

**MOKOLO AND CROCODILE  
WATER AUGMENTATION PROJECT  
PHASE 2 (MCWAP-2)**

**TENDER NO 054/2024/PMID/MCWAP2/RFB**

**PART C3.1  
SPECIFICATION**

**SECTION 25**

**ROADWORKS AND PAVING**

**PART C3.1**  
**SPECIFICATION**  
  
**SECTION 25**  
**ROADWORKS AND PAVING**  
  
**TABLE OF CONTENTS**

	PAGE
<b>SECTION 25</b> .....	<b>1</b>
<b>25.1 SCOPE</b> .....	<b>1</b>
<b>25.2 DEFINITIONS, ABBREVIATIONS AND REFERENCES</b> .....	<b>2</b>
25.2.1 Definitions .....	2
25.2.2 Abbreviations .....	2
25.2.3 References.....	3
<b>25.3 LAYER WORK AND SURFACING</b> .....	<b>3</b>
25.3.1 Materials .....	3
25.3.2 Construction.....	7
25.3.3 Testing .....	13
<b>25.4 CONCRETE BLOCK PAVING</b> .....	<b>14</b>
25.4.1 Materials .....	14
25.4.2 Construction.....	15
<b>25.5 ROAD MARKINGS</b> .....	<b>17</b>
25.5.1 Materials .....	17
25.5.2 Weather Limitations .....	18
25.5.3 Equipment for Painting .....	18
25.5.4 Surface Preparation .....	18
25.5.5 Setting Out the Road Markings .....	18
25.5.6 Applying the Paint.....	18
25.5.7 Tolerances .....	19
25.5.8 Road-studs .....	19
<b>25.6 ACCOMMODATION OF TRAFFIC</b> .....	<b>20</b>
25.6.1 Scope .....	20
25.6.2 General Requirements .....	20
25.6.3 Temporary Traffic-control Facilities.....	21
25.6.4 Roads Constructed in Half Widths.....	22
25.6.5 Pipe Road Crossings - full width deviation .....	22

PART C3.1 - SPECIFICATION

<b>25.7</b>	<b>OVERHAUL .....</b>	<b>23</b>
<b>25.8</b>	<b>MEASUREMENT AND PAYMENT .....</b>	<b>23</b>

LIST OF TABLES

<b>TABLE 25/1 REQUIREMENTS FOR SELECTED LAYER .....</b>	<b>3</b>
<b>TABLE 25/2 REQUIREMENTS FOR SUBBASE .....</b>	<b>4</b>
<b>TABLE 25/3 REQUIREMENTS FOR GRAVEL WEARING COURSE .....</b>	<b>5</b>
<b>TABLE 25/4 REQUIREMENTS FOR CHEMICALLY STABILIZED PAVEMENT LAYERS .....</b>	<b>5</b>
<b>TABLE 25/5 CONSTRUCTION LIMITATIONS FOR STABILISED LAYERS .....</b>	<b>11</b>
<b>TABLE 25/6 SPECIFIED DENSITY REQUIREMENTS.....</b>	<b>12</b>
<b>TABLE 25/7 TESTS FOR ACCEPTANCE OF SUBBASE MATERIAL .....</b>	<b>13</b>
<b>TABLE 25/8 MINIMUM SAMPLING AND TESTING FREQUENCIES .....</b>	<b>13</b>
<b>TABLE 25/9 BEDDING SAND GRADING REQUIREMENTS.....</b>	<b>14</b>
<b>TABLE 25/10 JOINTING SAND GRADING REQUIREMENTS .....</b>	<b>15</b>
<b>TABLE 25/11 CONCRETE BLOCK PAVING CONSTRUCTION TOLERANCES.....</b>	<b>17</b>

## SECTION 25

### ROADWORKS AND PAVING

#### 25.1 SCOPE

This Section deals with the work required for the construction of pavement layers, and finishing work for roads, pavements and parking areas. This Section also covers the construction of concrete block paving for roads, erection of guardrails and painting of road markings.

The Standard Specifications for Roads and Bridge Works for State Road Authorities, prepared by the Committee of Land Transport Officials (COLTO), as amended, shall apply to this Contract.

Generally the roadworks under this Contract includes:

- a) The permanent access roads to the Pump Stations;
- b) Pump Station yards;
- c) Temporary access roads;
- d) Permanent pipeline access and maintenance roads along the High-Lift Rising Main and Gravity Mains; and
- e) Maintenance of existing public roads extensively used by the construction activities.

Details of roadworks for a) and b) are indicated on the Drawings.

With reference to paragraph d), a permanent access road is required along these pipeline routes for patrolling and maintenance purposes after completion of construction. The road shall conform to the shape of the natural ground to prevent interference with surface drainage, shall be 3 m wide and be suitable for access with 4x2 LDV's and 10-ton maintenance trucks. The following pavement layers (from bottom to top) will be required at certain dedicated areas to ensure access along the complete pipeline routes under all weather conditions:

- 150 mm thick in-situ layer ripped and re-compacted to 93% Mod AASHTO; and
- 150 mm thick wearing layer of gravel material compacted to 95% Mod AASHTO with a cross fall of 3%.

Dump rock in wet areas and pipes, canals, culverts, side drains etc. across and parallel to the road will also be required at certain dedicated areas to accommodate storm water for a 1:10 year rainfall occurrence.

The Engineer will identify the dedicated areas on Site during construction and determine which pavement layers and stormwater works are required where.

A design standard and condition assessment of existing roads that will be used extensively during construction will be done by the Engineer. Based on the assessment, a maintenance and rehabilitation policy, together with applicable specifications, will be drafted for submission to the relevant road authority. The approved policy will be implemented during and after the completion of the construction phase.

## 25.2 DEFINITIONS, ABBREVIATIONS AND REFERENCES

### 25.2.1 Definitions

- a) **“Pavement layer”** or **“Layer work”** means the upper layers of the road comprising the subbase, wearing course and shoulders.
- b) **“Shoulder”** means:
  - i) When shoulder is referred to as a surface: The area between the outside edge of the travelled way and the shoulder breakpoint.
  - ii) When shoulder is referred to as a pavement: The layer on top of the subbase and lying between the outside edge of the base or, as applicable, wearing course and the shoulder breakpoint.
- c) **“Shoulder breakpoint”** means the line along which the extended flat planes of the surface of the shoulder and the outside slope of the fill and pavement intersect. This edge is normally rounded to a predetermined radius.
- d) **“Subbase”** means the layer of material of specified dimensions on top of the selected fill and below the base and shoulders.
- e) **“Wearing course”** means a layer of material of defined thickness and width constructed on top of the selected layer in the case of an unsurfaced road.
- f) **“Base”** means a layer of material of defined thickness and width constructed on top of the subbase, or in the absence thereof, the selected layer. A base may extend to outside the travelled way.
- g) **“Grading Coefficient (Gc)”** means the product of the percentage by mass, of the total sample, retained between the 26.5 mm and 2 mm sieves multiplied with the percentage by mass, of the total sample, passing the 4.75 mm sieve, divided by 100.
- h) **“Oversize Index (Io)”** means the mass of material retained on the 37.5 mm sieve, as a percentage of the total mass of the material.
- i) **“Shrinkage Product (Sp)”** means the product of the linear shrinkage and the percentage by mass of the total sample passing the 0.425 mm sieve.
- j) **“Bedding”** shall mean the layer of sand placed between the top of the subbase and the bottom of the paving block.
- k) **“Paving block”** shall mean a precast concrete paving block of such size that it can be lifted and laid with one hand. (The approximate dimensions of a block are normally as follows: length = 200 mm; width = 100 mm; thickness = 50 – 120 mm; and there are normally 40 – 50 blocks per square metre of paved area).
- l) **“TRH 20”** shall mean a manual published by the CSIR: The Structural Design, Construction and maintenance of unpaved roads.

### 25.2.2 Abbreviations

AASHTO	:	American Association of State Highway and Transportation Officials
BS	:	British Standard
CBR	:	Californian Bearing Ratio
CEM	:	Calcium Enriched Mixture (Cement)
COLTO	:	Committee of Land Transport Officials

## PART C3.1 - SPECIFICATION

---

CSIR	:	Council for Scientific and Industrial Research
EC	:	Electrical conductivity
GM	:	Grading Modulus
LL	:	Liquid Limit
LS	:	Linear Shrinkage
MDD	:	Maximum Dry Density
NITRR	:	National Institute of Technology Raipur
OMC	:	Optimum Moisture Content
PD	:	Permissible Deviation
PI	:	Plasticity Index
SANS	:	South African National Standard
TMH	:	Technical Methods for Highways

**25.2.3 References**

When reference is made to a Code of Practice, Specification or Standard, the reference shall be taken to mean the latest edition or replacement at time of tender of the Code, Specification or Standard; including addenda, supplements, modifications and revisions thereto. Where a previous version is intentionally used, it will be indicated as such. Where reference is made to a Code, Specification or Standard that has subsequently been withdrawn and not replaced, the intended content will remain relevant unless confirmed otherwise in writing by the Engineer.

**25.3 LAYER WORK AND SURFACING****25.3.1 Materials****25.3.1.1 General**

Layerwork material shall be obtained only from approved borrow areas or such other sources of supply as may be specified or approved for use from time to time. Only soil, gravel, aggregate or other approved material shall be used for the construction of layerworks.

**25.3.1.2 Selected layer**

Selected layer material shall, unless otherwise authorised, conform to the requirements given in Table 25/1 when finally placed.

**TABLE 25/1  
REQUIREMENTS FOR SELECTED LAYER**

<b>TYPE OF MATERIAL</b>	<b>G7</b>
DESCRIPTION OF MATERIAL	Natural material (soil, sand or gravel)
ADDITIONAL FINES	Not applicable

## PART C3.1 - SPECIFICATION

TYPE OF MATERIAL	G7
NOMINAL MAXIMUM SIZE	i) Uncrushed material: Two thirds of the compacted layer thickness ii) Crushed material: 75 mm
GRADING MODULUS (GM)	$2.7 \geq GM \geq 0.75$
ATTERBERG LIMITS FOR NATURAL MATERIAL (-0.425 MM FRACTION)	The PI shall not exceed 12 or a value equal to 3 times the GM plus 10, whichever is the higher value. In the case of calcrete the PI shall not exceed 17 provided that the LS does not exceed 7% and (% passing 0.425 mm sieve) $LS \leq 320$
SWELL (MAX)	Swell at 100% of modified AASHTO density shall not exceed 1,5%
STRENGTH (CBR)	CBR at 93% of modified AASHTO density shall be at least 15%
COMPACTION REQUIREMENTS	95% of modified AASHTO density

**25.3.1.3 Subbase Layer**

Subbase layer material shall, unless otherwise authorised, conform to the requirements given in Table 25/2 when finally placed.

**TABLE 25/2  
REQUIREMENTS FOR SUBBASE**

CRITERIA	SUBBASE - G5
Parent Material	Natural gravel or natural gravel and boulders which may require crushing, or crushed rock.
Additional Fines	May contain approved natural fines not obtained from parent rock.
Strength	CBR at 95% of Mod. AASHTO max. density shall be at least 45%. Swell at 100% of Mod. AASHTO max. density shall not exceed 0.5%.
Durability	Mudrock only to be used if directed by the Engineer.
Shapes	All alluvial or colluvial material shall be so crushed that at least 50% (by mass) of the fraction retained on the 4.75 mm sieve has at least one fractured face.
Atterberg Limits	LL shall not exceed 30. PI shall not exceed 10, except that if less than 30% of the sample passes the 2.00 mm sieve, the PI shall not exceed 12. LS shall not exceed 5%.
Grading	The maximum size of crushed material shall be 53 mm before compaction. The maximum size of uncrushed material shall be 63 mm. The percentage (by mass) passing the 2.00 mm sieve shall be not less than 20% and not more than 70%. Grading modulus shall be not less than 1.5 and not more than 2.5.
Compaction	The minimum dry density of the compacted layer shall be 95% of modified AASHTO density.

## PART C3.1 - SPECIFICATION

**25.3.1.4 Gravel Wearing Course**

The gravel wearing course material shall, unless otherwise authorised, conform to the requirements given in Table 25/3 when finally placed.

**TABLE 25/3  
REQUIREMENTS FOR GRAVEL WEARING COURSE**

PARAMETER	LIMIT	
	TYPE 1 (Urban)	TYPE 2 (Rural)
Maximum size, mm	37.5	37.5
Oversize Index ( $I_o$ ) (maximum), %	0	< 5
Shrinkage product ( $S_p$ )	100-240	100 – 365 (maximum of 240 preferable)
Grading coefficient ( $G_c$ )	16 – 34	16 – 34
CBR at $\geq 95\%$ modified AASHTO Compaction (soaked value) (minimum), %	$\geq 15$	$\geq 15$
$I_o$ = Oversize index (per cent retained on 37.5 mm sieve) $S_p$ = Linear shrinkage x per cent passing 4.25 mm $G_c$ = (Per cent passing 26.5 mm – per cent passing 2.0 mm) x per cent passing 4.75 mm/100		

**Note:** All parameters in Table 25/3 are defined in TRH 20

**25.3.1.5 Chemically Stabilized Pavements Layers**

The chemically stabilised pavement layers unless otherwise authorised, shall conform to the requirements of Table 25/4 when finally placed. The full cost of the testing to ensure the chemically stabilised pavement layers conform to Table 25/4 shall be covered in the tendered rates.

**TABLE 25/4  
REQUIREMENTS FOR CHEMICALLY STABILIZED PAVEMENT LAYERS**

Criteria	C3	C4
Material before treatment	G5 quality	G6 quality
Atterberg limits after treatment	PI shall not exceed 6	
Design strength (MPa)		
(a) At 100% of modified AASHTO density	Minimum: 1.5 Maximum: 3	Minimum: 0.75 Maximum: 1.5
(b) At 97% of modified AASHTO density	Minimum: 1 Maximum: 2	Minimum: 0.5 Maximum: 1



## PART C3.1 - SPECIFICATION

Criteria	C3	C4
Indirect tensile strength at 100% of modified AASHTO density (kPa)	Minimum: 250	Minimum: 200
Durability: Fines lost Wet-dry Freeze-thaw	Durability: The wet dry durability test shall be carried out to determine the durability of cement stabilized materials. Test method A19 (THM 1: Standard Test Methods for Road Building Materials) shall apply. The percentage material loss after 12 cycles shall not exceed 14%.	

**25.3.1.6 Compaction Requirements**

The minimum in-situ dry density of gravel material shall be as specified hereinafter for the respective layers in terms of a percentage of modified AASHTO density.

Subbase: 97% for material not chemically stabilized.  
96% for chemically stabilized material.

Shoulder and wearing course: 95%.

**25.3.1.7 Soluble Salinity**

The soluble salinity of base material shall be subject to the following:

**(a) Soluble Salts**

The percentage of soluble salts in the materials shall be subject to the following provisions:

- Untreated material (< 6.7 mm fraction);
- Witwatersrand quartzite: Crushed stone and mine stone;
- Where the pH < 6.0, the material shall be treated with lime until pH  $\geq$  10, and then used. (The aggregate is normally treated at the crusher, and if the pH exceeds 10 at that stage, the decrease which will occur later on, shall be ignored should it remain  $\geq$  8.0); and
- Where the pH  $\geq$  6.0, the material is used as it is.

**(b) Other Materials such as Natural Gravel and other Crushed Stone**

- Where the electrical conductivity (EC)  $\leq$  0.15 Sm  $\cdot$  <sup>-1</sup>, material may be used;
- Where the EC  $\geq$  0.15 Sm  $\cdot$  <sup>-1</sup>, the pH shall be determined;
- Where the pH  $\leq$  6.0, the material shall be treated with lime until the pH  $\geq$  10. The material may then be used. (Any later decrease of the pH shall be ignored should it remain  $\geq$  8.0); and
- Where the pH  $\geq$  6.0, it may be used, but special attention should be given to design and construction measures.

**(c) Material being stabilized (for example with lime or cement)**

- Where the  $\text{pH} \geq 6.0$  and the  $\text{EC} \leq 0.02 \text{ Sm}^{-1}$  and the qualitative test shows that sulphates do not pose a problem, the material may be used. If not, the material shall not be used; and
- The tests conducted for determining the above judgement parameters shall include the following:
 

– Electrical conductivity (EC)	– Method A21T of TMH1 (< 6.7 mm fraction)
– Qualitative sulphate test	– NITRR method CA21 (< 6.7 mm fraction)
– ph	– NITRR method CA 21 (< 6.7 mm fraction)

Where the salinity of the water used for compaction purposes is so high as to cause an increase in the salinity of the material, the Engineer shall be entitled to determine the soluble salinity from samples taken from any section of the compacted layer within 24 hours, and also before the surfacing is applied.

**25.3.1.8 Chemical Stabilizing Agents**

The stabilizing agent shall be either one or more of the following agents specified on the Drawings, listed in the Bill of Quantities or ordered by the Engineer.

**(a) Road Lime**

Road lime shall comply with the requirements of SANS 824 and shall bear the SABS mark.

**(b) Stabilizing Cement**

Cement shall comply with the requirements of SANS 50197-1. Cement used in stabilization shall be CEMII/B-V 32.5 or similar approved.

**25.3.2 Construction****25.3.2.1 Selection, Placing and Compaction****(a) Selection**

The material from cuttings and borrow pits shall be broken down in the cuttings or borrow pits to a maximum sizes as set out below:

- Rock fills                      750 mm maximum dimension
- Normal fills                  500 mm maximum dimension
- Pavement layers              300 mm maximum dimension

Pavement materials shall be further broken down to the sizes as specified for each layer by using grid rollers, and other suitable equipment, subject to the approval of the Engineer.

**(b) Stockpiling**

Materials excavated from borrow pits and cuttings shall be transported direct to and placed at the point where it is to be used. However, where utilizing materials in this manner is impracticable, and, if so instructed by the Engineer in writing, it shall be temporarily stockpiled for later loading and transportation to where it is to be used.

**(c) Placing**

All materials placed in position before compaction shall be spread evenly over the entire surface of the layer concerned, and the quantity of material spread shall be such that every layer will comply with the specified requirements for thickness when measured after compaction.

When the layer thickness after compaction is 200 mm or less, any oversized material which cannot be broken down to the required size shall first be removed from the road and then disposed of or used as may be prescribed by the Engineer.

The layer thickness shall comply with the requirements as indicated on the Drawings.

**(d) Spraying and Mixing**

Before the material is compacted, it shall first be thoroughly mixed by a grader or other suitable equipment so as to obtain an even mix of various types of material and to spread the fine and course material evenly throughout the mixture. If necessary during the mixing process, water shall also be sprayed evenly over and mixed into the material to bring it to the correct uniform moisture content.

**(e) Compaction**

Compaction shall be carried out in a series of continuous operations covering the full width of the layer concerned, and the length of any section of the layer being compacted shall be not less than 150 mm nor more than can be properly compacted with the available equipment.

The compaction shall comply with the requirements as indicated on the Drawings.

**25.3.2.2 Foundation Preparation**

Any roadbed material which is considered by the Engineer to be detrimental to the performance of the completed road shall be removed to such widths and depths as may be instructed by the Engineer and shall be disposed of as prescribed. The excavated spaces shall then be backfilled with approved imported material compacted to the required density.

**25.3.2.3 Layer works****(a) General**

Each layer shall only be constructed provided that the underlying layer or fill conforms to the relevant requirements specified for that layer. Dumping of the material for the succeeding layer may not commence on a particular section of road unless the Contractor has obtained, in writing, the Engineer's approval for the current layer. Immediately before placing the material, the underlying layer or fill shall be checked by the Contractor for damage or deficiencies, which shall be made good as directed by the Engineer.

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PART C3.1 - SPECIFICATION

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The finally compacted layer shall be free from surface laminations, portions exhibiting segregation of the fine and coarse aggregates, corrugations, or other defects that may adversely affect the performance of the layer.

Where specified or required by the Engineer the prepared surface shall be treated with an approved herbicide and ant poison before the layer of sand for bedding is placed.

The Contractor shall protect and maintain the completed selected fill without additional payment until the wearing course or block paving, as applicable, is constructed. Maintenance shall include the immediate repair of any damage or defects which may occur and shall be repeated as often as is necessary to keep the selected fill or subbase continuously intact. Repairs shall be done in a manner that will ensure restoration to an even and uniform surface.

**(b) Gravel Wearing Course**

Placement of the wearing course shall commence at the furthest point from a particular borrow pit being used and proceed in the direction of that borrow pit.

**(c) Shoulders**

Work shall be so constructed that the road will be adequately drained at all times by means of temporary drainage pipes passing through the shoulders. The Contractor shall not start constructing the final surfacing of any part of the road before he has completed the shoulders of such section and the Engineer has approved it.

**25.3.2.4 Chemical Stabilization**

**(a) Preparing the Layer**

The material to be stabilized shall be prepared and placed as specified elsewhere in this Section, and given at least one pass with a flatwheel roller. The material shall be damp.

**(b) Applying the Stabilizing Agent**

After the layer of soil or gravel has been prepared, the stabilizing agent shall be spread uniformly over the full area of the layer by hand. Pockets or bags of stabilizing agent shall be accurately spaced at equal intervals along the section to be stabilized so that the specified rate of application can be achieved. The stabilizing agent shall be spread as evenly as possible, and shall then be uniformly distributed over the entire surface to be treated. The Engineer may permit spreading of the hand-spaced stabilizing agent by motor grader, provided that he is satisfied that an even distribution of the stabilizing agent can be obtained.

**(c) Mixing in the Stabilizing Agent**

Immediately after the stabilizing agent has been spread, it shall be mixed with the material for the full depth of treatment. Care shall be taken not to disturb the compacted layer underneath, nor to mix the stabilizing agent in below the desired depth. Mixing shall be continued for as long as necessary and repeated as often as required to ensure a thorough, uniform and intimate mix of the soil or gravel and the stabilizing agent over the full area and depth of the material to be treated. Mixing shall be done by grader, disc harrow, rotary mixer or equivalent equipment, working over

PART C3.1 - SPECIFICATION

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the full area and depth of the layer to be stabilized by means of successive passes of the equipment. Mixing may also be done in central batch-mixing units, but the Contractor will not be entitled to payment for additional overhaul or incidentals resulting from such procedure.

**(d) Watering**

Immediately after the stabilizing agent has been properly mixed with the soil or gravel, the moisture content of the mixture shall be determined, and the required amount of water shall be added. Each application or increment of water shall be well mixed with the material so as to avoid the concentration of water near the surface or the flow of water over the surface of the layer. Particular care shall be taken to ensure satisfactory moisture distribution over the full depth, width and length of the section being stabilized and to prevent any portion of the work from getting excessively wet after the stabilizing agent has been added. The moisture content of the material during compaction shall never exceed 80% of the saturation moisture content of the natural material without stabilizing agent, calculated at maximum dry density. Any portion of the work that becomes too wet after the stabilizing agent has been added and before the mixture has been compacted, will be rejected, and such portions shall be allowed to dry out to the required moisture content and shall then be scarified, re-stabilized, re-compacted and again finished off in accordance with the requirements specified herein, all at the expense of the Contractor. The water supply and watering equipment shall be adequate to ensure that all the water required will be added and mixed with the material being treated within a short enough period to enable compaction and finishing to be completed within the period specified below.

**(e) Compaction**

During compaction, loss of moisture by evaporation shall be corrected by further light applications of water. During compaction of the stabilized layers, the Contractor shall lightly harrow or scarify the crust before final rolling, if so required by the Engineer, in order to prevent the formation of laminations near the surface of the layer. Final rolling shall be done with equipment that will give a smooth surface finish which conforms to the surface tolerances specified. Low patches on the surface may not be filled after compaction. The minimum compaction requirements shall be as specified for the particular layer in the various parts of this Section. A sufficient number of compacting units shall be employed on the work to ensure that, from the time when the stabilizing agent is first applied to the layer, the mixing process, watering, compacting, shaping and final finishing will be completed within the periods specified in Clause 25.3.2.4 (h).

**(f) Finishing at Junctions**

Any finished portion of the stabilized layer adjacent to new work, which is used as a turn-round 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 work already completed. When the adjoining section is being finally finished, such cover shall be removed to permit the making of a smooth vertical joint at the junction of the different sections. 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.

**(g) Curing the Stabilized Work**

The stabilized layer shall be protected against rapid drying out for at least seven days following completion of the layer. The stabilized layer shall be kept continuously wet or damp by watering at frequent intervals. This method will be permitted for up to a maximum period of 24 hours, thereafter

## PART C3.1 - SPECIFICATION

the layer shall be covered with the material of the next layer as soon as the moisture content of the stabilized layer so permits. Work which is not kept continuously wet or damp to the satisfaction of the Engineer, but is subjected to consecutive wet-dry cycles, may be rejected by the Engineer should he consider the layer to have been adversely affected. The stabilized layer shall be covered with the material required for the next layer while the stabilized layer is still wet or in a damp condition. The material forming the protective layer shall be watered at such intervals as may be required to keep the stabilized layer continuously wet or damp, and in dry weather this shall be done at least once in every 24 hours. No additional payment will be made for curing as described above.

#### (h) Construction Limitations

For cemented layers the stabilizing agent shall be applied only to a surface the size of which will permit all processing, watering, compacting and finishing to be completed within the period given in Table 25/5. For any special surface finishing operations the maximum period may be fractionally increased by the Engineer. For modification only, the maximum period allowed from the time the stabilizing agent comes into contact with the layer being modified until the completion of compaction shall be 48 hours in the case of slaked or unslaked lime. The starting time shall be the median time taken to complete the spreading of all the lime. No stabilization shall be done during wet weather or when, in the opinion of the Engineer, windy or freezing conditions may adversely affect the stabilizing operations. Any rain falling on the working area during the process of stabilization may be sufficient cause for the Engineer to order any affected areas to be reconstructed at the Contractor's cost.

**TABLE 25/5  
CONSTRUCTION LIMITATIONS FOR STABILISED LAYERS**

<b>STABILIZING AGENT</b>	<b>Maximum continuous period allowed from the time the stabilizing agent comes into contact with the layer being stabilized until the completion of compaction (see note)</b>
CEM II	6 hours
Slaked lime	10 hours
Unslaked lime	10 hours

**Note:** Starting time shall be the median time taken to complete the spreading of the stabilizing agent.

No traffic or any equipment not actually used for processing the layer may be allowed to pass over the freshly spread stabilizing agent. Only equipment required for curing may be allowed over the treated layers during the specified curing period, unless otherwise specified or approved by the Engineer.

#### 25.3.2.5 Construction Tolerances

##### (a) Level for Subbase, Shoulders and Wearing Course

At least 50, but preferably more, level measurements shall be taken according to a stratified random pattern of each section of the completed layer, and the specified levels shall then be determined. Outliers shall be identified and examined.

## PART C3.1 - SPECIFICATION

The lot will be considered to comply with the requirements in respect of surface levels if, before any repair work is undertaken, at least 90% of the level measurements show a deviation of less than 20 mm from the specified levels. Isolated spots, where the surface levels deviate by more than 25 mm of the specified levels shall be repaired to bring the deviation to within 20 mm.

**(b) Layer Thickness for Subbase, Shoulders and Wearing Course**

At least 30, but preferable more, layer thicknesses shall be determined in accordance with a stratified random pattern for each lot of completed layer work. Layer thickness may be determined by means of level measurements taken before and after construction of the layer in exactly the same position, but may be augmented by thickness measurements taken by means of holes made in the layer. Outliers shall be identified, disregarded if erroneous, and if possible, replaced with a fresh result.

The lot will be considered to comply with the requirements for layer thickness if:

- At least 90% of all the thickness measurements taken before any thickness repairs are made is equal to or greater than the specified thickness, minus 21 mm; and
- The mean layer thickness of the lot is not less than the specified thickness minus 5 mm. Isolated spots where the actual thickness is less than the specified thickness less 27 mm shall be repaired so as to fall within the 21 mm tolerance.

**(c) Compaction of Subbase, Shoulders and Wearing Course**

At least 4 relative density determinations shall be taken in the case of fill and selected fill in accordance with a random pattern. After outliers have been examined and replaced, compliance with the specified density requirements shall be determined in accordance with Table 25/6.

**TABLE 25/6  
SPECIFIED DENSITY REQUIREMENTS**

Prescribed compaction	Unit of measurement	Minimum average relative compaction for the following sample sizes						Minimum value for any single test for the following sample sizes					
		4	5	6	7	8	9	4	5	6	7	8	9
93%	Mod. AASHTO density	93.1	93.4	93.6	93.7	93.9	94.0	89.4	89.2	89.0	88.9	88.8	88.7
95%	Mod. AASHTO density	95.1	95.4	95.6	95.7	95.9	96.0	91.4	91.2	91.0	90.9	90.8	90.7
96%	Mod. AASHTO density	96.1	96.4	96.6	96.7	96.9	97.0	92.4	92.2	92.0	91.9	91.8	91.7
97%	Mod. AASHTO density	97.1	97.4	97.6	97.7	97.9	98.0	93.4	93.2	93.0	92.9	92.8	92.7

## PART C3.1 - SPECIFICATION

**(d) Rate of Application of Chemical Stabilizing Agents**

The rate of application of a chemical stabilizing agent, when applied by mechanical bulk spreading equipment and measured by the canvas-patch method, shall be equal to the specified rate of application,  $\pm 5\%$  measured over any section not exceeding 1.0 km in length, and no single measurement shall show a value deviating by more than 20% from the specified rate.

**25.3.3 Testing**

An exploration, sampling and testing programme shall be carried out by the Contractor in the designated borrow and quarry areas to confirm the borrow and quarry boundaries and material characteristics in accordance with Section 14 - Borrow and Excavated Materials.

**25.3.3.1 Acceptance Testing**

Acceptance testing for the subbase shall be as specified in Clause 25.3.3 to determine compliance of the aggregate with all the requirements of Clause 25.3.1.3. The total number of tests required for acceptance of stockpiles is given in Table 25/7.

**TABLE 25/7  
TESTS FOR ACCEPTANCE OF SUBBASE MATERIAL**

CBR	2
Atterberg Limits	3
Grading	3

**25.3.3.2 Routine Testing**

The Contractor shall carry out routine testing of materials and completed work for compliance with the requirements of Clause 25.3.1.3. The testing frequencies and sample and lot sizes shall be as specified in Table 25/8.

**TABLE 25/8  
MINIMUM SAMPLING AND TESTING FREQUENCIES**

PAVEMENT LAYER	PROPERTY	SAMPLING FREQUENCY
Subbase	Grading, Grading Modulus and Atterberg Limits	1 Sample/200 m <sup>3</sup> with min 6 samples/lot*
	CBR + CBR Swell	1 Sample per 900 m <sup>3</sup>
	Compaction : MDD : Density	2 Samples/lot* 6 Samples/lot*
Wearing Course	Grading	1 Sample/600 m <sup>3</sup>
	Atterberg Limits	1 Sample/300 m <sup>3</sup> with min 2 samples/lot*



## PART C3.1 - SPECIFICATION

PAVEMENT LAYER	PROPERTY	SAMPLING FREQUENCY
	CBR + CBR Swell	1 Sample/material type with min 1 sample/1 800 m <sup>3</sup>
	Compaction : MDD : Density	1 Sample/material type with min 1 Sample/1 800 m <sup>3</sup>  1 Sample/500 m <sup>3</sup> with min of 3 samples/lot*
Surfacing stone - Use acceptance testing results		

**Note:**

\* A "lot" is a day's work, except where the material or manner of processing changes, such change signifying the end of the lot.

MDD means Maximum Dry Density.

**25.4 CONCRETE BLOCK PAVING****25.4.1 Materials****25.4.1.1 Bedding Sand**

A layer of bedding sand shall be placed on top of the prepared surface of the underlying pavement layer. Bedding sand for concrete block paving shall not contain any deleterious impurities, clay or silt material.

The bedding sand shall comply with the following grading requirements shown in Table 25/9 below:

**TABLE 25/9  
BEDDING SAND GRADING REQUIREMENTS**

SIEVE SIZE (MM)	% PASSING THROUGH
9.52	100
4.75	95 - 100
2.36	80 - 100
1.18	50 - 85
0.600	25 - 60
0.300	10 - 30
0.150	5 - 15
0.075	0 - 10

**25.4.1.2 Jointing Sand**

Jointing Sand shall be worked in between the individual blocks in order to lock the blocks in position.

The jointing sand shall comply with the following grading requirements in Table 25/10 below:

**TABLE 25/10  
JOINTING SAND GRADING REQUIREMENTS**

<b>SIEVE SIZE (MM)</b>	<b>% PASSING THROUGH</b>
2.36	100
1.18	90 - 100
0.600	60 - 90
0.300	25 - 60
0.150	10 - 25
0.075	10 - 15

#### **25.4.1.3 Concrete Paving Blocks**

Concrete paving blocks shall comply with the requirements of SANS 1058. The block shall be of the class, type and thickness specified on the Drawings, or listed in the Bill of Quantities. The surface texture and colour of all blocks shall be uniform.

If not indicated elsewhere, the concrete paving bricks shall be Type S-A, Class 25 and 80 mm thick.

Cast in-situ concrete edge beams or intermediate beams shall be constructed in accordance with the provisions of Section 20 – Concrete Works (Structural). Prefabricated kerbing and channelling shall comply with the requirements of Section 20 – Concrete Works (Structural) and Section 27 – Drainage and Erosion Protection.

#### **25.4.1.4 Herbicide and Ant Poison**

The herbicide and ant poison shall be environmentally friendly and shall be subject to the Engineer's approval.

#### **25.4.1.5 Invert Emulsion Primer**

The priming material shall be an invert bitumen emulsion complying with SANS 1260.

### **25.4.2 Construction**

#### **25.4.2.1 Placing of Concrete Block Paving**

All the blocks shall be laid in a herringbone pattern unless shown on the Drawings or as instructed by the Engineer.

#### **25.4.2.2 Priming of Subbase Layers**

The subbase layer shall be primed prior to the placing of bedding sand for the concrete block paving with an approved emulsion primer at a nominal rate of 0.7 litres/m<sup>2</sup>.

No prime shall be applied under adverse weather conditions as described below:

- a) During foggy or wet conditions;
- b) When rain is imminent;
- c) When wind is blowing hard enough to cause uneven spray;
- d) When the surface of the layer is visibly wet;
- e) After sundown; and
- f) When the temperature of the surface is below 10°C.

The prime shall be sprayed at a spraying temperature of between 20 – 60°C.

The Contractor shall take adequate measures to protect any kerbing or paving from overspray caused during the priming operation. Any damage caused by prime to paving or kerbing shall be removed or such paving or kerbing replaced at the Contractor's expense, subject to the approval of the Engineer.

#### **25.4.2.3 Laying of Units**

The Contractor shall maintain a prepared area of bedding course, of adequate size, in advance of the paving operation.

Paving shall begin from a straight starting edge, which shall be either an edge restraint or a string line set up as a temporary guide.

Infill pieces of paving shall be incorporated along the starting edge, as the work proceeds, to establish the pattern.

Paving blocks shall be laid such that a joint width of 2 mm to 5 mm forms between each paving block with a target joint width of 3 mm. This can be achieved either by spacers or by the use of string lines. Mechanical force shall not be used to bring the paving blocks into contact.

Paving blocks shall be supplied to the advancing laying face over the new work and stacked approximately 1 m back from the leading edge. Heavy equipment shall not be permitted to run over the un-compacted, unlocked area of the wearing surface.

Paving blocks shall be laid to a string line and the pattern checked using a second string line at right angles to the first.

String lines, where used, are to be set parallel to the herring bone pattern and at 10 rows apart. Paving blocks deviating from the string line by more than the permissible deviation given in Clause 25.4.2.5, will need to be removed from several rows and re-laid to the string line.

Whole units shall be laid first. Full depth closure units, saw cut from whole units, shall be fitted into gaps around the perimeter and around service installations such as manholes. Any space, of which the size is less than 25% of the size of an unbroken block, shall be filled with 35/12 G50 concrete. The area shall be laid as far as possible using whole paving blocks. Infilling shall be completed before compaction commences.

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 low amplitude.

The compactor's plate surface shall be 0.2 m² to 0.4 m² and it shall develop a centrifugal force of 7 kN to 16 kN.

After compaction of the pavement as described above, dry 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 compactor.

**25.4.2.4    Edge Beams and Intermediate Beams**

Cast in-situ or prefabricated concrete edge beams and 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.

Expansion joints shall be placed every 6 m. The expansion joint should be 10 mm wide and shall be filled with an approved dark grey coloured polysulphide sealant.

**25.4.2.5    Tolerances**

The completed concrete block paving shall comply with the following construction tolerances:

**TABLE 25/11  
CONCRETE BLOCK PAVING CONSTRUCTION TOLERANCES**

LINE OF PATTERN	TOLERANCES
Maximum deviation from any 3 m straight line	10 mm
Maximum deviation from any 20 m straight line	20 mm
Vertical:	
Vertical deviation from a 3 m straight-edge	± 3 mm
At the edge beams	0 mm
Elsewhere	± 10 mm
Maximum difference in the surface levels of adjacent units	5 mm

**25.5            ROAD MARKINGS**

**25.5.1        Materials**

**25.5.1.1     Retro-reflective Road Marking Paint**

Retro-reflective road-marking paint shall comply with the requirements of SANS 731-1 and CKS 192. The no-pick-up time of road marking paint shall comply with the Class 1 requirement in SANS 731-1.

The paint shall be delivered to the Site in sealed containers marked in accordance with SANS 731-1. The viscosity of the paint shall be such that it can be applied without being thinned down.

**25.5.1.2 Colour**

The colours to be used shall be bright white, yellow or red, as specified in SANS 731-1.

**25.5.2 Weather Limitations**

Road-marking paint shall not be applied to a damp surface or at temperatures lower than 10°C, or when, in the opinion of the Engineer, the wind strength is such that it may adversely affect the painting operations.

**25.5.3 Equipment for Painting**

The equipment shall include an apparatus for cleaning the surfaces and all additional hand-operated equipment necessary for completing the work.

**25.5.4 Surface Preparation**

Before the paint is applied, the surface shall be clean and dry and completely free from any soil, grease, oil, acid or any other material which would 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. Where road markings are to be applied to a concrete pavement, all laitance and loose curing compound shall first be removed.

**25.5.5 Setting Out the Road Markings**

The dimensions and positions of road markings shall be as shown on the Drawings or as specified in the appropriate statutory provisions and the South African Road Traffic Signs Manual. The lines, symbols, figures or marks shall be pre-marked 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 pre-markings shall be agreed 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 agreed by the Engineer before painting is commenced.

**25.5.6 Applying the Paint**

The figures, letters, signs, symbols, broken or unbroken lines or other marks shall be painted as shown on the Drawings or as directed by the Engineer. Where the paint is applied by machine, it shall be applied in one layer. Before the road-marking machine is used, 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 agreed to by the Engineer after testing, may the machine be used on permanent work. The operator shall be experienced in the use of the machine.

Where two or three lines are required next to each other, the lines shall be applied simultaneously by the same machine. The paint shall be stirred before application in accordance with the manufacturer's instructions. Paint 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 the road, the paint shall be applied with one stroke only of the brush or roller. Ordinary road-marking paint shall be applied at a nominal rate of 0.42 ℓ/m<sup>2</sup> or as directed by the Engineer. Unless otherwise prescribed by the Engineer, the road marking shall be completed before a particular section of the road is opened to traffic. Each layer of paint shall be continuous over the entire area being painted.

### **25.5.7 Tolerances**

Road markings shall be constructed within the tolerances given in Clauses 25.5.7.1 to 25.5.7.4.

#### **25.5.7.1 Width**

The width of lines and other markings shall not be less than the specified width, nor shall it exceed the specified width by more than 10 mm.

#### **25.5.7.2 Position**

The position of lines, letters, figures, arrows, retro-reflective road studs and other markings shall not deviate from the true position by more than 100 mm in the longitudinal and 20 mm in the transverse direction.

#### **25.5.7.3 Alignment of Markings**

The alignment of the edges of longitudinal lines shall not deviate from the true alignment by more than 10 mm in 15 m.

#### **25.5.7.4 Broken Lines**

The length of segments of broken longitudinal lines shall not deviate by more than 150 mm from the specified length.

#### **25.5.7.5 Applying the retro-reflective beads**

The rate of application of the beads shall be 0.8 kg/ℓ of paint.

### **25.5.8 Road-studs**

Roadstuds shall be of the type indicated and shall be fixed in the position indicated and approved by the Engineer.

The roadstuds shall be fixed by means of an approved epoxy resin in accordance with the manufacturer's instructions, subject to such amendments to the method as may be required by the Engineer. The studs shall be protected against impact until the adhesive has hardened. Before fixing the roadstuds, the surface shall be thoroughly cleaned.

Permanent roadstuds shall be fixed after the painting of the road lines. Painting over roadstuds is strictly prohibited.

## **25.6 ACCOMMODATION OF TRAFFIC**

The following methods shall be used to accommodate traffic:

- Half width – stop/go arrangement; and
- Full width deviation (gravel).

The sign sequences of all the above have been shown on the Drawings.

### **25.6.1 Scope**

This part of Section 25 covers the construction and maintenance of the necessary temporary deviations and detours, barricades and signs, and measures necessary for the safe and easy passage of all public traffic during the construction and maintenance periods, and also the obliteration of temporary deviations as they become redundant. This part also covers the accommodation of traffic on existing roads without the deviation of traffic on to temporary deviations.

### **25.6.2 General Requirements**

#### **25.6.2.1 Safety**

The Contractor shall be responsible for the safe and easy passage of public traffic past and/or over sections of roads in which he is working. The Contractor shall at all times in all his operations and in using his constructional Plant take the necessary care to protect the public and to facilitate the normal flow of traffic.

The Contractor may not commence with any part of such works before he has made adequate provision for the accommodation of traffic.

#### **25.6.2.2 Access to Properties**

The Contractor shall also provide access to persons whose properties fall within or adjoin the area over which he is working. No separate payment will be made for the provision and maintenance of such accesses and facilities, except where it may be required outside the pipeline servitude.

#### **25.6.2.3 Road and Rail Traffic Supervisor**

The safety of the traveling public is of utmost importance and every effort must be made to ensure that all road signs, barricades, delineators, flagmen and speed controls are maintained and effective and that courtesy is extended to the public at all times.

The Contractor shall appoint a knowledgeable member of his staff on Site (the Road and Rail Traffic Supervisor) who shall be the responsible person for the arrangements and maintenance of all accommodation of traffic measures required for the duration of the Contract. The responsible person shall liaise daily with the Engineer in order to maintain proper traffic arrangements.

PART C3.1 - SPECIFICATION

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The Supervisor will be required to perform the following duties and this list shall not be deemed to be comprehensive. He shall:

- a) Be responsible for keeping the temporary traffic accommodation requirements up to specification 24 hours a day 7 days a week;
- b) Compile and maintain a complete daily record of traffic signs installed and the traffic signs sequence at each location during the execution of the Contract;
- c) Inspect and report to the Engineer on the state of all required road signs as often as the Engineer may require but in any event not less than once a day or at such other intervals as may be specified;
- d) Exercise control in terms of traffic safety over the safe movement of personnel, visitors and Plant on Site including the wearing of high visibility clothing, the operation of amber flicker lights, and the display and cleanliness of "construction vehicle" signs, all in accordance with the relevant Occupational Health and Safety act and Regulations;
- e) Be responsible for keeping all road signs and traffic cones clean and visible at all times. The Contractor shall remove all bituminous and other foreign matter from road signs and traffic cones or provide new road signs and traffic cones all at his own cost, and all as directed by and to the satisfaction of the Engineer;
- f) Compile complete records of traffic accident scenes which are in any way connected with construction activities, and draw up accident reports (including' inter alia, photographs);
- g) Attend to the training and performance of flagmen and all other personnel involved in the control of traffic; and
- h) Attend to all complaints and claims from the public with regard to traffic safety and report on such matters to the Engineer.

### **25.6.3 Temporary Traffic-control Facilities**

The Contractor shall provide, erect and maintain the necessary traffic-control devices, road signs, channelization devices, barricades, warning devices and road markings (hereinafter referred to as traffic-control facilities), as shown on the Drawings and in accordance with the South African Road Traffic Signs Manual, and shall remove them when no longer required. It shall be incumbent upon the Contractor to see to it that the traffic control facilities are present at all times and are functioning properly, and, prior to any section of the road which requires the above facilities being opened to traffic, the Contractor shall submit his design of the temporary works in this regard to the Engineer for his approval.

The Contractor shall immediately make good any shortcomings to the temporary traffic-control facilities. Road signs, channelization devices and barricades no longer required may be moved for re-use, and, if no longer suitable for use, replaced without any additional compensation if they are required for re-use.

The type of construction, spacing and placement of traffic-control facilities shall be in accordance with the prescriptions and recommendation of the latest edition of the South African Road Traffic Signs Manual, and in accordance with the Drawings. The various traffic-control facilities which may be required are given in Clauses 25.6.3.1 and 25.6.3.2.

#### **25.6.3.1 Traffic-control Devices**

Traffic-control devices include the use of flagmen, portable "STOP" and "GO / RY" signs, and traffic signals, whichever may be the most suitable method under prevailing circumstances. Traffic signals



PART C3.1 - SPECIFICATION

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shall be erected in compliance with the design of the temporary works or if so specified on the Drawings or upon an instruction in writing, by the Engineer.

If the road is partially closed and one-way traffic only is allowed over a section of road of which the length exceeds 250 m, the traffic shall be regulated by flagmen and STOP and GO-RY signs at both ends of such section. If it is necessary for effective communication between the flagmen only, an approved two-way communication system shall be in operation at the control points. If the closure extends into the night, lighting and temporary traffic signals shall be provided or a deviation needs to be constructed.

**25.6.3.2 Warning Devices**

All construction vehicles and Contractor's equipment used on the Works shall be equipped with rotating amber flashing lights. All lights shall be visible at all times and from all sides. The flashing lights shall be switched on at all times when the vehicles and equipment are used on the Site for the execution of the Works.

No separate payment will be made for the supply of flashing lights and the installation thereof on construction vehicles and equipment.

**25.6.4 Roads Constructed in Half Widths**

Where, by reason of difficult terrain or for any other reason, the construction of temporary deviations is unfeasible, the Contractor shall, upon the written instruction of the Engineer, construct the road in half widths to allow traffic to use that half of the road not under construction. The length of the half-width construction shall not exceed the length of the section of road that can be constructed and completed in one day. Provision shall be made for traffic traveling in opposite directions to pass at frequent intervals.

The Contractor shall ensure that the entire road width shall be open at night and shall be left, at the end of each day's work, in a good and safe trafficable condition to the satisfaction of the Engineer. See note under traffic control devices above.

During the day the traffic shall be controlled by a STOP and RY / GO system.

Should the road be not in a safe trafficable condition for two-way traffic over the entire width at the end of each day's work, the Contractor shall provide adequate flagmen, signs, barricades, lights and the necessary staff at his own cost to ensure a reasonably free flow of traffic alternately in each direction throughout the entire period when the roadway is open to one-way traffic only.

**25.6.5 Pipe Road Crossings - full width deviation**

Where the pipeline crosses the road, full width deviations shall be constructed 8 m wide with a pavement as follows:

- 150 mm gravel Wearing Course compacted to 93% of Modified AASHTO density;
- 150 mm selected layer compacted to 93% of Modified AASHTO density (G7 material);
- Fill layers if required compacted to 90% of Modified AASHTO density; and
- Roadbed preparation and compaction to 90% of Modified AASHTO density.

Proper signage will be erected as shown on the Drawings and the Engineer may order additional signs from time to time. A lump sum amount will only be paid once for the erection and dismantling of road signs at these crossings. This lump sum will only apply to sites where the pipe crosses existing roads.

**25.7 OVERHAUL**

Overhaul distances will be measured to the nearest 0.1 km from the end of the 1.0 km free haul, using the shortest practical route agreed with the Engineer from the point of loading to the point of dumping in one direction only as follows (Distance categories to follow the free haul):

- a) Between 1 km up to and including 3 km
  - b) Between 3 km up to and including 5 km
  - c) Between 5 km up to and including 7 km
  - d) Between 7 km up to and including 9 km
  - e) Between 9 km up to and including 11 km
  - f) Between 11 km up to and including 13 km
  - g) Distances further than 13 km
- Unit: m<sup>3</sup>.km

The rate tendered shall include full compensation for all costs associated with loading, transporting and tipping of material applicable to the greater distance in a distance category over and above the free haul distance, including equipment, materials, fuel and personnel.

The haul distance for cut and borrow material shall be measured along the shortest route determined by the Engineer as being feasible and satisfactory. 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 designated by the Engineer.

Overhaul of material in excess of that required or for a further distance as may be necessary for the completion of the Works or otherwise not authorized by the Engineer will not be measured for payment purposes.

No payment will be made against this item for overhaul of material used for reinstatement of Contractor’s working and accommodation areas (including the areas designated for the Engineer’s use) and temporary roads.

**25.8 MEASUREMENT AND PAYMENT**

The rates tendered under this Section shall not include for the general obligations, Contractor’s Equipment and work deemed to be covered by the items provided in Section 1 - General.

The provision of material will be paid for, once only.

**25.001 Pavement layers constructed from gravel material**

- |                          |                                     |
|--------------------------|-------------------------------------|
| a) Selected layer        | Unit: cubic metre (m <sup>3</sup> ) |
| b) Subbase layer         | Unit: cubic metre (m <sup>3</sup> ) |
| c) Gravel wearing course | Unit: cubic metre (m <sup>3</sup> ) |

<b>d) Shoulder</b>	<b>Unit: cubic metre (m³)</b>
<b>e) Insitu-Layer</b>	<b>Unit: cubic metre (m³)</b>

Measurement will be the volume of material, calculated from the dimensions and levels given on the Drawings for that layer. A distinction will be made between subbase, base, shoulder and gravel wearing course layers.

The rates for (a) - (e) above shall cover the cost of selecting and taking delivery and loading of material excavated from borrow pits in the designated borrow area(s), or of selecting and loading the material at stockpiles. In all cases the rates shall also include for haulage, production of crushed material, preparing, spreading, breaking down by grid rolling, compacting to required densities, slushing and testing materials, removal to spoil of oversize material, and protecting and maintaining the layer works. The rates tendered shall include full compensation for all work required to construct layer works.

The Contractor shall note in particular that material for the selected fill, and subbase, for road layers shall be obtained from excavations for structures or stockpiled material removed during excavations.

**25.002 Excavation and fill for layer works**

<b>a) Cut to Fill</b>	<b>Unit: cubic metre (m³)</b>
<b>b) Cut to Spoil</b>	<b>Unit: cubic metre (m³)</b>
<b>c) Cut to Stockpile</b>	<b>Unit: cubic metre (m³)</b>

The unit of measurement shall be the cubic metre of excavation. The rate tendered shall include full compensation for all work required to excavate for the layer works as indicated on the Drawings in all materials and load, including excavation in stages where required, trimming and preparation of exposed surfaces and foundation surfaces, any overbreak, temporary support of excavated surfaces and any protective measures provided and for temporary stockpiling of material to suit the Contractor's method of working. No payment will be made for overbreak.

**25.003 Extra over 25.001(b) for constructing a chemical stabilised layer**

<b>a) Subbase layer</b>	<b>Unit: cubic metre (m³)</b>
-------------------------	-------------------------------

The unit of measurement shall be the cubic metre of stabilised material, the quantity of which shall be determined in accordance with the dimensions of the layers treated as indicated on the Drawings or instructed by the Engineer.

The tendered rate for chemical stabilisation shall be paid as extra over the rate tendered for constructing the un-stabilised layer. The tendered rate shall therefore include full compensation for spreading and mixing the stabilising agent, curing the stabilised sections, any extra water and watering required, and all materials, supervision, labour, Plant, equipment, tools and incidentals necessary for completing the specified work. The rate shall exclude the supply of the stabilising agent.

**25.004 Extra over 25.001(b) for constructing a chemical stabilised layer****a) Common cement to SANS (CEM II / B-V 32.5)****Unit: tonne (t)**

The unit of measurement shall be the tonne of stabilising agent provided as per specification.

The tendered rate shall include full compensation for providing the stabilising agent at the Works, including correct placing on the layer concerned irrespective of the rate of application specified or ordered by the Engineer, and shall make allowances for the mixing and compaction times specified for the stabilising agent.

**25.005 Trenching in layer works****Unit: cubic metre (m<sup>3</sup>)**

The unit of measurement will be the volume material excavated in the layerworks as indicated on the Drawings. The rates tendered shall include for all work required undertaking the necessary trenching as in indicated on the Drawings including the protecting and maintaining of the layerworks and removal of excavated materials to spoil.

**25.006 Terrain modification on Site****Unit: cubic metre (m<sup>3</sup>)**

If before, during or after the roadworks construction has commenced the Engineer orders material to be excavated or reshaped adjacent to the roadworks, a payment for the volume of material shall be made.

The rate shall include full compensation for the excavation or reshaping of material, loading and hauling the excavated material to the designated borrow and spoil dumps, offloading, spreading, shaping, watering and random compaction (or compaction to the density specified), and removal of loose material and any protective measures provided. No payment will be made for overbreak.

**25.007 Temporary traffic-control facilities**

- |   |                  |
|---|------------------|
| <b>a) Flagmen</b>   | <b>Unit: sum</b> |
| <b>b) Road signs</b>  | <b>Unit: sum</b> |
| <b>c) Amber flicker lights</b>  | <b>Unit: sum</b> |
| <b>d) Delineators</b>   | <b>Unit: sum</b> |
| <b>e) Barricading</b>   | <b>Unit: sum</b> |
| <b>f) Two-way communication devices</b>   | <b>Unit: sum</b> |
| <b>g) Personnel to manage and maintain temporary traffic-control facilities</b> | <b>Unit: sum</b> |
| <b>h) All other items not listed above</b>                                      | <b>Unit: sum</b> |

The tendered sum amounts for the respective traffic control facilities shall include full compensation for the design of the temporary works, supply and initial erection complete with posts, stakes, portable stands and sandbags as may be required, for cleaning and maintenance, for covering with non-transparent material when temporarily not required and removal off the Site when no longer required. 75% of the tariff will be payable when the items have been provided and erected in position for their first use on Site and 25% when finally removed from the Site. Facilities which become unserviceable or are damaged by vehicles or stolen, in particular delineators, shall be

## PART C3.1 - SPECIFICATION

replaced promptly at no additional cost. Refer to Clause 25.6.3 for compliance requirements and reference to applicable standards.

Road signs, channelization devices and barricades no longer required in each instance may be moved for re-use but, if no longer suitable for use, they shall be replaced without any additional compensation if they are required for re-use.

**25.008 Relocating of traffic-control facilities for:****Unit: lump sum****a) Maintenance for existing roads.**

The tendered lump sum shall include full compensation for dismantling, storing if necessary, transporting, re-erecting and inspecting the traffic-control facilities, and for all labour, equipment, constructional Plant and incidentals necessary to execute the work complete as specified or shown on the Drawings. This amount will be paid in proportion to the time expired contractually and the total amount is tendered for all signs to be erected whenever required.

**b) Full width deviations where the pipe crosses the road.**

The tendered lump sum shall include full compensation for dismantling, storing if necessary, transporting, re-erecting and inspecting the traffic-control facilities, and for all labour, equipment, constructional Plant and incidentals necessary to execute the work complete as specified or shown on the Drawings. The tendered amount will be paid per site and at each crossing.

**25.009 Concrete block paving (80 mm interlocking blocks)****Unit: square metre (m<sup>2</sup>)**

The unit of measurement shall be the square metre of completed concrete block paving. The quantity shall be calculated from the dimensions shown on the Drawings or authorised by the Engineer.

The tendered rate shall include full compensation for the furnishing of all materials, constructing the sand bedding, laying and compacting the concrete paving blocks, filling the joints with jointing sand, and for all other work necessary to complete the concrete block paving as specified.

**25.010 Concrete edging****(a) Cast in-situ edges****Unit: cubic metre (m<sup>3</sup>)****(b) Precast Figure 7 kerbs****Unit: metre (m)**

The unit of measurement shall be the cubic metre of concrete in edge and intermediate beams. The quantity shall be calculated from the dimensions shown on the Drawings or authorised by the Engineer.

The tendered rate shall include full compensation for the furnishing of all materials, constructing the edge and intermediate beams complete as specified, including all excavation and backfilling in all classes of material.

**25.011 Priming of subbase using Invert Emulsion Prime (Cationic) at 0.70 litres/m<sup>2</sup>****(a) Of subbase** **Unit: square metre (m<sup>2</sup>)**

The unit shall be the square metre of subbase primed. The rate shall cover all items including supply of prime, protection to kerbing, etc. to carry out the priming at the specified application rate.

**25.012 Provision of approved herbicide and ant poison****(a) Provision of materials** **Unit: provisional sum (PS)****(b) Contractor's charges and profit to be added to the prime cost sum** **Unit: per cent (%)**

Payment under the prime cost sum for providing ant poison and herbicide and the Contractor's costs and profit in this respect shall be made in accordance with the provisions of the General Conditions of Contract. In addition, the Contractor's tendered rate for costs and profit shall include full compensation for applying the chemicals as specified.

**25.013 Application of approved herbicide and ant poison** **Unit: square metre (m<sup>2</sup>)**

The unit shall be the square metre of herbicide and ant poison applied. The rate shall cover all items to apply the herbicide and ant poison in accordance with the supplier's specifications.

**25.014 Road markings: Retro-reflective road marking paint****(a) White lines (broken or unbroken) (100 mm)** **Unit: metre (m)****(b) Yellow lines (broken or unbroken) (100 mm)** **Unit: metre (m)****(c) White lettering and symbols** **Unit: square metre (m<sup>2</sup>)**

Measurement for painting the lines will be the metre of line painted. The quantity paid for will be the actual length of line painted in accordance with the Drawings or instructions of the Engineer, excluding the length of gaps in broken lines.

The unit of measurement for painting the lettering and symbols will be the square metre, and the quantity to be paid for will be the actual surface area of lettering and symbols completed.

The rate tendered per metre or per square metre as the case may be for painting the traffic markings will include full compensation for procuring and furnishing all material, including the retro-reflective beads in the case of retro-reflective paint, and the necessary painting equipment, and for painting, including the setting-out of lettering and symbols and setting out and pre-marking the lines.

**25.015 Road studs (type stated)** **Unit: number (No)**

The unit of measurement for road studs shall be the actual number of approved road studs placed.

The tendered rate shall include full compensation for procuring and furnishing all the necessary material, labour and equipment, and for fixing and maintenance as specified. Distinction shall be made between various types of road studs.

**25.016 Gravelling and repair of temporary deviations****Unit: cubic metre (m<sup>3</sup>)**

The unit of measurement shall be the cubic meter of gravel provided as wearing course for the surfacing of temporary deviations, computed from the dimensions of the layer as actually constructed in place, in accordance with the Engineer's instructions.

Where measurement by the above method is considered to be impracticable by the Engineer, the volume may be computed by taking 70% of the loose volume of the gravel as measured in the hauling vehicles.

The tendered rate shall include full compensation for procuring, furnishing, placing and compacting the gravel wearing course, including the subgrade preparation, including a free-haul distance of 1,0 km, and the repair of local sections of the temporary deviations.

**25.017 Watering of temporary deviations****Unit: Lump sum (Sum)**

The unit of measurement shall be the kilolitre of water applied to the temporary deviations during the use of the deviation on the written instruction of the Engineer. Water required for the construction of temporary deviations will not be measured for payment.

The tendered rate shall include full compensation for the supply, transport and application of the water. Overhaul shall not apply to transporting the water used for the watering of temporary deviations.

**25.018 Overhaul on material hauled in excess of 1.0 km****Unit: cubic metre (m<sup>3</sup>)**

Overhaul distances will be measured to the nearest 0.1 km from the end of the 1.0 km free haul, using the shortest practical route agreed with the Engineer from the point of loading to the point of dumping in one direction only as follows (Distance categories to follow the free haul):

- a) Between 1 km up to and including 3 km
  - b) Between 3 km up to and including 5 km
  - c) Between 5 km up to and including 7 km
  - d) Between 7 km up to and including 9 km
  - e) Between 9 km up to and including 11km
  - f) Between 11 km up to and including 13 km
  - g) Distances further than 13 km
- Unit: m<sup>3</sup>.km

The rate tendered shall include full compensation for all costs associated with loading, transporting and tipping of material applicable to the greater distance in a distance category over and above the free haul distance, including equipment, materials, fuel and personnel. Overhaul of material in excess of that required or for a further distance as may be necessary for the completion of the Works or otherwise not authorized by the Engineer will not be measured for payment purposes.

No payment will be made against this item for overhaul of material used for reinstatement of Contractor's working and accommodation areas (including the areas designated for the Engineer's use) and temporary roads.

**25.019 Road signs**

Road sign boards with painted or coloured semi-matt background. Symbols, lettering and borders in semi-matt black or in Class 1 retro-reflective material, where the sign board is constructed from:

- a) Aluminium sheet (2.0mm thick) - Area not exceeding 2 m<sup>2</sup> **Unit: Square metre (m<sup>2</sup>)**

**Extra over item a) for using:**

- b) Painting and Lettering:
- i) Background of retro-reflective material Class III (COLTO) **Unit: Square metre (m<sup>2</sup>)**
  - ii) Lettering, symbols, numbers, arrows, emblems and borders of retro-reflective material Class III **Unit: Square metre (m<sup>2</sup>)**

**Road sign supports (overhead road sign structures excluded):**

- c) Timber Posts **Unit: metre (m)**
- d) Excavation and backfilling for road sign supports (not applicable to kilometre posts) **Unit: Cubic metre (m<sup>3</sup>)**
- e) Extra over item (d) for cement-treated soil backfill **Unit: Cubic metre (m<sup>3</sup>)**
- f) Extra over item (d) for rock excavation **Unit: Cubic metre (m<sup>3</sup>)**

The rates tendered shall include full compensation for all costs associated for the item.

**25.020 Finishing to sides of roads****Unit: kilometre (km)**

Finishing the road and road reserve - Single-carriageway road.

The rate tendered shall include full compensation for all costs associated with scarifying, shaping transporting, tipping and spreading of topsoil.

**25.021 Guard rail****Unit: metre (m)**

The rate tendered shall include full compensation for all costs associated with guard rails complete as per drawing 2A-C6-007, including fixing to concrete base, the concrete base, treated timber posts, reflectors, closed ends, hot dip galvanising finishes, galvanised nuts, bolts and washers, trenching, backfilling, bending to all radiuses for curved guard rails, etc.