D10.1.8, D10.1.9 and D10.1.10.
- b) Establish a fair valuation of the costs or damages that may be incurred due to the defective work and request payment of such amounts from the Contractor. Once such payments have been received the Performance Guarantee shall be released to the Contractor.
- c) The Contractor may elect to undertake all outstanding remedial work, which shall be undertaken in accordance with Clauses D10.1.8, D10.1.9 and D10.1.10. Upon satisfactory completion of such remedial work and acceptance by the Engineer and the Employer, the Performance Guarantee shall be released to the Contractor

Once the conditions stated under either a), b) or c) above have been met, the Contract shall be complete and the Contractor shall then have no further liability for the performance of the Works.

D10.1.7.4 Assessment at any time during the Performance Period

The Employer or the Engineer shall be entitled to carry out an assessment of the work at any time during the Performance Period. Should any parameter/s fall into the remedial-work-required category, the Employer or his agent shall inform the Contractor who shall immediately propose a solution to rectify the problem/s and obtain the Employer's or his agent's approval and rectify the problem/s in accordance with Clauses D10.1.8, D10.1.9 and D10.1.10.

D10.1.8 ADDITIONAL PROCEDURES TO BE ADOPTED IN THE EVENT OF FAILURE

In addition to procedures described in Clause D10.1.7 the following shall apply:

- a) The Engineer's approval shall be obtained prior to the Contractor's carrying out any remedial work. Notwithstanding the approval by the Engineer of the remedial work, the Contractor shall remain fully liable for the performance of his proposed remedial action/s measured in terms of the specified performance parameters.
- b) Lane rental shall be applicable when repair work is undertaken by the Contractor during the Performance Period at the rates specified in the Contract Documentation.
- c) In the event of the Contractor's failing to undertake the required steps to rectify/reinstate any defects to conform with the specified requirements, the Employer reserves the right to withhold payment of any monies which are payable to the Contractor or which may become payable to him under the Contract.

D10.1.9 NOTIFICATION OF REMEDIAL WORK

The Employer or his agent shall notify the Contractor in writing of any remedial work or repairs required to the surfacing in terms of this section of the specifications. Such notification shall take place at any time during the Performance Period, but at least after each year of the Performance Period.

The Contractor shall search and find the cause and mechanism of failure and propose appropriate remedial actions within fourteen (14) days of the date of such notification.

Following acceptance by the Employer, a programme of work must be submitted for approval to the Employer or his agent within fourteen (14) days of the date of such acceptance.

The Contractor shall commence with the remedial work within thirty (30) days from the date on which the site is handed to him by an order in writing from the Engineer.

D10.1.10 REMEDIAL WORK

All remedial work or repairs to the surfacing shall comply with the following requirements:

- a) The Contractor shall, at his own cost, supply, erect and maintain the necessary temporary traffic-control signs in accordance with the requirements in the Contract Documentation and the latest version of the South African Road Traffic Signs Manual,
- b) The Contractor shall, also at his own cost, repair/reinstate such items as road studs, road marking, etc., should these be damaged or influenced by the required remedial work.
- c) The various types of remedial work contained in Table D10.1.10-1, depending on the degree of distress, shall be undertaken by the Contractor, at his own cost, to reinstate/rectify specified defects in the pavement surfacing during the specified Performance Period.

Final acceptance shall only be given upon completion of all remedial works to the satisfaction of the Employer and the Engineer.

Table D10.1.10-1: Remedial work for surfacing seals

Type of Distress	Acceptance Criteria	Minimum Remedial Measures
Surface Failure	Requirements in Table D10.1.5-3 not met	Mill out full depth of defective surfacing and replace with suitable asphalt surfacing
Surface Cracking	Requirements in Table D10.1.5-3 not met	Investigation
Surface Ravelling	Requirements in Table D10.1.5-3 not met	Application of a fog spray and slurry texture treatment
Bleeding	Requirements in Table D10.1.5-3 not met	Water cutting of surfacing
Surface Macrotexture	Requirements in Table D10.1.6-4 and Table D10.1.6-5 not met	Water cutting of surfacing

CHAPTER 11: ANCILLARY ROAD WORKS

11.1 PITCHING, STONWORK, CAST IN SITU CONCRETE FOR PROTECTION AGAINST EROSION

CONTENTS

PART A: SPECIFICATIONS

A11.1.1 SCOPE

A11.1.2 DEFINITIONS

A11.1.3 GENERAL

A11.1.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

A11.1.5 MATERIALS

A11.1.6 CONSTRUCTION EQUIPMENT

A11.1.7 EXECUTION OF WORKS

A11.1.8 WORKMANSHIP

PART B: LABOUR ENHANCEMENT

PART C: MEASUREMENT AND PAYMENT

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

A11.1 PITCHING, STONEMASONRY, CAST IN SITU CONCRETE FOR PROTECTION AGAINST EROSION PART A: SPECIFICATIONS

A11.1.1 SCOPE

This Section covers the furnishing of materials and the construction of protective coverings using stone, cast in situ concrete, bricks, prefabricated concrete elements, wire or alternative materials on exposed surfaces such as earth slopes, drains and stream beds, as well as heavier protective layers in the form of riprap and the construction of stone masonry for walls, as specified and shown on the drawings, or as specified in the Contract Documentation.

A11.1.2 DEFINITIONS

No specific definitions.

A11.1.3 GENERAL

No general items.

A11.1.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

None applicable.

A11.1.5 MATERIALS

The material specifications are the required specifications for the materials as placed and/or processed in its final position within the road reserve.

It remains the Contractor's responsibility to ensure that the materials delivered to the road shall meet these specified requirements

Materials removed under this Section from existing works, except where excavated materials are specified to be reused or disposed of, or except where provision has been made in Part C for their reuse or specific disposal, shall be deemed to be the property of the Contractor.

A11.1.5.1 Stone

Stone for pitching shall be sound, tough and durable, without any stones less than 200 mm in minimum dimension, except that smaller pieces or spalls may be used for filling spaces between the larger stones. The shapes of the rocks or stones shall be so as to form a stable protective layer of the required thickness. Rounded boulders shall not be used on slopes steeper than 2:1 unless cement grouted. Unless suitable stone can be located on site, the stone for pitching shall be procured from commercial sources but, from whatever source, it shall be subject to the prior approval of the Engineer.

Stone for masonry walls shall have a minimum mass of 8,0 kg for each stone, except that smaller pieces or spalls may be used for filling spaces between the larger stones. Stones shall have a minimum vertical dimension of 75 mm and have a flat and stratified shape if locally available.

Stone for riprap shall be hard field or quarry stone of angular shape, not susceptible to disintegration or excessive weathering on exposure 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 quantity elongated stones.

The required size of the stone will depend on the "critical mass" specified. At least 50 % by mass of the material comprising the riprap shall consist of stones with a mass heavier than the critical mass, and not more than 10 % by mass of the material shall consist of stones with a mass of less than 10 % of the critical mass or more than 5 times the critical mass.

A11.1.5.2 Sand

a) Sand for concrete

Sand for concrete, cement slurry and cement mortar shall comply with the requirements of SANS 1083. This sand can be from natural sources, crushed or obtained from commercial sources.

A11.1.5.3 Grass blocks

Concrete grass blocks shall consist of concrete slabs of the dimensions and strength class shown on the drawings, with openings through the slab totalling at least 20 % of the surface area.

A11.1.5.4 Concrete and mortar

All concrete work shall be carried out in accordance with the requirements of Section A13.4 of Chapter 13, read together with the provisions of this Section. Cement shall comply with SANS 50197-1 for CEM I or CEM II with a strength class of 32.5 or greater, and a rate of strength gain of N or greater.

Unless the Contractor obtains the concrete from a commercial concrete supplier, the Contractor shall be responsible for providing suitable materials, determining the mix proportions and manufacturing the concrete of the required quality to comply with SANS 50206.

The mix design shall be based upon obtaining an average concrete compressive strength sufficiently above the specified characteristic compressive strength so that, considering the expected variability of the concrete and test procedures, no more than 5 % of strength tests will be expected to fall below the specified characteristic compressive strength.

Where concrete is supplied by a commercial source outside the direct control of the Engineer, the concrete supplier shall ensure compliance with the requirements of SANS 50206 (SANS 878), and the Contractor shall have full responsibility to implement acceptance control testing in accordance with the specification.

All concrete mixed on the site of works shall be weigh-batched unless the Contractor can demonstrate to the Engineer that his method of proportioning the concrete ingredients consistently produces uniform concrete, which meets the strength requirements.

Unless otherwise specified, mortar shall consist of a mixture of six parts of concrete sand to one part of cement.

Concrete and mortar shall be properly mixed to a uniform consistency. The total period between the time that the cement is placed into the mix until mixing starts shall not exceed 15 minutes.

Concrete and mortar shall be so transported to its final position that segregation or loss of any of the ingredients or contamination will be prevented and that the mix is of the required workability at the point and time of placing. It shall be protected against rain, heat, direct sunlight and/or evaporation by means of covers. No additional water may be added in transit or where delivered or placed.

Once the casting of concrete has begun, it shall be carried out in a continuous process between construction joints. Concrete shall be placed within 60 minutes from the start of mixing. This time may be extended by the Engineer where a retarding admixture has been used. All excavations and other contact surfaces of an absorbent nature such as timber formwork shall be damp but no standing water shall be permitted to remain on these surfaces. The formwork shall be clean on the inside.

A11.1.5.5 Permeable material for filter layer

Permeable material for filter layers shall comply with the requirements specified for permeable material for subsoil drains in Clause A3.1.5 of Chapter 3.

A11.1.5.6 Geotextiles

Geotextiles shall be of the grade and type specified in the schedule of quantities or Contract Documentation, and shall comply with the requirements of Section A12.11 of Chapter 12.

A11.1.5.7 Alternative materials

Alternative materials, used amongst others for the lining of drains and channels or other erosion protection, their property requirements, construction, measurement and payment shall be specified in the Contract Documentation.

A11.1.6 CONSTRUCTION EQUIPMENT

The Contractor shall submit his plant and equipment list for excavating, stockpiling if specified, loading and hauling as part of his method statement.

A11.1.7 EXECUTION OF THE WORKS

A11.1.7.1 Classification of Materials

Where clearing and grubbing and the removal of trees is specified, it shall be executed as specified in Clause A1.6.7 of Chapter 1.

All excavations for pitching, stonework and protection against erosion shall be excavated in the position and to the required dimensions. Overbreak in width or depth, unless specified by the Engineer, shall be in filled by the Contractor and shall not be measurable for payment.

All excavations shall be classified as follows for payment purposes:

Hard material: Material which cannot be excavated except by drilling and blasting, or with the use of pneumatic tools or mechanical breakers,

and

Boulders exceeding 0,1 m³; where more than 40 % by volume of any material consists of boulders, each exceeding 0,1 m³ in size, the material shall be classified as hard material.

Soft material: All material not classified as hard material shall be classified as soft material.

A11.1.7.2 Stone pitching

a) Plain stone pitching

The area shall be prepared by the excavating, shaping and trimming necessary for pitching, and by thoroughly compacting the area by handramming to prevent subsequent settlement. A trench shall be excavated as specified along the toe of any slopes to be pitched or along the unprotected edge of the pitching in the beds of streams. All loose material shall be compacted to a density of not less than 93 % of MDD. Where the in situ material is unsuitable, the Engineer may instruct that it be removed to the required depth and replaced with selected material compacted to a density of 93 % of MDD to the required grade and level. Where excavations for open drains are in rock, overbreak shall be backfilled as specified, either with mass concrete or with selected gravel or soil compacted to a MDD of at least 93 %. Two pitching methods follow, and the method to be adopted shall be specified.

Method 1

Commencing at the bottom of the trench, the stone shall be laid and firmly bedded into the slope and against adjoining stones. The stones shall be laid with their longitudinal axes at right angles to the slope and with staggered joints. The stones shall be well rammed into the bank or surface to be protected and the spaces between the larger stones shall be filled with spalls of approved pitching stone securely rammed into place.

Method 2

The technique and requirements laid down in Method 1 shall also apply to Method 2, except in the following aspects:

- No small stones or spalls shall be used to fill in spaces between larger stones.
- Simultaneously with the placing of stones, topsoil shall be introduced between individual stones, and sufficiently rammed so as to provide a firm bonded structure. The topsoil shall be provided to the full depth of the stone pitching at any point
- Rooted grass or tufts of grass shall then be planted in the topsoil between stones and watered immediately and copiously and thereafter at regular intervals until grass has been established.

Whichever of the above two methods is adopted, the finished surface of the pitching shall present an even, tight and neat appearance with no stones varying by more than 25 mm from the specified surface grades or lines. The thickness of the pitching, measured at right angles to the surface, shall not be less than 200 mm.

b) Grouted stone pitching with mortar

Grouted stone pitching shall be constructed in terms of Clause A3.3.7.1i) in Chapter 3.

c) Grouted stone pitching on a concrete bed

Grouted stone pitching on a concrete bed shall be constructed in terms of Clause A3.3.7.1i) in Chapter 3.

A11.1.7.3 Riprap

a) General

Riprap shall consist of a course or courses of large rock placed on bank slopes and toes in stream and riverbeds and at other localities where protection of this type may be required.

Two types of riprap are specified here, viz one type where the rocks are individually packed, which is designated as packed riprap, and the other type where the rock is dumped and then spread by machines, which is designated as dumped riprap.

The surface of areas to receive riprap shall be neatly trimmed to line and level and all loose material compacted. The perimeters of riprap areas 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 used in the construction of the adjoining riprap, but any voids shall be filled with smaller stone and the entire backfill shall be well compacted.

b) Filter bed

The filter bed shall consist of a layer or layers of permeable material placed on the prepared surface to the required thickness and each layer shall be finished to an even surface and thickness. Compaction of pervious material will not be required. Care shall be taken not to mix various grades of filter material neither to disturb material already placed when subsequent layers or riprap are being placed.

When the use of geotextile is required, the geotextile shall be placed on the prepared surface or on the filter bed, depending on the Instructions.

The overlap between adjacent sheets shall be 150 mm unless otherwise specified. Care shall be taken not to damage the geotextile when subsequent layers are being placed, neither to expose the geotextile to the sun for periods exceeding 3 days before it is covered up. **c)**

Packed riprap

Packed riprap shall be constructed with rocks placed individually to stagger the joints and so as to be firmly bedded in the prepared surface. The spaces between larger stones shall be filled with spalls or smaller stones securely rammed into place. On inclined surfaces the rock shall be laid in long horizontal strips starting from the bottom, and not in strips up the slope.

The completed riprap shall present a tight and even surface. Local surface irregularities of the riprap shall not exceed 150 mm. **d)**

Dumped riprap

Dumped riprap shall be constructed by dumping the stone on the prepared surface, spreading it by bulldozer, or other suitable earth-moving equipment, and trimming it to the required lines and levels. The material shall be placed in a manner that will prevent the segregation of the smaller and larger stones and the top layer shall be tight with a minimum of voids.

A11.2 NON-STRUCTURAL GABIONS PART A: SPECIFICATIONS

A11.2.1 SCOPE

This Section covers the construction of non-structural gabion boxes and mattresses for constructing lining channels, revetments and other antierosion and containment structures. For structural gabion work refer to Section A12.6 of Chapter 12.

A11.2.2 DEFINITIONS

No specific definitions.

A11.2.3 GENERAL

None applicable.

A11.2.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

Structural retaining walls specifically designed for particular applications are specified in Section A12.6 of Chapter 12.

A11.2.5 MATERIALS

A11.2.5.1 General material specifications

The required material specifications are for the materials as placed and/or processed in its final position within the road reserve.

It is the Contractor's responsibility to ensure that the materials delivered shall meet the specified requirements as per Clause A12.6.5 of Chapter 12.

A11.2.5.2 Materials

a) Rock

As per Clause A12.6.5.2 of Chapter 12.

b) Wire

As per Clause A12.6.5.2 of Chapter 12.

c) PVC-coated wire

As per Clause A12.6.5.2 of Chapter 12.

d) Galvanizing

As per Clause A12.6.5.2 of Chapter 12.

e) Wire mesh

As per Clause A12.6.5.2 of Chapter 12.

f) Geotextile behind and below the gabions

As per Clause A12.6.5.2 of Chapter 12.

g) Alternative materials

As per Clause A12.6.5.2 of Chapter 12.

A11.2.6 CONSTRUCTION EQUIPMENT

The Contractor shall submit his plant and equipment list for excavating, stockpiling if specified, loading and hauling as part of his method statement.

A11.2.7 EXECUTION OF THE WORKS

A11.2.7.1 Classification of materials

All excavations for gabion boxes and mattresses shall be excavated in the position and to the required dimensions. Overbreak in width or depth, unless specified by the Engineer, shall be in filled by the Contractor and shall not be measurable for payment.

All excavations under this Section shall be classified as specified under Clause A11.1.7.1.

A11.2.7.2 Constructing gabion boxes and mattresses a) General

Gabion boxes shall be manufactured from steel wire coated with zinc, zinc aluminium alloy double twisted wire mesh of the size and type and selvedge as specified in Section A12.6 of Chapter 12. The boxes will be of two types and shall be subdivided into cells by wire mesh diaphragms.

Mattresses which are generally used as single-layer aprons in revetments, channel linings, etc, which the maximum width of units shall be 2,0 m, and the maximum depth 0,3 m. Mattresses shall be subdivided by diaphragms into cells with a width of 1000 mm. Mattress shall be installed with diaphragm spaced at 1,0 m in the direction of the flow, unless otherwise specified by the Engineer.

For the standard size for gabion boxes and mattresses refer to Section A12.6 of Chapter 12. **b)**

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 as specified in SANS 1580.

Where the selvedge is not woven integrally with the mesh but has to be tied to the cut ends of the mesh, it shall be attached by tying the cut ends of the mesh to the selvedge, so that a force of more than 8,5kN applied on the selvedge in the same plane as the mesh of a mesh sample of 1,0 m in length will be required to separate it from the mesh.

c) Diaphragms and end-panels

The diaphragms and end-panels shall be selvedged on the top and vertical sides only. The end-panels shall be attached by the cut ends of the mesh wires at the bottom of the panel being twisted around the selvedge on the base of the gabion. Similarly, the diaphragms shall be attached by the cut ends of the mesh being twisted to the twisted joints of the mesh in the base of the gabion. In each case the force required to separate the panels from the base shall not be less than 6kN/m.

d) Binding and connecting wire

Sufficient binding and connecting wire for all the tying to be done during construction of the gabions as specified in A11.2.7.2 shall be supplied with the gabion boxes. The binding wire shall have the same properties as the gabion or mattress mesh wire.

e) Preparing the foundation and surface

The foundation surface on which the gabion boxes and mattresses are to be installed prior to their being filled with rock shall be levelled to the line and level 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 Clause A12.6.5.2b) of Chapter 12. Where required, a foundation trench along the toe of the revetment or wall shall be excavated to the dimensions specified and/or shown on the drawings. **f) Geotextile**

One layer of geotextile shall be placed where indicated on the drawings or as specified. The geotextile shall be placed, in strips with a minimum overlap of 300 mm at the joints, and shall be properly fastened to prevent any movement or slipping while the gabions are being placed. Geotextiles shall comply with the requirements as specified in Section A12.11 of Chapter 12.

g) Assembly

The methods of constructing, stretching, placing in position, wiring and filling the gabions with rock shall generally be in accordance with the manufacturer's instructions subject to the approval of the Engineer, but nevertheless sufficient connecting wires shall be tensioned between the vertical sides of all the outer visible cells and a sturdy frame shall be used to prevent the deformation of boxes as they are being filled with stone. Joints between boxes shall be wired together along all 4 joining edges.

It is essential that the corners of gabion boxes be securely wired together to provide a uniform surface and ensure that the structure does not resemble a series of blocks or panels. The layout and the tolerances for the layout of the boxes shall be as shown on the drawings or as specified in the Contract Documentation.

h) Rock filling

(i) Boxes in gabions

Particular care shall be taken in packing the visible faces of gabion boxes, where only selected stone of the specified size shall be used so as to obtain an even-faced finish. The boxes shall be filled in layers to prevent deformation and bulging. Boxes shall be wire braced and filled to just below the level of the internal wire braces, after which the braces shall be twisted to provide tension. Care must be taken to ensure that consecutive layers of boxes are filled evenly to a level surface ready to receive the next course.

Filling of gabion boxes by dumping rock shall not be permitted and packing shall be done by means of hand labour.

(ii) Mattresses used in revetments and aprons

The 0,17 m, 0,23 m and 0,3 m mattresses forming aprons and revetments shall be filled by random stones being packed in the first layer and by selected stones being used for the top layer so as to resemble normal stone pitching.

A11.2.8 WORKMANSHIP

A11.2.8.1 General

The Contractor shall determine the required frequency of testing and conduct sufficient tests on the sourced material for each type of material, in order to ensure that the quality of materials produced meets the specified requirements for the particular layer for which it will be used. Similarly, the Contractor shall conduct sufficient checks and controls during construction of the elements to ensure that the required lines, levels and finishes are achieved.

The Engineer may, at his discretion, decide to use the Contractor's test results if he is satisfied that the Contractor has complied with the process control requirements.

Any work or materials which do not comply with the specified requirements, shall be removed and replaced with work or materials which comply with the requirements or, if the Engineer so permits, shall be repaired so that it shall comply with the specified requirements after having been repaired.

A11.2.8.2 Tolerances

Tolerances for gabion and mattress materials and dimensions shall conform to the requirements of EN 10223-3.

A11.6 ROAD SIGNS PART A: SPECIFICATIONS

A11.6.1 SCOPE

This Section covers the supply of permanent and temporary road signs and the erection of permanent and temporary traffic signs alongside and over the carriageway, ramps and crossroads at intersections, and interchanges, and at the locations indicated on the drawings or as specified by the Engineer.

All road signs and traffic signals shall be of the applicable standard regulatory, warning, guidance and information signs or traffic signal requirements shall be in accordance with the SADC and the South African Road Traffic Signs Manual; as applicable, except where otherwise indicated on the drawings or in the Contract Documentation, or as specified by the Engineer.

The installation or relocation of permanent traffic signals, cabling and controllers, if required, shall be as specified in the Contract Documentation and undertaken by specialist sub-Contractors. Provision for payment is provided under Part C under this Section. The construction of ducting and concrete footings shall be constructed as specified in Section A2.2 of Chapter 2 and Chapter 13 respectively. The provision and operation of temporary or moveable traffic signals for traffic accommodation and other purposes shall be the undertaken by the Contractor as priced items.

The manufacture and erection of overhead road sign gantries including footings shall be as detailed in Section A13.10 of Chapter 13. The installation or attachment of road signs thereto shall be undertaken under this Section.

A11.6.2 DEFINITIONS

No specific definitions.

A11.6.3 GENERAL

No general specifications.

A11.6.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

Not required for Section A11.6.

A11.6.5 MATERIALS

A11.6.5.1 General material specifications

The material specifications are the required specifications for the materials as placed and/or processed in its final position within the road reserve.

It is the Contractor's responsibility to ensure that the materials delivered to the road shall meet these specified requirements.

Materials removed under this Section from existing works, except where excavated materials are specified to be reused or disposed of, or except where provision has been made in Part C for their reuse or specific disposal.

A11.6.5.2 Materials

a) Structural steel

Structural steel shall comply with the requirements of BS 4360 for the type of steel specified or shown on the drawings. Unless otherwise specified, channels, square tubes, angle irons and other steel members on the reverse side of the signboards and steel tubes for sign supports shall be coated in accordance with Clause A11.6.7.2a).

Where specified, all structural steel, including tubes shall be galvanized in accordance with the requirements of SANS 121 Steel tubes shall comply with the requirements of SANS 657.

b) Bolts, nuts and rivets

Steel bolts and nuts shall comply with SANS 135 or SANS 1143. Aluminium bolts and nuts shall be manufactured from alloy B51S or D65S. Stainless steel bolts, nuts and fasteners shall comply with SANS 1700-5-8, SANS 1700-5-9 or SANS 1700-5-10.

All steel bolts, nuts and washers shall have a hot-dip (galvanized) zinc coating, which complies with the requirements of SANS 121.

Blind rivets used for fixing road signboards to square tubing framework shall be 4,8 mm diameter rivets of sufficient length manufactured from or coated with a material that prevent corrosion to the rivets or fastened members through electrolytic action. Hardened blind or aluminium rivets shall be used for attaching aluminium sections.

c) Steel plate and steel profiles

• Steel plate

Steel plate for road signs, prior to the application of any reflective sheeting or painting, shall be 1,4 mm thick Z275 galvanized steel plate, which has been treated on both sides to the paint system requirements specified in Table A11.6.5-1. **Table A11.6.5-1: Steel plate paint system requirements**

Property	Test conditions	Method	Values
Resistance to UV Weathering (Colour Change)	QUV-A	ASTM G154 ISO 7724/1/2/3	After 2000 hrs: $\Delta E < 2$
Resistance to UV Weathering (Chalking)	QUV-A	ASTM G154 ASTM D659-04	After 2000 hrs: Rating No 8
Resistance to corrosion: - Edge creep - Blister size	Salt Spray	ISO 7253 ASTM D1654 ISO 4628/2	After 1000 hrs: 8 mm max 2-S2
Bending		ASTM D4145	3T, No adhesion loss
Impact resistance		ISO 6272	No adhesion loss
Pencil Hardness		ASTM D3363	F – H
Scratch Hardness		ISO 1518	25-40 N
Dry Film Thickness		ISO 2808, 5B	<u>Top surface:</u> 38 μ m minimum inclusive of primer <u>Bottom surface:</u> 20 μ m minimum inclusive of primer
Specular Gloss at 60°	At time of coating	ISO 2813	25 – 35 %

The reverse side of a STOP sign R1 and all its derivatives shall be painted white. The reverse side of all other signs shall be dark grey.

Where a non-reflectorised road sign is required, its reverse side shall be painted with a dark grey prime coat and the face with only the specified topcoat.

• Steel profiles

Standard sign profiles shall be 200 mm steel sections with a thickness, prior to the application of any reflective sheeting or painting, be 1,0 mm thick Z275 galvanized steel plate, which has been treated on both sides to the paint system requirements specified in Table A11.6.5-1), and shall comply with the details on the drawings.

d) Other plate material

Temporary roadworks delineators signs TW401 and TW402 shall be manufactured from a flexible material and shall comply with the requirements of SANS 1555. These signs shall either bend or break under vehicular impact and cause minimal damage to vehicles on impact with them. Steel shall not be used in either the signs or the footings.

Other plate material shall be as specified in the Contract Documentation.

e) Aluminium and aluminium composite

Aluminium flat plate shall be manufactured from grade 5251.H.3 alloy and shall comply with the requirements of BS 1470 and shall be 2,0 mm in thickness.

Aluminium composite shall be a minimum of 3,0 mm thick composite flat plate, comprising a polyethylene core and two bonded aluminium cover sheets (AlMg1, EN AW-5005 A alloy), each measuring 0,3 mm in thickness, with a traffic grey modified polyester system lacquer coating, and comply to the specifications of SANS 1519-2.

f) Paint

All paints used shall comply with the requirements of SANS 1519-2, including the standards mentioned therein.

In the case of prepainted steel plate, used for non-reflective background signs, the Contractor or supplier shall ensure that the colours and shades thereof match with those shown in SANS 1091.

g) Retro-reflective material

Retro-reflective material shall be supplied in the following grades and shall comply with the requirements of SANS 1519:

Class I material - 7 year warranty grade

Class III material - 10 year warranty grade

Class IV a) and b) material - 10-12 year warranty grade

The use of materials from different manufactures or different batches for the same colour shall not be used on any one sign.

Materials from different manufacturers shall not be overlaid without specific approval of the Engineer and subject to such conditions as the Engineer may impose.

The material shall be supplied with a pressure sensitive adhesive backing protected by a removable lining. **h)**

Timber posts for road sign supports

Timber posts for road sign supports shall conform to the requirements of SANS 754, shall be equal to or better than strength group B timber posts and shall be affixed with the SABS mark. The posts shall be treated as specified in Clause A11.4.5.2b)(i). The exposed surface of any cut shall be given two coats of the specified preservative. Any holes drilled in the timber posts after treatment with the preservative shall be re-treated. **i)**

Corrosion-protection tape

Corrosion-protection tape used between aluminium and steel shall be a black PVC tape not less than 0,25 mm in thickness, shall be resistant to ultra-violet rays, and shall have an adhesive backing. The breaking strength of the material shall be more than 3,5 kN/m. **j) Silkscreening and digital printing**

Silkscreen or digital printed materials shall comply with the requirements of SANS 1519-1 and the screening or printing of road signs shall only be acceptable after verification of endorsement by the manufacturer of the retro-reflective material to provide an equal or better service life to the specified retro-reflective material

k) Black vinyl

Black vinyl material shall provide an equivalent warranty as the lowest class of retro reflective material used on a road sign. Black vinyl shall comply with the requirements for non-reflective sheeting in SANS 1519-1.

l) Concrete

All concrete work shall be carried out in accordance with the requirements of Section A13.4 of Chapter 13, read together with the provisions of Clause A11.1.5.4.

m) Alternative materials

Alternative materials for road signage elements may be specified in the Contract Documentation.

A11.6.6 CONSTRUCTION EQUIPMENT

The Contractor shall submit his plant and equipment list for excavating, stockpiling if specified, loading and hauling as part of his method statement to perform the different elements of the Works.

A11.6.7 EXECUTION OF THE WORKS

A11.6.7.1 Classification of Materials

All excavations for road signs shall be excavated in the position and to the required dimensions. Overbreak in width or depth, unless specified by the Engineer, shall be in filled by the Contractor and shall not be measurable for payment. All excavations under this Section shall be classified as specified under Clause A11.1.7.1.

A11.6.7.2 Manufacturing of road signboards and supports

The road sign face refers to the semi-matt or fully retro reflective painted background plus the text that includes all letters, symbols, numbers, arrows, emblems and borders.

The road signboard refers to the assembled sign consisting of the road sign face on the specified plate or profiles, the supporting framework, cross bracing, struts and connecting mechanisms for mounting onto the sign support structure.

The sign support structure refers to the steel or timber supports on which the road signboard is erected and includes the foundations.

No additional payment will be made for steel members such as amongst others hanging channels and U-bolts that are required to complete and erect the total sign structure according to the specifications and the drawings.

a) Road signboards

Road signboards shall be manufactured by a manufacturer of road signs being affiliated to a recognised traffic sign manufacturer association such as SARTSMA or a permit holder under SANS 1519-2. Permanent road signs shall be newly manufactured. Temporary road signs may be previously used signs, however their condition shall be compliant to the specifications, and shall be subject to the acceptance by the Engineer.

Road signboards shall be manufactured strictly in accordance with the details on the drawings. They shall be manufactured from either steel plate or steel profiles, or aluminium plate or aluminium composite sections according as specified on the drawings.

Retro-reflective material shall be affixed to the sign face strictly in accordance with the specifications of the manufacturer of the retro-reflective material.

All lettering shall be accurately affixed to the signboards after the background material has been applied.

In so far as is possible, road signboards shall be manufactured as one unit. Where road signs are manufactured in more than one unit, the completed units shall be assembled in the workshop prior to delivery to ensure that all sections and legends fit together properly. Joints in road signboards shall be provided only at locations and to details as shown on the drawings.

Before any sign manufacture commences the Contractor shall ensure that the manufacturer has confirmed that he has received all the relevant details and information to manufacture the road sign in accordance with the Contract requirements and the Contractor shall make every effort to ensure that signboards are correct in all respect. Before dispatching the boards from the manufacturer's factory the Engineer shall be provided with a 100 mm x 150 mm colour photograph or digital representative of each sign face for verification of the correctness of the legend and layout. Such verification will not imply final acceptance of the board. If the Contractor is in any doubt as to the correctness of the sign detail, enquiry to Engineer shall be made for design verification.

- **Steel and aluminium plate road signboards**

All road signs exceeding 600 mm in length (i.e. measured horizontally) shall be stiffened by a supporting framework as shown on the drawings. On all rectangular signs the supporting framework shall be positioned so that the distance to the edge of the sign plate shall not exceed 5,0 mm.

When road signboards are made up in sections the sections shall be joined with 10 mm galvanized bolts and nuts through 12 mm holes drilled in both adjoining members of the supporting framework sections with a maximum horizontal spacing of 500 mm and a maximum vertical spacing of 250 mm. All such drilling shall be done prior to painting.

The framework panels for a particular road signboard shall be equal in size, so that the sign will have a balanced and symmetrical appearance when viewed from the rear. All such framework panels shall be placed on the rear of the road signboard.

The sign plate shall be riveted to the framework wherever the plate is supported by the framework, and not on the edges only. The rivets shall have a maximum spacing of 150 mm on condition that even the shortest bracing will not have fewer than three rivets (one at each end and one in the middle). The colour of the rivets shall be the colour of the background on which they are fixed.

Fastening clamps and/or erection brackets shall be manufactured, positioned and fastened to the framework in accordance with the details on the drawings. Care shall be taken by the Contractor to ensure that the erection brackets are positioned in such a way that the road sign will be vertically and horizontally true to line when mounted.

Each sign that does not require a supporting framework shall have two mounting holes of 12 mm diameter each located 25 mm from the sign edges so that the sign may be erected on a vertical post.

The surface of structural steel for the framework of road signs shall be prepared by it being cleaned with a wire brush and shall either be galvanized, or powder coated in accordance with SANS 1274 for Type 6 coatings. The colour of the framework shall be Dark Grey (reference number G13, as shown in SANS 1091).

Direct contact between aluminium and any supporting steel framework shall be avoided by adhering corrosion protection tape to the parts of the board in contact with the steel frame.

- **Steel profile road signboards**

Steel profile road signboards shall be manufactured in accordance with the details on the drawings.

Manufactured profiles shall be without length distortion and the front faces of completed signs shall have a uniform flat appearance without inward or outward bowing of individual profile faces. The corners of each profile shall have sharp bends without excessive rounded corners.

Steel profile road signboards shall not be joined longitudinally unless the length of the sign exceeds 6,0 m. In such a case the sign shall be manufactured in sections of equal length and joined in accordance with the details on the drawings. Steel profile sections for road signboards shall be jointed together by blind aluminium rivets or stainless-steel bolts and nuts.

Where possible, letters across the joint between two sections should be avoided. If it cannot be avoided, the letters concerned shall be bisected on the joint and the edges properly pressed home.

Where steel profile sections are to be faced with retro-reflective background material, it shall be applied in advance to individual sections before assembly, with the material taken around the face edges of each section for at least 10 mm. Subject to the manufacturers approval, retro-reflective material shall be heated to facilitate adhesion around the edges and to prevent damage being done to the material. During the heating process the temperature shall not exceed the manufacturer's recommendations. Prismatic retro-reflective materials, however, are not required to be folded around the radius, but the ends shall be securely bonded to the panels.

Where possible, letters across the joint between two sections should be avoided. If it cannot be avoided, the letters concerned shall be bisected on the joint and the edges properly pressed home, however, prismatic retro-reflective materials are not required to be folded around the radius, but the ends shall be securely bonded to the panels.

Retro-reflective material to adjoining panels on a sign shall be a visual match of the specified colour.

- **Composite plate road signboards**

Road signboards shall be manufactured as specified for steel and aluminium plate road signboards as specified in Clause A11.6.7.2a). **b)**

Welding

All welding of steelwork shall be carried out in accordance with the standards laid down in BS 5135. All welding shall be done before painting, powder coating or galvanizing. Pre-painted steel sheets shall not be welded.

c) Structural steel

The relevant provisions for Structural Steelwork in Section A13.9 of Chapter 13, shall apply to all steel supporting structures for road signs. **d)**

Galvanizing

Where the galvanizing of structural-steel frames and sign-board supporting structures is specified, it shall be done as far as is practicable after welding. Where, however, this is not practicable, the steel sections shall be galvanized before assembly and then welded. All welds shall be thoroughly cleaned, 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 Contract Documentation, galvanized steel will not require painting. **e)**

Road sign supports

Road sign supports shall be constructed in accordance with the details shown on the drawings. **f)**

General

Where details for the construction of road signboards, the frame work of the road signboards and their attachment to the supporting steel framework are not shown on the drawings, the Contractor himself shall design them and submit the details to the Engineer for approval before manufacture.

A11.6.7.3 Road sign faces and painting

a) Colours, symbols and legends

Paint colours, symbols, legends and borders used on road signs shall comply with the applicable statutory provisions, and also with the requirements of the SADC and South African Road Traffic Signs Manual.

The colours shall conform to the colours and shades specified in SANS 1519-1 & -2.

The templates for all letters, numerals, arrows, borders, symbols, etc or the actual legend itself shall be cut by a method acceptable to the Engineer.

b) Preparing surfaces and applying paint and retro-reflective sheeting

The preparation of surfaces and the painting shall be carried out as specified in Clause A13.10.7 of Chapter 13.

The surface of structural steel for the frames and supports of road signs shall be prepared by it being cleaned with a wire brush and shall then be coated as specified in Clause A13.10.7 of Chapter 13.

Unless otherwise specified, aluminium road signs, with the exception of painted road signboards, will not require painting Galvanized frameworks will not require painting.

Road signboards with a semi-matt finish manufactured from pre-painted plate or composite plate of the specified colour shall not require pretreatment or painting. No re-painting of these boards shall be accepted.

The preparation of surfaces and application of retro-reflective sheeting shall be done in strict accordance with the recommendations of the sheeting manufacturer. The preparation of the surface shall receive particular attention: as will the surface of a fully retro-reflective sign background prior to the application of the legend thereon.

All signs delivered to the site must be provided with a protective material to prevent damage to the sign-faces. The service provider must provide a patching specialist to repair any signs that are damaged during loading and offloading at their own cost. **c) Date of manufacture**

The faces and backs of road signboards and the legend shall not be painted more than six months prior to their erection.

The manufacturer shall paint an identification code on the reverse side of every completed road signboard in the lower corner nearest to the road surface in a position where the code will not be obscured by the framework or the erection posts. The code shall be in the form X-MM-JJ where X is the letter used by the manufacturer to identify the manufacturer and MM-JJ indicates the month and year of the manufacture. These letters shall be painted in white (black on STOP signs) and shall not be larger than 50 mm in height.

d) Advertisements

No advertisements may be displayed on or attached to any part or any side of a road signboard or a road sign support. **e)**

Application of retro-reflective material

Where applied to pre-painted, pre-formed steel sections, retro-reflective material shall be affixed to the sign face strictly in accordance with the specifications of the manufacturer of the retro-reflective material.

A11.6.7.4 Storage and handling

Finished road signs shall be packaged to prevent damage from signs rubbing against each other and stored vertically. Road signs should be transported in a covered truck or trailer to prevent water damage. Large signs may be shipped uncrated or unpacked in open or closed trucks or trailers, provided the signs are secured vertically in racks to prevent damage.

On site, signs and signboards shall be stored on wooden, steel or plastic spacers in the vertical position so that the signs are not in contact with the ground. There shall be sufficient space between the finished road signboards to permit free air circulation and moisture evaporation. Contact of road signboards with treated timber and diesel, or storage where road signboards come into contact with dirt or water will not be permitted.

When required, existing or newly erected road signs shall be fully or partially covered with burlap or other approved adequately ventilated material to obscure destinations that are temporarily inapplicable or irrelevant. The covers shall be neatly applied and firmly fixed in position so that they will be able to withstand strong gusts of wind or eddies caused by passing traffic. The fixing shall be done in a way that will not cause any damage to the road sign face.

The following shall not be allowed on the completed sign face:

- Drilling of holes, except for the fastening of overlays
- Application of any form of adhesive
- Cleaning with any chemicals that are not specifically approved by the manufacturer of the retro-reflective material.
- Covering the sign face with an impermeable material that does not allow free circulation of air during storage.

All signs damaged during offloading, storage and handling shall be repaired at the Contractor's cost.

A11.6.7.5 Erecting road signs

a) Position

Road signs shall be erected in the positions shown on the drawings or specified by the Engineer. **b)**

Excavation and backfilling

Excavations for the erection of road 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 if so specified by the Engineer. The soil or soil-cement mixture shall then be placed at optimum moisture content in 100 mm thick layers in the excavation and shall be compacted to a minimum of 93 % of MDD.

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 Section A13.4 of Chapter 13. 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.

This Clause shall apply to ground-mounted signs only. Excavating and backfilling for the foundations of overhead steel structures are specified and measured in Section A13.1 of Chapter 13.

When material from the excavations is not suitable for backfilling or for the preparation of soilcrete, suitable material shall be obtained from site or commercial sources.

c) Erection

Road signboards must be inspected by the Engineer before the boards are taken from the manufacturer to the site for erection. The Contractor shall notify the Engineer at least one (1) week before the said inspections are required.

Road signs shall be erected strictly in accordance with the details and instructions on the drawings and as directed by the Engineer. The Contractor shall take into account the wind speed factor during installation.

During erection, the structural steelwork shall be firmly bolted and protected to prevent buckling or damage from being caused during erection, or by the equipment used for erection. Posts to which road signs are to be fixed shall be vertical and the undersides of road signs shall be horizontal after having been erected.

Where timber posts are used for erecting the signs, all holes that are drilled in the timber shall be retreated with two coats of the approved preservative. A road sign identification number (as indicated on the layout drawings) shall be painted with white enamel paint on the reverse side of the road signboard, above the month and year of manufacture in 50 mm high letters and numbers on the side closest to the road surface. Identification numbers on overhead signs shall be painted in a position that is visible from the road shoulder as specified by the Engineer.

After erection, the signboard shall be thoroughly cleaned with a cleaning agent approved by the retro-reflective material's manufacturer.

All vegetation obstructing the new or replaced sign board shall be removed prior to installation and disposed of by the Contractor at no additional payment in order to provide clear visibility of the sign to road users.

d) Field welding

All welding done during erection shall comply with the requirements for welding during manufacture. **e)**

On-site painting

All painting done after the road signs have been erected shall comply with the requirements for painting during manufacture.

All places where the paintwork has been damaged during erection shall be repaired by the Contractor at his own cost to the satisfaction of the Engineer.

f) Time of erection

Road signs shall be erected immediately prior to the road being opened to public traffic, unless otherwise specified by the Engineer. **g)**

General

All destinations and route numbers shown on the drawings shall be subject to amendment, and confirmation of the details shall be obtained from the Engineer before any particular signs may be made.

A11.6.7.6 Protection and maintenance

The Contractor shall protect the completed road signs against damage until they have been finally accepted by the Employer, and he shall maintain the road sign until the completion of the contract. Damage or defects caused by negligence or faulty workmanship shall be rectified by the Contractor at his own cost to the satisfaction of the Engineer.

A11.6.7.7 Dismantling, storing and re-erecting existing road signs

Where specified by the Engineer, the Contractor shall dismantle and remove existing road signs, store them, and re-erect them at new positions indicated. Dismantling shall be done with the least damage possible to the signs.

Where specified by the Engineer, the signs shall be repainted or repaired and new materials shall be used for part or all of the supporting structure.

Existing overhead and ground mounted road signs that are being replaced by new signs shall be dismantled by the Contractor, unless alternative placement is specified by the Engineer. The removal of existing signs shall be delayed until after replacement signs are erected, unless not physically possible. Regulatory and warning signage shall in all circumstances be displayed at all times. Where dismantling of an existing sign is required before erection of the replacement sign, the dismantling shall not take place until immediately before work is to commence on the replacement, and the replacement shall be completed and the new sign displayed within 72 hours thereafter.

Dismantling shall include sign panels and ground mounted sign supports, unless otherwise specified by the Engineer.

Ground mounted sign supports shall be cut off just below ground level. Material excavated for removal of buried poles shall be replaced, and any depression made good using excess material from excavation for new signs.

A11.6.8 WORKMANSHIP

The Contractor shall determine the required frequency of testing and conduct sufficient tests on the sourced material for each type of material, in order to ensure that the quality of materials produced will meet the specified requirements for the particular layer for which it will be used.

A copy of the process control test results shall be submitted to the Engineer for comments.

11.7 ROAD MARKINGS AND ROAD STUDS

CONTENTS

PART A: SPECIFICATIONS

A11.7.1 SCOPE

A11.7.2 DEFINITIONS

A11.7.3 GENERAL

A11.7.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

A11.7.5 MATERIALS

A11.7.6 CONSTRUCTION EQUIPMENT

A11.7.7 EXECUTION OF THE WORKS

A11.7.8 WORKMANSHIP

PART B: LABOUR ENHANCEMENT

PART C: MEASUREMENT AND PAYMENT

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

A11.7 ROAD MARKINGS AND ROAD STUDS PART A: SPECIFICATIONS

A11.7.1 SCOPE

This Section covers the temporary and final marking of the road surface with lines and symbols and the supply and fixing of retro-reflective or solar powered road studs as indicated on the drawings or specified by the Engineer. This Section also covers the removal of existing road studs and repair of the road surface, as well as the supply and fixing of temporary road studs as specified by the Engineer, and the removal of existing road markings. Temporary road marking shall be retro-reflective and serve the purpose of guiding and warning road users during construction processes and under reduced speed restrictions.

All road markings shall be of the standard regulatory, warning and guidance markings as detailed on the drawings and in accordance with the SADC and South African Road Traffic Signs Manuals.

Road marking application shall be based on materials conforming to various SANS requirements and divided either on method and type of material application specification; or alternatively based on performance based application, where the road marking performance shall be monitored and measured, and payment based on such measured performance over time. Performance based criteria shall be specified in the specifications and measurement and payment section. Selection of either the method and type of material application specification; or performance based application shall be as specified by the Engineer but shall be instructed prior to the application of the road marking, and additionally performance based application shall not be applicable to first road marking application applied after road surfacing, resurfacing or bitumen rejuvenation.

The Contractor shall provide temporary traffic control facilities in accordance with the specifications given in Section A1.5 of Chapter 1 to ensure traffic safety where work is being executed.

A11.7.2 DEFINITIONS

No specific definitions.

A11.7.3 GENERAL

No general specifications.

A11.7.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

A11.7.4.1 Road Marking

Where indicated under the specifications and measurement and payment, road marking shall be a performance based application where payment shall be based on specified achieved criteria such as reflectivity, luminance, skid resistance measured over fixed periods.

A11.7.4.2 Road Studs

Where indicated under the specifications and the measurement and payment, road studs shall be a performance based application.

A11.7.5 MATERIALS

A11.7.5.1 General material specifications

The material specifications are the required specifications for the materials as placed and/or processed in its final position within the road reserve.

It is the Contractor's responsibility to ensure that the materials delivered to the road shall meet these specified requirements.

Materials removed under this Section from existing works, except where provision has been made in Part C for their reuse or specific disposal, shall be deemed to be the property of the Contractor.

A11.7.5.2 Materials

a) Marking materials

The responsibility for the selection of the appropriate road marking materials for road markings to ensure conformance with the requirements of this specification rests with the Contractor. The road marking materials shall provide the characteristics for retro-reflectivity, luminance, skid resistance and durability as required in the material specifications.

Where thermoplastic, also known as hot melt plastic, or Methyl Methacrylate (MMA), also known as cold plastic, is used, the Contractor shall obtain approved certification, from the manufacturer, that the product complies with the specification and submit this certification to the Engineer.

(i) Road marking paint (solvent borne and water borne)

Road marking paint shall be Type 1 as specified in SANS 731-1 for solvent borne paints and SANS 731-2 for water borne paints. Only paint, manufactured in a SANS approved and accredited facility shall be accepted. The no-pick-up time of road marking paint shall comply with the Class 1 requirement in accordance with SANS 731-1 and -2.

The paint shall be delivered at the site in sealed containers marked in accordance with the requirements of SANS 731-1 and -2.

The viscosity of the paint shall be such that it can be applied according to the manufacturers recommended guidelines for optimum performance.

(ii) Retro-reflective road marking

Retro-reflective road marking paint shall comply with the requirements of road marking paint in A11.7.5.2a)(i) above with retro reflective drop on beads complying with SANS 51423. Unless otherwise specified by the Engineer or in the Contract Documents, the Contractor may select either solvent or water borne paint.

Determination of coefficient of retro-reflected luminance by means of portable retro-reflectometer shall be carried out using SANS 6261.

(iii) Thermoplastic road marking material

Thermoplastic road marking material shall comply with the requirements of EN 1436, and SANS 51423 for drop-on glass beads for road marking and anti-skid aggregates and mixtures thereof. Blending of thermoplastic road marking material and glass beads shall comply with SANS 51424.

The binder shall be a plasticised synthetic resin and the material shall be reflectorised by mixing in a minimum of 20 % by mass Class A glass beads in accordance with SANS 51424. An additional topping of drop on glass beads shall be applied to the hot surface of the material for immediate retro-reflectivity.

The white road marking material shall contain 6,0 % by mass minimum titanium dioxide content and shall have a skid resistance of 45 S.R.T. – units or higher. SABS Method 1248 shall be used for determination of traffic wear index; indication of durability.

The following minimum lumination values are required for the completed road marking for performance based application:

250mcd/m².lux and 120mcd/m²/lux for white & yellow lines respectively, at 30 days after application.

200mcd/m².lux and 100mcd/m²/lux for white & yellow lines respectively, at 6 months after application.

Determination of coefficient of retro-reflected luminance by means of portable retro-reflectometer shall be carried out using SANS 6261. The timing for the application of thermoplastic road marking over previously applied marking during the contract period shall be carried out as specified in the Contract Documentation.

(iv) Methyl Metacrylate (MMA) Cold Plastic Marking Material

Screed applied cold plastic road marking material shall be used for symbols, arrows and letters (hand painted markings) when specified by the Engineer and shall consist of a solvent-free two component reactive acrylic resin, stuffing, beads and pigment to which a hardener shall be added. Application is carried out using a trowel, screed box or an appropriate roller. Material applied by paint brush shall not be used.

Cold plastic road marking material shall be reflectorised by mixing in a minimum of 20 % by mass (or 400g/m²) Class A glass beads in accordance with SANS 51424. An additional topping of glass beads shall be applied to the wet surface of the material after application and shall comply with EN 1423 (v) *Drop on retro-reflective beads*

Retro-reflective glass drop on beads shall be applied to the road marking material before the material dries, cools down or sets.

The beads shall comply with Class A beads in accordance with EN 1424 and SANS 51424.

The beads shall be delivered to site in sealed bags, marked with the name of the manufacturer and the batch identification number. The Contractor shall, at all times, be in possession of a SANS certificate on site certifying that the beads have been tested with the requirement of SANS 51424.

(vi) Pre-Formed Road Marking Tape

A pre-formed, conformable polymer layer made from high quality polymeric materials, pigments and glass beads, designed to be used as an inlay marking on hot asphalt or as an overlay application on concrete and asphalt surfaces. **b) Road studs**

Road studs, excluding solar powered road studs, shall comply with the requirements of SANS 1442 or SANS 1463-1 and -2 as required and paid under the relevant items under Section C11.7 of Part C. Unless otherwise stated in the Contract Documentation, all road studs shall be bidirectionally reflective; or omnidirectional reflective for circular glass road studs.

Road studs shall be of the size and classification or type specified, based on the drawings in the Contract Documentation. The Contractor shall, after receiving confirmation of the classification or type and number to be installed from the Engineer, submit to the Engineer samples of the type of road studs he proposes to supply for approval. The manufactures' specifications, warranty (if any) installation requirements, forming holes for

anchors and adhesive requirements shall be provided. All studs subsequently used shall be of an equal specification, quality or better. In the event that manufacturers' installation specifications are not available, the Contractor shall submit his installation procedure to the Engineer prior to installation.

Where specified, road studs shall be supplied and installed in accordance with the areas of application set out in Table A11.7.5-1 with reference to SANS 1463.

Table A11.7.5-1: Areas of application for road studs

Classification	Area of Application			
	RSA-1	RSA-2	RSA-3	RSA-T
Description	Bi-directional	Bi-directional	Circular CatsEye	Bi-directional
Material	Galvanized steel or cast iron shell	Plastic or plastic composite	Glass	Plastic
Design	Type A	Type A	Type A	Type A
Use	Type P	Type P	Type P	Type T
Reflector	Type 2 or 3	Type 2 or 3	Type 1	Type 2
Reflectivity	PRT1	PRT1	PRT1	PRT0
Installation System	Anchored road stud	Bonded road stud	Embedded road stud	Self-adhesive or Bonded road stud
Height above Road	H2-H3	H2-H3	H1	H1
Dimensions (min-footprint)	100 mm x 80 mm	100 mm x 100 mm	100 mm diameter	100 mm x 50 mm
Colours	W – R - Y	W – R -Y	W	W – R - Y
Road Trials	S1; R3	S1; R3	S1:R2	Not Applicable

Road stud type and use is classified for the following areas of application:

Road Stud Application 1 (RSA-1): High trafficked center line of narrow roads less than 3,5 m lane width, yellow shoulder line application on single carriageway roads (1 lane in each direction) where paved shoulder width is wider than 1,5 m.

Road Stud Application 2 (RSA-2): Low to high trafficked centre line application on single carriageway roads (1 lane of at least 3,5 m width in each direction), and undivided dual carriageways (2 or more lanes in each direction). Low trafficked yellow and all white shoulder line applications on divided and undivided dual carriageways (2 or more lanes in each direction). All painted island and lane dividing lines at intersections.

Road Stud Application 3 (RSA-3): High trafficked lane dividing lines on divided and undivided dual carriageways (2 or more lanes in each direction).

Road Stud Application T (RSA-T): All temporary deviations and temporary demarcation.

In special circumstances at higher risk locations, solar powered illuminated road studs, of specified colour, shall be installed on instruction of the Engineer. The Contractor shall, after receiving confirmation of the type and number to be installed from the Engineer, submit to the Engineer samples of the type of solar powered road studs he proposes to supply for approval. The manufactures' specifications, warranty, installation requirements, and adhesive requirements shall be provided. Solar powered road studs shall be installed midway between retro reflective road studs or as per the drawings.

Solar powered road studs shall conform to the following requirements

- The body of the unit shall be of either UV resistant PVC or aluminium with a shank
- Maximum dimensions are 100 x 100 mm or 100 mm diameter, with an installed maximum height of 22 mm
- The solar panel, electronics and optics shall be sealed inside the unit which shall be waterproof (minimum IP67)
- A suitable power storage battery or capacitor must be incorporated
- Battery life to be 3 years
- The unit must be capable of operating for a minimum of 36 hours continuously after a charge time of 8 hours

- Each unit must be provided with super bright LEDs (18 milli candelas per LED) (number and colour per unit to be as specified in the Contract Documentation and/or the Schedule of Quantities)
- Operating temperature range -20°C to 60°C
- Compression resistance of unit to be between 200-300 kN
- The spacing of the road studs will be determined by the road geometry, at least 3-4 road studs should be visible at a time

A11.7.6 CONSTRUCTION EQUIPMENT

The Contractor shall submit his plant and equipment list for applying, installing or removal of road marking and road studs as part of his method statement to perform the different elements of the Works.

A11.7.6.1 Mechanical equipment for painting

The equipment shall consist of an apparatus for cleaning the road surfaces, a mechanical road-painting machine, sandblasting equipment and all additional hand-operated and other equipment necessary for completing the work. The mechanical road marking machine shall be capable of painting at least three lines simultaneously and shall apply the paint to a uniform film thickness at the rates of application specified hereinafter. The road-painting machine shall be so designed that it will be capable of consistently painting the road markings to a uniform width with edges and position within the tolerances specified hereinafter, without the paint running or splashing or spattering, and applying the glass beads simultaneously with painting. The machine shall further be capable of painting lines of different widths by adjusting the spray jets on the machine or by means of additional equipment attached to the machine. The road marking machine shall be fitted with a device to guide the operator to the centre of the line to be painted. This device shall be used at all times of operation.

The machine shall be capable of spraying at a speed of more than 5,0 km/h, and shall be provided with clearly visible amber warning flashing lights, which shall always be in operation when the machine is on the road. The machine shall always be operated in the same direction as the traffic flow when applying lane markings under traffic

A11.7.6.2 Thermoplastic heating equipment

Equipment for heating of thermoplastic material shall be so regulated as not to cause heat damage to the thermoplastic material by overheating or concentrated heating.

A11.7.7 EXECUTION OF THE WORKS

A11.7.7.1 Surface preparation

Final road marking shall be applied to newly surfaced bituminous surfaces only after a minimum of 15 days, or such longer period specified due to climatic conditions, has elapsed, to ensure that no damage or discolouration is caused by volatiles evaporating from the surfacing. However, where the road is to be opened to traffic before this condition is met, temporary lines shall be painted using water borne road marking paint in the position of the future final lines. This shall be done as soon as possible after completion of each section of surfacing and before opening to traffic wherever possible.

Before the road marking 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 surface where the paint is to be applied shall be properly cleaned by means of watering, brooming or compressed air if required. The onus is on the Contractor to ensure that the surface on which the road markings are to be applied is sufficiently clean and dry to ensure that the quality of the road markings will not be adversely affected. The Contractor is also responsible for protecting road studs from being painted over, and the subsequent cleaning thereof if such over-painting should occur. Cleaning of road studs shall be done in such a manner that the functionality of the road studs will not be detrimentally affected by the cleaning agent used.

Where road markings are to be applied to a concrete pavement, all laitance and loose curing compound shall be removed. Concrete primers may be recommended for specific road marking paints which will require curing times. Particular care shall be taken to ensure that the surface shall be clean, fresh concrete on all areas where road studs are to be fixed.

No additional payment for cleaning and preparation of the road surface for road marking will be made, and such cleaning and preparation shall be deemed to be included in the rates for road marking items.

A11.7.7.2 Setting out the road markings

Where road markings are to be replaced after any construction activity, all existing road markings shall be accurately surveyed and referenced before commencement of any such construction activity which may obliterate the existing road markings. Before commencing with the referencing, the Contractor shall submit his proposed method of referencing to the Engineer for his approval.

The position of barrier lines shall be re-assessed on site by the Engineer before the Contractor commences with the road marking. The dimensions and positions of road markings shall be as shown on the drawings or as specified in the appropriate statutory provisions and the SADC and South African Road Traffic Signs Manual.

The lines, symbols, figures or marks shall be premarked by means of paint spots of the same colour as that of the final lines and marks. These paint spots 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 apart. Normally spots of approximately 10 mm in diameter should be sufficient.

After spotting, the positions of the proposed road markings such as broken lines and the starting and finishing points of barrier lines shall be indicated on the road. These premarkings shall be approved by the Engineer prior to any painting operations being commenced.

The positions and outlines of special markings shall be produced on the finished road in chalk and shall be approved by the Engineer before they are painted. Approved templates may be used on condition that the positioning of the marking 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.

A11.7.7.3 Applying the markings

The Contractor's establishment on site and general obligation shall be deemed to fully include the establishment of the road marking team, irrespective of the number of times the road marking team is required to be on site or is required to move within the site or whether markings are temporary or final.

The figures, letters, signs, symbols, broken or unbroken lines or other marks shall be marked as shown on the drawings or as specified by the Engineer.

Where the marking is applied by machine, it shall be applied in one layer and operation. Before the road marking machine is used on the permanent works, the satisfactory operation of the machine shall be demonstrated on a suitable site, which is not part of the permanent works. Adjustments to the machine shall be followed by further testing. 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 work. The operator shall be experienced in the use of the machine.

After the machine has been satisfactorily adjusted, the rate of application shall be checked and adjusted if necessary before application on a large scale is commenced.

Where two or three lines are required next to each other, the lines shall be applied simultaneously by the same machine. Paint shall be stirred before application in accordance with the manufacturer's instructions and shall be applied without the addition of thinners.

Where, under special circumstances, painting is done by hand, it shall be applied in two layers, and the second layer shall not be applied before the first layer has dried out sufficiently. As most road marking paint reacts with the bitumen surface of newly surfaced roads, the paint shall be applied with one stroke only of the brush or roller.

Solvent and water borne road marking paint shall be applied at a nominal rate of 0,42 l/m²; or as specified as the recommended application rate by the paint manufacturer; or as specified by the Engineer (non performance based). Spray thermoplastic road marking shall be applied at a nominal rate of 2,5 kg/m² to achieve a minimum thickness of 1,25 mm to 1,5 mm; or as specified by the Engineer (non performance based). Screeded cold plastic road marking shall be applied hand by means of a trowel, screed box or an appropriate roller at a nominal spreading rate of 4,5 kg/m² to achieve an estimated 2,0 mm material thickness. The desired symbol or line shall be marked with a tape or a template on the road surface. Thereafter the required volume of material shall be applied and spread uniformly over the entire area. When dry or set, the tape or template shall be removed.

In order to ensure proper coverage on all types of surfaces the Engineer may order an increase in the above nominal application rates. Payment for these variations in application rates shall be made under items for variation.

A daily log-sheet, in a format approved by the Engineer, shall be completed and signed by the Contractor and the Engineers representative, recording the quantities of paint and glass beads used on that day and shall be available for inspection at all times. The completed and signed logsheet for the period covered by a payment certificate shall be submitted to the Engineer prior to his approval of the certificate

Where roads are constructed under traffic, solvent or water borne temporary road marking as specified by the Engineer shall be carried out within 14 days of opening the road full width to traffic after the completion of the surfacing, or such other period specified by the Engineer.

If in the opinion of the Engineer, conditions are unsafe, the centre-line shall be painted immediately as temporary road marking after 2,0 km of continuous road has received a new asphalt layer, or 4,0 km of continuous road has received a new seal surfacing.

A11.7.7.4 Applying the retro-reflective beads

Where retro-reflective road markings are required, the retro-reflective beads shall be applied by means of a suitable machine in one continuous operation, immediately after the paint has been applied. The rate of application of the beads shall be 400 g/m² or such other rate as may be specified by the Engineer. Machines which apply the beads by means of gravity only shall not be used. The beads shall be sprayed onto the paint layer by means of a pressure sprayer.

The thermoplastic road marking material and cold plastic road marking material shall contain intermixed glass beads of minimum content of 20 % by mass in order to obtain night visibility (reflectivity). The Contractor shall immediately apply additional surface glass beads at 400 g/m² to obtain immediate reflectivity. The beads shall be sprayed onto the road marking layer by means of a pressure sprayer. Where letter, symbol, traverse line and island road marking is undertaken by hand, the glass beads may be applied by hand if approved by the Engineer. Prior to any hand application work, the Contractor shall first request approval from the Engineer.

Beads shall be applied in accordance with SANS 51423 and SANS 51424.

A11.7.7.5 Installation of road studs

Road studs shall be of the type specified and/or indicated on the drawings and shall be fixed in the positions specified and/or indicated on the drawings.

Where anchored or embedded road studs are specified the making of anchor holes or embedment holes shall be made in accordance to the manufacturers specifications or in accordance to an accepted procedure provided by the Contractor.

The road studs shall be fixed by means of an approved epoxy resin or other specified adhesive in accordance with the manufacturer's Instructions, subject to such amendments to the method as may be specified by the Engineer. Different adhesives shall be used in winter and summer as per the manufacturers' specifications. Where road studs are to be replaced after seal work, care must be taken that sufficient adhesive is used so that the road studs are well supported and bonded. The studs shall be protected against impact until the adhesive has hardened. Before fixing the road studs, the surface shall be thoroughly cleaned as specified in Clause A11.7.7.1. Where surface bonded road studs are affixed to road surfaces

recently covered with second slurry of a Cape Seal or a texture treated road surface, the risk of delaminating of the upper slurry shall be assessed prior to using surface bonded road studs.

Permanent road studs shall be fixed after the road marking of the road. Prior to the application of bituminous surface treatment, all existing road studs shall be adequately protected. Road marking over road studs shall not be accepted. During placement of aggregate chips, rolling and brooming care shall be taken to protect all existing road studs against damage or breakage. The Contractor shall replace at his own cost any road studs that have been damaged by constructional activities or that have been stained and cannot be cleaned entirely. Where specified by the Engineer, the Contractor shall remove the existing road studs prior to the application of the surfacing seal.

Where specified by the Engineer, temporary road studs shall be installed. The Contractor shall maintain the temporary road studs in position until the final road markings have been completed.

Not more than 5 % loss of road studs during the Defects Notification Period (where applicable) will be accepted. Failure to meet this requirement shall be rectified at the Contractor's expense.

A11.7.7.6 Protection

After the road marking has been applied, the markings shall be protected against damage by traffic or other causes. The Contractor shall be responsible for erecting, placing and removing all warning boards, flags, cones, barricades and other protective measures which may be necessary in terms of any statutory provisions and/or as may be recommended in the SADC and South African Road Traffic Signs Manual.

A11.7.7.7 Weather limitations

Road marking or road studs shall not be applied to a damp road 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.

A11.7.7.8 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 painted sections shall remain the same. Lines shall not be painted more than 3 months prior to the road being opened to public traffic. Where there are risks of previously applied lines wearing through thin surfacing such as slurries, the new lines shall be applied to match the old lines accurately.

Lines on curves, whether broken or unbroken, shall not consist of chords but shall follow the correct radius. Particularly on curves in the road, and where roads are widened such as at climbing or passing lanes, the lines shall form continuous single curves without kinks.

The Contractor shall provide a warranty for the road marking, as specified in the Contract Documentation.

Where indicated by the Engineer, the Contractor shall remove existing painted markings from the existing surfaces by means of sand blasting or as specified by the Engineer. Suitable precautions shall be taken to avoid damage to nearby vehicles or other property during the sand blasting process.

The use of black paint or chemical paint remover to obliterate existing markings will not be permitted, except where it is specified by the Engineer as a temporary measure. Where black paint is used, it shall be matt.

11.9 FINISHING THE ROAD AND ROAD RESERVE AND TREATING OLD ROADS

A1.9 FINISHING THE ROAD AND ROAD RESERVE AND TREATING OLD ROADS PART A: SPECIFICATIONS

A11.9.1 SCOPE

This Section covers the final finishing and cleaning up of the road and road reserve and all associated works on the site at the completion of construction, including scarifying and treating old roads, temporary deviations and other temporary works.

Construction may be as new construction, as renewal construction or as a combination of both. When construction includes elements under Section A1.6 of Chapter 1: Clearing and Grubbing, Chapter 4: Borrow Materials, and Mass Earthworks; and Section A11.8 of Chapter 11: Landscaping and planting plants, then this Section does not cover the required finishing under those Chapters and Sections.

A11.9.2 DEFINITIONS

No specific definitions.

A11.9.3 GENERAL

No general requirements.

A11.9.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

Not required for Section A11.9.

A11.9.5 MATERIALS

A11.9.5.1 General material specifications

There are no general materials specifications as finishing and cleaning results in the collection and removal of surplus and unwanted excess material, vegetation and construction litter.

It is the Contractor's responsibility to ensure that the materials vegetation and other litter collected are disposed of, to approved and authorised waste disposal sites and not to contravene environmental legislative requirements.

A11.9.5.2 Materials

No specific materials required.

A11.9.6 CONSTRUCTION EQUIPMENT

The Contractor shall submit his plant and equipment list for the finishing and cleaning, disposal, stockpiling if specified, loading and hauling as part of his method statement to perform the different elements of the Works.

A11.9.7 EXECUTION OF THE WORKS

A11.9.7.1 Finishing the road and road reserve

For new construction, after completing the seal, surfacing or gravel surfacing on gravel roads; or other final activities where surfacing is not included, the road and road reserve shall be cleared of all excess earth, stones, boulders, debris, litter, garbage, unwanted vegetation and other waste or excess material resulting from the construction of the works or the use of the road. All finishing and cleaning not previously done or required as specified in the sections of the specifications set out in Clause A11.9.1 above, shall be undertaken and completed. This specification, however, does not intend the finishing, cleaning and maintenance, which must be undertaken as provided for in other Sections of these specifications, to be postponed until the final finishing operations provided for in this section.

For renewal construction after completing construction work within the site, the Contractor shall ensure that all construction generated or related material that may have been swept, windrowed, stockpiled, stored or spread beyond the road surface is removed. This shall be done before any other rehabilitation work is undertaken, including shaping, topsoiling and grassing. Should, during the removal of construction generated or related material, existing vegetation or topsoil be disturbed or destroyed, the Contractor shall, at his own cost, re-instate the road reserve to its original state. This shall include ripping, should the construction material and processes have compacted the original surfaces.

Culvert inlets and outlets, culvert barrels, and open drains shall be cleared of debris, soil, silt undesirable vegetation and other material generated from the construction activities.

The surfacing shall be cleared of all dirt, mud and foreign objects. Brooming or other non-damaging actions shall be used on finished surfacing and dragging, pushing or scraping material across surfacing shall not be permitted.

All junctions, intersections, islands, kerbing and other elements making up the completed works shall be neatly finished off.

The Contractor shall ensure that all noxious weeds have been removed from the road reserve and borrow pit areas.

All materials resulting from the finishing operations shall be disposed of at approved locations, such as approved waste disposal sites or approved disused borrow pits. Excess stone in particular from resurfacing operations shall be collected and removed from the site to ensure that future grass cutting

maintenance work will not be hindered by remaining surfacing stone. The Contractor shall make his own arrangements with the owners of properties on which such materials are to be deposited. Disposal shall be carried out in a neat and uniform manner. Disused materials such as pipe culverts, not further required and left with approval on adjoining properties, shall be disposed of out of sight from the road to ensure the road appearance reflects a fully complete and finished project.

All materials resulting from the finishing operations shall be disposed of at approved spoil sites.

A11.9.7.2 Treating old roads

All old roads, temporary deviations, haul roads and construction roads shall, in so far as is practicable, be levelled with the original ground. Surfaces shall be scarified and broken up to a depth of 150 mm for promoting plant growth.

Where specified by the Engineer, in order to prevent soil erosion, banks, dykes or ditches shall be constructed over the old road to dimensions specified by the Engineer.

All roads and temporary deviations treated as above shall be left in a neat and tidy state.

A11.9.8 WORKMANSHIP

No specific testing of materials is required.

B11.9 FINISHING THE ROAD AND ROAD RESERVE AND TREATING OLD ROADS PART B: LABOUR ENHANCEMENT

CONTENTS

B11.9.1 SCOPE

B11.9.2 DEFINITIONS

B11.9.3 GENERAL

B11.9.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

B11.9.5 MATERIALS

B11.9.6 CONSTRUCTION EQUIPMENT

B11.9.7 EXECUTION OF THE WORKS

B11.9.8 WORKMANSHIP

B11.9.1 SCOPE

This Section covers the final finishing and cleaning up of the road and road reserve after construction and scarifying and treating old roads and temporary deviations.

This Section includes work with a large component of labour.

This Part B therefore only covers additional specifications for work to enhance the labour component of construction activities where specified in Part A.

B11.9.2 DEFINITIONS

The provisions of Part A shall apply.

B11.9.3 GENERAL

The provisions of Part A shall apply.

B11.9.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

The provisions of Part A shall apply.

B11.9.5 MATERIALS

The provisions of Part A shall apply.

B11.9.6 CONSTRUCTION EQUIPMENT

The provisions of Part A shall apply.

B11.9.7 EXECUTION OF THE WORKS

Finishing the road and road reserve and treating old roads shall be deemed to be a labour enhanced construction process.

B11.9.8 WORKMANSHIP

The provisions of Part A shall apply.

C11.9 FINISHING THE ROAD AND ROAD RESERVE AND TREATING OLD ROADS PART C: MEASUREMENT AND PAYMENT**(i) Preamble**

The tendered rate for each item shall include full compensation for providing, maintaining and decommissioning upon completion, of all the plant, equipment, labour, tools, incidentals and supervision to carry out the activity or construct the works in the item, unless otherwise stated.

Any prime cost or provisional sums shall be paid in accordance with the provisions of the conditions of contract. The charge or mark-up tendered or allowed for is a percentage of the amount actually paid under the prime cost or provisional sum. This percentage shall cover all the Contractor's handling, supervision, profit and liability costs to provide the services in the prime cost or provisional sum item.

The requirements of Section C1.1 of Chapter 1 shall apply.

Where pay item descriptions include any wording in brackets it is an indication that contract specific information is to be inserted in the Pricing Schedule included in the Contract Documentation. **(ii) Notes on measurement and pay items**

None.

(iii) Items that will not be measured separately

The following activities, whether required to complete the specified work or not, will not be measured and paid for separately and the Contractor shall include the cost thereof in other pay items as he deems appropriate:

1. No separate payment will be made for backfilling excess excavations/trimming and disposing of surplus material not removed previously, etc. or any other contingent work, unless the work is specifically specified or ordered.
2. No separate payment will be made for setting out the works.
3. No separate payment will be made for the protection or repair as required of any existing or new road furniture, infrastructure or services damaged by the Contractor's activities.
4. No additional payment shall be made, nor shall any claim for additional payment be considered, for any specified work in confined or restricted areas. Any additional costs associated with working in confined or restricted areas shall be deemed to be included in the standard applicable pay items.
5. No separate payment will be made for the hauling of any materials where the material is moved over a distance of less than, and up to 1,0 km.
6. No separate payment will be made for transporting materials from commercial sources irrespective of the haul distance.
7. No separate payment will be made for the removal or any surplus material imported to complete the works.
8. For all Works performed, precautionary measures required in terms of the Occupational Health and Safety Act (Act 85 of 1993) and the latest amendments thereof as well as the latest Construction Regulations shall be deemed included in the rates tendered for the relevant products.

(iv) Items to be measured and paid for using items specified elsewhere in the specifications

The following items of work, when specified, shall be carried out, measured and paid for in accordance with the appropriate Sections of the specifications.

Table C11.9-1: Payment items from other Chapters or Sections

Activity	Section 11.9 reference	Section item reference
Loading and hauling	C11.9	Section C1.7 of Chapter 1 – All applicable items
Scarifying for loosening topsoil	C11.9	C11.8.3.2
Construction of banks, dykes or open drains	C11.9.2	C3.1.6 of Chapter 3

(v) Items specifically for this Section of the specification

Item	Description	Unit
C11.9.1	Finishing the road and road reserve:	
C11.9.1.1	Dual carriageway road	kilometre (km)
C11.9.1.2	Single carriageway road	kilometre (km)

The unit of measurement shall be the kilometre of road measured along the centerline. No separate measurement will be made of ramps at interchanges or at crossroads where intersections have been constructed.

No distinction shall be made between new works and renewal construction.

The tendered rates shall include full compensation for cleaning, trimming, disposing of material, tidying and all other work to be done for finishing off the road and road reserve as specified.

Item	Description	Unit
C11.9.2	Treatment of old roads and temporary deviations	
C11.9.2.1	Conventional construction methods	kilometre (km)

C11.9.2.2 By hand only kilometre (km)

The unit of measurement shall be the kilometre of old road or temporary deviation treated.

The construction of banks, dykes or open drains shall be measured and paid for under Section C3.1 of Chapter 3.

The tendered rate shall include full compensation for levelling and scarifying any surfaces and tidying old roads and temporary deviations as specified.

No payment will be made in regard to treating Contractor constructed haul roads and construction roads not intended for public road users, for which the Contractor shall make allowance in his rates for constructing the relevant Items of work for which such roads are necessary

CHAPTER 20: QUALITY ASSURANCE

20.1 TESTING MATERIALS AND JUDGEMENT OF WORKMANSHIP

CONTENTS

PART A: SPECIFICATIONS

A20.1.1 SCOPE

A20.1.2 DEFINITIONS

A20.1.3 TEST METHODS

A20.1.4 PUBLISHED TEST METHODS

A20.1.5 UNPUBLISHED TEST METHODS

A20.1.6 SPECIAL TEST METHODS

A20.1.7 ACCEPTANCE CONTROL BY STATISTICAL JUDGEMENT PRINCIPLES

PART B: LABOUR ENHANCEMENT

PART C: MEASUREMENT AND PAYMENT

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES – NOT APPLICABLE

A20.1 TESTING MATERIALS AND JUDGEMENT OF WORKMANSHIP PART A: SPECIFICATIONS

A20.1.1 SCOPE

ASAP

During the execution of the work, control testing shall be conducted on materials and workmanship to monitor compliance with the requirements of the specifications. Tests, measurements, and inspections shall be carried out using manual, mechanical and electronic equipment on materials and workmanship before, during and after construction to ensure compliance with the quality requirements of the specifications.

This Chapter also describes the schemes that are specified to ascertain compliance with the specification of certain materials properties and workmanship. This is achieved by means of tests and measurements, and, where applicable, by applying statistical judgement plans.

These statistical acceptance control requirements, unless otherwise specified, apply to Class A, B, C and D roads, as classified in TRH 26 South African Road Classification & Access Management Manual. The acceptance control requirements for lower classes of roads shall be specified in the Contract Documentation.

A20.1.2 DEFINITIONS

Independent site laboratory - This laboratory is procured by the Employer for carrying out the ordinary test required on site for both process and acceptance control testing which serves the Contractor and the Engineer. Irrespective of the requirements of Clause A20.1.3.3a)(ii)2 this laboratory operates under the auspices and systems of the main commercial laboratory which is SANAS accredited as a testing laboratory facility in terms of their accredited tests with an ISO17025 management system and with the necessary quality assurance plans. The commercial laboratory shall be responsible for frequent and regular auditing of the Independent Site Laboratory and provide reports to the Engineer of such audits and correlation tests conducted.

Independent commercial laboratory - This laboratory refers to a SANAS accredited testing laboratory facility in terms of their accredited test schedule and conformance with the ISO 17025 requirements. This laboratory is located away from site and conducts ordinary and special tests. The testing work is charged to whichever client places the order, at the applicable rates and tariffs.

Engineer's laboratory - This type of laboratory refers generally to the Independent Site Laboratory and/or a specific independent commercial laboratory nominated for certain tests by the Engineer.

Approved laboratory/Testing authority - An approved laboratory shall mean any locally accredited laboratory that is located away from site and has been approved by the Engineer for the testing of materials, products, elements and mixes used on site. Whenever the need exists the Engineer will also seek the consent of the Contractor.

Contractor's satellite laboratory - A laboratory established by the Contractor on site or at manufacturing plants for asphalt and concrete. The Contractor's satellite laboratory also carries out process control on materials stockpiles and bulk binder storage, as well as during the manufacture of asphalt and concrete mixes. All tests and procedures are undertaken in terms of a quality control plan.

Ordinary tests - Ordinary tests refer to the range of tests that are routinely carried out as part of process and acceptance control.

Special tests - Special tests refer to tests that require the use of specialised equipment and expertise not normally available in an independent site laboratory, unless otherwise provided for. These tests are applicable to certain products, structural elements, drainage, and in the design of special mixes. The use thereof, in terms of conformance to the requirements and obligations of the Contract and the cost of such testing, shall, unless otherwise specified, be included in the Contractor's rates.

Lot - A lot is a sizeable portion of work or quantity of material that is assessed as a unit for the purposes of acceptance control and selected to present material or work produced by essentially the same process and from essentially the same materials.

Random sampling - 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 following tables of random numbers published in TMH5 or any other random number generating tool as approved on condition that there are no other causes for rejection as described in Clause A20.1.7.5.

Stratified sampling - This involves the subdivision of the "lot" to be assessed into uniform strata equal to the selected number of "n" tests. These sub-lots may be in the form of truckloads, batches or subdivisions of a "lot" of pavement layers.

Stratified random sampling - This is a combination of random and stratified sampling as a means of eliminating clustering in the position or portion of samples within the "lot".

Sample mean ($\bar{x}_n$):

$\bar{x}_n$ is the arithmetic mean of a set of "n" test results constituting the sample, i.e. $(x_1 + x_2 + x_3 + \dots + x_n) / n$

$\bar{x}_n = \sum x/n$ where x is individual test result n is the number of individual test results or measurements

Sample standard deviation (S) - The sample standard deviation S is defined by:

$$S = \sqrt{(\sum x^2 - n\bar{x}_n^2)/(n-1)}$$

Where $\bar{x}_n$ is the sample mean

x is the value of an individual sample portion, i.e. an individual test result or measurement.

n is the sample size, i.e. the number of individual test results or measurements.

Specification limit (L_s) - This is the limit value of the property of any product outside which not more than a certain specified percentage ($\emptyset$) 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 consisting of a lower limit L_s and an upper limit L_s.

ASAP

Acceptance limit (L_a) - This is the limit value of the sample mean within which the lot will be accepted. 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 a L_a and L_a respectively.

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 A20.1.7.6.

Rejection limit (Lr) - This is the limit value of the sample mean outside which conditional acceptance cannot be considered. It may be a lower limit L_r or an upper limit L'_r .

Payment reduction factor (fr) - This is the factor by which payment at contract rates shall be multiplied for calculating the payment for conditionally accepted work subject to the provisions of Clauses A20.1.7.6a) and A20.1.7.6b) (i), (ii) and (iii).

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 further investigations must be carried out. To determine whether or not a test result is a possible outlier, the methods and procedures given in Clause A20.1.7.3 shall be followed.

Factors k_a , k_{ad} , k_r and k_{rd} - These factors are used for calculating the various judgement limits, as follows: a)

Acceptance limits (L_a and L'_a)

k_a is used for determining the acceptance limits for single-limit specifications.

k_{ad} is used for determining the acceptance limits for double-limit specifications.

b) **Rejection limits (L_r and L'_r)**: The rejection limits shall be determined in accordance with the provisions of Table A20.1.7-14.

Ø (%) - Ø is the maximum percentage of a statistical population of values of a product property permitted to lie outside the specification limits where the product may still be regarded as being acceptable.

First submission - The submission of a lot for approval will be classified as a first submission when submitted for the first time or when submitted for a second time on the basis of a second set of test values to be regarded as a first submission in terms of Clause A20.1.7.4 because the properties of the first and the second sets of test values differ significantly.

Resubmission - 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 Clause A20.7.4 because the properties of the first and second sets of test values do not differ significantly.

Repair and rehabilitation work - Quality control of non-continuous repair and rehabilitation work in small lots, portions and sections shall be carried out as specified in the Contract Documentation.

A20.1.3 TESTING METHODS

A20.1.3.1 General

All time related implications, brought about by the testing regime as specified herein, are deemed to be included in the contract rates and the Contractor's programme, and no Contractor's claims whatsoever to that effect will be entertained.

All sampling, testing measurements, etc. shall be performed and recorded by competent staff in terms of ISO 17025 and facilities accepted by the Engineer.

The responsibility to deliver the product in terms of the specification shall always remain the obligation of the Contractor in terms of the contract.

A20.1.3.2 Standard Methods

All tests shall be conducted in accordance with the standard methods specified in the following list, in order of precedence, unless indicated otherwise in the other Chapters:

- a) South African National Standards (SANS) codes of practice and coordinating specifications (CKS) as published by the South African Bureau of Standards (SABS)
- b) Relevant TMH methods
- c) British Standards Institute Specifications (abbreviated as BS)
- d) European standards maintained by CEN (European Committee for Standardization) (abbreviated as EN)
- e) The methods/specifications of the American Society for Testing and Materials (abbreviated as ASTM).
- f) The methods/specifications of the American Association of State Highway and Transportation Officials (abbreviated as AASHTO).
- g) The standard methods of testing of the South African Bitumen Association (abbreviated as Sabita)
- h) The standard methods of testing of the International Union of Laboratories and Experts in Construction Materials, Systems and Structures (abbreviated as RILEM).
- i) The Asphalt Academy

In addition to the above standard methods of testing, standard specifications or test methods of other bodies may also be referred to in these specifications, or test methods as described in the Contract Documentation where no acceptable standard methods exist.

Note: In all cases the latest amendment or revision current at the closing date of the tender is implied when reference is made to one of the above standards in the specification.

A20.1.3.3 The Costs of Testing

ASAP

a) Material and workmanship for quality control

(i) *The cost of testing may be borne by the Contractor and Employer in several ways, as specified in the Contract Documentation, i.e.:*

1. Process and acceptance control testing are carried out by the Contractor. The cost of the testing is deemed to be included in the rates, or
2. Process control testing is carried out by the Contractor, and acceptance control testing by the Engineer. The cost of process control testing is borne by the Contractor and the cost of acceptance control testing is borne by the Employer, or

3. All materials testing, including process and acceptance control testing is carried out by an independent site laboratory. The Contractor shall contribute to the costs of such laboratory under the pay items under Section C20.1.

(ii) *When the testing is undertaken by an independent site laboratory, the Employer stipulates that:*

1. The Contractor accepts the test results of the laboratory. Should there be any doubts or disputes regarding certain test results, this shall be settled by another independent SANAS accredited testing laboratory facilities mutually agreed upon that shall retest the work in question. The cost in such cases shall be to the account of the party at fault by means of the aggregate results obtained by all test facilities.
2. The Contractor accepts that the Engineer will be in charge of the independent site laboratory.
3. The total estimated cost of the independent site laboratory for the contract period is reflected in the Contract Documentation.
4. A negative pay item representing the Contractor's monthly contribution to be deducted from the Contractor's interim payment certificates has been provided under Section C20.1.
5. The monthly contribution by the Contractor shall be a negative amount for all process control testing, excluding acceptance control and other testing ordered by the Engineer, as a portion of the total cost (per month).

A20.1.3.4 Compliance Certificates and Testing

Where the properties of materials or manufactured products are required in these specifications to comply with 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 it is specified that a product shall comply with SABS specifications, it means that the product shall have been tested and evaluated in accordance with the requirements of the relevant SABS specification. Where a SABS mark is specified, a certificate will be required.

The Engineer shall be entitled to take samples of and order tests to be made on products and materials in respect of which certification of compliance are required. The Contractor shall be paid at the appropriate rates if the costs of such tests are itemised in the pricing schedule and if no appropriate rates exist, such tests shall be classed as an extra works order, provided that such tests indicate compliance with the specifications, otherwise the cost shall be borne by the Contractor.

A20.1.3.5 Taking and submitting samples

The method of taking samples shall be as specified in the appropriate sampling and testing methods. The sampling methods described in TMH5, SABS, SANS and AASHTO shall apply where relevant. If no sampling method is specified, the sampling methods described in TMH5 and in SABS method 5827 shall take precedence.

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, who shall be liable for the consequence of such default, including resultant time delays. All samples shall be submitted in sufficient time for proper testing.

The Engineer's approval of any sampled materials shall in no way relieve the Contractor's obligation to provide materials, mixtures and workmanship that comply with the specification.

All samples for testing shall be taken in a random pattern, or in any position, as prescribed by the Engineer. Where specified or required by the Engineer, stratified random sampling methods shall be followed. For the testing of layer work stratified random sampling methods shall be used for obtaining all the sample positions and for determining the locations for in-situ tests.

The Engineer shall have full access to the works for the purpose of taking samples. The Contractor shall render any assistance necessary for taking the samples and shall be responsible for the reinstatement to the specified standards of pavement layers or other structures at the position where the samples have been taken. Full compensation for time delays and for rendering assistance with sampling and for reinstatement where samples have been taken shall be deemed to be included in the rates tendered for the various items of work tested and no additional payment will be made in this respect.

Table A20.1.3-1 provides guidelines for submitting materials with regard to the time and quantity of material required for testing, approval and mix designs. As the time stated in this table does not make any allowance for possible rejection and the resubmission of alternative materials, the Contractor shall submit any materials of marginal quality at an early stage or together with alternative materials in order to minimise any delays in final approval.

The Contractor shall note that any samples submitted direct to the Engineer for approval shall be properly marked and shall be accompanied by a covering letter with all the required information and countersigned by the Engineer's representative upon delivery.

ASAP

Table A20.1.3-1: Schedule showing quantities and times for submitting the materials for approval and mix designs

Material submitted	Proposed use	Submission for quality approval only	Submission for quality approval and mix design

		Minimum time to be allowed for testing and approval	Minimum quantity to be submitted	Minimum time to be allowed for testing, approval and mix design	Minimum quantity to be submitted
Crushed stone	Coarse aggregate for concrete	2 weeks	50 kg of each type and size of aggregate	8 weeks for structures and concrete pavements	150 kg of each size of aggregate for each class of concrete
	Bituminous seals	2 weeks * ¹	50 kg of each type and size of aggregate	2 weeks	50 kg of each size of aggregate
	Asphalt mix design Marshall Method	2 weeks * ¹	50 kg of each type and size of aggregate	8 weeks * ²	100 kg of each size of aggregate as well as proposed binder * ²
	Asphalt mix design Level 1	4 weeks * ¹	50 kg of each type and size of aggregate	10 weeks * ²	100 kg of each size of aggregate as well as proposed binder * ²
	Asphalt mix design Level 2	6 weeks * ¹	50 kg of each type and size of aggregate	12 weeks * ²	100 kg of each size of aggregate as well as proposed binder
	Asphalt mix design Level 3	8 weeks * ¹	50 kg of each type and size of aggregate	16 weeks * ²	100 kg of each size of aggregate as well as proposed binder * ²
	Crushed-stone base or subbase	3 weeks	50 kg	8 weeks (stabilisation)	200 kg
Fine aggregate	Fine aggregate for concrete	2 weeks	50 kg of each type and size of aggregate	10 weeks	150 kg of each type proposed for use for each class of concrete
	Asphalt mix design Marshall Method	2 weeks * ¹	50 kg of each type and size of aggregate	8 weeks * ²	150 kg of each type proposed for use * ²
	Asphalt mix design Level 1	4 weeks * ¹	75 kg of each type and size of aggregate	10 weeks * ²	150 kg of each size of aggregate as well as proposed binder * ²
	Asphalt mix design Level 2	6 weeks	50 kg of each type and size of aggregate	12 weeks * ²	150 kg of each size of aggregate as well as proposed binder * ²
	Asphalt mix design Level 3	8 weeks	50 kg of each type and size of aggregate	16 weeks * ²	150 kg of each size of aggregate as well as proposed binder * ²
	Slurry or sand seal	2 weeks	50 kg of each type proposed for use	6 weeks	50 kg of each type proposed for use as well as proposed binder
Gravel	Subbase and/or base	4 weeks	200 kg of each type	8 weeks (stabilisation)	200 kg as well as stabilising agent
Binders	Asphalt	2 weeks	5 ℓ	4 weeks	10 ℓ
	Surface treatments	2 weeks	5 ℓ	4 weeks	10 ℓ
	Bituminous stabilised materials	2 weeks	5 ℓ	4 weeks	10 ℓ

Material submitted	Proposed use	Submission for quality approval only		Submission for quality approval and mix design	
		Minimum time to be allowed for testing and approval	Minimum quantity to be submitted	Minimum time to be allowed for testing, approval and mix design	Minimum quantity to be submitted
Bituminous stabilised materials	Bituminous stabilised mixes	2 weeks	50 kg of each type of aggregate and reclaimed asphalt (RA)	4 weeks	100 kg of each type of aggregate and RA
Other materials e.g. paint, cement, additives, Concrete, Additives, etc.	As specified	As prescribed by the Engineer			

*1 In the event of PSV and Soundness testing an additional 2 weeks shall be allowed for.

*2 In the event of "check only" mix designs the minimum time and quantities can be reduced, depending upon the properties to be validated, and shall be agreed with the Engineer after the submission of the original mix design.

A20.1.3.6 Classifying the tests for costing and payment purposes

For the purposes of this Chapter tests are classified as follows:

a) Ordinary tests

Ordinary tests are tests that are constantly conducted by the Contractor on a regular basis in terms of his obligations. These tests, for which no specified pay items have been provided, include, inter alia:

- (i) Tests for determining the properties of all natural materials such as, inter alia, sand, stone, water, soil and gravel, provided by the Contractor for use in the works.
- (ii) Tests on processed natural materials such as aggregate for concrete, asphalt and seals, purchased or produced on the site by the Contractor.
- (iii) 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 sub-Contractors.
- (iv) Tests on completed elements of construction such as fills, pavement layers, concrete structures, concrete pavements, etc, for establishing compliance with the specified properties. ASAP

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. **b)**

Special test

Special tests that have to be conducted by the Contractor only at the specific request of the Engineer include the following:

- (i) Tests on commercial products such as cements, lime, paint, bituminous products, pipes, valves, cranes and bridge bearings. The requirements are specified as a whole or in part by reference being made to the specifications of a standards organisation such as the SABS.
- (ii) 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, unless otherwise specified.
- (iii) Any test requested by the Engineer purely for purposes of acceptance control, acceptance of products and mix designs. With reference to Clause A20.1.3.3a)(i), points 1 and 2, only the cost of testing for acceptance control will be paid for.
- (iv) 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 A1.2.8.1 of Chapter 1 and with a view to submit the result to the Engineer for his approval of the completed works.

The payment of special tests required by the Engineer shall be borne by the Employer for which provision is made in Section C20.1, provided that such tests indicate compliance with the specifications.

A20.1.4 PUBLISHED TEST METHODS

The test methods listed in this section are contained in the standard test methods referred to in Clause A20.1.3.2. These include the following test methods:

A20.1.4.1 Testing of aggregates

SANS 3001-AG1

Civil Engineering test methods Part AG1: Particle size analysis of aggregates by sieving

SANS 3001-AG2

Civil Engineering test methods Part AG2: Determination of the average least dimension of aggregates by direct measurement **SANS**

3001-AG3

Civil Engineering test methods Part AG3: Determination of the average least dimension of aggregates by computation

SANS 3001-AG4

Civil Engineering test methods Part AG4: Determination of the flakiness index of coarse aggregate **SANS**

3001-AG5

Civil Engineering test methods Part AG5: Sand equivalent value of fine aggregates

SANS 3001-AG9

Civil Engineering test methods Part AG9: Determination of the Treton impact values for aggregates and gravels **SANS**

3001-AG10

Civil Engineering test methods Part AG10: ACV (aggregate crushing value) and 10 % FACT (fines aggregate crushing test) values of coarse aggregates

SANS 3001-AG11

Civil Engineering test methods Part AG11: Determination of the Polished Stone Value of Aggregates **SANS**

3001-AG12

Civil Engineering test methods Part AG12: Soundness of aggregates (magnesium sulfate method)

SANS 3001 AG13

Civil Engineering test methods Part AG13: Determination of the soundness of mudrock aggregates (Venter test)

SANS 3001-AG14 Civil Engineering test methods Part AG14: Determination of the ethylene glycol durability index for rock

SANS 3001 AG15

Civil Engineering test methods Part AG15: Determination of rock durability using 10 % FACT (fines aggregate crushing test) values after soaking in ethylene glycol

SANS 3001-AG16 Civil Engineering test methods Part AG16: Determination of the durability mill index for aggregates

SANS 3001-AG20

Civil Engineering test methods Part AG20: Determination of the bulk density, apparent density and water absorption of aggregate particles retained on the 5 mm sieve for road construction materials

SANS 3001-AG21

Civil Engineering test methods Part AG21: Determination of the bulk density, apparent density and water absorption of aggregate particles passing the 5 mm sieve for road construction materials

SANS 3001-AG22

Civil Engineering test methods Part AG22: Apparent density of crushed stone base

SANS 3001-AG23 Civil Engineering test methods Part AG23: Particle and relative densities of aggregate

SANS 195: 2006

Sampling of aggregates

SANS 197: 2006

Preparation of test samples of aggregates

SANS 202

Chloride content of aggregates

SANS 5831: 2006

Presence of chlorides in aggregates

SANS 5832: 2006

Organic impurities in fine aggregates

SANS 5833: 2006

Detection of sugar in fine aggregates

SANS 5834: 2006

Soluble deleterious impurities in fine aggregates (limit test)

SANS 5835

Estimation of the effect of fine aggregate on the water requirement of concrete

SANS 5837

Low density materials content of aggregates

SANS 5836

Effect of fine and coarse aggregate on the shrinkage and expansion of cement: aggregate mixes (mortar prism method)

SANS 5840

Shell content of fine aggregates

SANS 5843

Water absorption of aggregates

SANS 5844

Particle and relative densities of aggregates

SANS 5845

Bulk densities and voids content of aggregates

SANS 5846

Abrasion resistance of coarse aggregate (Los Angeles machine method)

SANS 5849

Total water-soluble salts content of fines in aggregates

SANS 5850-1

Sulfates content of fines in aggregates Part 1: Water soluble sulfates in fines in aggregates

SANS 5850-2

Sulfates content of fines in aggregates Part 2 Acid-soluble sulfates in fines in aggregates

SANS 5855

Free water content of aggregates

SANS 5856

Bulking of fine aggregates

SANS 6242

Acid insolubility of fine aggregate

ASAP

SANS 6243: 2008

Deleterious clay content of the fines in aggregate (methylene blue adsorption indicator test)

SANS 6245: 2006

Potential reactivity of aggregates with alkalis (accelerated mortar prism method)

AASHTO T-19

Standard method of test for bulk density and voids in aggregate

ASTM C142-97

Percentage clay lumps and friable particles

ASTM D3398

Standard Test Method for Index of Aggregate Particle Shape and Texture

BS 812

Tests on active filler

FNB 22-67 (2008)

Determination of Aggregate Finger Value and Aggregate Pliers Value: Published by Dr F Netterberg (Frank.Netterberg@gmail.com)

A20.1.4.2 Testing of cement, extenders and admixtures

SANS 50197

Testing of cement

SANS 50450

Testing of fly ash

SANS 53263

Testing of silica fume

SANS 55167

Testing of GGBS

SANS 50934 4-6

Testing of admixtures

SANS 1083

Testing of aggregates

A20.1.4.3 Testing of concrete

SANS 5861-1:2006 (SANS 3001-CO1-1)

Concrete tests — Mixing fresh concrete in the laboratory

SANS 3001-CO1-2

Concrete tests — Sampling of freshly mixed concrete

SANS 5862-1:2006 (SANS 3001-CO1-3)

Concrete tests — Consistence of freshly mixed concrete — Slump test

SANS 5862-3:2006 (SANS 3001-CO1-4)

Concrete tests — Consistence of freshly mixed concrete — Vebe test

SANS 3001-CO1-5

Concrete tests — Consistence of freshly mixed concrete — Compacting factor and compaction index

SANS 5862-2:2006 (SANS 3001-CO1-6)

Concrete tests — Consistence of freshly mixed concrete — Flow test

SANS 6250:2006 (SANS 3001-CO1-7)

Concrete tests — Density of compacted freshly mixed concrete

SANS 6252:2006 (SANS 3001-CO1-8)

Concrete tests — Air content of freshly mixed concrete — Pressure method

SANS 3001-CO1-9 (EN 12350-8)

Self-compacting concrete — Slump-flow test

SANS 3001-CO1-10 (EN 12350-9)

Self-compacting concrete — V-funnel test

SANS 3001-CO1-11 (EN 12350-10)

Self-compacting concrete — L box test

SANS 3001-CO1-12 (EN 12350-11)

Self-compacting concrete — Sieve segregation test

SANS 3001-CO1-13 (EN 12350-12)

Self-compacting concrete — J-ring test

SANS 5860:2006 (SANS 3001-CO2-1)

Concrete tests — Dimensions, tolerances and uses of cast test specimens

SANS 5861-3:2006 (SANS 3001-CO2-2)

Concrete tests — Making and curing of test specimens for strength tests

SANS 5863:2006 (SANS 3001-CO2-3)

Concrete tests — Compressive strength of hardened concrete

SANS 5864:2006 (SANS 3001-CO2-5)

Concrete tests — Flexural strength of hardened concrete

SANS 6253:2006 (SANS 3001-CO2-6)

Concrete tests — Tensile splitting strength of hardened concrete

SANS 6085:2006 (SANS 3001-CO2-7)

Concrete tests — Initial drying shrinkage and wetting expansion of concrete

ASAP

SANS 6251:2006 (SANS 3001-CO2-8)

Concrete tests — Density of hardened concrete

SANS 6255 (SANS 3001-CO2-9)

Mortar tests – Compressive strength of mortar

SANS 6254 (SANS 3001-CO2-10)

Mortar tests – Initial drying shrinkage and wetting expansion of mortar

SANS 3001-CO3-1

Concrete tests — DURABILITY INDEX Tests - Part 1: Preparation of test specimens

SANS 3001-CO3-2

Concrete tests — DURABILITY INDEX Tests - Part 2: Oxygen permeability test

SANS 3001-CO3-3

Concrete tests — DURABILITY INDEX Tests - Part 3: Chloride conductivity test

SANS 5865:2006 (SANS 3001-CO3-5)

Concrete tests - The drilling, preparation, and testing for compressive strength of cores taken from hardened concrete **ASTM**

C232

Determining the bleeding of fresh concrete

SANS 51008

Mixing water for concrete – Specification for sampling, testing and assessment for suitability of water, including water recovered from processes in the concrete industry, as mixing water in concrete.

AASHTO T 132

Determination of the tensile strength of hydraulic cement mortars

BS EN13391

Tests on structural concrete

A20.1.4.4

Testing soils, gravel and crushed stone for earthworks and pavement layers

SANS 3001-AG16

Civil Engineering test methods Part AG16: Determination of the durability mill index for aggregates **SANS 3001- GR1** Civil Engineering test methods Part GR1: Wet preparation and particle size analysis

ASAP

SANS 3001- GR2

Civil Engineering test methods Part GR2: Dry preparation and dry particle size analysis of gravels and sands **SANS**

3001 GR3

Civil Engineering test methods Part GR3: Particle size analysis of material smaller than 2 mm (hydrometer method)

SANS 3001 GR5

Civil Engineering test methods Part GR5: Wet preparation and air-drying of samples for plasticity index and hydrometer tests **SANS**

3001-GR10

Civil Engineering test methods Part GR10: Determination of the one-point liquid limit, plastic limit, plasticity index and linear shrinkage **SANS**

3001-GR11

Civil Engineering test methods Part GR11: Determination of the liquid limit with the two-point method **SANS**

3001-GR12

Civil Engineering test methods Part GR12: Determination of the flow curve liquid limit

SANS 3001-GR20

Civil Engineering test methods Part GR20: Determination of the moisture content by oven drying

SANS 3001-GR30

Civil Engineering test methods Part GR30: Determination of the maximum dry density and optimum moisture content **SANS**

3001-GR31

Civil Engineering test methods Part GR31: Determination of the maximum dry density and optimum moisture content of laboratory mixed cementitiously stabilized materials

SANS 3001-GR35

Civil Engineering test methods Part GR35: Determination of in-place dry density (sand replacement) **SANS**

3001-GR40

Civil Engineering test methods Part GR40: Determination of the California bearing ratio

SANS 3001

Civil Engineer
-GR41

ing test methods Part GR41: Determination of the California bearing ratio of lime treated materials

TMH 1: A21T

Determination of the Electrical Conductivity of a saturated soil paste and water

TMH 6

Draft TMH6-ST11: Determination of the in-situ density of material containing very large grains (Rondavel Method)

A20.1.4.5 Tests of bituminous stabilised materials

SANS 3001 BSM1

Civil Engineering test methods Part BSM1: Determination of foamed bitumen characteristics

SANS 3001 BSM2

Civil Engineering test methods Part BSM2: Preparation of bitumen stabilized samples for testing

SANS 3001 BSM3

Civil Engineering test methods Part BSM3: Vibratory hammer compaction of test specimens of bitumen stabilized material **SANS**

3001 BSM4

Civil Engineering test methods Part BSM4: Determination of indirect tensile strength of bitumen stabilized material

SANS 3001 BSM5

Civil Engineering test methods Part BSM5: Determination of the shear properties of bitumen stabilized material (triaxial test)

A20.1.4.6 Testing with nuclear gauges

SANS 3001 NG1

Civil Engineering test methods Part NG1: Administration, handling and maintenance of a nuclear density gauge

SANS 3001 NG2 Civil Engineering test methods Part NG2: The validation of standard calibration blocks

SANS 3001 NG3

Civil Engineering test methods Part NG3: Calibration of a nuclear density gauge

ASAP

SANS 3001 NG4

Civil Engineering test methods Part NG4: Verification of a nuclear density gauge

SANS 3001-NG5

Civil Engineering test methods Part NG5: Determination of in-situ density using a nuclear density gauge

A20.1.4.7 Testing of bituminous binders

SANS 4001-BT1

Civil Engineering test methods Part BT-1: Penetration grade bitumen

SANS 4001-BT2

Civil Engineering test methods Part BT2: Cutback bitumen

SANS 4001 BT3

Civil Engineering test methods Part BT3: Anionic road emulsion

SANS 4001 BT4

Civil Engineering test methods Part BT4: Cationic road emulsion

SANS 4001 BT5

Civil Engineering test methods Part BT5: Inverted road emulsion

SANS 4001-BT10

Civil Engineering test methods Part BT-10: Performance grade bitumen

AASHTO-102

N Heptane xylene (spot test)

SABITA TG1 –Series on modified binders

TWEESPRUIT ACCESS ROAD

SANS 3001

Civil Engineer

A20.1.4.8

Testing of asphalt

SANS 3001-AS1

Civil Engineering test methods Part AS1: Making of asphalt briquettes for Marshall tests and other specialized tests

-AS2 ing test methods Part AS2: Determination of Marshall stability, flow and quotient

SANS 3001-AS3

Civil Engineering test methods Part AS3: Gyratory compaction of asphalt briquettes

SANS 3001-AS4

Civil Engineering test methods Part AS4: Determination of indirect tensile strength of asphalt

SANS 3001-AS5

Civil Engineering test methods Part AS5: Determination of dynamic creep of bituminous mixtures **SANS**

3001-AS10

Civil Engineering test methods Part AS10: Determination of bulk density and void content of compacted asphalt

SANS 3001-AS11

Civil Engineering test methods Part AS11: Determination of the maximum void-less density of asphalt mixes and the quantity of binder absorbed by the aggregate

SANS 3001-AS20

Civil Engineering test methods Part AS20: Determination of the soluble binder content and particle size analysis of an asphalt mix **SANS**

3001-AS21

Civil Engineering test methods Part AS20: Determination of the bitumen content of an asphalt mix by ignition **SANS**

3001-AS22

Civil Engineering test methods Part AS22: Determination of binder content of mixtures used in bituminous slurry seals

SANS 3001-AS23

Civil Engineering test methods Part AS23: Determination of moisture in asphalt

SANS 3001-AS25

Recovery of binder from mixed asphalt

SANS 3001 PD1

Civil Engineering test methods Part PD1: MMLS3 testing of asphalt mixtures ASAP

BS 812

BS 812 1995 Part 2: Testing of aggregates: Methods of determination of density

EN 12697 :2004

EN 12697 :2004: Test methods for hot mix asphalt: Permeability of specimen

AASHTO T324

Hamburg wheel tracking test for permanent deformation

AASHTO T321

Four-point beam fatigue test

AASHTO TP79

Dynamic modulus/stiffness of asphalt

AASHTO T331

Corelok method for bulk relative density of asphalt

ASTM C142

Standard test method for clay lumps and friable particles in aggregates

ASTM D4867M

Durability - Modified Lottman test

Sabita Manual 35

SANS 3001

Civil Engineer

Design and Use of Asphalt in Road Pavements: Determining the binder film thickness in asphalt mixes **Sabita**

Manual 35

Design and Use of Asphalt in Road Pavements: Determining the Richness Modulus of EME asphalt mixes

A20.1.4.9 Testing of surface treatments

SANS 3001-BT10

Civil Engineering test methods Part BT10: Ball penetration test for the design of surfacing seals

-**BT11** ing test methods Part BT11: Texture depth measurement for the design of surfacing seals

SANS 3001-BT20

Civil Engineering test methods Part BT20: Certification of a binder distributor

SANS 3001-BT21

Civil Engineering test methods Part BT21: Validation of a binder distributor dipstick

SANS 3001-BT22

Civil Engineering test methods Part BT22: Power and road speed indicator tests for a binder distributor **SANS**

3001-BT23

Civil Engineering test methods Part BT23: Pump system performance of a binder distributor

SANS 3001-BT24

Civil Engineering test methods Part BT24: Measurement of transverse distribution ('Bucket test') for a binder distributor

A20.1.4.10 Testing related to chemical stabilisation

SANS 3001-GR50

Civil Engineering test methods Part GR50: Preparation, compaction and curing of specimens of laboratory mixed cementitiously stabilized materials

SANS 3001-GR51

Civil Engineering test methods Part GR51: Sampling, preparation, compaction and curing of field mixed freshly cementitiously stabilized materials including the determination of the maximum dry density and optimum moisture content

SANS 3001-GR52

Civil Engineering test methods Part GR52: Sampling and preparation of cored specimens of field compacted, matured, cementitiously stabilized material

SANS 3001-GR53

Civil Engineering test methods Part GR53: Determination of the unconfined compressive strength of compacted and cured specimens of cementitiously stabilized materials

SANS 3001-GR54

ASAP

Civil Engineering test methods Part GR54: Determination of the indirect tensile strength of compacted and cured specimens of cementitiously stabilized materials **SANS 3001-GR55**

Civil Engineering test methods Part GR55: Determination of the wet-dry durability of compacted and cured specimens of cementitiously stabilized materials by hand brushing

SANS 3001-GR56

Civil Engineering test methods Part GR56: Determination of the wet-dry durability of compacted and cured specimens of cementitiously stabilized materials by mechanical brushing

SANS 3001 GR57

Civil Engineering test methods Part GR57: Determining the initial stabilizer consumption of soils and gravels

SANS 3001 GR58

Civil Engineering test methods Part GR58: Determination of the cement or lime content of stabilized materials by means of back-titration (acid base) method

A20.1.4.11 Testing of pavements

SANS 3001-BT12

Civil Engineering test methods Part BT12: Determination of the in-situ permeability of a bituminous surfacing (Marvil test) **ASTM**

E 1705-95 (2005)

Test method for measuring rut depth of pavement surfaces using a straightedge **TMH**

SANS 3001

Civil Engineer

Draft TMH6 1984: ST 3: Rolling straight edge for measuring surface irregularities **TMH**

6

Draft TMH6 1984: ST 6: Measurement of the in-situ strength of soils by the Dynamic Cone Penetrometer (DCP)

TMH 9

Visual assessment of pavements

SANS 3001

Civil Engineer

TMH 13

TMH13: Automated road condition assessments: Macro-texture, roughness, rutting and deflection testing subject to the provisions of Clause A20.1.5.5

A20.1.4.12 Testing of structural elements

BS 5400 Part 9.2

Tests on elastomeric bearings

A20.1.4.13 Testing geosynthetics and geotextiles

SANS 1525

Geosynthetics – Wide- width Tensile test

SANS 9862

Geosynthetics – Sampling and preparation of test specimens

SANS 9863-1

Geosynthetics –Determination of thickness at specified pressures Part 1: Single layers

SANS 9864

Geosynthetics –Test method for the determination of mass per unit area of geotextile-related products **SANS 10318**

Testing geo-synthetics and geo-textiles

SANS 12224

Geotextiles and geotextile-related products – Determination of the resistance to weathering **SANS 12236**

Geosynthetics – Static Puncture test (CBR test)

SANS 13431

Geotextiles and geotextile-related products – Determination of tensile creep and creep rupture behaviour

SANS 13433

ASAP

Geotextiles and Geotextile-related products – Dynamic Perforation Test (Drop Cone test)

ASTM D 4533

Standard Test Method for Trapezoid Tearing Strength of Geotextiles (commonly referred to as Trapezoidal Tear Strength) **ASTM D 4632 S**

Standard Test Method for Grab Breaking Load and Elongation of Geotextiles (commonly referred to as Grab Strength) **ASTM D 4355**

Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus **a) Hydraulic Properties**

SANS 11058

Geotextiles and geotextile-related products – Determination of water permeability characteristics normal to plane, without load **SANS 12956**

Geotextiles and geotextile-related products – Determination of the characteristic opening size **SANS 12958**

Geotextiles and geotextile-related products – Determination of water flow capacity in their plane **b) Testing of soil compatibility**

ASTM D 5101

Standard Test Method for Measuring the Filtration Compatibility of Soil-geotextile Systems (Gradient Ratio Test)

c) Testing of paving fabrics in road maintenance applications

ASTM D 6140

Standard Test Method for Determining the Asphalt Retention of Paving Fabrics used in Asphalt Paving for Full-width Applications **d) Testing for site adjudication and acceptance**

ASTM D 4759

Standard Practice for Determining the Specification Conformance of Geo-synthetics -

TWEESPRUIT ACCESS ROAD

ASTM D 4873

Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples

A20.1.5.3 Testing Bitumen and Asphalt**a) Tests described in the standard specifications for bitumen and bituminous emulsions**

The Engineer shall be entitled to order the Contractor to have materials tested by an approved laboratory for compliance with all or any of the requirements specified. The Contractor shall arrange with the testing laboratory for the original results of such tests to be submitted directly to the Engineer with copies to himself as required.

The payment of such tests, on condition that the products comply with the requirements, shall be as specified in Section

C20.1. b) Cantabro abrasion test

If required, the resistance of porous asphalt briquettes to abrasion loss shall be determined by means of the Cantabro test described below. This test method entails a combination of published test methods. The abrasion loss value for freshly compacted specimens shall not exceed the values specified in Chapter 9.

(i) Apparatus

The apparatus shall be a Los Angeles Testing Machine as described in ASTM Method C131 or SANS 5846.

The machine shall consist of a hollow steel cylinder, closed at both ends, having an inside diameter of 710 mm ± 5,0 mm and an inside length of 510 mm ± 5,0 mm.

The cylinder shall be mounted with stub shafts, attached to the end of the cylinder but not ending it and shall be mounted in such a manner that it may be rotated with the axis in a horizontal position with a tolerance in slope of 1 in 100.

An opening in the cylinder shall be provided for introduction of the test sample.

A suitable, dust-tight cover shall be provided for the opening with means for bolting the cover in place.

The cover shall be designed to maintain the cylindrical contour of the interior surface unless the shelf is so located that the charge and/or test sample will not fall on the cover or come in contact with it during the test.

A removable steel shelf extending the full length of the cylinder and projecting 92 mm ± 2,0 mm inward shall be mounted on the interior cylindrical surface of the cylinder, in such a way that a plane centred between the large faces coincides with an axial plane.

The shelf shall be 25 mm ± 1,0 mm thick and mounted by bolts or other suitable means so that it is firm and rigid.

The position of the shelf shall be such that the distance from the shelf to the opening measured along the outside circumference of the cylinder in the direction of rotation, shall not be less than 1 270 mm.

The machine shall be driven and counterbalanced to maintain uniform peripheral speed of 30 – 33 rpm for 300 revolutions.

If an angle is used as the shelf, the direction of rotation shall be such that the charge is caught on the outside surface of the angle.

(ii) Test Procedure

Marshall specimens shall be prepared as described in SANS 3001-BT1, but for this test each Marshall specimen shall be compacted with 50 blows only on each side. For each binder content, three specimens shall be made for the abrasion test.

ASAP

The compaction temperature depends on the type of binder to be used. For 50/70 penetration-grade bitumen) it shall be 115°C to 120°C and for bitumen-rubber (wet method) it shall be 135°C to 140°C, measured in the mould just prior to compaction.

The thickness of the test specimen shall be 63,5 mm ± 1,25 mm.

The mass of the specimen in air (P1) to the nearest 0,1 g and the average thickness to the nearest 0,1 mm, shall be determined.

The test specimen shall be placed in the Los Angeles apparatus without the abrasive charge of steel balls and the cover shall be fitted.

The machine shall be switched on and allowed to operate for 300 revolutions at a speed between 30 – 33 rpm.

After the required number of revolutions, the machine shall be stopped, and the specimen removed, and the mass determined (P2) to the nearest 0,1 g.

The test shall be carried out for each binder content in triplicate.

(iii) Calculations

The percentage abrasion loss for each specimen shall be calculated as follows:

$$P = 100 \times (P1 - P2) / P1$$

Where:

P1 = mass of specimen before testing.

P2 = mass of specimen after testing.

Note: The means of the three specimens shall be determined at each binder content.

(iv) Notes:

The determination of the optimum binder content is based on the following factors:

1. A minimum binder content limit to ensure resistance against aggregate loss due to traffic and to enhance durability.
2. A maximum binder content limit to avoid binder run-off and to ensure good drainage in the mix as a layer on the road.

c) Air Permeability Test

Determination of the air permeability of compacted Marshall specimens or cores.

(i) Scope

The measurement of air permeability is non-destructive and may be performed on laboratory-compacted Marshall specimens or cores removed from a pavement.

(ii) Apparatus

Model AP-400 A, Asphalt Paving Meter, is a self-contained device capable of measuring air flow rates of up to 5,0 l per minute at low pressure differentials. The device has a maximum volume capacity of 1,0 l. It is equipped with two calibrated sight tubes; one measures in 25 ml increments for dense specimens, and the other is graduated in 500 ml increments for open, permeable specimens.

Incorporated in the unit are the valves required to perform the test: a pressure squeeze bulb for filling the test system with water; a sensitive manometer for pressure setting; a metal cylindrical jacket slightly larger than the 101,6 mm diameter Marshall specimen and containing a 101,6 mm diameter rubber triaxial sleeve as an inner liner; a domed test cap; and a specimen support.

(iii) Test Procedure

1. Remove either stem valve by screwing counter-clockwise and lifting out of the case. Set the main control valve at 'exhaust' or 'test'. Fill the unit with 2 000 ml of water through the recess left by the stem valve.
2. Replace the stem valve in its mounting.
3. Fill one of the two calibrated volumetric cylinders in the following manner: NOTE: 1 000 ml cylinder is used for open specimens. 300 ml cylinder is used for dense specimens. (a) Push the main control valve to the 'off' position. (b) Open the stem valve above the selected cylinder by turning counter-clockwise. One revolution is adequate. Check to make certain that the volumetric cylinder stem valve not being used is closed tightly. The air flow valve on top of the rubber bulb assembly should be open (unscrewed about two turns). (c) Squeeze the rubber bulb, pumping air into the reservoir. The pressure will force water from the reservoir into the measuring cylinder, as can be seen by the rising water-level in the sight tube. Continue pumping until the sight tube is filled to within approximately 25 mm of the top. Close the stem valve connected to this tube. (d) Turn the main valve to the 'exhaust' position to allow excess air pressure to escape from the reservoir.

Connect the rubber tube of the specimen test cap to the pressure port located in the lower left corner of the instrument. Connect the second tube of the specimen test cap to the manometer port located at the top left of the manometer. (The rubber tubes of the test cap are interchangeable and may be connected to either the pressure port or the manometer port.)

4. Level the instrument by observing the level bubble and adjust the instrument on the swivel tripod.
5. Set the manometer at the 'zero' reading by loosening the screw at the bottom of the manometer and sliding the scale until the 'zero' reading coincides with the level of the manometer fluid in the nearly horizontal tube of the manometer. Be sure that ^{ASAP} the manometer valves are in an open position while zeroing the manometer and during a test.
6. The Marshall specimen is placed on the support and the metal cylinder, with the rubber triaxial sleeve in place, is slipped over both. The domed test cap with rubber tubes attached is then placed over the top of the specimen and the rubber -sleeve inflated with the hand bulb to seal the cap, specimen and support. If the vertical face of the specimen is rough, it may be sealed with paraffin wax prior to placing in cylinder.
7. The instrument is now ready to perform the test: the main valve is set at 'exhaust', the measuring cylinder is full, both manometer valves are open, the manometer is reading 'zero' and the test cap is sealed to the specimen.
8. Proceed as follows:
 - Push the main control valve to the 'test' position. Close the airflow valve at the top of rubber assembly.
 - Open the stem valve of the filled volumetric cylinder slowly, allowing water to flow from the cylinder back to the reservoir. Adjust the stem valve so that a constant pressure is developed and recorded by the manometer. Normally, tests are run at 6,4 mm of water pressure. The pressure is held constant throughout the test by minor adjustments to the stem valve.
 - Once constant pressure has been attained, the time required for water to flow between two of the calibration marks on the sight tube is measured accurately. A volume of flow sufficiently large to require a time interval of at least 20 seconds should be selected to obtain accurately repeatable results. Time intervals exceeding 2 minutes do not add to the accuracy of the test and only prolong the testing time.
9. A minimum of three Marshall specimens should be tested at each binder content and the mean rate of air flow through the specimens taken.
10. Calculation

The air permeability is then calculated using the following formula:

$$QL$$

$K = 2,331 \times 10^{-9} \frac{h}{L}$ Where:

TWEESPRUIT ACCESS ROAD

K = fundamental permeability (cm^2)

Q = rate of air flow through specimen (cm^3/s) L = average height of specimen (cm) h = air pressure difference expressed in height of water column (cm)

It should be noted that the above formula applies only to a 101,6 mm diameter cylindrical specimen.

A20.1.5.4 Testing relating to chemical stabilisation

a) Test for cementitious-binder content

Where the Contract Documentation requires the determination of the cementitious-binder content due allowance shall be made for the presence in the unstabilised material of naturally occurring MgO or CaO (e.g. basalts, calcrete, etc., as well as previously stabilised layers, which affects the result 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 randomly spaced transversely as well as longitudinally over the area to be tested or as directed by the Engineer and if the material is road-mixed, separate samples shall be taken from the top and bottom of each hole.

b) Test to determine bulk spread rate of powdered chemical stabilising agents using the canvas patch test

The following method shall be used for determining the bulk spread rate of a chemical stabilising agent where bulk distributors are used.

Clean canvas patches, each measuring 1,0 m x 1,0 m, shall be placed flat on the road in selected positions in relation to the bulk distributor's track. The number of patches shall be proportional to the length of powdered stabilising agent spread, varying from 10 patches for sections of at least 400 m, 6 patches for sections from 100 m to 400 m and 3 patches for sections under 100 m.

After the stabilising agent has been spread by the bulk distributor, the canvas patches shall be carefully lifted and all the material on the patches transferred to a container and weighed. The total mass of stabilising agent on each patch is then recorded and the average rate of application determined. Instead of canvas patches, flat metal trays may be used for collecting the stabilising agent.

c) Test for mix uniformity in chemically stabilised layers

Where required by the Engineer, the Contractor shall determine the mix uniformity of chemically stabilised layers by means of indirect tensile strength tests, using SANS 3001-GR54

The Contractor shall timeously make the necessary arrangement to take samples in accordance with the requirements of the method used.

A20.1.5.5 Tests on pavements

a) General

The testing of macro-texture, roughness, rutting and deflection by specialised equipment in terms of TMH13: Automated Road Condition Assessments (various parts), shall be subject to the provisions herein.

b) Surface macro texture: Instrument assessment

The surface macro-texture shall be measured following draft TMH 13 – Part E using non-contact laser spot sensors with a minimum resolution of 64KHz capable of meeting the output requirements for Mean Profile Depth (MPD) specified in ISO 13473-1 calculated and recorded at 10 m intervals. The position of the measurements shall be as specified and demarcated by the Engineer which normally includes one or both wheel paths and in-between wheel paths for segment lengths of 1,0 km or as otherwise specified in the ^{ASAP} Contract Documentation.

The operation and quality checks of the equipment shall be undertaken by an Independent ISO 9001-2015 certified service providers in accordance with the manufacturer's and draft TMH 13 requirements.

A validation of the equipment components shall be conducted and analysed for conformance by the Employer or his experienced and approved agent following the draft TMH 13 validation protocols. Such validation shall not be older than six months or as otherwise specified in the Contract Documentation. The Engineer, however may also conduct validation checks on site following the validation protocols on surfaces with texturing similar to that to be measured.

c) Road Roughness Measurements

(i) Direct Contact Roughness Measuring Devices

Direct contact Roughness devices, also known as static devices, which are class 1 for vertical sampling intervals and class 3 longitudinal sampling interval profiling devices taking direct roughness measurements using precision inclinometers on the road surface, with built-in data capturing systems and outputs in International Roughness Index (IRI) reported in m/km or which can be processed into IRI outputs using public domain "Road Ruf" or "Proval" software. Longitudinal sampling intervals of 250 mm, or less, are typically used. These devices must be operated by experience staff and are used for benchmarking of IRI-values on selected road sections for Validation and Calibration purposes of other high-speed roughness measuring devices. These devices shall meet the standards and data output criteria, in IRI (m/km), specified in draft TMH 13 - Part C. These devices can also be used for the measuring of IRI (m/km) of shorter lengths of roadway, averaged for 100 m lengths, in both wheel paths separately of all traffic lanes and shoulders in excess of 2,0 m widths following the manufacture's operation manual and the requirements of TMH 13 – Part C. Using these devices, unless otherwise specified in the Contract Documentation, only one single pass of measurement is normally sufficient. For judgement purposes, the Average IRI per 100 m for a traffic lane or shoulder is calculated as follows:

Average IRI 100 m = $(100 \text{ m IRI left wheel path} + 100 \text{ IRI right wheel path})/2$ for single passes with the equipment.

(ii) High Speed Inertial Non-Contact Laser Profilometers

All the equipment elements are attached to a motor vehicle which measures roughness at high speeds (between 30 and 100 kms/h). The accuracy and data output of profilometers shall comply with draft TMH 13 – Part C with a class 1 vertical resolution of equal to or less than 0,1 mm and a class 1 longitudinal sampling interval of less than or equal to 25 mm as defined in ASTM E95009.

The roughness output, in International Roughness Index (IRI) in m/km is characterised by a fixed and specific computer algorithm for both wheel paths separately recorded and stored at 10 m intervals and averaged for each 100 m. The processing of the data in each wheel path shall be in accordance with ASTM E1170-97 and the World Bank Technical Paper 46.

These profilometers are calibrated by the manufacturer and shall be validated regularly on road sections specifically selected for this purpose against known IRI reference values established by class 1 direct contact profiling devices conforming to the requirements of TMH 13 – Part C. The validation shall be conducted and analysed for conformance by the Employer or his experienced and approved agent following the draft TMH 13 – Part C procedures and protocols. Such validation certificate shall not be older than six months or as otherwise specified in the Contract Documentation.

The operation of the device shall be conducted by trained and experienced staff of an Independent ISO 9001 - 2015 certified service provider following ASTM E950-09(or latest version) test procedures together with strict daily quality measures and check lists. The roughness measurements for each wheel path shall be taken simultaneously, with the lasers, at a spacing of 1,75 m apart for all traffic lanes and shoulders in excess of 2,0 m in width, as determined according to the final line markings, following the Manufacturer's operational manual and the procedures of draft TMH13 - Part C. The lengths for testing with high speed inertial non-contract profilometers shall be 1,0 km or multiples thereof, unless otherwise specified in the Contract Documentation.

Three repeat runs for each measured traffic lane or shoulder, unless otherwise specified in the Contract Documentation, shall be conducted and the measurements of the left and right wheel paths per 100 m IRI-values of the runs shall be averaged to produce an Average IRI for each 100 m. The Average IRI for the 100 m traffic lane or shoulder is calculated as follows:

Run 1 IRI 100 m average = (100 m IRI left wheel path + 100 m IRI right wheel path)/2

Run 2 IRI 100 m average = (100 m IRI left wheel path + 100 m IRI right wheel path)/2

Run 3 IRI 100 m average = (100 m IRI left wheel path + 100 m IRI right wheel path)/2

Average IRI 100 m = (Run 1 IRI 100 m average + Run 2 IRI 100 m average + Run 3 IRI 100 m average)/3 d)

Rutting Measurements

(i) High speed profilers

These profilers are high speed (80 km/h) instrumented vehicles using non-contact laser sensors to measure the transverse profile of the road surface meeting the requirements of ASTM E950-09 referred to in draft TMH13 Part D. To meet the accuracy requirements, the number of lasers shall be between 15 and 25 with the spacing configuration and focus of the sensors optimised to locate the low and high profiles in both wheel paths separately covering a measuring width of at least 3,2 m. At least one inertial motion sensor (IMS) shall also be fitted rendering the data collected suitable for the calculation of other rutting parameters such as rut area, ponding area cross fall and gradient.

The average rut depth in mm is characterised by a fixed mathematical algorithm and shall be recorded and stored at 10 m intervals, averaged and reported for each wheel path at 100 m intervals. In addition, the maximum rut measured within the reported 100 m average for each wheel path shall also be reported. The operation and quality checks of the equipment shall be undertaken by experienced staff of an independent ISO 9001-2015 certified service provider in accordance with the manufacture's and draft TMH 13 – Part D requirements. A validation of the equipment components and systems shall be conducted following the TMH13 protocols and analysed for conformance by the Employer or his experienced and approved agent following draft TMH13 – Part D validation protocols. Such validation certificate shall not be older than six months or as otherwise specified in the Contract Documentation.

e) Deflection measurements using the Falling Weight Deflectometer (FWD)

(i) The FWD system for the measurements of deflections is based on a dynamic impulse load on a rubber buffer that transmits the force to a standard sized load plate with geophones (velocity transducers) attached to a bar to capture the deflection bowl of the pavement structure. A target load of 40 KN, as well as a 50KN, or as otherwise specified in the Contract Documentation, is normally applied for 20 – 30 milliseconds.

(ii) The primary equipment elements consist of the following:

- An appropriate vehicle or a vehicle and trailer combination
- A FWD device with a 300 mm diameter split or segmented base plate with a 5 mm patterned rubber pad
- A sensor bar with geophone sensors pointing in the direction of travel
- Appropriate weights to apply loads of 10 – 120 KN fitted on to adjustable height stops
- Appropriate thermometers for the measurements of air and road surface temperature – and / or pavement temperatures, when specified in the Contract Documentation.
- A calibrated distance measuring instrument fitted to the vehicle
- A real time differentially corrected Global Positioning System (GPS) linked to the data fitted directly above the load plate - A computer and operating system
- Software with real time displays for quality checks during the testing operations
- Drill and bits for at depth pavement temperatures measurements, if required
- An auxiliary power source for the operation of hydraulic / electrical equipment
- Aerosol paint for spot markings of test points
- Safety signs and flashing amber lights

The minimum requirements of the measuring components and data acquisition system are specified in draft TMH 13 – Part F.

(iii) The minimum number of geophone sensors shall be nine or eleven spaced at offsets as outlined in Table A20.1.5-1 for basic deflection bowl parameters i.e.:

- Maximum deflections (Y_{max}) : D0
- Base layer index (BLI) : D0 – D300
- Middle layer Index (MLI) : D300 – D600
- Lower layer Index (LLI) : D600 – D900

Note: D denotes the offset from the centre of the load plate.

Table A20.1.5-1: Sensor offsets from the centre of the base plate, for nine or eleven configurations shall be as follows

SENSOR NO	OFFSETS IN MILLIMETRES	
	NINE SENSOR CONFIGURATION	ELEVEN SENSOR CONFIGURATION
1	0	0
2	200	200
3	300	300
4	450	400
5	600	500
6	900	600
7	1 200	750
8	1 500	900
9	1 800	1 200
10	-	1 500
11	-	1 800

(iv) Deflection measurements, in microns, are taken at test positions specified in the Contract Documentation, or the Engineer, following the manufacturer's procedures, regular quality control checks and operator validations/ operating procedures.

The weight shall be dropped four times at each test point as follows:

Drop 1: At 40KN load, for seating purposes and not reported

Drop 2 & 3: At 40KN load and the deflections are reported individually for each drop

Drop 4: At 50KN load and the deflections reported separately

The deflections for each sensor are normalised for allowable small variation from the target loads, recorded for each drop separately and reported for each test position. The air and road temperatures together with the date and time shall also be recorded and reported together with the location details of each test point. All the deflection measurements shall be undertaken by trained and experienced staff of an Independent and ISO 9001 – 2015 certified service provider.

(v) In the absence of formalised calibration trials for FWD equipment, as compiled by CROW and referred to in Draft TMH13, and for uniformity of calibrations, the protocols by SHRP and accepted by AASHTO designation: R32-11, shall be followed, the "reference" calibration of the load cell and sensors as well as the "relative" calibration of sensors (inter-sensor correlation) shall be conducted annually by an independent AASHTO-certified calibrating person. The operator shall in addition to the above independent calibrations also conduct at least monthly "operators" verification / reference Calibrations for temperature probes, distance measuring instruments, position of sensors and inter-sensors correlation (relative calibration). All the calibration and verification certificates and documentation shall be made available to the Engineer and /or Employer.

(vi) For testing on trafficked roads, appropriate traffic accommodation shall be provided by the service provider or the Employer as specified in the Contract Documentation.

A20.1.5.7 Determining the effect of sand on the water demand of a concrete mix a) Definition

Water demand is defined as the quantity of water per cubic metre of concrete required to achieve a slump of 75 mm in a concrete with an optimum quantity of stone with a nominal size of 20 mm.

b) Materials

The following materials are required:

- Ordinary Portland cement
- Crushed stone with a nominal size of 20 mm
- Sand or a sand mix to be tested.

c) Method

(i) Determine the relative density (R_{sa}) in accordance with SABS method 844 and the fineness modules (FM) of the sand or sand mix.

(ii) Determine the compacted bulk density (CBD) of the 20 mm aggregate in accordance with SABS method 845. Also determine the relative density of the stone (R_{st})

(iii) Determine the required quantity of stone (S) per cubic metre of mix in kg/m^3 in accordance with formula:

$$S = CBD (0.975 - 0.1FM)$$

(iv) Estimate the water demand (W) of the mix in l/m^3 . As a starting point 220 l/m^3 may be used.

- (v) Determine the required cement content (C) for the mix in kg/m^3 by using the water content (W) as obtained from (iv) and a water:

cement ratio of 0.59.

- (vi) Determine the required sand content (SC) of the mix in kg/m^3 in accordance with the formula:

$$SC = 1 - (C/3140 + W/1000 + S/Rst)$$

- (vii) Decide on the mix size which will apply to the available equipment and calculate the mix quantities in relation to the calculated quantities per cubic metre. Do not produce a mix of less than 10 ℓ .

- (viii) Prepare the mix and determine the slump in accordance with SABS method 862. Where the slump does not amount to 75 mm, repeat the test with adjusted quantities of cement, water and sand. A good rule to remember is that a change of 10 ℓ/m^3 in the water content either halves or doubles the slump.

- (ix) The water content giving a slump of 75 mm will then be the water demand for the mix.

- (x) In view of obtaining repeatable results, the following parameters shall be kept constant in so far as is possible:

- Material temperature
- Mixing time
- Source of cement
- Source of stone

A20.1.7.2 Taking samples

a) Stratified random sampling

When any lot is tested, whether a normal sized lot or an isolated section that clearly exhibits an abnormal variation of the property under consideration, all samples shall be taken in a stratified random pattern. For this purpose, use shall be made of fractional tables generated by recognised random number systems. Refer to examples in TMH5.

b) Minimum samples per lot

For purposes of acceptance control and in the absence of it being specified in the Contract Documentation the Engineer shall, in advance, determine sample size "n". The larger the sample, the more reliable the analysis will be, and no sample sizes shall be smaller than those given in Tables A20.1.7-9 and A20.1.7-10.

A20.1.7.6 Conditional acceptance

a) General provisions

Where a lot is rejected under judgement plan A or Judgement Plan B 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:

- (i) conditional acceptance shall be in the sole discretion of the Engineer and is not an option that may be exercised by the Contractor or a right the Contractor may claim;
- (ii) the lot is approved in respect of all other requirements including those not judged by a statistical judgment plan;
- (iii) the Contractor shall have the option to remove and reinstate at his own cost conditionally acceptance work with work which complies with the requirements for acceptance at full payment;
- (iv) conditional acceptance and the corresponding reduced payment shall apply only in respect of the work and properties listed in Clause A20.1.7.6b) below.
- (v) none of the obligations of the parties shall change as defined in the Contract Documentation.

b) Properties to which conditional acceptance applies

Conditional acceptance may be applied in respect of the properties listed below in Table A20.1.7-12

Table A20.1.7-12: Properties in respect of which conditional acceptance may be applied

Property	Structure
Relative compaction	i) Asphalt base or surfacing ii) Chemically stabilised layers iii) Plant mixed paver laid layers iv) BSM layers
Bituminous binder content	Asphalt base or surfacing
Voids in mix	Asphalt base or surfacing
28-day compressive Strength	All strength concrete. (concrete pavements not included. See note 1)
Concrete cover	All reinforced and pre-stressed concrete

Oxygen Permeability Chloride Conductivity Water Sorptivity	All durability properties (Class D) concrete

Note 1:

See Clause A6.1.8 of Chapter 6 for details regarding reduced payment in the case of inadequate concrete strength or layer thickness in concrete pavements.

(i) Criteria for conditional acceptance for Judgement Plan A

Any lot that does not comply with the requirements for acceptance, in accordance with judgement plan A may be conditionally accepted should the value of the sample mean $\bar{x}_n$ lie within the rejection limits given in Table A20.1.7-14.

The payment reduction factors shall be calculated in accordance with Table A20.1.7-13.

Table A20.1.7-13: Fixed payment reduction factors for concrete

Property	Payment reduction
Concrete Cover	70 %
Oxygen Permeability	80 %
Chloride Conductivity	80 %
Water Sorptivity	80 %

ASAP

The percentage reduced payment shall be applied to the complete specific concrete member represented by the lot and shall apply to all the relevant pay items of the applicable Chapters in terms of concrete durability and cover.

(ii) Criteria for conditional acceptance for Judgement Plan B

Any lot that does not comply with the requirements for acceptance, judgement plan B may be conditionally accepted should the value of the sample mean $\bar{x}_n$ lie within the rejection limits given in Table A20.1.7-14.

The variable payment reduction factor (f_r) shall be calculated in accordance with the following formula:

For conditional acceptance at a lower limit

$$f_r = 0,67 + 0,3 (\bar{x}_n - L_r) / (L_a - L_r)$$

For conditional acceptance at an upper limit

$$f_r = 0,67 + 0,3 (L'_r - \bar{x}_n) / (L'_r - L'_a)$$

See Clause A20.1.2 for the meaning of the symbols.

(iii) Applying the payment-reduction factor

The payment-reduction factor, either fixed or variable type, shall be applied to all payment items related to the assessed products.

Table A20.1.7-14: Rejection limits (L_r en L'_r) for sample mean ($\bar{x}_n$)

Property	Structure	Rejection limits (L_r and L'_r)
Relative compaction	Chemically stabilised layers	$L_r = (L_a - 1,500) \% \text{ of relative compaction}$
	Asphalt base or surfacing	$L_r = (L_a - 1,000) \% \text{ of relative compaction}$ $L'_r = (L'_a + 0,500) \% \text{ of relative compaction}$
	Bituminous stabilised materials	$L_r = (L_a - 1,500) \% \text{ of relative compaction}$

Concrete compressive strength	All strength concrete (excluding that in pavement)* ¹	$L_r = 0,9 L_a$
Concrete Cover	All reinforced and pre-stressed concrete	$L_r = (\text{specified cover} - 7 \text{ mm})$
Concrete Durability	Oxygen Permeability (OPI)	$L_r = (\text{Specified OPI} - 0,40)$
	Chloride Conductivity (CC)	$L'_r = (\text{Specified chloride conductivity} + 0,40)$
	Water sorptivity (WS)	$L'_r = (\text{Specified water sorptivity} + 2,50)$
Bituminous binder content (%)	Asphalt	$L_r = (L_a - 0,200) \% \text{ binder}$ $L'_r = (L'_a + 0,200) \% \text{ binder}$
Voids in mix (%)	Asphalt	$L_r = (L_a - 0,300) \% \text{ voids}$ $L'_r = (L'_a + 0,300) \% \text{ voids}$

ASAP

Where payment items are introduced into the Contract Documentation or are changed in the schedule of quantities, the payment reduction factor shall apply to the payment items corresponding to the relevant payment items.

Where a lot is conditionally accepted in regard to more than one property, the payment-reduction factor for each property shall be computed and the factor that gives the largest reduction shall be applied.

*¹ In the case of concrete pavement, the provisions of Clause A6.1.8 of Chapter 6 shall apply.

SITE INFORMATION

1. INTRODUCTION

1.1 TERMS OF REFERENCE

Motheo Region was requested to carry out the assessment, preliminary- and detail designs as well as contract administration for the special maintenance of road S604: Tweespruit Access Road. This project will address the following basic needs of the community:

TWEESPRUIT ACCESS ROAD

- Enhanced accessibility and mobility in a cost-effective manner
- Road user- and pedestrian safety
- Small Contractor Development
- Job Creation and skills development
- Stimulation of the Local Economy

1.2 LOCATION

S604 is situated in Tweespruit, under Thaba Nchu District, Motheo Region. It falls under Mangaung Metropolitan Municipality in the Southern Free State. The road connects N8 East to the Tweespruit local road networks, with the Unicom Agricultural College and the Tweespruit catholic church placed next to it. The major public transport routes in the vicinity are the R709 from Hobhouse to Excelsior and the N8 from Bloemfontein to Ladybrand and Lesotho.

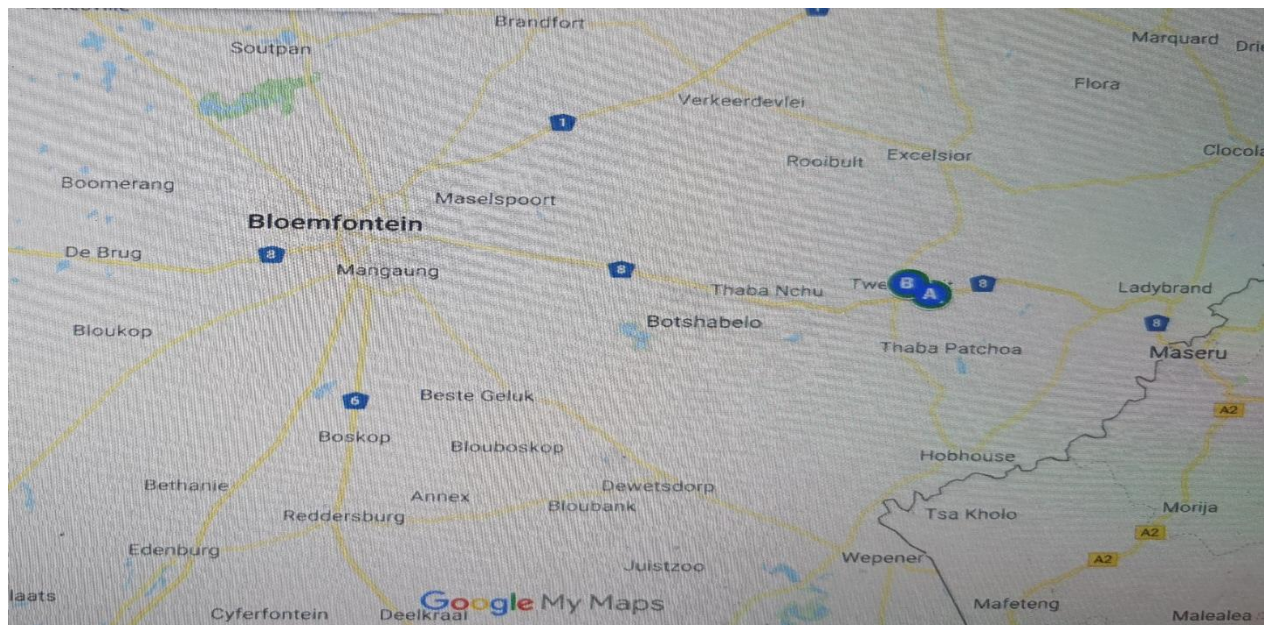


Figure 1a: Road Location from Bloemfontein

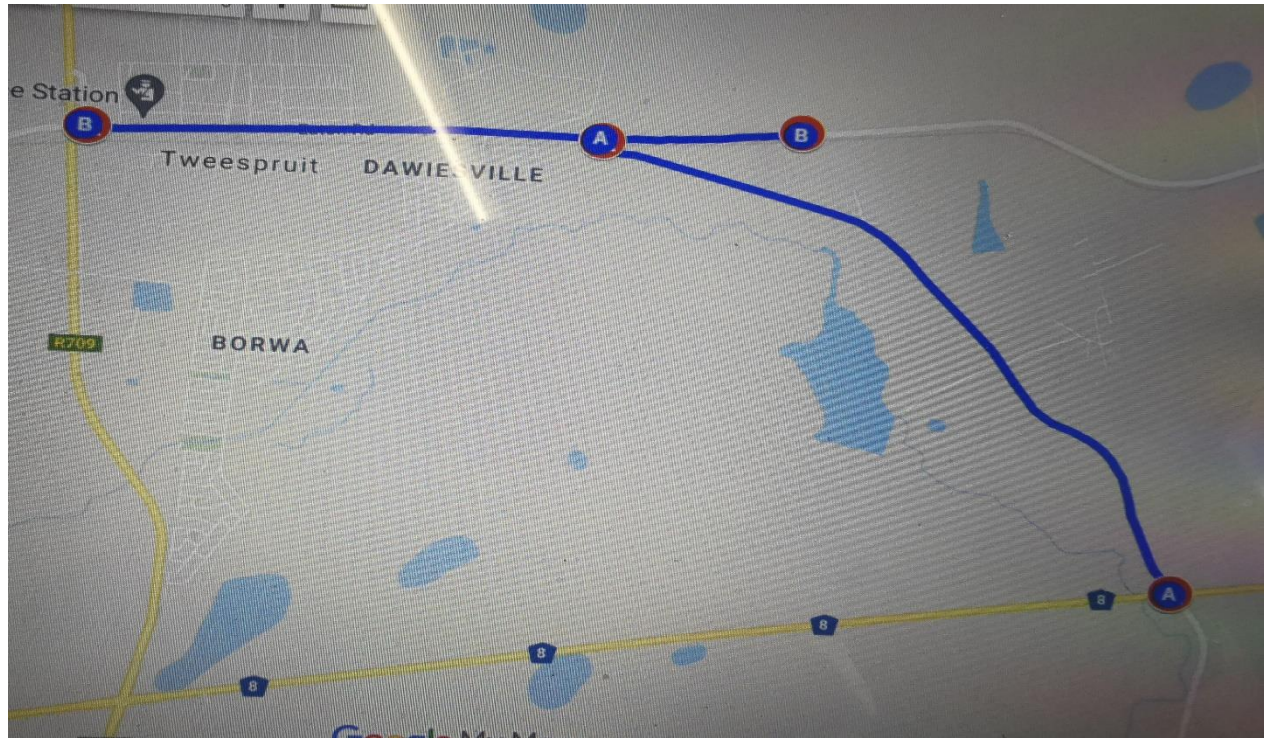


Figure 1b: Road Location in Tweespruit

1.3 CURRENT ROAD CONDITIONS

The road has largely deteriorated asphalt surfacing with a total length target of 4.8km consisting of 7.4m width. With the high rainfall in the area, the riding quality of the road have been a constant problem, also keeping in mind the limited maintenance performed on these dirt roads due to budget constraints. The road was assessed using the TMH9 assessment tools and principles, and these were some of the findings:

1.4 PROJECT STAKEHOLDERS

The following interested and affected parties to be conferred with during the initial stages of the project:

- Community leaders must be consulted and be kept informed about the project development and progress. They must be allowed to play their role in appointment of EPWP Local labourers.
- The planning and designs to be done on close collaboration with the Road Planning Directorate of the Department.
- The Department Facilitation Office must be consulted and given the space to play their part.
- The agricultural community and landowners to be consulted during land survey- as well as land acquisition processes.

2. ROAD ASSESSMENT: PHYSIOGRAPHY

2.1 Visual Assessment

Table 1: Visual Road Assessment



Figure 2: Vegetation: Road Reserve

2.2 Geotechnical Investigation

Geotechnical investigation was conducted for an existing pavement layers by the Department's Laboratory Unit. The Laboratory results are as attached on table 2:

Table 2: Laboratory Results, Appendix A Attached

District	MOTHEO
Roadnumber	S 604
Date	12.07.2017
Kilometre	400M

Base Type	
Granular	X
Stabilized	
Moisture Content	
Dry	
Optimum	X
Wet	
Soaked	
Deformation	
Rutting	
Deformed	
"Pumping"	
Croc-Cracks	
Long-Cracks	X
Other	

CM 64

Depth 10 mm

Layer Thickness (mm)		
From	To	Layer
0	150	150
150	300	150
300	450	150
450	600	150
600	750	150
		750

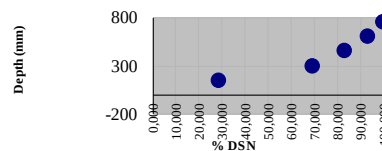
Position on Road		
L	C	R
	X	

Condition		
Poor	Average	Good
	X	

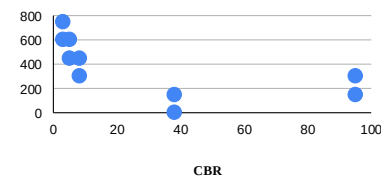
MESAL(req)	2,5	Structural Capacity		Condition
Road Category	C	8,0 MESAL		Sound

Results			DSN ₈₀₀ = 251			Bn ₁₀₀ = 17		
Average Equivalent Strength								
From - To (mm)		DN (mm/b)	Blows	DCP CBR	CBR "LAB"	UCS (KPa)	DCP Class.	
							Gran.	Stab.
0	150	2,083	72	161	38	380	G5	-
150	300	1,471	102	251	95	829	G1,G2,G3	C4
300	450	4,286	35	65	8	103	G9	-
450	600	6,000	25	42	5	69	G10	-
600	750	8,824	17	26	3	44	G10	-

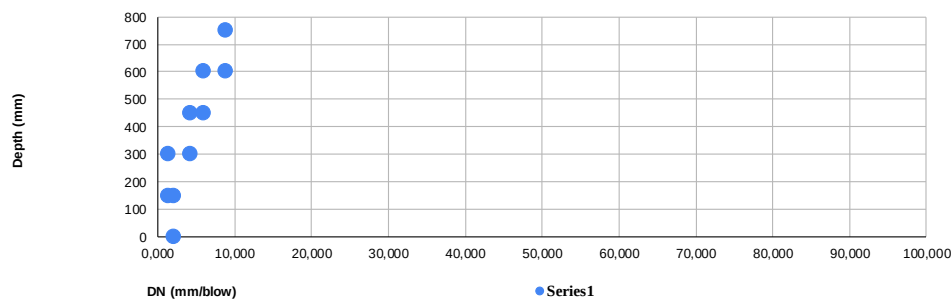
Balance Curve



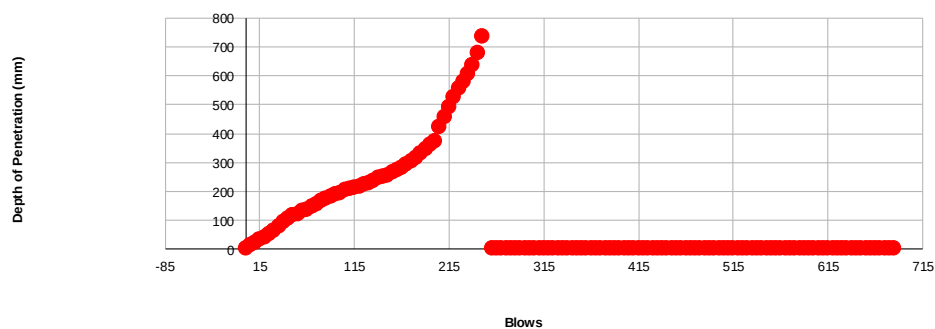
Layer-Strength Diagram (CBR/Depth)



Layer-Strength Diagram (DN/Depth)



DCP Curve



Blows	Depth	Blows	Depth
1	0	73	360
2	5	74	365
3	10	75	370
4	15	76	375
5	20	77	380
6	25	78	385
7	30	79	390
8	35	80	395
9	40	81	400
10	45	82	405
11	50	83	410
12	55	84	415
13	60	85	420
14	65	86	425
15	70	87	430
16	75	88	435
17	80	89	440
18	85	90	445
19	90	91	450
20	95	92	455
21	100	93	460
22	105	94	465
23	110	95	470
24	115	96	475
25	120	97	480
26	125	98	485
27	130	99	490
28	135	100	495
29	140	101	500
30	145	102	505
31	150	103	510
32	155	104	515
33	160	105	520
34	165	106	525
35	170	107	530
36	175	108	535
37	180	109	540
38	185	110	545
39	190	111	550
40	195	112	555
41	200	113	560
42	205	114	565
43	210	115	570
44	215	116	575
45	220	117	580
46	225	118	585
47	230	119	590
48	235	120	595
49	240	121	600
50	245	122	605
51	250	123	610
52	255	124	615
53	260	125	620
54	265	126	625
55	270	127	630
56	275	128	635
57	280	129	640
58	285	130	645
59	290	131	650
60	295	132	655
61	300	133	660
62	305	134	665
63	310	135	670
64	315	136	675
65	320	137	680
66	325	138	685
67	330	139	690
68	335	140	695
69	340	141	700
70	345	142	705
71	350	143	710
72	355	144	715

RR91/241, Pavement Rehabilitation Design based on Pavement Layer Component Tests (CBR and DCP), Department of Transport, March 1994

RR92466/1, Towards Appropriate Standards for Rural Roads: Discussion Document, Department of Transport, March 1993

Deon Roux 2003

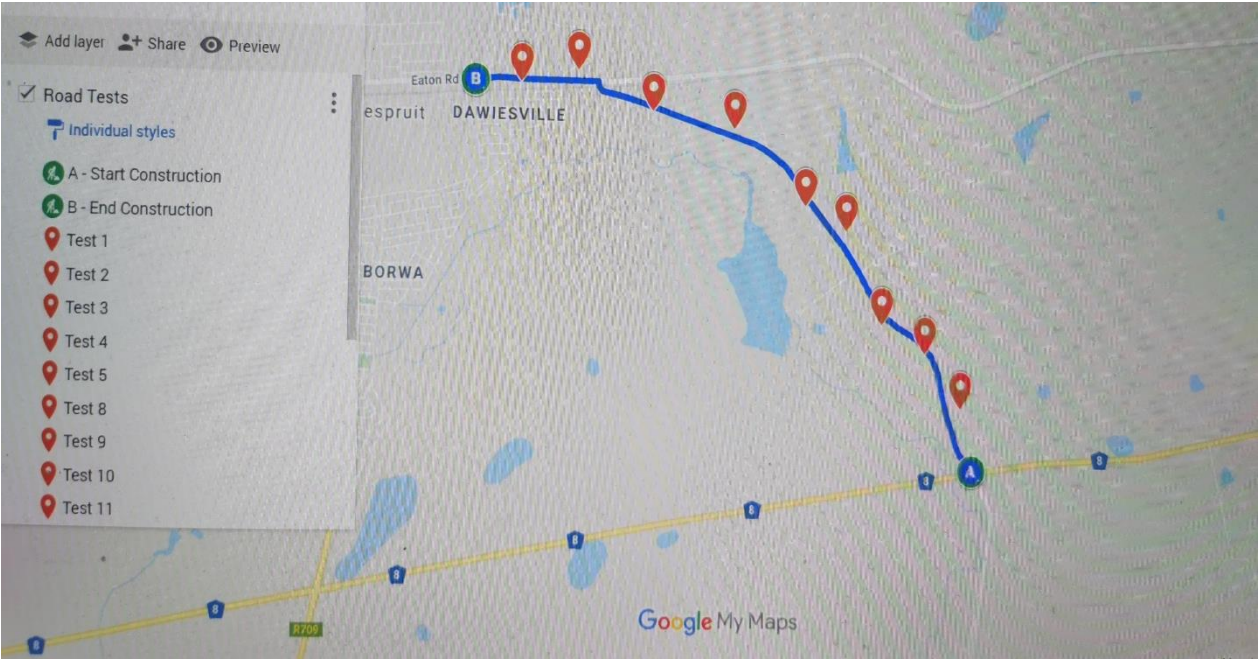


Figure 3: Laboratory tested points

2.3 DRAINAGE

There are existing earth drainage structures on the road reserves. They need to be maintained to ensure their efficiency. The overall management of this storm water can without difficulty be managed by means of formalised drainage structures.

2.4 TRAFFIC

Traffic data obtained from RAMS office:

Table 3: RAMS Traffic Count

ROAD ID	R CLASS	START KM	END KM	LENGTH	AADT L	AADT B	AADT TL	AAD T
S604	4	0,000	4,80	4,80	132	8	12	147
S34	4	0,00	2,287	2,287	197	3	19	224

Table 4: Road Assessment: Visual, TMH9

ROAD_ID	LANE_CODE	START_KM	END_KM	ROAD_WIDTH	Condition	Treatment Type
S604	2	0,000	0,500	7,4	Poor	Heavy Rehabilitation

S604	2	0,500	1,000	7,4	Poor	Heavy Rehabilitation
S604	2	1,000	1,500	7,2	Poor	Heavy Rehabilitation
S604	2	1,500	2,000	7,1	Poor	Heavy Rehabilitation
S604	2	2,000	2,500	7,4	Fair	Light Rehab/Overlay
S604	2	2,500	3,000	7,4	Fair	Light Rehab/Overlay
S604	2	3,500	4,000	7,4	Poor	Heavy Rehabilitation
S604	2	4,000	4,800	7,4	Poor	Heavy Rehabilitation

3. PAVEMENT DESIGN

3.1 ROAD CATEGORY

In South Africa, roads are categorized according to the importance and level of service required. Table 2 gives details of the four road categories used (TRH4; TRH12 and cncPAVE). The “approximate design reliability” is linked to the category. Photographs of typical roads in each category are given in Figure 2.

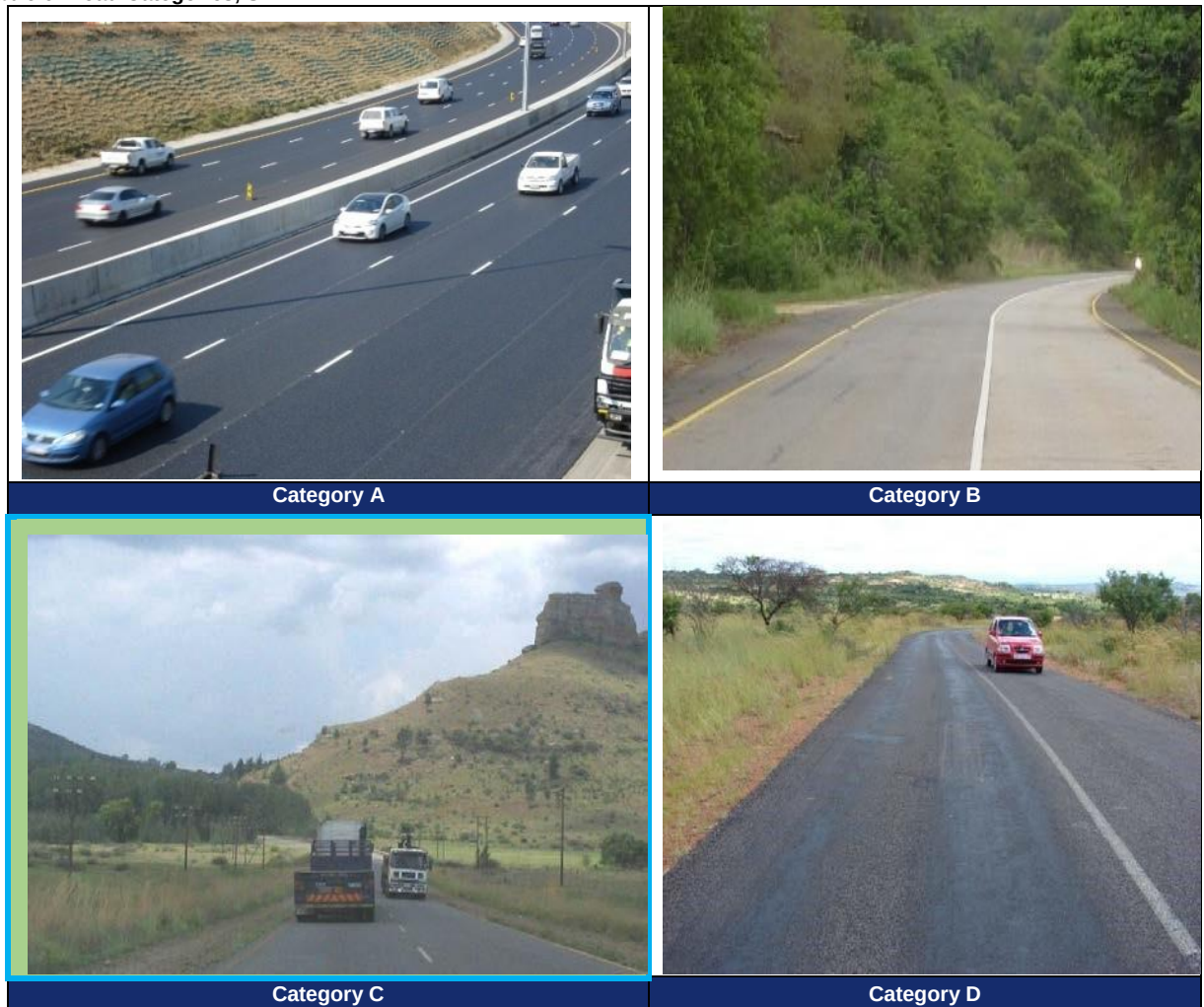
For new design, the design reliability is usually introduced when estimating the structural capacity of a potential design. This process is discussed in more detail in Theyse et al (1995 and 1996) for flexible pavements. For rehabilitation design, the road category not only determines the approximate reliability for the future structural capacity of the rehabilitated road, but also provides guidance on the percentile levels to use during the assessment of condition data for the existing road.

Table 5: Definition of the Four Road Categories

	Road Category			
	A	B	C	D
Description	Major inter-urban freeways and major rural roads	Inter-urban collectors and rural roads	Lightly trafficked rural roads, strategic roads	Rural access roads
Importance	Very important	Important	Less important	Less important
Level of service	Very high	High	Moderate	Moderate
Typical Pavement Characteristics				
Approximate design reliability (%)	95	90	80	50 ¹

Length of road exceeding terminal distress condition at end of structural design life	5	10	20	50
Total equivalent traffic loading (E80/lane)	3 – 100 million over 20 years	0.3 – 10 million Depending on design strategy	< 3 million Depending on design strategy	< 1 million Depending on design strategy
Typical pavement class ²	ES10 – ES100	ES1 – ES10	< ES0.03 – ES3	ES0.003 – ES1
Daily traffic (evu)	> 4000	600 – 10 000	< 600	< 500
Riding quality: <u>Constructed</u> IRI	2.4 – 1.6	2.9 – 1.6	3.5 – 2.4	4.2 – 2.4
<u>Terminal</u> IRI	3.5	4.2	4.5	5.1
Rut level for flexible pavements (mm) Warning Terminal	10 20	10 20	10 20	10 20
Area of shattered concrete for rigid pavements (%) ³ <u>CRCP and UTCRCP</u> Warning Terminal	0.2 0.5	0.3 0.7	0.4 0.8	0.5 1.0
<u>JCP and DJCP</u> Warning Terminal	2 5	3 6	4 8	5 10

Table 6: Road Categories, SAPEM



Category B Roads. Financial constraints may dictate the selection of a shortened structural design period of 10 years. If it is foreseen that structural rehabilitation will be difficult, a longer period of 20 years may be appropriate.

Financial constraints, relatively low traffic volume and light traffic loads has dictated the selection of **Category B** Road rehabilitation design.

3.2 TRAFFIC COUNT (E80S CALCULATIONS)

TRAFFIC VOLUMES: FROM RAMS													
ROAD_ID	R_CLASS	LANE_CODE	START_KM	END_KM	LENGTH	DT_LST_CNT	AADT_L	AADT_B	AADT_TL	AADT_T	START_LONGITUDE	START_LATITUDE	DISTRICT
S34	4	M15531	0,000	2,287	2,287	17/10/2016	197	8	19	224	-29,186100	27,049640	Motheo
S604	4	M16700	0,000	3,997	3,997	17/10/2016	132	3	12	147	-29,208392	27,073444	Motheo
Average Traffic Volume, HVV = 186 vpd Calculated E80s = 2,9 million E80s (Equivalent Design Traffic)													

Table 7: E80s Calculation

Parameter	Data	Comments
Step 1: Determine General Design Input Parameters		
Time of traffic survey or date of published/known data	2021/04/22	From CTO data (Figure 26).
Date of opening	2021/04/23	Assumed from project data.
Step 2: Determine the Four Basic Input Parameters		
Daily heavy vehicle volume per lane for the base year (HVV)	186	ADTT from CTO Data in Figure 26.
Heavy vehicle volume growth rate (h)	5%	Assumed from Table 17, range of 4 – 7% (routes connecting centres of moderate economic development, long-term values).
E80/HV at the survey time	1.5	Estimated average E80/truck from CTO Data in Figure 26.
E80/HV growth rate (v)	2%	Assumed from Table 18, for “all heavy”.
Combined heavy vehicle growth and E80/HV growth	$i = [(1+h)(1+v)-1]$ $= [(1+0.05)(1+0.02)-1]$ $= 0.07$	Equation (13), input from this step.
Step 3: Calculate the ADE at the Time of the Traffic Survey		
Adjust for lane distribution	N/A	CTO Data in Figure 26 indicates only 1 lane.

	$ADE = \frac{\frac{E_{80}}{HV} \cdot HVV}{Duration \times lanes}$ $= \frac{1.5 \cdot 186}{1 \times 1} = 279$	Equation (4), input from Step 2. Data duration for full year.
Step 4: Adjust ADE to AA DE		
Weekend/weekday variation	N/A	Data available for full year.
Seasonal variation		
Exceptional periods		
	ADE = AADE = 279	No adjustments for variations.
Step 5: Project AADE from Date of Traffic Survey to Date of Opening		
Time from survey to opening date (n)	1 year	
AADE at time of opening	$AADE_0 = AADE_s \cdot (1 + i)^1$ $= 279(1 + 0,07)^1$ $= 299$	Equation (14), input from Steps 3 and 2.
Step 6: Calculate Equivalent Design Traffic		
Structural design period	15 years	Design assumption.
Equivalent traffic	$ET = 365 \cdot AADE_0 (1 + i) \frac{[(1+i)^Y - 1]}{i}$ $= 365 \cdot 299 (1 + 0.07) \frac{[(1+0.07)^{15} - 1]}{0.07}$ $= 2\,935\,710 \text{ E80s}$ $= \mathbf{2,9 \text{ million E80s (2,9 MESA)}}$	Equation (15), input from Steps 6 and 2.

3.3 MATERIAL

Structural layers are designed to resist the high stress conditions imposed by external loads and to provide sufficient protection of the pavement foundation during the structural design period. Material of appropriate quality will therefore be sourced for the imported subgrade and structural pavement layers. Chapters 6, 8 and 9, and TRH3, TRH14 and TG2 provide detailed information on the behaviour of specific material types. The use of a materials checklist indicating the availability and cost of materials in the vicinity of the project is recommended.

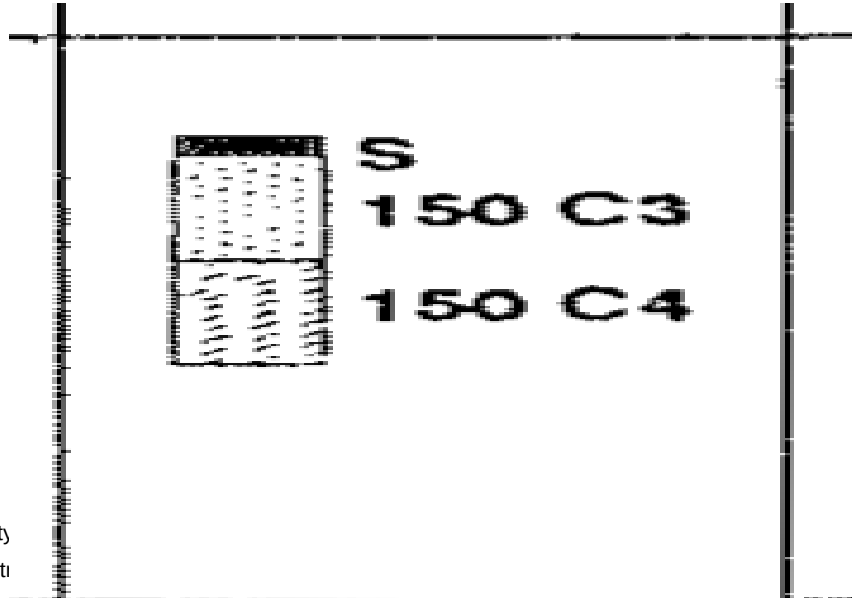
Therefore, a 150mm layer of G5 material will be sourced from the surrounding available Borrow Pits, recycled and stabilized with existing granular material to form a C3 base layer.

3.4 REHABILITATION – PAVEMENT DESIGN

A specific pavement design is based on certain estimates of the traffic loading that will be applied during its life, properties of the material it will be constructed from and subgrade strength it will be constructed on. It follows that the pavement design input parameters are not precisely known, and that a range of values exists for each of these parameters. In addition, variability is built into the pavement during construction because material in quarries and borrow pits vary spatially and with depth; testing is not sufficiently detailed to identify areas with poorer materials; and, material selection is by visual inspection. Furthermore,

compaction moisture content and compaction effort vary from one construction section to the next, resulting in a variance in layer density and, therefore, strength. The constructed layer thickness can vary up to a maximum of 27 mm from the design thickness and still be within specification. In such cases where the input parameters are variable and construction techniques result in further variability in the material properties, it is often better to determine the probability of a certain outcome rather than try to predict the exact outcome. Confidence limits are, therefore, frequently used in pavement engineering to take variability in materials strength parameters into account. The confidence limits are further coupled to a specific level of service. The following are used in TRH4:

- 95% confidence limit for Category A roads
- **90% confidence limit for Category B roads**
- 80% confidence limit for Category C roads



The variability
current consti

nents. It appears that
o an acceptable level.

This is a shortcoming, as premature pavement failures are often related to variability in material strength and layer thicknesses introduced during construction.

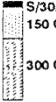
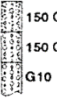
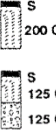
TABLE A9

Present worth of costs for a longer structural design period (alternative strategy) (Base year 1995)

Pavement structure	Initial costs/m ²	Maintenance	Initial costs/m ²	Discounted maintenance costs/m ²			Present worth of costs/m ²		
				Discount rate			Discount rate		
				6 %	8 %	10 %	6 %	8 %	10 %
S2	5,10	S1 (5 yrs)	5,10	3,81	3,47	3,17			
150 C3	9,45	S1 (10 yrs)	5,10	2,85	2,36	1,97			
300 C4	18,51	S1 (15 yrs)	5,10	2,13	1,61	1,22			
		S1 (20 yrs)	5,10	1,59	1,09	0,76			
		S2 (25 yrs)	5,10	1,19	0,74	0,47			
	33,06			11,57	9,28	7,58	44,63	42,34	40,64

100

Structural design of flexible pavements
DRAFT TRH4, Pretoria, South Africa, 1996

CEMENTED BASES											DATE 1996
PAVEMENT CLASS AND DESIGN BEARING CAPACITY (80 kN AXLES/LANE)											
ROAD CAT.	ES0.003 < 3000	ES0.01 0,3-1,0x10 ⁴	ES0.03 1,0-3,0x10 ⁴	ES0.1 3,0-10x10 ⁴	ES0.3 0,1-0,3x10 ⁶	ES1 0,3-1,0x10 ⁶	ES3 1,0-3,0x10 ⁶	ES10 3,0-10x10 ⁶	ES30 10-30x10 ⁶	ES100 30-100x10 ⁶	Foundation
A											
B											
C											
D											

Symbol A denotes AG, AC, OR AS. A0, AP may be recommended as a surfacing measure for improved skid resistance when wet or to reduce water spray.
S denotes Double Surface Treatment (seal or combinations of seal and slurry)
S1 denotes Single Surface Treatment
* Crushing of cemented base may occur

Figure 6: Selected Design
Road Section: km 0 to km 6.4

- Surfacing:
- Continuously Medium graded Asphalt using 60/70 penetration grade bitumen (40mm thickness)
- Base layer:
- 150mm Chemically treated G5 Gravel material obtained from Borrow Pits to C3 Layer, compacted to 88% 97% Mod AASHTO
- Sub-base layer:
- 150mm Chemically treated subbase to C4/C3, up to 200mm deep (compactd to 98% of Modified AASHTO density)
- Granular layer:
- 150mm G6/G7 granular layer

This Design alternative was selected as the most appropriated following the site investigation. The selection was mostly undertaken based on the economic aspects and efficiency or design confidence of road Category B.

3.4.1 Compaction

Insufficient compaction may result in field densities below the minimum required. In such cases, the strength of the material is not fully utilised, and densification or failure may occur under traffic. Quality control on site must ensure that the design specifications are met through proper construction and compaction practices. SAPEM (TRH14) and the Standard Specifications provide recommendations on the minimum density requirements for pavement layers. Any special density requirements should be discussed with the Project Manager or Project Engineer.

Compaction problems may result from material grading deficiencies or poor construction practices, such as not compacting at the optimum moisture content, poor mixing of the material and compaction fluid, or insufficient or inappropriate compaction energy. Blending of material from different sources, to improve the grading and compaction potential of the material, may be better than trying to achieve density with excessive rolling.

When compacting a layer, the support layer needs sufficient support to act as an anvil, otherwise the compaction energy is transmitted and lost through the pavement structure. The use of impact rollers can improve the strength and support from the subgrade substantially.

4. MATERIAL RESOURCES

Material to be collected from all identified borrow pits must be strictly tested, and can thereon be considered for utilisation when they pass the laboratory tests. The material will be used for construction of shoulders (where necessary), sub-base and base layers. The quarries with available material around S604 are as listed on table 5:

Table 8: Available Borrow Pits around Tweespruit

BORROW PITS AROUND TWEESPRUIT FOR S604 ROAD				
ROAD NAME	BORROW PIT	DISTRICT	CO-ORDINATES	
			LATITUDE	LONGITUDE
S604 : Tweespruit Access Road	Borrow Pit 1	Thaba Nchu	-27,724010	27,182390
	Borrow Pit 2	Thaba Nchu	-27,729813	27,174996
	Borrow Pit 3	Ladybrand	-27,897269	27,10874
	Borrow Pit 4	Ladybrand	-27,893709	27,08705
	Borrow Pit 5	Thaba Nchu	-27,920349	27,065619
	Borrow Pit 6	Ladybrand	-27,894060	27,086700
	Borrow Pit 7	Ladybrand	-27,856870	27,125589
	Borrow Pit 8	Ladybrand	-27,698647	27,200410
	Borrow Pit 9	ladybrand	-27,711013	27,176233

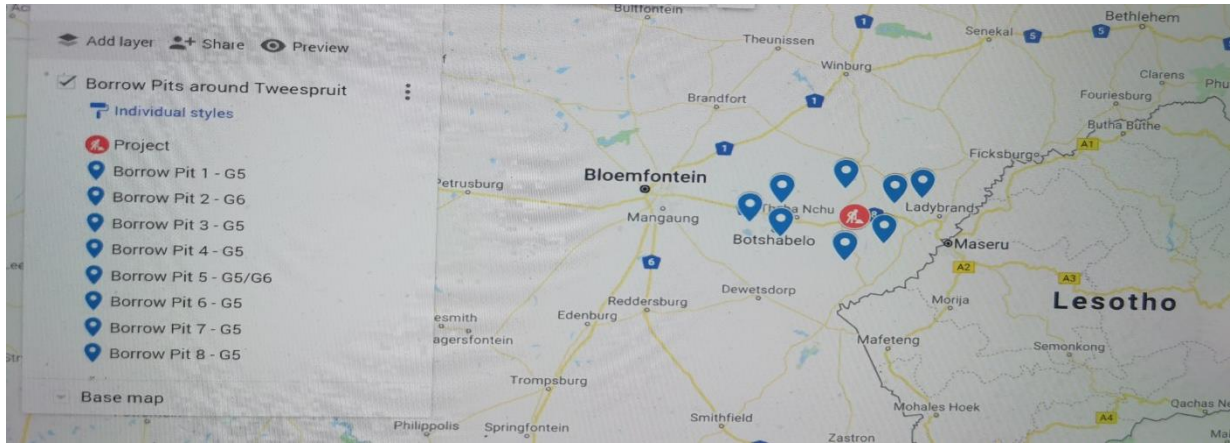


Figure 4: Borrow Pit Locations

5. GEOMETRICAL DESIGN

No horizontal re-alignments were required along the route.

Alterations to the vertical alignment were only applied to conform to acceptable engineering standards.

6. TRAFFIC ACCOMMODATION

Traffic Accommodation will be arranged as planned for by the Project Engineer and authorised by the Project manager to ensure safety and free flow of existing traffic. Bypass routes will be temporarily constructed appropriately on the road side to avail the road site for the construction.

7. ENVIRONMENTAL IMPACT ASSESSMENT

Environment Consultants to be appointed to conduct the environmental assessments regarding the impact of the road works and mining operations on the environment.

8. SMALL CONTRACTOR DEVELOPMENT

The principles of the EPWP will be strictly adhered to and labour will be sourced from the immediate areas.

The following elements of road construction will be designed and constructed labour intensively:

- Grass cutting and road reserve maintenance
- Traffic accommodation
- Security services
- Concrete kerbing, cast on-site or Precast
- Concrete edge beam
- Erection of road signs
- Earth side drains
- Concrete side drains
- Gabions
- Finishing

SANS 3001

Civil Engineer

TWEESPRUIT ACCESS ROAD