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COTO

Committee of Transport
Officials

Standard Specifications for Road and Bridge Works for State Road Authorities

**Committee Draft Final (CDF)
CHAPTER 11: ANCILLARY ROAD
WORKS
August 2019**

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Comments

Comments on the Chapters must be provided in writing as per the format provided on the SANRAL website www.nra.co.za and e-mailed to cotorevision@nra.co.za no later than **04 October 2019**.

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CHAPTER 11: ANCILLARY ROAD WORKS

A11.1 PITCHING, STONEMWORK, CAST IN SITU CONCRETE FOR PROTECTION AGAINST EROSION

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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. *Revised stone mass from 10 to 8,0 kg and vertical dimension*

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 hand-ramming 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)(i) 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)(ii) 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.

A11.1.7.4 Stone Masonry Walls

a) General

Stone masonry walls may be plain packed stone walls with mortared stone walls with stones bedded in cement mortar as specified and indicated on the drawings.

b) Plain packed stone walls

A foundation trench shall be excavated down to rock, or to material with an adequate bearing capacity at a minimum depth of 300 mm below ground level or as indicated on the drawings. Large selected stones shall be used for the foundation layer. Thereafter flat and stratified stones shall be laid with the largest dimension in the horizontal plane. Stones shall be packed individually to stagger the joints and to provide a minimum of voids, and shall be firmly bedded against adjoining stones. The spaces between the larger stones shall be filled with spalls securely rammed into place. The larger stones shall not bear on the spalls used for filling the voids. The top and ends of the wall shall be neatly finished with selected coping stones.

The appearance of the completed wall shall present an even, tight surface.

c) Cement-mortared stone walls

The foundation and walling shall be constructed as specified for plain packed walls in Clause A11.1.7.4b), with the exception that the stones, including the foundation layer, shall be wetted and set in a mortar bed. The exposed parts of the stones on the wall faces shall be cleaned of all mortar by washing or wire-brushing. The mortar shall be flush pointed to the specification of the Engineer, who may require a capping and end treatment of the same mortar.

Weep holes shall be provided as prescribed and shall be cleaned of mortar or any other clogging material that may have entered during construction.

The walling shall be protected from the elements and kept moist for a minimum period of four days after completion.

A11.1.7.5 Concrete pitching

a) General

The underlying layers for surfaces to be pitched shall be constructed as specified or as indicated on the drawings. Where no specified requirements have been set in respect of the underlying layers, the top layer shall be mechanically compacted to at least 93 % of MDD down to at least 150 mm from the top. During this process the top layer shall be trimmed to the required grades and levels.

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

b) Edge beams

Concrete edge beams or any such other edge supports shall be constructed onto the supporting layer in accordance with the details shown on the drawings and shall be constructed and left to cure before any paving blocks are laid.

c) Concrete grass blocks

Concrete grass blocks of the size specified or shown on the drawings shall be placed on areas prepared for grassing as specified in Section A11.8. The holes in the blocks shall be filled with topsoil, and grassed with grass cuttings or hydroseeding as specified in Section A11.8.

A11.1.7.6 Cast in situ concrete pitching

The areas where cast in situ concrete pitching is to be constructed shall be compacted, trimmed and prepared as described in Clause A11.1.7.5a). The areas shall also be treated with vegetation destroyer and ant poison if required.

Prior to placing the concrete, the surface shall be watered and kept damp until the concrete has been placed. Where specified, steel reinforcing of the type specified shall be placed at the required location and depth. Unless otherwise specified, class C20/25-20 concrete shall be used, and the concrete shall be accurately laid in alternate panels to the lines and levels indicated, after which the remaining panels shall be similarly placed. Accurately set-up guides shall be used to achieve the required line and slope. The concrete shall be thoroughly compacted and finished to a class U2 surface finish.

Where indicated, the concrete pitching shall be contained by concrete edge beams being constructed as described in Clause A11.1.7.5b).

The concrete pitching shall be cured for at least seven days and no traffic shall be allowed to move across the surface before the specified 28-day strength has been reached.

The final surface may nowhere deviate by more than 25 mm from the specified levels and planes, and no irregularities exceeding 10mm may occur during testing with a 3,0 m straightedge.

A11.1.8 WORKMANSHIP

A11.1.8.1 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 will meet the specified requirements for the particular layer for which it will be used.

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.

A11.1.8.2 Finishing requirements: Grass-block pavement

The completed grass-block pavement shall have a neat and even appearance. The final surface of the pavement may not deviate by more than 15 mm from the specified levels and planes over the entire surface.

B11.1 PITCHING, STONEMASONRY, CAST IN SITU CONCRETE FOR PROTECTION AGAINST EROSION

PART B: LABOUR ENHANCEMENT

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B11.1.8	WORKMANSHIP

B11.1.1 SCOPE

This Section covers the furnishing of materials and the construction of protective coverings using stone, cast in situ concrete, bricks or prefabricated concrete blocks 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 by the Engineer

This Section therefore 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. This Section includes concrete mixed by hand.

B11.1.2 DEFINITIONS

The provisions of Part A, shall apply.

B11.1.3 GENERAL

The provisions of Part A, shall apply.

B11.1.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

The provisions of Part A, shall apply.

B11.1.5 MATERIALS

B11.1.5.1 General material specifications

When packed riprap is constructed using labour enhanced construction methods, the stone for the riprap shall have a maximum size of 0,03 m³ or a maximum mass of 30 kg.

B11.1.5.2 Concrete

a) Concrete mixing by hand

Concrete may be mixed by hand or in hand-turned concrete mixers for small pours up to one (1) cubic metre. Larger pours greater than one cubic metre shall be machine mixed with on-site mechanical mixers and/or batch plants.

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.

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.

B11.1.6 CONSTRUCTION EQUIPMENT

The provisions of Part A, shall apply.

B11.1.7 EXECUTION OF THE WORKS

B11.1.7.1 Classification 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 B11.1.7-1 or, if the Contractor does not agree with the classification, in terms of Table B11.1.7-2. 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 B11.1.7-1: 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 B11.1.7-2: 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.

B11.1.7.2 Concrete mixing by hand

The sand shall be measured off, tipped onto the mixing floor and spread in a circle. The cement (one or two whole sacks, as required by the mix design) shall then be spread evenly across the sand and mixed in with shovels, turning the mixture into the middle of the circle and out again. When the colour is even, the mix shall be shaped with a hollow in the centre.

Part of the mixing water shall be poured into the hollow and mixed in. More water shall be slowly added and mixed in until all the water has been added. The materials shall be turned into the middle of the circle and out again at least twice. The mix should be soft and even with no dry patches. The mix shall then be spread in a circle.

The stone shall be measured off and spread evenly across the mortar and mixed with shovels, by turning the mixture into the middle and out again at least twice. Concrete shall be properly mixed to a uniform consistency without fatty or harsh patches. The total period between the times that the cement is placed into the mix until mixing starts shall not exceed 15 minutes.

If specified, concrete shall be transported by wheelbarrows up to a maximum haul distance of 50 m. When the haulage exceeds 50 m, the concrete shall be transported by dumper or other means for the full distance.

B11.1.8 WORKMANSHIP

The provisions of Part A, shall apply.

C11.1 PITCHING, STONEMWORK, CAST IN SITU CONCRETE FOR PROTECTION AGAINST EROSION

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.

(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).
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 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, 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 C11.1-1: Items from other Chapters or Sections

Activity	Section 11.1 Clause reference	Section – item reference
Clearing and grubbing and removal of trees	A11.1.7.1	C1.6 of Chapter 1
Loading and hauling	A11.1	C1.7 of Chapter 1

(v) **Items specifically for this section of the specifications**

Item	Description	Unit
C11.1.1	Foundation trenches for stone masonry walls	
C11.1.1.1	Excavating foundation trenches in soft material using labour enhanced construction methods 0 m to 1,0 m depth	cubic metre (m ³)
C11.1.1.2	Excavating foundation trenches in intermediate material using labour enhanced construction methods 0 m to 1,0 m depth	cubic metre (m ³)

The unit of measurement shall be the cubic metre of material excavated for foundation trenches in accordance with the authorised dimensions, measured in place before excavation.

Excavations shall be done using labour enhanced construction methods as specified and measured.

The tendered rates shall include full compensation for the excavation of the foundation trenches to the required dimensions, lines, levels and grades, the trimming of the open drain and the loading and disposal of the material as directed.

Loading and hauling, where applicable, including a haul of 1,0 km, shall be measured and paid as specified in 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.

Item	Description	Unit
C11.1.2	Stone pitching	
C11.1.2.1	Plain stone pitching	
(a)	Method 1	square metre (m ²)
(b)	Method 2	square metre (m ²)
C11.1.2.2	Grouted stone pitching with mortar	square metre (m ²)
C11.1.2.3	Grouted stone pitching on a concrete bed	square metre (m ²)

The unit of measurement for pitching shall be the square metre of each type of pitching in place.

The tendered rate for each type of stone pitching shall include full compensation for furnishing all materials, making all excavations excluding trench and bulk excavations, compacting and trimming the excavated surfaces, forming the joints, placing stones and grouting, or wiring and grouting where applicable grassing and watering (applicable to Method 2) and for all other work necessary for completing the pitching as specified. The tendered rate for grouted stone pitching on a concrete bed shall also include full compensation for the concrete bed.

The tendered rates shall also include full compensation for mixing and/or procuring concrete, mortar and grout as indicated.

Excavations for foundation trenches and concrete edge beams and the construction of the concrete edge beams will be paid for separately.

Item	Description	Unit
C11.1.3	Riprap	
C11.1.3.1	Packed riprap ("critical mass of stone" and thickness indicated)	cubic metre (m ³)
C11.1.3.2	Extra over item C11.1.3.1 for constructing packed riprap using labour enhanced construction methods (Maximum size of stone shall be 0,03 m ³ or a maximum mass of 30 kg)	cubic metre (m ³)
C11.1.3.3	Dumped riprap (critical mass of stone and thickness indicated)	cubic metre (m ³)
C11.1.3.4	Filter layer consisting of:	
(a)	Crushed stone	cubic metre (m ³)
(b)	Filter sand	cubic metre (m ³)
(c)	Geotextile (type, class and grade stated)	square metre (m ²)

The tender rate for item C11.1.3.4(a) and (b) will be as specified in Clause A3.1.5.2b) of Chapter 3 and A11.1.7.2b).

The unit of measurement for riprap and filter layer shall be the cubic metre of riprap or filter layer in place and shall include rock used in trench backfill. The unit of measurement for item C11.1.3.4(c) shall be the square metre of geotextile laid as specified, including overlaps.

Item C11.1.3.2 is an extra over item which will be paid if instructed to construct packed riprap using labour enhanced construction methods.

The rates tendered shall include full compensation for preparing the surfaces, including excavation (but excluding excavation for trenches and bulk excavations) and for the furnishing, transporting, handling and placing of riprap or filter layers. The rate tendered for item C11.1.3.4(c) shall include full compensation for procuring and furnishing the geotextile and for laying it as specified, including wastage. Collectively the rates shall also include full compensation for all other incidentals necessary for completing the work as specified.

Excavations for foundation trenches and bulk excavation will be paid for separately.

Item	Description	Unit
C11.1.4	Stone masonry walls:	
C11.1.4.1	Plain packed stone walls	cubic metre (m ³)
C11.1.4.2	Cement-mortared stone walls	cubic metre (m ³)
C11.1.4.3	Extra over items C11.1.4.1 and C11.1.4.2 for procuring stone from commercial sources	cubic metre (m ³)

The unit of measurement for stone masonry walls shall be the cubic metre of actual walling constructed and accepted.

The tendered rate for each type of stonewall shall include full compensation for furnishing all materials, trimming the areas, placing the stones and cement-mortared masonry where necessary, and all other work necessary for completing the walls in accordance with the specifications. Excavation of foundation trenches and bulk excavations will be paid for separately.

The tendered rates shall also include full compensation for mixing and/or procuring concrete, mortar and grout as indicated.

The tendered rate for item C11.1.4.3 shall include full compensation for procuring, furnishing and offloading stone from commercial suppliers, including the cost of transporting the material to the site irrespective of haul distance.

Item	Description	Unit
C11.1.5	Concrete pitching or paving	
C11.1.5.1	Cast in situ concrete pitching or paving (class of concrete and thickness of pitching or paving indicated)	square metre (m ²)
C11.1.5.2	Prefabricated concrete grass blocks (type and thickness indicated)	square metre (m ²)
C11.1.5.3	Welded steel fabric used for cast in situ pitching or paving (type indicated)	kilogram (kg)

The unit of measurement shall be the square metre of each type constructed.

The tendered rates shall include full compensation for furnishing all materials, all excavation (but excluding bulk excavation and excavation for foundation trenches and edge beams), compacting and trimming all the excavated areas, treating the prepared surface with an approved herbicide and ant-poison, laying concrete grass blocks (item C11.1.5.2), topsoiling and grassing, (item C11.1.5.2), constructing concrete pitching or paving, including normal formwork and the shaping of surfaces (item C11.1.5.1), making and cleaning weepholes (item C11.1.5.1) and for all other work necessary for completing the work as specified.

The tendered rates shall also include full compensation for mixing and/or procuring concrete, mortar and grout as indicated.

Welded steel fabric used for cast in situ pitching or paving shall be as specified in Section A13.3 of Chapter 13.

Item	Description	Unit
C11.1.6	Concrete edge beams (class of concrete indicated)	cubic metre (m ³)

The unit of measurement shall be the cubic metre of concrete in edge beams constructed as specified.

The tendered rate shall include full compensation for furnishing all materials and labour, including formwork as necessary, placing concrete and shaping all surfaces and all excavations required. Where excavations cannot be efficiently done by labour then machinery can be employed.

The tendered rates shall also include full compensation for mixing and/or procuring concrete as indicated.

Item	Description	Unit
C11.1.7	Provision of approved herbicide and ant poison:	
C11.1.7.1	Provision of materials	Prime cost sum
C11.1.7.2	Contractor's charges and profit added to the prime cost sum	Percent (%)

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, but, in addition, the Contractor's tendered rate for costs and profit shall include compensation for applying the chemicals as specified.

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D11.1 PITCHING, STONEMWORK, CAST IN SITU CONCRETE FOR PROTECTION AGAINST EROSION

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

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No specific items in this Section.

Where applicable, details must be provided in the Contract Documentation.

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A11.2 NON-STRUCTURAL GABIONS

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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 anti-erosion 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.

Tolerances

Tolerances for gabion and mattress materials and dimensions shall conform to the requirements of EN 10223-3.

B11.2 NON-STRUCTURAL GABIONS

PART B: LABOUR ENHANCEMENT

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B11.2.7	EXECUTION OF THE WORKS
B11.2.8	WORKMANSHIP

B11.2.1 SCOPE

This Section covers the furnishing of materials and the construction of gabion aprons for constructing minor non-structural retaining walls, lining channels, revetments and other anti-erosion and containment structures.

The construction of gabion boxes and mattresses shall be deemed to be a labour enhanced construction process.

This Section therefore 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.

B11.2.2 DEFINITIONS

The provisions of Part A, shall apply.

B11.2.3 GENERAL

The provisions of Part A, shall apply.

B11.2.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

The provisions of Part A, shall apply.

B11.2.5 MATERIALS

The provisions of Part A, shall apply.

B11.2.6 CONSTRUCTION EQUIPMENT

The provisions of Part A, shall apply.

B11.2.7 EXECUTION OF THE WORKS

B11.2.7.1 Classification of excavation

All excavations under this Section shall be classified as specified under Clause B11.1.7.1.

B11.2.8 WORKMANSHIP

The provisions of Part A, shall apply.

C11.2 NON-STRUCTURAL GABIONS

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.

(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).
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 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, 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 C11.2-1: Items from other Chapters or Sections

Activity	Section 11.2 reference	Section Item reference
Loading and hauling	C11.2.1	C1.7 of Chapter 1

(v) **Items specifically for this section of the specification**

Item	Description	Unit
C11.2.1	Foundation trench excavation:	
C11.2.1.1	Excavating 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)
C11.2.1.2	Extra over sub-item C11.2.1.1 for excavation in hard material, irrespective of depth	cubic metre (m ³)
C11.2.1.3	Excavating soft material within 1,5 m below the surface level using labour enhanced construction methods:	cubic metre (m ³)
C11.2.1.4	Excavating intermediate material within 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 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.

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, temporary timbering, shoring and strutting, including unavoidable overbreak, the trimming of the trenches and compacting the trench inverts, backfilling of over excavation and compacting the backfill, keeping excavations safe, dealing with any surface or subsurface water and the loading and disposal of the excess material as directed. The tendered rates shall also include full compensation for any other operations necessary for completing the work as specified, but excluding surface preparation for bedding the gabions.

Loading and hauling, where applicable, including a haul of 1,0 km, shall be measured and paid as specified in 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 above under Classification of Materials.

Item	Description	Unit
C11.2.2	Surface preparation for bedding the gabion boxes and mattresses	square metre (m²)

The unit of measurement for levelling and preparing surfaces for receiving the gabion boxes and mattresses shall be the square metre to the neat dimensions of revetments, aprons or wall foundations.

The tendered rate shall include full compensation for excavating, filling any cavities with rock, and levelling the ground surface so as to be ready for receiving the gabion boxes for retaining walls, aprons and revetments.

Item	Description	Unit
C11.2.3	Gabion boxes and mattresses:	
C11.2.3.1	Galvanized gabion boxes (dimensions of box)	cubic metre (m ³)
C11.2.3.2	PVC coated gabion boxes (dimensions of box)	cubic metre (m ³)
C11.2.3.3	Galvanized gabion mattresses (dimensions of mattress)	cubic metre (m ³)
C11.2.3.4	PVC-coated gabion mattresses (dimensions of mattress)	cubic metre (m ³)

The unit of measurement shall be the cubic metre of the rock-filled boxes or mattresses and the quantity shall be calculated from the dimensions of the gabions indicated on the drawings irrespective of any accepted deformation or bulging of the completed gabions. Gabions boxes and mattresses shall be measured to the nearest specified size.

The tendered rates shall include full compensation for supplying all the materials, including rock fill, wire-mesh boxes, galvanizing, PVC-coating, tying and connecting wires, loading, transporting and off-loading, the assembling and filling of the boxes, disposal of waste, and any other work necessary for constructing the gabions. It shall exclude any geotextile fabrics which, if required, shall be

measured and paid for under item C11.2.4.

Placing of rock by dumping shall not be allowed and the tendered rates shall also include full compensation for placing rock by means of hand labour.

Item	Description	Unit
C11.2.4	Geotextile (type and grade indicated)	square metre (m²)

The unit of measurement shall be the square metre of area covered with geotextiles placed in position as specified in Section A12.11 of Chapter 12.

The tendered rate shall include full compensation for supplying the geotextiles, cutting, waste, placing, joining, overlapping, and securing the material in position.

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D11.2 NON-STRUCTURAL GABIONS

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- D11.2.2 GENERAL**
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- D11.2.4 FUNCTIONAL PERFORMANCE ASSESSMENTS**
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- D11.2.7 EVALUATION FOR ACCEPTANCE**
- D11.2.8 ADDITIONAL PROCEDURES TO BE ADOPTED IN THE EVENT OF FAILURE**
- D11.2.9 NOTIFICATION OF REMEDIAL WORK**
- D11.2.10 REMEDIAL WORKS**

No specific items in this Section.

Where applicable, details must be provided in the Contract Documentation.

A11.3 GUIDE BLOCKS AND KILOMETRE MARKERS

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PART A: SPECIFICATIONS

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A11.3.2 DEFINITIONS

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A11.3.8 WORKMANSHIP

PART B: LABOUR ENHANCEMENT

PART C: MEASUREMENT AND PAYMENT

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

PART A: SPECIFICATIONS

A11.3.1 SCOPE

This Section covers guide blocks and other posts of precast concrete construction. Guiding demarcations or kilometre posts not of concrete construction shall be specified and included under Section A11.6.

Guide blocks are located on the outer extremities of particularly narrow width roads to assist and guide road users in demarcating the road edge. Kilometre markers are located at full or partial kilometre positions to demarcate the distance and route numbering. This section covers the manufacturing, supply and erection of guide blocks and markers, mainly constructed of precast concrete, in positions and in accordance with the dimensions specified and/or shown on the drawings. Other precast elements may also be included under this Section, as specified under the Contract Documentation.

A11.3.2 DEFINITIONS

No specific definitions.

A11.3.3 GENERAL

No general items.

A11.3.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

Not applicable.

A11.3.5 MATERIALS

A11.3.5.1 General material specifications

The material specifications are the required specifications for the materials and guide blocks as manufactured placed and/or processed in their final position within the road reserve.

It is the Contractor's responsibility to ensure that the elements constructed and 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.

A11.3.5.2 Concrete

All concrete work shall be carried out as precast elements in accordance with the requirements of Section A13.4 of Chapter 13. Unless otherwise specified, a mixture of four parts of concrete sand or grit to one part of cement (Cem II 32.5) shall be used.

A11.3.5.3 Sand and grit

Sand and grit shall comply to the specifications in Clause A13.4.5.2 of Chapter 13. Grit shall comply to the aggregate grading as specified in Table A9.1.5-5 of Chapter 9.

A11.3.5.4 Paint

Paint for guide blocks shall be non-reflectorised roadmarking paint as specified in Section A11.7. Paint for the recess in the block shall be retro-reflective solvent or water-based paint as specified in Section A11.7. Unless otherwise specified, paint for the block shall be of white colour.

A11.3.5.5 Alternative materials

Alternative materials for posts, foundations or markers may be specified in the Contract Documentation.

A11.3.6 CONSTRUCTION EQUIPMENT

The Contractor shall submit his plant and equipment list for manufacturing as part of his method statement to perform the different elements of the Works.

A11.3.7 EXECUTION OF THE WORKS

A11.3.7.1 Classification of Materials

All excavations for guide blocks and kilometre markers 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.

A11.3.7.2 Fabricating

Precast units shall be fabricated to the dimensions specified and/or shown on the drawings. The forms shall be smooth and shall have accurate dimensions. The concrete mixture shall be placed in the forms and vibrated on a vibrating table or by other approved means. The units shall be reinforced as shown on the drawings and shall have an F3 surface finish.

The units shall be true to shape, smooth, and without any honeycombing or other blemishes. After curing of the concrete, the recess near the top of the unit shall be painted with the reflective paint specified, while the remainder of the top half of the unit shall be painted with road marking paint of the specified colour.

A11.3.7.3 Spacing the guide blocks and kilometre markers

The guide blocks and kilometre markers shall be spaced and located as specified and/or shown on the drawings.

A11.3.7.4 Erecting

Guide blocks shall be erected after the surfacing has been completed.

Holes shall be excavated in the shoulder of the road and the blocks placed vertically and square to the road centre line.

Kilometre markers shall be erected after the completion of all machine trimming at the positions indicated on the drawings or as specified by the Engineer.

Backfilling shall be compacted in layers not exceeding 100 mm from the bottom of the hole. Surplus excavated material shall be disposed of by the Contractor at no additional payment.

The units shall be painted prior to installation. Care shall be exercised not to damage or soil the exposed painted surfaces during transportation and installation.

Guide blocks and kilometre markers shall be maintained and protected during the entire construction period and any units damaged or broken before the seal has been completed, the road markings have been painted or the certificate of completion has been issued,

shall be repaired or replaced, as may be required, at the Contractor's cost.

A11.3.8 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 may, at his discretion, elect 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 agrees, shall be repaired so that it shall comply with the specified requirements after having been repaired.

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B11.3 GUIDE BLOCKS AND KILOMETRE MARKERS

PART B: LABOUR ENHANCEMENT

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PART B: LABOUR ENHANCEMENT

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B11.3.5	MATERIALS
B11.3.6	CONSTRUCTION EQUIPMENT
B11.3.7	EXECUTION OF THE WORKS
B11.3.8	WORKMANSHIP

B11.3.1 SCOPE

This Section covers the manufacturing, supply and erection of guide blocks and kilometre markers, mainly constructed of precast concrete, in positions and in accordance with the dimensions specified and/or shown on the drawings.

This Section therefore 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. This Section includes concrete mixed by hand.

B11.3.2 DEFINITIONS

The provisions of Part A, shall apply.

B11.3.3 GENERAL

The provisions of Part A, shall apply.

B11.3.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

The provisions of Part A, shall apply.

B11.3.5 MATERIALS

The provisions of Part A, shall apply.

B11.3.5.2 Concrete

a) Concrete mixing by hand

Concrete may be mixed by hand or in hand-turned concrete mixers for small pours up to one (1) cubic metre. Larger pours greater than one (1) cubic metre shall be machine mixed with on-site mechanical mixers and/or batch plants.

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.

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.

The sand shall be measured off, tipped onto the mixing floor and spread in a circle. The cement (one or two whole sacks, as required by the mix design) shall then be spread evenly across the sand and mixed in with shovels, turning the mixture into the middle of the circle and out again. When the colour is even, the mix shall be shaped with a hollow in the centre.

Part of the mixing water shall be poured into the hollow and mixed in. More water shall be slowly added and mixed in until all the water has been added. The materials shall be turned into the middle of the circle and out again at least twice. The mix should be soft and even with no dry patches. The mix shall then be spread in a circle.

The stone shall be measured off and spread evenly across the mortar and mixed with shovels, by turning the mixture into the middle and out again at least twice. Concrete shall be properly mixed to a uniform consistency without fatty or harsh patches. The total period between the times that the cement is placed into the mix until mixing starts shall not exceed 15 minutes.

B11.3.6 CONSTRUCTION EQUIPMENT

The provisions of Part A, shall apply.

B11.3.7 EXECUTION OF THE WORKS

B11.3.7.1 Classification of excavation

All excavations under this Section shall be classified as specified under Clause B11.1.7.1.

B11.3.8 WORKMANSHIP

The provisions of Part A, shall apply.

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C11.3 GUIDE BLOCKS AND KILOMETRE MARKERS

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.

(ii) Notes on measurement and pay items

1. Unless otherwise ordered or stated in the Contract Documentation, for excavations will be measured from the ground surface.
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. 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.

(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, 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 C11.3-1: Items from other Chapters or Sections

Activity	Section 11.3 Clause reference	Section – item reference
Kilometre markers on posts	C11.3.2/C11.3.3	C11.6.4

(v) Items specifically for this section of the specification

Item	Description	Unit
C11.3.1	Guide blocks	number (No)
C11.3.2	Kilometre markers	number (No)
C11.3.3	Kilometre markers mounted on concrete reinforced pipes (diameter to be specified)	number (No)

The unit of measurement shall be the number of units supplied and erected in accordance with the specifications and detailed on the drawings. Excluded from items C11.3.2 and C11.3.3 shall be kilometre markers on posts measured under item C11.6.4.

The tendered rate shall include full compensation for supplying all materials and labour, manufacturing and transporting the precast units, setting out, excavating and backfilling all the holes and disposing of surplus excavated material placing and painting the guide

blocks and kilometre markers and all the equipment the tools and incidentals necessary for completing and maintaining the works described in this section. Where kilometre markers are erected in concrete pipe units, the tendered rate shall include the provision and installation of such concrete pipes, as detailed on the drawings.

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D11.3 GUIDE BLOCKS AND KILOMETRE MARKERS

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

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D11.3.1 SCOPE

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D11.3.8 ADDITIONAL PROCEDURES TO BE ADOPTED IN THE EVENT OF FAILURE

D11.3.9 NOTIFICATION OF REMEDIAL WORK

D11.3.10 REMEDIAL WORKS

No specific items in this Section.

Where applicable, details must be provided in the Contract Documentation.

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A11.4 ROAD RESTRAINT SYSTEMS

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A11.4.7 EXECUTION OF THE WORKS

A11.4.8 WORKMANSHIP

PART B: LABOUR ENHANCEMENT

PART C: MEASUREMENT AND PAYMENT

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

PART A: SPECIFICATIONS

A11.4.1 SCOPE

This Section covers the supplying, installing and maintaining of various types of Road Restraint Systems (RRS) at locations and in accordance with the specifications and details, dimensions and design shown on the drawings; or specified by the Engineer; or as specified by the performance based system manufacturer. There are two types of Road Restraint Systems, namely Vehicle Restraint Systems (VRS) and Pedestrian Restraint Systems (PRS), these systems may either be rigid, semi rigid or flexible, with transitions between the different types.

Vehicle Restraint Systems shall be divided into systems based either on:

1. Method specification timber post systems with elements conforming to SANS 1350 and other SANS compliant material requirements and installation specifications; or concrete barrier systems detailed in the Contract Documentation; OR
2. Performance based systems where the installation shall conform to EN 1317 (Parts 1 to 8) and/or AASHTO MASH or NCHRP350 as alternative where no MASH product is available.

The selection of use shall be based on the risk threshold as determined by the designer. Performance based systems criteria shall be specified in the specifications and measurement and payment section and the Contractor shall be obligated to provide a system which is fully compliant.

Included are end wings, bullnoses, and bridge adaptors to SANS 1350; end treatments and transitions to rigid elements to specific project requirements and indicated on the drawings or specified by the Engineer; and end treatments, crash cushions and transitions to rigid elements of performance based specification compliant to EN1317 and/or AASHTO MASH.

Moveable vehicle restraint systems required for traffic accommodation during construction and truck mounted attenuators are specified in Clauses A1.5.5.4, A1.5.5.7, A1.5.6.1 and A1.5.7.11 of Chapter 1.

A11.4.2 DEFINITIONS

Road Restraint Systems (RRS) – are primarily used to protect vehicle occupants from impacting road furniture or hazards and vehicles reaching opposing carriageways. They are also intended to protect pedestrians, and any other entity using a roadway.

Vehicle Restraint Systems (VRS) – which include, but are not limited to:

- Longitudinal barriers
- Terminals and transitions
- Safety barriers
- Vehicle parapets

- Crash cushions
- Arrestor beds

Pedestrian Restraint Systems (PRS) – which include, but are not limited to:

- Pedestrian parapets
- Pedestrian guardrails

AASHTO MASH – American Association of State Highway and Transportation Officials and Manual for Assessing Safety Hardware

EN 1317 (Parts 1 to 8) – European Norm for Road Restraint Systems

- Part 1: Terminology and general criteria for test methods
- Part 2: Performance classes, impact test acceptance criteria and test methods for safety barriers
- Part 3: Performance classes, impact test acceptance criteria and test methods for crash cushions
- Part 4: Performance classes, impact test acceptance criteria and test methods for terminals and transitions
- Part 5: Product requirements and evaluation of conformity for vehicle restraint systems
- Part 6: Pedestrian Restraint Systems
- Part 7: Performance classes, impact test acceptance criteria and test methods for terminals of safety barriers
- Part 8: Motorcycle Road Restraint Systems

Containment levels – defines the ability of the RRS to restrain the design vehicle. A containment level is achieved by the system withstanding a defined crash test influenced by the speed, the mass and impact angle of the vehicle which needs to be contained and redirected.

Normalised working width – is a measure of the deformation of a barrier under impact, i.e. the space needed behind the barrier in order for the system to work properly. The working width is divided into 8 classes, W1 to W8 (EN 1317).

A11.4.3 GENERAL

Road Restraint Systems, for both temporary and permanent use, shall be sourced from a reputable manufacturer or supplier, being affiliated to a recognised industry association, and installed by a competent installer, who is either certified by the manufacturer or supplier, or affiliated to a recognised industry association.

A11.4.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

Performance based vehicle restraint systems provided by the Contractor shall be required where specified on the drawings or Contract Documentation, both as temporary and permanent applications, as specified for containment level and working width and shall conform to the product class specification criteria and containment levels as per the latest version of EN 1317 or NCHRP350/MASH based on the risk profile determined at the specific location(s) by the Engineer. Included into the Contractors submission shall be the requirements and procedures to maintain EN 1317 and/or AASHTO MASH compliance in the event of repairs due to damage during the construction period and post construction. The specific materials and construction requirements for repair and maintenance activities shall be provided to the Engineer together with the manufactures' specifications.

Where offered and accepted or specified to be used, steel posts or other steel elements being part of an approved vehicle restraint system as tested and complying with EN 1317 and/or AASHTO MASH shall be galvanized in compliance with the requirements of SANS 121.

Where such vehicle restraint systems are placed on concrete retaining walls or concrete structures, the steel posts attachment to the concrete shall be required to be an element of a system shall be specified as also complying with EN 1317.

A11.4.5 MATERIALS

A11.4.5.1 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 site shall meet these specified requirements.

The type of non-performance based guardrail systems installed will be selected based on the Employer's maintenance strategy to ensure that the systems selected do not impose an onerous maintenance burden on the Employer for post construction repair or replacement 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.

A11.4.5.2 Materials

a) Steel guardrails for erection on timber posts

Steel guardrails shall comply with the requirements of SANS 1350 and carry the SABS mark or a mark by any other SANAS approved certification body for the applicable SANS specification for 3,81 m length railings, as specified.

The dimensions of guardrails, end wings, bull noses and bridge adaptors shall be in accordance with the details indicated in the appropriate figures defined in SANS 1350. The dimensions of end treatments and alternative bridge adaptors shall be in accordance with the details shown on the drawings.

Steel guardrails shall be supplied together with all the bolts, nuts, washers and fixing materials required

Unless specified to the contrary in the Contract Documentation, all guardrails shall be galvanized with a hot-dip zinc coating, which complies with the requirements of SANS 121.

All bolts, nuts and washers shall have a hot-dip zinc coating, which complies with the requirements of SANS 121.

Galvanized guardrails shall be stacked according to the manufactures specifications and not be nested directly on each other when stacked for storage.

b) 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.

c) Guardrail posts

(i) Timber posts

Timber posts and spacer blocks shall be supplied in lengths and dimensions as shown on the drawings and shall comply with the requirements of SANS 457 part 2 or part 3.

Posts shall have a top diameter of not less than 150 mm. Posts with a top diameter up to 230 mm will be acceptable, provided that posts with widely varying diameters shall not be used together in the same length of guardrail. The tops of poles shall either be domed or bevelled to ensure rainwater is drained.

Posts shall be drilled and shaped as shown on the drawings and supplemented with the necessary bolts, nuts, washers and spacer blocks for fixing.

Timber posts and spacer blocks shall be treated in accordance with SANS 10005 with creosote that complies with SANS 616, or if it is approved by the Engineer it shall be treated with a copper-chrome-arsenic compound for timber preservation, which complies with SANS 673. The preservative specified in the Contract Documentation shall be used. After the posts have been treated, they shall not be sawn, drilled or shaped without being retreated with preservative in accordance to SANS 10005.

Timber Posts which, in accordance to the inspection methods detailed in SANS 457, exhibit a degree of cracking that would render them unfit for service shall not be used.

(ii) Steel posts

Steel posts, where specified for special application purposes, shall meet the requirements indicated on the drawings and be galvanized in compliance with SANS 121.

(iii) Steel base plates for timber posts

Where it is necessary to install timber guardrail posts on top of a culvert or other concrete structure, and/or where the total thickness of the fill and pavement layers over such structure is less than 1,0m, the timber posts shall be fastened to the structure by means of steel base plates as shown on the drawings.

d) Reflective plates

Reflective plates shall conform to the colour, layout and shape requirements of the SADC or South African Road and Traffic Signs Manual, to be visible from both directions and constructed to bolt onto metal guardrails or alternative attachment to other vehicle restraint systems.

(i) Steel plates

Steel plates used for reflective plates shall be galvanized and painted to comply with the requirements of Clause A11.6.5.2c). The complete reflective unit shall comprise a securely attached and firm unit proven to be vandal resistant, UV stabilised and impact modified to ensure brittleness does not occur within the expected 7 year lifetime. Unless otherwise specified, the outer surfaces shall be coated with class I white retro-reflective prismatic material and class III red retro-reflective material, which complies with the provisions of SANS 1519-1.

(ii) *Plastic plates*

Plastic guardrail reflector housing shall be fabricated with a Carbon Black UV Resistant "Acrylonitrile Butadiene Styrene" (ABS) with impact strength for moderate mechanical impacts. It should also have a 7 year lifespan with local outdoor conditions without becoming brittle or cracking. The reflectors should be securely fixed to the guardrails at specified distances or as per the drawings. Unless otherwise specified, the outer surfaces shall be coated with class I white retro-reflective prismatic material and class III red retro-reflective material, which complies with the provisions of SANS 1519-1.

Specification certificates must be requested from the manufacturer.

A11.4.6 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.

A11.4.7 EXECUTION OF THE WORKS

A11.4.7.1 Classification of Materials

All excavations for vehicle restraint systems 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.

A11.4.7.2 Construction of guardrails on timber posts

The holes for the guardrail timber posts shall be of sufficient size to permit the proper setting of the posts and to allow sufficient room for backfilling the hole and tamping the filling. At least 1,0 m of a post shall be embedded in the ground.

The holes for the guardrail posts shall be spaced to suit the standard length of the guardrail supplied in accordance with SANS 1350, unless otherwise specified by the Engineer or indicated on the drawings. Where shown on the drawings or indicated in the Contract Documentation, posts shall be set at half or quarter the standard spacings.

The posts, spacer blocks (if applicable) and guardrails shall be completely erected and set true to line and level, so that the guardrails will be at the required height above the level of the completed road shoulder. Where jointed, the end of the guardrails, which overlaps on the side of the traffic, shall point in the direction of the traffic movement. The guardrail shall be suitably braced to prevent any movement, and all bolts shall be tightened prior to any holes being backfilled. Steel posts where specified for use at specific locations, shall be installed as indicated on the drawings, and shall be deemed to resort under this Clause A11.4.7.2

After the Engineer has signified his acceptance of the guardrail alignment so erected, the holes shall be backfilled with an approved sandy soil. The material shall be mixed with the correct quantity of water to ensure that the mixture will be placed while at or near the optimum moisture content. The mixture shall then be placed and thoroughly rammed in layers not exceeding 100mm of compacted thickness.

End treatments shall be constructed as shown on the drawings.

When the backfilling has been completed and the bracing removed, the posts shall be rigid and vertical, and the guardrail shall be true to line and level and firmly fixed to the posts. Excess excavated material shall be disposed of by the Contractor at no additional payment.

Steel posts installed on concrete retaining walls or concrete structures as part of a timber supported guardrail section shall be erected and fixed as shown on the drawings.

All guardrails shall be so erected as to have no projecting ends, which might interfere with or endanger traffic, particularly during the installation process. The edges and the centre of the guardrails shall touch either the spacer block or the post where no spacer blocks are used. Guardrails, if specified, shall be provided with end units as shown on the drawings. All splices of guardrails shall be at posts, and guardrails shall make contact over the entire area of the splice.

Reflective plates shall be fixed in accordance with the details shown on the drawings or in accordance with the manufacturers specifications. The reflective surfaces shall be arranged with the colours facing the direction as shown on the drawings.

A11.4.7.3 Removing, renovating and re-erecting existing guardrails on timber posts

Where existing guardrails have to be removed, or removed and re-erected, or removed, renovated and re-erected, the three processes of removal, renovation and re-erection shall be carried out as follows:

a) Removing guardrails

All guardrails, reflective plates and end units shall be loosened. Posts shall be carefully dug out and the holes shall be filled and compacted in 100 mm layers of suitable material from site or commercial sources as indicated by the Engineer (minimum of G7 quality material). Items used for fixing, such as bolts, nuts and washers, together with the reflective plates, shall be placed into bags, after which all the material shall be transported to a store approved by the Engineer and all stored in groups by type.

Where material is intended for re-use, it shall first be unpacked for inspection by the Engineer for deciding which material will be suitable for re-use. Suitable material shall then be stored separately from material, which is unsuitable for reuse. The Contractor shall dispose of material that is unsuitable for reuse.

All guardrail holes shall be backfilled and material compacted in 100 mm layers to minimum of 93 % of MDD using material of at least G7 quality.

b) Renovating and painting guardrails

If so directed by the Engineer, guardrails and end treatments suitable for re-use shall be taken to a workshop for cleaning and painting. Renovated guardrail dimensional tolerances shall comply with SANS 1350. Painting of guardrails shall be executed as specified in Clause A13.10.7.6 of Chapter 13. Damaged guardrails should not be used or retrofitted. Re-rolling of guardrails shall not be permitted.

Timber posts suitable for re-use shall be cleaned and treated by applying a coating of creosote. Bolts, nuts and washers to be re-used shall be cleaned and all rust removed, and shall then be oiled.

c) Re-erection

The guardrails shall be erected in the positions as indicated, and all the removed material suitable for re-use and as much supplementary new material as may be necessary shall be used. Re-erection shall be as specified for new guardrails, including fixing the retro-reflective plates.

A11.4.7.4 Construction of concrete barrier systems

Non-performance based concrete barrier systems shall be constructed as specified in Section A13.8 of Chapter 13 and the Contract Documentation.

A11.4.7.5 Construction of performance based vehicle restraint systems

Construction, installation and repair (if required) of performance based systems shall be in accordance with the manufacturers specifications, and in compliance with EN 1317 or AASHTO MASH certification requirements, as relevant.

A11.4.8 WORKMANSHIP

The completed vehicle restraint system shall have a neat appearance and shall not show any visible deviations from line and grade. Posts shall be straight and vertical. Longitudinal elements shall not be warped but shall be in a vertical plane parallel to the road centreline except at flared terminal sections. The galvanized surface on the vehicle restraint systems shall be smooth and continuous and free from abrasions or scratches. Any damage to the surface shall be repaired or replaced at the Contractor's expense. The methods of repair to the galvanized zinc coating shall be as specified in SANS 121. Zinc rich paint systems applied with aerosol techniques shall not be permitted.

Vehicle restraint systems, which do not comply with the prescribed requirements, shall be replaced or otherwise repaired.

The Contractor shall avoid any damage to completed road sections, or the spillage of concrete on completed road surfaces. Any such damage or spillage shall be rectified at the Contractors cost.

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 use for which it is intended.

B11.4 ROAD RESTRAINT SYSTEMS

PART B: LABOUR ENHANCEMENT

CONTENTS

PART B: LABOUR ENHANCEMENT

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B11.4.8	WORKMANSHIP

B11.4.1 SCOPE

This Section covers the supplying, installing and maintaining of Road Restraint Systems at locations and in accordance with the specifications and details, dimensions and design shown on the drawings.

The construction of guardrails on timber posts shall be deemed to be a labour enhanced construction process.

This Section therefore 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.

B11.4.2 DEFINITIONS

The provisions of Part A, shall apply.

B11.4.3 GENERAL

The provisions of Part A, shall apply.

B11.4.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

The provisions of Part A, shall apply.

B11.4.5 MATERIALS

The provisions of Part A, shall apply.

B11.4.6 PLANT AND EQUIPMENT

The provisions of Part A, shall apply.

B11.4.7 EXECUTION OF THE WORKS

B11.4.7.1 Classification of excavation

All excavations under this Section shall be classified as specified under Clause B11.1.7.1.

B11.4.8 WORKMANSHIP

The provisions of Part A, shall apply.

C11.4 ROAD RESTRAINT SYSTEMS

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.

(ii) Notes on measurement and pay items

1. Unless otherwise ordered or stated in the Contract Documentation, excavation depths will be measured from the ground surface.
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. 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.

(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, 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 of 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 C11.4-1: Items from other Chapters or Sections

Activity	Section 11.4 Clause reference	Section – item reference
Loading and hauling	C11.4.3	C1.7 of Chapter 1
Concrete barriers (in situ and precast)	C11.4.3.1/C11.4.3.2	C13.8.1.1 of Chapter 13
Painting guardrails, end wings and bullnoses	C11.4.8.1	C13.10.1.3 of Chapter 13

(v) Items specifically for this section of the specification

Item	Description	Unit
C11.4.1	Erecting of guardrails at 3,81 m spacing	
C11.4.1.1	Complete galvanized system compliant to SANS 1350:	
(a)	On timber posts (Drawing reference)	metre (m)

(b)	On steel posts used at specific locations (Drawing reference)	metre (m)
(c)	On concrete or other surfaces, with spacer blocks but without posts (Drawing reference)	metre (m)
(d)	Extra over C11.4.1.1(a) and C11.4.1.1(b) for excavating holes of posts using labour enhanced methods (soft and intermediate)	metre (m)
C11.4.1.2	Terminal sections for 3,81 guardrails comprising of:	
(a)	End wings to SANS 1350	number (No)
(b)	Bullnoses to SANS 1350	number (No)
(c)	Bridge adapters to SANS 1350	number (No)
(d)	End treatments where single guardrail sections are specified (Drawing reference)	number (No)
(e)	End treatments where double guardrail sections are specified (Drawing reference)	number (No)
(f)	Bridge adaptors (including extra rails and posts) (Drawing reference)	number (No)
(g)	Extra over C11.4.1.2(d) and C11.4.1.2(e) for excavating holes for posts using labour enhanced methods (soft and intermediate)	number (No)

The unit of measurement for C11.4.1.1(a) (b) and (c) shall be the metre of new guardrail systems as erected, including curved guardrails but excluding length of terminal sections. The use of steel posts shall be deemed relevant under this item.

The unit of measurement for item C11.4.1.1(d) shall be the metre of guardrail system erected with holes specified to be excavated using labour enhanced methods, paid extra over items C11.4.1.1(a) and C11.4.1.1(b).

The unit of measurement for C11.4.1.2(a) to (f) shall be the number of complete new end treatments of each type installed.

The unit of measurement for C11.4.1(g) shall be the number of end treatments with holes excavated using labour enhanced methods of construction, paid extra over items C11.4.1.2(d) and C11.4.1.2(e).

The tendered rates shall include full compensation for furnishing all materials and labour for erecting and galvanizing the guardrails, complete with posts, spacer blocks, bolts, nuts, washers and reinforcing plates, and excavating holes in all classes of material, concrete, backfilling and removing any surplus material. It shall also include full compensation for incidentals in respect of supplying and erecting guardrails, end treatments, and turned down sections.

Reflective plates to guardrails and drilling and blasting of holes shall be paid for separately

The tendered rate of item C11.4.1.1(c) and C11.4.1.2(g) shall include full compensation for excavating the necessary holes using labour enhanced construction methods where specified by the Engineer, and shall be paid as an extra over item.

Item	Description	Unit
C11.4.2	Performance based vehicle restraint systems	
C11.4.2.1	Complete longitudinal barrier system to EN 1317 or AASHTO MASH or NCHRP350 as alternative where no MASH product is available:	
(a)	Guardrail system (state criteria including containment level & working width)	metre (m)
(b)	Cable barrier system (state criteria including containment level & working width)	metre (m)
(c)	Concrete barrier system (state criteria including containment level & working width)	metre (m)
(d)	Etc for other types, permanent and temporary	metre (m)
C11.4.2.2	Terminal sections for the following to EN 1317 or AASHTO MASH or NCHRP350 as alternative where no MASH product is available:	
(a)	End treatments (State criteria EN or MASH and containment level)	number (No)
(b)	Crash cushions (State criteria EN or MASH and containment level)	number (No)
(c)	Transitions (State criteria EN or MASH and containment level, etc.))	number (No)
(d)	Other types (State criteria EN or MASH and containment level, etc.)	number (No)
C11.4.2.3	Relocation of temporary systems (Type, EN or MASH, or NCHRP350 as alternative where no MASH product is available, containment level and working width indicated)	metre (m)

The unit of measurement for C11.4.2.1 shall be the metre of specified vehicle restraint system (complying with EN 1317) as fully erected, excluding length of terminal sections but including curved guardrails.

The unit of measurement for C11.4.2.2 shall be the number of complete end treatments of each type fully supplied and installed compliant with EN1317 or AASHTO MASH or NCHRP350 as alternative where no MASH product is available as relevant.

The tendered rate for item C11.4.2.3 shall be metre of temporary vehicle restraint system removed and relocated to a different position, regardless of the distance relocated. The tendered rates shall include full compensation for furnishing all materials and labour for erecting or removing (where applicable) and galvanizing the guardrails, complete with posts, spacer blocks, bolts, nuts, washers and reinforcing plates as may be required, and excavating or making holes in all classes of material, concrete, backfilling and removing any surplus material. It shall also include full compensation for incidentals in respect of supplying and erecting guardrails, end treatments, crash cushions, etc. as applicable.

Where end treatments are specified not to comply with EN 1317 or AASHTO MASH or NCHRP350 as alternative where no MASH product is available, but as indicated on drawings or specified by the Engineer, measurement and payment shall be made under item C11.4.1.2 or C11.4.9.

Reflective plates and drilling and blasting of holes will be paid for separately.

Drilling and blasting will be paid for separately under item C11.4.11.

Item	Description	Unit
C11.4.3	Project specific concrete barrier systems	
C11.4.3.1	In situ cast concrete barriers (reference to drawing)	metre (m)
C11.4.3.2	Precast concrete barriers (reference to drawing)	metre (m)
C11.4.3.3	Installation and removal of precast concrete barrier system (reference to drawing)	number (No)
C11.4.3.4	Relocating or stacking precast barrier moved in excess of 1,0 km	number (No)

The unit of measurement for items C11.4.3.1 and 2 shall be the metre of concrete balustrade constructed in place or precast in accordance with the drawings and specifications in Section A13.8 of Chapter 13.

The unit of measurement for item C11.4.3.3 shall be the number precast units installed, initially and subsequently, and removed as instructed by the Engineer, with installation and removal of precast units measured once only for any instructed location or position.

The tendered rate shall include full compensation for furnishing all materials and labour for installing and removal of precast units complete with bolts, nuts, washers and reinforcing plates as may be required.

The unit of measurement for item C11.4.3.4 shall be the number of units moved in excess of 1,0 km, which each precast unit has been transported, either for re-installation or for stacking.

Loading and hauling, where applicable, including a haul of 1,0 km, shall be measured and paid as specified in Section C1.7 of Chapter 1.

The tendered rate shall include full compensation for furnishing all materials labour equipment and transport required to relocate precast units of all sizes for re-use or stacking, including all costs related to stacking the units.

Item	Description	Unit
C11.4.4	Extra over for horizontally curved guard rails	
C11.4.4.1	Extra over C11.4.1 and C11.4.11 for horizontally curved guard rails factory bent to a radius of less than 45 m	metre (m)
C11.4.4.2	Extra over C11.4.2.1(a) for horizontally curved guard rails factory bent to a radius of less than 45 m	metre (m)

The unit of measurement shall be the metre of curved guardrail specified and erected and measured in place.

The tendered rate extra over the rates tendered for items C11.4.12 and C11.4.11 or C11.4.2.1(a) shall include full compensation for all incidentals in respect of supplying and erecting curved guardrails of radius less than 45 m.

Item	Description	Unit
C11.4.5	Additional guardrail posts for 3,81 m systems:	
C11.4.5.1	Timber	number (No)
C11.4.5.2	Steel (drawing reference)	number (No)

C11.4.5.3	Extra over C11.4.5.1 and C11.4.5.2 for excavating holes of posts using labour enhanced methods	number (No)
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The unit of measurement for additional guardrail posts shall be the number erected over and above those erected in accordance with the normal spacing shown on the drawings.

The unit of measurement for item C11.4.5.3 shall be the number of holes specified to be excavated using labour enhanced methods.

The tendered rates of items C11.4.5.1 and C11.4.5.2 shall include full compensation for supplying and installing additional posts complete as specified, excavating the necessary holes, erecting the posts, and backfilling the holes.

The tendered rate of item C11.4.5.3 shall include full compensation for excavating the necessary holes using labour enhanced construction methods and shall be paid as an extra over items C11.4.5.1 and C11.4.5.2.

Drilling and blasting will be paid for separately under item C11.4.11.

Item	Description	Unit
C11.4.6	Reflective plates	
C11.4.6.1	Steel plates	number (No)
C11.4.6.2	Plastic plates	number (No)

The unit of measurement shall be the number of reflective plates, steel and/or plastic installed.

The tendered rate shall include full compensation for supplying all materials and labour required for manufacturing, painting and fixing the reflective plates as specified and as shown on the drawings.

Item	Description	Unit
C11.4.7	Removing existing guardrails:	metre (m)

The unit of measurement shall be the metre of guardrail removed, and the length shall be measured between the terminal points of the sections removed including the end treatments, but excluding the anchor blocks and anchor cables, if any, projecting beyond the end treatments.

The tendered rate shall include full compensation for the work as described in Clause A11.4.7.3a) including loading, transporting to any point on the site, and off-loading and stacking the material, and disposing of material unsuitable for re-use.

The tendered rate shall also include full compensation for the backfilling of all guardrail holes using material from site or commercial sources of at least G7 quality and compacting material to minimum of 93 % of MDD.

Item	Description	Unit
C11.4.8	Renovating guardrail material:	
C11.4.8.1	Painting guardrails, end wings and bullnoses	metre (m)

The unit of measurement for sub item C11.4.8.1 shall be the metre of single guardrail, whether straight or curved, or end units painted as specified, the length of which shall be measured in accordance with the measurements of the guardrail elements after dismantling.

The unit of measurement for subitem C11.4.8.2 shall be the number of treated posts.

The tendered rates shall include full compensation for the work as specified in Clause A11.4.7.2b), surface preparation, applying all the coats of paint, repairing any damaged surfaces, and all materials and construction plant necessary for completing the work including the loading, transporting to and from the workshops, off-loading and storing of the material.

Item	Description	Unit
C11.4.9	Re-erection of guardrails with recovered or provided material:	
C11.4.9.1	Single guardrail	metre (m)
C11.4.9.2	Double guardrail	metre (m)
C11.4.9.3	Extra over C11.4.9.1 and C11.4.9.2 for excavating holes of posts using labour enhanced methods	metre (m)

The unit of measurement of items C11.4.9.1 and C11.4.9.2 shall be the metre of single or double guardrail re-erected with used and/or new material and measured between the points where they are joined to the end units.

The unit of measurement for item C11.4.9.3 shall be the metre of guardrail system erected with holes specified to be excavated using labour enhanced methods.

The tendered rates of items C11.4.9.1 and C11.4.9.2 shall include full compensation for re-erecting the guardrails as specified in

Clause A11.4.7.3c), including the loading, transporting between any two points on the site and off-loading the material and providing new fixing material. Payment shall be made separately for any new material required, including spacer blocks, but not for other fixing materials. Where sections are made entirely from new material, payment therefore shall be made under the appropriate items for new guardrails.

The tendered rate of item C11.4.9.3 shall include full compensation for excavating the necessary holes using labour enhanced construction methods and shall be paid as an extra over items C11.4.9.1 and C11.4.9.2.

Item	Description	Unit
C11.4.10	End treatments to existing guardrails with recovered or provided material:	
C11.4.10.1	End wings	number (No)
C11.4.10.2	Bullnoses	number (No)
C11.4.10.3	Bridge adaptors	number (No)
C11.4.10.4	End treatments with single guardrails	number (No)
C11.4.10.5	End treatments with double guardrails	number (No)
C11.4.10.6	Extra over C11.4.10.4 and C11.4.10.5 for excavating holes of posts using labour enhanced methods (soft and intermediate)	number (No)

The unit of measurement shall be the number of end treatments installed with recovered and, in part, new material.

The tendered rates shall include full compensation for installing the end treatments and for all excavation and backfill, providing all anchors, fixing materials and anchor blocks but excluding costs for steel and timber materials.

Apart from anchors, anchor blocks and fixing materials, payment will be made separately for all new materials. End treatments made completely from new materials shall be paid for in accordance with the appropriate rates for new end treatments.

The tendered rate of item C11.4.10.6 shall include full compensation for excavating the necessary holes using labour enhanced construction methods and shall be paid as an extra over items C11.4.10.4 and C11.4.10.5 per number of end treatments

Item	Description	Unit
C11.4.11	New material required for the re-erection guardrails with recovered materials:	
C11.4.11.1	Guardrails, 3,81 m compliant to SANS 1350	number (No)
C11.4.11.2	Timber posts compliant to SANS 1350	number (No)
C11.4.11.3	Steel posts	number (No)
C11.4.11.4	Reflective plates	number (No)
C11.4.11.5	Spacer blocks compliant to SANS 1350	number (No)
C11.4.11.6	Splice bolt complete with nut and washer compliant to SANS 1350	number (No)
C11.4.11.7	Post bolt complete with nut and washer compliant to SANS 1350	number (No)
C11.4.11.8	Reinforcing plates (reference to drawing)	number (No)

The unit of measurement for subitem C11.4.11.1 shall be the metre of guardrail provided, measured in accordance with the measurements of the loose guardrail.

The unit of measurement for subitems C11.4.11.2 to 8 shall be the number of new timber posts, steel posts, reflective plates, spacer blocks, splice bolts, post bolts and reinforcing plates provided, respectively.

The tendered rates shall include full compensation for supplying the material as specified. Item C11.4.3 shall apply to horizontally curved guardrails factory bent to a radius of less than 45 m.

Item	Description	Unit
C11.4.12	Extra over items C11.4.1 and C11.4.2 for drilling and blasting holes for guardrail posts	number (No)

The unit of measurement shall be the number of holes drilled and blasted with explosives in hard material, which cannot be excavated except by drilling and blasting, or with the use of pneumatic tools or mechanical breakers.

The tendered rate shall include full compensation for additional work including amongst others all drilling, explosives, materials, labour

and equipment and all Incidentals required for making holes in hard materials by means of drilling and blasting.

Item	Description	Unit
C11.4.13	Steel base plates for guardrail posts on structures	number (No)

The unit of measurement is the number of steel base plates installed complete as shown on the drawings or directed by the Engineer.

The tendered rate shall include full compensation for supplying all labour, materials, equipment and transport required for manufacturing, galvanizing and installing the base plates complete with cement mortar pad, for cutting the guardrail post to the required length, drilling an additional hole, treating the hole and butt face with creosote and fixing the post all as specified on the drawings

Item	Description	Unit
C11.4.14	Nailing of gang nail plates on top of timber guardrail posts	number (No)

The unit of measurement shall be the number of gang-nail plates supplied and fixed as specified.

The tendered rate shall include full compensation for supplying all materials and labour and for fixing to the top of the sealed guardrail post.

Item	Description	Unit
C11.4.15	Disposal of existing guardrails	
C11.4.15.1	Straight or curved longitudinal guardrails	metre (m)
C11.4.15.2	End treatments with single guardrails	metre (m)
C11.4.15.3	End treatments with double guardrails	metre (m)

The unit of measurement shall be the metre of guardrail section, regardless of condition, disposed of, and the length shall be measured between the terminal points of the sections removed. Item C11.4.15.1 shall include end wings, bull noses and bridge adapters but exclude the end treatments.

The tendered rate may be positive or negative as assessed by the Contractor. The tendered rate shall include full compensation for the removal from site and disposal of the guardrails, poles, spacer blocks, bolts and nuts as scrap including loading, transporting and off-loading. A full record of the destination of guardrails disposed of shall be provided to the Engineer for control purposes.

Removal of the guardrails shall be measured and paid under item C11.4.7.

D11.4 ROAD RESTRAINT SYSTEMS

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

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D11.4.1 SCOPE

Refer to Clause A11.4.1 for performance based systems which comply to the EN 1317 and/or AASHTO MASH or NCHRP350 as alternative where no MASH product is available.

D11.4.2 GENERAL

Reflective sheeting suppliers for reflector plates shall supply an official test report as per the requirements of SANS 1519-1.

D11.4.3 PERFORMANCE GUARANTEE REQUIREMENTS

D11.4.3.1 Performance based Vehicle Restraint Systems

Suppliers of Performance Based Systems will be required to obtain, from the foreign testing facility where the product was tested, a Type Approval Report and submit it to a SANAS accredited Certification Body for independent verification at the cost of the supplier. Once verified, the Certification Body will conduct auditing of the product being manufactured, to ensure that it is the same product as described in the Type Approval Report, which will verify the testing report provided to the Engineer.

The manufacturer of the RRS will be required to issue a limited material defects warranty for a period of not less than 12 months.

The entity that is tasked with the installation of the RRS system must be a certified installer and certify that the system has been installed in accordance with the manufacturers installation guidelines in order to comply with the crash testing conditions.

D11.4.4 FUNCTIONAL PERFORMANCE ASSESSMENTS

D11.4.5 VISUALLY ASSESSED PROPERTIES

D11.4.6 INSTRUMENTALLY ASSESSED PROPERTIES

D11.4.7 EVALUATION FOR ACCEPTANCE

D11.4.8 ADDITIONAL PROCEDURES TO BE ADOPTED IN THE EVENT OF FAILURE

D11.4.9 NOTIFICATION OF REMEDIAL WORK

D11.4.10 REMEDIAL WORKS

It is a requirement that the installer and repairers of a performance based system issue a certificate of compliance every time the work has been completed.

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A11.5 FENCING

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PART A: SPECIFICATIONS

A11.5.1 SCOPE

This Section covers the erecting of new fences and associated works, the repair or improvement of existing fences and moving of existing fences where necessary along the boundaries of the road reserve and elsewhere as indicated on the drawings or as specified by the Engineer. Also included shall be the erection of temporary fences as well as the removal and stacking of fencing where specified by the Engineer.

Except when otherwise specified or approved, new or temporary fences shall be erected before construction on a particular section of the road is commenced with, before other properties are occupied for construction related work, or before temporary bypasses are opened to traffic. The requirement to ensure the safety of road users and protection of property and other rights of the public against access over property lines by vehicles, pedestrians and animals shall be enhanced by functional fences installed and maintained at the appropriate time and position.

A11.5.2 DEFINITIONS

No specific definitions are applicable.

A11.5.3 GENERAL

The Engineer and Employer shall identify and point out any cadastral beacons to the Contractor prior to any clearing or digging of holes is undertaken for fencing purposes. Any disturbed or removed cadastral beacons shall only be replaced by a registered Land Surveyor. Cadastral beacons shall be clearly demarcated to avoid disturbance.

A11.5.3.1 Protection of livestock and property

From the time of the site being handed over up to the date of the final completion of the works by the Contractor, he shall take all measures necessary for preventing the ingress of vermin, and for protecting and controlling vehicles, pedestrians, livestock, other property, etc, on the sections of the properties affected by his operations. He shall provide gates at the positions in existing fences cut by him for gaining access and shall ensure that all gates are kept closed except when they are opened for admitting his traffic. No fences shall be cut for access without the approval of the Engineer, and consultation with the owner/rights holder of the adjoining property.

Where alternative arrangements cannot be made, the Engineer may direct the Contractor to erect temporary fencing where necessary to protect livestock or game that may stray or be lost; or are exposed to vermin through his operations. Such fencing shall be of an adequate standard and shall be erected ahead of construction operations. The temporary fencing shall be maintained in a good order

during construction operations and, on completion of the work, it shall be removed from the site and all surfaces shall be restored. The Engineer may order that any permanent fencing which is required erected up ahead of construction operations, where practicable, in lieu of erecting temporary fencing.

When the replacement of fences is required, the Contractor shall either erect the new fence before removing the old fence, or alternatively engage with the adjoining landowner(s)/rights holders to temporarily remove their stock from the affected camps to enable him to remove the old fence before erecting the new fences. Payment for any additional cost of restricted working conditions in replacing of fences shall not be made, but included in the various rates for the replacement of fencing.

Payment for the protection of livestock during fencing operations, but excluding the cost of erection of temporary fences, shall be included in the amounts tendered for the Contractor's general obligations as specified in Clause A1.3.2 and Section C1.3 of Chapter 1.

A11.5.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

Not generally required for Section A11.5. High security fencing may in certain circumstances be required to be provided under performance based specifications as specified in the Contract Documentation.

A11.5.5 MATERIALS

A11.5.5.1 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 and that proof of compliance is retained.

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.

A11.5.5.2 Straining posts, stays, standards and droppers

Straining posts, stays, standards and droppers shall be of the type, size and length indicated on the drawings.

Timber posts shall comply with the requirements of SANS 457 part 2 or part 3. Timber posts shall be treated in accordance with SANS 10005 with creosote that complies with SANS 616, or if it is approved by the Engineer it shall be treated with a copper-chrome-arsenic compound for timber preservation, which complies with SANS 673. The preservative specified in the Contract Documentation shall be used.

Tubular straining posts and stays shall have a wall thickness of at least 2,95 mm and shall be galvanized in accordance with SANS 121, or shall be painted as specified in Section A13.10 of Chapter 13 as may be required on the drawings. Unless otherwise shown on the drawings, all tubular posts shall be provided with a 230 mm x 230 mm footplate and a pressed-steel or cast-iron cap. Tubular stays shall have a nominal bore of at least 60 mm.

Unless otherwise specified or shown on the drawings, rolled steel posts shall be 15 or 22 kg/m rails and standards shall be 2,3 kg/m Y-sections. Rolled steel shall be provided with a protective coating of bitumen or other approved material.

Steel droppers shall be at least 0,56 kg/m ridgeback-pattern droppers, unless otherwise specified or shown on the drawings. Steel droppers shall be provided with a protective coating of bitumen or other approved material.

A11.5.5.3 Bolts for stays

Bolts shall be galvanized steel bolts of the required length and diameter, which shall not be less than 12 mm. All the necessary bolts, nuts and washers, shall be supplied with each post. All steel bolts, nuts and washers shall have a hot-dip (galvanized) zinc coating, which complies with the requirements of SANS 121.

A11.5.5.4 Wire

Barbed wire shall comply with the requirements of SANS 675 for class A zinc coating, and shall be one or more of the following types:

High-tensile-grade steel single-strand 3,15 mm x 2,50 mm oval-shaped zinc-coated wire, with a 2,82 mm equivalent diameter and with a 1,8 mm diameter barb

High-tensile-grade steel single strand 2,80 mm x 1,90 mm oval-shaped zinc-coated wire, with a 2,31 mm equivalent diameter and with a 1,6 mm diameter barb. This shall not be used below 500 mm above ground where there is risk of veld fire such as where the dry grass density exceeds 1,0 kg per square metre.

Mild-steel-grade zinc-coated double-strand uni-directional-twist wire, each strand 2,50 mm in diameter with a 1,8 mm diameter barb, for use at any height above ground.

Barbs shall be spaced at a maximum of 150 mm apart.

Smooth wire shall comply with the requirements of SANS 675 for class A zinc coating and shall be of the types specified below:

Straining wire high-tensile-grade steel 4,0 mm diameter zinc-coated wire for use at any height above ground.

Fencing wire high-tensile-grade steel 2,24 mm diameter zinc-coated wire for use above 500 mm above ground where there is a risk of veld fire.

Tying wire shall comply with the requirements of SANS 675 for class A zinc coating and shall be 2,50 mm diameter mild-steel zinc-coated wire for tying fencing wire to standards and droppers and 1,6 mm mild-steel zinc-coated wire for tying netting and mesh wire to the fencing wire.

The actual diameter of wire supplied shall equal the specified diameter subject to the appropriate tolerance given in SANS 675.

A11.5.5.5 Diamond mesh

Diamond mesh (chain-link fencing material) shall comply with the requirements of SANS 1373. The width shall be shown on the drawings and the edge finish shall be both sides clinched or barbed.

The nominal diameter of the wire shall be 2,5 mm and the mesh size shall be 63 mm x 63 mm.

The wire shall be fully galvanized.

A11.5.5.6 Wire netting

Wire netting shall be fully galvanized mild-steel wire with a minimum diameter of 1,8 mm with 75 mm hexagonal mesh.

The height shall be as indicated on the drawings.

A11.5.5.7 Barbed-tape security barrier

Barbed-tape security barrier shall comply with the requirements of SANS 1620. The high-tensile steel wire shall be heavily galvanized (class A), and the barbed tape and concertina clamps shall also be heavily galvanized (class Z600). The diameter of the roll shall be 950 mm or 700 mm according to specifications.

A11.5.5.8 Gates

Gates shall be manufactured to the dimensions and details shown on the drawings.

Gates shall be complete in every respect, including hinges, washers, bolts and locking chains attached to the gate.

Gates shall be zinc-coated as specified in SANS 121, or painted as specified in Section A13.10 of Chapter 13, or as indicated on the drawings.

A11.5.5.9 Timber posts for wire mats

Timber posts of the required length and diameter for holding down wire mats where the fence crosses streams shall comply with the requirements of Clause A11.5.5.2.

A11.5.5.10 Hinge joint mesh

Hinge joint mesh wire shall be zinc-coated in accordance with SANS 675. It shall consist of 2,0 mm diameter high tensile line wires and 2,0 mm diameter mild steel vertical stay wires twisted or interlocked together in a rectangular grid. Unless otherwise indicated on the drawings or Contract Documentation, the vertical and horizontal wire spacing shall both be 100 mm. The height of the mesh shall be as indicated on the drawings, or as specified under the measurement and payment item.

A11.5.5.11 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.

A11.5.5.12 Alternative materials

Alternative materials for pedestrian, security or game fences may be specified in the Contract Documentation.

A11.5.6 CONSTRUCTION EQUIPMENT

The Contractor shall submit his plant and equipment list for excavating, stockpiling if specified, loading, hauling and installation as part of his method statement to perform the different elements of the Works.

A11.5.7 EXECUTION OF THE WORKS

A11.5.7.1 Classification of Materials

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 under this Section shall be classified as specified under Clause A11.1.7.1.

A11.5.7.2 Types of fencing

The following types of fences shall be erected in accordance with the dimensions shown on the drawings.

- Stock-proof fences
- Vermin-proof fences
- Pedestrian fences
- Security fences
- Game fences

Where existing fences have to be dismantled and re-erected and the dismantled materials are in usable condition, they shall be erected either to the same design as the original, but with such modifications as may be specified, or they shall be erected up to one of the standards specified above.

A11.5.7.3 Clearing and grubbing the fence line

Prior to the removal of indigenous vegetation, verification of compliance with Environmental legislation shall be undertaken.

The fence line shall be cleared over a 2,0 m wide strip, 1,0 m on either side of the centre line of the fence and surface irregularities shall be smoother and graded so that the fence will follow the general contour of the ground. Clearing and grubbing and the removal of trees shall be executed as specified in Clause A1.6.7 of Chapter 1.

Any areas outside the road reserve where clearing is not permitted or is impracticable shall not be cleared.

A11.5.7.4 Erecting straining posts and standards

Straining posts shall be erected at all terminal points, gates, low points (as required), corners and bends in the fencing and at all junctions with other fences. Straining posts shall not be spaced further apart than shown on the drawings. The length of posts above ground shall be such that the correct clearance between the lowest wire and the ground can be obtained.

Straining posts shall be accurately set in holes and shall be provided with concrete bases to the dimensions shown on the drawings. Care shall be taken not to destroy or disturb any cadastral boundary beacons particularly at corner or bends in fences. Any disturbed or destroyed cadastral beacons shall be re-instated by the Contractor at his cost.

Holes shall be dug to the full-specified depth. Where, on account of the presence of rock, the holes cannot be excavated by hand or by pneumatic tools and the Contractor has to resort to the use of explosives, separate payment for the drilling and blasting operations will be made.

All straining posts shall be braced by means of stays or anchors as shown on the drawings or as directed by the Engineer. Tubular stays, where used, shall be bolted to the posts.

Standards shall be firmly planted into the ground at the spacing's shown on the drawings or as directed by the Engineer. The spacing of standards between any two successive straining posts shall be uniform and not greater than that shown on the drawings. In rock or hard material standards shall be either driven or set in holes drilled into the rock. The size of drilled holes shall provide a tight fit to the standards. Care shall be taken when driving steel standards to prevent their buckling or being damaged.

All straining posts and standards shall be accurately aligned and set plumb. Where verandah-type of security fencing is used, the posts shall be planted with the overhang on the roadside and perpendicular to the direction of the fence. After the straining posts and standards have been firmly set in accordance with the foregoing requirements, fence wires shall be attached thereto at the vertical spacing shown on the drawings.

A11.5.7.5 Erecting fence wires

All fencing wire shall be tied to the standards or posts to prevent the wires from being displaced or becoming loose. Generally tensioned wires shall be located to the outside of the road reserve posts to ensure stressing the fence due to animals leaning on fences is transferred directly to the posts rather than to the tie wires. The wire shall be carefully tensioned without sagging, and true to line, care being exercised not to tension the wire to such an extent that it will break, or that end, corner, straining or gate posts will be pulled out, or that it will be easily damaged during veld fires. The effects of temperature during tensioning shall be considered to prevent excessive under or over tensioning due to extreme hot or cold weather. Each strand of fencing wire shall be securely tied in the correct position hard up to each standard with soft galvanized tying wire. The tying wire for each strand shall pass through a hole or notch in the standard, while the ends of the tying wire shall be wound at least four times around the fencing wire to prevent it from

moving in a vertical direction.

At all straining posts at terminal points, gates, corners, bends and other specified positions, the fencing wire shall be securely wrapped twice around the post and secured against slipping by tying the end tightly around the wire by means of at least six snug tight twists.

Where high-tensile wire is used, two long twists may first be made followed by the six tight, snug twists around the post to prevent the wire from breaking at the first twist. When smooth wire is used, the loose end shall preferably be bent over and hooked into the notch between the fencing wire and the first twist.

Splices in the fencing wire shall be permitted if made in the following manner with a splicing tool. The end of each wire at the splice shall be taken at least 75 mm past the splicing tool and wrapped snugly around the other wire by not less than six complete turns with the two separate wire ends being turned in opposite directions. After the splicing tool has been removed, the space left by it in the spliced wire shall be closed by pulling the wire ends together. Unused wire ends shall be cut close so as to leave a neat splice.

The gaps between gate posts and the adjacent straining posts shall be fenced off with short lengths of fencing wires.

Droppers shall be tied to each fence wire with soft tying wire in the required position as specified for standards to prevent slippage in a vertical direction. The spacing of droppers between any two straining posts shall be uniform. Anchoring to structures shall be done as shown on the drawings.

Barbed-tape security barrier shall be attached to the fence as shown on the drawings at maximum spaces of 1,0 m between tying points. Barbed-tape security barrier rolls shall be spliced by overlapping for one full circle and tied at four evenly spaced points along the circumference. Spliced ends shall coincide with the positions of the standards.

A11.5.7.6 Erecting diamond mesh or wire netting

Where vermin-proof, pedestrian or security fences are erected, or where specified by the Engineer, wire netting or diamond mesh shall be stretched against the fence and properly tied to the fencing wire as shown on the drawings. The diamond mesh or wire netting shall be secured by soft tying wire at 1,2 m centers along the top and bottom wires and at 3,0 m centers along each of the other fencing wires, unless otherwise shown on the drawings.

In the case of vermin-proof fencing, vermin shall be prevented from creeping under the fence by either one of the two methods described below as specified:

- By folding back the bottom 130 mm of the wire netting so that it lies flat on the ground and by tightly packing stones (having a minimum dimension of 200 mm) end to end on this flap to secure it in position.
- By embedding the lower 130 mm of the wire netting in the ground and thoroughly compacting the earth around it on both sides, to secure the netting.

A11.5.7.7 Erecting special purpose fencing

Special purpose fencing may be specified where higher security or access control is required. This may include additional elements appended to standard fencing such as barbs to electrification or complete fencing systems. Due to the variability in such fencing system, the materials, standards and specifications shall be detailed in the Contract Documentation, drawings and measurement and payment sections.

A11.5.7.8 Closing openings under fences

At ditches, streams, drainage channels or other depressions where the fence cannot be erected so as to follow the general ground contour, the Contractor shall close the opening under the fence with horizontal barbed wires at 150 mm distances, stretched between additional posts or straining posts as shown on the drawings or directed by the Engineer. In the case of pedestrian, vermin-proof and security fences the opening shall be covered with strips of wire netting or diamond mesh 1,0 m wide, fixed to the barbed wires.

In the case of larger streams where damming of debris against the fence would constitute a hazard, the opening below the bottom fencing wire shall be closed with loose-hanging wire nets. For this purpose additional straining posts shall be planted on both sides of the stream with a cable consisting of at least live strands of smooth fencing wire stretched between them. Onto this cable vertical strips of diamond mesh hanging down to ground level shall be fixed. The edges of the various strips of diamond mesh shall be tied to each other so that the entire mat will be raised by water flowing underneath to leave a free stream area. These mats at streams shall be erected only if specified. If it should be necessary to keep the bottoms of the mats on the ground, the Engineer may order that timber posts or pipes be fixed horizontally to the bottom ends of the diamond-mesh strips.

A11.5.7.9 Existing fences

Where a new fence joins an existing fence whether in line or at an angle, the new fence shall be erected with a new straining post positioned at the terminal of the existing fence.

Existing fences that require to be taken down or moved to a new location shall be dismantled, material not required for re-erection or unsuitable for re-use shall be neatly stacked at approved locations in accordance with the Engineer's instructions. Fencing wire and wire netting shall be stacked clear of the ground. Payment will be made only for fences removed in accordance with the written instruction of the Engineer.

Where fences require moving, the Contractor shall re-use all the material, declared to be suitable for this purpose by the Engineer, plus such new material as may be required to put up the fence again to the standard specified for new fences. The Engineer shall not be responsible for any delays or costs arising from the breaking of re-used wire during straining.

A11.5.7.10 Erecting gates

Gates shall be erected at the positions indicated by the Engineer. The gates shall be hung on gate fittings in accordance with the requirements shown on the drawings. Gates shall be so erected as to swing in a horizontal plane at right angles to the gate posts, clear of the ground in all positions. In pedestrian and security fences the double swing gates shall leave a gap not exceeding 25 mm between them when closed and other gates shall not be further than 25 mm from the gate post when closed.

The clearance below the gates shall not exceed 75 mm with the gates closed.

A11.5.7.11 Temporary fencing and gates

If required, the Contractor shall erect temporary fencing and gates in accordance with the drawings, Contract Documentation or the Engineer's instructions. The material and erection shall be in accordance with the provisions of this Section, but the material need not necessarily be new. Where used materials are offered, they shall nevertheless be in a good condition and approved in advance by the Engineer.

When no longer required, the temporary fencing and gates shall be dismantled and removed.

A11.5.8 WORKMANSHIP

The completed fence shall be plumb, taut, true to line and ground contour, with all posts, standards and stays firmly set. The height of the lower fencing wire above the ground at posts and standards shall not deviate by more than 25 mm from that shown on the drawings. Other fencing wires shall not deviate by more than 10 mm from their prescribed vertical positions.

The Contractor shall, on completion of each section of fence, remove all off-cuts and other loose wire or netting, poles and concrete so as to not create a hazard to grazing animals or a nuisance to the owners or occupiers of the properties.

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 may, at his discretion, elect 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 agrees, shall be repaired so that it shall comply with the specified requirements after having been repaired.

B11.5 FENCING

PART B: LABOUR ENHANCEMENT

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PART B: LABOUR ENHANCEMENT

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B11.5.7	EXECUTION OF THE WORKS
B11.5.8	WORKMANSHIP

B11.5.1 SCOPE

This Section covers the erecting of new fences, the repair or improvement of existing fences and moving of existing fences where necessary along the boundaries of the road reserve and elsewhere as indicated on the drawings or as specified by the Engineer. It shall also include the erection of temporary fences as well as the removal of fencing where specified by the Engineer.

The construction and removal of fencing shall be deemed to be a labour enhanced construction process.

This Section therefore 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.

B11.5.2 DEFINITIONS

The provisions of Part A, shall apply.

B11.5.3 GENERAL

The provisions of Part A, shall apply.

B11.5.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

The provisions of Part A, shall apply.

B11.5.5 MATERIALS

The provisions of Part A, shall apply.

B11.5.6 CONSTRUCTION EQUIPMENT

The provisions of Part A, shall apply.

B11.5.7 EXECUTION OF THE WORKS

B11.5.7.1 Classification of excavation

All excavations under this Section shall be classified as specified under Clause B11.1.7.1.

B11.5.8 WORKMANSHIP

The provisions of Part A, shall apply.

C11.5 FENCING

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.

(ii) Notes on measurement and pay Items

1. Unless otherwise ordered or stated in the Contract Documentation, excavations will be measured from the ground surface.
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. 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.

(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, 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 of 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 C11.5-1: Items from other Chapters or Sections

Activity	Section 11.5 reference	Section Item reference
Clearing and grubbing	A11.5.7.3	C1.6 of Chapter 1
Loading and hauling	C11.5	C1.7 of Chapter 1

(v) Items specifically for this Section of the specification

Item	Description	Unit
C11.5.1	Supply and erect new fencing material for new fences and for supplementing material in existing fences which are being repaired or removed:	
C11.5.1.1	Zinc-coated barbed wire (<i>grade, and size indicated</i>)	kilometre (km)
C11.5.1.2	Zinc-coated smooth wire (<i>grade and size Indicated</i>)	kilometre (km)
C11.5.1.3	Diamond mesh	square metre (m ²)

C11.5.1.4	Wire netting	square metre (m ²)
C11.5.1.5	Barbed-tape security barrier	kilometre (km)
C11.5.1.6	Hinge joint mesh square	square metre (m ²)
C11.5.1.7	Standards (material, protection, <i>length, diameter and type indicated</i>)	number (No)
C11.5.1.8	Droppers (material, protection, <i>length, diameter and type indicated</i>)	number (No)
C11.5.1.9	Straining posts, stays and anchors:	
	(a) Vertical	
	(i) Steel straining posts (<i>type, size and length and whether galvanized or painted indicated</i>)	number (No)
	(ii) Timber straining posts (<i>protection, length and diameter indicated</i>)	number (No)
	(b) Inclined	
	(i) Steel stays and anchors (<i>protection, length, diameter and wall thickness indicated</i>)	number (No)
	(ii) Timber stays and anchors (<i>protection, length and diameter indicated</i>)	number (No)
	(iii) Wire stays and anchors (<i>diameter and type indicated</i>)	number (No)
	(c) Horizontal	
	(i) Steel stays and anchors (<i>protection, length, diameter and wall thickness indicated</i>)	number (No)
	(ii) Timber stays and anchors (<i>protection, length and diameter indicated</i>)	number (No)
	(iii) Wire stays and anchors (<i>diameter and type indicated</i>)	number (No)
C11.5.1.10	Extra over items C11.5.1.3; C11.5.1.4 and C11.5.1.6 for stone packing	metre (m)
C11.5.1.11	Extra over items C11.5.1.3; C11.5.1.4 and C11.5.1.6 for trenching	metre (m)

The quantity of material used shall be determined by measuring the quantities of individual Items of material used in the completed fence. The linear measurement of the completed fence shall not apply.

The appropriate units of measurement are as follows:

- **Straining posts**

The unit of measurement shall be the number of posts, vertical; inclined or horizontal, as follows:

All straining posts erected in accordance with the maximum specified spacing or such lesser spacing as authorised by the Engineer, all corner posts and posts at bends authorised by the Engineer, and all end posts. Wire cross bracing between vertical posts shall not be measured separately and the cost thereof be deemed to be included in the rate for the posts.

- **Standards and droppers**

The unit of measurement shall be the number of standards and droppers erected to the maximum specified spacing or such lesser spacing as authorised by the Engineer.

- **Fencing wire (items C11.5.1.1 and C11.5.1.2)**

The unit of measurement shall be the kilometre of each type of fencing wire measured between end posts. Tying wire and wire used for anchoring the posts shall not be measured for payment.

- **Diamond mesh, wire netting and hinge joint mesh (items C11.5.1.3; C11.5.1.4 and C11.5.1.6)**

The unit of measurement shall be the square metre of diamond mesh, wire netting or hinge joint mesh, the quantity of which shall be calculated according to the prescribed width and the length between straining posts or gate posts, or the length of strips used for covering openings under fences, or the length used for covering the gates.

- **Barbed-tape security barrier (item C11.5.1.5)**

The unit of measurement shall be the kilometre of fencing provided with barbed-tape security barrier of which each concertina is opened to the maximum effective open concertina length.

- **Stays and anchors**

The unit of measurement shall be the number of stay and anchor combinations of each type installed.

The tendered rate for each straining post, standard, dropper, each kilometre of fencing wire and barbed-tape security barrier, and each square metre of diamond mesh, wire netting or hinge joint mesh, and for each anchor or stay shall include full compensation for providing all the materials, including all concrete, tying wire, straining wire, bolts, washers and nuts, for excavating or drilling holes for standards, for erecting the posts, standards and droppers and the complete putting up of the fence as specified and as shown on the drawings. No separate payment will be made in respect of stone packing and/or trenching in the case of wire netting.

The tendered rates shall also include full compensation for digging all holes. Where, on account of the presence of rock, the holes cannot be excavated by hand or by pneumatic tools and the Contractor has to resort to the use of explosives, he will be paid separately for the drilling and blasting operations required under payment item C11.5.7.

Item	Description	Unit
C11.5.2	New gates (size and type indicated)	number (No)

The unit of measurement shall be the number of new gates erected.

The tendered rates shall include full compensation for procuring and furnishing all material, including gates, zinc-coating, painting, hinges and bolts, and for installing the gates complete as specified and as shown on the drawings. It shall not include compensation for any fencing wire or mesh fitted onto the gate. Gate posts will be paid for under subitem C11.5.1.9(a).

Item	Description	Unit
C11.5.3	Moving existing fences and gates:	
C11.5.3.1	Fences:	
(a)	Stock-proof fences	kilometre (km)
(b)	Vermin-proof fences	kilometre (km)
(c)	Pedestrian fences	kilometre (km)
(d)	Security fences	kilometre (km)
(e)	Game fences	kilometre (km)
C11.5.3.2	Gates	number (No)

The unit of measurement for moving existing fences shall be the kilometre of fence, the quantity of which shall be taken as the length of fence, which has been put up permanently with material obtained from fences, which have been dismantled elsewhere. Additional new material used during the re-erection of existing fences shall be measured under item C11.5.1. The unit of measurement for moving gates shall be the number of gates moved.

The tendered rate for each kilometre of existing fence moved or for each existing gate moved shall include full compensation for dismantling the old fence, coiling and stacking the material unsuitable for re-use, moving all material, including posts and wire and again putting up the fence or gate at the new position and the provision of binding, tying and straining wire. New material used for re-erection of old fences shall be paid for under item C11.5.1.

The tendered rate for each gate moved shall include full compensation for taking down the gate and re-erecting it where required, including all new bolts, nuts and other accessories required but excluding new gate posts.

Item	Description	Unit
C11.5.4	Dismantling existing fences and gates:	
C11.5.4.1	Fences:	
(a)	Stock-proof fences	kilometre (km)
(b)	Vermin-proof fences	kilometre (km)
(c)	Pedestrian fences	kilometre (km)
(d)	Security fences	kilometre (km)
(e)	Game fences	kilometre (km)

C11.5.4.2 Gates (type and size indicated) number (No)

The unit of measurement for the dismantling of existing fences shall be the kilometre of each type taken down and dismantled on the Instruction of the Engineer. The unit of measurement for the dismantling of gates shall be the number of gates dismantled on the instruction of the Engineer.

The tendered rates shall include full compensation for taking down existing fences and gates, coiling wires, rolling netting into rolls, transporting the material to designated sites and stacking the material.

Item	Description	Unit
C11.5.5	Providing temporary fences and gates:	
C11.5.5.1	Stock-proof fence	kilometre (km)
C11.5.5.2	Vermin-proof fence	kilometre (km)
C11.5.5.3	Pedestrian fence	kilometre (km)
C11.5.5.4	Game fences	kilometre (km)
C11.5.5.5	Temporary gates (type and size indicated)	number (No)

The unit of measurement for items C11.5.5.1 to C11.5.5.4 shall be the kilometre of each type of temporary fencing erected on the instructions of the Engineer.

The tendered rates shall include full compensation for providing all labour, new or suitable second-hand material putting up the temporary fence and when no longer required, dismantling and removing it from the site to any new locality where it is required, and for neatly restoring the ground surface.

The unit of measurement for item C11.5.5.5 shall be the number of temporary gates provided by the Contractor.

The tendered rate shall include full compensation for procuring, supplying and erecting new or second-hand gates, their later removal, and replacing the gate with fencing.

Where new or second-hand material is used which has been provided by the Employer, e.g. material obtained from taking down existing fences, such material obtained from taking down the temporary fences or gates shall remain the property of the Employer.

Material provided by the Contractor for temporary fences will similarly become the Contractor's property after the temporary fences have been dismantled.

Item	Description	Unit
C11.5.6	Ringbolts for anchoring fencing to structures	number (No)

The unit of measurement shall be the number of ringbolts supplied and fixed to the structure.

The tendered rate shall include full compensation for supplying and fixing ringbolts of the type shown on the drawings to the structure, including, where necessary, drilling holes, anchorage, grouting ringbolts in with epoxy resin, and for all Incidentals.

Item	Description	Unit
C11.5.7	Drilling and blasting holes for posts and anchors	number (No)

The unit of measurement shall be the number of holes for posts and anchors made by drilling where excavation by hand or by pneumatic tools cannot be done economically.

The tendered rate shall include full compensation for drilling and blasting the holes and for all other expenses in connection with providing, storing, transporting and using explosives.

Item	Description	Unit
C11.5.8	Posts fixed horizontally to the bottom of wire mesh for the closing of openings under fences:	
C11.5.8.1	Timber posts (diameter indicated)	metre (m)
C11.5.8.2	Mild steel pipes (diameter and wall thickness indicated)	metre (m)

The unit of measurement shall be the metre of post of each type installed.

The tendered rate shall include full compensation for procuring, furnishing and fixing the posts, complete as specified and as shown on the drawings.

Item	Description	Unit
C11.5.9	Repairing existing fences (Type indicated)	kilometre (km)

The unit of measurement for repairing existing fences shall be the kilometre of existing fence repaired on the instruction of the Engineer.

The tendered rate shall include full compensation for untying the existing fence (where necessary) and reinstating it, tying of droppers and repairing and re-aligning of standards to the satisfaction of the Engineer as well as for coiling and stacking material unsuitable for re-use. Fencing material replaced shall be paid for under items C11.5.1 and C11.5.2.

If the existing fence is damaged by the Contractor's construction activities, the Contractor shall repair the fence at his own cost.

Item	Description	Unit
C11.5.10	Disposal of existing fencing materials	
C11.5.10.1	Type indicated	kilometre (km)
C11.5.10.2	Etc Type indicated	kilometre (km)
C11.5.10.3	Etc Type indicated	kilometre (km)
C11.5.10.4	Etc Type indicated	kilometre (km)
C11.5.10.5	Etc Type indicated	kilometre (km)
C11.5.10.6	Gates (Type indicated)	number (No)

The unit of measurement of fencing shall be the kilometre of fencing, regardless of condition, disposed of, and the length shall be measured between the terminal points of the sections removed.

The unit of measurement for gates shall be the number of gates removed regardless of condition including all fittings.

The tendered rate may be positive or negative as assessed by the Contractor. The tendered rate shall include full compensation for the removal from site and disposal of the fencing, poles, bolts and nuts of gates as scrap including loading, transporting and off-loading. A full record of the destination of fencing material disposed of shall be provided to the Engineer for control purposes.

Dismantling of fencing shall be measured and paid for under item C11.5.4

D11.5 FENCING

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

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D11.5.10 REMEDIAL WORKS

No specific items in this Section.

Where applicable, details must be provided in the Contract Documentation.

A11.6 ROAD SIGNS

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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 manufacturer's 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. Prepainted 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 pre-treatment 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

All road signs or parts of road signs shall be so transported and so handled and so stored in a weather-proof storeroom as to prevent any damage and deformation.

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.

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B11.6 ROAD SIGNS

PART B: LABOUR ENHANCEMENT

CONTENTS

PART B: LABOUR ENHANCEMENT

B11.6.1	SCOPE
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B11.6.6	CONSTRUCTION EQUIPMENT
B11.6.7	EXECUTION OF THE WORKS
B11.6.8	WORKMANSHIP

B11.6.1 SCOPE

This Section covers the supply of permanent and temporary road signs and the erection of permanent traffic signs alongside and over the carriageway, ramps and crossroads at intersections, and interchanges, and at the locations indicated on the drawings or as directed by the Engineer.

The construction of road signs shall be deemed to be a labour enhanced construction process.

This Section therefore 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.

B11.6.2 DEFINITIONS

The provisions of Part A, shall apply.

B11.6.3 GENERAL

The provisions of Part A, shall apply.

B11.6.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

The provisions of Part A, shall apply.

B11.6.5 MATERIALS

The provisions of Part A, shall apply.

B11.6.6 CONSTRUCTION EQUIPMENT

The provisions of Part A, shall apply.

B11.6.7 EXECUTION OF THE WORKS

B11.6.7.1 Classification of excavation

All excavations under this Section shall be classified as specified under Clause B11.1.7.1.

B11.6.8 WORKMANSHIP

The provisions of Part A, shall apply.

C11.6 ROAD SIGNS

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.

(ii) Notes on measurement and pay Items

1. Unless otherwise ordered or stated in the Contract Documentation, excavations will be measured from the ground surface.
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. 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.

(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, 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 C11.6-1: Items from other Chapters or Sections

Activity	Section 11.6 reference	Section Item reference
Loading and hauling	C11.6	C1.7 of Chapter 1
Overhead road sign supporting structures	C11.6.3	C13.9 of Chapter 13

(v) Items specifically for this section of the specification

Item	Description	Unit
C11.6.1	Road signboards with painted or coloured semi-matt background. Symbols, lettering and borders in semi- matt black or in Class I retro-reflective material, where the sign board is constructed from:	
C11.6.1.1	Aluminium sheet (2,0 mm thick):	
(a)	Area 0 to 0,5 m ²	square metre (m ²)
(b)	Area exceeding 0,5 m ² but not 2,0 m ²	square metre (m ²)

	(c) Area exceeding 2,0 m ² but not 10 m ²	square metre (m ²)
	(d) Area exceeding 10 m ²	square metre (m ²)
C11.6.1.2	Aluminium composite sheet	
	(a) Area 0 to 0,5 m ² (indicate plate thickness, 2,0 or 3,0 mm)	square metre (m ²)
	(b) Area exceeding 0,5 m ² but not 2,0 m ² (indicate plate thickness, 2,0 or 3,0 mm)	square metre (m ²)
	(b) Area exceeding 2,0 m ² but not 10 m ² (3,0 mm plate thickness)	square metre (m ²)
	(c) Area exceeding 10 m ² (3,0 mm plate thickness)	square metre (m ²)
C11.6.1.3	Prepainted galvanized steel plate:	
	(a) Area 0 to 0,5 m ²	square metre (m ²)
	(b) Area exceeding 0,5 m ² but not 2,0 m ²	square metre (m ²)
	(c) Area exceeding 2,0 m ² but not 10 m ²	square metre (m ²)
	(d) Area exceeding 10 m ²	square metre (m ²)
C11.6.1.4	Prepainted galvanized steel profiles (200 mm high panels):	
	(a) Area 0 to 0,5 m ²	square metre (m ²)
	(b) Area exceeding 0,5 m ² but not 2,0 m ²	square metre (m ²)
	(c) Area exceeding 2,0 m ² but not 10 m ²	square metre (m ²)
	(d) Area exceeding 10 m ²	square metre (m ²)
C11.6.1.5	Other material (details indicated):	
	(a) Area 0 to 0,5 m ²	square metre (m ²)
	(b) Area exceeding 0,5 m ² but not 2,0 m ²	square metre (m ²)
	(c) Area exceeding 2,0 m ² but not 10 m ²	square metre (m ²)
	(d) Area exceeding 10 m ²	square metre (m ²)
C11.6.1.6	Extra over items C11.6.1.1 to C11.6.1.4 for attaching signboards to overhead gantry structures and overhead to bridges	square metre (m ²)
C11.6.1.7	Regulatory signs, permanent	
	(a) 600 mm diameter (signboard material, background and symbol retro-reflective class indicated)	number (No)
	(b) 900 mm diameter (signboard material, background and symbol retro-reflective class indicated)	number (No)
	(c) 1200 mm diameter (signboard material, background and symbol retro-reflective class indicated)	number (No)
C11.6.1.8	Regulatory signs, temporary	
	(a) 600 mm diameter (signboard material, background and symbol retro-reflective class indicated)	number (No)
	(b) 900 mm diameter (signboard material, background and symbol retro-reflective class indicated)	number (No)
	(c) 1200 mm diameter (signboard material, background and symbol retro-reflective class indicated)	number (No)
C11.6.1.9	Warning signs, permanent	
	(a) 600 mm size (signboard material, background and symbol retro-reflective class indicated)	number (No)

	(b) 900 mm size (signboard material, background and symbol retro-reflective class indicated)	number (No)
	(c) 1200 mm size (signboard material, background and symbol retro-reflective class I indicated)	number (No)
C11.6.1.10	Warning signs, temporary	
	(a) 600 mm size (signboard material, background and symbol retro-reflective class indicated)	number (No)
	(b) 900 mm size (signboard material, background and symbol retro-reflective class indicated)	number (No)
	(c) 1200 mm size (signboard material, background and symbol retro-reflective class indicated)	number (No)
C11.6.1.11	Supplementary plates to permanent regulatory or warning signs (signboard material, background and symbol retro-reflective class indicated)	square metre (m ²)
C11.6.1.12	Supplementary plates to temporary regulatory or warning signs (signboard material, background and symbol retro-reflective class indicated)	square metre (m ²)

The unit of measurement for items C11.6.1.1 to 5 and C11.6.1.11 and C11.6.1.12 shall be the square metre of completed road signboard.

The unit of measurement for items C11.6.1.7 to C11.6.1.10 shall be the number of regulatory or warning road signs provided and installed as specified.

The tendered rate for items C11.6.1.1 to C11.6.1.5 and items C11.6.1.7 to C11.6.1.12 shall include full compensation for procuring and furnishing all the materials, and for manufacturing and supplying the completed road signboard, including amongst others the supporting framework, reinforcement, cross bracing, struts, fixing brackets, angle-irons, channel profiles, galvanizing (if specified), painting, retro-reflective or semi-matt black lettering, symbols, numbers, arrows, emblems and borders, for attaching the road signboard to a road sign support structure and for all materials, equipment, labour, supervision, nuts, bolts, transport, handling, etc necessary for the manufacture, completion, delivery, installation of the road sign board complete as specified, and the removal and disposal of all vegetation obstructing the motorists' view of the new or replaced sign board. Payment for road sign supports shall be made under item C11.6.3, except for temporary road sign removal and re-erection which is paid for under traffic accommodation items.

Payment shall distinguish between road signboards made from the various sign board materials specified.

The tendered rate for item C11.6.1.6 shall include full compensation for all additional costs for working at height over trafficked or un-trafficked road lanes in attaching road signboards to overhead gantry structures or bridges.

Item	Description	Unit
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)
	(b) Class III	square metre (m ²)
	(c) Class IV specify a) or b)	square metre (m ²)
C11.6.2.2	Lettering, symbols, numbers, arrows, emblems and borders of retro-reflective material:	
	(a) Class III	square metre (m ²)
	(b) Class IV specify a) or b)	square metre (m ²)

The area measured for payment shall be the full area of the road sign face as measured in item C11.6.1.

The tendered rates paid extra over subitems C11.6.1 shall include full compensation for the additional cost of providing retro-reflective background, symbols, lettering, numbers, arrows, emblems and borders of the type specified in each case.

Item	Description	Unit
C11.6.3	Road sign supports (overhead road sign structures excluded):	
C11.6.3.1	Steel tubing (diameter and wall thickness indicated)	ton (t)
C11.6.3.2	Timber (diameter and type indicated)	metre (m)

The unit of measurement of supporting structures manufactured from steel tubing shall be the ton of steel tubing used. Bolts and other accessories shall not be measured.

The unit of measurement for timber supporting structures shall be the metre of each diameter post used. Bolls and other accessories shall not be measured. Only the actual length of completed posts shall be measured. Cut-off sections shall not be measured.

The tendered rates shall include full compensation for manufacturing, supplying and erecting the road sign supports, including all materials, equipment, labour, supervision, bolts, screws, rivets, welding and accessories, together with the painting and galvanizing required, treatment of timber supports and the provision and treatment of breakaway holes in timber supports.

The tendered rates shall also include full compensation for tidying up, clearing, trimming, disposing of material at approved dumping sites provided by the Contractor, and finishing the area around each sign footing.

Overhead road sign supporting structures shall not be measured and paid for under this item, but under the appropriate items of Chapter 13.

Timber supporting structures will not be paid for until the break-away holes have been drilled and treated as specified.

Item	Description	Unit
C11.6.4	Kilometre markers	
C11.6.4.1	Kilometre markers on posts (type and post indicated and reference to drawings)	number (No)
C11.6.4.2	Replace marker boards on existing kilometre posts	square metre (m ²)

The unit of measurement for item C11.6.4.1 shall be the number of kilometre markers on posts provided and erected in accordance with the drawings. Excluded from this item shall be concrete kilometre marker posts measured under item C11.3.2 and C11.3.3. Markerboards shall be assembled by the supplier prior to delivering on site.

The tendered rate shall include full compensation for all the labour and material, painting, lettering, posts, excavation, backfilling with soil or concrete, etc, as may be necessary for completing the work in accordance with the details shown on the drawings.

The unit of measurement for item C11.6.4.2 shall be the number of reference marker boards provided and attached to existing kilometre posts in accordance with the drawings.

The tendered rate shall include full compensation for the manufacturing and supplying of the completed marker boards, for attaching the marker board to existing posts along the route and for all materials equipment, labour, nuts and bolts necessary for attaching the marker board as specified.

Item	Description	Unit
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)
C11.6.5.2	Excavating soft or intermediate material and backfilling using labour enhanced construction methods	cubic metre (m ³)
C11.6.5.3	Extra over item C11.6.5.1 and 2 for cement-treated soil backfill	cubic metre (m ³)
C11.6.5.4	Extra over item C11.6.5.1 for hard material excavation	cubic metre (m ³)
C11.6.5.5	Imported backfill material from commercial sources	cubic metre (m ³)

The unit of measurement for items C11.6.5.1 and C11.6.5.2 shall be the cubic metre of excavation measured in place according to the neat dimensions of the footings or excavations as shown on the drawings or directed by the Engineer. In the case of timber posts not in concrete, the plan area of the excavated hole shall be taken as 0,36 m², irrespective of the actual size of the excavated hole.

Excavation shall be done using conventional construction methods and/or labour enhanced construction methods as specified and measured.

The tendered rate shall include full compensation for excavating, backfilling and compacting the backfill material, for the disposal of all surplus excavated material, and for providing the backfill material.

The unit of measurement for item C11.6.5.3 shall be the cubic metre of excavation backfilled with cement-treated soil, measured as specified for item C11.6.5.1 and C11.6.5.2.

The tendered rate shall include full compensation for the additional cost of providing and mixing in cement in the backfill material.

The unit of measurement for item C11.6.5.4 shall be the in situ cubic metre of hard material excavated within the excavation limits specified in item C11.6.5.1

The tendered rate shall include full compensation for the additional cost of excavating in hard material.

Item	Description	Unit
C11.6.6	Dismantling, storing and re-erecting road signs with a surface area of:	
C11.6.6.1	Area 0 to 0,5 m ²	square metre (m ²)
C11.6.6.2	Area exceeding 0,5 m ² but not 2,0 m ²	square metre (m ²)
C11.6.6.3	Exceeding 2,0 m ² but not 10 m ²	square metre (m ²)
C11.6.6.4	Exceeding 10 m ²	square metre (m ²)

The unit of measurement shall be the square metre of signs dismantled, stored and re-erected in each size group.

The tendered rates shall include full compensation for dismantling and storing the road signs and supporting structures, transporting the material to a new location, re-erecting the road signs, and restoring the location where they were dismantled.

Payment for excavations, and the new material and concrete required for re-erecting the road signs shall be made under the appropriate Item, and any repairs and painting which may be necessary, shall be paid for as additional measurement and payment. No separate payment shall be made for new bolts and nuts required for such re-erection, the cost of which shall be included in the rates tendered above.

Item	Description	Unit
C11.6.7	Dismantling and storing of road signs and overhead signs	
C11.6.7.1	Dismantling and storing of road signs with a surface area of:	
(a)	Area 0 to 0,5 m ²	square metre (m ²)
(b)	Area exceeding 0,5 m ² but not 2,0 m ²	square metre (m ²)
(c)	Exceeding 2,0 m ² but not 10 m ²	square metre (m ²)
(d)	Exceeding 10 m ²	square metre (m ²)
C11.6.7.2	Dismantling and storing of overhead signs with a surface area of:	
(a)	Area exceeding 0 m ² but not 2,0 m ²	square metre (m ²)
(b)	Exceeding 2,0 m ² but not 10 m ²	square metre (m ²)
(c)	Exceeding 10 m ²	square metre (m ²)

The unit of measurement shall be the square metre in each size group dismantled and stored.

The tendered rates shall include full compensation for carefully dismantling and disassembling the road signs and overhead road signs, loading, transporting, off-loading and carefully stacking all the materials as specified by the Engineer. It shall also include compensation for restoring the site where the road signs and overhead road signs have been dismantled.

The tendered rates shall also include full compensation for demolishing the concrete footings of existing signs to at least 200 mm below the adjacent ground level, disposing of the resulting debris at approved dumping sites provided by the Contractor, and cutting timber or steel support structures at not less than 200 mm below the adjacent ground level.

Item	Description	Unit
C11.6.8	Danger plates at culverts/structures	
C11.6.8.1	Size 150 x 600 mm (<i>state post type and reflective material</i>)	number (No)
C11.6.8.2	Size 200 x 800 mm (<i>state post type and reflective material</i>)	number (No)
C11.6.8.3	Size 300 x 1200 mm (<i>state post type and reflective material</i>)	number (No)

The unit of measurement shall be the number of danger plates provided and erected in accordance with the drawings in the Contract Documentation.

The tendered rate shall include full compensation for all labour and material, painting, specified posts, excavation, backfilling with soil etc., as may be necessary for completing the work in accordance with the details shown on the drawings.

Item	Description	Unit
C11.6.9	Installation of traffic signals	
C11.6.9.1	Specialist installation of traffic signals	Prime cost sum (PC)
C11.6.9.2	Handling cost, profit and all other charges of sub item C11.6.9.1	Percentage (%)

Payment under item C11.6.9.1 for the provision specialist installation of traffic signals shall be made in accordance with the provisions of Chapter 1 and the General Conditions of Contract applicable to Prime Cost Sums.

The tendered percentage under sub-item C11.6.9.2. shall be a percentage of the actual amount spent under sub-item C11.6.9.1 and shall include full compensation for handling costs, profit and any other costs associated with the specialist installation of traffic signals on site.

Item	Description	Unit
C11.6.10	Disposing of road signs with a surface area of:	
C11.6.10.1	Area 0 to 0,5 m ²	square metre (m ²)
C11.6.10.2	Area exceeding 0,5 m ² but not 2,0 m ²	square metre (m ²)
C11.6.10.3	Exceeding 2,0 m ² but not 10 m ²	square metre (m ²)
C11.6.10.4	Exceeding 10 m ²	square metre (m ²)

The unit of measurement shall be the square metre of road signs, regardless of condition, disposed of in each size group.

The tendered rate may be positive or negative as assessed by the Contractor. The tendered rate shall include full compensation for the removal from site and disposal of the road signs, poles, bolts and nuts as scrap including loading, transporting and off-loading. A full record of the destination of road sign materials disposed of shall be provided to the Engineer for control purposes.

Dismantling of road signs shall be measured and paid for under item C11.6.7.

Note:

Concrete, formwork and reinforcing steel for road sign gantry footings shall be measured and paid for in accordance with the provisions of Section A13.4 of Chapter 13, but such payment items shall appear under this Section in the schedule of quantities.

Item	Description	Unit
C11.6.11	Disposing of overhead road signs:	
C11.6.11.1	Up to 10 m ²	square metre (m ²)
C11.6.11.2	Exceeding 10 m ²	square metre (m ²)

The unit of measurement shall be the square metre of overhead road signs, regardless of condition, disposed of in each size group.

The tendered rate may be positive or negative as assessed by the Contractor. The tendered rate shall include full compensation for the removal from site and disposal of the overhead road signs, bolts and nuts as scrap including loading, transporting and off-loading. A full record of the destination of overhead road sign materials disposed of shall be provided to the Engineer for control purposes.

Dismantling of road signs shall be measured and paid for under item C11.6.7.

D11.6 ROAD SIGNS

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

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D11.6.10 REMEDIAL WORKS

D11.6.1 SCOPE

As per Clause A11.6.1.

D11.6.2 GENERAL

The Engineer must ensure that the necessary compliance certificates are provided by the Contractor.

Compliance certification required:

- Affiliation of road sign manufacturer to a recognised traffic sign manufacturer association or being a permit holder under SANS 1519-2.
- Compliance of materials used in road signs to SANS 1519-1.

A11.7 ROAD MARKINGS AND ROAD STUDS

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PART B: LABOUR ENHANCEMENT

PART C: MEASUREMENT AND PAYMENT

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

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 lamination 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 bi-directionally 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 Cats-Eye	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

Classification	Area of Application			
	RSA-1	RSA-2	RSA-3	RSA-T
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/m^2 ; 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/m^2 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/m^2 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 log-sheet 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/m^2 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/m^2 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.

A11.7.8 WORKMANSHIP

A11.7.8.1 Faulty workmanship or materials

If any material which does not comply with the requirements is delivered to the site, or is used in the works, or if any work of an unacceptable quality is carried out, such material or work shall be removed, replaced or repaired as specified by the Engineer at the Contractor's own cost. Rejected road studs, road markings and paint which has been splashed or dripped onto the pavement, kerbs, structures or other such surfaces, shall be removed by the Contractor at his own cost, in an approved manner so that the markings or spilt paint will not show up at all.

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 work produced will meet the specified requirements for the particular purpose for which it will be used.

A copy of the process control test results shall be submitted to the Engineer for comments.

In order to monitor the application of paint film thickness and application of glass beads the following control mechanisms shall be employed for all non-performance based road marking:

- At the start of this work, all paint and bead containers shall be recorded and marked together by the Contractor and Engineer and on completion of the work, all empty containers shall again be recorded, which measures shall be used for calculating the application rates.
- At regular intervals, plates shall be placed in the line of marking and be painted over in order to calculate the paint thickness and bead application.
- On extended sections of road marking, the spray machines shall be dipped for volume determination at the start and end or each run, as well as recording the start and end measures of beads. In addition a discrete marking shall be made at each start and end position in order to determine the area painted.
- A comprehensive record shall be kept of all the measurements, and submitted to the Engineer on a daily basis.

Property and/or road marking or studs damaged by the Contractor, his personnel, his agents or sub-Contractors shall be repaired or restored to their condition prior to the damage at the Contractor's expense.

A11.7.8.2 Tolerances

Temporary road marking are generally non removable on final road surfaces and may be over-painted with final road marking of the specified type, which requires their positioning and spacing to be sufficiently accurate to allow over-painting to meet the required tolerances

Road markings shall be constructed to accuracy within the tolerances given below:

a) Width

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

b) 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.

c) 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.

When an unbroken line and a broken line are painted alongside each other, the beginning and the end of the unbroken line shall coincide with the beginning of one broken line and the end of another broken line. When existing lines are repainted, the new markings shall not deviate more than 100 mm in the longitudinal direction nor 10 mm in the transverse direction from the existing marking.

The alignment of the road studs shall not deviate from the true alignment by more than 10 mm and shall be positioned so that the reflective faces are within 5° of a right angle to the centre line of the road

d) Broken lines

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

e) Testing of plant and equipment

Before applying any final road markings, the Contractor shall satisfy himself and the Engineer, by painting test lines on a section of pavement other than the section required to be marked:

- that the painting machine is in good working order and properly adjusted;
- that the operator is fully experienced; and
- that the machine sprays at the specified rate of paint application.

The Contractor shall bear the cost of all materials and workmanship required for the above plant tests.

In addition, the Contractor shall conduct random paint thickness tests and dip/spread tests as specified by the Engineer.

While work is in progress, tests shall be carried out on materials and/or the quality of work to ensure compliance with the specified requirements. The sampling methods are specified in SANS 731-1. The sampling methods described in TMH5 shall be followed where applicable.

B11.7 ROAD MARKINGS AND ROAD STUDS

PART B: LABOUR ENHANCEMENT

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B11.7.8	WORKMANSHIP

B11.7.1 SCOPE

This Section covers the marking of the road surface with painted lines and symbols and the supply and fixing of retro-reflective road studs as indicated on the drawings. This section also covers the removal of existing road studs, and the supply and fixing of temporary road studs as specified by the Engineer, and the removal of existing road markings. Also included is the painting by hand of kerbs to the colours specified.

This Section therefore 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.

B11.7.2 DEFINITIONS

The provisions of Part A, shall apply.

B11.7.3 GENERAL

The provisions of Part A, shall apply.

B11.7.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

The provisions of Part A, shall apply.

B11.7.5 MATERIALS

B11.7.5.1 Road marking paint (solvent borne and water borne)

The provisions of Part A, shall apply.

B11.7.6 CONSTRUCTION EQUIPMENT

On certain low order roads and within urban areas, the Engineer may authorise labour enhanced road marking by means of hand held or pushed equipment using rollers or brushes of the required width or by mobile hand operated pressure applied road marking equipment.

B11.7.7 EXECUTION OF THE WORKS

Where road marking or the painting of kerbs by hand is authorised, the Contractor shall demonstrate by means of trial sections that the methods employed will meet all the required specifications, application rates and tolerances and will be maintained during the work execution.

The Contractor may select the type and make of hand operated line marking equipment subject to executing trial sections to verify to the Engineer that all the required specifications, application rates and tolerances are achieved and will be maintained during the work execution.

B11.7.8 WORKMANSHIP

The provisions of Part A, shall apply.

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C11.7 ROAD MARKINGS AND ROAD STUDS

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.

(ii) Notes on measurement and pay Items

Not applicable to this Section.

(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 setting out the works.
2. 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.
3. 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.
4. No separate payment will be made for the loading of any materials.
5. No separate payment will be made for the hauling of any materials.
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

Not applicable to this Section.

(v) Items specifically for this section of the specification

Item	Description	Unit
C11.7.1	Road marking:	
C11.7.1.1	White lines broken or unbroken (paint type and width of line indicated)	kilometre (km)
C11.7.1.2	Yellow lines broken or unbroken (paint type and width of line indicated)	kilometre (km)
C11.7.1.3	Red lines broken or unbroken (paint type and width of line indicated)	kilometre (km)
C11.7.1.4	White lettering and symbols (paint type indicated)	square metre (m ²)
C11.7.1.5	Yellow lettering and symbols (paint type indicated)	square metre (m ²)
C11.7.1.6	Red lettering and symbols (paint type indicated)	square metre (m ²)
C11.7.1.7	Transverse lines, painted island and arrestor bed markings (any colour) (paint type indicated)	square metre (m ²)
C11.7.1.8	Labour enhanced hand painted white lines broken or unbroken (paint type and width of line indicated)	square metre (m ²)
C11.7.1.9	Labour enhanced hand painted yellow lines broken or unbroken (paint type and width of line indicated)	square metre (m ²)
C11.7.1.10	Labour enhanced hand painted red lines broken or unbroken (paint type and width of line indicated)	kilometre (km)

C11.7.1.11	Labour enhanced hand painted white lettering and symbols (paint type indicated)	square metre (m ²)
C11.7.1.12	Labour enhanced hand painted yellow lettering and symbols (paint type indicated)	square metre (m ²)
C11.7.1.13	Labour enhanced hand painted transverse lines, painted island and arrestor bed markings (any colour) (paint type indicated)	square metre (m ²)
C11.7.1.14	Labour enhanced hand painted kerb markings (any colour) (paint type indicated)	square metre (m ²)
C11.7.1.15	Labour enhanced hand operated pressure applied machine white lines broken or unbroken (paint type and width of line indicated)	kilometre (km)
C11.7.1.16	Labour enhanced hand operated pressure applied machine yellow lines broken or unbroken (paint type and width of line indicated)	kilometre (km)
C11.7.1.17	Labour enhanced hand operated pressure applied machine red lines broken or unbroken (paint type and width of line indicated)	kilometre (km)
C11.7.1.18	Labour enhanced hand operated pressure applied machine white lettering and symbols (paint type indicated)	square metre (m ²)
C11.7.1.19	Labour enhanced hand operated pressure applied machine yellow lettering and symbols (paint type indicated)	square metre (m ²)
C11.7.1.20	Labour enhanced hand operated pressure applied machine transverse lines, painted island and arrestor bed markings (any colour) (paint type indicated).....	square metre (m ²)
Item	Description	Unit
C11.7.2	Retro-reflective road marking:	
C11.7.2.1	White lines broken or unbroken (paint type and width of line indicated)	kilometre (km)
C11.7.2.2	Yellow lines broken or unbroken (paint type and width of line indicated)	kilometre (km)
C11.7.2.3	Red lines broken or unbroken (paint type and width of line indicated)	kilometre (km)
C11.7.2.4	White lettering and symbols (paint type indicated)	square metre (m ²)
C11.7.2.5	Yellow lettering and symbols (paint type indicated)	square metre (m ²)
C11.7.2.6	Red lettering and symbols (paint type indicated)	square metre (m ²)
C11.7.2.7	Transverse lines, painted island and arrestor bed markings (any colour) (paint type indicated)	square metre (m ²)
C11.7.2.8	Hand painted white lines broken or unbroken (paint type and width of line indicated)	kilometre (km)
C11.7.2.9	Hand painted yellow lines broken or unbroken (paint type and width of line indicated)	kilometre (km)
C11.7.2.10	Hand painted red lines broken or unbroken (paint type and width of line indicated)	kilometre (km)
C11.7.2.11	Hand painted white lettering and symbols (paint type indicated)	square metre (m ²)
C11.7.2.12	Hand painted yellow lettering and symbols (paint type indicated)	square metre (m ²)
C11.7.2.13	Hand painted transverse lines, painted island and arrestor bed markings (any colour) (paint type indicated)	square metre (m ²)
C11.7.2.14	Hand operated pressure applied machine white lines broken or unbroken (paint type and width of line indicated)	kilometre (km)
C11.7.2.15	Hand operated pressure applied machine yellow lines broken or unbroken (paint type and width of line indicated)	kilometre (km)
C11.7.2.16	Hand operated pressure applied machine red lines broken or unbroken (paint type and width of line indicated)	kilometre (km)

C11.7.2.17	Hand operated pressure applied machine white lettering and symbols (paint type indicated)	square metre (m ²)
C11.7.2.18	Hand operated pressure applied machine yellow lettering and symbols (paint type indicated)	square metre (m ²)
C11.7.2.19	Hand operated pressure applied machine transverse lines, painted island and arrestor bed markings (any colour) (paint type indicated)	square metre (m ²)

The unit of measurement for painting the lines shall be a kilometre of each specified colour and width of line and the quantity paid for shall be the actual length of line painted in accordance with the instructions of the Engineer, excluding the length of gaps in broken lines.

The unit of measurement for painting the lettering, symbols, transverse lines or painted island and arrestor bed markings per required colour shall be a square metre, and the quantity to be paid for shall be the actual surface area of lettering. Symbols or transverse lines, painted island and arrestor bed markings completed in accordance with the drawings and Contract Documentation.

The tendered rate per kilometre or per square metre as the case may be for painting the road markings shall include full compensation for establishing specialist teams and equipment, and for procuring and furnishing all labour and material, including the retro-reflective beads In the case of retro- reflective paint, and the necessary equipment, and for painting, protecting and maintenance as specified, including the setting-out of lettering, symbols and transverse lines, painted island and arrestor bed markings, but excluding setting out and premarking the lines. Separate rates for different types of application are applicable.

Item	Description	Unit
C11.7.3	Thermoplastic road marking	
C11.7.3.1	Thermoplastic road marking, broken or unbroken (colour and width of line indicated):	kilometre (km)
C11.7.3.2	Performance based thermoplastic road marking, broken or unbroken (colour and width of line indicated):	kilometre (km)
C11.7.3.3	Reduced payment for thermoplastic road marking, white lines, broken or unbroken (width of line indicated):	kilometre (km)
C11.7.3.4	Reduced payment for thermoplastic road marking, yellow lines, broken or unbroken (width of line indicated):	kilometre (km)

The unit of measurement for painting the lines shall be a kilometre of each specified width of line and the quantity paid or deducted shall be the actual length of line painted in accordance with the instructions of the Engineer, excluding the length of gaps in broken lines.

Full payment of the tendered rate will be applicable upon approved completion of the application of the thermoplastic road marking for items C11.7.3.1 and C11.7.3.2. The tendered rate per kilometre for the road markings shall include full compensation for establishing specialist teams and equipment, and for procuring and furnishing all material, including the retro-reflective beads and the necessary labour and equipment, and for marking, protecting and maintenance as specified, including the setting-out of lettering, symbols and transverse lines, painted island and arrestor bed markings, but excluding setting out and premarking the lines.

Should the coefficient of retro-reflected luminance fall below the required minimum levels as specified in Clause A11.7.5.2a)(iii), payment will be deducted against item C11.7.3.2 on the following sliding scale under items C11.7.3.3 and C11.7.3.4. No contract price adjustment will be applicable to any reduced payment.

White lines:

Below 250mcd /m ² .lux at 30 days:	minus 10 % of the tendered rate; which shall then be termed the reduced rate.
Below 200 down to 180mcd /m ² .lux at 6 months:	minus 10 % of the reduced rate
Below 180 down to 160mcd/m ² .lux at 6 months:	minus 20 % of the reduced rate
Below 160 down to 140mcd/m ² .lux at 6 months:	minus 30 % of the reduced rate
Below 140mcd/m ² .lux:	repainting at Contractor's expense

Yellow lines:

Below 120 down to 100mcd /m ² at 30 days:	minus 20 % of the tendered rate; which shall then be termed the reduced rate.
Below 100 down to 80mcd/m ² .lux at 6 months:	minus 20 % of the reduced rate
Below 80mcd/m ² .lux:	repainting at Contractor's expense

The reduction in the tendered rate applicable for failing to meet the specified minimum luminance level at the 30 days and 6 months measurement dates shall be applied accumulative in the certificate immediately following the date of measurement

Item	Description	Unit
C11.7.4	Cold plastic road marking material	
C11.7.4.1	White lettering and symbols	square metre (m ²)
C11.7.4.2	Yellow lettering and symbols	square metre (m ²)
C11.7.4.3	Red lettering and symbols	square metre (m ²)
C11.7.4.4	Transverse lines, painted island and arrestor bed markings (any colour)	square metre (m ²)

The unit of measurement for applying the roadmarking material for the lettering, symbols, transverse lines, islands and arrestor bed markings shall be the square metre, and the quantity to be paid for shall be the actual surface area of the lettering, symbols, transverse lines, islands and arrestor bed markings, completed in accordance with the specifications and on instructions of the Engineer.

The tendered rate per square metre for applying the road marking material shall include full compensation for establishing specialist teams and equipment, and for procuring and furnishing all material, including the retro-reflective beads and all necessary equipment, and for applying, protecting and maintenance as specified, including the setting out of lettering, symbols, transverse lines, islands and arrestor bed markings.

Item	Description	Unit
C11.7.5	Variations in rate of application:	
C11.7.5.1	White paint	litre (ℓ)
C11.7.5.2	Yellow paint	litre (ℓ)
C11.7.5.3	Red paint	litre (ℓ)
C11.7.5.4	Retro-reflective beads	kilogram (kg)
C11.7.5.5	Thermoplastic material, all colours	kilogram (kg)
C11.7.5.6	Cold plastic marking material, all colours	kilogram (kg)

The unit of measurement for variations in the rate of application of the paint and retro-reflective beads shall be a litre and a kilogram respectively as the relevant unit. These items shall only be relevant to non-performance based road marking

Payment for variations shall be made as specified in item C1.1.4 of Chapter 1.

Item	Description	Unit
C11.7.6	Pre formed road marking tape	
C11.7.6.1	White (specify width)	metre (m)
C11.7.6.2	Yellow (specify width)	metre (m)
C11.7.6.3	Red (specify width)	metre (m)

The unit of measurement will be for the supply and installation of the pre formed road marking tape on asphalt or concrete surfaces as specified in Clause A11.7.5.2a)(vi).

Item	Description	Unit
C11.7.7	Road studs	
C11.7.7.1	Permanent road studs compliant to SANS 1442 (<i>type & colours stated</i>)	number (No)
C11.7.7.2	Permanent road studs compliant to SANS 1463 (<i>classification & colours stated</i>)	number (No)
C11.7.7.3	Temporary road studs compliant to SANS 1442 or 1463 (<i>type/classification & colours stated</i>)	number (No)
C11.7.7.4	Solar powered road studs (<i>No of LED's & colours stated</i>)	number (No)

C11.7.7.5	Provision of temporary and permanent road studs	Provisional sum (Prov Sum)
C11.7.7.6	Handling cost, profit and all other charges of sub item C11.7.7.5	percentage (%)
C11.7.7.7	Installation only of surface bonded road studs with anchor shanks	number (No)
C11.7.7.8	Installation only of surface bonded road studs without anchor shanks	number (No)
C11.7.7.9	Installation only of embedded glass road studs	number (No)
C11.7.7.10	Installation only of temporary stick on road studs (including removal)	number (No)

The unit of measurement for installed road studs shall be the actual number of approved road studs placed in terms of the specifications.

The tendered rate for items C11.7.7.1 to C11.7.7.4 shall include full compensation for establishing specialist teams and equipment, and 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. Payment under item C11.7.7.5 for the provision on site of approved road studs shall be made in accordance with the provisions of Section C1.5 of Chapter 1 and the General Conditions of Contract applicable to Provisional Sums.

The tendered percentage under item C11.7.7.6 shall be a percentage of the actual amount spent under item C11.7.7.5 and shall include full compensation for handling costs, profit and any other costs associated with providing the road studs on site.

The tendered rate for items C11.7.7.7 to C11.7.7.10 shall include full compensation for establishing specialist teams and equipment, and for procuring and furnishing all the necessary material (excluding the provided road studs), labour and equipment, and for fixing and maintenance as specified. Distinction shall be made between various types of road stud fixing methods.

No additional payment will be made should temporary or permanent road studs require replacement if lost or broken during the construction period or during after the issue of the Certificate of Completion in excess of 5 % of installed studs, unless failure is not due to normal tyre impact.

Item	Description	Unit
C11.7.8	Setting out and premarking the lines (excluding traffic island markings, lettering and symbols)	kilometre (km)

The unit of measurement for setting out lines shall be the kilometre of lines set out and marked. Where two or three lines are to be premarked for painted next to each other, and where the centre-to-centre distance between adjacent lines does not exceed 500 mm, the setting-out of all these lines shall be measured only once.

The tendered rate shall include full compensation for establishing specialist teams and equipment, and for setting out and premarking the lines as specified, including all necessary equipment, labour and materials.

Item	Description	Unit
C11.7.9	Re-establishing the painting unit during the defects notification period and at other instances on instruction of the Engineer	number (No)

The unit of measurement shall be the number of times the painting unit is re-established on site on instruction of the Engineer irrespective of the number of times the road marking team is required to move within the site.

The tendered rate shall include full compensation for the re-establishment on the site and for later removing all painting and road marking units including the traffic accommodation requirements and special equipment, personnel, etc, as may be required after instruction by the Engineer. The Contractor will be paid at tender rates for repainting the road markings. Contract price adjustment at the full index values will apply for this item, if the work is executed after the issue of the Certificate of Completion.

The establishment and re-establishment of road marking teams and equipment on site during the construction period shall not be paid for under this item, and allowance therefore shall be made by the Contractor in his programme and his rates for painting or other general obligation rates. The rate shall include for any preliminary and general costs applicable after the issue of the Certificate of Completion.

Item	Description	Unit
C11.7.10	Removal of existing, temporary or final road markings by:	
C11.7.10.1	Sandblasting	square metre (m ²)
C11.7.10.2	Water-jetting	square metre (m ²)
C11.7.10.3	Overpainting as temporary measure	square metre (m ²)

The tendered rate shall include full compensation for establishing specialist teams and equipment, and for the necessary equipment, labour and materials, for any specific protection measures, accommodation of traffic, and the cleaning of the area of all dust and debris, all as specified.

Item	Description	Unit
C11.7.11	Removal of existing road studs	number (No)

The unit of measurement shall be the actual number of road studs removed.

The tendered rate shall include full compensation for furnishing all equipment, labour and material to remove the existing road studs as specified and to repair the road surface in case of any damage, as well as the disposal of the road studs.

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D11.7 ROAD MARKINGS AND ROAD STUDS

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

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D11.7.9 NOTIFICATION OF REMEDIAL WORK

D11.7.10 REMEDIAL WORKS

D11.7.1 SCOPE

Refer to Clause A11.7.1.

D11.7.2 GENERAL

- a) Prior to applying any road marking on the road, the Contractor needs to provide the following approved certification from the manufacturer:

SANS 731-1 for solvent borne road marking paints

SANS 731-2 for water borne road marking paints

SANS 51423 for drop on beads

EN 1436 for thermoplastic road marking material

SANS 51424 for Class A glass beads

SANS 731-1 or SANS 731-2 for white paint

- b) The Contractor shall provide the road stud manufacturer / supplier's installation specifications for all application adhesives to the Engineer, prior to installation.

A11.8 LANDSCAPING AND PLANTING PLANTS

CONTENTS

PART A: SPECIFICATIONS

A11.8.1 SCOPE

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A11.8.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

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PART B: LABOUR ENHANCEMENT

PART C: MEASUREMENT AND PAYMENT

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

PART A: SPECIFICATIONS

A11.8.1 SCOPE

This Section includes all areas affected by construction activities but may also extend to other areas requiring landscaping and planting for functional or aesthetic purposes. It includes landscaping, grassing, rehabilitation, erosion protections and planting trees and shrubs.

A11.8.2 DEFINITIONS

A11.8.2.1 Weeds

Any declared weeds or alien invader plants (as listed in the Conservation of Agricultural Resources Act), including any tree, shrub, herb, water plant or any other plant which, on the instruction of the Engineer, poses any problems in specified areas (such as the road reserve, haul roads, borrow pits, camp sites, stockpile sites, drainage elements, etc.) at certain times or conditions.

A11.8.3 GENERAL

No general specifications

A11.8.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

Not required for Section A11.8.

A11.8.5 MATERIALS

A11.8.5.1 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, shall be deemed to be the property of the Contractor.

A11.8.5.2 Materials

a) Topsoil

Topsoil, as defined in Clause A1.6.2 of Chapter 1, shall be obtained from stockpiles and/or windrows of topsoil which have been prepared as specified in Clause A1.6.7.6 of Chapter 1.

Where so specified, the Contractor shall procure and furnish topsoil from commercial sources outside the site, after such sources have been approved by the Engineer.

b) Fertiliser/soil-improvement material

The type of fertiliser/soil-improvement material to be used shall be one or more of the following types or any other type of fertiliser/soil-improvement material specified in the Contract Documentation:

- Soil-improvement materials such as dolomitic lime, basic slag, gypsum, superphosphate and agricultural lime, compost, manure and mulches.
- Fertilisers such as limestone ammonium nitrate, 2:3:2 (22) and 3:2:1 (25).

c) Grass cuttings

Grass cuttings shall be fresh cuttings of an approved type of grass with sufficient root material to ensure good growth.

d) Grass seeds

Only fresh certified seed shall be used and the types of seeds in the seed mixture shall be as specified in the Contract Documentation.

Mixing the various types of grass seeds for obtaining the prescribed grass-seed mixture shall be done on the site in the presence of the Engineer. At any time during the planting process the Engineer has the right to take samples in order to test the quality of materials and workmanship. Storing and identifying the grass seeds and the grass-seed mixtures on the site shall be the responsibility of the Contractor.

The grass seed mixture, where required, shall be indigenous to the local area as specified in the Contract Documentation as follows:

(specify type) (specify kg/ha)

(specify type) (specify kg/ha)

(specify type) (specify kg/ha)

etc.

Total (specify kg/ha)

(Specify source of seed if applicable)

e) Trees and shrubs

Plants shall be of the variety and size shown on the drawings or in the Contract Documentation and/or the schedule of quantities.

The Contractor shall supply the required number of plants as shown on the drawings or in the Contract Documentation and/or the schedule of quantities. Plants must be healthy, shapely, well rooted and disease-free. Plants shall not show any evidence of having been restricted or deformed at any time. Plants shall be grown specifically to be able to cope with the adverse conditions as experienced in the road reserve and other required positions. The plants must be hardened off and be exposed to direct sunlight for at least six months prior to planting in the road reserve. A minimum amount of water/fertiliser should be administered in order to acclimatise the plants for their future environment as specified by the Engineer.

Each tree shall be supplied in a plastic plant container of at least 8 ℓ capacity and shall have a height of at least 1,5 m.

Each shrub shall be supplied in a plastic plant container of at least 4,5 ℓ capacity and shall have a height of at least 0,5 m.

Each plant shall be handled and packed in the approved manner for that species or variety, and all the necessary precautions shall be taken to ensure that the plants will arrive at the site of the works in an undamaged and healthy condition for successful growth. Trucks used for transporting plants shall be equipped with covers to protect the plants from windburn. Containers shall be in an undamaged condition.

The Contractor shall ensure that the plants are and remain in good condition and free from pests and diseases and he shall accept full responsibility for maintaining the plants in a good condition throughout the contract and the maintenance periods. The plants shall be fully maintained and watered during this period and any losses of plants on account of the lack of care, or are diseased, during the contract period up when they have established, shall be replaced at the Contractor's cost.

- Grass sods

Grass sods shall be either nursery-grown or veld sods as described below. Both types shall be harvested, delivered, planted and

watered within 36 hours unless otherwise specified by the Engineer. The grass sods shall be free from weeds and diseases. Sods delivered to the site shall be moist and shall have at least 30 mm soil thickness for nursery-grown sods and 50 mm soil thickness for veldsods, at the location of planting or placement. Sods shall also measure a minimum of 400 mm in width and 500 mm in length and shall retain the minimum dimensions once placed for planting.

- Nursery-grown sods

These sods shall be of the variety of grass specified in the Contract Documentation. The grass shall have been grown specifically for sod purposes, mown regularly and cared for to provide an approved uniformity to the satisfaction of the Engineer. It shall be harvested by sod cutting machines to ensure an even depth of cut with sufficient root material and soil.

The sods shall be free of weeds, weed seeds, insects and fungal diseases.

- Veld sods

These sods may be obtained from commercial or areas approved by the Engineer within or near the site where a suitable type and density of grass and type of soil are found. These areas shall also be mown regularly and cared for to provide suitable sods to the approval of the Engineer.

f) Anti-erosion materials

Anti-erosion compounds or hydraulic mulches shall consist of an organic or inorganic material to bind soil particles together or form a growth medium and shall be a proven product able to suppress dust and to form a protective encrustation. The application thereof shall be by means of a hydroseeding machine and the application rate shall conform to the manufacturer's recommendations, or be as specified by the Engineer. The materials used shall be of such a quality that sown seeds may germinate and grow through the crust. Hydraulic mulches may comprise of shredded straw and shall contain at least 25 % by mass of peat moss or paper fibre.

g) Manure

Manure shall, unless another type has been approved by the Engineer, be old sweated, pure kraal manure free from soil, noxious weed seeds or other undesirable material. It shall not contain any particles that will not pass through a 50 mm screen and shall be approved by the Engineer before being delivered to the site.

h) Compost

Compost shall be well decayed, friable and free from noxious weed seeds or any other undesirable materials. It shall not contain any particles that will not pass through a 50 mm screen and shall be approved by the Engineer prior to delivery on the site.

A11.8.6 CONSTRUCTION EQUIPMENT

The Contractor shall submit his plant and equipment list for excavating, stockpiling if specified, hydroseeding, loading and hauling as part of his method statement.

A11.8.7 EXECUTION OF THE WORKS

A11.8.7.1 Landscaping the areas

a) Shaping

Areas within the road reserve but outside the road prism which require shaping by means of bulk earthworks such as contoured areas at interchanges, intersections and rest areas which require earthworks shall be excavated, filled and compacted as required and shaped to the correct contours to within a tolerance of plus or minus 150 mm. Such work shall be regarded as being earthworks and measurement and payment therefore shall be made under Chapter 5, except that quantities may be measured by means of a grid system of levels taken at 10 m intervals before and after shaping or else it may be determined by leveled cross-sections.

b) Trimming

Trimming shall consist of trimming the existing or previously shaped ground to an even surface with the final levels generally following the original surface, and it is a requirement that the drainage remains effective without ponding. Trimming shall normally be done by grader, or in more confined or steep areas by bulldozer. If specified and where machine operations are not practicable, because of confined spaces or steep slopes, trimming shall be done with hand tools. When trimming is done on slopes, the ridges shall be made parallel to the contour. Such ridges shall be approximately 100mm wide, and the centres between the ridges approximately 400 mm. Trimming shall be done where specified by the Engineer generally to areas inside the road reserve but outside the road prism, i.e. normally outside the tops of cuts or the toes of fills but trimming of rock outcrops will not be required.

Trimmed surfaces shall be left slightly rough to facilitate a better binding with topsoil or the natural establishing of vegetation.

When subsequent grassing is required or when it is specified by the Engineer, areas previously shaped shall be trimmed as described above to within a tolerance of plus or minus 100 mm with all undulations following a smooth curve. The above tolerance shall apply only to areas where the final contours are given on the drawings

During trimming all surface stones in excess of 50 mm in size and all excess material shall be removed. Areas which require sodding shall be trimmed in such a way that, after cultivation and the application of topsoil, the finished surface of the area shall be at least 30 mm below the top of adjacent kerbing, channeling or pavement in the event of sodding with nursery grown sods,

and at least 50 mm below in the event of veld sods being placed.

c) Construction plant rates

The Engineer shall be entitled to pay for shaping and trimming as described above on the basis of hourly construction plant rates. The motor grader and bulldozer to be provided shall each have a flywheel power of not less than 93 kW. All machines shall be in a good condition. Any labour or other plant required shall be paid for on hourly or daily rates.

A11.8.7.2 Preparing the areas for planting

a) Soil ripping and scarifying

Where soil is too hard to be scarified with a light tractor, the soil shall be ripped up to a depth of 300 mm before it is loosened by a scarifier to a depth of 150 mm.

b) Areas which do not require topsoil

Where the areas to be grassed consist of organically suitable material, the topsoil shall be loosened by scarifying to a minimum depth of 150 mm. All loose surface stones exceeding 20 mm in size on areas to be mowed by machine and falling within the road reserve and all surface stones exceeding 50 mm in size in other areas shall be removed.

Fertilising may still be required as specified in Clause A11.8.7.2d).

In areas with large natural rock, i.e. not blasted or excavated rock, these rocks may be placed or retained so as to look like a natural part of the landscape.

c) Areas which require topsoil

Where areas to be grassed consist of organically unsuitable material, the surface shall be scarified to a minimum depth of 150 mm before topsoil is placed to ensure a proper bond between the topsoil and the subsoil. If required, the area shall be ripped and scarified as described A11.8.7.2a) above.

Topsoil shall be placed on the prepared surfaces and trimmed to the uniform thickness required. The topsoil shall be scarified by means of handraking or light rotavators and all stones removed as specified for areas not requiring topsoil in subparagraph (b) above.

Areas which will be inaccessible for topsoil being placed mechanically after the construction works have been completed shall be spread with topsoil and protected against erosion as construction works progress.

d) Fertilising

For all areas to be planted, and on instruction of the Engineer, the Contractor shall have the top 150 mm of the prepared surface including the topsoil analysed to determine the quantity and type of fertiliser which may be required for establishing proper growth conditions for the grass or to assess the requirement for any soil improvement required. The Engineer shall be furnished with the soil-analysis and subsequent fertiliser recommendations. Only after approval by the Engineer of the nature and quantity of the fertiliser, may the application proceed.

Soil-Improvement materials (such as lime, superphosphate, etc) shall be evenly applied over all surfaces where soil improvement is required, and shall then be thoroughly mixed with the soil to a depth of 150 mm either mechanically or manually. Where hydroseeding is to be performed, the fertiliser may be mixed with the anti-erosion compound and water used in the hydroseeding.

e) Vegetation growth media

In certain limited and unique cases, where topsoil is not available or cannot be retained on a steep slope, vegetation growth media such as hydraulic mulches or other media or blankets may be used at an approved application or installation rate, at the specification of the Engineer.

f) General

After an area has been prepared for grassing, the seeding or grassing shall be completed before crustification takes place. Where a crust has been formed before seeding or grassing is done, the Contractor shall, at his own cost, loosen the crust by scarifying to a depth of 50 mm.

g) Removal of undesirable vegetation

During the course of the contract the Engineer may instruct the Contractor to physically remove undesirable vegetation from within the road reserve. Such an operation shall take place before the flowering stage of the undesirable vegetation upon written instruction from the Engineer, but shall not relieve the Contractor of his obligation towards weeding sodded, grassed areas and any area directly affected by any construction activity. Should the Contractor fail to respond to the written instruction from the Engineer for the removal of the aforementioned undesirable vegetation before flowering, the Contractor shall be held contractually responsible for any growth or seeding of said vegetation for a period of not less than twelve (12) months in the affected area.

A11.8.7.3 Grassing

After preparing the areas for planting the method of establishing grass shall depend on the circumstances relating to each case, and the Engineer shall decide which method is to be used.

a) Planting grass cuttings

The areas to be grassed by means of grass cuttings shall, unless already moist, be thoroughly watered before the cuttings are

planted to ensure that the soil will be uniformly moist to a depth of at least 150 mm when the planting is done. This method shall only be used on flat areas, such as medians.

An approved variety of grass cuttings shall be evenly planted by hand or mechanically at a rate of at least 600 kg of cuttings per hectare and shall have the root system of the grass cuttings thoroughly planted within the topsoil layer to ensure good growth. No part of the grass root system shall be left protruding from the topsoil.

Only fresh cuttings shall be used but not any grass cuttings that have been allowed to dry out. Immediately after having been planted, the grass cuttings shall be given a copious watering.

b) Sodding

Areas to be grassed by sodding shall be given a layer of topsoil of at least 50 mm in thickness unless, where suitable soil is present, the Engineer orders the topsoil to be omitted. The areas to be sodded shall be thoroughly watered beforehand so that it will be moist to a depth of at least 150 mm during sodding. The surface shall be roughened slightly to ensure a good penetration of roots into the soil. Sods shall be protected against drying out and kept moist from the time of harvesting until they are finally placed. The handling of the sods shall not result in the sods losing their prescribed soil thickness.

The first row of sods shall, where possible, be laid in a straight line, and if on a slope, laying the sods shall start at the bottom of the slope. The sods shall be butted tightly against each other, and care shall be taken not to stretch or overlap the sods. Where a good fit cannot be obtained, any intervening spaces shall be filled with topsoil. The next row shall be similarly placed tightly against the bottom row with staggered joints, and so on until the entire area has been covered with sods. Sods shall be laid in such a way that unnecessary trampling over areas previously laid is prevented. To this end, a diagonal method of laying sods is preferred, moving up the slope and behind previously laid sods. On steep slopes the sods shall be held in position by a sufficient number of wooden stakes approximately 300 mm long by 20 mm in thickness and these stakes shall be knocked in to a depth of 100 mm into the subsoil.

Sods laid adjacent to concrete side drains shall be laid in such a manner that the sodding will be 20 mm higher than the concrete. The top surface of sods laid adjacent to the road pavement shall be 50 mm lower than the road surface. When stripsodding is required, the sods shall be laid in such a manner that the sods are proud of the surrounding ground level. During stripsodding the areas in between shall be hydroseeded and stripsodding shall be staked as specified above.

As sodding is completed each section shall be lightly rolled or firmly pressed to ensure a proper bond with the underlying material, and thoroughly watered afterwards.

Where it is specified that sodding is required the following sodding principles may be applied:

A 1,0 m wide strip be placed next to the road edge where no gravel shoulder exists. A 0,5 m wide strip be placed adjacent to concrete-lined drains. Full sodding be used for grass-lined drains. This sodding to extend over the entire drainage channel, including the tops of the sides. The use of grass sods to commence from the point of acceptance of water, up to the safe discharge of water. No area be left without grass sods within the drainage channel should it provide a risk of erosion. A minimum of a 1,0 m wide strip be placed over the shoulder breakpoint for fill slopes. Full sodding to be used for slopes steeper than 1:2. Any slope that exceeds 3,0 m in width be sodded, the type of which be determined by the slope.

c) Hydroseeding

Where it is specified that hydroseeding is to be carried out on topsoil, the thickness of the topsoil layer shall be as specified in the Contract Documentation or as specified by the Engineer.

The types and mixtures of seeds to be used shall be as specified in the Contract Documentation or, if not so specified therein, shall be agreed on by the Engineer and the Contractor before any seed of his choice is specified by the Contractor. The Contractor shall be solely responsible for establishing an acceptable grass cover, and any approval by the Engineer of seed or seed mixtures intended for use by the Contractor shall not relieve him of this responsibility.

Mulch shall be added to the hydroseeding mix at an approved rate.

Hydroseeding shall then be carried out with an approved hydroseeding machine at a rate of application of not less than 38 kg of seed mixture per hectare, unless otherwise specified in the Contract Documentation.

When the use of anti-erosion compounds is required and such compound is to be applied simultaneously with the hydroseeding, it shall be mixed with the hydroseeding mixture before application. Should hydraulic mulches be used, the quantities of the fertilisers shall be adjusted accordingly, subject to the Engineer's approval.

d) Topsoiling only

Where, in the opinion of the Engineer, the planting of grass or hydroseeding can be dispensed with on account of favourable climatic and other conditions, the Contractor may attempt to establish grass by topsoiling only. Topsoil shall be selected for the presence of natural grass and seeds and shall be removed and placed whenever possible at a time that would favour the establishing of grass. These areas shall be treated with an anti-erosion compound, if so specified by the Engineer. Fertilising shall be done as specified in Clause A11.8.7.2d).

After the topsoil has been placed, it shall be lightly rolled and well-watered, and afterwards watered and mown whenever specified by the Engineer.

The Contractor will not be held responsible for establishing an acceptable grass cover as defined in Clause A11.8.7.3b) when this procedure is followed, but will be responsible for the consequences of any omission to water or weed the grass as specified by the Engineer.

No payment for grassing shall be made other than for placing topsoil, providing and applying fertilisers and for watering, mowing

and weeding the grass, which will be paid for at the tendered rates. For any replanting of grass on bare patches, repairs caused by erosion, and similar work, the Contractor will be paid for as a variation in terms of the applicable general conditions of contract.

e) Grassing with an approved grass planter

Grassing shall be done with an approved grass planter which plants the seeds in rows spaced not more than 2,5 mm apart. The planter shall plant the seeds approximately 6,0 mm deep and shall lightly compact the soil. The prescribed fertiliser may be distributed simultaneously with the grass planting. The areas shall be thoroughly watered after completion of the operation

f) Sowing by hand

Sowing shall be done by hand particularly on areas inaccessible to machines. The top 20 mm of prepared topsoil shall be raked away in sections, the seed shall then be spread uniformly within the prepared area. The top 20 mm topsoil shall then be raked over the seedbed, ensuring an even thickness. This method is to be systematic, and where applicable, follow the contours of any slopes. The areas shall be thoroughly watered after completion of the operation

The thickness of the topsoil layer shall be as specified by the Engineer. The preparation of the soil of the soil for areas to be grassed is to include scarifying just before sowing the grass seed. Should erosion of any kind (by animal, wind or rain) have occurred before the Contractor applies the grass seed, the slope shall be re-instated, at the Contractor's cost, to its original, erosion free state before seeding commences.

The types and mixtures of seeds to be used shall be as specified in the Contract Documentation. The Contractor shall be solely responsible for establishing an acceptable grass cover, and any approval by the Engineer of seed mixtures intended for use by the Contractor shall not relieve him of his responsibility.

g) Other methods of grassing

Other specific methods of grassing may be included under this section in the Contract Documentation.

h) The grassing of borrow pits, temporary deviations, camp sites, access roads and stockpile sites

Prior to any grassing that may be required on such areas, the finishing-off of borrow pits, obliterating the temporary deviations and access roads, and the clearing of camp sites as described under the relevant Chapters, shall have been carried out as specified in the relevant sections.

A11.8.7.4 Maintaining the grass cover

a) Watering, weeding, mowing and replanting

All sodded and grassed areas shall be adequately watered at regular and frequent intervals to ensure the proper germination of seeds and growth of grass until the grass has established an acceptable cover and thereafter until the beginning of the maintenance period of the grass. The quantity of water and the frequency of watering shall be subject to the Engineer's approval. With hydroseeding the commencement of watering may be postponed until a favourable time of the year, but watering shall in any case commence and continue as soon as the seeds have germinated and growth has started.

The Contractor shall further mow the grass on all areas where grass has been established whenever so specified by the Engineer, until the end of the defects liability period. All grass cuttings shall be collected and disposed of at no additional cost if so directed by the Engineer. All weeds shall be eradicated and disposed of by approved means and provision for payment for such operations shall be made under the payment items. Weeds shall be eradicated before they have a chance to produce seed. Any bare patches where the grass has not taken or where it has been damaged or has dried out shall be recultivated, planted, sodded or hydroseeded at the Contractor's cost.

All grassed areas shall have an acceptable cover as defined below at both the start and the end of the maintenance period.

b) Acceptable cover

Acceptable grass cover shall mean that not less than 75 % of the area grassed or hydroseeded shall be covered with grass and that no bare patches exceeding one quarter in any area of 1,0 m x 1,0 m shall occur. In the case of sodding, acceptable cover shall mean that the entire area shall be covered with live grass at the end of any period not less than three months after sodding.

c) Maintenance period

A maintenance period in respect of grass shall commence when an acceptable grass cover has been certified by the Engineer to have been established and shall extend for the duration of the contract. During the maintenance period, the Contractor shall be responsible for damage to grass cover due to his own activities as well as for weeding the vegetated areas.

Any required watering or mowing shall be specified by the Engineer, and paid for under relevant items.

A11.8.7.5 Trees and shrubs

a) Positions of trees and shrubs

Where it is specified that trees and shrubs are required the following general principles shall be applied:

- Trees and shrubs shall be planted at locations shown on the drawings.
- Plants in the median shall be planted in a line 1,5 m from the centre line of the median or as directed by the Engineer. Generally only shrubs shall be planted in medians.
- When the carriageways are at different levels, the plants in the median shall be planted 3,0 m from the edge of the pavement

on the high side of the median or as directed by the Engineer.

- Where the road curves, the plants in the median shall be planted on the inside of the median centre line.
- Where the carriageways are at different levels as well as on a curve, the plants in the median shall be planted on the high side, provided they do not impede on sight distance, or as directed by the Engineer.
- At freeway crossings over roads or rivers, shrubs shall be planted in the positions shown on the drawings.
- Care shall be taken not to obscure traffic signs by plants.
- Trees shall not be planted closer than 10 m from the yellow line on the outside shoulder, or as directed by the Engineer.

b) Preparing plant holes

Unless otherwise directed by the Engineer, holes shall be spaced and prepared as follows:

- All holes shall be square in plan.
- Holes for shrubs shall be at least 500 mm square by 600 mm deep at intervals of at least 1,5 m centre to centre. Alternatively, a 500 mm wide trench 600 mm deep may be dug, subject to the Engineer's approval.
- Holes for trees shall be at least 700 mm square by 800 mm deep.
- The holes for plants shall be refilled with selected and approved topsoil thoroughly mixed beforehand with manure or compost (one 5 l bucket full for every shrub hole and one 10 l bucket full for every tree hole) and, depending on soil-analysis, the required quantity and type of fertiliser. The fill material shall contain an approved water-retaining admixture.
- The holes shall be thoroughly watered before plants are planted. Where the soil is poorly drained, 150 mm of crushed stone shall be placed at the bottom of the hole before it is filled with soil.

c) Planting

Before trees and shrubs are removed from their containers for planting purposes, they shall be watered to the point of saturation.

Directly after having been planted, each plant shall be well watered with a view to settling the soil. After the soil has settled, additional topsoil mixture shall be added where necessary to bring the replaced soil in the hole to within 150 mm of the ground surface, so as to ensure that sufficient water can be retained in the depression around the plant. All trees shall be tied by means of treated sisal rope to two creosote-treated timber stakes planted firmly in the ground on both sides of the tree directly opposite each other. The distance between the stakes shall be 1,0 m. The stakes shall have a minimum diameter of 50 mm and shall be at least 300 mm longer than the planted tree, but its length shall not exceed 1,5 m above ground level.

After planting, the ground surface around the shrubs shall be covered with straw or grass or other type of mulch to minimise evaporation and/or weed competition.

The ground surface around each tree shall be covered with a plastic membrane with a surface area of 1,0 m² and a thickness of 150 micron. Thereafter rocks or stones measuring 150 mm to 250 mm in size shall be placed in a riprap fashion following the contours of the plant hole.

Trees and shrubs shall be considered established once new growth is evident without die-off of portions of the plants, but not less than one month after planting. The Contractor shall water the trees and shrubs until they are established with payment under the relevant items.

d) Maintenance

A maintenance period in respect of trees and shrubs shall commence when their establishment has been certified by the Engineer and shall extend for the duration of the contract. During the period of maintenance, the Contractor shall be responsible for damage to plants due to his own activities as well as watering the trees and shrubs when necessary and keeping the plants free from weeds and pests. Every tree or shrub, which is not healthy or shows unsatisfactory growth, shall be replaced by the Contractor at his own cost, within one month of having been notified by the Engineer. Such notification may be given quarterly during the maintenance period. The plants shall be watered in accordance with an agreement concluded between the Engineer and the Contractor prior to the beginning of the maintenance period.

The watering of plants will be paid for under relevant items.

A11.8.7.6 Alternative slope and erosion protection

Alternative slope and erosion protection methods and materials shall be as specified in the Contract Documentation. These may include vegetation cylinders or logs attached to slopes, geotextile and organic blankets, topsoil alternatives, etc.

A11.8.7.7 General

a) Time for planting

Grass, trees and shrubs shall be planted as far as is practicable during periods of the year most likely to produce best growing results or dependent on the germination requirements of the seed mixture. The Contractor shall make every effort to programme his operations in such a manner that grass, trees and shrubs shall, as far as is possible, be planted during this period.

b) Traffic on grassed areas

The Contractor shall not plant any grass until all operations which may require road-building equipment to be taken over grassed areas have been completed. No road-building equipment, trucks or water carts shall be allowed onto areas which have been grassed and only equipment required for the preparations of areas, application of fertiliser and spreading of topsoil will be allowed to operate on areas to be grassed. All damaged areas shall be reinstated by the Contractor at his own expense.

c) Erosion prevention

During construction the Contractor shall protect all areas susceptible to erosion by installing all the necessary temporary and permanent drainage works as soon as possible and by taking such other measures as may be necessary to prevent the surface water from being concentrated in streams and from scouring the slopes, banks or other areas.

Any runnels or erosion channels developing during the construction period shall be backfilled and compacted, and the areas restored to a proper condition. The Contractor shall not allow erosion to develop on a large scale before effecting repairs and all erosion damage shall be repaired as soon as possible within the contract period. All topsoil or other material accumulated in side drains shall be removed at the same time. Topsoil washed away shall be replaced.

d) Proprietary brand materials used for erosion prevention

Certain proprietary brands of materials which may be necessary for erosion prevention to enable natural grass to become established shall, if required, be specified in the Contract Documentation. The method according to which the material is to be applied, the surface preparation required, the type of material to be provided and the method of payment shall be as specified in the Contract Documentation or in the suppliers specifications.

e) Responsibility for establishing an acceptable cover

Notwithstanding the fact that the Engineer will determine the method of grassing and that the type of seed or grass used and the rate of application of the seed may be specified or agreed on by the Engineer and that the frequency of mowing will be as specified by him, the Contractor shall be solely responsible for establishing an acceptable grass cover and for the cost of replanting grass or rehydroseeding where no acceptable cover has been established. Where however, in the opinion of the Contractor it is doubtful from the outset if it will be possible to establish an acceptable cover he may inform the Engineer of his reasons therefore, and the Engineer may, if he agrees, either adopt another method of grassing or agree to accept whatever cover can be obtained, provided that all reasonable efforts shall be made to establish a good grass cover by the proposed method. Any such agreement shall be valid only if given in writing by the Engineer beforehand.

In the case of grassing by topsoiling only the Contractor will not be held responsible for establishing an acceptable grass cover but will be held responsible for the consequences of supplying workmanship, which does not conform to the specifications, or for lack of proper care.

f) Refertilising

Should it become necessary, the Engineer may instruct the Contractor to undertake a refertilising programme on grassed areas during the defects liability period.

Payment for refertilising will be made under the relevant payment item.

g) Weeding

The Contractor shall maintain all areas affected by construction activities free of all weeds. They shall be removed before the seeding stage of each species. Should the Contractor fail to remove the alien plant species before seeding he shall be held responsible for weed removal within the affected area, for an additional period of one year, over and above the contractual one year defects liability period.

The method for the removal of weeds shall be either by hand, which shall include the removal of the complete root system, or by chemical means, through the use of a registered selective herbicide. Only a registered, licensed pest control operator, licensed for the industrial application of herbicides, shall administer the application of herbicides.

h) Establishment of vegetation within areas disturbed by construction activities

The Engineer shall assess any area within the construction boundaries that has been disturbed by construction activities, but which is not scheduled for formal revegetation within the contract. The assessment shall include whether re-vegetation is required. These disturbed areas, nonetheless remain the Contractor's responsibility for the removal of alien vegetation in terms of Clause A11.8.7.5d).

A11.8.8 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 may, at his discretion, elect 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 agrees, shall be repaired so that it shall comply with the specified requirements after having been repaired.

B11.8 LANDSCAPING AND PLANTING PLANTS

PART B: LABOUR ENHANCEMENT

CONTENTS

PART B: LABOUR ENHANCEMENT

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B11.8.1 SCOPE

This Section includes all areas affected by construction activities but may also extend to other areas requiring landscaping and planting. It includes landscaping, grassing, rehabilitation, erosion protections and planting trees and shrubs.

Landscaping and planting shall be deemed to be a labour enhanced construction process.

This Section therefore 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.

B11.8.2 DEFINITIONS

The provisions of Part A, shall apply.

B11.8.3 GENERAL

The provisions of Part A, shall apply.

B11.8.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

The provisions of Part A, shall apply.

B11.8.5 MATERIALS

The provisions of Part A, shall apply.

B11.8.6 CONSTRUCTION EQUIPMENT

The provisions of Part A, shall apply.

B11.8.7 EXECUTION OF THE WORKS

The provisions of Part A, shall apply.

B11.8.8 WORKMANSHIP

The provisions of Part A, shall apply.

C11.8 LANDSCAPING AND PLANTING PLANTS

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.

(ii) Notes on measurement and pay Items

Not applicable to this Section.

(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 C11.8-1: Items from other Chapters or Sections

Activity	Section 11.8 Clause reference	Section Item reference
Loading and hauling	C11.8	C1.7 of Chapter 1
Stockpiling of topsoil	A11.8.5.2a) and A11.8.7.2c)	C1.6.9 of Chapter 1

(v) Items specifically for this section of the specification

Item	Description	Unit
C11.8.1	Trimming:	
C11.8.1.1	Machine trimming	square metre (m ²)
C11.8.1.2	Hand trimming	square metre (m ²)

All bulk earth-moving operations as described under shaping in Clause A11.8.7.1a) of Part A shall be measured and paid for under Chapter 5.

The unit of measurement for trimming shall be the square metre of area trimmed on the instruction of the Engineer, including areas trimmed after having been shaped. No trimming within the road prism including cut and fill slopes shall be measured for payment.

The tendered rates shall include full compensation for trimming the areas to the specified finishing requirements, including the moving of a small quantity of material which would be inherent in this process and the removal of surplus material and stones. Payment shall distinguish between machine trimming and hand trimming which shall be specified.

Item	Description	Unit
C11.8.2	Trimming using machines for trimming or shaping (alternative to subitem C11.8.1.1):	
C11.8.2.1	Bulldozer	hour (h)
C11.8.2.2	Motor grader	hour (h)

The unit of measurement shall be the hour actually worked by each machine in trimming or shaping areas, when so specified by the Engineer. Standing time will not be measured. The tendered rates shall include full compensation for furnishing and using the machines, including the cost of fuel, operators, maintenance, transporting the machine to and from the point where it is to be used, and for all other Incidentals necessary for carrying out the work.

Item	Description	Unit
C11.8.3	Preparing the areas for grassing:	
C11.8.3.1	Ripping	hectare (h)
C11.8.3.2	Scarifying for loosening topsoil	hectare (h)
C11.8.3.3	Topsoiling within the road reserve where the following materials are used:	
(a)	Topsoil obtained from within the road reserve or borrow areas	cubic metre (m ³)
(b)	Topsoil obtained from commercial sources by the Contractor	cubic metre (m ³)
C11.8.3.4	Topsoiling of borrowpits by using topsoil obtained from borrow areas or from the road reserve	cubic metre (m ³)
C11.8.3.5	Providing and applying chemical fertilisers and/or soil-improvement material:	
(a)	Lime	ton (t)
(b)	Superphosphate	ton (t)
(c)	Limestone ammonium nitrate	ton (t)
(d)	2:3:2 (22)	ton (t)
(e)	3:2:1 (25)	ton (t)
(f)	Other fertilisers and / or soil-improvement materials if required	ton (t)

- **Ripping**

The unit of measurement for ripping shall be the hectare of soil ripped. Only areas ripped on the written instructions of the Engineer shall be measured for payment.

The tendered rate shall include full compensation for ripping complete as specified in Clause A11.8.7.2.

Loosening the soil by scarifying will be paid for under subitem C11.8.3.2.

- **Loosening the topsoil by scarifying**

The unit of measurement for loosening the topsoil by scarifying shall be the hectare of soil loosened and prepared in accordance with the specifications. Only areas loosened by scarifying on the written instructions of the Engineer shall be measured for payment.

The tendered rate shall include full compensation for loosening the topsoil by scarifying, removing stones, and levelling and trimming the surface.

- **Placing the topsoil**

The unit of measurement shall be the cubic metre of topsoil applied at the specified thickness or as directed by the Engineer, measured in situ after the topsoil has been placed. The quantity shall be calculated from the net area of the topsoiled surface multiplied by the average thickness of the topsoil but before the grass sods are placed. Any topsoil placed in excess of the average thickness specified or prescribed will not be measured for payment.

Payment shall distinguish between topsoil obtained from the road reserve and topsoil obtained by the Contractor from commercial sources.

The tendered rates shall include full compensation for loading the topsoil from stockpile or windrow, transport off-loading, placing

and spreading it to the required thickness, levelling it off to a smooth surface for removing any stones as specified and for roughening the surface to be topsoiled.

Loading and hauling, where applicable, shall be measured and paid as specified in Section C1.7 of Chapter 1. The tendered rate for topsoil from commercial sources shall also include full compensation for transporting the topsoil to the point of eventual use.

- **Providing and applying fertiliser and/or soil improvement material**

The unit of measurement for fertiliser shall be the ton of each type of fertiliser and/or soil-improvement material specified and applied.

The tendered rates shall include full compensation for furnishing the fertiliser and/or soil-improvement material, transporting it to the point of use, spreading and mixing it into the scarified soil or topsoil, irrespective of the method of application.

Item	Description	Unit
C11.8.4	Grassing	
C11.8.4.1	The planting of grass cuttings (type of grass indicated)	hectare (ha)
C11.8.4.2	Sodding by using the following types of sods:	
	(a) Nursery sods (type of grass specified)	square metre (m ²)
	(b) Veld sods	square metre (m ²)
C11.8.4.3	Hydroseeding:	
	(a) Providing an approved seed mixture for hydroseeding	kilogram (kg)
	(b) Providing an approved mulch	kilogram (kg)
	(c) Hydroseeding	hectare (ha)
C11.8.4.4	Planting grass seed with an approved grass-planting machine	hectare (ha)
C11.8.4.5	Hand sowing	square metre (m ²)
C11.8.4.6	Other methods (specify)	

- **Planting grass cuttings**

The unit of measurement for planting grass cuttings shall be the hectare of established grass with an acceptable grass cover.

The tendered rate shall include full compensation for furnishing and planting the cuttings, watering, weeding, and replanting if necessary, and all other incidentals, which may be necessary for establishing an acceptable cover and maintaining the grass except mowing.

- **Sodding**

The unit of measurement for sodding shall be the square metre covered with sods which has an acceptable cover.

The tendered rates shall include full compensation for procuring, excavating, loading, transporting, off-loading, placing and watering the sods, for replanting dead areas, for watering and weeding the grass, for supplying and placing timber stakes and for all other incidentals, except for mowing, which may be necessary for establishing an acceptable cover, and maintaining the grass. Payment shall distinguish between nursery-grown sods and veld sods obtained from within the road reserve or borrow areas. In the case of veld sods the tendered price shall include leveling-off and trimming areas from which the sods are taken.

- **Hydroseeding**

The unit of measurement for providing seed shall be the kilogram of seed of the specified seed mixture.

The tendered rate shall include full compensation for procuring, furnishing, mixing and storing the seeds.

The unit of measurement for providing approved mulch shall be the kilogram of mulch.

The tendered rate shall include full compensation for procuring and furnishing the mulch and applying it as specified, or as directed by the Engineer.

The unit of measurement for hydroseeding shall be the hectare of grass established by hydroseeding, which has an acceptable cover.

The tendered rate shall include full compensation for furnishing mulch and mixing it with seed and water and with any anti-erosion compound if required, applying the mixture, watering, weeding, re-hydroseeding bare patches, and for any other work, except

mowing, which may be necessary for establishing an acceptable cover and maintaining the grass.

The unit of measurement for planting any grass seeds by using an approved planter shall be the hectare of grass with an acceptable cover, where the seed has been planted with an approved planter.

The tendered rate shall include full compensation for all labour, material, equipment, weeding, and all incidentals, which may be necessary for planting the grass seeds and establishing an acceptable grass cover. The tendered rate shall also include full compensation for watering the planted areas until an acceptable grass cover has been established. Payment for the grass seed will be separate payment.

- **Hand-sowing**

The unit of measurement for hand-sowing the grass seeds shall be the square metre of grass with an acceptable covering on surfaces specified by the Engineer to be hand-sown.

The tendered rate shall include full compensation for all labour, materials, equipment, weeding, and all incidentals which may be necessary for planting the grass seeds and establishing an acceptable grass covering. The tendered rate shall also include full compensation for watering the planted areas until an acceptable grass covering has been established. Payment for the grass seeds shall be separate payment.

- **Other methods**

Whenever other methods of grassing are specified in the Contract Documentation, measurement and payment shall be as specified.

- **General**

Half of the payments under item C11.8.4 will become due when the grassing or hydroseeding has been done, and the remainder will become due when satisfactory cover has been established.

Item	Description	Unit
C11.8.5	Watering the grass when established by topsoiling only	kilolitre (kℓ)

The unit of measurement for watering areas which have been topsoiled on the Instruction of the Engineer but which have not been hydroseeded or planted with grass, shall be the kilolitre of water applied on the instructions of the Engineer and calculated from the number of tank loads applied, multiplied by the capacity of the tank used in each case.

The tendered rate shall include full compensation for procuring, transporting and applying the water as specified.

Item	Description	Unit
C11.8.6	Watering the already planted grass, trees and shrubs during the growing season	kilolitre (kℓ)

The unit of measurement for watering the grass, trees and shrubs shall be the kilolitre of water used.

The tendered rate shall include full compensation for obtaining, transporting and applying the water.

The Contractor shall keep a careful record of the quantity of water used by him for watering the grass, trees and shrubs planted and shall submit such Information to the Engineer on a daily basis. When there are times during the normal growing season, as specified in the Contract Documentation, when the monthly rainfall figure is less than 75 % of the monthly average, the Contractor will be compensated under this item for the same percentage of the quantity of water used for watering as that for the monthly rainfall that fell short of the average rainfall.

Note:

The rainfall figures and minimum and maximum temperatures for the contract area are set out in the Contract Documentation.

Item	Description	Unit
C11.8.7	Mowing the grass	hectare (ha)

The unit of measurement shall be the hectare measured each time when the newly established grass has been cut on the Instructions of the Engineer.

The tendered rate shall include full compensation for all plant, equipment and labour, required for every cutting of the grass and collection and disposing of the grass cuttings, ie payment will be made every time the grass has been cut on the instructions of the Engineer.

Item	Description	Unit
C11.8.8	Anti-erosion compound or hydraulic mulches (specify type)	kilogram (kg)

The unit of measurement shall be the kilogram net mass of anti-erosion compound or hydraulic mulches used with the approval of the Engineer.

The tendered rate for each kilogram of anti-erosion compound or hydraulic mulches applied with the hydroseeding or by itself shall

include full compensation for furnishing the material and mixing and applying it during hydroseeding or by itself.

Item	Description	Unit
C11.8.9	Trees and shrubs:	
C11.8.9.1	Providing trees and shrubs	
(a)	Trees (types and size/mass indicated)	number (No)
(b)	Shrubs (types and size/mass indicated)	number (No)
C11.8.9.2	Planting and establishing:	
(a)	Trees, all types and sizes	number (No)
(b)	Shrubs, all types and sizes	number (No)

The unit of measurement for item C11.8.9.1 shall be the number of each variety of tree or shrub furnished and established.

The tendered rate shall include full compensation for furnishing the plants at the point of final use, including substitutes for plants, which may become diseased or die.

The unit of measurement for item C11.8.9.2 shall be the number of each type planted and established.

The tendered rates shall include full compensation for excavating the holes to the specified dimensions, furnishing topsoil, wooden stakes, manure and compost and mixing them together with any fertiliser and water retaining admixture required for planting and refilling each hole with the topsoil mixture and other soli, for watering the plants until the end of the maintenance period, for weeding and keeping the plants free from pests and diseases during the maintenance period, furnishing and planting substitutes for plants that have died and for maintaining the plants as specified until the end of the maintenance period, including any other incidentals which may be necessary for properly executing the work.

The tendered rate for planting and establishing trees shall also include full compensation for furnishing and placing the membrane and riprap stone pitching at every plant hole, complete as specified.

Any chemical fertiliser and/or soil-improvement material required will be measured and paid for separately.

• **General**

Seventy-five percent of the payments under Item C11.8.9.2 will become due when the planting has been completed, and the remainder will become due when satisfactory growth has been obtained.

Item	Description	Unit
C11.8.10	Unspecified work for landscaping	Provisional sum (Prov sum)

The provisional sum allowed shall be expended at the discretion of the Engineer to cover the cost of work in addition to the scheduled items which may be required in respect of shaping and trimming areas where plant is used at hourly rates, eg the cost of loading and transporting surplus material, establishing grass by topsoiling only, repairing erosion damage after topsoil has been applied, or any other Items of work required for which no pay Items have been provided.

Payment shall be made as specified in applicable the general conditions of contract.

Item	Description	Unit
C11.8.11	Weeding all grass-seeded areas and the grass when established by topsoiling only	hectare(ha)

The unit of measurement for weeding all grass-seeded areas and areas that have been topsoiled on the instruction of the Engineer (but have not been hydroseeded or planted with grass), shall be the hectare.

The tendered rate shall include full compensation for weeding the prescribed areas in accordance with the specifications.

Note:

Measurement and payment for haul shall be as specified in Section C1.7 of Chapter 1, but no haul shall apply to topsoil paid for from commercial sources.

Item	Description	Unit
C11.8.12	Removal of undesirable vegetation	square metre (m²)

The unit of measurement shall be the square metre measured within the road reserve, and measured each time the Contractor has been instructed by the Engineer to remove the undesirable vegetation under this pay item. This item shall not include areas of undesirable vegetation that have occurred within areas affected by construction activities, and which are considered a contractual obligation

The tendered rate shall include full compensation for all plant, equipment, labour and consumables required to effectively remove the undesirable vegetation, including the entire root system, and disposing by approved means.

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D11.8 LANDSCAPING AND PLANTING PLANTS

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No specific items in this Section.

Where applicable, details must be provided in the Contract Documentation.

A11.9 FINISHING THE ROAD AND ROAD RESERVE AND TREATING OLD ROADS

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PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

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

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PART B: LABOUR ENHANCEMENT

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- 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.

(ii) Notes on measurement and pay Items

Not applicable to this Section.

(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: Items from other Chapters or Sections

Activity	Section 11.9 reference	Section Item reference
Loading and hauling	C11.9	C1.7 of Chapter 1
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.

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D11.9 FINISHING THE ROAD AND ROAD RESERVE AND TREATING OLD ROADS

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

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No specific items in this Section.

Where applicable, details must be provided in the Contract Documentation.