

DEVELOPMENT BANK OF SOUTHERN AFRICA
SPECIFICATIONS

FOR

CONTRACT 01/2019

**KZN DOE INFRASTRUCTURE DEVELOPEMNT AND
MAINTENANCE PROGRAMME:**

**ASBESTOS REPLACEMENT AND REPAIR OF STORM-DAMAGED
SCHOOLS IN KWAZULU NATAL**

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CONTRACT NUMBER - 01/2019

KZN DOE INFRASTRUCTURE DEVELOPMENT AND MAINTENANCE PROROGAMME

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C.3 SCOPE OF WORK

C3.1 THE SEVEN SCHOOLS

These Specifications cover the following seven (7) Schools located in the uMkhanyakude District of the KZN Province:

- Gawozi Secondary School
- Fangelakhe Primary School
- Fort Louis Primary School
- Ndluyesilo High School
- Ndabayakhe Primary School
- Nkosithandile Secondary School
- Ngqamzana Primary School

a) The Current Statuses of the Construction Sites

These project sites incorporate fully functioning schools; as such the onus rests on the contractor(s) to carry out his work in a way that does not disrupt the normal learning processes. The Contractor must also ensure that none of his employees have a criminal record unless if the DBSA allows him to do so after due notice (10 working days minimum). Persons with criminal records, in particular crimes against minors in any form (sexual abuse etc) may not enter the site or work for the Contractor unless the DBSA has been notified in advance and given a chance to respond formally to the notification in (10) working days.

Tenderers are encouraged to establish by personal viewing of the school sites the on-site conditions and any restrictions imposed by the surrounding existing buildings, limited access, condition of the roads, etc. No claims will be entertained due to poor road conditions, etc.

The contractors shall take all appropriate measures necessary for the general security and safety of the Site of the Works, including the provision of any temporary fencing, hoardings, dust screens, temporary signs, etc deemed necessary or are required by law, the cost of which are provided for in the Preliminaries Bill and no claims shall be entertained in this regard.

b) The Seven Construction Sites

Works that have to be executed for the first three of these schools are basically new replacement facilities in nature, whereas the rest of the schools are mainly works.

This Scope of Works and the respective specifications is to be read in conjunction with the latest version of the General Conditions of Contract and SANS 1200 Standardised Specifications for Civil Engineering Construction. In the event of any discrepancy between the Scope of Works and a part or parts of the SANS 1200 Standardized Specifications, the Bill of Quantities or the Drawings, the Project Specifications shall take precedence and prevail in the Contract.

The designs shall be executed in strict accordance with the Codes of Practice and the requirements specified in this Project Specifications below or as prescribed by the Engineer for the type of alternative offered. Where no such specifications are given, the Tenderer shall obtain the Engineer's requirements before submitting his alternative method and/or offer.

C3.2 SITE INFORMATION, LOCALITY MAPS AND EXISTING BUILDINGS

From above, each of the seven schools' locational details are enunciated below.

C3.2.1 Gawozi Secondary School

Gawozi Secondary School is located approximately 150km northward from Durban and falls in P230 Mandawe, Umlalazi Area, Eshowe 3815 in uMlalazi Local Municipality of King Cetswayo District and on Latitude (S) of **28°50'04.56"** and Longitude (E) of **31°30'54.72"** The locality map is as shown on the google extract Map 1 below.



Table 1: Developmental Blocks/Units on Gawozi Secondary School Site

Structure/Area	Number On Site	Relevant Details
School Premises Entrance	1	-
Block A – 4XClassroom +Store Area	1	- 413 m ² Stand-alone block
Block B: Library	1	117 m ² Total area
Block C: 5X Classroom Block + Office	1	443 m ² Total area
Block D: 5X Classroom Block	1	359 m ² Total area
Block E: 5X Classroom Block	1	359 m ² Floor Area
Block F: 5X Classroom Block + Administration Office	1	336 m ² Floor Area
Block G: Toilet Block	1	14 m ² Floor Area
Block H: Toilet Block	1	28 m ²
Block J: Toilet Block	1	38 m ²
Boundary Fence	lot	Existing and has Double Leaf Gate

C3.2.2 Fangelakhe Primary School

The school is located approximately 200km northward from Durban and falls within the Jozini Local Municipality of uMkhanyakude District and on Latitude (S) of **28°46'40.95"** and Longitude (E) of **31°18'40.65"**. The locality is as per google Map extract 2 below and Table 2 below the existing buildings.



Table 2: Developmental Units on Fangelakhe PS Site as at 2019

Structure/Area	Number On Site	Relevant Details
School Premises Entrance	1	-
Block C - Kitchen	1	29m ² Stand-alone building
Block A: Classroom + Admin	1	137m ² Total area
Block B: Classroom Block	1	307 m ² Total area
Block D: Grade R Classroom	1	117 m ² Total area
Block E: Boys Toilet	1	14 m ² Floor Area
Block F: Staff Toilet	1	19 m ² Floor Area
Block F: Girls Toilet Block	1	30 m ² Floor Area
Admin Block/Grade R	9	117 m ²
Temporary Structures	1	98 m ²
Boundary Fence	lot	1504 m long

C3.2.3 Fort Louis Primary School

The school is located approximately 250km northward from Durban and falls within the Nkandla Local Municipality of King Cetshwayo District and on Latitude (S) of **28°42'00.00"** and Longitude (E) of **30°97'05.00"** The locality is as per google Map extract 3 below and Table 3 below the existing buildings.

Figure 3: Location of Fort Louis School



Table 3: Fort Lous Primary School Structures (2019)

Structure/Area	On Site	Relevant Details
Entrance/ Gate House	1	Accommodates Security Guard, 5 m ²
Printing / Filing Room	2	Temporary structure at 15 m ²
Kitchen / Storage	3	26 m ²
Admin / 3x Classroom Block	4	Not in use due to dilapidation and water leaks
3 Classroom Block	5	Not in use due to dilapidation and water leaks
Library/Computer Lab	6	Not in use due to dilapidation and water leaks
5 Classroom Block	7	Not in use due to dilapidation and water leaks
3x Temporary Blocks	8	148 m ²
4x Temporary Block	9	192 m ²
3x Temporary Block	10	148 m ²
Toilet Block	11	3x Boys, 3x Girls, 1x disabled & 1x teacher

C3.2.4 Ndluyesilo High School

The school is located in Samungu Reserve, Eshowe 3815 approximately 140km northward from Durban and falls within the Mlalazi Local Municipality of King Cetshwayo District and on Latitude (S) of **28°59'31.37"** and Longitude (E) of **31°17'48.57"** The locality is as per google Map extract 4 below and Table 4 below the existing buildings.

**Google Map 4: Location of Ndluyesilo High School**

Table 4 below shows building units that constitute the current existing school and individual areas occupied.

Table 4: Developmental Units on Ndluyesilo High School Site as at 2019

Structure/Area	On Site	Relevant Details
Staff Building	1	Accommodate 3x staff room
Ablution Block	2	30 m ²
Ablution Block	3	20 m ²
Ablution Block	4	20 m ²
Ablution Block	5	30 m ²

5 Classroom Block	6	272 m ² Not used due to dilapidated structure
5 Classroom Block	7	298 m ² Only sound structure used on school premises
5 Classroom Block	8	272 m ² Not used due to dilapidated structure
Storage	9	16 m ²
Kitchen	10	Temporary container structure
Zink Structure	11	-
Zink Structure	12	-
Parking	13	No allocated parking
Existing Entrance Gate	14	Existing sliding gate in use
Perimeter Fence	15	Perimeter fence damaged

C3.2.5 Ndabayakhe Primary School

The school is located in Ndabayakhe Reserve, Empangeni rail 3910 approximately 160 km northward from Durban and falls within the **Umhlathuze** Local Municipality of King Cetshwayo District and on Latitude (S) of **28°47'49.02"** and Longitude (E) of **31°51'38.64"** The locality is as per google Map extract 5 below and Table 5 below the existing buildings.



Google Map 5: Location of Ndabayakhe Primary School

Table 5: Developmental Blocks/Units on Ndabayakhe Primary School Site

Structure/Area	Number On Site	Relevant Details
Boundary Fence	lot	Existing
School Premises Entrance	1	Double Leaf Gate
Block A – 4 x Classroom +Store Area	1	- 79 m ² Floor Area
Block B: 3 x Classrooms	1	212 m ² Floor area
Block C: 4 x Classrooms	1	283 m ² Floor area
Block D: Administration	1	86 m ² Floor area
Block E: 5 x Classrooms	1	316 m ² Floor Area
Block F: 3 x Classrooms	1	177 m ² Floor Area
Block G: 5 x Classrooms	1	316 m ² Floor Area
Block H: 3 x Classrooms	1	177 m ² Floor Area

Block J: Science Laboratory	1	153 m ² Floor Area
Block K: 7 x Temporary Toilets	1	7 x Temporary Toilet
Block L: 6 x Temporary Toilets	1	6 x Temporary Toilet
Block M: Dilapidated disused Toilet Block	1	Temporary Toilet Block

C3.2.6 Nkosithandile Secondary School

The school is located in Kwabiyela Area, Emkhamdwini Area, Empangeni, 3910 approximately 210 km northward from Durban and falls within the Mthonjaneni Local Municipality of King Cetshwayo District and on Latitude (S) of **28°30'58.37"** and Longitude (E) of **31°41'09.02"**. The locality is as per google Map extract 6 below and Table 6 below the existing buildings.



Google Map 6: Location of Nkosithandile Secondary School

Table 6: Developmental Blocks/Units on Nkosithandile Secondary School Site

Structure/Area	No. On Map 6	Relevant Details
Gate House / Entrance	1	Accommodate security guard
Tuck shop	2	Temporary Structure
Staff Residence	3	Old building structure
Toilet Block	4	4x Boys Toilets & 4x Boys Toilets
Toilet Block	5	7x Boys Toilets & 7x Boys Toilets
2 Classroom Block	6	113 m ²
5 Classroom Block	7	468 m ² Asbestos roof and storm damaged building
5 Classroom Block	8	468 m ²
4 Classroom Block	9	304 m ² Asbestos roof
4 Classroom Block/ Admin	10	Windows and doors damaged
Temporary Classroom Block	11	Damaged by storm
4 Classroom Block	12	Windows and doors damaged
Parking	13	No allowance for parking

C3.2.7 Nqamzana Primary School

The school is located in Samungu Reserve, Eshowe 3815 approximately 190 km northward from Durban in Kwabiyela Area/Emkhamdwini Area, Empangeni, 3910 within the uMlazi Local Municipality of King Cetshwayo District in and on Latitude (S) of **28°45'34.58"** and Longitude (E) of **31°43'45.17"**. The locality is as per google Map extract 7 below and Table 7 below the existing buildings.



Google Map 7: Location of Ngqamzana Primary School

Table 7: Developmental Blocks/Units on Ngqamzana Primary School Site

Structure/Area	Number on Map 7 above	Relevant Details per Site development Plan below
Block A: 6 x Classroom	1	483 m ²
Block Admin Block	2	209 m ²
Ablution Block – cum Storage Area	3	11 m ²
Ablution Block -cum-Storage Area	4	54
Container Block used as Temporary Kitchen	5	-
Block C – 6 x Classroom	6	486 m ²
Temporary Classrooms- 4 x Block	7, 8,9,10	4 x 49 m ²
Guard House -Temporary Structure	11	-
Car Parking (Earth)	12	-
Existing Entrance Double Leaf Gate	13	-
Perimeter Fence (Damaged)	14	-
Assembly Area	15	-

C3.3 LIST OF CONSTRUCTION DRAWINGS

C3.3.1 The Issued Drawings

A full list of drawings is provided per school in Table 8 below.

The Contractor shall use only the dimensions stated in figures on the Drawings in setting out the Works, and these shall not be scaled from the Drawings, unless required by the Engineer. The Engineer will, on the request of the Contractor in accordance with the provisions of the Conditions of Contract, provide such dimensions as may have been omitted from the Drawings.

The Drawings prepared by the Employer for the permanent Works are listed below and bound in a separate Volume per school.

The Employer reserves the right to issue amended and/or additional drawings during the Contract. The individual schools Contract Name Boards constitute one such drawing as it will be individualised for each particular school.

Name of School	Architectural Drawings	No.	Civil & Structural Drawings	No.	Electrical/Mechanical Drawings	No.
Gawozi SS	Boys Ablution Block	SP100	Staff Ablution Block Layouts, Sections & Details	GAWO/001	Boys Toilet Electrical Layout	EE-LL-01
	Girls Ablution Block	SP200	Boys Ablution Block Layouts, Sections & Details	GAWO/002	Girls Toilet Electrical Layout	EE-LL-11
	Staff Ablution Block	SP300	Girls Ablution Block Layouts, Sections & Details	GAWO/003	Staff Toilet Electrical Layout	EE-LL-13
			Soakaway, Subsurface Drain, Water Spreader & Tank Stand Details	GAWO/004		
Fangelakhe HS	5 Classroom Block Floor Plan	SP001	5 Classroom Block Layouts, Sections & Details	FANGE/001	5 Classroom Block Lighting Layout	EE-LL-01
	Elevations & Section	SP002			Small Power & Data	EE-SP-01
					Fire Protection	ME.F001
					Ventilation	ME.AC001
Fort Louis PS	SDP	SP000			Mechanical Drawings	
	5 Classroom Block Floor Plan & Door Schedule	SP100	3 Classroom & Multi-Purpose Classroom Block	FL/001	5 Classroom Block Fire Protection	ME.F001
	5 Classroom Block Section & Elevations	SP101	Layouts Sections & Details		3 Classroom Fire Protection	ME.F002
	3 Classroom Block Floor Plan & Door Schedule	SP200	5 Classroom Block Layouts Sections & Details	FL/002	Grade R Classroom Fire Protection	ME.F003
	3 Classroom Block Window Schedule Section & Elevations	SP201	Grade R & Kitchen Layouts Sections and Elevations	FL/004	Kitchen Fire Protection	ME.F004
	Grade R Classroom Floor Plan, Section and Elevation	SP300	Media Centre & Science Laboratory and Gate House	FL/004	Multi Purpose Fire Protection	ME.F005
	Grade R Sanitary Schedule Doors & Windows	SP301	Layouts Sections & Details		Media Centre Fire Protection	ME.F006
	Grade R Joinery	SP302	Admin Block Layouts Sections & Details	FL/005	Admin Fire Protection	ME.F007
	Kitchen Floor Plan, Section and Elevation	SP400			5 Classroom Block Ventilation	ME.AC001
	Kitchen Floor Plan, Section and Elevation	SP401	Grade R VIP Ablution Layouts Sections & Details	FL/AB/001	3 Classroom Ventilation	ME.AC002
	Gate House Plan, Sections and Elevations	SP500	Staff VIP Ablutions Layouts Sections & Details	FL/AB/002	Grade R Classroom Ventilation	ME.AC003
	Multi Purpose Floor Plan, Sections and Elevations	SP600	Boys VIP Toilet Ablution Layouts Sections & Details	FL/AB/003	Kitchen Ventilation	ME.AC00
	Multi Purpose Floor Plan, Sections and Elevations	SP601	Girls VIP Ablution Layouts Sections & Details	FL/AB/004	Multi Purpose Ventilation	ME.AC005
	Media Centre Floor Plan, Sections and Elevations	SP700	Soakaway, Subsurface Drain, Water Spreader & Tank Stand Details	FL/AB/005	Media Centre Ventilation	ME.AC00
	Media Centre Sections and Elevations	SP701			Admin Ventilation	ME.AC006
	Media Centre Sanitary Schedule Door & Windows	SP702			Kitchen Ventilation	ME.LP001
	Admin Floor Plan Section and Elevations	SP800			Electrical Drawings	
	Admin Sanitary Schedule, Door and Windows	SP801			Site Plan Electrical Layout	EE-SITE-01
	Girls Toilet Floor Plan, Sections and Elevations	SP901				
	Boys Toilet Floor Plan, Sections and Elevations	SP900			3 Classroom Block Earthing & Lightning Protection	EE-EL-01
	Grade R Toilet Floor Plan, Sections and Elevations	SP903			5 Classroom Block Earthing & Lightning Protection	EE-EL-02
	Staff Toilet Floor Plan, Sections and Elevations	SP904			Media Centre Earthing & Lightning Protection	EE-EL-03
	Joinery	SP1000			Multi-Purpose Earthing and Layout	EE-EL-04
	Joinery 02	SP1001			Kitchen Block Earthing and Lightning Protection	EE-EL-05
	Joinery 03	SP1002			Admin Block Earthing and Lightning Protection	EE-EL-06
	Joinery 04	SP1003			Guard House Earth & Lightning Protection	EE-EL-07
	Joinery 05	SP1004				
					3 Classroom Block Small Power & Data	EE-SP-01
					5 Classroom Block Small Power & Data	EE-SP-02
					Grade R Small Power & Data	EE-SP-04
					Media Centre Small Power & Data	EE-SP-05
					Admin Block Small Power & Data	EE-SP-06

Table 8: List of Drawings

C3.3.2 The Contractor's Alternate Designs and Drawings

There are no requirements for Alternate Designs and Drawings for which the Contractor is responsible, except for the following items of individual masses greater than 320kg:

- Manhole rings
- Manhole cover slabs
- Precast concrete planks and pipes
- Masonry units and
- Edge beams

Approval of any material or plant and its operation, or of any construction procedure to be used, shall not imply any relaxation of the requirements governing the quality of the materials or of the finished work, or relieve the Contractor of his responsibilities under the Contract.

Approval which had been granted to the Contractor in the past regarding certain practices not wholly in accordance with these Specifications shall not be regarded as a precedent or waiver, and such prior practices shall not in any way prejudice the enforcement of these Specifications.

If the Engineer's Representative approves the workmanship or materials of any work, and the workmanship or materials are subsequently found to be not in compliance with the specified requirements, then the Contractor shall, at his own cost, remove and reinstate such work with work which complies with the specified requirements, if so ordered by the Engineer.

C3.3.3 The As-Built Drawings

The Employer is responsible for the design of the permanent Works as reflected in the Contract Documents unless otherwise stated.

The Contractor is responsible for the design of all necessary Temporary Works and their compatibility with the permanent Works.

The Contractor shall ensure that accurate As-Built records are kept of all installed or relocated superstructures and infrastructure services. The position of pipe bends, junction boxes, duct ends and all other underground infrastructure shall be given by co-ordinates. Where necessary, levels shall also be given. A marked-up set of drawings shall also be kept and updated by the Contractor. This information shall be supplied to the Engineer's Representative on a regular basis.

The Contractor shall submit all details necessary to assist the Engineer in the compilation of the As-Built drawings. This shall be done before a Certificate of Completion gets issued.

C4. MANAGEMENT OF THE WORKS

The applicable construction agreement is the: **JBCC Principal Building Agreement (Edition 4.1 Code 2101 of March 2005)** issued by the Joint Building Contracts Committee Inc. (including amendments).

The following Norms and Standards are applicable in the construction and management of the works as specified.

C4.1 The Generic Specifications

The following list is the applicable SANS 1200 Standardized Specifications.

SANS 1200 A	:	General (1986)
SANS 1200 AB	:	Engineer's office (1986)
SANS 1200 C	:	Site clearance (1980)
SANS 1200 D	:	Earthworks (1988)
SANS 1200 G	:	Concrete (structural) (1982)
SANS 1200 H	:	Structural steelwork (1990)
SANS 1200 HA	:	Structural steelwork (sundry items) (1990)
SANS 1200 HB	:	Cladding and sheeting (1985)
SANS 1200 HC	:	Corrosion protection of structural steelwork
SANS 1200 DB	:	Earthworks (pipe trenches) (1989)
SANS 1200 DM	:	Earthworks (roads, subgrade) (1981)
SANS 1200 GA	:	Concrete (small works) (1982)
SANS 1200 GE	:	Precast concrete (structural) (1984)
SANS 1200 L	:	Medium-pressure pipelines (1983)
SANS 1200 LB	:	Bedding (pipes) (1983)
SANS 1200 LC	:	Cable Ducts (1981)
SANS 1200 LE	:	Storm water drainage (1982)
SANS 1200 M	:	Roads (general) (1996)
SANS 1200 ME	:	Subbase (1981)
SANS 1200 MF	:	Base (1981)
SANS 1200 MG	:	Bituminous surface treatment (1996)
SANS 1200 MH	:	Asphalt base and surfacing (1996)
SANS 1200 MJ	:	Segmented paving (1984)
SANS 1200 MK	:	Kerbing and channelling (1983)
SANS 1200 MM	:	Ancillary Road works (1984)

C4.2 List of Standard Specifications and Codes of Practice

The Specifications below refers to these and those in C4.1 above.

a) South African National Standards (Sans)

Reference	Description
SANS 4	Locks, latches and associated furniture for doors (domestic type)
SANS 14	Malleable cast iron fittings threaded to ISO 7-1
SANS 28	Metal ties for cavity walls
SANS 32	Internal and/or external protective coatings for steel tubes - Specification for hot dip galvanized coatings applied in automatic plants
SANS 62-1	Steel pipes. Part 1: Pipes suitable for threading and of a nominal size not exceeding 150 mm
SANS 62-2	Steel pipes. Part 2: Screwed pieces and pipe fittings of a nominal size not exceeding 150 mm.
SANS 92	Bituminous roofing felt
SANS 110	Sealing compounds for the building industry, two-component, polysulphide base
SANS 121 Table 2 or 3	Hot dip galvanized coatings on fabricated iron & steel articles - Specifications and test methods
SANS 135	Metallic coatings - Electrode deposited coatings of nickel plus chromium and of copper plus nickel plus chromium
SANS 201	Fine content and dust content sieve analysis of aggregates
SANS 227	Burnt clay masonry units
SANS 242	Stainless steel sinks with draining boards (for domestic use)
SANS 248	Bituminous damp-proof courses
SANS 280	Hole location in fencing posts and droppers (105-1)
SANS 282	Bending dimensions and scheduling of steel for concrete
SANS 307	Penetration grade bitumens
SANS 308	Cutback bitumen
SANS 309	Anionic bitumen road emulsions
SANS 435	Mild steel rivets
SANS 455	Covered electrodes for the manual arc welding of carbon and carbon manganese steels
SANS 457-2	Wooden poles, droppers, guard posts and spacer blocks. Part 2: Softwood Species
SANS 457-3	Wooden poles, droppers, guard posts and spacer blocks. Part 3: Hardwood Species
SANS 460	Plain-ended solid drawn copper tubes for potable water
SANS 497	Glazed ceramic sanitary ware
SANS 515	Decorative paint for interior use
SANS 538	High temperature wood preserving creosote
SANS 539	Wood preserving creosote (lurgi-gasification process)

SANS 546	Cast iron fittings for asbestos-cement pressure pipes
SANS 548	Cationic bitumen road emulsions
SANS 558	Cast iron surface boxes and manhole and inspection covers and frames
SANS 559	Vitrified clay sewer pipes and fittings
SANS 630	Decorative high gloss enamel paints
SANS 657-1	Steel tubes for non-pressure purposes. Part 1: Sections for scaffolding, general engineering and structural applications
SANS 664	Cast iron gate valves for waterworks
SANS 673	Mixtures of copper-chromium-arsenic compounds for timber preservation
SANS 675	Zinc-coated fencing wire (plain and barbed)
SANS 677	Concrete non-pressure pipes
SANS 678	Primers for wood for interior and exterior use
SANS 679	Zinc chromate primers for steel
SANS 680	Glazing putty for wooden and metal window frames
SANS 681	Undercoats for paints
SANS 684	Structural steel paint
SANS 685	Fibre-cement sheets (flat and profiled)
SANS 719	Electric welded low carbon steel pipes for aqueous fluids (large bore)
SANS 723	Wash primer (metal etch primer)
SANS 727	Windows and doors made from rolled mild steel sections
SANS 731-1	Road and runway markings. Part 1: Single-pack solvent-borne and water-borne paints
SANS 731-2	Road and runway markings. Part 2: Single-pack water-borne paints
SANS 746	Cast-iron pipes and pipe fittings for use above ground in drainage installations
SANS 748	Road tar binders prepared from coke oven crudes
SANS 749	Road tar binders prepared from Lurgi-gassification crudes
SANS 791	Unplasticized poly vinyl chloride (PVC-U) sewer and drain pipes and pipe fittings
SANS 801	Epoxy-tar paints
SANS 802	Bituminous aluminium paint
SANS 819	Fibre-cement pipes, couplings and fittings for sewerage, drainage and low-pressure irrigation
SANS 824	Lime for soil stabilization
SANS 878	Ready-mixed concrete
SANS 887	Varnish for interior use
SANS 912	Calcium plumbate primer
SANS 920	Steel bars for concrete reinforcement

SANS 921	Pitch-impregnated fibre pipes, couplings and fittings
SANS 926	Two pack zinc-rich epoxy primer
SANS 927	Precast concrete kerbs, edgings and channels
SANS 935	Hot-dip (galvanized) zinc coatings on steel wire
SANS 952	Polyolefin film for damp-proofing and waterproofing in buildings
SANS 966-1	Components of pressure pipe systems. Part 1: Unplasticized poly (vinyl chloride) (PVC-U) pressure pipe systems
SANS 966-2	Components of pressure pipe systems. Part 2: Modified poly (vinyl chloride) (PVC-M) pressure pipe systems
SANS 974-1	Rubber joint rings (non-cellular). Part 1: Joint rings for use in water, sewer and drainage systems
SANS 986	Precast reinforced concrete culverts
SANS 1023	Preformed elastomeric compression joint seals
SANS 1024	Welded steel fabric for reinforcement of concrete
SANS 1058	Concrete paving blocks
SANS 1062	Pressure and vacuum gauges
SANS 1083	Aggregates from natural sources - Aggregates for concrete
SANS 1090	Aggregates from natural sources - Aggregates for plaster and mortar
SANS 1091	National colour standard for paint
SANS 1099	Hardwood furniture timber
SANS 1123	Pipe flanges
SANS 1128-1	Fire fighting equipment. Part 1: Components of underground and above-ground hydrant systems
SANS 1128-2	Fire fighting equipment. Part 2: Hose couplings, connectors and branch pipe and nozzle connections
SANS 1129	Steel doorframes
SANS 1143	Mushroom- and countersunk-head bolts and nuts
SANS 1149	Flat and taper steel washers
SANS 1151	Portable rechargeable fire extinguishers - Halogenated hydrocarbon type extinguishers
SANS 1217	The production of painted and powder-coated steel pipes
SANS 1223	Fibre-cement pressure pipes and couplings
SANS 1260	Invert bitumen emulsion
SANS 1273	Fasteners for roof and wall coverings in the form of sheeting
SANS 1282	High-strength bolts, nuts and washers for friction-grip joints
SANS 1294	Precast concrete manhole sections and slabs
SANS 1305	Sealing compounds for the building industry, one-component, silicone-rubber-base

SANS 1350	Guardrails for roads (w-section)
SANS 1373	Chain-link fencing and its wire accessories
SANS 1431	Weldable structural steels
SANS 1442	Roadstuds
SANS 1460	Laminated timber (glulam)
SANS 1519-1	Road signs. Part 1: Retro-reflective sheeting material
SANS 1519-2	Road signs. Part 2: Performance requirements for road signs
SANS 1586	Emulsion paints
SANS 1601	Structured wall pipes and fittings of unplasticized poly (vinyl chloride) (PVC-U) for buried drainage and sewerage systems
SANS 1620	Barbed tape security barriers
SANS 1700	Fasteners
SANS 1783-1	Sawn softwood timber. Part 1: General Requirements
SANS 1783-2	Sawn softwood timber. Part 2: Stress graded structural timber and timber for frame wall construction
SANS 1783-3	Sawn softwood timber. Part 3: Industrial timber
SANS 1783-4	Sawn softwood timber. Part 4: Brandering and battens
SANS 2813	Paints and Varnishes - Determination of Specular gloss of non-metallic paint films at 20, 60 and 85
SANS 3575	Continuous hot-dip zinc-coated steel sheet of commercial, lock-forming and drawing qualities
SANS 2001 series	Construction works standard and specification data
SANS 4427	Polyethylene (PE) pipes for water supply - Specifications
SANS 4998	Continuous hot-dip zinc-coated carbon steel sheet of structural quality
SANS 5121	Water covering capacity of aluminium pigment for paint
SANS 5767	Cleanliness of blast-cleaned steel surfaces for painting (assessed by pictorial standards)
SANS 5769	Cleanliness of blast-cleaned steel surfaces for painting (assessed by freedom from dust and debris)
SANS 5772	Profile of blast-cleaned steel surfaces for painting (determined by micrometer profile gauge)
SANS 5832	Organic impurities in fine aggregates (limit test)
SANS 5836	Effect of fine and coarse aggregate on the shrinkage and expansion of cement: aggregate mixes (mortar prism method)
SANS 5838	Sand equivalent value of fine aggregates
SANS 5841	Aggregate crushing value of coarse aggregates
SANS 5842	FACT value (10% fine aggregate crushing value) of coarse aggregates
SANS 5846	Abrasion resistance of coarse aggregates (Los Angeles machine method)

SANS 5847	Flakiness index of coarse aggregates
SANS 5848	Polished stone value of aggregates
SANS 5855 (1)	Free water content of aggregates
SANS 5856	Bulking of fine aggregates
SANS 5862-1	Concrete tests - Consistence of freshly mixed concrete - Slump test
SANS 5862-2	Concrete tests - Consistence of freshly mixed concrete -Flow test
SANS 5862-3	Concrete tests - Consistence of freshly mixed concrete - Vebe test
SANS 5862-4	Concrete tests - Consistence of freshly mixed concrete - Compacting factor and compaction index
SANS 5863	Concrete tests - Compressive strength of hardened concrete
SANS 5864	Concrete tests - Flexural strength of hardened concrete
SANS 5865	Concrete tests - The drilling, preparation and testing for compressive strength of cores taken from hardened concrete
SANS 10005	The preservative treatment of timber
SANS 10044	Welding: Parts 1-7
SANS 10064	The preparation of steel surfaces for coating
SANS 10088	Pile foundations
SANS 10090	Community Protection against Fire
SANS 10094	The use of high-strength friction grip bolts
SANS 10096	The manufacture of finger-jointed structural timber
SANS 10102-1	Selection of pipes for buried pipelines. Part 1: General provisions
SANS 10102-2	Selection of pipes for buried pipelines. Part 2: Ridged pipes
SANS 10109-1	Concrete floors part 1: Bases to concrete flooring
SANS 10109-2	Concrete floors part 2: Finishes to concrete floors
SANS 10112	The installation of polyethylene and poly (vinyl chloride) PVC-U and PVC-M pipes
SANS 10137	The installation of glazing in buildings
SANS 10142-1	The wiring of premises. Part 1: Low-voltage installations
SANS 10143	Building drawing practice
SANS 10160	The General procedures and loadings to be adopted for the design of buildings
SANS 10161	The design of foundations for buildings
SANS 10162-1	The structural use of steel. Part 1: Limit states design of hot-rolled steelwork
SANS 10162-2	The structural use of steel. Part 2: Limit states design of cold formed steelwork
SANS 10162-4	The structural use of steel. Part 4: The design of cold-formed stainless steel structural members

SANS 10164-1	The structural use of masonry Part 1: Unreinforced masonry walling
SANS 10164-2	The structural use of masonry Part 2: Structural design and requirements for reinforced and pre-stressed masonry
SANS 10268-1	Welding of thermoplastics - Welding processes. Part 1: Heated-tool welding
SANS 10268-2	Welding of thermoplastics - Welding processes. Part 2: Electrofusion welding
SANS 10268-3	Welding of thermoplastics - Welding processes. Part 3: Electrofusion welding
SANS 10268-4	Welding of thermoplastics - Welding processes. Part 4: Hot-gas extrusion welding
SANS 10268-5	Welding of thermoplastics - Welding processes. Part 5: Solvent welding
SANS 10268-6	Welding of thermoplastics - Welding processes. Part 6: Ultrasonic welding, staking and insertion
SANS 10268-10	Welding of thermoplastics - Welding processes. Part 10: Weld defects
SANS 10313	The protection of structures against lightning
SANS 10400	The application of the National Building Regulations
SANS 50197-1	Cement. Part 1: Composition, specifications and conformity criteria for common cements
SANS 50197-2	Cement. Part 2: Conformity evaluation
SANS 50413-1	Masonry cement. Part 1: Specification
SANS 50413-2	Masonry cement. Part 2: Test Methods
SANS 51423	Road marking materials - Drop on materials - Glass beads, anti-skid aggregates and mixtures of the two
SANS 51424	Road marking materials - Premix glass beads

b) Sans Co-Ordinating Specifications)

Reference	Description
CKS 55	Glass for glazing
CKS 82	Steel posts, stays, standards and droppers for strained wire fences
CKS 146	Gates, steel with tubular frames (for farm and domestic use)
CKS 176	Galvanized corrugated steel drainage pipes
CKS 388	Rubber waterstops
CKS 389	Flexible polyvinyl chloride waterstops
CKS 437	Components of curved galvanized corrugated steel structures in compacted earth surrounds

c) TMH's & TRH's (Dept of Transport)

Reference	Description
TMH5	Sampling methods for road construction materials.:
TMH6	Special methods for testing roads.

TRH5	Statistical concepts of quality control and their application in road construction.
TMH1	Standard methods of testing road construction materials.
TMH2	National standard for the spraying performance of binder distributors.
TRH3	Surfacing seals for rural and urban roads and compendium of design methods for surfacing seals used in the RSA
TRH8	Selection and design of hot-mix asphalt surfacings for highways
TRH14	Guidelines for road construction materials

d) American Society For Testing And Materials (ASTM)

Reference	Description
ASTM-C 260	Air entraining admixtures for concrete
ASTM-C 494/C494M	Chemical admixtures for concrete
ASTM-C 920	Sealants, Elastomeric joint
ASTM-D 2835	Lubricant for installation of preformed compression seals in concrete pavements

e) Miscellaneous Publications Referred to in the Specifications

Reference	Organization	Description
AWWA C205-00	American Water Works Association	Cement-Mortar Protective Lining and Coating for steel Water pipe - 4 in (100 mm) and larger
DIN 3202 Part 4		Face to face and centre to face dimensions of valves
ANSI/API 116.1 Rev 67:	American National Standards Institute	Two component elastomeric scaling compounds for the building trade.
ISO 8501-1	Swedish Standard:	Standard booklet with high quality colour pictures for the preparation of steel substrates before application of paints and related products
8040-03	California State Specification	Binder (adhesive), Epoxy resin base
API 1104	American Petroleum Institute	Welding of Pipelines and Related Facilities
Southern African Development Community		Southern African Development Community Road Traffic Signs Manual
International Slurry Surfacing Association		Slurry-bound Macadam
South African Institution of Civil Engineers (SAICE)		The Safety of Persons Working in small diameter shafts and Test Pits for Civil Engineering Purposes

WISA	Operator's Handbook on Sewage Purification chapter 25: Safety Precautions.
Transnet Limited	Specification E7 : Specification for Works on, over, under or adjacent to a railway line.
Specification E10: Specification for plate laying and ballasting.	
The provision and construction of private sidings.	
Permanent way instructions.	
Concrete Manufacturer's Association	Concrete Pipe Handbook.
National Building Research Institute (CSIR)	X/Bou 2-34: The NBRI air test for sewers and drains.
The Concrete Society (Great Britain)	Technical Report No 11: Concrete core testing for strength.
Transport and Road Research Laboratory (Great Britain)	TRRL Report No 290/1970: Methods of texturing new concrete road surfaces to provide adequate skidding resistance.
Dept of the Environment of Great Britain	Technical Memorandum (Bridges) No BE 1/76.
Southern Africa Institute of Steel Construction	Structural steel tables. 7th Revision 1997

f) Government Acts and Regulations

Atmospheric Pollution Prevention Act, 1965 (Act 45 of 1965)
Construction Regulations 2003, Government Gazette No 25207
Engineering Profession Act, 2000 (Act 46 of 2000)
Environmental Conservation Act, 1989 (Act 73 of 1989)
Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002)
Minerals Act, 1991 (Act 50 of 1991)
National Environmental Management Act, 1998 (Act No 107 of 1998)
National Monuments Act, 1969 (Act 28 of 1969)
National Parks Act, 1976 (Act 57 of 1976)
National Road Traffic Act, 1996 (Act 93 of 1996)
Regulations for combating and preventing the spread of certain insect pests affecting soft wood, Government Gazette, 2 August 1968
The Atmospheric Pollution Prevention Act, 1965 (Act 45 of 1965)
The Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983)
The Explosives Act, 2003 (Act 2615 of 2003)
The Explosives Regulations, 2002
The Mines Health and Works Safety Act ,1996, (Act 27 of 1996)

The National Water act, 1998 (Act 36 of 1998)
The Occupational Health and Safety Act, 1993 (Act 85 of 1993)
The CIDB: The Building and Construction Materials Sector, Challenges and Opportunities

C4.3 PARTICULAR SPECIFICATIONS

In addition to the Standardized and Project Specifications the following Particular Specifications shall apply to this contract and are bound in hereafter.

OHS ACT 85 OF 1993	Annexure 9.1
BASELINE RISK ASSESSMENT	Annexure 9.2
KZN DOE STANDARD ELECTRICAL SPECIFICATIONS	Annexure 9.3

C5. THE WORKS SPECIFICATIONS

C5.1 CONTRACTOR'S MOBILISATION

5.1.1 Services and facilities provided by the Contractor

(a) Water sources

The Contractor shall, in accordance with the provisions of sub clause C3.4.2.2(b), and at his own expense, make all arrangements necessary for the supply and distribution of all water required for Contract execution purposes as well as for use in and about his site establishment and for human consumption, as well as for making all arrangements in connection therewith.

The Contractor shall further, at his own expense, be responsible for providing all necessities for procuring, storing, transporting and applying water required for the execution of the Contract, including but not limited to all piping, valves, tanks, pumps, meters and other plant and equipment, as well as for all work and superintendence associated therewith.

The sources of all water utilised for the purposes of the Contract shall be subject to the prior approval of the Engineer, which approval shall not be unreasonably withheld.

The Contractor shall comply with all prevailing legislation in respect of drawing water from natural and other sources and shall, when required by the Engineer, produce proof of such compliance. The distribution of water shall be carried out by the Contractor strictly in accordance with the applicable laws and regulations.

All water provided by the Contractor shall be clean, free from undesirable concentrations of deleterious salts and other materials and shall comply with any further relevant specifications of the Contract. The Contractor shall, whenever reasonably required by the Engineer, produce test results demonstrating such compliance. Water provided by the Contractor for human consumption shall be healthy and potable to the satisfaction of the health authorities in the area of the Site.

No separate payment will be made to the Contractor for the obtainment, distribution and consumption of water, the costs of which will be deemed to be included in the Contractor's bided rates.

(b) Electricity supply

The Contractor shall, in accordance with the provisions of sub clause C3.4.2.2(c), and at his own cost, make all arrangements necessary for the supply and distribution of electrical power required for construction purposes as well as for use in and about his site establishment, as well as for making all arrangements in connection therewith, strictly in accordance with the applicable laws and regulations.

No separate payment will be made to the Contractor for the obtainment, distribution and consumption of electricity, the costs of which will be deemed to be in the Contractor's bided rates and prices.

(c) Site establishment

A specific area in or in close proximity to or on the Site of the Works of each Site will be availed by the Employer to the Contractor for the Contractor's site establishment. The site is handed over for the sole purpose of executing and completion of the contract. The contractor may under no circumstances violate or transgress the governing authority regulations.

The Contractor may erect his site offices, workshops, stores and other facilities required for the execution of the Contract. The Contractor shall not use the area nor allow it to be used for any purposes not directly associated with the execution of the Contract. The Contractor shall store materials and equipment for which he is responsible in an orderly manner and shall keep the Site free from debris and obstructions.

The Contractor shall be responsible for arranging, at his own cost, for the provision of all services he may require in the area, as well as elsewhere on the Site.

Further, the Contractor shall be responsible to obtain all the **Permits and Way Leaves** required under this Contract.

Should the Contractor deem the given site inadequate or unsuitable for the his needs, he is at liberty to make his own arrangements; provided that the use by the Contractor of any area other than that made available to him by the Employer shall be subject to prior written Engineer's approval, which approval shall not be unreasonably withheld. However, the Contractor shall have no claim against the Employer in respect of any costs incurred by him, either directly or indirectly in consequence of utilising any area other than that availed to him by the Employer, and which costs exceed those costs allowed for by the Contractor in his Bid.

(d) Telephone facilities

The Contractor is to make his own arrangements with the relevant authority for a telephone service. Cellular telephones will be acceptable.

C5.1.2 Site Facilities Provided by the Contractor

(a) Facilities for the Engineer

The Contractor shall provide on the Site, for the duration of the Contract and for the exclusive use of the Engineer and/or his Representative, the various facilities described hereunder. All such facilities shall be provided promptly on the commencement of the Contract and failure on the part of the Contractor to provide any facility required in terms of this specification shall constitute grounds for the Engineer to withhold payment of the Contractor's bade Preliminary and General items until the facility has been provided or restored as the case may be.

(i) Office accommodation

No separate office is required for the Engineer or his Representative as the Site Meeting Room will be allocated and thus demarcated for the exclusive use for this purpose.

The Contractor shall make the office comply with and be furnished in accordance with the requirements of sub clause 3.2 of SANS 1200 AB. The Contractor shall also maintain the office in accordance with the requirements of sub clause 5.2 of SANS 1200 AB. Such compliance issues shall be provided within the Contractor's site establishment facilities.

(ii) Site meeting venue

However, the Contractor shall provide within his own site establishment facilities, furnishings for the office for comfortably accommodating a minimum of **ten** (10) persons at site meetings. The Engineer shall be allowed free use of such venue for conducting any other meetings concerning the Contract at all reasonable times.

The same applies to provisions of amenities that include teas, when required.

(iii) Carports

The Contractor shall provide on Site 2 carports for the exclusive use of the Engineer.

(iv) Contract name-boards

Depending on the number of accesses to the school, the Contractor shall provide, erect and maintain **two** contract name- board, at such positions and locations as are directed by the Engineer, in accordance with the requirements set out in SANS 1200 AB (as amended).

The Contractor shall, before ordering or manufacturing any such contract name-boards, obtain the Engineer's written approval in respect of all names, wording and sizing to appear on the contract name-boards.

The Contractor shall keep the contract name-boards in good state of repair for the duration of the Contract and shall remove them on completion of the Contract.

(v) Survey equipment and assistants

The Engineer and the Engineer's Representative shall be allowed free use of survey equipment and assistants to carry out control work as and when required.

- **Survey equipment**

The Contractor shall, in accordance with the requirements of SANS 1200 AB (as amended) provide the following survey equipment for the exclusive use of the Engineer and his staff:

- 1 upright reading automatic level with tripod;
- 1 metric levelling staff with protective cover bag;
- 1 ranging rods;
- 1 100 metre Stilon tape measure;
- 1 ± 2 kg hammer.

Whenever reasonably required by the Engineer, the Contractor shall, in accordance with the requirements of SANS 1200 AB (as amended), make available to the Engineer or his representative, the following additional survey equipment:

- 1 tacheometer with tripod;
- 1 survey staff for tacheometer;
- 1 Distomat, complete with tripod, fully charged battery and all appurtenant accessories.

- **Survey assistants**

The Contractor shall, in accordance with the requirements of sub clause 85.5 of SANS 1200 AB, make available to the Engineer, two (2) survey assistants, whenever requested for as need arise.

(vi) Telephone facilities

Not required in this Contract, as the Engineer visits for Site meetings and/or as and when required.

(vi) Computer facilities

The Contractor shall, for the duration of the Contract, provide the computer equipment together with the software specified hereunder, for the exclusive use of the Engineer and the Employer:

- 1 printer

The printer shall be colour laser jet printer capable of A4 and A3 printing, scanning and emailing.

The printer provided shall be kept fully serviceable at all times by the Contractor. The Contractor shall have any defective equipment repaired or replaced at his own cost within 12 hours after notification by the Engineer's staff.

The Contractor shall further provide at his own cost, all paper and black ink cartridges and other consumables reasonably required by the Engineer.

vii) Site instruction book and diary

The Contractor shall provide and keep a triplicate book for site instructions and a Diary on the Site at all times. All instructions to the Contractor will also be recorded in the site instruction book. All site instructions to be signed by the Engineer or his Representative.

All construction activities, during the day, is to be recorded in the site diary.

All site visits conducted by the Engineer or his representative to be recorded and signed by the said Engineer or his Representative.

(b) Excrement Collection and Disposal

The Contractor shall, at his own expense, be responsible for safely and hygienically dealing with and disposing of all human excrement and similar matter generated on the Site during the course of the Contract, to the satisfaction of the responsible health authorities in the area of the Site and the Engineer. All such excrement shall be removed from the Site and shall not be disposed of by the Contractor on the Site.

The Contractor shall further comply with any other requirements in this regard as may be stated in the Contract.

No separate payment will be made to the Contractor in respect of discharging his obligations in terms of this sub clause and the costs thereof shall be deemed to be included within the Contractor's bided Preliminary and General items.

C5.1.3 Features requiring special attention

(a) Site maintenance

During progress of the work and upon completion thereof, the Site of the Works shall be kept and left in a clean and orderly condition. The Contractor shall store materials and equipment for which he is responsible in an orderly manner and shall keep the Site free from debris and obstructions.

(b) Testing and quality control

(b.1) Contractor to Engage Services of an Independent Laboratory

Notwithstanding the requirements of the Specifications pertaining to testing and quality control, the Contractor shall engage the services of an approved independent laboratory to undertake all testing of materials, the results of which are specified in, or may reasonably be inferred from, the Contract. These results will be taken into consideration by the Engineer in deciding whether the quality of materials utilised, and workmanship achieved by the Contractor comply with the requirements of the

Specifications. The foregoing shall apply irrespective of whether the specifications indicate that the said testing is to be carried out by the Engineer or by the Contractor.

The Contractor shall be responsible for arranging with the independent testing laboratory for the timeous carrying out of all such testing specified in the Contract, at not less than the frequencies and in the manner specified. The Contractor shall promptly provide the Engineer with copies of the results of all such testing carried out by the independent laboratory.

For the purposes of this clause, an "independent laboratory" shall mean an "approved laboratory" which is not under the management or control of the Contractor and in which the Contractor has no financial interest, nor which has any control or financial interest in the Contractor.

(b.2) Additional Testing Required by the Engineer

In addition to the provisions of sub clause C5.1.3(b)(i): Contractor to engage services of an independent laboratory, the Engineer shall be entitled at times during the Contract to require that the Contractor arrange with the independent laboratory to carry out any such tests, additional to those described in sub clause C5.1.3(b)(i), at such times and at such locations in the Works as the Engineer shall prescribe. The Contractor shall promptly and without delay arrange with the independent laboratory for carrying out all such additional testing as required by the Engineer, and copies of the test results shall be promptly submitted to the Engineer.

(b.3) Costs of Testing

(i) Tests in Terms of Sub clause C5.1.3(c)(i)

The costs of all testing carried out by the independent laboratory in accordance with the requirements of sub clause C5.1.3(c)(i), above shall be borne by the Contractor and shall be deemed to be included in the bidded rates and prices for the respective items of work as listed in the Schedule of Quantities and which require testing in terms of the Specifications. No separate payments will be made by the Employer to the Contractor in respect of any testing carried out in terms of sub clause C5.1.3(c)(i).

Where, as a result of the consistency of the materials varying or as a result of failure to meet the required specifications for the work, it becomes necessary to carry out additional tests (e.g. re-tests on rectified work and/or replacement materials), the costs of such additional testing shall be for the Contractor's account.

(ii) Additional tests required by the Engineer

The costs of any additional tests required by the Engineer in terms of sub clause C5.1.3(b)(i): Additional testing required by the Engineer, shall be reimbursed to the

Contractor against substitution of the Provisional Sum allowed therefore in the Schedule of Quantities; provided always that the costs of any such additional tests ordered by the Engineer, the results of which indicate that the quality of the materials utilised and/or the standard of workmanship achieved are/is not in accordance with the specifications, shall not be reimbursable to the Contractor.

(c) Subcontractors

All matters pertaining to subcontractors (including Nominated Subcontractors) and the work executed by them shall be dealt with directly between the Engineer and the Contractor in the context of all subcontract work being an integral part of the Works for which the Contractor is responsible.

The Engineer will not liaise directly with any subcontractors nor will he issue instructions concerning the subcontract works directly to any subcontractor.

All matters arising from the subcontract agreements shall be dealt with directly between the Contractor and the subcontractors and the Engineer will not become involved.

(d) Dealing with water

The Contractor shall be responsible for handling all surface and sub-surface water in such a way that construction can proceed with minimum of cost and at no time shall normal drainage flows be blocked.

(e) Dust suppression

All working surfaces and haul roads shall be wetted regularly so as to keep the creation of dust to a minimum. To this end the contractor shall have a water cart on site at all times.

(f) Surveying and Survey information

The Contractor shall provide for a surveyor and survey equipment required to successfully set out the works and establish the required levels. All survey work shall comply with TMH 11 "Standard Survey Guidelines issued by the Department of Transport".

The Contractor is to undertake survey and provide the Engineer with a full site survey of the existing landform of the area to be constructed before any construction commences. This survey will be used to compile the detailed setting out drawings and form the basis of the project construction drawings. The contractor must make provision to stake all the extraction system components before construction commences including wells, connector pipes, header pipes, tie-ins, condensate knock

outs, manifold boxes and road crossings. The elements to be inspected and approved by the Engineer before construction commences. As-Built surveys of the well positions, connector and header pipes surveyed in their trenches at 20m intervals prior to backfilling, tie-ins, condensate knock outs, manifold boxes and road crossings to be provided prior to backfilling. The survey information is to be according to the National LO co-ordinate grid system / WGS and is to be provided in digital format (either YXZ format or preferably in Model Maker file system ver. 8 or above).

Payment certificates will not be processed before this survey information has been evaluated and the final quantities verified using a DTM package.

Cost of all required survey shall be included in the rates.

From the above and per project site, a survey layout drawing in “dwg” or “dxf” format shall be provided to the engineer and must show the following information using various, clearly defined line types:

- Contours and contour elevation text at 0,5 m contour intervals.
- Natural Features e.g. streams, rock outcrops, trees, cultivated land, cut & fill slopes of trenches and quarries, dams, etc.
- All visible fixed manmade objects such as: buildings and other structures, fences, walls, roads, foot paths, survey benchmarks, overhead cables, manholes, kerb inlets, field inlets, culverts, road signs, paving, kerbs, etc.
- Where existing surfaced roads occur, the edge of surfacing as well as the edge of gravel shoulders shall be shown. The adjacent side drains if any will also be shown on the drawings.
- Invert levels to manholes and kerb inlets must be shown.
- Information such as farm names, portion and stand numbers, cadastral boundaries, right-of-way and other servitude boundaries and numbers, grids and grid values.
- The layout must include a grid on the WGS84 format, a north arrow and the lo system used.
- All CAD elements shall be grouped in layers according to the type of information e.g.:

Layer “Contours” shall contain all contours and contour elevation text.

Layer “River” shall contain all streams, rivers and river names.

A DTM shall also be provided and shall be obtained from a detailed tach- survey across the existing route, perpendicular to the centreline of the existing route at 20 m intervals. The width of the survey will be 20 m (measured on the centre line). If the centreline is situated within an existing road reserve, the survey shall extend at least 5 m beyond both road reserve boundaries unless specific limits are provided in the cover letter in which case the survey shall be executed between the limits provided. In the case were a new road reserve boundary is planned the surveyor will survey to the new road reserve boundary and 5 m

beyond as indicated in the drawings. The DTM will be in WGS ASCII format and a Modelmaker “tot” file shall be provided.

The following points shall be included in each cross section:

Each position where a change in cross sectional grade occurs e.g. camber of existing road, top and bottom of side drains, top and bottom of kerb etc.

- Spot shots at a minimum of 5 m intervals on sections with constant grade.
- In the case of existing roads:
- Lane separating lines
- Edge of surfacing (in addition to the bottom of kerbs when kerb-channel combinations occur)
- Edge of gravel shoulder
 - Profile of side drains
 - Other topographical irregularities:
 - Any other topographical irregularities shall also be represented in the DTM over and above the cross-sectional survey points.

All reference beacons shall be cast in concrete, painted white and the name/ number of the beacon clearly engraved in the concrete or on an attached metal tag.

The contractor will allow the Engineer 3 working days after the submission of the above information to provide design invert levels for construction. The survey will also be used to establish quantities. The surveyor is required to survey the as-built profile once construction is complete.

(g) Project supervision

The Contractor must allow for the **MINIMUM** level of site supervision in his establishment costs as indicated below:

Contracts Manager :	50% over the duration of the project;
Site Agent :	100% for the duration of the project.

The Contractor is to provide CV's of the proposed Contracts Manager and site agent at tender stage. Once appointed the site agents must remain at their allocated site for the duration of the project.

(h) Construction program

The Contractor shall submit a detailed, consolidated construction program showing all inputs and interactions with Sub Contractors and the Employer and shall:

- i. Be in sufficient detail to show the critical path, including any subsequent changes to the critical path in the event of amendments to the scope of the Works,

- ii. Be in sufficient detail to establish the logical procedure and method of operation to achieve the set key date and/or interim milestones set out in the enquiry document or as subsequently agreed with the Engineer,
- iii. Be a combination of a bar chart with each construction activity shown on the vertical scale and calendar dates on the horizontal scale: logic diagram/network indicating activity interdependencies; resource histogram and a cashflow (excluding VAT);
- iv. Be formulated using resource requirements and costs and production rates, which will ascertain time durations and the expenditure patterns and which information shall be submitted with the programme.
- v. The computer software to be used on this project is Microsoft Project, or an approved equivalent.
- vi. Activities must be broken down into sufficient detail so that it is possible to make an accurate assessment of the actual progress of work in relation to the programme at any time.
- vii. Each activity is to show production rates, applicable quantity (unit to be specified) and an associated approximate unit cost, excluding P&G, which shall be used in calculating the projected cash flow.
- viii. The lead time for the supply of material shall be indicated.
- ix. The updated programme shall be submitted to the Engineer at least 24 hours before each progress meeting and shall be in sufficient detail to enable The Engineer to calculate progress; resource usage and productivity for each and every activity in the project programme.
- x. Progress will be measured and agreed at regular intervals by prior agreement, and submitted to the Engineer and the programme updated to show current status.

If the Contractor fails to provide a program within the time stated in the Contract Data and other detail in time to the Engineer's satisfaction, these will be done on his behalf and at his cost."

(i) Local labour and training

The Bidder shall limit the utilisation of his permanently employed personnel to Key Personnel, such as Bids Managers, Site Agents, Foremen, Supervisors, Plant Operators, Materials and Survey Technicians, Trainers, Buyers, Storemen and the like should such expertise not be available out of the community. All other personnel and labourers shall be recruited locally. In this regard, the Employer may decide for the project to be registered as an EPWP project. The minimum EPWP general labourer applicable rate on this project shall be R160 per day or the latest figure as may change and be advised by the Employer.

The Bidder shall make maximum use of the human resources existing in the local community. The bidders shall apply to the employment labour desk, conveyed by the Steering Committee for details of those labourers who are available in the area of

work and he shall provide preference to those labourers identified by the Steering Committee.

Formal structured skills training of labour in certain fields have been done. The bidder shall utilise trained labour in all instances. The employment of labour from outside the local area will only be considered and permitted by the Engineer in the event of:

- a) the unavailability of sufficient numbers of local labourers to execute the work;
- b) the unavailability within the local community of the required skills necessary for the execution of specific portion of work, and where the completion period does not permit the creation of the necessary skills through training.

In both cases the Bidder shall prove to the satisfaction of the Engineer that he has exercised his best endeavours and taken all reasonable actions to recruit local labour.

The bidder shall maintain accurate and comprehensive **daily** records of all labour engaged on the bid and shall submit to the Engineer at two weekly intervals detailed labour returns substantiating the actual numbers of labourers employed, gender, education level, disability, the amounts actually paid in respect thereof, and details of the various activities undertaken by the labourers.

The employment of casual labour will be done in co-operation with community leaders and local structures. The bidder shall ensure that all remuneration paid to employees is in line with the relevant sectorial determination in terms of the Basic Conditions of Employment Act, No 75 of 1997, as determined by the Department of Labour.

(j) Monthly statements and payment certificates

The statement to be submitted by the Contractor in terms of the Conditions of Contract shall be prepared by the Contractor at his own cost, strictly in accordance with the standard payment certificate prescribed by the Engineer, in digital electronic computer format. (Microsoft Excel)

For the purposes of the Engineer's payment certificate, the Contractor shall subsequently be responsible, at his own cost, for making such adjustments to his statement as may be required by the Engineer for the purposes of accurately reflecting the actual quantities and amounts which the Engineer deems to be due and payable to the Contractor in the payment certificate.

The Contractor shall, at his own cost, make the said adjustments to the statement and return it to the Engineer within three (3) normal workings days from the date on which the Engineer communicated to the Contractor the adjustments required.

Any delay by the Contractor in making the said adjustments will be added to the times allowed to the Engineer in terms of the Conditions of Contract to submit the signed payment certificate to the Employer and the Contractor. Any such delay will also be added to the period in which the Employer is required to make payment to the Contractor.

(k) Notices, signs, barricades and advertisements

All notices, signs and barricades, as well as advertisements, may be used only if approved by the Engineer. The Contractor shall be responsible for their supply, erection, maintenance and ultimate removal and shall make provision for this in his bided rates.

The Engineer shall have the right to instruct the Contractor to move any sign, notice or advertisement to another position, or to remove it from the Site of the Works if in his opinion it is unsatisfactory, inconvenient or dangerous.

(l) Opening up and closing down of designated borrow pits

Measurement and payment for opening up and closing down designated borrow pits, including removing and stockpiling overburden and restoring the Site, shall be made under item 8.3.4 of SANS 1200 D.

This item applies to all borrow material required under this Contract. The requirements of subclause 5.2.2.2 of SANS 1200 D regarding the opening up, maintenance and closing down of borrow pits shall be adhered to.

(m) Workmanship and quality control

The onus to produce work that conforms in quality and accuracy of detail to the requirements of the Specifications and Drawings rests with the Contractor, and the Contractor shall, at his own expense, institute a quality control system and provide suitably qualified and experienced engineers, foremen, surveyors, materials technicians, other technicians and technical staff, together with all transport, instruments and equipment to ensure adequate supervision and positive control of the Works at all times.

The cost of supervision and process control, including testing carried out by the Contractor, will be deemed to be included in the rates bided for the related items of work.

The Contractor's attention is drawn to the provisions of the various Standardized Specifications regarding the minimum frequency of testing required. The Contractor shall, at his own discretion, increase this frequency where necessary to ensure adequate control.

On completion and submission of every part of the work to the Engineer for examination and measurement, the Contractor shall furnish the Engineer with the results of the relevant tests, measurements and levels to demonstrate the achievement of compliance with the Specifications.

C5.1.4 Extension of time due to abnormal rainfall

- (a) Where abnormal rainfall is experienced, an extension or reduction of contract period shall be granted, as agreed by the Engineer. Extension of time in respect of delays resulting from wet climatic conditions on the Site will only be considered in respect of abnormally wet climatic conditions and shall be determined for each calendar month or part thereof, in accordance with the formula given below. Extensions of time for part of a month shall be calculated using pro-rata values of N_n and R_n . It shall be calculated for the whole period of completion of the contract including any extensions thereof but excluding the annual builder's holiday.

$$V = (N_w - N_n) + (R_w - R_n)/X$$

in which formula the symbols shall have the following meanings:

V = Potential extension of time in calendar days for the calendar month under consideration:

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

When the value of V for any month exceeds the number of days in the particular month, V will be the number of days in the month.

N_w = Actual number of days in the calendar month under consideration on which a rainfall of Y mm or more was recorded on the Site

N_n = Average number of days, derived from existing records of rainfall in the region of the Site, on which a rainfall of Y mm or more was recorded for the calendar month

R_w = Actual rainfall in mm recorded on the Site in an approved rain gauge for the calendar month under consideration

R_n = Average rainfall in mm for the calendar month, derived from existing records of rainfall in the region of the Site

The factor $(N_w - N_n)$ shall be deemed to be a fair allowance for variations from the average number of days during which the rainfall exceeds Y mm.

The factor $(R_w - R_n)/X$ shall be deemed to be a fair allowance for variations from the average number of days during which the rainfall did not exceed Y mm but wet conditions prevented or disrupted work.

- (b) The rainfall records at rainfall station number OR Tambo International Airport for the period up to 1984 are reproduced in the accompanying table, and the monthly averages (R_n and N_n) for this period shall, for the purposes of this Contract be taken as normal and as the values to be substituted for R_n and N_n in the formula above. The values of X and Y shall be 20 and 10 respectively.

The potential extension of time V has been calculated for each month and year of the period concerned to indicate the possible effect of the rainfall formula. The values of V were obtained by applying the rainfall formula and using the actual rainfall figures and the calculated values of R_n and N_n indicated in the table.

- (c) The Contractor shall, at his own cost, provide and erect on the Site at a location approved by the Engineer, an approved rain gauge, which shall be fenced off in a manner which will prevent any undue interference by workmen and others. The Contractor shall, at his own cost, arrange for the reading of the rain gauge on a daily basis for the duration of the Contract. The gauge readings, as well as the date and time at which the reading was taken shall be recorded in a separate record book provided by the Contractor for this purpose. All entries in the rainfall record books shall be signed by the person taking the reading and the gauge shall be properly emptied immediately after each reading has been taken. If required by the Engineer, the Engineer shall be entitled to witness the reading of the gauge.
- (d) The Contractor's claims in terms of Sub clause 42.2 of the Conditions of Contract for extension of time in respect of delays resulting from wet climatic conditions on the Site during each month, shall be submitted in writing to the Engineer monthly;

always provided that

- (i) the period allowed to the Contractor in terms of Clause 48 of the Conditions of Contract in which to submit his claim for each month shall be reduced to seven (7) days, calculated from the last day of the month to which the claim applies; and

- (ii) the 28-day period allowed to the Engineer in terms of Sub clause 42.2 of the Conditions of Contract in which to give his ruling on the claim, shall be reduced to fourteen (14) days.

The Contractor's monthly claim shall be accompanied by a copy of the signed daily rainfall readings for the applicable month.

- (e) The extent of any extension of time which may be granted to the Contractor in respect of wet climatic conditions (whether normal or abnormal) shall be determined as the algebraic sum of the "V" values for each month between the Commencement Date and the Due Completion Date of the Contract, calculated in accordance with sub clause C5.2.4(a) above; provided always that
 - (i) rainfall occurring within the period of the Contractor's Christmas shut-down period (referred to in Sub clause 1.6 of the Conditions of Contract) shall not be taken into account in the calculation of the monthly "V" values;
 - (ii) rainfall occurring during any period during which the Contractor was delayed due to reasons other than wet climatic conditions on the Site, and for which delay an extension of time is granted by the Engineer, shall not be taken into account in the calculation of the monthly "V" values;
 - (iii) if the algebraic sum of the "V" values for each month is negative, the time for completion will not be reduced on account of subnormal rainfall, and
 - (iv) where rainfall is recorded only for part of a month, the "V" value shall be calculated for that part of the month using pro rata values for Nn and Rn.
- (f) The Engineer shall, simultaneous with granting any extension of time in terms of this clause, revise the Due Completion Date of the Contract to reflect an extension of time having been granted in respect of wet climatic conditions, to the extent of the algebraic sum of all the "V" values for all the preceding months of the Contract, less the aggregate of the "Nn" values for the remaining (unexpired) months of the Contract (viz less aggregate of the potential maximum negative "V" values for the remaining Contract Period). Thus, provided that where such period is negative, the Due Completion Date shall not be revised.
- (g) Any extension of time in respect of wet climatic conditions granted in terms of this clause shall not be deemed to take into account delays experienced by the Contractor in repairing or reinstating damage to or physical loss of the Works arising from the occurrence of abnormal climatic conditions. Extension of time in respect of any such repairs or reinstatement regarding damage shall be the subject of a separate application for extension of time in accordance with the provisions of Clause 42 and Clause 48 of the Conditions of Contract.

- (h) The Contractor shall make due allowance within his programme submitted in terms of Clause 12 of the Conditions of Contract, for a total anticipated delay to items on the critical path resulting from wet climatic conditions, during the Contract.

RAINFALL TABLE

MONTH	Nn	Rn (mm)
January	4.4	125
February	3.7	90
March	3.6	91
April	2.0	54
May	0.4	13
June	0.3	9
July	0.1	4
August	0.1	6
September	1.0	27
October	2.5	72
November	4.9	117
December	3.9	105
Annual Average	26.9	713

C5.2 EXISTING SERVICES

C5.2.1 Known services

The Contractor is to familiarise himself with the known services as may have or have not been marked on the construction drawings.

C5.2.1 Treatment of existing services

The Contractor shall take all necessary steps to ascertain the location of existing services before commencing any section of the Works and shall exercise the greatest care when working in the vicinity of such services.

The Contractor needs to establish all information indicating the approximate positions of these services and the Contractor will be expected to locate and expose these by hand excavation before any excavation operations commence. Any problems encountered shall be immediately brought to the attention of the Engineer.

In addition, certain items of work require to be connected to existing works. The new work must therefore be co-ordinated and arranged in such a manner so as to cause minimum interference with the existing work and must also be carried out so as to match and blend in with the existing work.

The Contractor shall take all necessary steps to ascertain the location of existing services before commencing any section of the Works and shall exercise the greatest care when working in the vicinity of such services. No more than three weeks and not less than one week before commencing his operations in any particular area, the Contractor shall the location of the existing services.

No additional payment will be made for the care required or for any additional costs incurred by the Contractor when constructing in the proximity of existing works or survey pegs, etc., nor will payment be made for connecting any new works to existing works, except where specifically allowed for in the Schedule of Quantities.

Where existing services are either indicated on drawings supplied to the Contractor or indicated on Site, or in the course of excavation the Contractor shall lay bare any water mains, pipes, cables, telegraph cables or telephone poles, or any existing structures, these shall be severally shored, strutted or slung and sufficiently protected to ensure that no damage shall be done to them until filling has been placed around them. In the case of electric and telephone cables, if these shall be exposed in the course of excavation, the Contractor shall not refill the excavation around such cables until the cables have been inspected and passed as intact by their respective owners. The costs of exposing these services, protecting, maintaining and repairs necessitated by damage caused by the Contractor must be included in the rates measured as specified in Sub-Clause 8.3.2(a) of SANS 1200 DB.

C5.2.3 Damage to services

The Contractor shall take all necessary steps to protect any existing works whatsoever against damage which may arise as a result of his operations on Site. The Contractor shall bear the cost of the repair of damage to any service the possible existence of which could reasonably have been ascertained by him in good time.

C5.2.4 Reinstatement of services and structures as damaged during construction

Where the Contractor is responsible for the cost of repairs carried out by the Employer or an outside authority, the costs will be recovered by means of a

deduction from the Contractor's monthly Payment Certificates. The Employer will attend to the payment of monies due to outside authorities.

C5.3 ACCESSES, USE OF LAND, AND TRESPASSING

In case of no direct access onto a school, the Contractor shall make arrangements with the owners or tenants in respect of access to the Site across their properties and shall pay all costs incurred in this regard.

Where existing roads are used, they shall be protected from damage by Construction traffic. The Contractor shall keep all gates closed and shall immediately repair any damage done by him to fences, gateways, drains or to any other structure in the execution of the Contract and shall leave everything in the same state as it was found by him.

The Contractor shall not harm or destroy any vegetation by fire or by any other means nor allow any practice which may have a detrimental effect on the environment. He shall be responsible for any damage whatsoever caused by his employees.

The Contractor shall, as far as possible, confine his operations to within the limits of the respective school Site, but if this is inadequate for his purpose, he shall make all arrangements for any further land he may require and shall pay all costs and charges in this connection.

The Contractor shall not use the school premises for any purposes whatsoever other than for the proper execution of the Contract and shall be debarred specifically from any form of trading or bartering.

He shall erect and maintain suitable temporary fencing wherever necessary, and he shall pay for all damage in respect of trespassing, and for all damage to the stock, crop or other property on the land, which may arise from the inefficiency or disrepair of such temporary fencing or from interference with existing fencing in the course of the work.

The Contractor's employees and those seeking employment shall be prohibited from trespassing on adjoining lands and from killing and disturbing any life that may include game, livestock or domestic animals.

C5.4 CONTRACTOR ACTIVITIES ON PRIVATE PROPERTY

Action required prior to entering private property

The Contractor shall not enter onto private property or property not belonging to the Employer or school for the purpose of carrying out any work in connection with the Contract without having completed the following formalities well ahead of his intended date for entering such property:

- (a) The Contractor shall give notice, in writing, to the school, owner, or occupier, on a form approved by the Engineer, of his intention of entering upon the property, together with full details of the work he intends to carry out on the property and the intended dates and duration of occupation.
- (b) The Contractor shall arrange a meeting with the school, owner, lessee or occupier, to -
- confirm that the owner or occupier has permitted the Contractor to enter upon the property for the said purpose;
 - obtain details from the school, owner or occupier, regarding any special precautions that should be taken by the Contractor during the execution of the Works;
 - record details, with photographs if necessary, of the condition of the property at that stage, including any defects in buildings, swimming pools, outbuildings, fences, etc that may be affected by his activities;
 - record in writing the details of the above; the form and substance of such records and agreements shall be subject to the Engineer's approval and a copy of the details as recorded shall be sent to the Engineer for his records and his approval.
- (c) In the event of the Contractor failing to reach agreement with the school, owner or occupier of the property on any of the matters referred to above, the matter shall be referred to the Engineer for further action.
- (d) Not less than three days before actually entering such property, the Contractor shall again give notice in writing to the school, owner, or occupier of the exact date on which he intends to enter the property. If this date is not adhered to, he shall again give similar notice of his revised date.

Execution of the Works

The Contractor shall take all reasonable measures to limit as far as possible damage to gardens, fences, outbuildings, swimming pools and other property and disruption to the occupiers while he is working on private property. He shall particularly programme his activities to minimize his time of occupation, but not longer than the time in the Contract.

Where normal access by way of driveways and footpaths is obstructed, he shall provide suitable temporary vehicle or pedestrian crossings with the school's or owner's agreement. Grass and topsoil shall be carefully removed and stored separately for replacement upon completion of the work.

Upon completion of construction, the affected area shall be restored to its original condition within one week as far as this is reasonably possible, and all rubbish and debris shall be removed and all damage made good.

After completion of the work

As soon as the work on any property has been completed and the area restored as set out above, the Contractor shall obtain from the school, owner or occupier, on a form approved by the Employer/Engineer, a signed statement that the owner or occupier is satisfied with the condition to which the property has been restored and that he has no unsettled claims for damage. This statement shall be delivered to the Employer via the Engineer.

In the event of the school, owner or occupier refusing to sign such statement, the matter shall be referred to the Employer via the Engineer for further instructions.

Dumping on Private Property

In the case of the Contractor requesting permission to dump excavated material or any other material from the works on school or private property, the Contractor shall provide the Engineer with the following documentation before dumping commences:

- (a) A signed indemnification by both parties, that is the Contractor and the Owner of the property on which dumping will occur. The indemnification shall exempt both the school and the Employer from any claims that may arise from the dumping of material on the specific property.
- (b) The agreements or conditions under which dumping shall take place.

C5.5 WORKMEN TO BE KEPT WITHIN BOUNDS

The Contractor will be responsible for keeping all persons under his control, including personnel employed by subcontractors, within bounds and will be liable for all damage to adjoining premises and property caused by workmen, by transportation, or by any other occurrence under his control.

C5.6 EXTENT OF OCCUPATION OF SITE

The Contractor shall limit his occupation of the Site to such period and the number of working places to such number as would reasonably be necessary in the circumstances. Trenches shall not be allowed to remain open for longer than is necessary and access for the public shall be limited or restricted for as short a period as is reasonably possible.

C5.7 TEMPORARY CLOSING OF ROADS

The Contractor shall take every precaution to prevent a nuisance or an obstruction in public or private streets, roads, rights of way, footpaths and entrances and shall not interfere unnecessarily or improperly with the public convenience or the use or occupation of properties, buildings, etc.

Should the Engineer deem it advisable for any portion of a street, road, right of way, footpath or entrance to be temporarily closed, arrangements will be made by him to do so, in which case the Contractor shall comply with such orders and regulations as may be in force. The Employer will pay the cost of inserting advertisements in the public press to give notice of the intended closure and its probable duration. The Contractor shall notify the occupiers of premises along the route affected by any

proposed closure of the intended closure and its probable duration and shall, as punctually as possible, reopen same at the set time or times. Should circumstances arise which could defer reopening at the appointed time, the Contractor shall inform the Engineer and notify the occupiers timeously.

Where a trench crosses or traverses the length of any public or private road, the Contractor shall exhibit road signs in advance of the barricades at such distances as to give sufficient warning to approaching traffic that work is in progress on the road. The type of sign to be used shall be approved by the Engineer, the General Manager: Roads and Stormwater and the Chief of Police, Tshwane Metropolitan Police Department.

During the hours between sunset and sunrise the road signs shall be clearly illuminated as specified in clause 26 of this section.

C5.8 SERVICES REQUIRED BY CONTRACTOR

The Contractor is responsible for the provision of all the services he requires such as telephone, sewerage, accesses as well as water and electricity for domestic and/or construction purposes.

Should the Contractor wish to make use of the school for providing some or all of the above services, he will nevertheless remain fully responsible if the authority cannot fully meet his requirements regarding the type, capacity or quantity of the service.

Should the Contractor make use of the school services, he shall make arrangements, where applicable, for temporary connections to be made, complete with meters, from these services for use at the Site. All costs incurred in respect of these connections and the meters, pipes, cables, etc, from the connections to his facilities, the cost of the **water** and **electricity** consumed, the cost of the removal of **sewerage connection(s)/units** and the use of the **telephone**, and the cost for finally disconnecting, removing the services and making good shall be paid by the Contractor, who shall include full compensation for such costs in his tendered rates for the various items of work requiring the use of one or more of the services. The Contractor shall furnish the Engineer with documentary proof that proper notice has been given to the relevant authority for termination of the services and that all associated costs have been fully settled.

Sufficient back-up services shall be provided to ensure the uninterrupted execution of the Works such as storage tanks for water for use in the mixing of concrete, stand-by electrical power for work at night and for electrical plant and equipment used on Site.

The electrical wiring of all buildings shall be carried out by registered and licensed electricians in accordance with the requirements of SANS 10142-1 and the regulations of the local authority.

C5.9 PROTECTION OF EXISTING SERVICES

General

Specific requirements relating to the location, protection and work in the vicinity of certain services such as electrical cables may be included in the Project Specifications.

Location of existing services

Before any underground or excavation work is carried out, the Contractor shall ascertain the presence and position of all services likely to be damaged or interfered with by his activities. Where the Contractor is not certain, this may be confirmed by means of use of suitable detecting equipment and afterwards by careful hand excavation where necessary in order to expose the service at the positions of possible interference by his activities. The latter procedure shall also be followed in respect of any service not shown on plans but believed to be present.

All such services, the positions of which have been located at the critical points, shall be designated as "known" services and their positions shall be indicated on a separate set of drawings, a copy of which shall be furnished to the Engineer.

While he is in occupation of the Site, the Contractor shall be liable for all damage caused by him to known services as well as for consequential damage arising therefrom, whether caused directly by his operations or by lack of proper protection.

Protection during construction

The Contractor shall exercise all the necessary care to prevent damage to known services during construction operations. Major excavating equipment and other plant shall not be operated in dangerously close proximity of these services. Where necessary, excavation in close proximity of these services shall be carefully carried out by means of suitable hand tools, excluding picks wherever their use could cause damage to the services. No additional payment will apply to such more difficult work.

Services left exposed shall be suitably protected from damage.

Liability for damage and insurance

The Contractor's attention is drawn to the relevant clauses of the General Conditions of Contract and Special Conditions of Contract regarding liability for damage to the Works or property, or injury to persons arising from the construction of the Works and regarding insurance of the Works and public liability insurance to be effected.

Alterations and repairs to existing services

Unless the contrary is clearly specified or ordered, the Contractor shall not carry out any alterations to existing services. Where this may be necessary, the Contractor shall inform the Engineer, who will either make arrangements for such work to be executed by the owner of the service or instruct the Contractor to make such arrangements himself.

Where existing services are damaged by the Contractor, he shall immediately inform the Engineer and the relevant authority and shall obtain instructions as to who should carry out repairs. In urgent cases the Contractor shall take all necessary steps

to minimize damage to and the interruption of the service. No repairs shall be attempted to telecommunication cables or electric power lines and cables.

A list of the important telephone numbers to be used when services are damaged or need to be altered will be included in the Project Specifications.

No liability for damages arising from any delay in having such alterations or repairs effected will be accepted by the Employer. The Contractor shall provide all reasonable opportunity, access and assistance to persons doing alterations or repairs to existing services.

C5.10 NOTICES, SIGNS AND ADVERTISEMENTS

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

As part of his general obligations, the Contractor shall supply and erect the official name-board(s), the details of which are shown on the Drawings. The name-board(s) shall be erected in the position(s) indicated by the Engineer.

All notices, signboards, the official name-board(s), and advertisements shall be removed by the Contractor on completion of the Work or by the end of the defects liability period, as may be decided by the Engineer.

C5.11 TEMPORARY WORKS

Temporary Works will not be paid for under separate pay items, except where provision for this is specifically made elsewhere in the Specifications, and payment for temporary work not covered by specific pay items shall be included in the rates and prices tendered for the related items of permanent work which do or may require Temporary Works.

The Contractor shall be solely responsible for the safety and efficacy of all Temporary Works provided by him, but the Engineer may order such alterations or additions to be made to Temporary Works which he considers necessary for the safety of the Works or to comply with any other requirements under the Contract.

C5.12 WORK IN RESTRICTED AREAS

In certain cases, particularly in road work, trenching, excavations for structures and in pipe jacking operations, work may have to be carried out in restricted areas or in narrow widths which would preclude the use of equipment suitable only for work in unrestricted areas or normal full-width construction.

The Contractor shall note that no reclassification of excavated material and no additional payment over and above the rates for normal construction will be made for such work, unless provision for this has specifically been made in a particular case.

e) Site De-Establishment

During progress of the work and upon completion thereof, the Site of the Works shall be kept and left in a clean and orderly condition.

C5.13 USE OF EXPLOSIVES

The Contractor will generally be permitted to use explosives for breaking up rock and hard material during excavations, for demolishing existing structures and for such other purposes where they may normally be required, subject to any provisions to the contrary in the Project Specifications and to the following conditions:

(a) The Engineer shall be authorized to prohibit the use of explosives in cases where, in his opinion, the risk of injury to persons or damage to property or adjoining structures is too high. Such action by the Engineer shall not entitle the Contractor to any additional payment for having to resort to other less economical methods of construction unless otherwise provided in the Project Specifications.

(b) The Engineer's prior approval shall be obtained in writing in respect of each and every blasting operation carried out. Such approval may be withheld in the event of the Contractor not acting responsibly and carefully in his use of explosives.

(c) The requirements of the Various Acts and Regulations referred to in this section and the requirements of the Inspector of Explosives shall be complied with.

(d) Where the excavation work involves the use of explosives, a method statement shall be developed in accordance with the applicable explosives legislation, by an appointed person who is competent in the use of explosives for excavation work and the contractor shall ensure that the procedures therein are followed.

(e) Where the demolition work involves the use of explosives, a method statement is to be developed in accordance with the applicable explosives legislation, by an appointed person who is competent in the use of explosives for demolition work and the contractor shall ensure that the procedures therein are followed.

(f) Before any blasting is undertaken, the Contractor shall satisfy the Engineer that he has established, in collaboration with the Employer's Manager, Insurance Operations, whether or not the insurers concerned require pre- and post-blasting inspections of buildings and structures within a certain perimeter of the proposed blasting to be carried out.

Should such inspections be required, the Contractor shall, together with the Engineer and the insurer, examine and measure up any buildings, houses or structures in the vicinity of the proposed blasting and establish and record, together with the owner or occupier thereof, the extent of any cracking or damage that may exist before the commencement of blasting operations. It shall be the responsibility of the Contractor to make good at his own expense any further damage to such houses, buildings or structures which is a result of the blasting.

- (g) Where there is a reasonable possibility of damage to power and telephone lines or any other property, the Contractor shall suitably adapt his method of blasting and the size of charges and shall use adequate protective measures, such as cover blasting, to limit the risk of damage as far as possible. Specific requirements relating to certain services may be included in the Project Specifications.
- (h) All accidents, injury to persons and damage to property shall be reported in detail and in writing to the Engineer as soon as is practicable.
- (i) The Engineer shall be given 36 hours' notice by the Contractor before each blasting operation is carried out.
- (j) Where blasting is to be performed in built-up areas or close to infrastructural components susceptible to vibration damage, the Contractor shall, before commencing blasting, employ the services of a specialist blasting consultant to prepare a method statement for approval by the Engineer, specifying in detail the requirements for all the activities related to blasting operations, to ensure that the vibration damage potential is controlled by keeping within the limiting criteria for vibration levels. These criteria shall be in accordance with acknowledged international standards, as approved by the Engineer, and shall relate to both peak particle velocity and wave frequency. The method statement shall be based on site-specific vibration characteristics determined by trial blasting as planned and monitored by the specialist-blasting consultant.

Vibrations caused by blasting operations shall be recorded by one or more blasting seismographs of a type as approved by the Engineer and in positions as described by the specialist blasting consultant.

C5.14 WORK ON, OVER, UNDER OR ADJACENT TO A RAILWAY LINE

All work carried out on, over, under or adjacent to a railway line shall be carried out strictly in accordance with the requirements of the owner of such railway line. Specific requirements in this regard may be included in the Project Specifications.

C5.15 SITE MEETINGS AND PROCEDURES

The Contractor will be required to attend regular site and technical meetings which will normally be held once a month to discuss general progress, quality of work, problems, claims, payments, etc, but not any matters concerning the day-to-day running of the Contract. The Contractor shall keep at set of minute for all site/progres meetings, up-todate Site Instruction Book, Resources Book, a set of UpToDate Drawings.

A site works inspection shall precede all Site Meetings. The notice period for the inspections is two (2) Days.

C5.16 CONSTRUCTION MATERIALS

The Contractor, when using materials that are required to comply with the given standard specification, shall, if so ordered, furnish the Engineer with certificates showing that the materials do so comply. Where so specified, materials shall bear the official mark of the appropriate authority. Samples ordered or specified shall be delivered to the Engineer's office on the Site free of charge.

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

Where proprietary products have been specified, similar products may be used subject to the prior written approval of the Engineer.

Unless anything to the contrary is specified, or approved by the Engineer in writing, all manufactured articles or materials supplied by the Contractor shall be new and unused.

Earth, stone, gravel, sand, and all other materials excavated or present on the Site or in borrow areas provided by the Employer shall not become the property of the Contractor but will be at his disposal only in so far as they are approved for use on the Contract. Existing structures on the Site shall remain the property of the Employer and, except as and to the extent required elsewhere in the Contract, shall not be interfered with by the Contractor in any way.

All materials to be included in the Works shall not be damaged in any way and, should they be damaged on delivery or by the Contractor during handling, transportation, storage, installation or testing, they shall be replaced by the Contractor at his own expense.

All places where materials are being manufactured or obtained for use in the Works, and all the processes connected therewith, shall be open to inspection by the Engineer (or other persons authorized by the Engineer) at all reasonable times, and the Engineer shall be at liberty to suspend any portion of work which is not being executed in conformity with these Specifications.

C5.17 ORDERING OF MATERIALS

Immediately upon his Tender being accepted, the Contractor shall purchase all materials which are in short supply or for which the delivery period may be long.

The quantities set out in the Schedule of Quantities are estimated quantities. The Contractor shall therefore, before ordering materials of any kind, confirm with the Engineer the quantities required. No liability or responsibility whatsoever shall attach to the Employer for materials ordered by the Contractor except if they have been ordered in accordance with written confirmation issued by the Engineer.

C5.18 MATERIALS SUPPLIED BY THE EMPLOYER

Materials designated in the Contract Documents to be supplied by the Employer shall not be obtained by the Contractor from any other source except from the Employer. All requisitions for materials which are to be supplied by the Employer

shall be submitted in writing and shall be signed by the Contractor or his authorized representative and the Engineer.

The Contractor or his authorized representative shall sign a receipt upon delivery of all such materials which, having once been accepted by the Contractor, will be deemed to be in sound and satisfactory condition and will be his sole responsibility thenceforth.

C5.19 REJECTION OF MATERIALS SUPPLIED BY THE EMPLOYER

The Contractor shall ensure that he accepts only sound materials from the Employer which are suitable for the purpose intended, and the Engineer shall be authorized to reject any materials on the Site of the Works, which are unsuitable, unsound or defective in any way. The Contractor shall immediately remove such rejected materials from the Site of the Works to a place designated by the Engineer and at the Employer's expense. However, should the Engineer believe that the Contractor should not have accepted the materials, such removal shall be carried out at the Contractor's expense.

C5.20 TOLERANCES AND AUTHORIZED DIMENSIONS

The work specified in the various sections of these Specifications shall comply with the various dimensional and other tolerances specified in each case. Where no tolerances are specified, the standard of workmanship shall be in accordance with normal good practice. No guarantee is given that the full specified tolerances will be available independently of each other, and the Contractor is cautioned in regard to the fact that the liberal or full use of any one or more of the tolerances may deprive him of the full or any use of tolerances relating to other aspects of the work. The latter would apply particularly in respect of level tolerances on layer work and the related requirements regarding layer thicknesses.

In the description of certain pay items where it is stated that quantities will be determined from the "authorized" dimensions, this shall be taken to mean the dimensions as specified or shown on the Drawings or, if changed, as finally instructed by the Engineer, without any allowance for the tolerances specified. Save as hereinafter specified to the contrary, all measurements for determining quantities for purposes of payment will be based on the "authorized" dimensions.

If the work is therefore constructed in compliance with the authorized dimensions plus or minus any tolerances allowed, quantities will be based on the authorized dimensions regardless of the actual dimensions to which the work has been constructed.

Where the work is not constructed in accordance with the authorized dimensions plus or minus any tolerances allowed, the Engineer may nevertheless in his sole discretion accept the work for payment. In such cases no payment shall be made in respect of quantities of work or material in excess of those calculated from the authorized dimensions and, where the actual dimensions are less than the

authorized dimensions minus any tolerance allowed, quantities for payment shall be based on the actual dimensions as constructed.

C5.21 SIGNS AND LIGHTING

Without limiting the Engineer's right to request additional requirements in terms of the General and Special Conditions of Contract, the following shall be regarded as the minimum requirements for safety and security of the Works:

Watching

At least one watchman shall be employed after hours to patrol the Works and to ensure, inter alia, that all warning lights have been placed in position and are burning, and that road signs are illuminated.

The watchman shall have access to a telephone if available, and to a list of the relevant telephone numbers in case of an emergency.

Lighting

Open trenches shall be illuminated by red lights in the following manner:

- At least two red lights shall be placed across the ends of open trenches, at a maximum spacing of 2 m.
- Red lights shall be placed along open trenches at 10 m intervals on the roadside and at 3 m intervals along the pedestrian side.
- At least one red lamp shall be placed at each of the four corners of each pedestrian crossing and at least two red lamps at each of the four corners of each vehicular crossing.
- All lamps shall be in position and burning between the hours of sunset and sunrise, and shall be provided with a chain and padlock and locked to suitable posts to prevent theft.

Open excavations (other than open trenches) which constitute a hazard to persons or traffic shall be provided with lighting as directed. The Contractor shall apply for directions from the Engineer in good time.

Fencing

Open excavations that may constitute a hazard to pedestrians and vehicular traffic, including all open trenches, shall be fenced off with stout temporary fencing in accordance with the details shown on the Drawings or as approved by the Engineer.

In addition, one line of red-and-white plastic warning tape of an approved design shall be securely fixed along the top of the fence for its full length.

C5.22 DEALING WITH WATER

The Contractor shall deal with and dispose of all water so as to ensure that the Works are kept sufficiently dry at all times so that they can be properly executed, and he shall protect them against flood damage.

For this purpose, the Contractor shall provide sufficient pumps, pipes and other equipment that may be necessary. Where necessary, the Contractor shall construct temporary berms, culverts and channels to drain away the water, but, in order to limit such work as far as possible, the permanent drainage provided in the Contract shall be constructed at the earliest opportunity as may be practicable.

Payment for dealing with water shall be included in the Contractor's rates for preliminary and general charges, except in so far as special provision for dealing with water may be made elsewhere in the Specifications.

C5.23 VARIATIONS FROM SPECIFIED NOMINAL RATES OF APPLICATION OR NOMINAL MIX PROPORTIONS

The various sections of these Specifications prescribe nominal rates of application or nominal mix proportions for materials such as bituminous materials, aggregates, mineral fillers, stabilizing agents, paint and the like. Tenderers shall base their Tenders on these nominal rates of application and mix proportions.

Allowance is made, in the various sections of the Specifications where such rates of application and mix proportions are given, for variations arising from different rates of application or mix proportions ordered by the Engineer to suit the materials and conditions on Site in every particular case.

Where the actual rates of application or mix proportions used in the Works vary from the nominal specified rates or proportions, compensation will be adjusted as follows:

- (a) As a payment to the Contractor in respect of any authorized increase in the quantities specified which has been ordered in writing by the Engineer;
or
- (b) as a refund to the Employer in respect of any decrease in the quantities specified, whether such decrease results from an authorized decrease in the rates of application or mix proportions, or from unauthorized reductions made by the Contractor.

Payment for a varied rate shall be based on the actual rate of application used, provided that this does not exceed the rate of application ordered by the Engineer plus any tolerance in the rate of application allowed. If the actual rate of application exceeds the above, payment shall be based on the rate of application ordered. If the actual rate of application is below the rate of application ordered, payment shall be based on the actual rate of application regardless of any tolerance allowed. Notwithstanding the above, the Engineer shall have full authority to reject work that has been constructed at variance with the Specifications or the rates of application ordered by him.

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

C5.24 THE CONTRACTOR'S ESTABLISHMENT ON SITE

General

The Contractor shall establish his construction camp on a Site made available for this purpose by the Employer or selected by him and approved by the Engineer.

The camp shall be fenced off and shall contain all offices, stores, workshops, testing laboratories, toilet facilities, etc. The camp shall always be kept in a neat and tidy condition and, upon completion of the Works, the camp shall be removed and the Site cleaned and restored to its original condition as far as is practicable, unless otherwise specified in the Project Specifications.

Housing

Unless the Contractor is specifically given permission in the Project Specifications to erect temporary housing for personnel on the Site, no personnel will be allowed to reside on the Site. Only night-watchmen may be on the Site after hours. Where permission is granted for personnel to reside on Site, provision for housing must be in accordance with the regulations of the relevant authority.

Workplace Facilities

Toilets, showers, change rooms and eating facilities shall be provided for the Contractor's personnel in accordance with Regulation 28 of the Construction Regulations, 2003 (Government Gazette No 25207) and the Facilities Regulations 1988, (Government Notice R1593 of 12 August 1988).

Such facilities shall at all times be maintained in a clean and hygienic condition and shall be sited so as not to be offensive.

The Contractor shall provide and maintain the facilities and move them to the required positions, and finally remove them, on completion of the Works, all to the satisfaction of the Health Care Division of the relevant authority. Toilets must be screened from public view and their use shall be enforced.

The Contractor shall make arrangements where necessary for the removal of nightsoil.

Storage

The Contractor shall provide adequate storage accommodation for and/or protection to all perishable materials to the satisfaction of the Engineer.

All materials shall, in addition, be stored or stacked in such positions as will preclude any interference with traffic and any public rights or the progress of the Works.

Materials subject to deterioration with time shall be used in the order in which they have been received.

C5.25 THE COMMUNITY LIAISON OFFICER

When scheduled, the Contractor shall appoint a Community Liaison Officer (CLO) from the local community after the person has been identified by the Ward Councillor and Ward Committee.

The Community Liaison Officer shall perform the following duties:

- Meet regularly with Ward Councillor, ward committee and the community;
- Attend and report at site meetings and PSC meetings;
- Coordinate community activities with construction works;
- Arrange special meetings;
- Interact with the Contractor daily
- Facilitate in resolving community disputes;
- Manage the labour desk
 - Coordinate local labour matters
 - Give feedback to the community on local labour matters,
 - Recruit local labour and local entrepreneurs
 - Keep record of the wages and labour force
 - Facilitate in resolving labour disputes.

The contract with the CLO shall make provision for payment by the Contractor to the CLO of a maximum amount shown in the respective Bill of Quantities. This amount is to include payment of contributions to all statutory charges. It is emphasised that, in the event of the construction period exceeding the tendered completion period and no extension of time been granted, the Contractor shall still pay the Community Liaison Officer the specified remuneration but shall not be reimbursed therefor.

Only one CLO shall be appointed per project, however, the functions of CLO and labour desk may be split between persons with the understanding that the remuneration will also be split.

Should the Contractor experience any difficulty with community matters, these matters shall immediately be brought to the attention of the Engineer who shall arrange a meeting with the relevant school/Ward Councillor(s) and the CLO to resolve such matters.

C6. GENERAL

C6.1 ENGINEER'S ACCOMMODATION

This section covers the provision of accommodation for the Engineer's resident staff that include office space, laboratory accommodation and houses, as well as the provision of all requisite services.

C6.2 SITE OFFICE ACCOMMODATION

The Meetings/Engineer's Office

As the Engineer will only perform Part-time Construction Monitoring (either Level 1 or Level 2), he will only need office accommodation that shall be constructed of timber, fibre-cement or other approved materials. The dust-proof office shall have double walls filled with insulating material and lined on the inside with timber or other approved material. Ceilings shall be provided for the office. The 20 m² floor shall have timber floors or concrete floors with vinyl floor tiles and accommodating up to 15 adults. The clear height of all offices between floor and ceiling shall be a minimum of 3 m. All windows shall be of the type of which the full window area can open. After erection, the office hut shall be painted with an approved paint and the paintwork shall be maintained during the Contract Period. Each door shall be provided with a lock and two keys. The office accommodation shall meet with the approval of the Engineer.

As most of the testing will be done by specialist subbies, there will be no laboratory on site.

The Office Detail

- (a) Each office desk shall have a surface area of at least 1,5 m² and shall be provided with at least three drawers, one of which can be locked.
- (b) A General-purpose steel cabinet shall have at least 1,5 m² shelf area and a volume of 0,70 m³ each. The cabinet shall have a lock with two keys.
- (c) Steel filing cabinets shall each be fitted with four drawers on runners. Each cabinet shall be fitted with a lock and shall be 1 300 mm high, 460 mm wide and 600 mm from front to back.
- (d) Shelves shall be suitable for storing all the Contract Drawings or shall be as detailed on the Drawings.
- (e) Each wash-hand basin shall be fitted with taps and a drain.
- (f) Air-conditioning units and heaters shall be as specified when required.
- (g) Lights shall be of the fluorescent type, either double 80 W, single 80 W or double 55 W, or of the incandescent type, as may be required or specified.
- (h) Each draughtsman's stool shall be fitted with a padded seat, the height of which shall be adjustable.
- (i) Electric power plug points shall be provided. The office shall have at least two 15 A plug points. Earth leakage shall be provided for the local authority's network.
- (j) Each drawing table shall have either an inclined or a horizontal surface, as may be required, and a smooth top constructed to the dimensions shown on the Drawings.
- (k) Chairs shall be sturdy and comfortable.
- (l) Telephone extensions shall be provided as specified and tendered rates shall include the cost of all local calls and trunk calls in connection with the Works.
- (m) Each conference table shall be large enough to seat 15 persons stipulated on the Drawings and schedules.
- (n) Blinds shall be one of two types:
 - (i) Venetian blinds shall be adjustable so as to permit light to enter the

room but shall shut out direct sunlight.
(ii) Opaque roller blinds.

Carports

A Carport shall be so constructed as to protect 2 vehicles parked under it at all times against the weather and sun. The car port shall be at least 20 m² in area and its floor shall consist of a layer of concrete or broken stone to minimize dusty and muddy conditions.

Areas surrounding offices and laboratories

The access and other roads and parking areas surrounding the offices shall be treated and maintained to make them dust free, either by using crushed stone or bituminous surfacing, or by any other approved means. They shall be well drained and kept trafficable and free from mud at all times. Footpaths shall be similarly treated to provide convenient access to all buildings.

An Air-conditioning unit and a heater

These will be catered for in the Site Meeting Room as provided for by the Contractor.

Ablution units

The Employer/Engineer shall share such units with the Contractor's Site Personnel's.

The Contractor's ablution/latrine facility shall be provided with vitreous enamel WC pans with PVC seats and covers. The latrine shall be provided with a door fitted with a latch. Each ablution unit shall be provided with an outside door with a lock. At least two keys shall be provided for each lock.

The Contractor shall be responsible for providing all sanitary services necessary to keep latrines in a clean, neat and hygienic condition.

The Contractor shall make provision for the removal of all rubbish.

Water, electricity, gas and telephone

The Contractor shall provide a constant supply of clean potable water suitable for human consumption, as well as the necessary 240 V power supply to the Site Meeting office.

There shall be lighting as pulled from the nearest electrified school building

The Contractor shall also provide a constant supply of liquid petroleum gas for the burners used in the laboratories.

Maintenance

The Contractor shall provide all labour, equipment and material which may be necessary to keep the office accommodation in a neat and clean condition, and repairs shall be done immediately upon their being noticed.

C6.3 GENERAL

- (a) The Contractor shall not order any buildings, materials, equipment or fittings on the basis of their having been specified or scheduled without the written confirmation of the Engineer having been obtained. The office hut shall be erected only on the Engineer's written instruction as to the exact position and orientation of the building.
- (b) Unless otherwise agreed upon, the office shall be erected in close proximity to the Contractor's offices.
- (c) The Contractor may not proceed with the permanent Works before the required office have been erected by him.
- (d) The ownership of all offices, sanitary facilities and other items provided by the Contractor shall, when they are no longer required by the Engineer, revert to the Contractor on the written advice of the Engineer and shall be dismantled and removed from the Site.
- (e) The Contractor shall take all reasonable precautions to prevent unauthorized entry to the office and to ensure the general security of the offices.

C6.4 SURVEY EQUIPMENT AND ASSISTANTS

When needed, the Contractor shall share his requisite Survey equipment with the Engineer. The Contractor shall do so together with the Survey Assistant. This equipment shall be properly adjusted for requisite accuracy, serviced, maintained and insured by the Contractor for the duration of the Contract and shall consist of a theodolite and an automatic level each fitted with an optical plumb as well as the necessary tripods, metric staffs with built-in plumb bubbles, ranging rods and tapes. A certificate stating that adjustment for accuracy has been done shall be provided and kept on site. The Contractor shall also make available to the Engineer's supervisory staff at least two capable survey assistants as and when required.

C6.5 MEASUREMENT AND PAYMENT

Please see the Bid Documentation and the Bill of Quantities.

C6.6 ANCILLARY WORK

C6.6.1 : SITE CLEARING AND GRUBBING

a) SCOPE

This section covers the clearing of the Site and the grubbing necessary for the construction of the Works covered by the Contract.

b) GENERAL

The taking down of fences and the sorting, coiling and stacking of the fencing material are specified in and shall be measured and paid for under section per the Bill of Quantities.

The same applies to pipelines, electricity transmission lines and cables, telephone lines and cables and other existing services.

c) AREAS TO BE CLEARED AND GRUBBED

Normally borrow areas and the portions of the Site on which excavations are to be made and embankments, fences and structures are to be constructed, shall be cleared or grubbed, or both, but the Contractor shall not commence clearing and/or for grubbing until the Engineer has designated, in writing and in detail, the exact areas or strips to be cleared and/or grubbed and the time when the work is to start. The Contractor shall ensure that the general shape, profile, and levels of the area are not materially altered during clearing and grubbing operations.

In order to avoid re-clearing or to control dust or erosion the Contractor shall, if so ordered, clear and grub at the latest practicable stage of construction.

d) CLEARING

Clearing shall involve the following:

- The removal of all trees and bushes (complete with roots), other vegetation, rubbish and all other material that may interfere with the construction of the Works.
- The removal of all rocks and boulders of up to 0,15 m³ in size, which are lying on the surface to be cleared or which are exposed during the clearing operations.
- The disposal of all material produced by the clearing.
- The removal and disposal of structures which encroach upon or may otherwise obstruct other work on the Site and which can be cleared by means of a bulldozer with a mass of approximately 20 t and a flywheel power of approximately 130 kW. (Structures that cannot be so cleared shall be dealt with as specified in the Bill of Quantities, the Project Specifications or as directed by the Engineer.)

The moving of a certain amount of soil or gravel may be inherent in or unavoidable during the clearing process. No extra payment will be made for the removal of such soil or gravel.

Areas that are cleared in strips for the purpose of constructing fences shall be cleared over the full length of the fence to a width as specified in the Project Specifications and as scheduled. Surface irregularities shall, in the case of fencing, be so graded that the fence will follow the general ground contour.

e) GRUBBING

All stumps and roots exceeding 75 mm in diameter shall be removed to a depth of at least 100 mm below the original ground level. In the case of roads and parking areas,

grubbing shall be done to a depth of at least 600 mm below the projected finished road level. Where a construction bed or any other area has to be compacted, all stumps and roots including matted roots shall be removed to a depth of at least 200 mm below the cleared surface.

All material produced by the grubbing shall be disposed of.

Except in borrow areas, cavities caused by grubbing shall be backfilled with approved material and compacted to a density equal to at least that of the surrounding ground.

f) THE CUTTING OF TREES

Protection of persons, animals and structures

The Contractor shall take the necessary precautions to prevent injury to persons and animals and damage to structures and other private and public property.

Where necessary, trees shall be cut in sections from the top downwards.

Branches overhanging boundaries

The branches of trees to be left standing shall be so trimmed as not to encroach upon the space (to a height of at least 7 m) vertically above any carriageway, railway formation, or other designated area.

Preservation of trees

No tree shall be cut down and no branches shall be trimmed off any of the trees to be preserved until the Engineer has given written authorization for such work to commence. Individual trees indicated and marked by the Engineer as trees to be preserved shall be left standing and undamaged. The amount stated in the Project Specifications shall be deducted from monies owing to the Contractor as a penalty in respect of every such tree that has been damaged or removed unnecessarily.

Indigenous forest

Before commencing the clearing of an indigenous forest or a part of such forest, the Contractor shall obtain from the Engineer a copy of the written confirmation of the Director-General of the Department of Environment Affairs, and Tourism to the effect that work may be proceeded with, and of the written instructions on which the Contractor is required to act.

g) THE RECLEARING OF VEGETATION

If during the currency of the Contract vegetation should again grow on any portion of the Site, borrow areas, or other areas or strips that have been cleared in accordance with the Specifications, the Engineer may, if it is deemed by him to be necessary, order that such area(s) be re-cleared.

Such re-clearing shall include the removal and disposal of grass, shrubs, and other vegetation, grubbing, the backfilling of holes, and the removal, transport and

disposal of material produced by these operations, as during the first clearing and grubbing operation.

h) THE CONSERVATION OF TOPSOIL

When suitable topsoil is found within the limits of the area to be cleared, the Contractor shall, if so ordered by the Engineer, remove and conserve the topsoil together with any grass or other acceptable vegetation in accordance with the requirements specified in section 201. If it is not used immediately, or if it is not stockpiled in windrows clear of the working areas, the topsoil shall be transported and deposited in stockpiles for later use. The Contractor will not be required to remove topsoil from any area in which the average depth of the topsoil is less than 150 mm.

The removal, stockpiling and placing of topsoil shall be measured and paid for per the Bill of Quantities.

Where the topsoil can be removed without prior clearing and grubbing, no payment will be made for clearing and grubbing under this section.

i) THE CONSERVATION OF FLORA

When so required in terms of the Project Specifications, certain designated flora encountered in areas to be cleared, including borrow areas, shall be preserved by the Contractor. He shall carefully remove and plant the flora in a protected and fenced-off area, and on completion of the Works he shall replant the flora on the Site or in the borrow areas in accordance with the Engineer's instructions.

j) THE DISPOSAL OF MATERIAL

Any material obtained from clearing and grubbing, the demolition of structures, the re-clearing of vegetation and the cutting of trees shall be disposed of in borrow pits or other suitable places indicated by the Engineer. Spoil areas shall be treated as specified for borrow areas herein. Where no such place for the disposal of material is indicated by the Engineer, the Contractor shall make his own arrangements to provide a suitable place which complies with the requirements laid down by the Engineer. The disposal or burning if specially permitted of combustible material on the Site may be done only with the prior written approval of the Engineer. Care shall be taken to observe the provisions of the Atmospheric Pollution Prevention Act, 1965 (Act 45 of 1965), and any regulations published in terms of the Act.

All tree trunks and major branches shall be sawn into transportable lengths before removal from the Site.

No haulage will be payable to the Contractor for the disposal of material obtained from clearing and grubbing, the demolition of structures, the re-clearing of vegetation, and from the cutting of trees.

k) MEASUREMENT AND PAYMENT

Please see the Bid Documentation and the Bill of Quantities

l) TRAFFIC CONTROL

General requirements

Wherever the Contractor's activities on Site affect or have the potential to affect the normal flow or safety of traffic during the construction and defects liability periods, he shall be responsible for all aspects of traffic control, including flagmen, warning devices, signs, channelization devices, layout of detours and bypasses, sign sequences and layouts, and all the requirements of the KZN Roads and Stormwater Division.

Full compensation for all aspects of traffic control as specified in this clause shall, in the case of detours and bypasses, be included in the rate tendered for in the BoQ, but, where construction takes place alongside an existing road as well as where trenches in roadways obstruct the traffic flow, full compensation for all aspects of traffic control shall be included in the rates tendered for in the BoQ.

Warning devices, signs, speed limits and channelization devices

The dimensions and other properties of all signs and devices and the sign and device sequences, layouts and spacings shall be in accordance with the provisions of the National Road Traffic Act, (Act 93 of 1996) and its Regulations. In addition, signs and devices shall be placed at the positions shown on the Drawings. In cases not covered by the Act, the signs, speed limits, devices, sequences, layouts and spacings shall comply with the requirements of The Southern African Development Community Road Traffic Signs Manual and of the Engineer.

Language

Traffic signs shall be in English.

m) DRAINAGE WORKS FOR BYPASSES

The Contractor shall construct and maintain the necessary temporary drainage works, such as side drains, catchwater drains, mitre drains, culverts, catchpits, chutes, berms, channels, etc, to deal adequately with surface run-off.

Temporary culverts shall be installed on existing drainage channels wherever required by the Engineer and shall be of the sizes and types as ordered by him.

Suitable metal or precast concrete culverts salvaged from existing roads or abandoned bypasses may be re-used if they are in a good condition and approved by the Engineer.

Any damage caused to bypasses by the inability of temporary culverts, installed in accordance with the Engineer's instructions, to cope with floods, shall be repaired and the Contractor shall be paid for the cost of such work at applicable rates or, where no such rates exist, the work shall be carried out on a daywork basis in accordance with the provisions of the General Conditions of Contract.

Payment for the construction of temporary culverts will be made under the appropriate items provided in this section. Full compensation for the construction of

the other temporary drainage works for bypasses and for the maintenance of all drainage works including temporary culverts shall be as contained in the Bill of Quantities.

Where the construction of bypasses necessitates the construction of elements of the permanent drainage works, such work will be measured and paid for under the relevant sections of these Specifications.

n) EARTHWORKS FOR ACCESS ROADS

The Contractor shall shape and grade the access roads, making full use of all approved material that can be obtained from alongside these roads, or from the immediate vicinity. If sufficient material cannot be obtained in this manner, he shall import material from other sources. Where necessary, cuttings shall be made to obtain a satisfactory vertical alignment. Where the in-situ material is not sufficiently dense in its natural condition, it shall be given a three-pass roller compaction as specified in section 203 prior to the construction of the earthworks.

The Contractor shall also do the necessary clearing and grubbing, including the removal of all trees and stumps, all as specified herein. Clearing and grubbing shall be measured and paid for in accordance with the Bill of Quantities.

All material shall be watered, mixed and compacted with suitable compaction equipment to give sufficient density to the material so that it will be capable of carrying traffic without undue wear or distress. In case of disagreement between the Engineer and the Contractor as to the adequacy of this compaction, a dry density of 90% of modified AASHTO density shall be taken as the required minimum density.

Any fills which may be necessary for any reason, e.g. for the construction of drifts, shall be constructed and compacted by the Contractor as described above. Wherever possible, drifts shall be constructed of rock fill or coarse material so as to limit flood water damage as far as possible.

o) GRAVEL WEARING COURSES FOR ACCESS ROADS

When the earthworks for bypasses as described in the above clause have been completed, those portions of the access roads and of existing gravel roads used as accesses indicated by the Engineer shall be provided with a wearing course of suitable gravel approved by the Engineer.

The Contractor shall provide, spread, water, mix and compact such material to a density at which it can carry traffic without undue wear and tear. In case of disagreement between the Engineer and the Contractor as to the adequacy of the compaction, a dry density equal to 93% of modified AASHTO density shall be taken as the required minimum density.

p) PAVEMENT LAYERS, STABILIZATION AND ROAD MARKING FOR BITUMEN-SURFACED ACCESS ROADS

Where shown on the Drawings or required by the Engineer, pavement layers such as gravel layers of subgrade or subbase quality, crushed-stone and asphalt base

courses, the stabilization of pavement layers and road marking shall be constructed and measured and paid for in accordance with the requirements of the relevant sections of these Specifications.

q) BITUMEN-SURFACED ACCESS ROADS

Standard bituminous surfacing

The following bituminous surface treatment shall be applied to the central 7,4 m width of the top compacted pavement layer for two-way traffic and 3,7 m for single-lane traffic, unless otherwise instructed or authorized by the Engineer:

(a) Prime

The prime coat shall be applied as specified below. Road tar of grade RTH 3/12P shall be used.

(b) Tack coat

A coat of RTH 45/50 road tar shall be applied at a rate of $1,0 \text{ l/m}^2$. This coat shall be applied only after the prime coat has dried and, in the opinion of the Engineer, will not pick up under traffic.

(c) Crushed-stone aggregate

- Immediately after the tack coat has been applied, it shall be covered by a 6,7 mm nominal size crushed-stone aggregate at a spread rate of $0,0050 \text{ m}^3/\text{m}^2$. No more than 10 minutes shall elapse between application of the tack coat and spreading of the chips at any particular point.
- Rolling shall be done as specified for the initial rolling herein.
- The grading of the 6,7 mm aggregate shall conform to that given herein for 6,7 mm aggregate.

Other types of surfacing

Any other type of surfacing or surface course may be ordered in lieu of the surfacing specified above and payment will be at the appropriate rates tendered or agreed on, as the case may be.

r) TEMPORARY FENCING AND GATES

New fencing and gates shall be provided or existing fencing and gates shall be moved and subsequently reinstated in accordance with the Specifications and Drawings or, in the absence thereof, to standards acceptable to the property owners concerned.

New fencing and gates shall be removed when no longer required, and previously existing fencing and gates which have been temporarily moved shall be reinstated to their original position and condition.

Temporary grid gates shall be constructed in accordance with the Drawings and shall be demolished and removed when they are no longer required.

s) EXISTING ROADS USED AS ACCESSES

The Contractor shall carry out all repairs, alterations or additions, as required by the Engineer, to bring existing roads which are to be used as accesses in a good and safe trafficable condition. When existing roads are no longer required as access, they shall be reinstated to their original condition.

Gravel courses for by access roads shall be measured and paid for per Bill of Quantities. All other work ordered by the Engineer in terms of this clause shall be measured and paid for per the Bill of Quantities.

C6.7 : ANCILLARY WORKS

C6.7.1 : LANDSCAPING AND GRASSING

a) SCOPE

This section covers the landscaping and/or the establishing of vegetation in such areas as indicated on the Drawings or ordered by the Engineer, in writing.

b) MATERIALS

Fertilizer

The type of fertilizer to be used shall be as specified in the Project Specifications, ordered by the Engineer or scheduled.

Grass cuttings

Grass cuttings shall be fresh and in a good condition for planting, with sufficient root material to ensure good growth. Species to be planted shall be local couch-grass ("kweek") or other species as specified in the Project Specifications.

Grass seed

Only good-quality fresh seed shall be used. The types of seed in the mixture and the pure live-seed content shall be as specified in the Project Specifications.

Trees, shrubs and ground covers

Plants shall be of the variety and size shown on the Drawings or indicated in the Project Specifications.

When trees, shrubs and ground covers are supplied and delivered to the Site by the Employer, the Contractor shall give the Engineer at least six weeks advance notice of his requirements. Upon receipt of the plants, the Contractor shall ensure that the plants are in good condition and free from obvious diseases and shall accept full responsibility to maintain the plants in good condition throughout the Contract, including the defects liability period. The plants shall be fully maintained and watered during this period, and any losses of plants due to lack of maintenance or

diseases developing during the Contract period and the defects liability period shall be replaced at the Contractor's expense.

Plants shall be handled and packed in the approved manner for the particular species or variety, and all necessary precautions shall be taken to ensure that plants will arrive at the point of use in proper condition for successful growth. Trucks used for transporting plants shall be equipped with covers to protect plants from windburn. Containers shall be in a good condition.

Plants supplied by the Contractor shall be healthy, shapely and well-rooted. Roots shall not show any evidence of having been restricted or deformed at any time.

Plants shall be well-grown and free from insect pests and diseases.

Grass sods

Grass sods shall be nursery-grown and shall be harvested, delivered and planted within 36 hours, unless otherwise authorized by the Engineer. Grass sods shall be free from noxious weeds and diseases and shall contain a minimum of 30 mm of soil.

Sods shall be of the variety of grass specified in the Project Specifications, unless otherwise approved by the Engineer. The grass shall have been grown specifically for sod purposes, mown regularly and maintained to provide an approved quality of uniformity. It shall be harvested by special machines manufactured for this purpose to ensure an even depth of cut with sufficient root material and soil.

Revegetation cylinders

Revegetation cylinders shall consist of cylindrical capsules with a diameter of approximately 125 mm and a length of 1 500 mm. They shall be manufactured from extruded plastic netting or similar approved biodegradable material. The plastic material shall be specially formulated to provide protection against ultra-violet rays from the sun, and shall be sufficiently robust to last for a period of not less than three years without disintegration under normal service conditions.

The revegetation cylinders shall be filled with shredded or partially compressed organic matter, such as wood chippings. Where wood chippings are used, only material passing a 31 mm sieve with round holes and having been retained on a 5 mm sieve with square holes shall be used. The wood chippings shall be treated with Tanalith C or a similar approved wood preservative.

The Contractor's attention is drawn to the fact that the use of revegetation cylinders is subject to patent rights and that all royalties shall be payable by the Contractor.

The Contractor shall, at the start of the Contract, ascertain what delivery period applies in respect of the cylinders so that orders can be placed in good time.

Anti-erosion compounds

Anti-erosion compounds shall consist of a plastic material in dispersion, such as Verdyol or a similar approved compound, which can be sprayed onto the soil to bind and protect it against erosion.

Topsoil

Topsoil shall consist of fertile loamy soil selected from areas showing a good coverage of natural vegetation, preferably grasses. It shall be free from deleterious matter such as large roots, any stones, refuse, stiff or heavy clays and noxious weeds, which would adversely affect its suitability for the planting of grass.

Topsoil shall be obtained wherever suitable material occurs, either from the Site or from borrow areas to be cleared, as described in the BoQ. The Engineer shall indicate his requirements to the Contractor regarding the quantity of topsoil required and the areas at which it shall be selected and whence it shall be removed. Unless otherwise specified or instructed by the Engineer, topsoil shall not be taken from more than 400 mm below the original undisturbed surface. If the Contractor fails to conserve topsoil as instructed, he shall obtain suitable substitute material from other sources at no extra cost to the Employer.

C6.8 : ANCILLARY WORK

C6.8.1 FENCING

a) SCOPE

This section covers the erection of new fences, the moving of existing fences, the erection and later removal of temporary fences, the dismantling of existing fences, and finally the stacking of the fencing material.

However, it is noted that this project may not include fencing.

b) TYPES OF FENCES

The following types of fences shall be erected in accordance with the dimensions shown on the Drawings:

- (i) Ordinary fences with diamond mesh, or tension fencing to the full height of the fence.
- (ii) Security fences, either the verandah type with diamond mesh or tension fencing on the vertical portion and barbed wire on the overhang, or the vertical type with full height diamond mesh, barbed wire or tension fencing, with or without rolls of barbed-tape concertinas fitted as shown on the Drawings. Verandah-type fences can also be fitted with barbed-tape concertinas.

c) MATERIALS

Posts, stays, standards and droppers

Posts, stays, standards and droppers shall be of the type and size indicated on the Drawings. Posts shall include gate posts, straining posts and corner posts.

Metal posts, stays, standards and droppers shall comply with the requirements of CKS 82 and SANS 280. "Acceptable" in CKS 82 means "acceptable to the Engineer".

Tubular posts shall be sealed at the top with caps and shall be fitted with base plates as shown on the Drawings.

Tubular posts, standards and stays shall be galvanised in accordance with SANS 32 quality B1 or SANS 121 Table 2 or 3, as applicable. All rail sections, Y-sections and metal droppers shall be provided with a protective coating of tar or other approved material.

Timber posts, stays, standards and droppers shall comply with the requirements of SANS 457 part 2 or part 3 as applicable and shall be creosote-impregnated in accordance with SANS 10005, with creosote complying with SANS 538 or SANS 539. All timber shall be straight and free from unsightly knots, splits and other imperfections.

Corner, gate and straining posts shall be suitably drilled for stay bolts or gate fittings as indicated on the Drawings.

Bolts for stays

Bolts shall be of mild steel and galvanized in accordance with SANS 121 Table 2 or 3, as applicable. The length and diameter of the bolts shall be as shown on the Drawings. All the necessary bolts, together with nuts and washers, shall be supplied with each post.

Wire

All wire shall conform to the requirements of SANS 675 and shall be zinc coated as set out in Table 3 of this specification.

(1) Barbed wire

Barbed wire shall be one or both of the following types:

- (i) High-tensile grade, oval shaped, single-strand wire, 2,60 x 2,00 mm.
- (ii) Mild-steel grade, double strand, uni-directional twist wire, each strand 2,50 mm in diameter.

Barbs shall be spaced at not more than 150 mm intervals.

(2) Smooth wire

Smooth wire shall be of the types specified below:

- (i) Straining wire shall be mild-steel wire, 4,00 mm in diameter.
- (ii) Fencing wire shall be high-tensile strength-grade 2,24 mm diameter wire.
- (iii) Tying wire or binding wire shall be 2,50 mm diameter, mild-steel for tying fencing wire to standards and droppers, and 1,60 mm diameter, mild-steel for tying wire mesh to fencing wire.

(3) Barbed-tape security barriers

Barbed-tape security barriers shall comply with the requirements of SANS 1620 for type A and shall consist of close-coiled high-tensile strength wire with a continuous strip of flat steel barbs (barbed tape) crimped to the wire along the entire length of the wire. The coils shall further be attached together by clips to

give a concertina configuration when pulled apart. The coils shall be of the diameter as shown on the Drawings. Each concertina shall have a minimum of 55 coils, and the maximum effective length of open concertina, when pulled apart, shall depend on the diameter of the roll but shall be at least 12 m.

The high-tensile wire shall be Class B galvanized as per SANS 935.

The barbed tape shall be made of cold-rolled carbon steel galvanized to Class Z600 as per SANS 934.

The concertina clips shall be manufactured from steel strip galvanized to Class Z600 as per SANS 934.

Diamond mesh

Diamond mesh (chain-link fencing) shall comply with the requirements of SANS 1373. The width shall be as shown on the Drawings, and both edges shall be clinched.

The diameter of the wire shall be 2,5 mm and the mesh size shall be as shown on the Drawings.

The wire shall be Class B galvanized as per SANS 935.

Tension fencing

Pre-assembled tension fencing shall be manufactured from wires complying with the requirements of SANS 675. The height shall be as shown on the Drawings with the edge wires and intermediate wires having a minimum diameter of 2,24 mm. Edge wires and intermediate wires shall be of a high-tensile strength grade, and all wires shall be galvanized as per SANS 935.

Gates

Gates shall comply with the requirements of CKS 146 and shall be manufactured to the dimensions shown on the Drawings.

Gates shall be complete in every respect, and shall include hinges, washers, bolts and locking mechanism.

Materials for temporary fences

All new material for temporary fences shall be of the same quality as the material for new fences. Second-hand material, whether available on Site or purchased, shall be thoroughly inspected for defects before use. The protective galvanized coating on all second-hand fencing wires shall be intact, but barbs, diamond mesh, posts, standards, droppers and gates may have a rusty appearance provided that the rust is superficial and does not impair the structural strength of the items.

Concrete

Concrete used for fencing shall comply with the requirements of this Specification.

d) CLEARING OF FENCE LINE

Strip clearing for the fence shall be carried out and paid for in accordance with the BoQ.

e) INSTALLING POSTS AND STANDARDS

Straining posts shall be erected at all ends, corners and bends in the line of fencing and at all junctions with other fences. Straining posts shall not be spaced further apart than shown on the Drawings. The height of the posts above the ground shall be such that the correct clearance between the lowest wire and the ground can be obtained.

Posts shall be accurately set in holes and, where indicated, shall be provided with concrete bases to the dimensions shown on the Drawings.

Holes shall be dug to the full specified depth. Where, owing to the presence of rock, the holes cannot be excavated by hand or by pneumatic tools and the Contractor has to resort to the use of explosives, he will be paid separately for the drilling and blasting operations required.

Corner, gate, end and straining posts shall be braced by means of stays or anchors, as shown on the Drawings. Pipe stays shall be bolted to the posts. Gate posts shall not be used as straining posts, but at each gate post a straining post shall be placed as shown on the Drawings and stayed by means of an anchor consisting of six strands of wire.

Standards shall be firmly planted in the ground at the spacing shown on the Drawings or as directed by the Engineer. The spacing of standards between any two straining posts shall be uniform. In rock or hard material non-tubular standards shall either be driven or set in holes drilled into the rock.

The size of drilled holes shall be such that a tight fit is obtained. Care shall be taken not to buckle or damage the standards when driven. Where indicated, standards shall be provided with concrete bases to the dimensions shown on the Drawings.

All posts and standards shall be accurately aligned and set plumb. Where verandah-type security fencing is used, the posts and standards shall be planted with the overhang as shown on the Drawings and at right angles to the direction of the fence. After posts and standards have been firmly set in accordance with the foregoing requirements, the fencing wire shall be attached thereto as described below.

f) INSTALLING WIRE AND TENSION FENCING

All fencing wire shall be carefully stretched and hung without sag and with true alignment, and care shall be taken not to stretch the wire so tightly as to cause breaking, to pull up straining posts, or to be easily damaged during veld fires.

Each strand of fencing wire shall be securely fastened in the correct position to each standard with galvanized binding wire. The binding wire for each horizontal fence wire shall pass through a hole or notch in the standard, and the ends of the wire shall be wound at least four times around the fencing wire.

At the end, corner, straining and gate posts the fencing wire shall be securely wrapped twice around the post and secured against slipping by tying the end tightly around the wire by means of at least six snug, tight twists. In the case of high-tensile

wire, two long windings must first be made before the six tight twists to prevent the wire from breaking at the first twist. Where smooth wire is used, the loose end shall be bent back and hooked into the opening between the fencing wire and the first winding.

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

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

Tension fencing shall be installed according to the methods and with the special tools recommended by the manufacturer.

g) INSTALLING DROPPERS

Droppers shall be tied to each fence wire with binding wire in the required position to prevent vertical slipping. The spacing of droppers between any two standards shall be uniform. Droppers shall be suspended clear of the ground at a distance as shown on the Drawings.

h) INSTALLING DIAMOND MESH

Where indicated on the Drawings, diamond mesh shall be stretched against the fence and properly tied to the fencing wire. The diamond mesh shall be secured by means of binding wire at 1,2 m centres along the top and bottom wires and at 3 m centres along each of the other fencing wires, unless shown otherwise on the Drawings.

i) INSTALLING BARBED-TAPE CONCERTINAS

Barbed-tape concertinas shall be positioned on the fence as shown on the Drawings. The concertinas shall be fastened to the appropriate fencing wires at each standard as well as at 1,0 m maximum intervals between standards.

Rolls of barbed-tape concertinas shall be joined with binding wire at four points, spaced at equidistant intervals around the circumference of the loop. Joints shall be made to coincide with the positions of standards.

j) CLOSING OPENINGS UNDER FENCES

At ditches, streams, drainage channels or other hollows where the fence cannot follow the general ground contour, the Contractor shall close the opening under the fence by means of horizontal barbed wires 150 mm apart and stretched between additional straining posts as shown on the Drawings. The opening shall be covered with strips of diamond mesh, 1 000 mm wide, fixed to the barbed wires.

In the case of larger streams the opening below the lower fencing wire shall be closed by means of loose-hanging wire nets as shown on the Drawings. These mats shall be erected at streams only on the instructions of the Engineer.

k) EXISTING FENCES

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

Existing fences that are required to be taken down or moved to a new location shall be dismantled and shall either be re-erected to the same design as originally constructed, with such modifications as the Engineer may require, or shall be erected to one of the standards specified in clause 02 if so scheduled.

Material not required for re-erection or declared to be unsuitable for re-use shall be neatly stacked at approved locations in accordance with the Engineer's instructions. Fencing wire, mesh or netting shall be stacked clear of the ground.

In the case of existing fences that require moving, the Contractor shall, where possible, re-use all material found to be suitable for this purpose, and shall supply any such new material as may be required for re-erecting the fence to the standards specified for new fences.

The Contractor shall take extreme care when straining used wire to avoid unnecessary breakage.

l) TEMPORARY FENCES

At any time during the currency of the Contract, the Engineer may direct the Contractor to erect temporary fencing where necessary in order to prevent unauthorised access to the Works. Such fencing shall be of one of the types mentioned above and the type to be used shall be as scheduled.

Should material be available from fences that have been dismantled elsewhere on the Site, it shall be utilized, where possible, before additional new or second-hand material is acquired for completing the fence.

The fencing shall be maintained in good order during construction operations, and on completion of the Works it shall be removed from the Site. Wherever practicable, the Engineer may instruct that permanent and not temporary fencing be erected before construction operations commence.

Payment for temporary fencing around the Contractor's camp shall be included in the amount tendered for the Contractor's establishment on Site as specified section a) above.

m) INSTALLING GATES

Gates shall be installed at the positions indicated on the Drawings.

The gates shall be hung on gate fittings in accordance with the details shown on the Drawings. Gates shall be so erected that they swing in a horizontal plane at right

angles to the gate posts and clear of the ground in all positions. Double swing gates shall close to have a gap of not more than 25 mm between them, and other gates shall close to be not further than 25 mm from the gate post.

n) GENERAL REQUIREMENTS AND TOLERANCES

The completed fences shall be plumb, taut, true to line and to the ground contour, and with all posts, standards and stays firmly set.

The height of the lower fencing wire above the ground at posts and standards shall not vary by more than 25 mm from that shown on the Drawings. Other fencing wires shall not vary by more than 10 mm from their prescribed relative vertical positions.

Anchoring of a fence to structures shall be done as shown on the Drawings.

The Contractor shall, on completion of each section of fence, remove all cut-offs and other loose wire or mesh so as to leave the fence with a neat and finished appearance.

o) MEASUREMENT AND PAYMENT

Please see the Bid Documentation and the respective Bills of Quantities

C6.9 : EARTHWORKS

C6.9.1 : GENERAL

a) SCOPE

This section covers provisions of a general nature relating to all earthworks and trenching operations.

b) DEFINITIONS

For the purposes of this section in particular and these Specifications in general, the following words and expressions shall, unless inconsistent with the context, have the meanings hereby assigned to them.

Borrow area

An area within designated boundaries, which has been approved by the Engineer for the purpose of obtaining borrow material. A borrow pit is the excavated pit in a borrow area.

Borrow material

Any gravel, sand, soil, rock or ash used in the construction of the Works and obtained from borrow areas, stockpiles or sources other than excavations which form part of the Works, but excluding crushed stone and sand obtained from commercial sources.

Excavations

(i) Hand excavations

Excavations which, on account of their size, shape or location, or of the need to avoid damage to existing services or structures, cannot be made by means of trenching or by large excavating equipment and have to be made by hand tools, but shall exclude the trimming by hand of excavations to their final shape.

No excavations shall be classified as hand excavations unless designated as such in the Project Specifications or ordered by the Engineer to be a hand excavation.

(ii) Mass excavations

Excavations which by virtue of their size, will permit their construction by large equipment such as bulldozers, motor graders, scrapers, mechanical shovels, etc.

(iii) Structure excavations

Excavations intended purely for accommodating structures such as reservoirs, retaining walls, culverts and bridges or elements of such structures, such as foundations or wing walls. Structure excavations which could also qualify as trenches or mass excavations by virtue of their shape or size will nevertheless be classified as structure excavations.

iv) Trench excavations

Long narrow excavations, specified to have vertical sides, which can be excavated, ground conditions permitting, with equipment specifically designed for trench excavation. Trenches which qualify as mass excavations will be classified as mass excavations.

Excess overburden

Overburden within a borrow area, which is neither required nor suitable for use in construction.

Mass earthworks

Earthworks, which include mass excavations as defined above, and fills that can be constructed with equipment normally used for fills and layer work in road construction.

Overbreak

An inevitable excess excavation caused by the use of explosives or heavy construction equipment during excavation operations.

Selected material

Material obtained and selected from excavations, borrow pits or other sources to be used as bedding material for pipes and services, backfilling around and over pipes and services, the construction of certain pavement layers, and for the making of soilcrete.

Spoil

Material originating from construction operations, and which is not utilized for construction purposes. Material resulting from clearing site and surplus excavated material shall be removed to a designated on-site spoil area.

c) GENERAL REQUIREMENTS

Prior to starting any excavations, construction-bed preparations, or embankment and fill construction, the Contractor shall obtain instructions from the Engineer regarding any stripping of topsoil or any clearing and grubbing that may be required.

Excavations shall be made within the applicable tolerances to the dimensions specified or shown on the Drawings. In the case of excavations made in hard material, a certain amount of overbreak is inevitable but the Contractor shall include in his rates tendered for excavation, the costs in respect of the backfilling of over-excavated sections as a result of overbreak or excavation outside the specified limits.

The Contractor shall not import, remove from the Site, or waste any material without the Engineer's approval, and he shall arrange the construction of fills and the backfilling of trenches so as to make the best possible use of excavated materials. The necessary safety precautions as set out in herein shall be observed at all times.

d) SELECTION OF MATERIALS

The Engineer may instruct that particular materials from excavations or borrow areas be selected for a specific purpose. Where such selection is instructed, the method of excavation and the sequence of carrying out the work shall be so arranged as to avoid the contamination or waste or the double handling of selected materials.

If selected materials are contaminated or used incorrectly or if they become unavailable through the injudicious planning of excavation operations, the Contractor shall be required to replace the shortfall with material of at

e) BORROW MATERIAL

Where sufficient quantities of suitable material cannot be obtained from the excavations or trenches to complete certain work, additional material shall be imported from borrow areas or other sources designated in the Project Specifications or by the Engineer.

Should borrow areas not be provided by the Employer for this Contract, the Contractor shall supply the necessary material from sources obtained by him. The following provisions shall apply in respect of borrow material obtained from sources provided by the Contractor, including material obtained from commercial sources:

- (e.1) Samples of all such material shall be submitted to the Engineer for approval before the material is brought onto the Site.
- (e.2) No haulage will be payable to the Contractor and the cost of transporting such material from its source to its final point of use shall be deemed to be included in the rates tendered for imported material.

- (e.3) The material will not be classified for purposes of excavation and breaking down, and no extra over-payment will apply in respect of material excavated in intermediate, hard or boulder formations.
- (3.4) Tendered rates shall include for all royalties and other charges whether in cash or in kind to be paid by the Contractor to the owner of such borrow material.
- (e.5) No payment will be made for removing overburden, bringing it back after completion of borrow operations, for stockpiling such material unless so ordered by the Engineer, for providing haul roads and for restoring the borrow area to the condition required by the owner.
- (e.6) The Contractor shall comply with the Mineral and Petroleum Resources Development Act, 2002 (Act No 28 of 2002) and its supporting Regulations, in respect of borrow material obtained from sources provided by him.
- Compliance with the provisions of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) and its Regulations does not necessarily guarantee that the Contractor is in compliance with other Regulations and legislation. Other legislation that may be immediately applicable includes, but are not limited to:

- National Monuments Act, 1969 (Act 28 of 1969)
- National Parks Act, 1976 (Act 57 of 1976)
- Environmental Conservation Act, 1989 (Act 73 of 1989)
- National Environmental Management Act, 1998 (Act No 107 of 1998)
- Atmospheric Pollution Prevention Act, 1965 (Act 45 of 1965)
- The National Water Act, 1998 (Act 36 of 1998)
- Mine Safety and Health Act, 1996 (Act 29 of 1996)
- The Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983).

Tendered rates shall also include full compensation for any costs or charges in complying with the above legislation by the Contractor.

Where borrow areas are provided by the Employer, the plans of borrow pits will be included in the Documents. The information shown on these plans reflects the results of Site investigations and laboratory tests and is furnished in good faith as to the material being of sufficient quantity and adequate quality. Should it therefore appear at any time during construction that the quantity of material in such borrow area is insufficient or its quality inadequate and should the Employer have no other borrow areas available, the Contractor shall make use of approved sources found by himself.

Prior to opening a borrow pit or extending an existing borrow pit belonging to the Employer, the Contractor shall obtain from the Engineer written instructions regarding the removal of topsoil and excess overburden, and any clearing and grubbing that may be required. The measurement of excess overburden shall be made only after the removal of topsoil and any clearing and grubbing if required. Clearing and grubbing and the removal of topsoil shall be measured and paid for in accordance with the provisions of the BoQ.

No contaminated material may be brought onto the Site. The Contractor shall exercise the necessary control in this respect during the loading of material from borrow pits.

On completion of his operations in the borrow areas provided by the Employer, the Contractor shall reinstate the entire area to blend with the surrounding area and so as to be suitable for the re-establishment of vegetation. For this purpose the borrow area shall be shaped to even contours with no slopes steeper than 1 in 2. Material which is incapable of supporting vegetation shall be buried and used for shaping the borrow area and shall be subsequently covered with material capable of supporting vegetation if available.

All haul roads shall be obliterated and their surfaces scarified, earth banks constructed to prevent erosion, and damaged fences reinstated.

The rates tendered for the various items of work for which borrow materials are used shall include full compensation for procuring and supplying borrow material and also, in the case of borrow areas provided by the Employer, for the final shaping and finishing off of the borrow areas, the reinstatement of fences, the prevention of erosion, and the obliterations of haul roads.

f) SURPLUS MATERIAL

Any surplus material produced by excavations, including waste or oversize material, shall be disposed of as directed by the Engineer, who may require that the material be somehow utilized in the Works or that the material be removed from the Site.

If the Employer does not provide spoil sites, this will be specified in the Project Specifications and it shall then be the responsibility of the Contractor to find the necessary spoil sites for material removed from the Site. All such spoil sites are to be approved by the Engineer in writing and the written consent of the owner shall be submitted to the Engineer. The rates tendered under the relevant sections for the removal of such material to spoil shall include full compensation for all haulage and for reinstating the spoil area.

Surplus material produced by trench excavations and carted to spoil shall be measured and paid for as follows

(f.1) Trenches for pipes with a diameter of 300 mm and less:

The volume of spoil shall be taken as being equal to the authorized volume of soil or gravel backfill material imported from outside sources.

(f.2) Trenches for pipes with a diameter exceeding 300 mm and for culverts:

The volume of spoil shall be determined as in (a) above, plus the volume occupied by the pipe or culvert.

The volumes occupied by beddings, encasings, manholes, junction boxes, etc, shall not be used for determining the amount of material carted to spoil.

The carting to spoil of surplus material produced by additional excavations, the excavation of tunnels, and excavations for subsurface drains in trench bottoms shall be deemed to be included in the rates tendered for such excavations.

When material for earthworks and layerwork is either oversize or otherwise unsuitable for use -

- because it has not been properly excavated to ensure adequate breaking down in the borrow pit or in excavation; or
- because it has not been properly selected or has been contaminated; or
- because careless excavation has spoilt the material for its intended final use;

it shall be removed from the Works and carted to spoil and, except as provided below, no payment shall be made in respect of the removal of such material to spoil. Where there is a local surplus of material from excavations other than trenches and material is also present which is unsuitable or oversize for the reasons set out above, the material removed shall be paid for as excavation to spoil to the extent of such local surplus of material.

Other oversize material removed from the Site shall, subject to the provisions of this clause, be paid for as specified herein.

Any soft material which the Engineer requires to be tipped over the sides of rock fills without further shaping or finishing shall be classified as excavation to spoil, but if shaping and finishing is required, material shall be classified as excavation to fill, and all such material shall be measured and paid for in addition to fill measured according to the net specified dimensions of the road, parking area or embankment.

g) STOCKPILING OF MATERIALS

Where materials from excavations cannot be placed directly in their required positions or cannot be temporarily stockpiled alongside the excavation such as in built-up areas, the Engineer may authorize their removal to temporary stockpiles. Stockpile sites shall be approved by the Engineer and shall be cleared prior to being used. The temporary stockpiling of all materials within or outside the free-haul boundaries shall be at the Contractor's own cost unless otherwise specified in the Project Specifications.

Overhaul will be paid on materials transported to and from authorized stockpiles, provided that the stockpiles are situated outside the free-haul boundaries.

The material shall be stockpiled in successive layers over the full stockpile area to the approximate dimensions required by the Engineer and shall subsequently be reloaded and placed.

Topsoil shall be stockpiled in separate loose heaps as tipped from the trucks and shall not be stockpiled higher than 2,0 m unless otherwise ordered.

Stockpiling, when specified or authorized in writing, shall be paid for in the case of topsoil, and in accordance with this section in the case of other material.

Where selected material and topsoil are stockpiled temporarily within a borrow-pit area, this operation shall not be paid for separately as temporary stockpiling but shall be deemed to be part of the obligations described in clause 05 of this section.

Selected material from trenching operations shall preferably be placed alongside the trench, separate from the other excavated material. Should sufficient space not be

available alongside the trench, the selected material shall be removed to stockpile sites when authorized by the Engineer.

h) PLANT

Plant and equipment used in the various construction activities shall be suitable for achieving the required end result under the condition applicable to the Site.

i) MEASUREMENT AND PAYMENT

Please see the Bid Documentation and the Bill of Quantities.

C6.10 : EARTHWORKS

C6.10.1 : TRENCHING

a) SCOPE

This section covers all work in connection with trenching for pipelines, ducts, culverts, cables and subsurface drains.

Where the dimensions of a trench allow bulldozers and motor graders to be used effectively for doing the excavations, the operation will be classified as mass earthworks as specified in section below whether or not trenching equipment is used.

b) GENERAL

The Contractor shall examine the route of the proposed trench well in advance of construction to determine whether the route is clear. Should he encounter unforeseen permanent obstacles such as buildings, swimming pools, etc, he shall immediately inform the Engineer thereof with a view to solving the problem without causing undue delay to construction activities. Where such investigations are made on private property, the Contractor shall adhere strictly to the requirements laid down in the BOQ.

Clearing and grubbing shall be carried out as specified, and the width of the strip to be cleared will be indicated in the Project Specifications or by the Engineer on Site. Where fences, precast walling, paving and other improvements to properties are to be temporarily removed from the line of the trench, they shall be carefully dismantled or lifted and stored, and later re-erected at or repositioned in the same place and in the same condition as before their removal. Material damaged by the Contractor shall be replaced at his own cost.

Except for trees with a girth exceeding 1,0 m, no separate payment will be made for such clearing and grubbing or temporary removal of improvements unless otherwise specified in the Project Specifications, and the cost thereof shall be included in the rates tendered for excavation.

The removal of trees with a girth exceeding 1,0 m will be paid for under appropriate bill items and the girth shall be measured as specified.

Where trenches are to be made in servitudes or designated areas of specified width, the Contractor shall confine all his construction activities to within the limits of such servitudes unless permission to encroach on his property has been obtained, in writing, from the owner, lessee or occupier.

The owner, lessee or occupier shall be afforded a reasonable time to remove any small trees, shrubs or other plants as well as improvements from the servitude should he wish to do so. Trees with a girth exceeding 300 mm shall not be removed by the Contractor without the written permission of the Engineer.

Before excavation may be started, the Contractor shall notify the Engineer, that the strip has been cleared, to enable the latter to obtain the necessary ground levels for measurement purposes.

The Contractor shall be responsible for maintaining accesses over trenches where applicable, in which regard he shall comply with the relevant requirements.

The Engineer reserves the right to limit the length of excavation of trenches in advance of pipe-laying and backfilling operations.

Where trenching, pipe-laying operations and culvert construction are carried out in built-up areas, the work shall be completed as quickly as possible so as not to unduly inconvenience the public. Payment for work carried out under this section as well as under sections 106, 302, 402 and 502 regarding such trenching, pipe-laying operations and culvert construction will only be made once the work has been completed and the surface has been reinstated as specified. The sections of trench affected by this requirement will be indicated in the Project Specifications.

c) CLASSIFICATION OF MATERIALS EXCAVATED

The materials excavated shall be classified as follows for payment purposes:

- **Soft material:**

Material that can be efficiently removed by a back-acting excavator of flywheel power approximately 0,10 kW per millimetre of tined-bucket width, without the use of pneumatic tools such as paving breakers.

- **Intermediate material:**

Material that requires a back-acting excavator of flywheel power exceeding 0,10 kW per millimetre of tined-bucket width or the use of pneumatic tools before removal by equipment equivalent to that specified above for soft material and shall include boulders of up to 0,15 m³.

- **Hard material:**

Material that cannot be efficiently removed without blasting or without wedging and splitting as well as boulders exceeding 0,15 m³.

Notwithstanding the above classification, all material excavated from previously constructed fills, embankments, pavement layers and from above existing services shall be classified as soft material.

The expression "efficiently removed" shall be taken to mean removed in a manner that can reasonably be expected from the equipment in question, having regard to the production achieved.

In the first instance the classification shall be based on inspection of the material to be excavated and the method of excavation proposed by the Contractor. In the event of disagreement between the Contractor and the Engineer, the Contractor shall, if required, make available such mechanical equipment as specified above in order to test the reasonable removability or otherwise of the material. The decision of the Engineer as to the classification shall thereafter be final and binding.

The Contractor shall immediately inform the Engineer as and when the nature of the material which is being excavated changes to the extent that a new classification for further excavation is warranted. Failure on the part of the Contractor to advise the Engineer in good time shall entitle the Engineer to classify, at his sole discretion, any material of a different nature which may have been excavated.

d) EXCAVATION

The type of excavation shall be classified in accordance with the definitions given herein based on the methods and equipment normally used irrespective of whether or not such methods and equipment have actually been used.

Trench excavations

Unless otherwise specified or shown on the Drawings, the width of trenches for single pipes and precast culverts shall be the authorized trench widths as determined below and will be used to calculate the quantities of material excavated. Excavations in excess of these predetermined widths will not be measured for payment and excavations narrower than these widths will only be allowed with the written approval of the Engineer.

The authorized trench widths shall, irrespective of the type of pipe or precast culvert and the type of bedding and floor slab, be determined by the following formula:

$W = B + 2S$ where

W = the authorized width

B = the outside diameter of the pipe or the external width of the culvert

S = the working space on each side of the pipe or culvert measured between the external surface of the conduit and the side of the trench.

For the purpose of these Specifications, S shall be allotted the following values:

S = 200 mm for values of B equal to or less than 620 mm and will apply to all pipes and culverts

S = 250 mm for values of B in excess of 620 mm
and will apply only to water pipes

S = 450 mm for values of B in excess of 620 mm
and will apply to all culverts and pipes with the
exception of water pipes.

The above formula and values of S will only apply to portal and rectangular culverts if the subsequent backfilling is done using natural gravel and reference shall be made to the details herein for trench widths applicable when backfilling with concrete or soilcrete.

The width of trenches for pipes encased in concrete or soilcrete or for multiple pipes or culverts shall be as specified in the relevant sections of these Specifications or as shown on the Drawings.

The Contractor may side-slope or bench the trench from a point above the top of the pipe at his own expense in compliance with the Construction Regulations 2003.

The depth of excavations shall be as specified or shown on the Drawings or as indicated by the Engineer on Site. Trenches for water pipes shall, unless otherwise specified, be excavated at a constant depth to follow the general surface contours wherever possible.

The cost of trimming excavations by hand or machine shall not be paid for separately but shall be included in the rates tendered for excavation.

The Contractor shall maintain the correct line and grade throughout the work. The trench shall be straight along the centre line and between pegs, where applicable. Between pegs the bottom shall be carefully graded and tested by sight rails and boning rods or other approved means. Trenches shall, except where otherwise indicated or permitted, or in the case of a statutory requirement, be excavated with vertical sides without any undercutting of the sides.

All excavated material shall be kept within defined limits and shall, wherever possible, be deposited alongside the trench. The material shall be deposited so as to leave a clear strip of at least one metre between the edge of the trench and the excavated material and shall not cause undue inconvenience to traffic and property owners. The material shall be placed and kept well clear of all manhole covers, culvert in- and outlets, fire hydrants, bench marks, stand pegs, fences, etc.

To prevent vertical trench walls from collapsing, excavated material shall, wherever possible, not be stacked on the side where underlying strata slope down towards the trench and in this regard, attention is specifically drawn to the shales sloping south to north in the Pretoria area.

Hand excavations

Where the use of conventional excavating equipment is either unpractical or likely to cause damage to services, trees or property, the Contractor shall advise the Engineer

thereof, who may then instruct, in writing, that the excavations be made by means of hand labour and paid for as hand excavation.

Excavations outside the normal trench profile

Excavations outside the normal trench profile, which are necessary for the removal of unsuitable material at founding levels, for accommodating structures such as manholes, valve chambers, junction boxes, thrust blocks, draw pits, catchpits, wing walls, and that portion of the sewer-house connections between the junction with the main sewer and its point of connection with the sewer from the property, will be measured and paid for separately from trench excavations. These excavations may be made by means of excavating plant wherever practicable, or otherwise by hand, in which case it shall not be classed as hand excavation. Excavations for handholes to accommodate pipe joints will not be included in payment for excavations outside the normal trench profile.

Mass earthworks

Where pipes are to be installed at a level lower than the level of any mass earthworks that have to be carried out for the purpose of constructing a structure or a road, the trenching and pipework shall, if so specified in the Project Specifications, be carried out after the mass earthworks have been completed.

e) TOPSOIL

The topsoil shall be removed from over the full width of the trench to a depth of 300 mm or to the actual depth of topsoil where subsoil or rock occurs closer than 300 mm to the existing natural surface. On completion of backfilling, the topsoil shall be replaced in its original position.

Topsoil is the property of the land owner and shall be kept separate from the subsoil. No separate payment shall be made for the removal and returning of topsoil, allowance for which shall be made in the rates tendered for excavation.

f) TIMBERING AND SHORING

The Contractor shall provide all the timbering, strutting and shoring required in terms of the Construction Regulations 2003 for the safety of the excavations and structures adjacent to the trenches, and shall be solely and wholly responsible for ensuring the adequacy of these measures for this purpose.

Without in any way affecting or detracting from the Contractor's responsibility, the Engineer shall have the right to instruct the Contractor to provide additional or improved timbering, shoring or strutting where he considers this to be necessary. The Contractor shall have no claim for additional payment on this account.

The shoring method adopted shall be compatible with the soil type and the excavating, backfilling and pipe-laying methods adopted and shall not place any undue restrictions on the laying of the pipes.

Timbering and shoring shall be left in position until the Engineer has authorized their removal.

Unless otherwise indicated in the Project Specifications, no separate payment shall be made for timbering and shoring, except where they are left in the excavations in accordance with instructions. The specified trench width shall be the clear width between the timbering and shoring. Any extra excavations required for the timbering and shoring shall be included in the rates tendered for excavations.

As an alternative to timbering and shoring, the Contractor may, where sufficient space is available and where the safety of nearby services and structures is not jeopardized, elect to slope the sides of the trench from a point above the pipe as mentioned in clause 04, and he shall also make allowance for such additional work in the tendered rates for excavation and backfilling.

g) TUNNELS AND BOLSTERS

The Contractor shall be permitted to tunnel underneath obstructions such as trees, walls, etc, provided that he has obtained the Engineer's written approval, the trench is of sufficient depth, and the in situ material is suitable for tunnelling. No blasting will be allowed for the excavation of tunnels and bolsters. Tunnelling will not be paid for as hand excavation.

The tunnel or bolster shall have the same width as the trench and shall have a minimum vertical height of 1 200 mm above the pipe. Tunnels and bolsters shall be properly timbered and shored where necessary.

Where a pipeline passes through a tunnel or bolster, the pipe shall, after having been tested, be encased in concrete or soilcrete as may be instructed by the Engineer, after which the tunnel or bolster shall be filled with hand-packed stones having a maximum dimension of 300 mm. The stones shall be so packed as to provide a minimum of voids. Voids remaining in the stone packing shall be filled with dry sand, as the packing proceeds. Payment will be made under the applicable pay items of this section.

A tunnel with a length of 4,5 metres or less shall be designated as a bolster and shall be paid for as an open trench, and a tunnel with a length in excess of 4,5 metres shall be paid for as a tunnel.

The minimum distance between two consecutive tunnels or bolsters shall be 3,0 metres.

h) EXCESS EXCAVATIONS

Should the Contractor for any reason whatsoever excavate beyond the limits of the authorized dimensions, he shall, at his own cost, carry out the additional backfilling that will be required as a result of such excess excavation, and shall use the same material that has been used for the rest of the trench at the level in question. Where the trench has been excavated deeper than the required depth, the bottom shall be reinstated to the correct level.

i) PREPARATION OF TRENCH BOTTOMS

Trench bottoms in hard material shall be cleared of all rock projections and of all rock fragments and particles of hard material. Poor founding material shall be removed to depths determined by the Engineer.

The trench bottom shall then be reinstated to the required level with selected gravel material compacted to 90% of modified AASHTO density, with concrete aggregate having a maximum size of 38 mm, with class 1:3:6/19 concrete, or with soilcrete as may be instructed by the Engineer in each case. Such reinstatement will not be paid for in the case of overbreak or where poor founding conditions have been caused by the Contractor's negligence.

Where selected gravel material is used to replace poor founding material, the gravel shall be compacted in layers not exceeding 100 mm of compacted thickness.

The minimum selected gravel bedding thickness for trenches in hard material is 150 mm.

Where trench bottoms consist of loose in situ gravel material, they shall be thoroughly compacted to the Engineer's approval to provide a firm floor. Trench bottoms shall be hand-trimmed to final levels and grades immediately before pipe beddings are placed or pipes are laid.

No separate payment will be made for the preparation of trench bottoms, except where material is imported to fill excess excavations authorized by the Engineer.

j) EXCAVATIONS FOR PIPE JOINTS

If necessary, accurately located recesses shall be cut into trench bottoms to accommodate pipe joints. Such recesses shall be properly shaped and sized to facilitate jointing. Recesses for pipes to be welded together in the trench shall provide a clear space of not less than 0,5 m below the pipes. Payment for making such recesses shall be included in the tendered rates for the supply, installation, joining and testing of the various types of pipes and fittings.

k) DEALING WITH WATER

Water that may be encountered during the trenching operations shall be dealt with as set out herein. The Engineer may instruct the Contractor to provide a layer of 38 mm maximum size concrete aggregate below the bedding to serve as a drain to dispose of excess water. The thickness of the layer shall be determined on Site by the Engineer.

In the case of trenches for sewer pipes, the Engineer may instruct the Contractor to install a subsurface drain below the bottom of the trench, which shall consist of 150 mm diameter vitrified clay pipes of commercial quality (known as irrigation or rejected pipes), surrounded by 19 mm crushed stone in a 300 mm x 300 mm trench. The position of the drain in the trench shall be as shown on the Drawings or as determined by the Engineer.

If required by the Engineer, the Contractor shall leave portions of the trench unexcavated to prevent the flow of water down the trench. These bulkheads shall be at least one metre thick and shall be spaced as directed by the Engineer. No

additional payment over and above normal excavation rates will be made for leaving these bulkheads temporarily unexcavated.

l) SOILCRETE

Soilcrete shall consist of an approved soil or gravel mixed with 5% cement of the type as specified in section 704 and only sufficient water to give it a consistency that will permit the soilcrete to be so placed, with the use of vibrators, as to properly fill all voids between the pipes and the sides of excavations.

The aggregate used for soilcrete shall preferably be a sandy material but may contain larger particles up to 38 mm and its plasticity index shall not exceed 10. Harmful percentages of silt or clay shall be avoided and the aggregate shall be obtained from an approved source.

The soilcrete shall be mixed on Site by means of suitable concrete mixers. The water and cement contents shall be carefully controlled during mixing. The material shall be placed and then thoroughly compacted by means of concrete vibrators so as to fill all voids as described above.

m) BACKFILLING

The backfilling of trenches to a point 300 mm above the tops of pipe barrels (200 mm in the case of water pipes) shall be carried out as specified in the relevant sections of these Specifications.

Further backfilling shall be done with approved excavated material, which shall not contain any stones larger than 150 mm. Backfilling shall, in the case of pipes on a class A concrete bedding, not be commenced before the concrete has attained a compressive strength of at least 15 Mpa. For other concrete beddings, further backfilling may commence 3 days after the backfilling over the pipes has been completed. All backfill material shall be compacted to 90% of modified AASHTO density in layers not exceeding 150 mm in compacted thickness and with the use of vibratory equipment.

Topsoil previously set aside shall be replaced as a final layer on top of the backfilling leaving the material 100 mm proud of the original ground surface to allow for settlement.

During the contract period and also during the defects liability period, the Contractor shall make good promptly and at his cost any settlement that may occur in the surfaces of roads, sidewalks, private or public property, etc, caused by his trenches. He shall be liable for any accidents caused by it and shall repair, at his cost, any damage to property.

The backfilling of culverts shall be carried out as specified.

n) TRENCHES WITHIN ROAD RESERVES

In this clause the word side-way denotes the area between the edge of a road and the boundary of the road reserve.

Where trenching operations are carried out in a roadway, at least half the roadway shall remain open to traffic at all times and where trenching is carried out on side-ways, safe, uncluttered thoroughfares shall be provided for pedestrians.

Where the temporary closing of any road to vehicular traffic is required in exceptional circumstances, the requirements set out in clause 11 of section 001 shall be adhered to.

Before construction equipment is allowed onto surfaced roadways or paved side-ways, the Contractor shall obtain approval from the Engineer for his proposals of how he intends operating his equipment without causing damage to the road and side-way surfaces. Such proposals shall include the following:

- the use of gravel, wood, tyres, etc as ramps where kerbs have to be negotiated;
- the use of tyres and rubber mats where crawler-tracked equipment is used;
- the placing of wooden blocks under the hydraulic stabilizing arms of excavators, cranes, etc;
- the tined buckets of excavating equipment shall be placed on wooden blocks when fully lowered; and
- loading equipment shall be fitted with buckets without tines and shall be used to remove dumped material to a minimum of 200 mm above a paved surface. The remaining 200 mm of material shall be removed by means of hand labour.

The Contractor shall at his own cost adhere to the approved proposals and will be held liable for repairing the damage caused by his equipment to surfaced roads, paved side-ways, kerbing, etc and restoring them to their original condition.

Before excavations are made in a surfaced roadway or paved side-way, the width of the trench or such other width as may be agreed on by the Engineer, shall be marked on the surface and the surfacing material or in situ concrete paving shall be neatly cut along the markings, to avoid any overbreak of the surfacing or paving beyond the limits agreed on. Paving units shall however not be cut but shall be lifted as near as possible along the markings and stored for re-use. The cost of removing surfacing and paving material shall be deemed to be included in the rates tendered for trenching.

Where services and culverts are to be installed across or along new roads that are under construction, such work shall be completed before the subbase layer is constructed.

The excavating and backfilling of trenches in road reserves shall be carried out as specified above except that the material shall be compacted during backfilling to the density specified hereafter.

Where excavated material cannot be temporarily placed alongside the excavation, the material shall be stockpiled as already specified herein.

The backfilling in respect of gravel roads shall be compacted to 93% of modified AASHTO density and shall be taken to the level of the existing road surface or, in the case of new roads under construction, to the top of the subgrade.

The backfilling in respect of surfaced roads shall also be compacted to 93% of modified AASHTO density and shall be taken up to a level 500 mm below the existing road surface. Selected material, stabilized by the addition of a quantity of cement of the type as specified in section 704 equal to 3% of the dry mass of the gravel and compacted in three 150 mm thick layers to 95% of modified AASHTO density shall be used to backfill the balance of the trench to a level 50 mm below the existing road surface.

The remaining 50 mm shall be filled with asphalt after the stabilized surface and the cut sides of the existing surfacing have been primed with a 60% anionic bituminous emulsion.

The asphalt shall be supplied by the Contractor and shall conform to the requirements for medium grade, continuously graded asphalt as specified. The asphalt shall be placed and thoroughly compacted by means of vibratory equipment and shall be finished off flush with the existing road surface.

If for some reason the remaining 50 mm cannot be filled immediately with asphalt, approved excavated material shall be used as a temporary measure, enabling the road to be opened to traffic as soon as possible. This temporary backfill shall be well compacted and maintained until the asphalt can be placed. Before priming is done and the asphalt placed, all traces of the temporary material shall be removed.

The backfilling of trenches in paved side-ways shall be carried out as specified for trenches in roadways and the compaction to 93% of modified AASHTO density shall be taken to below the paving material with due allowance, where applicable, for the thickness of the sand bedding layer.

The paving blocks or slabs shall be replaced as specified in section 609 and in situ concrete paving as specified. Payment will be made under item 609.05 for replacing blocks or slabs and under the respective items for in situ concrete paving.

After completion of the work in road reserves, the Contractor shall repaint in the manner specified in section 613, any traffic markings that have been damaged or obliterated. Payment for repainting traffic markings will be made under the applicable items.

o) TOLERANCES

A tolerance of plus or minus 25 mm in respect of the required level of the trench bottom shall be the maximum deviation allowed. The maximum permissible deviation in plan shall be 25 mm, whereas the grade of the trench shall be within the same tolerance limits as the service for which it is excavated.

Where trenches are deepened or widened to accommodate structures, etc, as mentioned in clause 04, the tolerance limits of the excavations shall be the same as those of the structures, etc, in so far as invert level and plan are concerned.

p) MEASUREMENT AND PAYMENT

Both these activities shall be undertaken as per the Bill of Quantities.

C6.11 : EARTHWORKS

C6.11.1 : MASS EARTHWORKS

a) SCOPE

This section covers the construction of mass earthworks. It mainly covers the construction of cuttings and embankments for road and railway construction up to the underside of the pavement or the sub ballast layers, and the construction of large excavations and embankments for other works such as sports fields.

b) DEFINITIONS

For the purposes of this section in particular and these Specifications in general, the following words and expressions shall, unless inconsistent with the context, have the meanings hereby assigned to them.

(i) Construction bed

The natural material on which fills or, in the absence of fills, pavement layers are constructed.

(ii) Cut or Cutting

A large excavation, in mass earthworks, usually for the purpose of accommodating a road or railway line.

(iii) Embankment

A structure consisting of imported material, usually rock, soil or gravel, and built above the natural ground level.

(iv) Fill

That portion of an embankment below the pavement, subballast or topsoil layers.

(v) Fill material

Material used in the construction of an embankment up to the underside of the pavement, subballast or topsoil layers.

(v) Girade line

The grade line is a reference line shown on the Drawings of the longitudinal sections of the road or railway line which at regular intervals indicates the elevations according to which the road or railway line is to be constructed. The grade line may refer to the surface level of the completed road or railway line, the base, fill or subballast and may indicate the elevations either along the carriageway or railway centre line or along any designated position on the cross-section.

(vi) Pavement layers

The upper layers of a road or parking area comprising the subgrade, subbase, basecourse and surfacing.

(vii) Pioneer layer

An initial layer constructed over a weak construction bed where selected material is used to provide a stable surface for the construction of subsequent layers.

(viii) Roller-pass or pass

One pass of a roller comprising a single coverage of the drum of a roller with only sufficient overlap to ensure that no area is left uncompacted.

(ix) Side drain

An open longitudinal drain situated adjacent to and at the bottom of cut or fill slopes.

(x) Slope

Unless otherwise stated, slope is expressed in terms of the ratio of the vertical difference in elevation between any two points and the horizontal distance between them. This ratio may also be expressed as a percentage.

c) MATERIALS

In situ materials

In situ materials in construction beds and excavations have been tested, and the results of the tests are shown on the Drawings. The test results, read in conjunction with these Specifications, give a preliminary indication as to the purposes for which excavated material may be used and the treatment, if any, to be given to the construction bed. During construction the Engineer shall give final instructions regarding the use of excavated material and the treatment of the construction bed.

Fill

Fill material shall conform to the requirements specified below.

- (i) The material shall contain no rock fragments with a maximum dimension exceeding 750 mm, unless otherwise authorized by the Engineer.
- (ii) The minimum CBR at a specified in situ density shall be as follows:

Depth below final fill level	Minimum CBR
0 m to 9 m	3
9 m to 12 m	5

By way of a written instruction the Engineer may allow or order the use of material not meeting these requirements, provided that he has satisfied himself regarding the stability of the fills to be constructed from such material and provided further that the minimum CBR of the material at 100% AASHTO density exceeds 3.

The requirements in respect of material in the lower layers of fills which exceed 12 m in height shall be set out in the Project Specifications.

- (iii) Compaction requirements, minimum in situ dry density.

- When compacted to a percentage of modified AASHTO density
90%
- When compacted by proof rolling 98% of proof density
- Rockfill no density specified

Sands which for the purposes of this requirement are specified as being non-plastic and, of which not less than 95% passes through a 4,75 mm sieve, shall be compacted to 100% of modified AASHTO density.

d) CLASSIFICATION OF EXCAVATED MATERIAL

Classes of material

The material from excavations and borrow shall be classified as follows for purposes of measurement and payment.

(i) Soft material

Material which can be efficiently removed or loaded, without prior ripping, by any of the following plant:

- A bulldozer having a mass, including the mass of a ripper if fitted, of 22 t and flywheel power of approximately 145 kW;
- or
- a tractor-scraper unit having a mass of approximately 28 t and flywheel power of approximately 245 kW, pushed during loading by a bulldozer equivalent to that specified in subclause 04.01(b);
- or
- a track-type front-end loader having a mass of approximately 22 t and flywheel power of approximately 140 kW.

(ii) Intermediate material

Material which can be efficiently ripped by a bulldozer of approximately 35 t mass when fitted with a single-tine ripper, and having a flywheel power of approximately 220 kW.

(iii) Hard material

Material which cannot be efficiently ripped by a bulldozer equivalent to that described in subclause 04.01 (b).

This material generally includes formations of unweathered rock, which can only be removed after blasting.

(iv) Boulder material Class A

Material containing more than 40% by volume of boulders between 0,03 m³ and 20 m³ in size in a matrix of softer material or smaller boulders.

Dolomite formations other than solid dolomite shall also be classed as Class A material if the formation contains more than 40% by volume of lumps of hard

dolomite between $0,03 \text{ m}^3$ and 20 m^3 in size in a matrix of soft material or smaller lumps of hard dolomite.

Solid boulders or lumps of hard dolomite in excess of 20 m^3 in size shall be classed as hard material. Fissured or fractured rock shall not be classed as boulder material but as hard or intermediate material according to the nature of the material.

(v) Boulder material Class B

Where a material contains 40% or less by volume of boulders or lumps of hard dolomite ranging between $0,03 \text{ m}^3$ and 20 m^3 in size, in a matrix of soft material or smaller boulders or lumps of hard dolomite, then those boulders or lumps of hard dolomite between $0,03 \text{ m}^3$ and 20 m^3 in size shall be classed in Class B boulder material.

The rest of the material shall be classed as soft or intermediate material according to the nature of the material.

All the equipment specified in subclauses (a), (b) and (c) above shall be in a good mechanical condition. The expressions "efficiently ripped", "efficiently removed" or "efficiently loaded" as used in this subclause shall in this context be taken to mean ripped, removed or loaded (as the case may be) in a manner than can reasonably be expected of the equipment in question having regard to the production achieved.

Method of classifying

The Contractor shall be at liberty to use any method he wishes to excavate any class of material, but the method of excavation shall not dictate the classification of the material.

The Engineer shall decide under which one of the classes excavated material shall be classified and paid for.

In the first instance the classification shall be based on inspection of the material to be excavated and the method of excavation proposed by the Contractor. In the event of disagreement between the Contractor and the Engineer, the Contractor shall, if required, make available at his own cost, such mechanical equipment as specified in subclauses 04.01 (a) and (b) in order to test the reasonable removability or otherwise of the material. The decision of the Engineer as to the classification shall thereafter be final and binding.

The Contractor shall immediately inform the Engineer as and when the nature of the material which is being excavated changes to the extent that a new classification for further excavation is warranted. Failure on the part of the Contractor to advise the Engineer in good time shall entitle the Engineer to classify, at his sole discretion, any material of a different nature which may have been excavated.

e) CLASSIFICATION OF COMPACTION

For purposes of measurement and payment, the method of processing and the compaction of material shall be classified as described below. The Engineer shall, except in the case of compaction to a minimum percentage of proof density, decide

in advance on the classification of compaction to be employed, and the classification of material for purposes of excavation shall have no bearing on the classification of the compaction of material.

Compaction to a minimum percentage of proof density shall be carried out only after a written request by the Contractor to use this type of classification has been received and approved by the Engineer.

Compaction to a minimum percentage of modified AASHTO density

Wherever a density requirement for a soil or gravel layer is specified in terms of a percentage of modified AASHTO density in these Specifications or on the Drawings or in the Project Specifications or when directed by the Engineer, the Contractor shall be at liberty to employ any type of compaction equipment he may prefer in order to achieve the required density over the full specified depth of the layer, always provided that he complies in all respects with the general requirements of these Specifications, and that the equipment employed is adequate and suitable for the purpose and is in no way detrimental to any part of the Works.

f) PLACING AND COMPACTION

General

This clause covers the placing, breaking down, watering, mixing and compaction of natural gravel materials by conventional construction techniques.

Spreading of materials

All materials which are deposited in place prior to compaction shall be evenly spread over the entire area designated for the layer concerned and in a quantity that will give the thickness of any one layer which, when measured after compaction, shall comply with the specified requirements.

A new layer of less than 75 mm of compacted thickness shall be bonded to the previous layer by the previous layer being scarified to a depth of not less than 25 mm, or to such greater depth as to give a total compacted thickness of the new layer plus the scarified portion of the previous layer, of not less than 100 mm.

Breaking down and preparation of the material

All material used in the construction of the fill shall be reduced to a maximum size of 750 mm in the excavation or the borrow pit by cross ripping, secondary blasting or other suitable means if necessary, before any breaking down on the fill is attempted.

Once reduced to this size, the material shall be either processed and broken down as described below, or it shall be utilized directly in rock-fill construction, all as instructed by the Engineer.

No separate payment shall be made for any breaking-down as described above, and the cost of such breaking-down, which shall include any secondary blasting, shall be included in the rates tendered for the construction of fill layers.

Excavated material not required for the construction of the Works, need only be broken down sufficiently to facilitate handling and so as not to be unsightly where it is finally deposited in spoil.

The material shall be broken down to a size not exceeding the compacted thickness of the fill layers. The thickness of the fill layers will depend on the size to which the material can be broken down by the specified techniques and will be decided on the Site by the Engineer.

To prevent the fill-layer thicknesses from being governed by the presence of isolated larger rocks, the Engineer may direct that any material, which cannot be broken down to the size which can generally be obtained for the rest of the material in the layer, be bladed off the fill and removed and that payment therefore be made as detailed herein.

The material placed on the fill shall be thoroughly broken down through the entire layer by equipment suited for this purpose. The Contractor shall be at liberty to use any equipment considered by him to be the most suitable, but in the event of disagreement between the Engineer and the Contractor as to the adequacy of the equipment used or the process employed, the material shall be given a normal grid rolling, and the Engineer may at any time require that all material be given a normal grid rolling or any equivalent alternative treatment approved by him.

During such processing the material shall be frequently bladed to bring oversize material to the surface to facilitate breaking-down.

When normal grid rolling cannot effectively break down the material to the required size, the Engineer may negotiate with the Contractor in regard to the use of specialized equipment such as heavy vibrating grid rollers and self-propelled tamping rollers to break down the material. Where the extensive use of such equipment is contemplated in advance, its use and payment for such use will be specified in the Project Specifications.

Where the coarse and fine fractions of the material are not uniformly distributed or have been allowed to become segregated, the material shall be thoroughly mixed on the road by blading with a motor grader being done in successive cuts over the full depth of the layer after the required amount of water has been added. Mixing shall continue until a uniform mixture of the variously sized fractions of the material has been obtained.

Watering and mixing

Any water that is required before the material is compacted shall be added to the material in successive applications by means of water sprinklers fitted with sprinkler bars or by means of pressure distributors, all capable of applying the water evenly and uniformly over the area concerned.

The water shall be thoroughly mixed with the material to be compacted by means of motor graders or other suitable equipment. Mixing shall continue until the required amount of water has been added and a uniform mixture is obtained, after which compaction may be proceeded with.

The amount of water to be added shall be sufficient to bring the material up to the optimum moisture content required for the compaction equipment used and to the required density, provided always that compaction shall not be attempted with and will not be approved in respect of materials the moisture content of which exceeds the optimum moisture content by 2%. Should the material be too wet on account of rain or for any other reason, it shall be harrowed and allowed to dry to attain a moisture content which conforms to the above requirement before compaction is proceeded with.

Compaction

Compaction shall be done in a series of continuous operations which cover the full width of the layer concerned. The length of any section of a layer to be compacted shall, wherever possible, neither be less than 150 m nor more than can be properly compacted with the available equipment.

The Engineer is authorized to instruct the Contractor to reduce the area of any layer which is compacted in any single operation if such layer is not being properly compacted.

The types of compaction equipment to be used and the amount of rolling to be done shall be of such a nature as to ensure that specified densities are obtained without damage being done to lower layers or structures. During compaction the layer shall be maintained to the required shape and cross-section, and all holes, ruts and laminations shall be eliminated.

Construction of thick layers

Where the blading and mixing of fill layers by motor grader becomes very difficult on account of the thickness of the layer to be constructed, the Engineer may allow this operation to be curtailed or entirely omitted during any breaking-down, mixing or watering process in which blading and mixing has been specified. In such cases the Contractor shall take all reasonable measures to ensure that the material is nevertheless thoroughly broken down and brought as near as is practicable to the moisture content required for proper compaction.

During breaking-down on the fill, the loose-layer thickness shall be adapted to the size of the material being handled and shall not be so excessive as to reduce the efficacy of the breaking-down process.

Normal grid rolling

For the purposes of this Specification, normal grid rolling shall be taken to mean the following:

- (i) The material to be grid-rolled shall be evenly spread over the entire width of the layer being prepared.
- (ii) The grid roller, which shall have a minimum mass of 13,5 t, shall make two complete passes over the material, where each pass shall consist of rolling with the grid roller in a longitudinal direction over the entire width of the layer so that each roll laps over half of the previous roll.
- (iii) The material shall then be bladed to a windrow on one side of the road, respread and subjected to two more grid-roller passes.

The above procedure shall apply to a compacted layer thickness of up to 150 mm. Where the actual layer thickness exceeds 150 mm, the number of passes of the grid roller shall be increased proportionately.

Drainage and protection

The compacted layers shall be adequately drained and shaped to prevent water from standing on or scouring the finished work. Windrows shall be removed to facilitate the drainage of water from the surface.

No material for a succeeding layer shall be placed if the underlying layer has been softened by excessive moisture.

Disposal of oversize material

The Engineer will direct that oversize material be disposed of or utilized elsewhere in the construction of the Works and that it be paid for in one of the following ways:

- (i) Where the oversize material is bladed off the fill and utilized in the uniform widening of fills beyond the specified dimensions, the material shall be paid for as "excavation to spoil" material.
- (ii) Where the material is bladed off the fill, loaded, transported and taken to spoil, the material shall be paid for under the item "removal of oversize material".
- (iii) Where the material is bladed off the fill, loaded, transported to the point of use and utilized in any other item of construction, it shall be paid for under the item "removal of oversize material" as well as under the item of construction for which it is utilized.

Notwithstanding the methods of payment described above, tender rates for the construction of all the fill layers from excavated or borrow material shall include full compensation for the removal of oversize material of up to 5% by volume at no additional payment to the Contractor.

Only that volume of oversize material removed in excess of 5% of the compacted volume of any fill layers constructed from excavated and borrow material will therefore be measured for payment under the items "removal of oversize material" in the case of (b) or (c) above, or as "excavation to spoil" material in the case of (a) above.

The Contractor shall take all reasonable care not to bring onto the fill any material which cannot be broken down to the required size by processing on the fill. This can be avoided by proper selection in excavation or in borrow. In excavation any material thus selected shall be taken direct to spoil or shall be utilized as directed by the Engineer.

g) EXCAVATION

Dimensions of excavations

The dimensions of excavations shall be generally in accordance with the details as shown on the Drawings and shall further be defined or amended during the course of construction as may be instructed by the Engineer. The Contractor shall obtain instructions beforehand from the Engineer regarding the slope of the sides of cuttings and other excavations and the depth to which excavations are to be taken, also regarding the dimensions of excavations during any in situ treatment that may be required below the pavement layers, where applicable.

In rock cuttings for road construction the rock shall be removed to such a depth as will permit the construction of the subbase layer, unless otherwise instructed.

All excavations carried below the specified depths shall be backfilled with suitable material and shall be compacted, all at the Contractor's own expense, as directed by the Engineer.

If deemed necessary by him, the Engineer may instruct the Contractor to widen any existing cuttings which have been completed or partially completed either uniformly or by altering the slopes of the sides of cuttings, cutting benches, or in any other way.

Those portions of cut slopes situated more than a vertical height of 2,5 m above the cutting floor and widened horizontally by less than 4 m, either by flattening the slope or by relocating the sloping side uniformly in an outward position, as well as by benches cut less than 4 m wide and situated at any height above the cutting floor, shall be measured and paid for per BoQ.

Those portions of cutting slopes widened horizontally by more than 4 m by any of the above-mentioned methods and irrespective of the height above the cutting floor, as well as those portions of cutting slopes less than 2,5 m above the cutting floor and irrespective of width, shall, except in the case of benching as described above, be measured and paid for as excavation to fill or excavation to spoil, as the case may be.

Use of excavated material

All suitable and approved materials excavated shall, in so far as it is practicable, be used in the construction of fill, shoulders, pavement layers, mitre banks and for such other purposes as shown on the Drawings or as directed by the Engineer.

Coarse rock encountered in excavations shall be utilized for the construction of the lower layers of fills to a sufficient height to accommodate thick layers or, where so

required, shall be conserved and used as directed for constructing the sides of embankments or to serve as protection against embankment or channel erosion.

The Engineer shall have full control of the use of all material produced by excavations, but the Contractor shall so plan his operations, and in particular his excavation to fill operations, that all excavated material can be used to the best economical advantage to the Employer. This would mean that no material shall be unnecessarily spoiled, borrowed or hauled.

The Contractor shall neither borrow nor spoil any material without the Engineer's approval and without satisfying the Engineer that it is necessary and the most economical method of constructing the Works.

h) FINISHING OF SLOPES

(h.1) Slopes of excavations

The slopes of cuttings and other excavations shall be trimmed to neat lines and to a standard that is generally attainable with proper care and workmanship in the type of material concerned. All loose rocks, stones and nests of loose material shall be removed, especially in solid-rock cuts, which must be completely free of such material. The final surface of batters must not be absolutely smooth but shall have a slightly rough surface which will be suitable for subsequent grassing or for the establishing of natural vegetation on the surface and, in the case of the slopes of open drains, the surface shall be trimmed as specified.

(h.2) Fill slopes

Fill slopes shall be finished to neat lines with all loose rocks and uncompacted material removed. The degree of finish required shall depend on the nature of the material used for the slopes, but the finish shall be as smooth as is consistent with the material involved and good workmanship.

No boulders exceeding 750 mm in size may be present, and isolated large boulders in otherwise smaller-size material shall not be allowed to project from the surface.

In the case of rock fill, the Engineer may order the dumping of soft material over the side and that it be worked into the interstices between the rock on the slope surface. It is recommended that the Contractor establish beforehand whether this will be required and that he follow this procedure as the fill is being built up. Payment for soft material thus worked into fill slopes shall be made per BoQ and the volume of such material shall be taken to be equal to 70% of the loose volume measured in the trucks.

(h.3) General

Except in solid rock, the tops and bottoms of all slopes, including the slopes of drainage ditches, shall be rounded as indicated on the Drawings or as instructed by the Engineer. Slopes at the junctions of excavations and fills shall be adjusted and warped to flow into one another or into the natural ground surfaces without any noticeable break.

When directed by the Engineer, slopes shall be adjusted to avoid harm being done to existing trees, and also to harmonize with existing landscape features. The transition to such adjusted slopes shall be gradual.

Slopes of excavations and fills shall be finished to give a uniform appearance without any noticeable breaks. The degree of finish required for all fill slopes and for slopes of excavations flatter than 1 in 4 shall be that normally obtainable by motor-grader or hand-shovel operations.

The slopes of excavations and fills which are designated for grassing shall, after having been finished, be prepared for grass planting with or without topsoil as specified in section 104 of these Specifications.

All trimming of the side slopes of cuttings shall be completed before any work on the subbase is commenced inside such cuttings.

j) CONSTRUCTION BED TREATMENT

(j.1) Removal of unsuitable material

All construction bed material which is considered by the Engineer to be of a quality that would prejudice the performance of the completed road, railway line or parking area, shall be removed to such widths and depths as instructed by the Engineer and shall be disposed of as directed. The excavated spaces shall then be backfilled with approved imported material compacted to the required density.

The Engineer may also instruct that material which is too wet to provide a stable platform for the construction of the fill be removed and replaced with suitable dry material. The Contractor shall be paid for this work, provided that the Engineer is satisfied that, despite any adequate temporary drainage installed by the Contractor and any permanent drainage that the Contractor may have installed on the Engineer's instructions, the wet conditions are not likely to be remedied within a reasonable period and could not have been reasonably foreseen and avoided by proper advance planning, e.g. by carrying out the construction during a dry period.

(j.2) Three-pass roller compaction

Any portion of the construction bed which, by reason of its inadequate natural density, is shown on the Drawings or is specified or directed by the Engineer to be given three-pass roller compaction, shall be prepared by shaping where necessary and by compacting with a vibratory roller complying with the requirements specified herein, or with an impact roller.

The impact roller shall be a multi-faced roller with a maximum of five flat or practically flat faces and a roller mass of between 8 t and 10 t. The roller and towing mechanism shall be designed in such a manner that all the energy applied in lifting the roller, when the roller is supported on the ridge between consecutive faces, will be available for dissipation on impact when the roller drops down again. The roller shall be towed at a speed of between 8 km/h and 24 km/h.

Except where otherwise authorized by the Engineer, compaction shall comprise not less than three complete coverages by the wheels of the roller specified or ordered over every portion of the area being compacted.

While the Contractor is not meant to apply water to the construction bed under this class of compaction and while no rigid moisture control will be exercised during compaction, the Contractor shall nevertheless satisfy the Engineer that every endeavour is being made to take full advantage of favourable soil-moisture conditions during the rainy season, and, as far as possible, to carry out such compaction when the construction bed is neither excessively dry nor excessively wet.

The Engineer is authorized to decide as to when conditions are favourable for compaction and where such compaction shall be done at any particular time, and he shall have the right to instruct the Contractor to water the construction bed at the Contractor's expense where, in the opinion of the Engineer, the Contractor has failed, neglected or refused to comply with these requirements.

(j.3) Preparation and compaction of construction bed

A construction bed which is classified as suitable for in situ use, save that it fails to meet density requirements, shall be scarified, watered and compacted to 90% of modified AASHTO density. The depth of compaction shall be as directed by the Engineer. If necessary, construction-bed material may have to be temporarily bladed off to windrow to attain the necessary depth of compaction.

Where additional material has to be imported to obtain the required levels and layer thicknesses, and where the thickness of the imported material, measured after compaction, is less than the specified layer thickness, the construction-bed material shall be scarified and the required imported material placed, and the combined material thus obtained shall be mixed and compacted to the full specified depth of the layer. The imported material shall be measured and paid for under "Excavation and borrow to fill" and the construction-bed material shall be measured and paid for under "Preparation and compaction of construction bed material".

(j.4) Draining of construction bed

A drainable, water-logged construction bed where saturated material overlies less pervious strata shall first be drained by all permanent surface or subsoil drainage shown on the Drawings or as directed by the Engineer being installed before any other construction is started on these sections.

Such drains shall be constructed, measured and paid for in accordance with the requirements of these Specifications.

(j.5) In situ treatment of construction bed

Wherever shown on the Drawings or directed by the Engineer, the construction bed shall be treated in situ by the breaking-up of undesirable formations of hard or rocky materials to attain a uniform standard of compaction or to improve drainage.

In situ treatment shall consist of ripping or blasting to depths below subgrade level. Unless otherwise indicated on the Drawings or directed by the Engineer, the depth of ripping shall be not less than 300 mm. Similarly the depth of drilling and blasting shall be not less than 700 mm.

After ripping or blasting, the material shall be processed as follows:

- Where the Engineer instructs the Contractor to rip the in situ material, all the material shall be sized by rolling or knapping until the maximum dimension of any clod or spall does not exceed two-thirds of the thickness of the layer after compaction.

The material shall then be compacted per given description herein by 12 passes being made by an approved combination of various rollers.

- Where the Engineer instructs the Contractor to blast the in situ material, all the material shall be processed and compacted as described.

In both cases surplus material produced by bulking after in situ treatment shall be removed and disposed of or utilized elsewhere, as directed by the Engineer.

j) FILL CONSTRUCTION

(j.1) General

The dimensions of fills shall be in accordance with the typical cross-sections and with the details shown on the Drawings, and as may be further defined or amended by the Engineer during the course of construction. Before construction, the Contractor shall obtain instructions regarding any matter that may affect the construction of the fill or sequence of operations.

All material used in the construction of fills shall be broken down during excavation and during the placement and compaction of the material.

The thickness of individual layers shall depend on the type of material encountered and on the maximum size of the particles in such material. Where the material can generally be broken down to a maximum size of 200 mm or less, the layer thickness shall not exceed 200 mm after compaction, except in the case of cohesionless sands where layers may be up to 400 mm thick, subject to specified densities over the full depth of compaction being attained.

In the case of material that cannot be reduced to a maximum size of 200 mm or less after removal of the oversize material, thicker layers shall be constructed, but the thickness of the loose layer shall not be more than is necessary to ensure that the maximum particle size generally does not exceed the completed layer thickness. The Engineer may, at his sole discretion, allow thicker layers than those specified above to be constructed, provided that he is satisfied that the specified densities can be obtained throughout the full depth of each layer and that the layers will be uniformly compacted with the use of equipment specifically suited to this purpose.

Wherever practicable, the successive layers of material shall be placed parallel to the final surface. The construction of tapered layers shall be restricted to the bottom layers where it may be unavoidable on account of the crossfall, tapering out of fills or super elevation of the final surface.

(j.2) Placing of rock

Rock material containing rock particles exceeding 300 mm in size shall not be used at a depth of less than 150 mm below the top of the fill level, unless otherwise authorized by the Engineer.

The Contractor shall, by judiciously planning the layer thicknesses and selecting the smaller-sized material to be placed in the thinner fill layers, avoid the unnecessary spoiling of the larger-sized rock material and ensure, wherever practicable, its full utilization.

(j.3) Placing on unstable ground

Where fill is to be constructed across water-logged or soft clayey soil that displays excessive movement under normal compaction equipment and haulage trucks so as to preclude the effective compaction of the bottom layers, the Engineer may direct the construction of a pioneer layer on the unstable ground. This layer shall be constructed by the dumping and spreading of successive loads of suitable coarse material in a uniform layer of a thickness just sufficient to provide a stable working platform for the construction of further layers which are to be compacted to a controlled density.

Light hauling equipment and, where necessary, end tipping shall be used to place the material, and the layer shall be compacted with such light compaction equipment as will give the most effective compaction without overstressing the construction bed. Pioneer layers need not be compacted to a controlled density.

The compacted volume of material used may be determined on the basis of 70% of the loose volume in trucks as an alternative to the taking of cross-sections before and after construction.

(j.4) Benching

Where the crossfall of the construction bed exceeds 1 in 4, the construction bed shall be cut away, as shown on the Drawings, to form benches with each bench being cut as the material is compacted and built up. The benches shall be of sufficient dimensions to allow placing and compaction equipment to operate on the benches.

Where solid rock occurs, the dimensions of the benches may be smaller than those required for the operation of equipment. Those benches may be made by stepping or serrating the slope, with the steps sloping inwards to ensure a satisfactory bond between the slope and fill. The fill in such cases shall preferably consist of rock.

The material shall be placed in a single layer at the toe of the fill to the minimum elevation that will allow the placing and compacting equipment to operate on such layer.

Material excavated from benches, if suitable, shall be incorporated in the fill. Bench-making shall be measured and paid for as "Excavation to fill" or "Excavate and spoil", unless otherwise provided in the Project Specifications.

(j.5) Construction of fills near structures

At all fills adjoining uncompleted structures such as bridges and large culverts, where the construction of the fill and the backfilling behind the structure cannot be done simultaneously, the fill shall be so constructed that the longitudinal slope of the surface of the fill will at any stage form a continuous plane sloping towards the structure with a gradient not exceeding 10%. When the structure is completed, the remaining portion of the fill shall be similarly completed and shall coincide with the backfilling of the structure, with the backfill behind the structure being maintained at the same elevation as the adjoining fill. No additional payment shall be made for similarly constructing the fill outside the restricted area.

k) PROTECTION OF FILLS

During construction the fills shall be kept well-drained and protected at all times. All windrows shall be cut away after construction to prevent flow being concentrated on completed layers, but, where necessary, flat berms shall be constructed to prevent an undue erosion of the slopes. All permanent drains shall be constructed as soon as possible, together with a sufficient number of additional temporary drains as may be necessary to protect the fill, and they shall be maintained in a good working order. Ruts and potholes which develop in the fill after completion shall be repaired and damaged sections shall be reshaped and recompacted at the Contractor's own cost.

All slopes shall be maintained by the Contractor until the final acceptance of the Works. All erosion and flood damage to slopes shall be promptly repaired.

Side drains and all other drains shall be so constructed as to avoid any erosion damage.

l) CONSTRUCTION TOLERANCES

The work described in this section shall be constructed to the dimensional tolerances given below.

(l.1) Level

The level tolerances referred above shall be as follows for fill:

$$\begin{array}{lcl} H_{90} & = & \pm 25 \text{ mm} \\ H_{\text{max}} & = & \pm 33 \text{ mm} \end{array}$$

(l.2 Width)

(i) Common fill

The transverse width of a fill at any level, measured horizontally, shall not at any place be more than 125 mm less or 250 mm more than the design width at that level.

(ii) Rock fill

The transverse width of rock fill at any level, measured horizontally, shall not at any place be more than 250 mm less or 500 mm more than the design width at that level.

(iii) Slopes of excavations

No specific tolerances are given, but the excavation slopes shall be finished to a standard generally attainable with proper care and workmanship, bearing in mind the nature of the material excavated. Care shall be taken not to undercut any slopes to give sections a slope steeper than specified. All loose material shall be removed.

m) TESTING

(m.1) Process control

The minimum testing frequency required from the Contractor in terms of clause 05 of section 901 for purposes of process control is shown in table 203/1.

(m.2) Routine Inspection and testing

Routine inspection and testing will be carried out by the Engineer in accordance with the provisions herein for testing the quality of materials and workmanship with a view to compliance with the requirements of this section.

The requirements specified herein for the compaction of fill material to a percentage of modified AASHTO density or proof density shall be deemed to have been complied with if at least 75% of in situ density tests on any lot are equal to or above the values specified and no single density is more than 5 percentage points of relative compaction below the value specified.

Any materials which do not comply with the specified requirements shall be removed and replaced with materials which comply with the specified requirements or, if the Engineer so permits, be repaired as specified so that it will comply with the specified requirements after having been repaired. Similarly any workmanship which does not comply with such requirements shall be made good so as to comply therewith.

Table 203/1 Test	Position or layer	Testing frequency	
		One test every -	Minimum number of tests per lot or road section
Materials			
Field density and OMC*	(i) Ordinary fill	2 000 m ³	4 per fill
(ii) Top 300 mm of fill and construction bed	5 000 m ²	4	

Tolerances		
Surface levels	Top of fill	20 m (1 test = 3 pts per cross-section)**
Width (for roads and railways)	Cut and fill slopes	500 m

* The determination of field density expressed as a percentage of modified AASHTO density implies a modified AASHTO density determination for each field density. Where material is homogeneous, this ratio can be decreased to one determination of the modified AASHTO-density, for up to four field densities

** For large areas such as parking areas, 1 test equals a series of points 5 m apart, in a straight line across the full width of the fill at every 20 m cross-section.

i) MEASUREMENT AND PAYMENT

Please see the Bill of Quantities

C6.12 : DRAINAGE AND EROSION PROTECTION

C6.12.1 : KERBING AND CHANNELLING

a) SCOPE

This section covers the work in connection with the construction of precast and cast in-situ concrete kerbing and channelling.

b) MATERIALS

(b.1 Concrete

All concrete work shall be carried out in accordance with the requirements of sections 702 and 704 of these Specifications.

(b.2) Kerbing and channelling

Precast kerbing shall be of the dimensions shown on the Drawings, shall comply with the requirements of SANS 927 and shall, unless otherwise directed, be supplied in 1,0 m long sections, except around curves at road intersections where they shall be 0,3 m in length. Kerbing and channelling cast in situ shall be of the class of concrete indicated on the Drawings.

(b.3) Bedding material

The material on which precast concrete kerbs are to be bedded shall consist of crushed stone, cinders, slag, sand or other approved porous material with a maximum particle size of 13,2 mm.

(b.4) Mortar

Mortar shall be mixed in the ratios of sand and cement specified.

Only ordinary cement shall be used.

c) TYPES OF KERBS

Kerbing shall be one or more of the following types:

- (i) Precast barrier kerbs (fig 3 in SANS 927) with cast in situ-channels
- (ii) Precast semi-mountable kerbs (fig 7 in SANS 927) with cast in situ channels
- (iii) Cast in situ sloping kerbs as indicated on the Drawings.

Sloping kerbs may also be constructed with slip forms in a continuous operation with an approved machine.

d) CONSTRUCTION

(d.1) General

Kerbing and channelling shall be constructed after the subbase, which extends below and beyond the kerbing and channelling, has been completed.

No excavation into the completed subbase is necessary to accommodate kerbing and channelling and in most cases, depending on the thickness of the base and wearing course, a difference in level exists between the top of the subbase and the bottom of the kerbing as is shown on the Drawing.

This difference in level will vary depending on how accurately the subbase layer has been constructed.

(d.2) Precast concrete kerbing

Precast kerbing shall be constructed on a bedding layer of the type of specified material, and approved by the Engineer.

Precast concrete kerbing shall be laid with close joints of 3:1 sand : cement mortar at the ends. The joints may not exceed 10 mm in width and must be neatly pointed with a pointing trowel. Guide-lines and straight-edges shall be used to ensure that the exposed faces of kerbs are set true to line and elevation. Kerbing around curves shall be laid along the full curve length before the joints are made, unless otherwise allowed by the Engineer.

After the precast kerbing has been constructed, the cast in situ channelling shall be constructed as specified in subclause below.

Precast kerbs shall be supported with a concrete backing of the dimensions and class of concrete as shown on the Drawings.

(d.3) Cast in situ kerbs and channels

Where there is a difference in level between the top of the subbase and the bottom of the cast in situ kerbs or channels, such difference shall be made up with the same concrete as specified for the kerb or channel. This additional concrete shall be cast in one operation with the kerb or channel. Alternatively, if the difference in level exceeds 75 mm, it can be made up with a layer of subbase material compacted to at least 90% of modified AASHTO density, the surface of which shall be finished off true to line and level.

Kerbs and channels cast in situ shall be cast in alternate sections. The lengths of sections shall be 2 m except where shorter sections are necessary for closures or where otherwise shown on the Drawings or required by the Engineer. Cast in situ channels used with precast kerbs shall be of the same length as the kerbs.

Forms shall be accurately set to line and elevation and shall be firmly fixed in position during the placing of the concrete. Stops at the ends of sections shall be placed accurately so as to ensure that the joints between adjacent sections are truly perpendicular to the surface of the concrete and at right angles to the edge of the road. After the concrete has been placed in the forms, it shall be tamped and spaded until the exposed surfaces are entirely covered with mortar. Exposed faces shall then be finished to smooth and even surfaces and edges shall be rounded to the radii shown on the Drawings.

The forms of concrete surfaces that will be exposed shall be removed within a period of 24 hours after the concrete has been placed. Minor defects shall be repaired with a 2:1 sand : cement mortar. Plastering shall not be permitted on exposed faces and all rejected portions shall be removed and replaced at the Contractor's expense.

Exposed surfaces shall be finished while the concrete is still green, by wetting a soft brick or a wooden block and rubbing the surfaces until they are smooth. When the concrete has been smoothed by using water, it shall be rubbed with a thin paste of 1:1 sand : cement mortar to obtain a uniform colour and texture.

When completed, the sections shall be cured in accordance with the requirements specified.

After the concrete in alternate sections has set, the intermediate sections shall be cast and finished off in accordance with all the requirements specified above for alternate sections. The exposed end surfaces of the alternate sections cast first shall be coated with an approved bituminous emulsion containing 60% net bitumen by mass, and the emulsion must be allowed to set and dry before the intermediate sections are cast.

Guide-lines and straight-edges shall be used to ensure that the exposed faces of kerbs and channels are formed true to line and elevation.

The Contractor may use an approved machine which is capable of placing cast in situ kerbs and channels in one continuous operation by means of slip forms. He must, however, be able to obtain at least the same standard of finish, in respect of both appearance and line, as can be obtained by the methods described above. The concrete strip shall also be provided with neat joints at the intervals described above.

(d.4) Backfilling

After completion of concrete work, the excavated spaces at the back of kerbs shall be refilled with approved material to shoulder or sidewalk level. Such backfill shall be placed in layers not exceeding 150 mm in thickness and each layer shall be watered and thoroughly compacted before the succeeding layer is placed thereon. The construction of medians, sidewalks, traffic islands and other unsurfaced areas behind kerbs shall be carried out in accordance with the relevant clauses of section

104 : Landscaping and grassing, and shall be measured and paid for under that section.

Where the basecourse is to be constructed after the kerbing has been laid, the concrete backing to the kerbs and backfill behind the kerbs shall be completed prior to the construction of the basecourse in order that the kerbing shall not be displaced during construction of the basecourse.

Where kerbs and channels are laid after the basecourse has been constructed, the spaces between the concrete and adjoining base shall be backfilled with premixed bituminous material.

(d.5) Protection

Care shall be taken to protect all precast units against chipping or breakage during transportation and laying. Broken or badly chipped sections may not be used and shall be removed and replaced with undamaged units.

Concrete kerbing and channelling as well as any other structures adjacent to the road shall be protected from discolouration by bitumen being sprayed or premix being placed. Where bitumen is to be sprayed, all such work shall be completely covered with polyethylene sheeting at least 0,25 mm thick and weighted down by packed stones and sand to prevent the sheeting from lifting during windy conditions. Any work discoloured by bitumen shall be broken down and replaced, unless all such bitumen is completely removed so that no discolouration is visible at all. Painting over discoloured sections will not be allowed.

e) TRANSITION SECTIONS

Transition sections for kerbing and kerbing-channelling combinations shall be constructed to the same standards and by the same methods as described for the uniform sections, but with the required modifications as detailed on the Drawings. Sections may be either precast or cast in situ units. Transition sections which form part of inlet structures shall be measured for payment.

f) TOLERANCES

Concrete kerbing and channelling shall be constructed to within the following dimensional and alignment tolerances:

(f.1) Horizontal alignment:

The maximum deviation of edges, the centre line or vertical surfaces from the specified position shall be 25 mm.

The maximum deviation of edges, the centre line or vertical surfaces from the specified horizontal alignment shall be 1:500 when taken over any section exceeding 10 m in length.

(f.2) Vertical alignment and level:

The inside edge of channelling shall nowhere be less than 20 mm and not more than 30 mm below the finished road surface. The invert level of channels and the top of kerbing shall nowhere deviate more than 10 mm from the required level, and nowhere shall channels have any adverse grade.

(f.3) Trueness of exposed surfaces:

When tested with a 3 m straight-edge, no surface irregularities shall exceed 6 mm.

(f.3) Cross-sectional dimensions:

All cross-sectional dimensions shall be within 6 mm of the specified dimensions, except that the underside of channelling may extend up to 25 mm below the level at which it would have the required thickness.

g) SURFACE FINISH

All unformed exposed concrete surfaces shall have a class U2 surface finish, and all formed exposed concrete surfaces shall have a class F2 surface finish.

h) MEASUREMENT AND PAYMENT

Please refer to the Bill of Quantities

C6.13 : DRAINAGE AND EROSION PROTECTION

C6.13.1 : OPEN DRAINS

a) SCOPE

This section covers the construction of open drains, either as unlined excavations and banks, lined excavations, or as concrete drains.

b) DEFINITIONS

For the purpose of this section in particular and these Specifications in general, the following words shall have the meanings hereby assigned to them.

(b.1) Catchwater drain

An open drain constructed at the top of a cutting to prevent water from running down the face of the cutting.

(b.2) Channel

Any open drain other than a chute, mitre drain, catch-water drain or side drain.

(b.3) Chute

A drain, usually in precast concrete, running down the slope of an excavation or embankment. Chutes are called down-lets in railway work.

(b.4) Mitre drain

An open drain consisting of an excavation and bank, normally at an angle to the road or rail centre-line, for the purpose of conveying water away from the road or rail reserve.

(b.5) Open drain

A chute, mitre drain, catchwater drain, side drain or channel constructed for the purpose of conveying stormwater.

(b.6) Side drain

A longitudinal open drain situated adjacent to and at the bottom of a cutting or embankment slope or adjacent to the shoulder of a road.

c) EXCAVATIONS

(c.1) Classification of excavations according to the type of material excavated

Excavations shall be classified as either soft excavations or hard excavations in accordance with the specs.

(c.2) Mass excavations

All mass excavations for road and railway cuttings shall be completed, measured and paid for. Only the remainder of such excavations which is required solely for the purpose of constructing open drains will be measured and paid for in accordance with the provisions of this section. (See diagram 504/01 below.)

In the case of large open drains, the excavation thereof or part thereof shall be treated as mass excavations (and earthworks), or be measured and paid for under that section wherever so specified in the Project Specifications, otherwise they shall be constructed, measured and paid for in accordance with the provisions of this section.

(c.3) Hand excavation

In the case of open drains paid for as type designs, and in the case of mitre drains, catchwater drains and concrete chutes, no extra over payment will apply in respect of hand excavations, and the Contractor shall, as may be necessary, make allowance in his rates for all hand excavations.

For side drains and channels paid for by components, the Engineer shall classify as hand excavation such excavations or parts thereof as he may consider can be excavated only by hand tools, and the Contractor shall be paid accordingly. Notwithstanding the above, any hand excavation required solely for the purpose of accurately trimming the excavations to the final shape specified, shall not be classified or paid for as hand excavation.

(c.4) General

Open drains shall be excavated true to line, grade, level and cross section, and unlined drains shall be maintained to this shape until completion of the Works has been certified. Care shall be taken not to excavate beyond the limits of the required cross section, and any over-excavation or overbreak shall be backfilled to the required cross section and at the Contractor's own cost, either with class 1:3:6/19 concrete, soilcrete or with compacted gravel, as may be directed by the Engineer.

Where open drains are to be lined, the final trimming of excavations shall be done by hand and shall be guided by the use of accurately installed profile guides or other approved means. Trimming shall include the removal by hand of not less than the

final 75 mm of material or such additional thickness as may be necessary under the circumstances to ensure accurate excavation.

d) CONSTRUCTION

(d.1) Mitre drains and banks

Mitre drains and banks shall be constructed to the dimensions shown on the Drawings and as instructed by the Engineer. The mitre banks shall be constructed with the material excavated from the drains or with imported material, which shall be thoroughly compacted to 90% of modified AASHTO density.

Payment will only be made for material in the mitre banks and not for the excavation of the material used in the mitre banks.

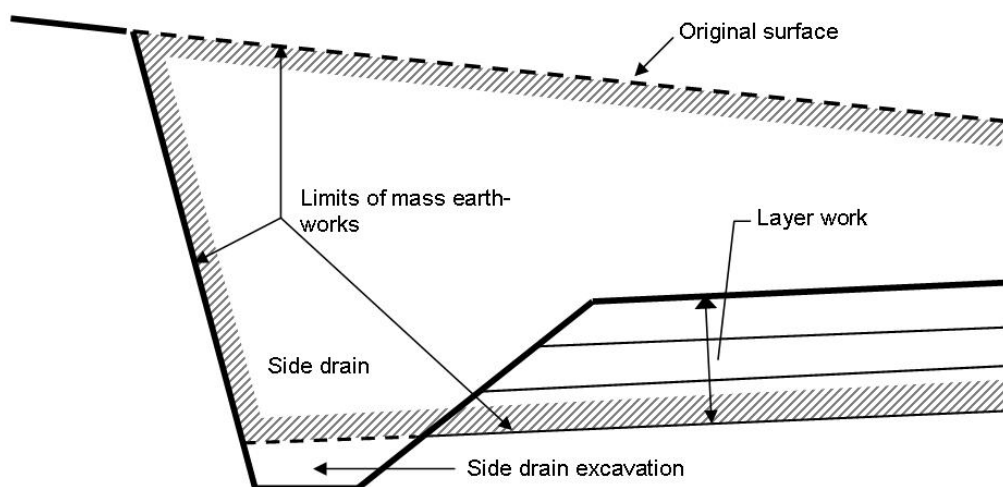
(d.2) Catchwater drains

Catchwater drains shall be constructed in accordance with the details shown on the Drawings and as instructed by the Engineer. Material excavated from catchwater drains shall be placed on the lower side of the drain and thoroughly compacted. Where a sufficient quantity of suitable material cannot be obtained from the excavations, imported material shall be used. The larger-sized stones shall be placed on the inside faces of catchwater drains to afford protection against erosion. As is the case with mitre drains, payment will only be made for the material in the banks and not for excavations.

(d.3) Side drains

After completion of any mass earthworks (see diagram 504/01 below), such further excavations as may be necessary shall be done by hand to complete the excavations for the side drains to the dimensions shown on the Drawings.

DIAGRAM 504/01



Where the shape of side drains is of such a nature that mass excavation methods can produce the final shape of the side drains, no further payment will be made for side drains except if they have to be lined for erosion protection.

The final surface of the side drains shall be neatly cut and trimmed to shape. Where required, the side drains may be lined for erosion protection, or they may be constructed entirely from concrete. Side drains that are paved with or constructed from concrete shall be protected against disfigurement by bitumen being split onto the concrete during surfacing operations. This shall be done by covering the side drains completely in plastic sheeting which has been properly weighted down by stones or by other means. All bitumen spilt on the paving or concrete of the side drains shall be removed entirely, and no overpainting will be allowed.

(d.4) Channels

Channels shall be excavated with any suitable excavating or earth-moving equipment and, where the size and shape of the channel precludes the use of excavating equipment, with hand tools.

Surplus excavated material shall be utilized, as far as possible, in the construction of fills, banks and other structures and, where this is not feasible, the material shall be removed to spoil as instructed by the Engineer. Where specified or instructed by the Engineer, channels shall be protected against erosion by means of gabions, grassing or concrete lining, or they may be constructed entirely from, in which case formwork shall also be used for the outer faces of the channel sides.

The final surfaces of all channel excavations shall be neatly cut and trimmed to shape.

(d.5) Chutes

Chutes shall be constructed, as may be required, either in precast units or from cast in situ concrete to the details shown on the Drawings.

The excavations for chutes shall be thoroughly compacted and accurately trimmed to shape, and graded so as to be ready to receive the cast in situ concrete or precast units.

Outlet structures shall be constructed before the chutes are constructed so as to provide the necessary support for the chute.

Precast units shall be laid from the bottom upwards and firmly bedded, and the space between the side walls and the excavation shall be backfilled and thoroughly compacted.

Inlet sections shall be provided as shown on the Drawings.

(d.6) Protective linings

Where open drains are required to be provided with protective linings which consist of gabions, stone pitching, riprap, masonry walls, concrete-block pitching or cast in situ concrete, these shall be constructed in accordance with the provisions of section 505 and this section.

(d.7) Concrete construction

Where open drains are required to be constructed in concrete either from precast units or from cast in situ concrete, they shall be constructed as specified. Where the drains are lined with concrete, they shall also comply with the given requirements. Similarly, inlet, outlet and transition sections shall be constructed in accordance with the specifications.

The excavations shall be compacted and accurately trimmed to receive the concrete. Where side walls are not cast against the excavation, the excavation shall be widened just sufficiently to accommodate the formwork and, on completion of the concreting, the excavation shall be backfilled against the side walls and thoroughly compacted.

(d.8) Casting against the side of the excavation

Where soil conditions are suitable, the concrete side walls or paving of open drains shall be cast against the prepared excavations, in which case inside formwork shall be used where the slope of the side walls exceeds one vertical to two horizontal.

Where prices are based on type designs, the Contractor shall be at liberty to choose whatever method of construction he may prefer, either by casting against the prepared surface, or by doing additional excavation and using inside and outside formwork for the side walls.

Where payment is based on components, the Engineer shall decide whether casting side walls against the excavation is practicable or whether outside formwork is necessary, and payment will be based on his ruling irrespective of the method of construction ultimately employed by the Contractor.

(d.9) Excess excavation and overbreak

The Contractor shall take due care not to excavate outside the authorized dimensions and any over-excavation shall be backfilled at the Contractor's own expense, with a stiff soilcrete, well compacted, in the case of unlined drains and with class 1:3:6/19 concrete or a stiff soilcrete, as the Engineer may require, in the case of lined open drains cast against the excavations.

The Contractor shall make allowance in his unit rates for the construction of the drains for the risk of overbreak as no specific payment will apply in respect of overbreak.

d) MISCELLANEOUS DETAILS

(e.1) Joints

Watertight joints in concrete shall be constructed in accordance with the details shown on the Drawings and the provisions of section 706. During the construction of butt joints, the exposed joint surfaces of alternate panels cast first shall be coated with two coats of an approved bituminous emulsion which contains 60% bitumen by mass, and the emulsion shall be allowed to set and dry before the intermediate panels are cast.

(e.2) Surface finish

All unformed concrete surfaces shall be finished to a class U2 surface finish, and all formed surfaces to a class F2 surface finish, all as specified.

(e.3) Polyethylene sheeting

Unless otherwise specified, the surfaces on which concrete lining is to be cast shall, after having been trimmed, be covered with polyethylene sheeting, 0,150 mm thick, and all joints in the sheeting shall overlap by at least 150 mm. Care shall be taken not to damage this sheeting during concreting or the placing of reinforcement.

(e.4) Transition sections

Transition sections for concrete-lined open drains shall be constructed to the same standards and according to the same methods as described in respect of uniform sections, but with the necessary modifications.

(e.5) Inlet and outlet structures

Inlet and outlet structures for channels, side drains and chutes shall be constructed using the same methods as described in respect of the uniform sections, but with the necessary modifications.

(e.6) Tolerances

No specific constructional tolerances shall apply in respect of unlined open drains, but the following tolerances shall apply in respect of lined open drains and open drains constructed in precast concrete:

(i) Horizontal alignment:

The maximum deviation from the true position of the centre line shall be 25 mm.

(ii) Vertical alignment:

The invert level shall not at any place deviate more than 25 mm from the required level and the inverts shall not at any place have an adverse grade.

(iii) Trueness of exposed surfaces: When tested with a 3 m straight-edge, no exposed surface shall show surface irregularities exceeding 10 mm.

(iv) Cross-sectional dimensions:

Shall be within 10 mm of the specified dimensions.

(v) Thickness of concrete lining:

Shall not at any place be less than the specified thickness, nor shall it be thicker by more than 10 mm or 10% of the specified thickness, whichever is the greater.

f) MEASUREMENT AND PAYMENT

Per the Bill of Quantities

C6.14 : ROADS AND PARKING AREAS

C6.14.1 : GRAVEL PAVEMENT LAYERS

a) SCOPE

This section covers the construction of subgrade and subbase layers using unstabilized or stabilized selected gravel material and the construction of base layers using only unstabilized material.

This section does not, however, include the construction of shoulders and gravel wearing courses, which are dealt with in the preceding sections.

b) DEFINITIONS

For the purpose of this section in particular and these Specifications in general, the following words and expressions shall have the meanings hereby assigned to them, except where the context otherwise requires:

(i) Subgrade

The layer or layers of gravel material of specified dimensions on top of the fill or embankment and below the subbase. The material may include construction-bed material compacted in situ. (Construction bed is defined in section 203.)

(ii) Subbase

The layer of material of specified dimensions on top of the subgrade and below the base and, where applicable, below the shoulders.

(iii) Base

A layer of material of specified dimensions constructed on top of the subbase or, in the absence thereof, on top of the subgrade.

c) MATERIALS

(c.1) General

Gravel material to be used in subgrade, subbase and base layers shall be obtained from borrow pits provided by the Employer, from excavations, cuttings or from sources provided by the Contractor.

The Engineer must approve all sources of supply and shall have the authority to direct from which sources all materials are to be obtained. The approval of a specific source of supply will not imply that all material from such a source is suitable for use, but it means that suitable material is available for selection from that source.

Gravel material for pavement layers shall, unless otherwise specified in the Project Specifications, conform to the requirements of TRH 14. The subgrade layer, as defined above, is referred to in TRH 14 as the selected layer.

(c.2) Compaction requirements

Below is an indication of the minimum in-situ gravel material dry density for the three layers, expressed as a percentage of modified AASHTO density.

- Subgrade: G9 material 90%
 - G8 material 90%
 - G7 material 93%
 - G6 material 93%
- Subbase: G6 material 95%
 - G5 material 95%
- Base: G4 material 98%

The G classification used above is that of TRH 14.

The materials to be used in the various layers and its/their compaction, will be specified in the Project Specifications.

(c.3) Soluble salinity

When specified in the Project Specifications, the soluble salinity of base material shall be subject to the requirements of this specifications.

d) CONSTRUCTION

(d.1) Removal of in situ material

In situ material falling within the specified levels of the subbase and base layers shall, whether or not the material is suitable for the construction of the subbase and base layers, be removed unless otherwise instructed by the Engineer.

Should the material thus exposed not conform to the requirements for the subgrade, it shall be excavated and replaced with suitable material or be stabilized as ordered by the Engineer. However, if the material is classified as suitable for use in situ, save that it fails to meet the requirements for density, it shall be scarified to the full depth of the subgrade layer and watered and recompact to the specified percentage of modified AASHTO density.

(d.2) Placing and compaction

All pavement layers shall only be constructed on condition that the underlying layers conform to the requirements specified for the layer concerned. Immediately before placement of the material, the underlying surface shall be checked by the Contractor for any damage or deficiencies, which shall be made good as directed by the Engineer.

The material shall be placed, spread, broken down and compacted all in accordance with all requirements except that wherever the word "fill" is used, it shall be taken to read as "pavement" or "pavement layer", as may be required by the context.

Coarse gravel containing non-plastic or slightly plastic soil fines and used in the construction of the gravel base may require slushing and rolling in addition to the specified compaction to obtain a firm, well-knit surface.

If so directed by the Engineer, the base shall, after having been processed and compacted as specified above, be watered well, in short sections at a time, slushed and rolled with compactors and/or heavy flat-wheel rollers with a mass of not less than 10 t each. This shall continue over a section until all excess fines have been brought to the surface of the layer.

Such excess fines shall be uniformly distributed over the surface of the layer by means of stiff brooms, and watering, rolling and brooming shall continue until all areas deficient in fines have been suitably corrected. All excess fines shall be finally removed from the surface of the layer.

(d.3) Crushing and screening

Where the material intended for use in the pavement layers cannot be suitably broken down by the methods described in subclause 06.03 of section 203, or requires modification by screening out certain fractions, the Engineer may direct that the material be crushed or screened, or crushed and screened.

For single-stage crushing the material shall be passed through a single-stage crusher capable of breaking down oversize material to the maximum size specified for the layer concerned.

For crushing and screening the material shall be passed through a multiple-stage crusher and shall be screened so that, after the crushing and screening, the material will conform to the grading specified for the layer concerned.

For screening only the material shall be passed through one or more screens, the smallest of which shall be the 6,7 mm, for the material to be separated at this size, and any specified proportion of the minus 6,7 mm material shall be added back, if required.

(d.4) Stabilization

Material chemical stabilization or mechanical modification to be as specified.

Where a natural binder addition is necessary to reduce the plasticity index or to improve the grading of gravel base material, the Engineer may direct for stabilization by mechanical modification using a suitable binder, all as specified.

(d.5) Protection and maintenance

The Contractor is to protect and maintain completed layers at his own expense until the next layer or, in the case of the base, the bituminous surface has been constructed. Maintenance includes the immediate repair of any damage or defects that may occur to a layer and shall be repeated as often as is necessary to keep the layer continuously intact. Repairs shall be done in a manner that will ensure restoration to an even and uniform surface. Traffic is not be allowed on any completed layer unless authorized by the Engineer.

e) CONSTRUCTION TOLERANCES

The work described in this section shall conform to tolerances given below.

(e.1) Level

The level tolerances shall be as per table below:

	Subgrade	Subbase	Base
H ₉₀	±25 mm	±25 mm	±10 mm
H _{max}	±33 mm	±33 mm	±25 mm

(e.2) Width

The average width of the layer shall be at least equal to that shown on the Drawings and the outer edge of the layer shall not at any place be less than the lines shown on the Drawings. (Where kerbing has been installed, the base shall be contained within the kerbs.)

(e.3) Thickness

The thickness tolerances referred to in subclause 05.02 of section 902 shall be as follows:

	Subgrade	Subbase	Base
D ₉₀	30 mm	27 mm	27 mm
D _{max}	40 mm	35 mm	35 mm
D _{average}	10 mm	5 mm	5 mm

(e.4) Cross-section (for roads)

At any transverse section of the subbase and base layers, the difference in level between any two points shall not vary by more than 20 mm from their difference in level as computed from the cross-sections shown on the Drawings.

When the base layer is tested with a 3 m straight-edge laid at right angles to the road centre line, the surface shall not deviate from the bottom of the straight-edge by more than 10 mm.

(e.5) Grade (for roads)

For the base layer, the deviation from the specified longitudinal grade as a result of deviations from level shall not exceed the following:

Length of grade measured (m)	Maximum variation from specified grade (%)
2	0,34
5	0,27
10	0,21
20	0,13
30	0,08

(e.6) Surface regularity (for roads)

When tested with a rolling straight-edge, the number of surface irregularities in the base layer shall not exceed the following:

- (i) The average number of irregularities per 100 m equal to or exceeding 6 mm when taken over 300 m - 600 m lengths shall not exceed 4
- (ii) The number of irregularities equal to or exceeding 6 mm when taken over 100 m sections shall not exceed 6
- (iii) The maximum value of any individual irregularity measured with the rolling straight-edge or a 3 m straight-edge laid parallel to the road centre line shall not exceed 10mm

* The determination of field dry density expressed as a percentage of modified AASHTO density implies a modified AASHTO density determination for each field density. Where material is homogeneous, this ratio can be decreased to one modified AASHTO density determination for up to four field densities.

** For parking areas, 1 test equals a series of points, 5 m apart, in a straight line across the full width of the parking area, at every 20 m cross-section.

(f) Routine Inspection and testing

Routine inspection and testing will be carried out by the Engineer in accordance with the provisions of the specifications, to test the quality of materials and workmanship for compliance with the requirements of this section.

Compliance with the density requirements specified of this section, shall be controlled in accordance with the statistical judgment scheme specified.

Any materials or workmanship which do not comply with the specified requirements shall be removed and replaced with materials and workmanship which comply with the specified requirements or, if the Engineer permits, shall be repaired as specified in section 901 so that they will comply with the specified requirements after having been repaired.

g) MEASUREMENT AND PAYMENT

Please see the Bill of Quantities

C6.15 : ROADS AND PARKING AREAS

C6.15.1 : UNPAVED AREAS

a) SCOPE

This section covers the construction of gravel wearing courses for unsurfaced roads and parking areas and gravel shoulders for surfaced roads.

This section does not apply to medians, sidewalks, traffic islands and other unsurfaced areas, which shall be constructed in accordance with this specifications.

b) MATERIALS

Material for gravel shoulders and wearing courses shall be obtained from borrow pits provided by the Employer, from excavations, cuttings or from sources provided by the Contractor.

In respect of borrow material obtained from sources provided by the contractor, the provisions of this specification are applicable.

The Engineer shall approve all sources of supply and has authority to direct from which sources all materials get obtained. The approval of a specific source of supply will not imply that all material from such a source is suitable for use, but that suitable material is available for selection from that source.

After compaction, the coarse aggregate in the gravel shall have a maximum dimension not exceeding 40 mm, unless otherwise ordered by the Engineer. Oversized aggregate in the gravel shall be broken down on the road or parking area and any remaining oversized material shall be bladed off and disposed of. Alternatively, the material shall be crushed as specified.

Gravel finally placed in the shoulders or wearing course shall conform to the quality of the material suitable for the construction of subbase, with the proviso, that the plasticity index shall not exceed 10 +3 (GM) unless otherwise authorized by the Engineer. The plasticity index shall not be less than 6.

c) CONSTRUCTION

(c.1) General

Construction shall be carried out in such a manner that adequate drainage will take place at all times and, in the case of shoulder construction, temporary drains shall be opened through the shoulder material and properly maintained until the base has been completed.

The Contractor shall not commence with bituminous work on any particular section of the road until the shoulders on that section of road have been completed and have been approved by the Engineer.

(c.2) Placing and compaction

Gravel wearing courses shall be constructed to the dimensions specified on top of the final fill layer.

Where shoulders are to be constructed from the same material as the base, the shoulders shall be constructed at the same time as the base.

Where a crushed-stone base must be constructed, the shoulders shall be constructed first and shall be cut true to line to provide lateral support for the crushed-stone material. Care shall be taken to prevent shoulder material from contaminating the base material. In the case of asphalt bases, the gravel shoulders may be constructed after the base has been compacted.

Shoulder and wearing-course material shall be spread, broken down, watered, processed and compacted per the Specification. The material shall be compacted to a density of not less than 93% of modified AASHTO density.

d) PROTECTION AND MAINTENANCE

The Contractor shall protect and maintain the completed shoulders and wearing course. Maintenance shall include the immediate repair of any damage or defects which may occur and shall be repeated as often as is necessary to keep the work

continuously intact until the end of the prescribed maintenance period, excluding normal wear and tear after the road has been opened to the public.

e) CONSTRUCTION TOLERANCES

The completed shoulders or wearing course shall comply with the construction tolerances set out below:

(a) Grade

The finished surface shall nowhere be more than 25 mm above or below the specified grade.

(b) Width

The outer edge of the shoulder or wearing course shall nowhere be more than 150 mm outside the lines shown on the Drawings. The tolerances for the position of the inner edge of the shoulder shall be as dictated by the tolerances for the width of the base.

(c) Thickness

The average thickness of the shoulder or wearing course as determined by way of test holes or accurate levels taken at the same position before and after construction, shall not be less than the specified thickness nor shall the thickness at any point be more than 30 mm less than the specified thickness.

f) TESTING

(f.1) Process control

The minimum frequency of testing the Contractor will be required to do in terms of is Specification for the purpose of process control shall be as shown in table 603/1.

(f.2) Routine inspection and testing

Routine inspection and testing will be carried out by the Engineer in accordance with the Specs to test the completed work for compliance with the dimensional tolerances, quality of material, density of compaction and any further requirements stated in this section.

Compliance with the specified density requirements of this section shall be controlled in accordance with the judgment scheme specified.

Any materials or workmanship which does not comply with the specified requirements shall be removed and replaced with that which complies with the specified requirements or, per the Engineer permission, be repaired comply with the specified requirements.

Table 603/1 Testing Frequency (TF)

Test	TF: One test every	Minimum No of tests per lot or section of road
Materials		
Field density and OMC*	1 500 m ²	4
Indicator tests	2 500 m ²	2
Tolerances		

Surface levels	40 m (3 pts per cross section)**	
Width	200 m	-
Thickness	-	30

* The determination of field dry density expressed as a percentage of modified AASHTO density implies a modified AASHTO density determination for each field density. Where material is homogeneous, this ratio can be decreased to one modified AASHTO density determination for up to four field densities.

** For parking areas, 1 test equals a series of points, 5 m apart, in a straight line across the full width of the parking area, at every 40 m cross section.

g) MEASUREMENT AND PAYMENT

Please see the BILL OF Quantities

C6.16 : ROADS AND PARKING AREAS

C6.16.1 : SEGMENTED PAVING

a) SCOPE

This section covers the paving of roads, parking areas, sidewalks, etc, with individual paving units forming a segmented pavement. Paving units can be precast concrete segmental blocks or precast concrete paving slabs albeit the latter are used for pedestrian and cycle traffic only.

b) DEFINITIONS

The following words and expressions shall have the meanings hereby assigned to them unless inconsistent with the context:

(b.1) Bedding

The operation of placing a paving unit on top of a compacted sand layer.

(b.2) Lock-up

This occurs with to segmented paving when the sealing of the joints between the paving units is improved by the action of compaction equipment, traffic and weathering. It is also defined as the initial settling-in improvement of the paving.

(b.3) Interlock

The interaction between adjoining paving units preventing random movement.

c) MATERIALS

(c.1) Precast concrete segmental blocks

Precast concrete segmental blocks of the thickness, colour, class of concrete, shape and type (S-A, S-B or S-C) specified in the Specifications, shall comply with the relevant requirements of SANS 1058, and shall be obtained from a manufacturer approved by the Engineer, in writing.

The colour of coloured blocks shall penetrate to a depth of at least 5 mm below the wearing surface of each unit and the coloured layer shall be integrally bound to the body of the unit.

(c.2) Precast concrete paving slabs

Precast concrete paving slabs shall be square and, unless otherwise specified, shall measure 450 mm x 450 mm x 50 mm at the base with the sides sloping slightly inward towards the top.

The slabs shall be manufactured from class 30/19 concrete and their appearance shall be as specified in clause 3.3 of SANS 927 for precast concrete kerbs and channels. When specified in the Project Specifications, the upper surface of the paving slabs shall have an approved skid-resistant pattern.

(c.3) Sand for bedding

(c.3.1) Sand for bedding the segmental blocks

Sand for bedding shall be free from deleterious substances or substances that could cause the discolouring of paving units. The sand shall not contain more than 3% silt and clay by mass and shall conform to the following grading:

Nominal sieve size (mm)	Percentage passing by mass
9,52	100
4,75	95 - 100
2,36	80 - 100
1,18	50 - 85
0,600	25 - 60
0,300	10 - 30
0,150	5 - 15
0,075	0 - 10

(c.3.2) Sand for bedding the paving slabs

Sand for bedding the paving slabs shall comply with the requirements for concrete sand and shall not contain more than 3% silt and clay by mass.

(c.3.3) Sand for jointing

Jointing sand shall pass through a 1,18 mm sieve and shall contain between 10% and 15% of material that passes through a 0,075 mm sieve. The sand shall not contain substances which may cause the staining of the units.

d) CONSTRUCTION

(d.1) Construction of paving with segmental blocks

(d.1.1) General

Prior to constructing the paving on roads and parking areas, the subgrade or subbase shall be checked for conformance with the requirements specified in the relevant sections of this series. The earthworks on sidewalks, traffic islands, etc, to be paved shall be trimmed to within plus or minus 10 mm of the specified level.

Local high spots shall be removed and local depressions shall be filled with approved gravel mixed with 5% CEM I cement by mass. Alternatively, the levelling

course may consist of lean concrete with a minimum of 7-day cube strength of 5 MPa.

Under no circumstances shall depressions be levelled with bedding sand.

(d.1.2) Edge restraints

Edge restraints such as kerbs, channelling, concrete strips or other forms of restraints shall be constructed and approved well in advance of the paving.

(d.1.3) Grass and weed control

When specified in the Project Specifications, the surface of the layer below the bedding sand shall be treated with a suitable herbicide to control growth of grass and weed. The herbicide shall be applied strictly in accordance with the specified requirements.

(d.1.4) Placing of sand for bedding

To ensure an even paved surface, sand from a single source shall be used. The sand shall have a moisture content of between 4% and 8%, unless otherwise permitted by the Engineer.

The sand shall be evenly spread over the area to be paved, and the kerbs and other restraints shall be used as screeding guides. For wide pavements, temporary screeding guides shall be set up in intermediate positions.

The uncompacted thickness of the sand shall be such that, after compaction, the sand layer will be 20 mm plus or minus 10 mm thick. The sand bed shall be laid slightly in advance of the placement of the paving units. Where the sand is accidentally compacted before the units are laid, it shall be raked and evenly re-screeded.

(d.1.5) Laying of paving blocks

The units shall be laid in a herringbone pattern if the block shape so permits, and, where the units cannot be so laid, shall be laid with their long axes at right angles to the line of traffic. Except where curved patterns are required, the pattern lines shall be straight and parallel to kerbs or buildings or other approved structures which adjoin the paved areas.

Full units shall be laid first, care being taken to ensure that the joint lines are straight and square. To control alignment, string lines set up in two directions shall be used.

The disturbance of laid units prior to compaction by foot or light construction traffic shall be prevented by placing boards on the paving.

Areas against kerbs, manholes, etc, that require infilling shall be filled with units cut to size with appropriate cutting tools.

Less than 25 per cent of the area of a full block unit or with a 25 mm minimum dimension shall be filled in with 30 MPa concrete with 10 mm coarse aggregate. Smaller areas shall be filled with a 1:3 cement:sand mortar.

After compaction, joints between the blocks shall not be wider than 3 mm.

(d.1.6) Compaction

The surface shall be compacted immediately after the blocks are laid, but no compaction shall be attempted within 1m of the laying face. At the completion of each day's work, the surface shall be left fully compacted to within 1 m of the working face.

Units damaged during compaction shall be removed and replaced. Compaction shall be done with a vibrating-plate compactor which produces a centrifugal force of approximately 16 to 20 kN at a frequency of approximately 75 to 100 Hz, and which has a plate area of between 0,35 and 0,5 m². For blocks of less than 80 mm thick, a vibrating-plate compactor with a centrifugal force of 7 to 16 kN, a plate area of 0,2 to 0,4 m² and a frequency of 75 to 100 Hz shall be used. Sufficient passes shall be made to compact the bedding course fully to produce an even surface.

(d.1.6) Joint filling

Immediately after the initial compaction made by two passes of the compactor, a layer of jointing sand shall be uniformly distributed over the surface of the pavement and lightly broomed into the joints. Further passes of the plate vibrator shall then be made to fill the joints, and more sand shall be spread over the surface if required. Finally, the excess sand shall be removed. The sand and the area treated shall be perfectly dry.

After the joints have been filled, construction traffic shall be allowed onto the pavement for maximum lock-up achievement. Where this is not feasible, lock-up shall be achieved, especially in the case of heavy-duty paving, by at least five passes of a heavy pneumatic-tyred roller.

(d.02) Construction of paving with paving slabs

Subclauses (d.01) (a) up to and including (d.01) (d) above apply to the construction of paving with paving slabs, except that the sand shall comply with the requirements of subclause (c.03)(b).

Where specified in the Specifications, the sand shall be mixed with 5% CEM I cement by mass, and sufficient water added to form a fairly dry and crumbly mixture. The mixture shall then be spread and screeded as specified for sand, and slabs laid thereon before the initial set has taken place.

When slabs are laid in sand or on a sand-cement mixture, a rubber hammer shall be used to bed the slabs firmly. The use of string lines is compulsory.

The slabs shall be laid with their bases butting, and the joint formed by the inward sloping sides shall be filled with a 1:3 cement:sand mortar. The slabs shall not be cut for infilling but the filling-in with a class 30/13 concrete which shall be finished off with a steel trowel.

No pedestrian traffic will be allowed on the paving until 24 hours after the joints and infills have been completed.

e) TRIAL SECTION

Full-scale paving shall not commence until a trial section which has been laid as part of the permanent paving for the purpose of assessing the Contractor's ability to produce a paving that complies with the requirements of the Specifications, has been approved by the Engineer.

A trial section in the case of roads or narrow strips of up to 5 m wide shall be a 20 m long section over the full width of the road or strip. A trial section in the case of parking areas shall be an area 20 m long and at least 5 m wide with one of the long sides butting on a permanent edge restraint.

f) TOLERANCES

Three months after it has been opened to traffic, the finished paving shall be accurate to within the following limits:

(f.1) Line of pattern

- | | |
|---|---------------|
| (a) Deviation from any 3 m straight line | 10 mm maximum |
| (b) Deviation from any 20 m straight line | 20 mm maximum |

(f.2) Vertical deviation from a 3 m straight edge

- | | |
|--|---------------------|
| (f.2.1) At the edge restraints | plus 3, minus 0 mm |
| (f.2.2) Elsewhere, except at vertical curves | plus 10 minus 15 mm |

(f.3) Surface levels of adjacent units -

Shall not differ by more than	3 mm
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g) MEASUREMENT AND PAYMENT

Please refer tot the Bill of Quantities.

C6.17 : ROADS AND PARKING AREAS

C6.17.1 : TRAFFIC SIGNS

a) SCOPE

This section covers the supply and erection of permanent traffic signs at the locations indicated on the Drawings or directed by the Engineer.

Overhead traffic-sign supports shall be manufactured in accordance with the requirements of the specifications.

The signs shall be of the standard regulatory, warning and information signs as detailed on the Drawings and shall be fabricated in accordance with the provisions of the National Road Traffic Act (Act 93 of 1996) and the Southern African Development Community Road Traffic Signs Manual, except where otherwise indicated on the Drawings.

b) MATERIALS

b.01) Structural steel

The structural steel shall comply with the requirements of BS 4360 for the type of steel specified or shown on the Drawings. Where specified, all structural steel, including tubes, shall be galvanized in accordance with the requirements of SANS 32 quality B1 or SANS 121, Table 2 or 3, as applicable.

Steel tubes shall comply with the requirements of SANS 657-1 and shall be D-shaped.

b.02) Bolts, nuts and rivets

Steel bolts and nuts shall conform to the appropriate parts of SANS 1700 or SANS 1143. Aluminium bolts and nuts shall be manufactured from alloy B51S or D65S.

All steel bolts, nuts and washers shall have a hot-dip (galvanized) zinc coating that complies with the requirements of SANS 121, Table 2 or 3, as applicable.

Blind rivets used for fixing sign faces to square tubing framework shall be 4,76 mm rivets manufactured from or coated with a material that will not cause corrosion through electrolytic action. Blind rivets used for joining aluminium extrusions shall be hardened aluminium blind rivets.

b.03) Chromadek steel plate

Steel plate for road signs shall be 1,40 mm thick Chromadek G275 galvanized Iscor steel plate, which has been treated on both sides with an epoxy primer followed by a silicon polyester top coat. The total dry thickness of the treatment shall be at least 0,025 mm.

Where a reflectorized road sign is required, its reverse side shall be painted with a dull grey prime coat and the face with only the specified top coat.

b.04) Other plate material

Other plate material shall be as specified in the Project Specifications.

b.05) Aluminium

Aluminium sections shall be of the sizes detailed on the Drawings, shall be manufactured from grade 6063.T.5 alloy and shall comply with the provisions of BS EN 12020 parts 1 and 2.

Aluminium plate shall be manufactured from grade 5251.H.3 alloy and shall conform to the requirements of BS EN 537 and shall be 2,0 mm in thickness.

b.06) Concrete

Concrete shall be manufactured and placed as specified. Class 20/19 concrete shall be used for the erection of traffic sign supports, unless otherwise shown on the Drawings or directed by the Engineer.

b.07) Paint

All paints used shall comply with the requirements of SANS 1519-2, including the standards mentioned therein.

Except where reflecting surfaces are specified, the surface of painted traffic signs shall not be excessively glossy. The 60° specular gloss measured in accordance with SANS Method 2813 should, if possible, not exceed 50. No thinners shall be added to the paint.

b.08) Retro-reflective material

Retro-reflective material shall be supplied in the following grades and shall comply with the requirements of SANS 1519-1:

Class I - Engineering-grade retro-reflective material

Class II - Super-engineering-grade retro-reflective material

Class III - High-intensity grade retro-reflective material.

The material shall be supplied with a pressure-sensitive or heat-applied adhesive backing protected by a removable liner.

b.09) Timber poles for sign supports

Timber poles for sign supports shall comply with SANS 457 part 2 or 3, shall be equal to or better than Strength Group B timber poles, and shall be stamped with the SANS mark. The posts shall be treated with a preservative as specified below, and after treatment only one cut per pole will be allowed to obtain the correct length and chamfer at the top of the post. The exposed surface of the cut shall be given two coats of the appropriate preservative.

The poles shall be treated as defined in Paragraph 1 (b) of Schedule B of the Regulations for Combating and Preventing the Spread of Certain Insect Pests affecting Soft Wood, per the Government Gazette of 2 August 1968.

The type of preservation material will be specified in the Project Specifications and shall be copper-chrome-arsenate salts which comply with SANS 673, or creosote complying with SANS 538 or 539.

b.10) Steel reinforcement

Steel reinforcement shall comply with the requirements of section 703.

b.11) Corrosion-protection tape

The corrosion-protection tape used between aluminium and steel shall be Scotch rap 50 or an equivalent approved material.

c) MANUFACTURE OF TRAFFIC-SIGN BOARDS AND SUPPORTS

c.01) Traffic-sign boards

Traffic-sign boards shall be manufactured strictly in accordance with the details tabulated on the Drawings, and shall be manufactured either from steel plate, aluminium plate or extrusion, or from particle board, as may be specified on the

Drawings. Particle board shall normally be used only on traffic signs not exceeding 10 m² in area.

Wherever possible, the traffic-sign boards shall be manufactured as one unit. Traffic signs which are too large to be transported as one unit may, with the approval of the Engineer, be manufactured in sections. The completed sections shall be assembled in the shop prior to delivery to ensure that all the sections fit together properly and that the legends are properly spaced and aligned. Joints in sign faces shall be provided only at locations and to details approved by the Engineer.

Direct contact between aluminium plate and steel supporting framework shall be avoided by corrosion protection tape being applied to the sign face over the contact areas.

c.02) Welding

All welding of steelwork shall be carried out in accordance with the standards laid down in BS EN 1011. Welding shall be done before painting.

c.03) Structural steel

The relevant provisions of section 809 shall apply to all steel supporting structures for traffic signs.

c.04) Aluminium extrusions

Aluminium extrusions for sign boards shall be joined by blind rivets or bolts. They shall preferably not be joined longitudinally, but if this cannot be prevented without excessive waste, they shall be joined neatly and the joints staggered. No sections shorter than 500 mm shall be used.

Where aluminium extrusions are to be faced with retro-reflective background material, it shall be pre-applied to individual sections before assembly, with the material taken around the face edges of each extrusion for at least 10 mm. Retro-reflective material shall be heated to facilitate binding around edges without damaging the material. Where possible the placing of letters across the joint between two extrusions shall be avoided.

c.05) Galvanizing

Where the galvanizing of structural steel sign-board frames and sign-board supporting structures is specified, it shall be done as long after welding as may be practicable. However, where this is not feasible, the steel sections shall be galvanized before assembly and then welded. All welds shall be thoroughly cleaned and loose material removed and dressed, after which the welds shall be coated with two coats of an approved zinc-rich paint.

Unless otherwise specified in the Schedule of Quantities or the Project Specifications, galvanized steel will not require painting.

Traffic-sign supports shall be constructed in accordance with the details shown on the Drawings.

Where no details for the construction of sign boards, the framework of the sign faces or the attachment thereof to the supporting framework are shown on the Drawings, they shall be designed by the Contractor himself, and he shall submit such details to the Engineer for approval before manufacture.

d) PAINTING

d.01) Colours, symbols and legends

Paint colours, symbols, legends and borders used on traffic signs shall comply with the regulations of the National Road Traffic Act, (Act 93 of 1996) and its Regulations, and also with the requirements of the Southern African Development Community Road Traffic Signs Manual.

The colours and shades shall conform to the colours and shades specified in SANS 1519-2 and shown in SANS 1091.

d.02) Preparation of surfaces and application of paint

The preparation of surfaces and all painting shall be carried out as specified in SANS 1519-2.

Unless otherwise specified, only the faces of aluminium road signs will require painting.

d.03) Time of painting

Traffic sign boards and legends shall not be painted more than six months prior to their erection.

e) STORAGE AND HANDLING

All traffic signs or portions of traffic signs shall be so handled and stored in a weatherproof storeroom to prevent any permanent deformation or damage to painted surfaces.

All unpainted surfaces and steelwork shall be protected against corrosion.

f) ERECTION OF TRAFFIC SIGNS

f.01) Position

Road signs shall be erected in the positions shown on the Drawings or indicated by the Engineer.

f.02) Excavation and backfilling

Excavations for the erection of traffic signs shall be made according to the dimensions shown on the Drawings. Where the excavations are to be backfilled with soil, a 1:12 cement:soil mixture shall be made and thoroughly compacted at optimum moisture content in 100 mm thick layers.

Where posts or structures are to be fixed in concrete, or where concrete footings are to be cast, the concrete, formwork and reinforcement shall comply with the requirements of the appropriate sections. 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.

f.03) Erection

Traffic signs shall be erected as shown on the Drawings or as directed by the Engineer. During erection the structural steelwork shall be firmly bolted and protected to prevent any buckling or damage being caused during erection or by the equipment used for erection.

Posts to which signs are to be fixed shall be vertical, and the undersides of signs shall be horizontal after completion of erection.

The month and year of erection of the road signs shall be indicated with white paint on the back of the sign in the bottom right-hand corner. The letters and figures shall be 25 mm in height.

Where signs are erected with timber poles, all the holes that are drilled in the timber shall be impregnated with hot creosote.

f.04) Field welding

All welding done during erection shall comply with the requirements for welding during manufacture.

f.05) Painting on Site

All painting done after erection shall comply with the requirements for painting during manufacture.

All places where the paintwork has been damaged during erection shall be made good by the Contractor, at his own cost, to the satisfaction of the Engineer.

f.06) Time of erection

Traffic signs shall be erected immediately prior to the opening of the road or parking area to public traffic, unless otherwise decided by the Engineer.

g) PROTECTION AND MAINTENANCE

The Contractor shall protect the completed traffic signs against all damage until the road or parking area has finally been accepted by the Employer, and he shall maintain the signs until the defects liability period has expired. Damage or defects caused by faulty workmanship or negligence shall be made good by the Contractor, at his own cost, to the satisfaction of the Engineer.

h) DISMANTLING AND RE-ERECTION OF

i) EXISTING TRAFFIC SIGNS

Where ordered by the Engineer, the Contractor shall dismantle existing signs and re-erect them at new positions indicated by him. This work shall be done with as little damage as possible to the signs.

Where required by the Engineer, the signs shall be repainted or repaired and new materials shall be used for part of or the entire supporting structure.

j) MEASUREMENT AND PAYMENT

Please see Bill of Quantities

C6.18 : ROADS AND PARKING AREAS

C6.18.1 : TRAFFIC MARKINGS

a) SCOPE

This section covers the permanent marking of road and parking area surfaces with white or yellow painted lines or symbols and the supplying and fixing of retro-reflective road studs as indicated on the Drawings or where required by the Engineer.

b) MATERIALS

b.01) Paint

(b.01.1) Road-marking paint

Road-marking paint shall comply with the requirements of SANS 731 parts 1 and 2.

Premix glass beads shall comply with the requirements of SANS 51424.

Drop on material such as glass beads, anti-skid aggregates and mixtures of the two shall comply with the requirements of SANS 51423.

The paint shall be delivered to the Site in sealed containers bearing the name of the manufacturer and the type of paint.

The viscosity of the paint shall be such that it can be applied without thinning.

(b.01.2) Retro-reflective road-marking paint

Retro-reflective paint shall comply with the requirements of SANS 731 parts 1 and 2.

(b.01.3) Proprietary brand road-marking paint

If specified in the Project Specifications, proprietary brand plastic road-marking materials shall be used.

(b.01.4) Colour

The colours to be used shall be bright white or yellow.

The colour of the yellow paint shall match colour Number B49 (golden yellow) in SANS 1091.

b.02) Road studs

Road studs shall be of the size and type indicated on the Drawings, specified in the Project Specifications or listed in the Schedule of Quantities and shall comply with the relevant requirements of SANS 1442.

The Contractor shall submit samples of the type of road studs he proposes to supply to the Engineer for his approval prior to delivery. All studs subsequently used shall be of a quality equal to or better than that of the sample.

c) WEATHER LIMITATIONS

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

d) MECHANICAL EQUIPMENT FOR PAINTING

The equipment shall consist of an apparatus to clean the surface, a mechanical road-painting machine and all additional hand-operated equipment necessary to complete the work. The mechanical road-marking machine shall paint at least two lines simultaneously and shall the paint film thickness uniform at the specified rate of application. The machine shall be so designed that it will be capable of painting the traffic markings to a uniform width with sides within the tolerances specified hereafter, without the paint running or splashing. The machine shall further be capable of painting lines of different widths by adjusting the spray jets on the machine or by attaching additional equipment to the machine.

The machine shall be capable of spraying at a speed of not less than 5,0 km/h.

e) SURFACE PREPARATION

Traffic markings shall be applied to bituminous surfaces only after sufficient time has elapsed to ensure that the painted surface is not damaged by volatile substances evaporating from the bituminous surfacing. In no way shall traffic markings be applied until at least 2 weeks after the completion of the bituminous surfacing or after any period preferred by the Engineer has expired.

Before applying paint, the surface shall be clean, dry and completely free from soil, grease, oil, acid or any other material detrimental to the bond between the paint and the surface. The portions of the surface where the paint is to be applied shall be properly cleaned by means of watering, brooming or with compressed air, if so required. Where road markings are to be made on concrete pavement, all laitance and loose curing compounds shall be removed. Particular care shall be taken to expose surface of fresh concrete on all areas where road studs are to be fixed.

f) SETTING OUT OF TRAFFIC MARKINGS

The lines, symbols, figures or marks shall be set out by means of paint spots of the same colour as that of the proposed final lines and marks. These spot marks shall be at such intervals as will ensure that the traffic markings can be accurately applied, and in no case shall they be more than 1,5 m from each other. Normally spots with a diameter of approximately 10 mm should be adequate.

The dimensions and positions of traffic markings shall be as shown on the Drawings or as specified in the National Road Traffic Act, (Act 93 of 1996) and its Regulations and the South African Road Traffic Signs Manual. After spotting, the positions of the

proposed road markings such as dotted lines and the starting and finishing points of barrier lines shall be indicated on the road.

These pre-markings must be approved by the Engineer before commencing painting operations.

The positions and outlines of special markings shall be set out in chalk on the finished road surface and approved by the Engineer before painting. The use of approved templates is permissible on condition that the positioning of the markings is approved by the Engineer prior to commencement.

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.

g) APPLICATION OF PAINT

The paint shall be applied as figures, signs, letters, symbols, broken or unbroken lines or other marks, as shown on the Drawings or directed by the Engineer.

Paint applied with a machine shall be applied in single layers. Before road-marking done on the permanent Works, the satisfactory working of the machine shall be tested on a similar site which is not part of the permanent Works. If adjustments are made to the machine, further testing must be done. Only when the machine has been correctly adjusted per the Engineer's approval, shall the machine paint the permanent Works. The operator shall be experienced in the use of the machine.

After the machine is satisfactorily adjusted, the rate of application shall be checked and adjusted, if necessary, before commencing full scale painting.

Where two or three lines are required next to each other, they shall be sprayed simultaneously. The paint shall be stirred before application, in accordance with the manufacturer's instructions. No thinners shall be applied.

Where need be, hand painting can be applied but in two layers. The second layer shall not be applied before the first layer has dried out sufficiently. As most road-marking paints react with the bitumen surface of the road, the paint shall be applied with only one stroke of the brush or roller.

Ordinary road-marking paint shall be applied at a nominal rate of 0,42 litre/m², or as directed by the Engineer, and proprietary brand paints shall be applied at the rates specified in the Project Specifications.

Road marking shall be completed before a particular section is opened to traffic. Each layer of paint shall be done continuously over the requisite area.

h) APPLICATION OF RETRO-REFLECTIVE BEADS

Where retro-reflective paint is required, the retro-reflective glass beads shall be applied by means of a suitable machine immediately after the paint has been applied, in one continuous operation. The rate of application of the beads shall be 0,8 kg/litre of paint or any such other rate as may be selected by the Engineer. Machines that apply the beads by gravity only shall not be used. The beads shall be sprayed onto the paint layer by means of a pressure sprayer.

i) ROAD STUDS

Road studs shall be of the types indicated on the Drawings and shall be fixed in the positions indicated and approved by the Engineer.

Before any studs are fixed, the surface shall be thoroughly cleaned as specified. The studs shall be fixed to the road surface with an approved epoxy resin, in accordance with the manufacturer's instructions, after the road lines have been completed.

Sufficient adhesive shall be used to give complete coverage of the contact area and to provide a slight excess. The road studs shall be pressed down onto the prepared area and all excess adhesive pressed out.

The excess adhesive shall then be removed immediately with a suitable solvent. The studs shall be protected against impact until the adhesive has hardened.

j) TOLERANCES

Traffic markings shall be constructed to accuracy tolerances given below:

j.01) Width

The line widths and other markings shall be +/-10mm within the specified.

j.02) Position

The position of lines, letters, figures, arrows, retro-reflective road studs and other markings shall be +/-20mm from the specified true position in transverse direction, or more than 100 mm in the longitudinal direction.

j.03) Alignment of markings

The alignment of any edge of a longitudinal line shall not deviate from the true alignment by more than 10 mm in 15 m length.

j.04) Broken lines

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

k) GENERAL

Lengths of broken lines segments and the gap between them shall be per the Drawings. If these lengths are altered by the Engineer, the ratio of paint lengths to the length of the gap between the painted sections shall remain the same. Lines shall not be painted more than 3 months before the road or parking area is opened to public traffic.

Lines on curves, whether broken or unbroken, shall not consist of chords but shall follow the correct radius.

Where plastic road-marking material is used, the Contractor shall produce an approved guarantee from the manufacturer as specified in the Project Specifications.

l) FAULTY WORKMANSHIP OR MATERIALS

If any material which does not comply with the requirements is delivered on Site or used on the Works, or if any substandard work is carried out, such material or work shall be removed, replaced or repaired as may be required by the Engineer and at

the Contractor's own cost. Rejected traffic markings and paint that has been splashed or has dripped onto the surfacing, kerbs, structures or other such surfaces shall be removed by the Contractor, at his own cost, in such a manner that the markings or spilt paint will not show up later.

m) PROTECTION

After paint has been applied, the traffic markings shall be protected against damage by traffic or by other causes. The Contractor shall be responsible for the erection, placing and removal of all warning boards, flags, cones, barricades and other protective measures which may be necessary in terms of any statutory regulations and/or as may be recommended in the Southern African Development Community Road Traffic Signs Manual.

n) MEASUREMENT AND PAYMENT

Please see the Bill of Quantities and the Bid Documentation

C6.19 : STRUCTURES

C6.19.1 : FOUNDATIONS FOR STRUCTURES

a) SCOPE

This section covers the foundation work for all structures except prefabricated culverts and pipes, and it also covers excavations to accommodate structures and for the founding of structures, as well as dewatering, cofferdams, backfilling, foundation fill, grouting, etc. Piling is also covered herein.

b) MATERIALS

b.01) Rock for foundation fill

Rocks shall be hard, angular, field or quarry rocks of a quality that will not disintegrate upon exposure to water or the weather. The rocks shall be free from overburden, shale, organic and other deleterious material. The width and thickness of any rock shall each be at least one third of its length. The average mass of a single rock shall be as specified in the Project Specifications. Not more than ten per cent of the total volume of a rock fill shall consist of rocks with a mass of less than half the mass specified and not more than ten per cent of the volume of rock fill shall consist of rocks with a mass of more than five times the mass specified. At least fifty per cent of the total volume of a rock fill shall consist of rocks with a mass greater than the specified mass.

b.02) Crushed stone for foundation fill

Crushed stone shall be clean, hard, durable stone from approved sources. The aggregate crushing value of the stone shall not exceed 30 when tested in accordance with method B1 of TMH1. Crushed stone for foundation fill shall comply with the grading requirements as specified in the Project Specifications.

b.03) Granular material for foundation fill

Granular material shall be approved granular material of at least gravel subbase material quality.

c) GENERAL

c.01) Subsurface conditions

The Contractor shall take note of the General Conditions of Contract provisions. If, during the course of excavation, the load-bearing strata are found to differ from those on the Drawings or set out in the Specifications, the Contractor shall immediately notify the Engineer in writing.

The Engineer shall be entitled, as often as he may deem it necessary during the course of excavation, to instruct the Contractor to make additional foundation investigations and to carry out tests at or below the founding level in order to establish safe bearing pressures and founding depths.

(c.02) Stream flow

Stream flow shall be maintained and freshwater life shall be preserved at all times. Stream crossings shall be constructed without the stream flow being disrupted at the point of crossing. On completion of the work, all surplus excavated materials, materials used in cofferdams, artificial islands and other temporary works, and also in situ material, shall be removed to the original stream-bed level or from such lower level as may be specified or required by the Engineer. The Contractor shall dispose of all such materials.

d) COFFERDAMS, ARTIFICIAL ISLANDS AND DEWATERING

(d.01) Cofferdams

These are not part of this contract.

(d.02) Artificial islands

Where required, artificial islands shall be constructed to gain access to foundation positions and to carry out foundation work.

The platform for supporting material, plant and equipment shall, where necessary, be consolidated to provide firm support. The Contractor may use any material he may deem suitable to construct the island.

On completion of the work, the Contractor shall remove the artificial island and reinstate the Site to the satisfaction of the Engineer.

(d.03) Dewatering of foundation excavations

Over and above general obligations in dealing with water, the Contractor shall be responsible for preventing water ingress into foundation excavations. Such preventative measures may include construction and maintenance of intercepting and diversion berms and drainage channels, primarily along the boundaries of the excavations and further supported by grid(s) of longitudinal and cross drainage

channels, with all channels effectively draining towards lower lying natural drainage routes or pumps, with all the necessary bailing and pumping equipment supplied, operated and maintained by the Contractor. The preventative measures shall allow the necessary construction operations to be properly executed.

These measures, with the exception of pumping, shall be maintained until the backfilling has been completed, after which all settled silt, mud, etc, shall be removed from the exposed surfaces. Between the various construction stages, pumping may be interrupted as may be decided by the Engineer. The draining or pumping of water from foundation excavations shall be done in such a way that no concrete materials are carried away.

Where the drainage channels are filled with crushed stone, as directed by the Engineer, this stone will be measured for payment as foundation fill.

(d.04) Payment

If a lump sum has been set out in the Schedule of Quantities for the dewatering of foundations and a provisional sum for the construction of cofferdams and artificial islands, the method of payment for work authorized by the Engineer shall be in accordance with the provisions of the relevant pay items. Work not authorized by the Engineer shall not be paid for.

If no lump sum or provisional sum is in the Schedule of Quantities, the tendered rates for foundation excavations and backfilling shall include full compensation for the construction of artificial islands and for the dewatering of foundations.

e) EXCAVATION

(e.01) Clearing and grubbing, and topsoil

The Contractor shall not commence with the excavations for structures before he has obtained written instructions from the Engineer regarding any requisite clearing and grubbing and any removal and stockpiling of topsoil.

(e.02) Reference surface for excavation

The Contractor shall notify the Engineer in good time of his intentions to commence with specific excavation so that the average surface level of the undisturbed ground from which the excavation is to be measured can be established and agreed on by the Engineer and the Contractor

(e.03) Excavation limits for payment purposes

For measurement and payment purposes, the limits of the excavations for structures shall be as shown on the Drawings.

Where no excavation limits are shown on the Drawings and the Engineer has decided that formwork has to be provided for the sides of a concrete member, the limits of the excavation for measurement and payment purposes shall be the vertical planes 0,6 m outside the perimeter of the concrete member for which the formwork is to be provided, and the founding level shown on the Drawings.

In suitable stable material, the excavations shall be carried out and trimmed to the neat dimensions of the concrete members shown on the Drawings or as may be directed by the Engineer so that the excavated surfaces will act as forms for the casting of the concrete.

To prevent moisture loss in the concrete where excavated surfaces act as forms for the casting of the concrete, a foundation lining shall be installed as specified in this section, or provided that sufficient space has been made available during excavation, an additional 50 mm of concrete cover over and above the specified cover shall be provided, all as specified on the Drawings or as directed by the Engineer.

(e.04) Over-excavation

Over-excavation in hard material shall be backfilled with the same class of concrete as that in the concrete member or with mass concrete as specified or as directed by the Engineer and shall be at the Contractor's expense.

Over-excavation in soft material shall be backfilled with suitable material approved by the Engineer and shall be compacted all at the Contractor's own expense and as directed by the Engineer.

(e.05) Unsuitable material

Boulders, logs or any other unsuitable excavated material shall be taken to spoil.

Where, in the opinion of the Engineer, unsuitable material is encountered at founding level, such material shall be removed and replaced with foundation fill in accordance with the requirements of this section and as directed by the Engineer.

(e.06) Preparation of the founding surface

Where hard material suitable for founding is encountered at the founding level, it shall be cut and trimmed to a firm surface, either level, stepped or serrated, as may be required.

Where there are indications that the material at the founding level will be soft material or hard material that will deteriorate rapidly on exposure, the excavation of the final layer with a thickness of 150 mm shall be postponed until just before the blinding layer is placed.

Where shown on the Drawings or ordered by the Engineer, excavations shall be extended to a specified depth below the undersides of the slabs and footings to make provision for the placing of a concrete blinding layer.

(e.07) Classification of excavation

For payment purposes, all material excavated for structures shall be classified as follows:

(i) Hard material

Boulders of 0,15 m³ each or more in volume, and material that cannot be excavated except by drilling and blasting or with the use of pneumatic tools or mechanical breakers shall be classified as hard material.

(ii) Soft material

All material not classified as hard material shall be classified as soft material.

(e.08) Blasting

Where blasting is permitted, it shall be carried out in accordance with the requirements of clause 18 of section 001.

(e.09) Deterioration of foundation excavations

Where the bottoms or sides of foundation excavations are softened as a result of negligence on the part of the Contractor in allowing stormwater or other water to enter the excavation, the softened material shall be removed and replaced with foundation fill as directed by the Engineer, at the Contractor's expense.

(e.10) Excavation safety

The Contractor shall take the necessary precautions to safeguard the stability and safety of the excavations and adjacent structures.

No person's safety shall be placed in jeopardy, nor shall any situation be allowed to arise which may result in damage of any nature whatsoever.

All excavations shall be carried out strictly in accordance with the requirements of the Construction Regulations 2003.

(e.11) Inspection

No concrete shall be placed before the Contractor has properly cleaned the excavation and it has been inspected and approved by the Engineer.

f) FOUNDING

As there may be possible variations in the anticipated founding conditions, the dimensions and founding levels specified or shown on the Drawings may have to be varied during construction.

The Engineer has full and absolute power in terms of this Contract to order such variations and to specify the actual founding level for each foundation fill and base during construction, and his decision shall be final and binding on the Contractor.

The Contractor shall not be entitled to any additional payment as a result of any such variation in the dimensions or founding depths over and above that provided in this section, regardless of the stage of construction at which the instruction to vary the dimensions or founding depths is given. However, if as a result of such variation order the Contractor is compelled to replace machines and equipment with other machines and equipment in order to complete the work successfully, the Engineer may, at his discretion, reimburse the Contractor for additional expenses incurred, provided that the original machines and equipment were suited to the work required prior to the variation order being issued.

No base shall be founded unless authorized by the Engineer. Each founding level shall be accurately measured and recorded.

The term "founding level" used in these Specifications shall be deemed to have the following meanings in respect of –

- foundation fill: the surface of the in situ material that has been prepared to receive foundation fill and
- footings: the underside of the footings.

g) UTILIZATION OF EXCAVATED MATERIAL

Excavated material and material recovered from temporary work shall, in so far as it is suitable, be utilized for backfill. Material unsuitable for use as backfill or in excess of the quantity required to complete the backfill shall be spoiled or utilized as directed by the Engineer.

Excavated material not used for backfill or not taken to spoil but used in the construction of embankments or other parts of the work, as directed by the Engineer, shall be paid for under foundation excavation as well as under the relevant item for the purpose for which it is used.

No haulage shall be paid for excavated material and imported material for backfill where such material is transported within the free-haul boundaries.

Excavated and stockpiled material shall be deposited in such a manner that it does not endanger the uncompleted structure either by direct pressure or indirectly by overloading the banks contiguous to the structure, or in any other way.

h) BACKFILL AND FILL NEAR STRUCTURES

(h.01) General

When placing backfill and fill, the following precautions shall be taken:

- In so far as it is practicable, the material shall be placed simultaneously to approximately the same elevation on all sides of a structure or structural member where appropriate. If conditions require that backfill or fill be placed appreciably higher on one side than on the opposite side, the additional material on the higher side shall not be placed until authorized by the Engineer and preferably not until the concrete has been in place for 14 days, or until tests show that the concrete has attained sufficient strength to safely withstand any pressure that will be created by the backfill or fill or by the method of construction.
- The material behind structural members restrained at the top by the superstructure, e.g. portal-type structures, shall be placed as stated on the Drawings or as directed by the Engineer.
- The material behind the walls of concrete culverts shall not be placed until the top slab has been placed and cured, unless otherwise authorized by the Engineer.

(h.02) Backfill

Excavated areas around structures, between the structure and the vertical walls of the surrounding excavation, shall be backfilled with approved material in horizontal layers not exceeding 150 mm in depth after compaction, to the level of the original ground surface or to the level specified on the Drawings. Each layer shall be moistened or dried to the optimum moisture content for the material and be compacted to a density of not less than 90% of modified AASHTO density, except in a road prism, where the material shall be compacted to a density of not less than 93% of modified AASHTO density.

In cases where structures are founded on backfill material, the density shall be as specified in the Project Specifications but shall not be less than 95% of modified AASHTO density.

(h.03) Prevention of wedge action

Before the fill in the space between a structure and any adjacent sloping fill and the backfill between a structure and the sloping sides of the surrounding excavation is constructed, the slope of the fill and of the sides of the excavation shall be benched or serrated in order to prevent wedge action between the structure and the fill or the sides of the excavation during backfilling and compaction.

The distance between the exposed face of the structure and the toe of the fill or excavation side shall be sufficient to allow proper compaction.

(h.04) Fill within restricted area

The portion of the fill within 3 m of the concrete faces of the structure and other portions of the fill shall be termed "fill within restricted area" only when designated as such on the Drawings.

Fill within the restricted area shall comply with the requirements, except that it shall be compacted to a density of not less than 93% of modified AASHTO density. In order to achieve the specified density, the Contractor shall, where necessary, import material of suitable quality.

Payment for the construction of fill within restricted areas shall be made only in respect of fill designated as "fill within restricted areas" on the Drawings.

i) FOUNDATION FILL

If, during the course of excavation, the material at the indicated founding depth does not have the required bearing capacity as specified on the Drawings, the excavations shall be extended at the discretion of the Engineer until satisfactory founding material is encountered. The Engineer may then order the Contractor to make up the difference in levels with foundation fill.

Where the foundation fill consists of rock or crushed stone, it shall be constructed in accordance with the requirements of the Project Specifications or as directed by the Engineer.

Foundation fill consisting of granular material shall comply with the requirements specified in section 601 for subbase and shall be constructed in layers not exceeding 150 mm in thickness after compaction. Each layer shall be moistened or dried to optimum moisture content for the material and be compacted to a density of not less than 95% of modified AASHTO density.

Mass concrete fill to be used shall be of the class or mix specified or directed by the Engineer.

Unless otherwise specified or directed by the Engineer, the foundation fill constructed with rock, crushed stone or compacted granular material shall be defined by a prism with vertical sides. The base of the prism lies in the founding

plane and coincides with the base of a prismoid with trapezium-shaped sides which extend downwards and outwards at an angle of 60° with the horizontal from the outer edges of the underside of the footing down to the founding level. The upper plane of the prism is to lie in the plane of the underside of the footing.

Where shown on the drawings or ordered by the Engineer, a concrete blinding, 75 mm thick and of class 15/19 concrete, shall be placed underneath all footings, except where mass concrete fill is used.

Where mass concrete fill is constructed under a footing, it shall be constructed accurately to the final levels of the underside of the footing.

j) GROUTING OF ROCK FISSURES

Where specified, fissures in the rock below and around the footings shall be sealed by pressure grouting with a neat cement or sand-cement grout with a water cement ratio as agreed to by the Engineer. The extent of fissuring shall be established by water testing under pressure.

Holes of at least 40 mm in diameter shall be drilled in positions ordered by the Engineer and grout shall be pumped into these holes under suitable pressure. Grouting shall be carried out in 3 m maximum depth increments to the maximum depth ordered. Care shall be taken to avoid further fracturing of the rock strata by excessive grouting pressure.

Grouting of rock fissures shall be carried out by specialists approved by the Engineer.

k) FOUNDATION DOWELS

Where required, foundation dowels of specified material, diameter and length shall be installed at the positions and to the dimensions shown on the Drawings or as directed by the Engineer. After exposing, clearing and trimming of the rock formation, holes of not less than 40 mm in diameter and of specified depths shall be drilled into the rock. Prior to the dowels being installed, the holes shall be cleaned by water jetting or with compressed air and shall be filled with a 2:1 sand:cement grout.

l) FOUNDATION LINING

Where specified or directed by the Engineer, foundation lining shall be installed as described hereafter. The Engineer shall have the right to order the use of lining against the sides of excavations and the underside of footings in lieu of formwork and concrete blinding.

All surfaces to be lined shall be covered with an approved sheeting to provide a clean, impervious layer. The material shall be of sufficient strength to provide a durable working surface and support the concrete and reinforcement without tearing. The joints between strips shall have a 150 mm overlap and the lining shall be held firmly in position with nails, pegs, etc. Polyethylene sheeting with a minimum thickness of 0,150 mm is generally considered adequate for this purpose.

m) MEASUREMENT AND PAYMENT

Please see Bid Documentation and Bill of Quantities

C6:20 : STRUCTURES

C6.20.1 : FALSEWORK, FORMWORK AND CONCRETE FINISH

a) SCOPE

This section covers the design, supply and erection of all falsework and formwork used in the construction of permanent work.

This section also describes the classes of concrete-surface finishes on formed and unformed concrete surfaces.

b) MATERIALS

(b.01) General

The materials used in the construction of falsework and formwork shall be suitable for the purpose for which they are required and shall be of a quality that will produce the specified standard of work. The type, grade and condition of the materials shall be subject to the Engineer's approval.

(b.02) Falsework

Timber, structural steel and scaffolding used shall be free from defects that may impair the falsework stability. The jacks, devices, clamps and fittings shall all be in good working order and of an adequate design and strength.

(b.03) Formwork

(i) Tongued and grooved boarding

Tongued and grooved boarding shall be suitably dried timber that will not warp, distort or cause discolouration of the concrete. The widths of the boards shall be as specified on the Drawings or as directed by the Engineer. Boards shall be supplied in lengths not shorter than 3 m.

(ii) Steel forms to exposed surfaces

For a class F3 surface finish for which steel forms are permitted and for a class F2 surface finish, the individual and assembled panels shall be sufficiently rigid and adequately clamped so that they will not deform or kick during handling or under the pressure of the wet concrete.

The surfaces of forms that are to be in contact with concrete shall be clean, free from deposits or adhering matter, weld runs, ridges and spatter that will impart irregularities and blemishes to the concrete surface. They shall also be free from indentations and warps.

(iii) Void formers

Void formers used in permanent work shall be subject to the Engineer's approval.

Where void formers of a particular type or special design are required, details of the material, its thickness, and any relevant information in regard thereto will be specified in the Project Specifications or in the Schedule of Quantities or on the Drawings.

Void formers shall be manufactured from material that will not puncture, tear or be damaged during the course of construction and shall be of such a tight construction that it will prevent any undue loss of the mortar component of the concrete through leakage. The units shall be sufficiently rigid so that they will not be deformed during handling or under the pressure of the wet concrete.

Unless otherwise specified, the metal thickness for mild-steel spiral-lock-formed (seamed) void formers shall be as follows:

(iii.i) Unbraced void formers

- 0,6 mm for diameters of up to 600 mm
- 0,8 mm for diameters exceeding 600 mm and up to 800 mm
- 1,0 mm for diameters exceeding 800 mm and up to 1 000 mm

(ii) Braced void formers

- 0,6 mm for diameters of up to 800 mm
- 0,8 mm for diameters exceeding 800 mm and up to 1 000 mm
- 1,0 mm for diameters exceeding 1 000 mm and up to 1 200 mm
- 1,2 mm for diameters exceeding 1 200 mm.

The thickness specified for braced void formers shall apply to formers internally braced with timber or equivalent braces. The braces shall be at spacings not exceeding 2,0 m and not further than 1,0 m from the end of each unit. Timber cross braces shall consist of members with cross-sectional dimensions of at least 50 mm x 50 mm.

All hollow void-former units shall be provided with a 12 mm diameter drainage hole at each end.

(iv) Chamfer and recess fillets

Wooden fillets used to form chamfers and recesses on exposed surfaces shall be of new material, unless otherwise authorized by the Engineer. Other materials intended for use as fillets shall be subject to approval by the Engineer.

(v) Jack rods for sliding formwork

The jack rods, base plates and couplers shall be strong enough to carry the design load under all operating conditions without buckling or becoming distorted or causing damage to the concrete. Jack rods that are to remain permanently embedded in the concrete shall comply with the requirements herein. Under no circumstances shall bent rods be used in the work.

The jack rods which are used have a diameter of at least 25 mm.

c) GENERAL

Notwithstanding the Engineer's approval of the design and drawings prepared by the Contractor for the falsework and formwork and the acceptance of the falsework and formwork as constructed, the Contractor shall be solely responsible for the safety and adequacy of the falsework and formwork and shall indemnify and keep indemnified the Employer and the Engineer against any injury to or claims by persons or losses of or damage to property whatsoever which may arise out of or in consequence of the design, construction, use and maintenance of the falsework and

formwork and/or against all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

For works on, over, under or adjacent to any railway line the Contractor shall, inter alia, comply with the requirements for the preparation and submission of drawings for falsework and formwork, and the submission of certificates for the proper construction thereof, all in accordance with the requirements of the owner of such railway line.

After construction of the falsework and formwork, and prior to the placing of reinforcing steel and/or the placing of concrete, the Contractor shall inspect the them. Dimensions shall be checked, unevenness of surface shall be corrected and special attention shall be paid to the adequacy and tightness of bolts, ties and bracings as well as to the soundness of the foundations.

The Contractor shall notify the Engineer at least 24 hours in advance of his intention to place concrete, in order to enable him to inspect all aspects of the completed work. However, before notifying the Engineer, the Contractor shall satisfy himself that the work complies with the Specifications in all respects.

Concrete sections with dimensions smaller than 200 mm shall not be formed with sliding formwork, unless approved by the Engineer in writing.

Where no provision has been made in the Schedule of Quantities for sliding formwork, the Contractor may, in a covering letter to the Tender, submit a lump sum which reflects a saving in the costs for the use of sliding formwork in lieu of conventional formwork.

d) DESIGN

(d.01) General

The Engineer may require the Contractor to submit to him, for his consideration and approval, the design and drawings of the falsework and formwork for any structure.

(d.02) Falsework

The Contractor shall make his own assessment of the allowable bearing pressure on the foundation material and shall design the footings and falsework to guard against overloading, differential settlement and unacceptable overall settlement. In assessing the allowable bearing pressure, due consideration shall be given to the effect which wetting has on the foundation material.

When designing the falsework, cognisance shall also be taken of the load redistribution load that may occur on account of the effect of temperature, wind force, prestressing of curved and skewed structures, stage construction, flooding and debris.

Particular attention shall be given to the provision of transverse and diagonal bracing as well as to web stiffeners on cross bearers.

(d.03) Formwork

(i) General

Formwork shall be designed to be sufficiently rigid to ensure that the specified dimensional tolerances can be achieved under the combined action of self-weight, dead loads and imposed loads as well as the additional loads resulting from the rate of concreting, the lift cast in one operation, and the method of placing and compaction.

(ii) Sliding formwork

The Contractor shall be responsible for designing the sliding formwork assembly. Prior to fabrication or bringing the assembly and auxiliary equipment to the Site, the Contractor shall submit drawings of the complete sliding formwork assembly to the Engineer for approval. The drawings shall show full details of the forms, jacking frames, access ladders, hanging platforms, safety rails and curing skirts, and also details of the jacks and jack layouts.

The Contractor shall be required to submit to the Engineer, before sliding commences, an instruction manual which details the sliding technique, the jacking procedure, methods of keeping the formwork level, the procedure to be adopted to prevent bonding of the concrete to the forms and the method of releasing the forms in the event of bonding, the instrumentation and monitoring of the slide, correcting for verticality, twisting and levelness, etc.

The formwork panels shall be inclined to give a small taper, and the forms shall be slightly wider at the bottom than at the top. The taper shall be designed to produce the specified concrete thickness at the mid-lift level of the form.

The spacing of the jacks with their jack rods must be so designed that the dead load of the sliding formwork assembly, the frictional load, and the mass of materials, personnel and equipment will be evenly distributed and within the design capacity of the jacks used.

e) CONSTRUCTION

(e.01) Falsework

The falsework shall be erected in accordance with the approved drawings which shall incorporate such modifications as may be required by the Engineer.

The Contractor shall take precautions to guard against deterioration of the foundations during the course of construction.

The falsework shall incorporate features that will permit the alignment of the formwork to be adjusted to compensate for any expected settlement and deflection under load.

(e.02) Formwork

(i) General

The formwork shall be erected to levels calculated from the information given on the Drawings. The levels shall be adapted to make allowance for the specified pre-camber as well as for the expected deflection and settlement of the fully loaded falsework and formwork. The levels shall be set out

For the construction of the formwork the Contractor may use any material suited to and compatible with the class of surface finish and dimensional tolerances specified for the particular member.

Formwork shall be sufficiently rigid to maintain the forms in their correct position, shape and profile and shall be of such tight construction that the concrete can be placed and compacted without undue loss or leakage of the mortar component of the concrete.

The joints between contiguous formwork elements shall be closely butted and, where necessary, if undue leakage is expected, the joints shall be caulked, taped or packed with a sealing gasket, all at no extra payment. Paper, cloth or similar materials shall not be used for this purpose.

The formwork construction shall permit accurate erection and easy stripping without shock, disturbance or damage to the cast concrete. Where necessary, the formwork assembly shall permit the removal or release of side forms independently of the soffit forms.

Metal supports, ties, hangers and accessories embedded in the concrete shall be removed to a depth of not less than the cover specified for the reinforcement. The use of wire ties is not permitted.

All external corners shall be chamfered by the fixing of fillet strips into the corners of the formwork to form 25 mm x 25 mm chamfers. Re-entrant angles need not be chamfered unless specified.

(ii) Formwork to exposed surfaces

The forms and boards shall be arranged to form a uniform and regular pattern in line with and perpendicular to the main axis of the member, unless otherwise approved or directed by the Engineer.

Joints between contiguous members shall, after caulking, taping or sealing, be treated to prevent blemishes, stains and undue marks from being imparted to the concrete surface.

Bolt and tie positions shall be so arranged that they will conform to the symmetry of the formwork panels or boards. Bolts and rivet heads that will be in contact with the formed surface shall be of the countersunk type and shall be treated to prevent marks from forming in the concrete surface.

The formwork at construction joints shall be braced to prevent steps from being formed in the concrete surfaces at the joints between successive stages of construction.

Where moulding or recess strips are specified, they shall be neatly butted or mitred.

(iii) Formwork to open joints

Requirements for open joints in respect of formwork, unless otherwise specified, shall apply only to cases where the distance between opposite concrete surfaces is equal to or less than 150 mm.

Formwork to open joints shall be constructed to produce a class F1 surface finish to concealed surfaces or a class F2 or F3 surface finish which corresponds to the in-plane surface finish of the bordering concrete surfaces. The material used and the

construction of the formwork shall permit its complete removal to form the open joint. Where polystyrene or a similar material that is susceptible to damage is used to form open joints, it shall be lined with a hard surface on the side to be concreted.

The hard material shall be sufficiently resilient to ensure that the required quality of work can be achieved.

(iv) Openings and chases

Openings and chases shall only be provided if detailed or authorized by the Engineer. Frames for openings shall be rigid and firmly secured in position to prevent displacement. Temporary holes shall be so formed that they will not create an irregular pattern in relation to the rest of the exposed formed concrete surface.

(v) Sliding formwork

(v.i) Plant and equipment

Unless otherwise specified in the Project Specifications, hoisting equipment for sliding formwork that works stepwise with upward movements of between 10 mm to 100 mm is acceptable. However, it is preferable to use linked hydraulic or pneumatic jacks that are reversible and are driven by an electrically operated pump, and that can hoist at a steady rate. The jacks shall have independent controls for regulating verticality and levelness. The jacking system shall ensure that the sliding formwork assembly can be evenly hoisted.

The use of hoisting systems that work without jack rods shall be subject to the Engineer's approval.

All equipment shall be thoroughly tested and inspected before installation and shall be maintained in a good working order throughout the sliding operation.

The Contractor shall keep adequate back-up plant, equipment and quantities of materials on the Site to ensure uninterrupted sliding.

(v.ii) Instrumentation and monitoring

The Contractor shall supply and install suitable instrumentation on the sliding platform and foundations and at the sides of the structure for monitoring height, verticality, twisting and levelness at regular intervals. The equipment used, its utilization and the frequency of recording the readings shall be approved by the Engineer.

The Contractor shall be responsible for all monitoring work and shall ensure that the records of all readings and measurements taken are filed systematically and are at all times available to the Engineer and the person in control of the sliding operation.

Unless otherwise specified, the verticality of the structure shall be controlled with laser alignment apparatus or optical plummets, and the levelness of the sliding forms with a water-level system with reference control points placed at strategic locations.

Height and verticality shall be monitored at intervals not exceeding 4 hours. The measurements shall immediately be plotted on graphs. When the structure is more than 10 mm out of vertical the Engineer shall be notified immediately.

(v.iii) Supervision

During the entire duration of the sliding operations, a competent person who is fully acquainted with the sliding technique and the Contractor's methods of construction shall be in attendance on the sliding platform and in control of the sliding operations.

(v.iv) Construction

The jacking frame shall be constructed with adequate clearance between the underside of the cross members and the top of the formwork to allow the horizontal reinforcement and embedded items to be correctly installed. A control procedure shall be agreed on by the Contractor and the Engineer in order to ensure that all the reinforcement has been placed. At all times there shall be horizontal reinforcement above the level of the top of the formwork panel.

Guides shall be provided to ensure that the vertical reinforcement can be placed correctly and that the specified concrete cover over the reinforcement is maintained. Where jack rods are to be recovered, adequate provision shall be made for their removal without damage to the concrete.

Where jack rods occur at openings or chases, adequate lateral support shall be provided to prevent their buckling.

Equipment and material shall be distributed on the working platforms, to distribute the load evenly to the jacks.

Deflector plates shall be provided at the top of the forms of the outside walls to prevent concrete from falling down the outside.

The framework, forms and platforms shall be cleared regularly to prevent the accumulation of concrete remnants.

The Contractor shall take all precautions to prevent contamination of the concrete and reinforcing steel by leaking oil or other causes.

(v.v) Sliding

The Contractor shall give the Engineer 24 hours' notice before commencing with a slide. Engineer's Permission to commence with the slide may not be given until the sliding formwork assembly is fully operative, and the complete stock of all the required materials and the back-up plant and equipment are on the Site.

The Contractor shall ensure that the rate of sliding is such that the concrete at the bottom of the formwork has obtained sufficient strength to support itself and all loads that may be imposed upon it at the time, and that the concrete does not adhere to the sides of the forms.

The sliding operations shall be continuous, until the full height of the structure is reached, and shall be geared and organized for an average sliding rate of 350 mm/h.

(v.vi) Interruptions

Once the sliding operations are delayed for more than 45 minutes, the Contractor shall prevent adhesion of the setting concrete to the formwork panels by easing the forms or by moving them slightly every 10 minutes, or alternatively, where reversible jacks are used, by lowering the forms by 10 mm - 25 mm. Wherever interruptions occur, emergency construction joints shall be formed and treated accordingly.

Before concreting is restarted, the form shall be adjusted to fit snugly into the hardened concrete so as to avoid steps from forming on the exposed concrete surface. When sliding is recommenced, care shall be taken to prevent the fresh concrete from being lifted off from the old concrete.

(vi) Permanent formwork

Void formers shall be secured in position at regular intervals to prevent displacement and distortion during concreting. The void formers shall be supported on precast concrete blocks or rigid welded steel cradles, all subject to the approval of the Engineer. The ties securing the void formers shall be attached to the formwork and cross bearers of the falsework. The void formers shall not be tied to or be supported on the reinforcement.

Fibre-cement plates shall be supported so that the plate spans in the direction parallel to the orientation of the fibres.

(vii) Preparation of formwork

The surfaces of forms that are to be in contact with fresh (wet) concrete shall be treated to ensure non-adhesion of the concrete to the form and easy release during stripping of the formwork.

Release compounds and agents shall be approved by the Engineer in writing and shall be applied in accordance with the manufacturer's instructions, and precaution shall be taken to avoid contamination of the reinforcement, prestressing tendons and anchorages. In selecting compounds and agents due regard shall be given to maintenance of uniform colour and appearance of all exposed concrete surfaces.

Before the concrete is placed, all dirt and foreign matter shall be removed, and the forms shall be thoroughly wetted with water.

f) REMOVAL OF FALSEWORK AND FORMWORK

Falsework and formwork shall not be removed before the concrete has attained sufficient strength to support both its own mass and any imposed loads. This condition shall be assumed to require that, after the concrete has been placed, the formwork shall remain in position for the appropriate minimum period of time per table 702/1, unless the Contractor proves to the satisfaction of the Engineer that shorter periods are sufficient for fulfilling this condition. In such a case the formwork may be removed after the agreed shorter periods of time.

Falsework and formwork shall be removed carefully without shock, disturbance or damage being done to the cast concrete or structure. Weather may be regarded as "normal" when atmospheric temperatures adjacent to the concrete, as measured by a maximum and minimum thermometer, do not fall below 15°C, and as "cold" when temperatures measured in the same way fall below 5°C. When minimum temperatures lie between these values, the stripping times shall be between the periods specified for normal and cold weather.

Any period during which the temperature remains below 2°C shall be disregarded in the calculation of the minimum time which shall elapse before forms are removed.

On continuous reinforced concrete structures, the falsework and supporting formwork shall not be removed before the concrete of the last pour has reached the appropriate minimum age given in table 702/1 below or the appropriate minimum strength.

Where the structure is constructed in stages, the falsework and supporting formwork shall be removed as specified on the Drawings or as directed by the Engineer.

In lieu of the times specified in table 702/1, the falsework and formwork to soffits of slabs and beams may be removed once the concrete has attained 70% of its specified cube compressive strength. The compressive strength of the concrete shall be established from a representative and adequate number of cubes that have been stored under conditions that simulate the field conditions. Similarly, side forms may be removed when the concrete has attained a cube compressive strength of 2 MPa.

Table 702/1: Removal Of Falsework And Formwork : Minimum Times (Days)

Falsework & formwork to-	TYPE OF CEMENT USED					
	Normal Cement		Rapid-Hardening Cement		CEM III*	
	Normal Weather	Cold Weather	Normal Weather	Cold**	Normal Weather	Cold Weather
Beam sides, walls & unloaded columns	1	2	1	1	2	4
Soffits of slabs and beams:						
a) Spans to 3m						
b) Spans over 3m up to 6m	4	7	2	4	6	10
c) C) spans over 6m up to 12m	10	17	5	10	14	24
d) Spans over 12 m	14	24	10	18	21	28
	21	30	18	28	28	36

* Also applicable to a 50/50 mixture of CEM-I and ground granulated blast-furnace slag.

** Shorter periods may be used for sections with a thickness exceeding 300 mm.

g) FORMED SURFACES : CLASSES OF FINISH

(g.01) General

In addition to complying with the tolerances specified here in, the concrete surface finish on formed surfaces shall also comply with the following requirements.

(g.02) Class F1 surface finish

After surface defects have been remedied, no further treatment of the as-stripped finish shall be required. This finish is required on concealed formed surfaces.

(g.03) Class F2 surface finish

This finish shall be equivalent to that obtained by the use of wrought-thickened, square-edge timber panels and boards, shutter boards, or from steel forms arranged

in a regular pattern. The finish is intended to be left as struck, but surface defects shall be remedied accordingly.

While minor surface blemishes and discolourations are permissible, large blemishes and severe stains and discolouration shall be made good as directed by the Engineer. Such surface finishing is intended for exposed formed surfaces that cannot readily be seen by the general public, as in the case of culverts, remote structures and structures with restricted access.

Where sections of structures are required to support loads additional to their own mass before the concrete has attained sufficient strength, the removal times shown in table 702/1 shall not apply, and longer times before their removal shall be agreed upon by the Engineer and the Contractor and shall be confirmed in writing.

On prestressed-concrete structures the falsework and supporting formwork shall be removed after the full pre-stressing force relating to the particular stage of construction has been applied, unless otherwise shown on the Drawings or directed by the Engineer.

(g.04) Class F3 surface finish

This finish shall be that obtained by first producing a class F2 surface finish with joint marks forming a regular pattern approved by the Engineer to fit in with the appearance of the structure. Thereafter all projections shall be removed, irregularities repaired and the surface rubbed or treated to form a smooth finish with a uniform texture, appearance and colour. This surface finish is required on all exposed formed surfaces, unless class F2 finish is specified.

Steel forms shall not be used to form surfaces for which class F3 surface finish has been specified, unless authorized by the Engineer or where provision is made specifically in the Schedule of Quantities.

(g.05) Board surface finish

This finish shall be that obtained by using tongued and grooved timber boarding arranged in a regular pattern approved by the Engineer. The finish is intended to be left as struck, but surface defects shall be remedied in accordance with subclause 08.02 of this section and large fins trimmed where directed by the Engineer.

(g.06) Protection of surfaces

The Contractor shall ensure that permanently exposed concrete surfaces are protected from rust marks, spillage and stains of all kinds and from any other damage during construction.

h) REMEDIAL TREATMENT OF FORMED SURFACES

(h.01) General

Any remedial treatment to surfaces that may be agreed on by the Engineer after an inspection has been made immediately after the removal of the formwork, shall be

carried out without delay. No surface may be treated before an inspection has been made by the Engineer.

(h.02) Repairs

Surface defects such as small areas of honeycombing cavities produced by form ties, large isolated blowholes, broken corner edges, etc, shall be repaired with mortar consisting of a cement:sand ratio equal to that of the concrete being repaired.

The colour of repaired areas of exposed surfaces shall match the colour of the surrounding concrete.

For the repair of large or deep areas of honeycombing and defects, special methods and techniques, such as pneumatically applied mortar, pressure grouting, epoxy bonding agents, etc, may be used as agreed on by the Engineer.

Where, in the opinion of the Engineer, the extent of the honeycombing or defects is such that the effectiveness of repair work will be in doubt, the Contractor shall, at his own expense, perform a load test in accordance with SANS 10160 or any other test that may be required by the Engineer, to prove that the structural integrity of the repaired member is adequate. Should the tests fail or should the Engineer be of the opinion that the work is substandard or does not comply with the requirements of the Specifications, he can instruct that the structure shall be rebuilt in part or in full at the Contractor's expense.

Where the concrete has been damaged by the concrete having adhered to the formwork panel, the cracked and loose concrete shall be removed; where the fresh concrete has lifted off at construction joints, the crack shall be scraped out immediately on both sides of the wall to a depth of at least 50 mm. The cavities so formed shall thereafter be repaired as described above.

(h.03) Rubbing of surfaces

If the finish of exposed formed surfaces does not comply with the requirements in respect of uniformity of texture, appearance and colour, the Contractor shall, when so instructed by the Engineer, rub down the exposed surfaces of the entire structure or any part thereof as specified below.

The surface shall be saturated with water for at least one hour. Initial rubbing shall be carried out with a medium-coarse carborundum stone, with a small amount of mortar in the proportions specified in subclause (h.02) of this section being used on the face.

Rubbing shall be continued until all form marks, projections and irregularities have been removed and a uniform surface has been obtained.

The paste produced by the rubbing shall be left in place. The final rubbing shall be carried out with a fine carborundum stone and water. This rubbing shall continue until the entire surface is of a smooth, even texture and is uniform in colour. The surface shall then be washed with a brush to remove surplus paste and powder.

Where the concrete surfaces formed by sliding formwork require treatment for achieving the surface finish specified for the member, the concrete shall, as soon as the surfaces are exposed under the formwork, be floated with rubber-lined floats to the desired finish.

i) UNFORMED SURFACES : CLASSES OF FINISH

(i.01) Class U1 surface finish

This surface finish is required on those portions of concrete slabs which are to receive bituminous or concrete surfacing or which are to be covered by backfilling material.

After the concrete has been placed and compacted as specified herein, the top surface shall be screeded off with a template to the required cross-section and be tamped with a tamping board to compact the surface thoroughly and to bring mortar to the surface, so as to leave the surface slightly ridged but generally at the required elevation.

(i.02) Class U2 surface finish

This surface finish is required on sidewalks, the tops of wingwalls and retaining walls, on the exposed concrete shoulders and unsurfaced areas on bridge decks, and on the inverts of box culverts.

The surface shall first be given a class U1 surface finish, and after the concrete has hardened sufficiently, it shall be wood-floated to a uniform surface free from trowel marks. For non-skid surfaces as on sidewalks and bridge decks, the surface shall thereafter be given a broom finish. The corrugations produced shall be approximately 1 mm deep and uniform in character and width, and shall have a pattern perpendicular to the centre line of the pavement.

(i.03) Class U3 surface finish

This surface finish shall be required for bearing areas and tops of concrete railings. The surface shall be given a class U1 finish, and after the concrete has hardened sufficiently, it shall be floated with a steel float to a smooth surface to within the dimensional tolerance specified herein .

Rubbing with a carborundum stone after the concrete has hardened may be done, but under no circumstances will plastering be permitted.

j) MEASUREMENT AND PAYMENT

Please see the Bid Documents and the Bill of Quantities

C6.21 : STRUCTURES

C6.21.1 : STEEL REINFORCEMENT FOR STRUCTURES

a) SCOPE

This section covers the supplying and placing of steel reinforcement in concrete structures.

b) MATERIALS

(b.01) Steel bars

Steel reinforcing bars shall comply with the requirements of SANS 920. Mild steel shall be hot-rolled bars with plain, round cross-sections. High-yield-stress steel shall be hot-rolled deformed bars.

The use of cold-worked bars shall be subject to the written approval of the Engineer. Cold-worked reinforcing bars shall bear the SANS mark or alternatively be subject to consignment inspection by the SANS at the plant, factory or steel yard, at the Contractor's expense.

The type of bar required shall be identified on the Drawings by the symbols R, Y or Z in accordance with SANS 282.

(b.02) Welded steel fabric

Welded steel fabric shall comply with the requirements of SANS 1024.

(b.03) Mechanical couplers

The tensile properties as established by way of a test specimen with a maximum gauge length of 610 mm, which consists of reinforcing bars that have been butt-jointed with a mechanical coupler, shall comply with the following requirements:

- (i) When tested in accordance with the relevant requirements, the tensile properties shall show an improvement of at least 10% on the requirements of SANS 920.
- (ii) When the test specimen is subjected to a load equal to 0,58 of the specified minimum yield force of the bar, the elongation measured on the gauge length shall not exceed the calculated theoretical elongation for a 610 mm length of bar, based on a stress of 0,58 of the specified minimum yield stress of the bar and a modulus of elasticity of 200 GPa.

The Contractor shall submit test certificates from a recognized testing authority to the Engineer, certifying that the couplers offered comply with the specified requirements.

The use of mechanical couplers as well as the type offered shall be subject to the written approval of the Engineer.

c) STORAGE OF MATERIALS

Steel reinforcement shall be stacked off the ground and, in aggressive environments, protection shall be provided in the form of sheds or tarpaulins.

d) BENDING OF REINFORCEMENT

Reinforcement shall be cut or cut and bent to the dimensions shown on the bending schedules and in accordance with SANS 82.

High-tensile-steel bars shall not be flame-cut, except with the approval of the Engineer.

Except as provided below, all bars shall be bent cold, and bending shall be done slowly, with a steady, even pressure being used without jerking or impact.

If approved, the hot bending of bars with a diameter of at least 32 mm will be permitted, provided that the strength of the bars will not depend on cold working. Where hot bending is approved, the bars shall be heated slowly to a cherry-red heat (not above 840°C) and, after bending, shall be allowed to cool slowly in air. Quenching with water will not be permitted.

Reinforcing bars that have already been bent shall not be rebent at the location of the original bend without the permission of the Engineer.

e) SURFACE CONDITION

Immediately before the concrete is placed around the reinforcement, the reinforcement shall be clean, free from mud, oil, grease, paint, loose rust, loose mill scale or any other substances that may have an adverse chemical effect on the steel or concrete or will reduce the bond.

f) PLACING AND FIXING

Reinforcement shall be positioned as shown on the Drawings and shall be accurately secured in these positions within the tolerance given herein by means of stools, clips, links, spacers and cover blocks and by tying with 1,6 mm or 1,25 mm diameter annealed wire, or, where permitted by the Engineer, by tack welding.

The cover and spacer blocks required for supporting the reinforcement shall be of approved design and material.

The ends of ties, clips or wire shall not project into the concrete cover.

Where protruding bars will be exposed to the elements for an indefinite period, the bars shall be adequately protected against corrosion and damage and shall be properly cleaned before being permanently encased in concrete.

In members that are formed with sliding formwork, mild-steel spacer "ladders" for the placing and fixing of the wall reinforcement shall be used at spacings indicated on the Drawings or as directed by the Engineer. The ladders and their design shall be approved by the Engineer. The ties of the ladder shall be spaced at multiples of the horizontal bar spacing in the wall, and shall be used to secure the horizontal reinforcement. The laps in the horizontal reinforcement shall be staggered to ensure that no part of two laps in any four consecutive layers will lie in the same vertical plane.

g) COVER

The term "cover" in the context of this section shall mean the clear thickness of concrete between the surface of the reinforcement and the concrete face.

The cover shall be as shown on the Drawings. Where no cover is indicated, the cover provided shall be in accordance with the appropriate values shown in table 703/1 below. The cover shall be within the tolerances herein.

The cover shall be increased by the expected depth of any surface treatment, e.g. when concrete is bush-hammered or when rebates are provided.

Additional cover as directed by the Engineer shall be provided if porous aggregates are used.

The cover blocks or spacers required to ensure that the specified cover is obtained shall be of a material, shape and design acceptable to the Engineer.

Where concrete spacer blocks are used, they shall be made from a 5 mm maximum size aggregate and shall be of the same strength and from the same material source as the surrounding concrete. The blocks shall be formed in specially manufactured moulds, and the concrete shall be compacted on a table vibrator and afterwards cured, all to the approval of the Engineer.

Table 703/1: Concrete Cover Over Reinforcement

Condition of exposure	Description of member/surface to which the cover applies	Cover (mm)				
		Concrete class				
		20	25	30	40	50
1. Moderate Sheltered from severe rain and not subject to freezing while saturated	1.1 Enclosed Surfaces					
	1.2 Surfaces protected by an overlay					
	1.3 Buried structures/members	40	40	30	25	25
	1.4 Structures/members continuously					
	1.5 Concrete cast under water	75	75	N/A	N/A	N/A
	1.6 Surface formed with permanent formwork					
	Transnet Limited** structures – as for 2.3 to 2.6	20	20	20	20	20
	1.8* Piles, cast in situ (wet cast against casing)	40	40	40	40	40
	1.9 Piles, cast in situ (dry cast against soil)	50	50	50	50	50
	1.10 Piles, cast in situ (wet cast against soil)	50	50	50	50	50
2. Severe Exposed to driving rain, alternate wetting and drying. Subject to heavy condensation, freezing while wet, corrosive fumes, chemicals, and aggressive soils	1.11 Piles, precast	35	35	35	30	30
	2.1 Exposed Surfaces	N/A	50	40	30	25
	2.2 Buried structures/members	N/A	50	40	30	25
	2.3 Transnet Ltd substructures, exposed surfaces	50	40	40	40	40
	2.4 Transnet Ltd substructures, surfaces in contact with soil	N/A	50	50	50	50
	2.5 Transnet Ltd Superstructures	N/A	N/A	40	40	40
	2.6 Piles in-situ (wet cast against casing)	50	50	50	50	50
	2.7* Piles in-situ (dry cast against soil)	75	75	75	75	75

	2.8 Piles in-situ (wet cast against soil)	75	75	75	75	75
	2.9 Piles, precast	40	40	40	35	35
3. Very Severe Exposed to abrasion, and water with pH below 4,5	3.1 Marine structures	N/A	N/A	N/A	60	50
	3.2 Piles, cast in situ (wet cast against casing)	N/A	N/A	N/A	80	80
	3.3 Piles, precast	N/A	N/A	N/A	50	50

* Shall apply to concrete cast under water

** "Transnet Limited structures" shall mean all structures over or within the property of Transnet Limited.

h) LAPSAND JOINTS

Laps, joints, splices and mechanical couplings shall be made in accordance with the methods and details and at the positions as specified or shown on the Drawings, or as agreed on by the Engineer.

i) WELDING

The welding of reinforcement shall be carried out only where shown on the Drawings or agreed on by the Engineer.

Flash-butt welding shall be carried out only with the combination of flashing, heating, upsetting and annealing to the Engineer's approval, and only machines that automatically control this cycle of operations shall be used.

Metal-arc welding of reinforcement shall be carried out in accordance with SANS 10044 for Grade A welds and the recommendations of the reinforcement manufacturers, subject to the approval of the Engineer and the satisfactory performance of trial joints.

Other methods of welding, e.g. resistance welding, may be used subject to the approval of the Engineer and to their satisfactory performance in trial joints.

Welded joints shall be full-strength welds, the strength of which shall be assessed by destruction tests on samples selected by the Engineer.

j) MEASUREMENT AND PAYMENT

Please see Bid Documentation and Bill of Quantities

C6.22 : STRUCTURES

C6.22.1 : CONCRETE

a) SCOPE

This section covers the manufacture, transportation, placing and testing of concrete used where plain, reinforced or prestressed concrete is specified, and the manufacture and placing of no-fines concrete.

b) MATERIALS

(b.01) Cement

The cement used for concrete shall be any of the following:

- (i) Normal cement conforming to the requirements of SANS 50197-1 (CEM I class 32,5 unless otherwise approved).

The strength class of the cement shall be 32,5N unless otherwise specified in the Project Specifications or approved by the Engineer. Cement extenders, if allowed in terms of the Project Specifications, shall comply with the requirements of SANS 1491-1, SANS 1491-2 and SANS 1491-3 for ground granulated blastfurnace slag, fly ash and condensed silica fume respectively.

- (ii) Blast-furnace cement (CEM III class 32,5) conforming to the requirements of SANS 50197-1).
- (iii) A 50/50 mixture of CEM I and ground granulated blast-furnace slag conforming to the requirements of SANS 1491-1. The cement and ground granulated slag may be mixed in the concrete mixer together with the other ingredients of the concrete.

The use of CEM III or a 50/50 mixture of CEM I and ground granulated slag may not be used unless authorized in the Project Specifications or in writing by the Engineer.

The use of CEM III will not be permitted in prestressed concrete members or units.

(b.02) Aggregates

Both coarse aggregate (stone) and fine aggregate (sand) shall comply with the requirements of SANS 1083, subject to the following:

- (i) The shrinkage of both the fine and the coarse aggregate, when tested in accordance with SANS Standard Method 5836, shall not exceed the following limits:
- (ii) For use in prestressed concrete, concrete bridge decks and slender columns, the shrinkage of both fine and coarse aggregate shall not exceed 130% of that of the reference aggregate.
- (iii) For use in other reinforced concrete members, the shrinkage of the fine aggregate shall not exceed 175% and that of the coarse aggregate 150% of that of the reference aggregate.
- (iv) For use in mass concrete substructures and unreinforced concrete head walls and wing walls, the shrinkage of both the fine and the coarse aggregate shall not exceed 200% of that of the reference aggregate.

Where there is any doubt about the shrinkage characteristics of aggregates, the Contractor shall submit a certificate from an approved laboratory, indicating the shrinkage characteristics of the aggregate.

- (v) The flakiness index of the stone as determined by TMH1 Method B3 shall not exceed 35.
- (vi) Aggregates shall not contain harmful amounts of organic materials such as grass, timber or similar materials.

- (vii) Where 38 mm aggregate is used in 30 MPa and stronger concrete, the aggregate shall be supplied in two nominal sizes, the larger of which shall be 38 mm and the smaller of which shall be 19 mm or 13,2 mm. The relative proportions of large and smaller aggregate used shall be determined by the mix design.
- (viii) Aggregates that may be potentially alkali reactive shall be assessed in accordance with SANS Standard Method 1245 and if there is a potential danger of any alkali aggregate reaction, the Engineer's decision as to the suitability of the aggregate shall be final and binding.
- (ix) Aggregates for concrete in contact with sewage or sewage gases shall be of dolomitic origin. All concrete for sewers and sewerage works, except concrete for the following, shall therefore be made with aggregates of dolomitic origin:
- blinding
 - mass concrete for foundation fill
 - concrete for encasing and bedding pipes

The quantity of insoluble matter in respect of concrete made with aggregates of dolomitic origin, determined according to the method described in SANS 677, Appendix C, shall not be more than 15%.

(b.03) Water

Water shall be clean and free from harmful concentrations of acids, alkalis, salts, sugar or other organic or chemical substances. If the water used is not obtained from a public drinking-water main, the Engineer may require the Contractor to have the suitability of the water proved by tests made by an approved laboratory. The costs of these tests or any subsequent tests ordered by the Engineer shall be borne by the Contractor.

(b.04) Admixtures

Admixtures shall not be used in concrete without the written approval of the Engineer, who may require that tests be made before they are used, to prove their suitability.

Admixtures, if allowed, shall comply with the following requirements:

- (i) Admixtures shall be used only in liquid form and shall be batched in solution in the mixing water by means of a mechanical batcher capable of dispensing the agent in quantities accurate to within 5% of the required amount.
- (ii) Admixtures shall comply with the requirements of ASTM C494/C494M-99a or AASHTO M-194 and shall be of an approved brand and type.
- (iii) Air-entraining agents shall comply with the requirements of ASTM C-260 or AASHTO M-154.
- (iv) Admixtures shall not contain any chlorides.

c) STORAGE OF MATERIALS

(c.01) Cement

Cement which is stored on the Site shall be kept under a cover that provides adequate protection against moisture and other factors that may cause deterioration of the cement.

Where the cement is supplied in bags, the bags shall be closely and neatly stacked to a height not exceeding 12 bags, and they shall be so arranged that they can be used in the order in which they were delivered to the Site. Different brands and/or types of the same brand shall be stored separately.

The storage of cement in bulk in silos or similar containers shall be permitted, provided the cement drawn for use is measured by mass and not by volume.

Cement shall not be kept in storage for longer than 6 weeks from the date of manufacture without the Engineer's permission.

The Engineer may order the removal of cement, which is older than 6 weeks, from the Site or the alteration of the design mix if he does allow its use. Alternatively, he may allow the cement to be used in concrete of less critical importance, as in blinding layers.

(c.02) Aggregates

Aggregates of different nominal sizes shall be stored separately to avoid the intermixing of the different aggregates and the contamination thereof by foreign matter.

(c.03) Storage capacity

The storage capacity provided and the amount of material stored (whether cement, aggregates or water) shall be sufficient to ensure that the progress of the work is not interrupted by lack of materials during concrete-casting operations.

(c.04) Deteriorated material

Material that has deteriorated or that has been contaminated or otherwise damaged shall not be used in concrete. Such material shall be removed from Site immediately.

d) CONCRETE QUALITY

(d.01) General

Fresh or pre-scribed concrete shall comply with the requirements for its strength.

(d.02) Strength concrete

The Contractor shall be responsible for the design of the concrete mix and for the proportions of the constituent materials necessary to produce concrete that complies with the requirements specified in table 704/1 for each class of strength concrete.

The Engineer will have the authority to instruct the Contractor to have the concrete mix designed by a specialist organization such as SABS Holdings (Pty.) Ltd. or the Cement and Concrete Institute (CCI), in which case the Contractor will only be reimbursed the invoiced charges of such organization.

The class of strength concrete is indicated by its 28-day cube characteristic compressive strength in MPa and the maximum size of coarse aggregate in its mix. Class 30/38 concrete will therefore mean concrete with a cube characteristic compressive strength of 30 MPa at 28 days and a maximum size of coarse aggregate of 38 mm.

Strength concrete used under this Contract will be one or more of the classes given in table 704/1 unless otherwise specified in these Specifications or in the Project Specifications.

The cement content for any class of concrete shall not exceed 500 kg/m³ of the concrete, unless otherwise specified.

The slump of the concrete shall be within the range as specified in table 704/3.

Where for reasons of durability or other considerations a minimum cement:water (c:w) ratio is specified in the Project Specifications, such concrete shall be designated by the normal designation followed by a "w" and the minimum c:w ratio in brackets, e.g. class 30/38 (w/2,0) concrete is class 30/38 concrete with a minimum c:w ratio of 2,0.

In such cases the characteristic strength of the mix shall be based on the specified 28-day characteristic compressive strength of the concrete.

Before starting any concrete work on the Site, the Contractor shall furnish the Engineer with samples, for his approval, of the constituent materials of the concrete and a statement of the mix proportions which he proposes to use for each class of concrete indicated in the Schedule of Quantities.

Table 704/1: Classes of Concrete

Class of concrete	28-day characteristic compressive strength (MPa)	Maximum size of aggregate (mm)
15/19	15	19
15/38		38
20/13 20/19 20/38	20	13
		19
		38
25/13 25/19 25/38	25	13
		19
		38
30/13 30/19 30/38	30	13
		19
		38
40/13 40/19 40/38	40	13
		19
		38
50/13 50/19 50/38	50	13
		19
		38
60/13 60/19 60/38	60	13
		19
		38

The samples shall be accompanied by evidence that they comply with the requirements for the various materials specified. The statement of mix proportions

shall be accompanied by evidence which will indicate that concrete made with the materials in the proposed proportions will have the specified properties.

Evidence shall be in the form of either -

- a statement from an approved laboratory on the results of tests, or
- an authoritative report or record of previous use and experience.

The actual mix proportions used as well as any changes thereto shall be subject to the Engineer's approval, but such approval shall in no way relieve the Contractor of his responsibility to produce concrete with the specified properties.

The Contractor is cautioned that the quality of cement may vary between consignments to an extent that will necessitate adjustments in the cement content of mixes. In order to ensure a uniform quality of concrete, the Contractor shall obtain from the manufacturer the relevant cement quality data for each consignment to ascertain the required adjustment to the cement content. This information shall be submitted to the Engineer.

(d.03) Prescribed-mix concrete

The Engineer will be responsible for determining the proportions of each constituent material of the prescribed-mix concrete. The Contractor shall produce the concrete by using the specified materials and in the proportions ordered by the Engineer.

The Contractor shall be responsible for supplying the constituent materials for the concrete and he shall furnish the Engineer, at least four weeks before the start of any concrete work on the Site, with samples of each aggregate for testing purposes. If the materials comply with the Specifications, the Contractor shall supply further samples of sizes indicated by the Engineer for determining the mix proportions for each class of concrete.

The classes of concrete for prescribed mixes shall be specified in the Project Specifications, except for the three "nominal" classes given in Table 704/2 A and B.

Table 704/2A: NOMINAL MIXES (9,5 or 13,2 mm stone)

Constituent or Property	Class 1.4.8 Concrete	Class 1.3.6 concrete	Class 1.2.4 concrete
Cement (kg)	50	50	50
Aggregate (m ³) sand	0.175	0.130	0.100
Stone	0.095	0.080	0.070
Estimated 28-day compressive strength (MPa)	10	15	20

Table 704/2B: NOMINAL MIXES (19,0 or 26,5 mm stone)

Constituent or Property	Class 1.4.8 Concrete	Class 1.3.6 concrete	Class 1.2.4 concrete
Cement (kg)	50	50	50
Aggregate (m ³) sand	0.170	0.125	0.095
Stone	0.145	0.120	0.100
Estimated 28-day compressive strength	10	15	20

(MPa)			
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The Engineer has the right to vary the proportions of the constituents of the concrete as the work proceeds. Payment for variations will be made at the tendered rates as specified in the Project Specifications.

Notes:

- The maximum size of coarse aggregate in mm required in a mix shall be designated as a suffix to the class, e.g. Class 1:4:8/38.
- The ratio of fine to coarse aggregate shall be adjusted to produce a dense, workable mix.
- The total quantity of water shall include that contained in the aggregates.
- The volume of cement in one 50 kg bag of cement shall be taken as 0,033 m³.
- The mix should contain only enough water to achieve the required consistence. Consistence may be assessed by eye or measured by carrying out the slump test (SANS 5862-1).

Recommended slumps are:

50 - 100 mm for compaction by mechanical vibration

100 - 150 mm for compaction by hand.

(d.04) Consistency and workability

Slump measurements obtained in accordance with the test prescribed in section 903 on concrete used in the Works shall fall within the ranges specified in table 704/3.

The concrete shall be of a suitable workability without the excessive use of water so that it can be readily compacted into the corners of the formwork and around reinforcement, tendons and ducts without segregation of the material.

e) MEASURING OF MATERIALS

(i) Cement

Where cement is supplied in standard bags, it shall be assumed that each bag contains 50 kg. All cement taken from bulk storage containers and from partially used bags shall be batched by mass to an accuracy of within 3 per cent.

Table 704/3: Slump Values

Type of Construction	Slump (mm)	
	Max	Min
1. Paving, concrete nosings and precast units	75	50
2. Prestressed Concrete	75	25
3. Reinforced foundation walls, footings and cast-in-situ piles (except dry-cast piles)	125	50
4. Slabs, beam columns and reinforced walls	125	50
5. Concrete bases, caissons and substructure walls	100	25

* Where high-frequency vibrators are used, the

above values shall be reduced by one-third.

(ii) Water

The mixing water for each batch shall be measured, either by mass or by volume, to an accuracy of within 3 per cent.

The amount of water added to the mix shall be adjusted to make allowance for the moisture content (if any) of the aggregates.

(iii) Aggregates

All aggregates shall be measured separately by mass, to an accuracy of within 3 per cent, except if otherwise provided in this clause .

The mass of the aggregates and the water demand of the mix shall be adjusted to make allowance for the moisture content of the aggregates.

Aggregates for prescribed-mix concrete as specified in subclause 04.03 of this clause may be measured separately by volume.

Classes 15, 20, 25 and 30 strength concrete may be volume batched in special circumstances, for instance when the volume of concrete required is small. Aggregates for other classes of strength concrete may also be volume batched, subject to the approval of the Engineer and to the quantity of cement being increased, at the Contractor's expense, by 25 kg/m³ of concrete over and above that which would have been required in the case of batching aggregates by mass.

Batching boxes for volume batching shall be filled without tamping, ramming or consolidation of any kind (other than that occurring naturally during the filling process), and shall be screeded off level with the topmost edges.

Volumes shall be adjusted by supplementary containers of the appropriate size being used. Adjustments made by partly filling the batching boxes to marks on their inside faces will not be permitted.

Fine aggregate shall be tested for bulking at the beginning of and halfway through each concreting shift, and adjustment shall be made to the batch volume to give the true volume required.

Cement may not be measured in gauge boxes, and volume batching shall be planned for whole bags of cement.

(f) MIXING

Note:

If ready-mixed concrete is delivered to the Site, the requirements of SANS 878 shall supersede those set out in this section.

(f.01) General

The materials for concrete shall be mixed by an experienced operator. Unless otherwise approved, mixing shall be carried out in a mechanical batch mixer of an

approved type which shall be capable of producing a uniform distribution of ingredients throughout the batch.

(f.02) Charging the mixer

The sequence of charging shall be approved by the Engineer and, unless otherwise instructed, the same sequence shall be maintained.

The volume of the mixed material per batch shall not exceed the manufacturer's rated capacity of the mixer.

(f.03) Mixing and discharge

The period of mixing shall be measured from the time when all the materials are in the drum until discharge is commenced.

The mixing period shall be 90 seconds and may only be reduced if, on the grounds of site tests, the Engineer is satisfied that the reduced mixing time will produce concrete with essentially the same strength and uniformity as concrete mixed for 90 seconds. However, the reduced mixing time shall not be less than 50 seconds or the manufacturer's recommended mixing time, whichever is the greater.

A suitable timing device in a good working order shall be attached to the mixer to ensure that the minimum mixing time is complied with.

The first batch to be run in a clean mixer shall contain only 2/3 of the required amount of coarse aggregate to facilitate "coating" of the mixer drum.

Discharge shall be so carried out that the materials in the mix will not segregate. The mixer shall be emptied completely before it is recharged.

(f.04) Maintenance and cleaning of the mixer

If the mixer has stopped running for any period in excess of 30 minutes, it shall be thoroughly cleaned out, particular attention being given to the removal of any build-up of materials in the drum, in the loader and around the blades or paddles. Worn or bent blades and paddles shall be replaced.

Before any concrete is mixed, the inner surfaces of the mixer shall be cleaned and all hardened concrete shall be removed.

(f.05) Standby mixer

Where sections are cast where it is important for casting to continue without interruption, a standby mixer shall be held in readiness to run at 15 minutes notice in case of a breakdown of the stock mixers.

g) PLACING AND COMPACTION

(g.01) General

Concrete shall be transported and placed in a manner that will prevent segregation or loss of constituent materials and contamination.

Concrete shall not be placed in any part of the Works until the Engineer's approval has been given. If concreting is not started within 24 hours of approval having been given, approval shall again be obtained from the Engineer.

Concreting operations shall only be carried out during normal working hours unless the Engineer has approved of concreting being carried out outside normal working hours, in which case proper lighting arrangements shall be made and the lights shall be in working order by noon. Workmen shall not be allowed to work in double shifts, and the Contractor shall provide a fresh team for night shifts.

The placing and compaction of concrete shall at all times be under the direct supervision of an experienced concrete supervisor.

Once concreting has begun, it shall be carried out in a continuous process between construction joints. Concrete shall be placed within 15 minutes of the mixing being completed and within one hour of mixing having started. All excavations and other contact surfaces of an absorbent nature, such as timber formwork, shall be kept damp, but no free water shall be permitted to remain on these surfaces. The formwork shall be clean on the inside.

(g.02) Placing

Whenever possible, concrete shall be deposited vertically into its final position. Where chutes are used, their lengths and slopes shall be such as to not cause segregation, and suitable spouts or baffles shall be provided at the lower end to minimize segregation. The displacement of concrete by vibration instead of direct placing will not be allowed.

When casting structural members of substantial thickness, care shall be taken to avoid layering of the concrete, and in so far as is possible, the entire thickness shall be placed in one pass.

Fresh concrete shall not be placed against concrete that has been in position for more than one hour unless a construction joint is formed.

The pumping of concrete and the equipment to be used therefor shall be subject to the written approval of the Engineer. Aluminium pipes shall not be used for this purpose.

In plain (unreinforced) concrete with at least a 300 mm thickness, hard, clean plum stones with a mass of 15 kg - 55 kg may, if approved by the Engineer, be included to replace concrete for up to 20% of the total volume, provided -

- such plums have no adhering films or coatings;
- no plums have a dimension greater than one-third of the smallest dimension of the concrete member, or 300 mm, whichever is the smaller;
- each plum is surrounded by at least 75 mm of concrete; and
- each plum is more or less cubic in shape with no dimension being less than 60% of the longest dimension.

(g.03) Placing under water

Normally concrete shall be placed only in the dry. Placing under water shall be allowed only in exceptional circumstances where, in the opinion of the Engineer, dewatering before placing is not feasible. No concrete shall be placed in flowing water.

Underwater concrete shall be placed by means of tremies. Full details of the method proposed for use by the Contractor shall be submitted to the Engineer in advance, for his approval. Placing by skip or pipeline will also be considered in certain circumstances.

During concreting by tremie, air and water must be excluded from the tremie by keeping the pipe filled with concrete at all times. When charging the tremie, a plug formed of suitable paper or sacking shall first be inserted in the top of the pipe. Once concreting has begun, the discharge end of the tremie shall be kept well below the surface of the concrete. Should this seal be broken, the tremie shall be lifted and plugged before concreting is recommenced. Distribution of concrete by lateral movement of the tremie will not be permitted.

The concrete mix used for underwater placing shall be specially designed and approved for this purpose to ensure good fluidity, plasticity and cohesion. The sand and cement content required for these mixes will usually be higher than that of normal mixes.

(g.04) Compaction

Concrete shall be fully compacted by approved means during and immediately after placing. It shall be thoroughly worked against the formwork, around reinforcement, tendons, ducts and embedded fittings and into corners in order to form a solid mass free from voids.

The concrete shall be free from honeycombing and planes of weakness and successive layers of the same lift shall be thoroughly bonded together.

Unless otherwise agreed upon by the Engineer, concrete shall be compacted with vibrators. Internal vibrators shall be capable of producing not less than 10 000 cycles per minute and external vibrators not less than 3 000 cycles per minute. A sufficient number of standby vibrators shall be held available in case of breakdowns.

Vibration shall be applied by experienced labour, and over-vibration resulting in segregation, surface water and leakage shall be avoided. Contact with reinforcement and formwork shall, in so far as is practicable, be avoided when internal vibrators are used.

Concrete shall not be subjected to disturbance by vibration within 4 to 24 hours of compaction.

Whenever vibration is applied externally, the design of the formwork and positioning of vibrators shall be so as to ensure efficient compaction and the avoidance of surface blemishes.

Special attention shall be given to the compaction of concrete in the anchorage zones for post-tensioned cables and behind the anchor plates, in the proximity of joint formers, waterstops and ducts and in all places with high concentrations of reinforcing steel or cables.

In cases where the placing and compaction of concrete is difficult, a mix containing smaller-sized aggregate may be used, but only with the approval of the Engineer and after a mix containing such aggregate has been designed and tested.

(g.05) Requirements where sliding formwork is used

Where sliding formwork is used, the following additional requirements shall apply:

- The Contractor shall take all the necessary measures to ensure the continuity of operations. All the necessary lighting and standby equipment for mixing, hoisting, placing and compaction shall be provided and all the materials required for completing each structure shall be ready on the Site before casting commences.
- Concrete shall be cast in uniform layers along the formwork so that the top surface of the concrete will not vary by more than 150 mm at any part of the formwork. In addition, the level of the concrete shall never be more than 300 mm below the top of the sliding panel. The working platform must be kept clean, and no concrete which has partially dried out may be swept into the formwork.
- The concrete shall be compacted during and immediately after placing. Care shall be taken not to damage or disturb previously placed concrete. To ensure the proper bonding of successive layers, not more than one hour shall elapse between placing of the successive layers. If delays do occur, layer thicknesses shall be adjusted rather than allowing the time between the placing of the successive layers to exceed one hour.
- Attention is drawn to the other requirements specified in subclause 05.02 (e) of section 702.

h) CONSTRUCTION JOINTS

(h.01) General

Concreting shall be done continuously up to the construction joints shown on the Drawings or as approved, except that, if concreting has to be interrupted because of an emergency (such as the mixing plant breaking down or unsuitable weather occurring), a construction joint shall be formed at the place of stoppage in the manner that will least impair the durability, appearance and proper functioning of the concrete.

Unless otherwise shown on the Drawings, the exact position of horizontal construction joints shall be marked on the formwork by means of grout checks in order to obtain truly horizontal joints.

Stub columns, stub walls or kickers on footings shall be cast integrally with the footings and not afterwards, even where a different class of concrete is to be used.

(h.02) Preparation of surfaces

When the concrete has set and while it is still green, the surface film and all loose material shall be removed, without disturbing the aggregate, by means of a water jet assisted by light brushing to expose the aggregate and to leave a sound, irregular surface.

Where this is not possible, the surface film shall be removed after the concrete has hardened, by mechanical means appropriate to the degree of hardness of the concrete to expose the aggregate and leave a sound, irregular surface. The roughened surface shall be washed with clean water to remove all laitance, dirt and loose particles.

(h.03) Placing fresh concrete at construction joints

When fresh concrete is placed on the same day as that on which the construction joint has been formed, the fresh concrete shall be cast directly against the face of the construction joint.

When concreting recommences a day or more after the construction joint has been formed, the following procedure shall be followed:

- The construction joint shall be kept continuously wet for a period of at least 2 hours before concreting starts, but any further applications of water shall cease just before reconcreting so that the surface will be just damp when further concreting is commenced.
- Any dirt, excess water or loose particles shall be removed prior to reconcreting being started.
- For horizontal construction-joint surfaces, a freshly mixed slurry consisting of sand, cement and water mixed in the same proportions as those used in the concrete, approximately 10 mm thick, shall be applied to the construction-joint surface immediately ahead of concreting. The slurry must still be in a plastic state when applied. For vertical construction-joint faces, a thin coat of a freshly mixed paste of neat cement and water, made with as little water as is practicable, shall be applied to the construction joint immediately before concreting.
- Epoxy resins specially designed for bonding old concrete to new concrete shall be used at construction joints where so directed by the Engineer. The preparation of the construction-joint surface and the application of the epoxy resin shall be strictly in accordance with the manufacturer's recommendations and the Engineer's instructions. The actual brand and type of resin used shall be subject to the Engineer's approval.

i) CURING AND PROTECTION

Formwork shall be retained in position for the appropriate times and as soon as is practicable in the opinion of the Engineer, all exposed concrete surfaces shall be protected from loss of moisture by one or more of the following methods:

- Retaining formwork in place for the full curing period.

- Ponding the exposed surfaces by means of water, except where atmospheric temperatures are low, i.e. less than 5°C.
- Covering with sand, or mats made of a moisture- retaining material, and keeping the covering continuously wet.
- Continuous spraying of the whole area of the exposed surfaces with water (only on surfaces where ponding or sand cover is not possible).
- Covering with a waterproof or plastic sheeting firmly anchored at the edges.
- Using an approved curing compound applied in accordance with the manufacturer's instructions, except that where the surface has to be subsequently waterproofed, coated or gunited, this method may not be used.
- Steam curing (precast units)

The method adopted for curing shall be subject to the Engineer's approval and shall not cause staining, contamination or marring of the surface of the concrete.

The curing period shall be continuous for at least 5 days for concrete made with ordinary cement, at least 2 days for that made with rapid-hardening cement, and at least 7 days if CEM III cement or a mixture of CEM I cement and ground, granulated blast-furnace slag is used.

When the ambient air temperature falls below 5°C, these minimum curing periods shall be extended by the period during which the temperature of the concrete was below 5°C.

Where sliding formwork is used, the concrete shall be protected against the weather and rapid drying out with a 4 m long skirt attached to the lower perimeter of the formwork and hanging over the working platform. The skirt shall consist of hessian in summer months but of canvas or other suitable material in winter. The skirt shall be weighted at the bottom to prevent it from flapping about in windy conditions.

Where sliding formwork is used, the concrete shall be cured by fog spraying to keep it continuously wet for the periods stated above or until a curing compound is applied. The concrete shall be wetted with a fixed spraybar over the full length of the sliding formwork. The spraybar shall be connected to a suitable high-pressure water supply. Wetting shall be discontinued when the ambient air temperature drops below 5°C, and care shall be taken to ensure that the water will not erode the fresh concrete surface.

j) ADVERSE WEATHER CONDITIONS

(j.01) Cold weather

Concrete shall not be placed during falling temperatures when the ambient air temperature falls below 7°C or during rising temperatures when the ambient air temperature is below 3°C. When concrete is placed at air temperatures below 5°C, the temperature of the concrete to be placed shall not be allowed to drop below 10°C before it is placed.

The temperature of placed concrete shall not be allowed to fall below 5°C until the concrete has attained a strength of at least 5 MPa, and the Contractor shall be responsible for all the necessary protective measures to ensure this. All concrete that

has been damaged by frost or by the formation of ice in the concrete shall be removed and replaced by the Contractor at his own expense.

(j.02) Hot weather

When the ambient air temperature exceeds 32°C during a concreting operation, the Contractor shall take measures, which have been approved by the Engineer, to control the temperature of the concrete ingredients so that the temperature of the placed concrete will not exceed 25°C. Such measures will include the spraying of aggregate stockpiles with water to promote cooling down by evaporation and, where feasible, the shading of stockpiles and the area where the concreting is carried out. Curing shall commence immediately after the concrete has been placed to prevent excessive loss of moisture.

(j.03) Additional precautions where sliding formwork is used

When sliding operations take place in cold weather, the water only, or the water and aggregate, shall be heated to ensure that the concrete temperature will not drop below 10°C until it has attained a strength of 5 MPa.

The Contractor shall make all the necessary arrangements to heat the material and protect the concrete against loss of heat. Heated water and aggregate shall be mixed first and the cement added only at temperatures below 30°C.

During cold weather the rate of sliding shall be suitably decreased to ensure that the concrete leaving the bottom of the formwork will have sufficient strength.

k) PIPES AND CONDUITS

No pipes and conduits other than those shown on the Drawings shall be embedded in the concrete without the Engineer's approval. Pipes and conduits passing through concrete walls shall be embedded in the wall simultaneously with the casting of the wall. The clear space between such pipes or between such pipes and any reinforcement shall be at least 40 mm or the maximum size of the aggregate plus 5 mm, whichever is the greater. The amount of concrete cover over pipes and fittings shall be at least 25 mm.

The ends of all ferrules used for bracing formwork shall be neatly finished off to the details shown on the Drawings. Where no details are given on the Drawings, ferrules shall be cut back and the holes filled in with mortar and finished off flush with the concrete surface.

l) APPLIED LOADING

No load shall be applied to any part of a structure until the specified curing period has expired, and any loading applied thereafter shall only be allowed after approval by the Engineer. The Engineer's decision will be based on the type of load to be applied, the age of the concrete, the magnitude of stress induced and the propping of the structure.

No structure shall be opened to traffic until test cubes made of the concrete in all parts thereof have attained the specified minimum 28-day strength.

m) PRECAST CONCRETE

This clause applies to all reinforced and prestressed concrete members other than precast concrete piles, culverts and pipes in so far as they are dealt with separately elsewhere in these Specifications.

All precast members shall be manufactured in accordance with the requirements specified for cast in situ members in so far as these requirements are relevant. In addition, the following shall apply:

- The Contractor shall take all the necessary safety measures and precautions during the handling and erection of precast members and shall ensure the stability of members as positioned prior to casting in.
- Where concrete members are precast off Site, the manufacturer shall keep and make available to the Engineer full records of all the concrete mixes and strength tests pertaining to the members cast. The Contractor shall notify the Engineer in advance of the casting dates to arrange for the inspection and testing of precast members.
- For the purpose of identification, all members shall be marked with paint in neat lettering with the number of the member shown on the Drawings or ordered by the Engineer and an identification number relating to the manufacturing records. Letters, etc shall be so positioned that they will not be visible when the member is placed in its final position in the completed structure.
- All precast members that have been chipped, cracked, warped or otherwise damaged to such an extent that the damage will, in the opinion of the Engineer, impair the appearance, function or structural integrity of the members, shall be rejected or, where so allowed, repaired to the satisfaction of the Engineer.

n) TESTING AND QUALITY CONTROL

(n.01) Process control

The Contractor's minimum obligations in terms of clauses 04 and 05 of section 901 shall be the following:

(i) Testing of aggregates

Coarse aggregate shall be tested for grading once for every 100 m³ delivered on Site and fine aggregate once for every 50 m³ delivered.

(ii) Testing of 28-day compressive strength

The 28-day cube compressive strength of concrete shall be controlled by the Contractor at not less than the following frequencies:

Volume of lot	Minimum No of tests per lot
0 - 75 m ³	3
75 - 150 m ³	4
over 150 m ³	5

Notes:

- A test result shall be the average test value for three cubes prepared from the same batch of concrete.
- Where the Engineer of his own accord runs a full programme of routine tests for 28-day compressive strength he may, at his sole discretion, relieve the Contractor of his obligation to run his own tests, but in such case any reliance placed by the Contractor on the Engineer's tests shall be entirely at the Contractor's risk and no claims resulting from such reliance placed on tests by the Engineer, which may subsequently prove to have been incorrect, will be considered.

(iii) Accelerated cube-compressive-strength tests

In the case of major structures, the Contractor is advised to carry out regular accelerated compressive-strength tests in order to predict the 28-day compressive strength of concrete. The methods of testing and predicting 28-day strengths shall be as determined in consultation with the Engineer. Whenever accelerated tests indicate that the 28-day strengths will not be obtained, the Contractor shall immediately effect such changes in materials and mix proportions as may be necessary to ensure future compliance. Accelerated tests shall be additional to the 28-day routine tests. When specified in the Project Specifications, the use of accelerated tests shall be obligatory.

(iv) Control charts

The Contractor shall institute a system of control charts depicting test results of all 28-day concrete strengths and, where applicable, accelerated compressive strengths,

(v) Record keeping

The Contractor shall maintain written records that indicate the following:

- The date on which each section was concreted, the class of concrete, the time taken for placing, and the position of the section in the Works.
- Daily maximum and minimum temperatures.
- Nature of samples and dates on which they were taken, including identification marks.
- Results of tests on samples taken and the description of each concrete section represented by samples.

These records shall be kept in a form agreed upon by the Engineer, a copy of which shall be supplied to the Engineer as soon as results become available.

(n.02) Quality control by the Engineer

(i) Criteria for compliance with requirements

Routine inspection and quality control will be carried out by the Engineer. The criteria for compliance with the specified requirements for 28-day characteristic strength.

(ii) Procedure in the event of failure to comply with the requirements

Any lot represented by test cubes which fails to meet the criteria specified for the characteristic strength -

- shall be rejected,
- or
- may be conditionally accepted at reduced payment, subject to the provisions of this specification,
- or

- the Contractor may apply for resubmission of the lot on the basis of cores drilled from the concrete section in question. The methods of taking and testing cores and evaluating the test results shall be as described herein. The procedure for determining compliance of test results shall be as specified hereafter in subclause (o.02) (iii). The cost of drilling and testing the cores shall be for the Contractor's account, regardless of the outcome of the tests on the cores. Before cores are taken, the members concerned shall be cured and allowed to age for at least 28 days but for not more than 56 days.

Where the Engineer so directs, full-scale load tests shall be carried out in accordance with SANS 10160 to determine whether a specific structure or member can be accepted. The cost of such tests shall be for the Contractor's account, regardless of the outcome of the tests. In all cases where concrete has been produced that fails to meet the strength requirements, the Contractor shall immediately take the necessary remedial action by changing the mix proportions to obtain the required strength.

(iii) The strength requirements for concrete cores

The actual number of cores to be taken from a resubmitted lot shall depend on the size of the lot and the nature of the structure and will be determined by the Engineer.

The lot shall be deemed to have met the requirements for characteristic strength if the "estimated potential strength" of the cores, determined as specified herein, meets the requirements for 28-day cube-compressive-strength tests.

(iv) Testing ordered by the Engineer

Where routine testing of concrete cubes is not carried out on Site by the Engineer, he may order the Contractor to have the concrete cubes that have been made by the Engineer tested at an approved testing laboratory.

o) NO-FINES CONCRETE

(o.01) Materials

Cement, aggregate and water shall comply with the requirements of clause 02 of this section. Each size of aggregate shall be a single-sized graded in accordance with SANS 1083.

(o.02) Classes of no-fines concrete

No-fines concrete shall be classified by the prefix NF and the size of the aggregate to be used. Class NF 19 means a no-fines concrete with a 19 mm nominal size aggregate.

The volume of aggregate per 50 kg of cement for each class of no-fines concrete shall be as depicted in table 704/4.

Table 704/4: Volume of Aggregate

VOLUME OF AGGREGATE Class	Aggregate per 50 kg Cement
NF 38	0,33 m ³

NF 19	0,33 m ³
NF 13	0,27 m ³

(o.03) Protection

All no-fines concrete shall be protected from the elements and loss of moisture. Protection against loss of moisture shall be accomplished in one or more of the following ways:

- Retaining formwork in place.
- Covering exposed surfaces with sacking or other approved material kept continuously wet.
- Covering exposed surfaces with plastic sheeting.

No-fines concrete placed during cold weather shall be adequately protected against frost for at least 3 days.

p) MEASUREMENT AND PAYMENT

Please see the Bill of Quantities.

C6:23 : STRUCTURES

C6:22.1 : JOINTS IN STRUCTURES

a) SCOPE

This section covers the supply and installation of all permanent joints that will permit relative movement between contiguous structural members.

b) MATERIALS

(b.01) General

All materials used in the forming, construction and sealing of permanent joints, as well as all proprietary or custom-built expansion-joint assemblies shall be subject to the approval of the Engineer.

When required by the Engineer, the Contractor shall submit test certificates from an approved independent testing authority to show that the respective materials comply with the specified requirements, or a certificate from the patent holder or designer to certify that the manufactured item complies in all respects with relevant product specifications.

(b.02) Joint filler

Joint filler shall consist of sheets or strips of the following materials complying with the requirements of the relevant specifications listed:

- Bitumen-impregnated fibre board and bitumen- impregnated cork board - US Federal Specification HH-F-341 F or AASHTO Specification M213.
- Resin-impregnated cork board - US Federal Specification HH-F-341 F.

- (iii) Flexible foams of expanded polyethylene, polyurethane, PVC or polypropylene - AASHTO Specification M153.
- (iv) Rigid foams of expanded polyethylene, polyurethane or polystyrene - BS 4840 or BS 3837.

Other joint-filler materials may be used if approved by the Engineer after submission of full specifications and information by the Contractor.

(b.03) Sealants

- (i) Thermoplastic hot-poured sealants shall comply with the requirements of US Federal Specification SS-S-1401B, BS 2499 or AASHTO Specification M-173.
The sealants shall be of the rubberized bituminous type containing a minimum of 20% natural or synthetic rubber.
- (ii) Thermoplastic cold-applied sealants shall comply with the requirements of US Federal Specification SS-S-200E(2).
The sealant shall be of the rubberized bituminous type containing a minimum of 20% natural or synthetic rubber.
- (iii) Thermosetting chemically curing sealants shall comply with the requirements of BS4254 or ASTM C 920. The final IRHD (international rubber hardness degree) of the sealant shall be 20 ± 5 . Other sealants may be used if approved by the Engineer after submission of full specifications and information by the Contractor.

(b.04) Preformed elastomeric compression seals

Preformed elastomeric compression seals shall comply with the requirements of SANS 1023.

(b.05) Waterstops

Waterstops shall be of natural rubber, or plasticized, virgin, non-biodegradable PVC, and of the type specified or shown on the Drawings.

- (i) Natural rubber waterstops shall comply with the requirements of CKS 388.
- (ii) Flexible polyvinyl chloride (PVC) rubber waterstops shall comply with the requirements of CKS 389.

(b.06) Accessory materials

(i) Primers

When a primer is to be used in conjunction with the sealant, it shall be of the prescribed proprietary material.

(ii) Adhesives

Adhesives used in conjunction with preformed seals shall be of a proven and approved type which is compatible with the material of the seal.

(iiic) Bond breakers

Polyethylene tape, coated papers, metal foils or similar material may be used where bond breakers are required.

(iv) Back-up material

Back-up material shall consist of a compressible material of correct width and shape in order to ensure that it will be in approximately 50% compression after installation and that the sealant can be formed to the specified depth.

Back-up materials shall be compatible with the sealant used. Material containing bitumen or volatiles shall not be used with thermosetting chemically curing sealants.

(v) Cover plates

Steel cover plates shall be of grade 43A steel which complies with the requirements of BS EN 10025, or of grade 300W steel which complies with the requirements of SANS 1431. Galvanizing shall comply with the requirements of SANS 32 and/or SANS 121, as applicable. Anchor bolts shall be of stainless steel grade X10CrNi18-8Co.05-0.155=0.015, which complies with the requirements of BS EN 10088 part 1.

(b.07) Storage

All materials used in the forming, construction and sealing of permanent joints and all proprietary or custom-built expansion-joint assemblies shall be stored off the ground under cover that provides adequate protection against sunlight, physical or chemical damage or other factors that may cause its deterioration.

c) FILLED AND UNFILLED JOINTS

(c.01) General

Wherever polystyrene or a similar material which is susceptible to damage is used to form joints, it shall be lined with a hard surface on the side to be concreted. The hard surface shall be sufficiently resilient to ensure that the joint and surfaces can be formed free from defects.

(c.02) Filled joints

Filled joints shall be accurately formed to the dimensions shown and with the filler material specified on the Drawings. The filler shall be secured in position so that it will not be displaced during or after concreting if it is to remain permanently in the joint.

(c.03) Unfilled joints

Unfilled joints shall be accurately formed to the dimensions given on the Drawings, and all external corners chamfered or rounded for at least 5 mm. The concrete face against which the fresh concrete is placed shall be treated in good time with an approved bond breaker.

d) SEALING OF JOINTS

(d.01) General

Sealed joints shall be made watertight over the full length of the joints, unless otherwise permitted by the Engineer, and the joint dimensions shall be as shown on the Drawings.

(d.02) Preparation of joints

The reaming of joints by sawing or other means shall be undertaken at a stage when edge spalling or ravelling can be avoided and shall be subject to the Engineer's approval.

After removal of the temporary filler material or the breaking-out of the excess concrete, the inside faces of the joint shall be wire-brushed or grit-blasted to remove all laitance and contaminants. Thereafter the joint shall be cleaned and blown out with compressed air to remove all traces of dust. Solvents shall not be used for removing contaminants from concrete and porous surfaces.

Care shall be taken to ensure that primers or adhesives are applied only to surfaces that are absolutely dry. The primer or adhesive shall be applied strictly in accordance with the manufacturer's instructions. Unless otherwise specified, the primer shall be applied within the temperature range of 10°C to 40°C and the sealant shall be applied after the curing period of the primer and within the period during which the primer remains active.

(d.03) Sealants

Sealants shall be applied strictly in accordance with the manufacturer's instructions by a person skilled in the use of the particular type of sealant. The trapping of air and the formation of voids in the sealant shall be avoided. The sealant shall be finished to a neat appearance flush with the edges of the concrete or to the specified depth.

Thermoplastic hot-poured sealants shall not be poured into the joints when the temperature of the joint is below 10°C.

The safe heating temperature shall not exceed the specified pouring temperature by more than 10°C.

Two-part thermosetting chemically curing sealants shall not be applied after expiry of the specified potlife period, which shall commence once the base and activator of the sealant have been combined.

(d.04) Preformed compression seals

The seal shall be inserted and secured with a lubricant adhesive which covers both sides of the seal over the full area in contact with the inside faces of the joint. The lubricant adhesive shall be applied immediately before the seal is inserted.

The seal shall be installed in a compressed state, with the appropriate equipment, so that the seal will remain in compression even under the most adverse conditions. The final position of the seal shall be as shown on the Drawings or as directed by the Engineer.

Joints in seals shall be bonded or fused and shall be only at positions agreed on by the Engineer.

(d.05) Waterstops

(i) General requirements

The waterstops shall be supplied in unjointed standard production lengths. Site jointing shall be limited to the absolute minimum. Where lengths in excess of the

standard production lengths are required, such longer lengths shall preferably be factory-jointed.

At intersections, transitions and abrupt changes of direction, factory-moulded watertight junction pieces shall be used so that any site jointing can be restricted to simple joints.

When a waterstop with a centre bulb is intersected, the centre bulb shall be continuous throughout the intersection irrespective of the make-up of the intersection.

(ii) Rubber waterstops

All joints shall be vulcanized and shall have a tensile strength of at least eighty (80) per cent of that of the unjointed material for water-retaining structures, and fifty (50) per cent for other structures.

Site joints shall be vulcanized joints made in accordance with the requirements of these Specifications and the manufacturer's instructions, and with equipment prescribed or supplied by the manufacturer and approved by the Engineer.

The vulcanizing process shall be a hot process with strict control on the pressure, the temperature and the time. The vulcanizing temperature shall be between 150°C and 160°C. The rubber shall not be heated above 160°C. The vulcanizing time for the specific type of rubber of the waterstops involved shall be determined with a curometer for the above-mentioned vulcanizing temperatures before a vulcanized joint is made. The recommended pressure between the two sections which must be vulcanized is 3,4 MPa and the minimum allowable pressure is 2,4 MPa.

The contact faces of the sections to be jointed shall be accurately and evenly cut at the angle shown on the Drawings or prescribed by the Engineer to obtain a precise fit and complete contact.

Care shall be taken to keep centre bulbs unobstructed at the joints so that the lateral flexibility of the waterstops will not be affected by the presence of clotted rubber inside the bulbs.

The rubber of the waterstop shall not have any porosity or voids between the contact faces of the sections and/or at the finished vulcanized joint, especially at the centre bulb.

The vulcanizing equipment shall comply with the following minimum requirements:

- The heating elements shall be equipped with an automatic temperature-control device to keep the elements at the required temperature.
- It shall be equipped with an automatic temperature-control device to keep the heating elements at the required temperature, with a device to measure the temperature at the vulcanizing plane, a device to measure the temperature applied to the external faces of the rubber, and with a pressure gauge to regulate the applied pressure within the specified limits in relation to the liquidity of the rubber.
- During the vulcanizing process the pressure shall be spread evenly over the entire contact area, and the pressure plates shall be sufficiently rigid that they will not bend under the applied pressure. The cut-out forms of the pressure plates shall fit

accurately over the waterstops so that all the faces of the waterstops will be in contact with the pressure plates.

- The planes of contact of the two sections of the waterstops to be joined together shall be prevented from sliding from each other when pressure is applied to the plates.
- A shield shall be available to shield the apparatus against wind, rain, etc, when joints are made in the open to ensure proper temperature control.
- The apparatus as a whole shall be safe in all respects and shall comply with all the appropriate statutory requirements.

(iii) Plasticized, flexible PVC waterstops

The waterstops shall be manufactured from high-quality virgin material and shall not contain any scrap or reclaimed material. The waterstops shall be light coloured so as to reduce heat absorption when exposed to sunlight.

The waterstops shall be precision moulded or extruded to the required cross-sectional profile, they shall be free from porosity or other imperfections, and shall be provided with eyelets so that they can be securely fixed to prevent displacement during concreting.

All joints shall be butt-jointed hot-welded joints. Where joints cannot be factory-made, Site joints shall be made in accordance with the manufacturer's instructions with equipment prescribed or supplied by the manufacturer and approved by the Engineer.

e) PROPRIETARY EXPANSION JOINTS

(e.01) General

The use of any type of expansion joint shall be subject to the approval of the Engineer. Tenderers are advised to obtain approval for the type of expansion joint they intend to use prior to submitting their Tenders.

(e.02) Dimensions

Attention is drawn to the overall dimensions of the expansion joints and to the limiting concrete dimensions of that portion of the structure that is to accommodate the joints. No alterations to the concrete that will be visible in the final structure nor any major re-arrangements of the prestressing anchorages to accommodate joints of excessive size will be permitted.

All joints to be installed along a skew shall be accurately dimensioned to ensure compliance with clause 06 of this section.

In the case of bridges, proprietary expansion joints shall include the complete expansion joint assembly traversing the roadway, kerbs, sidewalks and median, and shall include the coping and parapet cover plates as well as the drainage system for draining the expansion joint.

(e.) Design and manufacture

The expansion joint shall be designed to withstand movements, displacements and rotations specified on the Drawings in conjunction with the loads prescribed in the

Code of Practice adopted for the design of the structure without overstressing any part in terms of "working load" requirements or exceeding the requirement for serviceability limit state. The cost of any strengthening of the supporting member required to resist forces imparted by the joint to the structure shall be for the Contractor's account.

The specified movements, displacements and rotations shall be accepted without impairment of the efficacy and the serviceability of the joint.

The expansion joint shall be vibration free and shall comply with the requirements in the Project Specifications in respect of resistance to mechanical wear and other forms of abrasion, resistance to corrosion, skid resistance, water tightness, riding characteristics and accessibility for inspection, maintenance and repair.

Prior to the manufacture of the joints, the Contractor shall submit detail drawings of each expansion joint to the Engineer for his acceptance.

The expansion joints delivered to Site shall be suitably marked to show clearly the sequence and position of installation.

f) INSTALLATION OF EXPANSION JOINTS

No expansion joint or part thereof shall be installed before the final surfacing levels have been established as based on a complete level survey of the contiguous surfaces. The survey shall be made before the kerbs, channels or bituminous surfacing is constructed.

For bridges, the expansion joint shall form an even surface with the road surface on either side, and the deviation across and along the expansion joint shall comply with the requirements of subclause 05.04 of section 601 for cross-section and subclause 05.06 of section 601 for surface regularity measured with an ordinary straight-edge.

On completion of the installation of proprietary expansion joint(s), the Contractor shall furnish the Engineer with a certificate from the manufacturer or supplier of the joint(s) which certifies that the expansion joints have been properly installed.

The issuing of such a certificate shall not relieve the Contractor of his responsibilities under the Contract.

g) MEASUREMENT AND PAYMENT

Please refer to the Bill of Quantities.

C6:24 : STRUCTURES

C6:24:1 : CONSTRUCTION TOLERANCES FOR STRUCTURES

a) SCOPE

This section covers the requirements in regard to the construction tolerances applicable to the various structures and structural elements.

b) DEFINITIONS

Except where otherwise specified, the following aspects of construction to which tolerances apply shall have the meanings assigned to them below:

(b.01) Position

The position of a structure or structural element shall be the horizontal position of its reference line(s) and/or reference point(s) in relation to the overall setting-out of the Works as shown on the Drawings.

(b.02) Horizontal alignment

The horizontal alignment of a structure or structural element shall be the horizontal alignment of its reference line(s) in relation to the overall setting-out of the Works as shown on the Drawings. Deviation from true horizontal alignment shall be measured in degrees of an arc.

(b.03) Leading and cross-sectional dimensions

The leading and cross-sectional dimensions of a structure or structural element shall be the dimensions relating to width, length, height, thickness, etc which collectively determine its shape as shown on the Drawings. Dimensional tolerances which do not relate to leading or cross-sectional dimensions shall be shown on the Drawings.

(b.04) Levels

The level of any structure or structural element shall be the level of the upper or lower surface, as the case may be, with reference to an established datum level on the Site as shown on the Drawings.

(b.05) Surface regularity

Surface regularity is the shape of a surface with reference to a 3 m straight-edge (or template in the case of curved surfaces) placed on the surface.

The tolerance on surface regularity is expressed as a distance by which the surface tested may deviate from a straight-edge (or template in the case of curved surfaces) held against the surface.

c) TOLERANCES

The tolerances given below are the maximum permissible deviations from the specified dimensions, levels, alignment, positions, etc, as shown on the Drawings of the structures or structural elements.

(c.01) Foundation fill

(i) Average level of top of fill	± 25 mm
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(c.02) Footings

(i) Position	15 mm
(ii) Horizontal alignment:	
(iii) Horizontal alignment of individual elements	5°
(iv) Horizontal alignment of elements as they collectively determine the horizontal alignment of the structure as a whole	1 minute

(c) Dimensions:

(i) Leading dimensions in plan	± 25 mm
(ii) Thickness	+ 25 mm or- 15 mm
(d) Levels:	
Average level of slabs, footings, etc	± 25 mm

(c.03) Vertical elements such as columns, walls, piers, abutments, etc

(i) Position	10 mm
(ii) Horizontal alignment: Horizontal alignment of walls, piers, abutments and column groups	2 minutes
(i) Dimensions: Leading dimensions of walls, piers, abutments, etc	± 25 mm
(iv) Thickness of walls, piers and abutments and cross-sectional dimensions of columns:	
(iv.i) Plus tolerance	25 mm
(iv.ii) Minus tolerance: 3% of the specified dimensions within the range of 5 mm to 25 mm	

(v) Levels:

Average levels of finished or trimmed/cut columns, piers, walls, abutments, etc ±10 mm

(vi) Verticality:

(vi.i) In the case of ordinary formwork:	1 in 400 Maximum 25 mm
(vi.ii) In the case of sliding formwork:	1 in 200 Maximum 50 mm

(g) Surface regularity:

(i) In the case of ordinary formwork	3 mm
(ii) In the case of sliding formwork	6 mm

(c.04) Horizontal elements of the super- structure such as beams, slabs, etc

(i) Position	10 mm
(ii) Horizontal alignment: Superstructure as a whole	1 minute
(iii) Dimensions: Leading dimensions in plan	± 25 mm

Thickness of slabs, width and depth of beams:

(i) Plus tolerance	15mm
(ii) Minus tolerance: 3% of the specified dimensions within the range of	5 mm to 15 mm
Surface regularity	3 mm

(c.05) Reinforcing steel

Except for the requirements set out below, no tolerances are given for the placing and fixing of reinforcing steel. However, the steel shall be neatly and accurately fixed in

a manner that is consistent with proper workmanship and the structural integrity of the member. The following requirements shall apply specifically:

(i) Tension steel

The actual position of tension steel shall not deviate from the true position by an amount that would reduce the effective lever arm by more than 2% of the overall depth of the member, or 10 mm, whichever is the greater.

(ii) Concrete cover

The concrete cover on reinforcing steel + 20 percent or
- 0 percent

(iii) Spacing between bars

The spacing between closely spaced parallel bars, especially in beams and columns, shall, unless otherwise detailed, be not less than the maximum size of aggregate used in the concrete.

(iv) Bending of reinforcement

The requirements of SANS 282 regarding dimensional tolerances for the cutting and bending of reinforcing steel shall apply, with the proviso that the other requirements stated in this clause shall be met even if the tolerances in SANS 282 are not exceeded.

(c.06) Prestressing

Prestressing tendons shall be placed and maintained in position within the following accuracies:

- (a) In the direction of the width of the member:
 - (i) For members of up to 200 mm in depth ± 20 mm
 - (ii) For members exceeding 200 mm in depth ± 10 mm
- (b) In the direction of the depth of the member:
 - (i) For members of up to 200 mm in depth ± 0,025 x depth
 - (ii) For members over 200 mm in depth ±,010
x depth within the
tolerance range of
± 5 mm to ± 25 mm

(c.07) Bearings

Bearings shall be installed to within 5 mm of the positions shown on the Drawings and to within 2 mm of the required levels.

Dimensional tolerances for elastomeric bearings shall comply with the requirements of BS 5400 part 9.2.

(c.08) Miscellaneous

(i) Chamfers:

Fillets used to form chamfers shall be made to a tolerance of 1 mm in cross-sectional dimensions, and the actual chamfer on the concrete shall not vary by more than 3 mm from the specified dimensions, as measured from a 3 m straightedge.

(i) Kerbs, copings, sidewalks, bridge railings, parapets, etc:

The elements shall be constructed to the specified dimensions within a tolerance of plus or minus 5 mm on any dimension. The alignment shall not deviate from the true alignment by more than 10 mm in any place nor shall the alignment deviate by more than 5 mm from the true alignment over any length of 5 m.

d) USE OF TOLERANCES 2

Attention is drawn to the requirements of clause 25 of the section regarding the use of tolerances. In addition, the following shall apply:

Notwithstanding the tolerances stated in this section, the Contractor shall be responsible for ensuring that all components of the work will finally fit together properly and he shall be solely responsible for the cost of rectifying defects and poor fitting arising from any deviations from the specified dimensions regardless of the tolerances specified in this section but having regard to any tolerances specified on the Drawings.

C7 : ELLECTRICAL POWER SUPPLY WORKS

C7.1 : CONSTRUCTION TOLERANCES FOR STRUCTURES

The following KZN DoE's specifications here below apply.

C7.1.1 STANDARD SPECIFICATIONS, ACTS, REGULATIONS AND BY-LAWS

Wherever any reference is made to the South African National Standard (SANS) and the British Standard specification (BS) in either of the General Specification (Section 1), Project Specification (Section 2) and Quality Specification (GP/E5/2 Rev 0, March 2003) this reference shall be deemed to read "SANS or equivalent standard" and "BS or equivalent standard" respectively.

The following shall apply to this contract:

- (a) The latest issue of "SANS 10142-1:2003: The wiring of premises, Part 1: Low-voltage installations", hereafter called the "Wiring Code".
- (b) The Occupational Health & Safety Act, Act 85 of 1993.
- (c) The Municipal By-Laws and any special requirements of the local Supply Authorities.
- (d) The local Fire Office Regulations.

C7.1.2 NOTICES AND FEES

The contractor shall make all arrangements and give all notices required by, and pay all necessary fees, including any inspection fees, due to the local Supply Authority relating to the connection, alteration, or upgrade of the electricity supply to the premises.

The actual net amounts paid will be refunded to the contractor upon receipt of proof of payment.

Amounts to cover these costs are allowed for in the Bill of Quantities and an allowance is made for the tenderers to price for attendance, profit and all incidental costs relating to this requirement.

C7.1.3 SCHEDULE OF FITTINGS

In all instances where schedules of lights, socket outlets and power points are attached or included on the drawings, these schedules are to be regarded as forming part of the specification.

C7.1.4 QUALITY OF MATERIALS

Only new, unused equipment and materials of prescribed quality shall be used, and all materials shall be subject to the approval of the Employer's Agent.

Wherever applicable material is to comply with the relevant South African National Standard specifications, or to British Standard Specifications, where no SANS specifications exist. Materials must be of South African manufacture wherever possible.

C7.1.5 DELAY

If the electrical sub-contractor's work should cause any delay to the building operations, he will be held responsible for any claims arising out of such delay.

C7.1.6 MAINTENANCE PERIOD AND RETENTION MONEY

The maintenance period mentioned in the Conditions of Contract (see Part A of the tender document) will also apply to the work covered by this Part B, calculated from the date the installation has been taken over by the Employer.

Payment of the retention money mentioned in the Conditions of Contract (if applicable) will be effected after the lapse of the maintenance period stated provided the installation has been in satisfactory working order during this period.

C7.1.7 CONDUIT AND CONDUIT ACCESSORIES

The indoor installation may be in black enamelled conduit or PVC conduit. All conduits shall be concealed in the building work where possible. Black enamelled conduit shall be screwed or plain end.

Should for some reason it not be possible to conceal conduit in the building work requiring the conduit to be surface mounted, only steel conduit may be used, secured neatly in vertical and horizontal positions by means of galvanised steel spacer saddles.

Steel conduit exposed to damp or weather conditions shall be galvanised to SANS 121.

Galvanised draw wires must be provided in all conduits provided for other services.

All steel conduit joints in concrete slabs and all running joints must be painted.

No chasing by hammer and chisel will be accepted. Slots for conduits must be cut by using power cutting disk tools where necessary.

Bushes on metal conduit shall be of brass only.

All outlet box cover plates must be metal and steel outlet boxes must be hot-dipped galvanized to SANS 121.

Where cavity walls or face brick walls are encountered deep back-to-back (one end closed) wall boxes must be used.

Blank cover plates on round outlet boxes must be fixed with flat head brass screws and a gasket to seal the box.

Blank cover plates on 100 x 100 mm outlet boxes must be fixed with two countersunk chrome screws.

Where outlet boxes or draw boxes are mounted on finished surfaces the electrical contractor shall take care that such outlets are mounted symmetrically. It will not be sufficient to scale the position of any outlet off the drawings. No extra payment will be allowed where the outlets are not mounted symmetrically and have to be changed.

Unless other methods of installation are specified for certain circuits, the installation shall be in conduit throughout. No open wiring in roof spaces or elsewhere will be permitted.

The conduit and conduit accessories shall comply fully with the Quality Specifications (GP/E5/2 Rev 0, March 2003) or latest edition.

All PVC conduits shall be installed in accordance with Appendix C of SANS 950 as well as SANS 10142-1.

Non-metallic conduit or conduit boxes shall not support luminaries and other fittings. These fittings shall be secured to the surrounding structure in a way that is acceptable to the Employer's Agent.

Surface mounted conduit shall be supported and fixed with saddles with a maximum spacing of 1,5 m, even in roof spaces. (Refer to SANS 10142-1).

The contractor shall supply and install all additional supporting timbers required. It shall be possible to rewire the completed installation in the future without undue difficulty.

Non-metallic conduit and fittings shall not be used under the following conditions:

- (a) Outside a building (unless protected, or sheltered under eaves).
- (b) For mechanical load bearing.
- (c) Where it may be subjected to temperatures below -10°C or above 70°C for prolonged periods.
- (d) As primary electrical insulation.
- (e) In areas where it may be subject to mechanical damage.
- (f) For applications other than those for which it is designed.

C7.1.7.1 Painting of Conduits

Exposed conduit may be painted with normal oil or PVA paints, but care must be taken to ensure that the paint used does not contain any component that will soften or have any other detrimental effect on the materials from which the conduit and fittings are manufactured.

C7.1.7.2 Connecting of Conduit to Metal Equipment/Components

When any part of a non-metallic conduit system has to be connected to metal equipment or components (e.g. switchboard, surface socket-outlet or switch box, existing metallic conduit system, etc.) fittings and couplings manufactured

specifically for this purpose must be used. Non-metallic conduit must not be threaded to fit metallic connectors.

C7.1.7.3 Bends

The technique applied in bending conduit shall result in a smoothly bent conduit without conduit surface ripple, cracking or flattening of the conduit. Suitable bending tools shall be applied to achieve this where manual methods are inadequate. Bends shall comply with SANS 10142-1. Conduits shall be secured immediately following bending.

C7.1.7.4 Adhesive Joints

All adhesive joints must be made in a clean dry area. The surfaces of all components to be bonded must be dry and clean. The technique applied in jointing conduit shall ensure that a mechanically sound and watertight joint with an insertion depth equal to half the length of the coupling is achieved, and that no excess jointing adhesive is squeezed into the conduit or accessory.

NOTE: Solvent adhesives containing highly volatile liquids and their containers should not be left open.

C7.1.7.5 Cutting of Conduit

A fine-tooth hacksaw shall be used to cut conduit to the required length. Each cut end shall be square and free from swarf, burrs and loose material. When determining the length of conduit to be cut, allowance must be made for the length of couplings or accessories attached to the conduit. Incorrect determination will cause bulging of the conduit or insufficient joint length.

C7.1.8 CONDUIT IN ROOF SPACES

In roof spaces, the conduit shall be installed in such a manner as to allow for all wiring to be executed from below the ceilings.

Conduit shall be secured at intervals not exceeding 1,5 m by means of saddles fixed to the roof timbers by means of screws or acceptable clout nails.

In the case of repairs and renovations, conduit runs from a distribution board shall, where possible, terminate in fabricated sheet steel draw boxes installed directly above or in close proximity to the boards.

C7.1.9 WIRING

Except where otherwise specified in Section 2 of the specification or indicated on the drawings, wiring shall be carried out in conduit throughout. Only one circuit per conduit will be permitted.

No wiring shall be drawn into conduit until the conduit installation has been completed and all conduit ends provided with bushes. All conduit is to be clear of moisture and debris before wiring is commenced.

Wiring of the installation shall be carried out in accordance with the latest edition of the Wiring Code (SANS 10142). It is a specific requirement of this contract that earth conductors be provided and drawn into the conduit with the main conductors to all points, including all lighting points throughout the installation, irrespective of the type of conduit used.

Wiring for lighting circuits is to be carried out with 2,5 mm² conductor and a 2,5 mm² earth conductor. For socket outlet circuits the wiring shall comprise 2,5 mm² and a 2,5 mm² earth conductor. In certain instances, as will be directed in Section 2 of this specification or shown on the drawings, the sizes of the aforementioned conductors may have to be increased for specified circuits.

Sizes of conductors to be drawn into conduits in all other instances, such as feeders to distribution boards, power points etc, shall be as specified elsewhere in this specification or indicated on the drawings. Sizes of conductors not specified must be in accordance with the Wiring Code.

The stipulations concerning the installation of earth conductors to a certain maximum length for a given size of conductor as set out in the "Wiring Code" are to be strictly applied.

The loop-in system shall be followed throughout, and no joints of any description will be permitted.

The wiring shall be done in PVC insulated 300/500V grade cable to SANS 1507.

Where cable ends connect to switches, fittings, etc. the end strands must be neatly and tightly twisted together and firmly secured. Cutting away of wire strands of any cable will not be allowed.

Insulated heat-resistant wiring shall be used to connect totally enclosed luminaires and other fittings where excessive temperatures are likely to occur.

C7.1.10 SWITCHES AND SOCKET OUTLETS

All switches and switch socket outlet combination units shall be of the same manufacture and pattern throughout the installation and shall comply with the Quality Specification (GP/E5/2 Rev 0, March 2003) and must be approved by the Employer's Agent.

No other than 16A 3 pin sockets are to be used unless other special purpose types are distinctly specified or shown on the drawings.

All light switches shall be installed with the centre line at 1,4 m above finished floor level and all socket outlets with the centre line at 300mm above finished floor level or, where applicable, between a worktop and window sill in such manner that it is either totally within or totally above any tiled area unless a specific mounting height is indicated on the drawings or specified in the Project Specification (Section 2).

Screws longer than 30mm to affix light switch or switch socket cradles the draw box will not be accepted.

C7.1.11 SWITCHGEAR

Switchgear, which includes circuit breakers, metal-clad switches, interlocked switch-plug units, contactors, time switches, etc., is to comply with the Quality Specification (GP/E5/2 Rev 0, March 2003).

C7.1.12 DISTRIBUTION BOARDS

C7.1.12.1 General

All boards shall be in accordance with the types as specified, be constructed according to the detail or type drawings and must be approved by the Employer's Agent before installation.

In all instances where provision is to be made on boards for the Supply Authority's main switch and/or metering equipment the contractor must ensure that all requirements of the authorities concerned in this respect are met.

Two spare 25mm dia. and three spare 20mm dia conduits must be supplied from all distribution boards to roof spaces.

Three sets of factory drawings on all distribution boards must be submitted for approval before manufacture of the distribution boards commence.

The Employer's Agent must be notified at least two weeks in advance of the completion of the distribution boards in order that an inspection may be carried out before delivery.

C7.1.12.2 Construction

The construction must comply with the specification contained in the Quality Specification (GP/E5/2 Rev 0, March 2003).

Apparatus and requirements by the Supply Authority are not indicated on the distribution board diagrams and schedules. It is expected of the Electrical Contractor to install all such apparatus, accessories and systems as may be required by the Supply Authority, as part of the electrical contract price.

Busbar stubs must be provided where more than one conductor terminates on equipment.

C7.1.12.3 Installation

All distribution boards shall be supplied and installed in the positions shown on the drawings.

All distribution boards must be flush mounted unless otherwise indicated, and are to be installed with the top of the board 2,0 m above the finished floor level.

The distribution boards must be placed in such a way that it can be built into the walls where applicable. Special provision must be made that the distribution board tray is not damaged or distorted while being built in.

Where boards have to be installed in walls of single brick width an expanded mesh shall be affixed to the rear of the board tray to provide support to plaster. All distribution boards must be installed level.

Where a sleeve to provide cable entry into a flush board is required, the distribution board tray shall be set back into the wall to permit the sleeve to terminate below the tray for its full diameter. Facebrick facets shall in such instances be used to conceal the sleeve. Slots in the wall with a cover plate will not be permitted unless specifically approved by the Employer's Agent.

Earth conductors must be fastened with screws and/or lugs to earth bars.

Cables must be mounted with compression glands to the distribution board tray. Earth rings and glands must be used to earth cable armouring inside distribution boards

C7.1.12.4 Labelling

Circuit breakers that do not feed any load must be marked "SPARE" on the distribution boards.

Labels indicating the source of supply and size of the supply cable must be provided on each distribution board.

Where switchboards are positioned behind doors of the building structure i.e. built-in cupboards, a suitable approved electrical danger sign as well as the applicable distribution board designation label must be supplied and fitted in a suitable position on the outside top section of one of the entrance doors at each such location.

C7.1.13 WORKMANSHIP AND STAFF

All employees employed on the service must be under the constant supervision of a registered accredited person.

The workmanship shall be of the highest grade and to the satisfaction of the Employer's Agent.

All inferior work shall, on indication by the Employer's Agent, be removed immediately and rectified by and at the expense of the electrical contractor.

C7.1.14 EARTHING OF INSTALLATION

The type of main earth provided must be as required by the Supply Authority, in addition to any requirements indicated by the Employer's Agent, who may require additional earthing to achieve desired results.

Earth rods or trench earths will be required as specified or directed by the Employer's Agent.

Installations shall be effectively earthed in accordance with the Wiring Code.

All hot and cold water and waste pipes are to be effectively bonded by means of 12,5 mm x 1,6 mm solid or perforated copper tape (not wire), clamped by means of brass bolts and nuts. The tape is to be fixed to walls by means of rounded brass screws at intervals not exceeding 150 mm.

Provision must be made for conduit to be installed in the wall for all earthing requirements. Main earth copper tapes / wires must be installed in these conduits. Where provision was not made as stipulated above, 20 mm diameter galvanised steel conduit must be installed from below ground level to 3 m above ground level. This conduit must be securely fixed to the walls. Corrugated iron roofs and guttering must be effectively earthed with copper tape and brass bolts with nuts at intervals not exceeding 2m. Self-tapping screws are not acceptable as a means of securing earth conductors.

Connection from the main earth bar on the main board must be made at the cold water main, the incoming service earth conductor, if any, and the local earth electrode by means of 12,5 mm x 1,60 mm solid or perforated copper tape or 16 mm² stranded (not solid) bare copper wire or such conductor as the Employer's Agent may direct.

C7.1.15 LIGHTNING PROTECTION

The buildings shall be protected against lightning by way of 40mm x 4mm aluminium strip secured to the roof tiles along the ridges. Fixing shall be done in such manner that no tile is penetrated or cracked, using M7 concrete anchors at every second tile edge.

The aluminium strip shall be installed perfectly straight without weaving or twisting.

At the roof edges the strip shall be bonded to a down conductor consisting of 10mm² bare copper earth wire contained in a 20dia PVC conduit, running from a point close to the roof edge to the earth pegs below.

A 100 x 100mm draw box with cover shall be provided 300mm above floor level and another above ceiling level to facilitate installation.

Bonding shall be by means of M8 stainless steel bolts washers and nuts.

C7.1.16 MOUNTING AND POSITIONING OF LIGHT FITTINGS

The contractor must note that in the case of board and acoustic tile ceilings, i.e. as opposed to concrete slabs, close co-operation with the contractor is necessary to ensure that as far as possible, the light fittings are symmetrically positioned with regard to the ceiling pattern.

The layout of the fittings as indicated on the drawings must be adhered to as far as possible, but the exact positions must be confirmed with the Employer's Agent.

Fluorescent fittings installed against concrete ceilings shall be screwed to the outlet boxes and in addition 2 x 6mm expansion or other approved type fixing bolts are to be provided. The bolts are to be $\frac{3}{4}$ of the length of the fittings apart.

Fluorescent fittings to be mounted on board ceilings shall be secured by means of two 40 mm x No. 10 round head screws and washers and in turn secured to the ceiling brandering. The fittings shall also be bonded to the circuit conduit by means of locknuts and brass bushes. The fixing screws are to be placed $\frac{3}{4}$ of the length of the fitting apart. The use of Butterfly clips to secure the light fittings will not be acceptable.

Incandescent fittings are to be screwed directly to outlet boxes in concrete slabs. Against board ceilings, the fittings shall be secured to the brandering or joints by means of two 40 mm x No. 8 round head screws and also to the outlet boxes.

C7.1.17 VARIATIONS IN EXTENT OF CONTRACT

The Employer reserves the right to instruct the contractor to carry out variations to the contract either in terms the Conditions of Contract or in accordance with prices quoted by the contractor in the Price Schedule for Variations or Bill of Quantities, whichever is applicable.

For variations not provided for in the Price Schedule or Bill of Quantities the Employer may call on the contractor to submit a separate written quotation.

Labour and material shall be based on the Conditions of Contract, and no payment will be made for the transport of labour and material to and from the service.

The Employer, however, reserves the right to execute any alterations or additions that may be necessary by others.

Before the Contractor orders any light fittings, the School and Employer's Agent must approve the manufacture and types of these fittings.

The Employer reserves the right to omit the supply of light fittings, cooking appliances, air conditioners and hot-water cylinders from the contract in whole or in part, and to deliver such material to the contractor by others.

C8 : THE MASONRY AND BUILDING WORKS

For all the schools (new and/or repairs), the building and masonry works shall be in accordance with the Act 103 of 1977 – National Building Regulations and Building Standards Act of 1977 plus the following SANS standards:

- 1215
- 10400
- 227
- 10164 and
- 10249

Materials used in the construction of sewers, storm water, manholes and catch-pits, and bedding shall comply with all the relevant requirements of Section 15 – Backfilling and Bedding, and Section 27 of SANS 10400– Drainage and Erosion Protection.

Channels for rainwater and surface water drainage shall be 150 mm half round precast concrete units 1.0 m long, complying with SANS 927.

a) Foundations

The foundation details are as per the Construction Structural drawings issued.

b) Filling

Filling shall be G5 material complying with the relevant requirements of Section 25 – Roadworks and Paving, compacted as specified in Clause

Soil poisoning for Termite Control

Poison the soil against the inside of foundation walls and under floors with Chlordane soil insecticide complying with SANS 1165, applied according to SANS 10124:

- by a certified pest control contractor
- not when soil is excessively wet
- do not disturb treated surface
- do not bury scraps of timber in ground fill
- treat foundation trench bottoms before casting
- treat every 300 mm backfill before compacting
- treat full length of pipe and cable trench inside the building and for a distance of 3 m outside the building
- take necessary health precautions on site.

A written guarantee shall be provided to the Engineer by the pest control contractor for ten years for the effectiveness of the treatment.

c) The Walls

As detailed on corresponding Construction Drawings issued to the Contractor, the brick work shall compose of the following:

- Corobrik FBA face brick walls in stretcher bond with ruled joints and perpends internally and externally or similar but approved by the Engineer before their purchase.
- Corobrik NFP for plastered walls.
- Corobrik engineering bricks to be used in plinth walls below DPC level
- Brickforce to be used as follows:
 - every brick course from strip footing to top of floor level; then
 - every 4th course from floor level to the top of window level and
 - to all courses from window head to underside of wall plate
- Galvanised crimp wire ties to be laid staggered; 7 per square metre
- The external face of the internal skin of 230mm walls to be bag washed and painted with bitumen
- Beam filling to be done on the underside of roof sheets
- Expansion joints to be as indicated on the Plan to be formed with a continuous strip of 12mm bitumen impregnated softboard between the 230mm walls. Also to be sealed internally and externally with 10mm deep polysulphide sealant.

Generally: No false headers shall be built in and none but whole masonry units shall be used except where legitimately required for the formation of bond. Burnt clay bricks shall be well soaked in water immediately before being laid and the course of bricks last laid shall be well wetted before laying a fresh course upon it. Concrete units shall not be wetted and if the stockpile has been exposed to rain, the units shall only be used once they have dried out.

Masonry shall have the joints flushed up at every course solid throughout the whole width of each course and all to be laid on a solid bed of mortar.

All walls shall be carried up regularly so that no part of the walling is more than 1.3 m higher than the adjoining work except as shown on the Drawings.

Mortar joints to masonry generally shall not exceed 10 mm in thickness. The joints of all walls intended to be plastered or tiled shall be raked out as the work proceeds to form a key for the plaster or mortar.

Where facing and pointing is specified, the walls shall be faced with facing units as specified on the Drawings and, unless otherwise specified, built in stretcher bond in 3:1 cement mortar, and pointed with a neat recessed joint formed with a steel jointing tool well pressed into the joints as the work proceeds. The face masonry shall be tied back to the walling with wire ties at the rate of 7/m². – for cavity walls only. The face work shall be protected by pasting paper over exposed surfaces, or

by other means approved by the Engineer. On completion, the face shall be cleaned down in accordance with the brick supplier's specifications / instructions.

Ventilators, gratings, dowels, corbels, ties, ends of timber, and slips for fixing joiner's work shall be built in as the work proceeds.

Damp Proof Course

Damp proofing in the walls shall be laid without any longitudinal joints and lapped 150 mm at all end joints and intersections. Damp proofing shall be kept 10 mm back from the external face of walls and pointed in cement mortar.

Damp proofing under floors shall be laid with 150 mm laps at all joints in both directions and sealed with pressure sensitive tape.

In cavity walls, it shall be stepped up one course over a cement mortar triangular fillet in the bottom of the cavity.

Doors and windows shall be provided with damp proofing to sills and joints.

Mortar

Mortar shall be mixed in small quantities, with the materials mixed dry on a proper platform with water added gradually through a fine rose and the mixture turned over until the ingredients are thoroughly incorporated.

It is essential that mixing platforms be well cleaned and stale mortar removed before any batch of new mortar is prepared for mixing. Mortar shall be used within 2 hours of cement being mixed in.

d) Ventilation

Provide and appropriately incorporate 229mmx152mm terra-cotta vermin proofed Air-Bricks as indicated on the Gable elevations in the Construction drawings.

e) Plastering

Plaster sealed for the internal walls shall be prepared by mixing one part lime to five parts dry sand and to be 13 to 16mm thick. Immediately before use, one part cement shall be thoroughly mixed with twelve parts of the above lime/sand mix.

One coat plaster shall be applied to the surface, left to stiffen, struck off with a striker board, and wood floated to an even surface and to a thickness of 10 to 15 mm. If plaster is to be applied in two coats, or is to be tiled, the first coat shall be scored with roughly parallel lines about 20 mm apart and 5 mm deep to provide a key for the finishing coat or the tile adhesive.

Cement-sand finishing coats shall be 5 to 8 mm thick.

Where a roughcast finish is specified, the same mix shall be spattered onto the still green rendering coat with a spatter-dash machine to achieve an approved finish.

Where a bagged finish is specified, sharp projections shall be removed and spread over the surface with a rolled-up sack until all holes and cracks have been filled.

Plaster for rendering to concrete surfaces, beams and manholes shall be composed of one part cement to three parts sand.

In the case of soft clay brickwork, external plasterwork that is to be tiled, single leaf walls where metal roof straps are surface fixed as a substitute for V-joints between different materials, or in the case of chases in walls exceeding 75 mm in width, the following shall apply:

- metal lath or mesh shall be nailed to the wall at 300 mm centres horizontally and vertically with galvanized or stainless steel nails and spacers to provide a gap of 5 mm between substrate and lath, and stretch tightly
- the first coat shall be applied by forcing plaster through lath and scored.
- the finishing coat shall be applied
- in the case of soft clay brickwork, a class III mix shall be used.

Plaster shall be finished with a wooden trowel, to an even and smooth finish.

Single wall surfaces shall be plastered in one operation.

Surfaces shall be protected against drying out for three days.

Knife joints shall be formed through full plaster thickness over movement joints, where different materials meet, and along the line of the damp proof course at floor level, with arris-rounded or V shaped edges

Gypsum plaster

Hardwall gypsum plaster shall be a retarded hemi-hydrate finishing plaster.

Gypsum finishing coats shall be 3 to 5 mm thick.

Barite plaster

Barite must be plaster grade barium sulphate (BaSO_4). Mix one part cement to five parts barite by weight.

Barite plaster shall be applied in layers of 6 to 7 mm at a time, to a final thickness as specified. Each layer shall be well floated while setting to prevent the formation of cracks.

f) Painting – Colour To Be Approved the school and the Engineer

1 coat Undercoat

2 coats 'Wall N' All' emulsion paint

g) Concrete Slab

To be 100mm thick power floated 30MPa concrete slab, reinforced with Ref 19 mesh reinforcement set 25mm above 250 micron Ginplas USB Green DPC on 50mm thick

treated and rammed river sand on clean earth fill in layers not exceeding 150mm thick well watered and compacted to 90% mod AASHTO. The soil is to be poisoned in accordance with SANS 1 and certificate shall be provided.

h) The Roof

Roof **pitch** to 17.5 degrees

Sheeting to be 0.8mm thick continuous corrugated iron 'S' profile roof sheeting with pre-painted factory finish. The sheeting to be fixed with leak king roofing screws whole holes should be drilled and not punched. Sendor polyclosures at ridge flashing and mastic sealant to all side laps.

The prevailing wind direction should be determined before laying of the sheets is done.

The sheets should:

- project a minimum of 50mm beyond the purlins ends at eaves
- be fixed to 70mm x 50mm purlins at maximum of 1250mm centres on trusses at maximum of 1250mm centres strapped to 114mm x 38mm wall plate with 30 x 1.6 x 1600mm long galvanised hoop iron straps built into the coursing.
- Sisalation 'RSA 420' underlay over trusses and under purlins on straining wires.
- Prefabricated cleated roof trusses or trusses manufactured onsite to be to KZN DoE Engineer's approval and constituting of the following (per details issued)
 - 114mm x 38mm Rafters and ties
 - 114mm x 38mm intermediate members
- Hurricane clips to be used to secure purlins at eaves overhangs, that is, externally
- Double wound 2.5mm diameter galvanised wire to be used to secure purlins on the internal side.
- All exposed roof timber to be painted with 2 coats of ABE Provonite before fixing of roof sheets, fascia and barge boards

i) The Ceilings

It will be 9mm thick Rhino board clout nailed to 38mm x 50mm brandering to be:

- placed at 450mm centres
- Primed, filled and sand levelled for painting
- Place 12mm wide H-profile metal cover strips to joints
- 75mm x 20mm softwood cornice spiked to wall
- All joints to be levelled, primed, sanded before applying undercoat and 2 coats of PVA paint

j) Pre-Stressed Concrete Lintels

Regardless of whether the width of pre-stressed units is full, half brick or 150 mm, they shall be laid to the full width of the bricks in the wall. The lintels shall have a bearing of not less than 225 mm at each side of the opening.

k) Masonry Lintels

Masonry lintels shall be formed of masonry units complying with the same specifications as those of the wall in which the lintel is being formed except as specified in Clause 46.3.4.1. They shall be properly bonded longitudinally and be bedded in 1:3 cement mortars. At each reveal, the end unit of the bottom course shall have a bearing of at least half its width.

Masonry lintels shall be reinforced for their full length and shall be formed at least of the minimum number of courses, all as set out in Table 46/1, below.

Masonry lintels shall be formed on rigid temporary supports which shall be left in position for seven days or such longer period as the Engineer shall instruct.

Subject to prior written approval, pre-stressed concrete lintels may be used provided they comply.

Masonry shall be built in 1:3 cement mortar with all joints filled solid with mortar. Lintels shall have a bearing of not less than 225 mm on each side of the opening.

Table 46/1: Type of Lintels

Type Of Lintel	Width Of Opening m	Min. No. Of Brick Courses Over Lintel	Reinforcing Per Half Unit Soffit Width
Brick Reinforced	under 1.50	4	3/3,15 mm HT wire
	1.50 to 2.25	6	3/6 mm Mild Steel or 3/3,15 mm HT wire
	2.25 to 3.00	8	4/3,15 mm HT wire
Concrete Pre-stressed	under 1.80	Beam + 3	(See Clause 46.3.3.2)
	1.81 to 3.00	Beam + 4	(See Clause 46.3.3.2)

l) Barge and Fascia Boards

Use Everite Nutec Fibre Cement socketless barge boards (product number 521-731) 200mm x 80mm with H-Profile Aluminium barge board pointers (product number 685-187)

To drill for and fix with hot dipped galvanised screws and washers.

75mm x 50mm Trimmer Batten fixed to underside of Purlin ends for barge Board fixing.

Everite Nutec medium density fibre cement fascia board (product number 685-187) 12mm x 225mm with H-Profile Aluminium fascia board (product number 685-195)

Drill for fixing with hot dipped galvanised screws and washers.

m) Gutters and Downpipes

These should be Seamless Aluminium Ogee Gutters with baked enamel finish and fixed to Supplier's specifications, with 100mm x 75mm fluted Aluminium Downpipes with baked enamel finish and fixed to Supplier's specification.

n) Veranda Walkways

The concrete veranda slab to be:

- 100mm thick
- of 30MPa grade
- Reinforced with mesh Ref 193 set at 25mm above 250 microns gunplas USB Green DPC on 50mm thick treated and rammed river sand on fill compacted to 95% mod ASHTO.
- Laid with 25mm fall away from the wall
- Cast in alternate panels of 2 000 mm width
- Expansion joints sealed with 10mm polysulphide sealant with baking-strip and softboard

o) Concrete Aprons and Channels

These are for Stormwater drainage away from the building. The concrete Apron to be:

- Cast on even fill that is compacted to 95% mod AASHTO
- Of 30 MPa strength
- 75 mm thick
- Fall of 1 in 200 away from the building to relief points
- Cast in alternate panels with control joints cut every 2 000mm
- Control joints to be sealed with 10mm thick polysulphide

Precast concrete channels shall be laid at falls from each downpipe as shown on the Drawings.

p) Windows and Door Frames

Before building-in, any damage to the shop primer shall be made good by painting with zinc chromate primer.

Windows and doorframes shall wherever possible be built into walls during construction and the lugs well secured. They shall be securely strutted to prevent distortion while the masonry is being built.

After completion and before plastering, the space between the frames and masonry shall be carefully and thoroughly filled with 3:1 cement mortar, and the external joints raked out to a depth of at least 10 mm and caulked with mastic cement forced into the joints.

Steel windows and doorframes, after glazing, shall receive two coats of oil paint to selected colours, after any damage to the zinc chromate primer has been made good.

q) Burglar bars

Where required, burglar bars shall be of 8 mm diameter mild steel rod or 10mm square bars with full strength butt welds at all intersections and ends flattened to 30 mm and drilled 5 mm for 4,5 mm rivets. Bars must be factory finished with epoxy polyester electrostatic powder coating.

r) Plumbing and Drainage

All materials used for plumbing and drainage shall comply with SANS 10400, The Application of the National Building Regulations.

Unless otherwise listed in the Bill of Quantities, water piping shall be in copper, the piping and valves conforming to SANS 460 and SANS 226 respectively.

When galvanized iron piping is listed in the Bill of Quantities or shown on the Drawings, the piping shall conform to BS 1387 Medium Series, and shall have screwed and socketed joints.

Brass bib-cocks shall be heavy pattern with polished bodies to the finish listed in the Bill of Quantities or ordered by the Engineer.

Kitchen sinks and baths shall have 40 mm PVC-U traps and waste pipes with cleaning eyes fitted to each bend and trap and complying with SANS 967. Vent pipes shall be 110 mm PVC-U pipes to SANS 967.

Fittings for fixing waste and vent pipes to walls shall consist of approved pressed steel holderbats plugged to walls.

Drain pipes and fittings shall comply with SANS 559 for vitrified clay or SANS 791 for PVC-U. Unless otherwise listed in the Bill of Quantities, sewer and drain connections shall be in vitrified clay pipe with rubber ring or factory applied resilient plastic joints.

Where scheduled in the Bill of Quantities or shown on the Drawings, the following shall apply:

- ii) The hot water cylinder shall be a horizontal combination type, bearing the SANS mark, of 90 litres capacity unless otherwise indicated on the Drawings, and shall be installed on brackets sufficient to carry the mass of the filled geyser. The Contractor shall allow for all items, excluding the

electrical connection (which is included elsewhere in the Contract), to install the cylinder.

- iii) The kitchen sink shall be 1 050 mm long of standard stainless steel single bowl type, bearing the SANS mark, and fitted with grid, plug, chain and screwed union for waste trap and pipe. The whole shall be rigidly supported by metal brackets.

If a hot water system is being installed, two 13 mm brass bib-cocks shall be fitted to the sink. If no geyser is being installed, one 13 mm bib-cock shall be fitted, with provision made for a future hot water bibcock.

C9: ANNEXURES

ANNEXURE C9.1:

OCCUPATIONAL HEALTH AND SAFETY SPECIFICATIONS

C9.1.1 HEALTH AND SAFETY REQUIREMENTS AND PROCEDURES

(a) Construction Regulations, 2003

The Contractor shall be required to comply with the Occupational Health and Safety Act, 1993: Construction Regulations, 2003 (the regulations) as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003. Non-compliance with these regulations, in any way whatsoever, will be adequate reason for suspending the Works.

The proposed type of work, materials to be used and potential hazards likely to be encountered on this Contract are detailed in the Project Specifications, Schedule of Quantity and Drawings, as well as in the Employers' health and safety specifications (regulation 4(1)) of the Construction Regulations 2003.

The Contractor shall in terms of regulation 5(1) provide a comprehensive health and safety plan detailing his proposed compliance with the regulations, for approval by the Employer.

The Contractor shall at all times be responsible for full compliance with the approved plan as well as the Construction Regulations and no extension of time will be considered for delays due to non-compliance with the abovementioned plan or regulations.

Payment items are included in the Schedule of Quantities to cover the Contractor's cost for compliance with the OHS Act and the abovementioned regulations.

b) The Construction Work

The Contractor's attention is drawn to some Health and Safety Risks related to the Construction Work.

- i) Dangerous Traffic Conditions that will occur regarding to Limited view/sight distance of road users.
This may impact on both the construction vehicle drivers or pedestrian workers entering or leaving Site.
- ii) The loading and offloading of materials, goods or equipment may injure workers. Special measures to avoid unnecessary bystanders or workers close to loading activities needs be implemented. Lifting gear to be in good condition.
- iii) Objects falling from height above may cause seriously injuries. Contractor will provide safety hats to workers, or implement working procedures.

iv) The risk of Power tool injuries during various stage needs to be managed. Such injuries may be caused due to electric shock, dynamic impact, restriction of movement or rotation of machine components. (drilling, grinding, post tensioning). Safety gear protecting workers will be used at all times.

v) Dangerous conditions exist in the vicinity of schools. The contractor may expect to monitor the movement of scholars and make allowance for their protection. This may include additional signage and/or visual monitoring.

vi) Although high voltage cables are not directly affected by the works, the contractor may have to work in the vicinity of such services. Cognisance of this must be taken by the contractor and provision must be made to make hi staff aware of the dangers associated with these services. Although fire risk is low, special consideration needs to be given to storage of chemicals fuel and oil.

vii) Construction Regulations 2014 The Contractor shall be required to comply with the Occupational Health and Safety Act, 1993: Construction Regulations 2014 (the regulations) as promulgated in Government Gazette No 37305 and GNR 84 of 07 February 2014. (A copy of the Construction Regulations will be provided and discussed with the successful Contractor). Non-compliance with these regulations, in any way whatsoever, will be adequate reason for suspending the Works.

The proposed type of work, materials to be used and potential hazards likely to be encountered on this Contract are detailed in the Project Specifications, Schedule of Quantity and Drawings, as well as in the Employers' health and safety specifications (regulation 5(1)) of the Construction Regulations 2014, which will be issued separately by the Employer on appointment of the successful Contractor.

The Contractor shall in terms of regulation 7(1) provide a comprehensive health and safety plan detailing his proposed compliance with the regulations, for approval by the Employer.

The Contractor shall at all times be responsible for full compliance with the approved The risk of Power tool injuries during various stage needs to be managed. Such injuries may be caused due to electric shock, dynamic impact, restriction of movement or rotation of machine components. (drilling, grinding, post tensioning). Safety gear protecting workers will be used at all times.

approved plan as well as the Construction Regulations and no extension of time will be considered for delays due to non-compliance with the abovementioned plan or regulations.

A payment item is included in the Schedule of Quantities to cover the Contractor's cost for compliance with the OHS Act and the abovementioned regulations.

Further, the contractor shall/must submit the following to the manager OH&S to obtain a certificate of compliance from OH&S of the Local Municipality before any work may commence.

1. Proof of Registration with the Compensation Commissioner.
2. Letter of “Good Standing” with Compensation Commissioner.
3. Certified copy of first aid certificate.
4. Physical address where contract is taking place (on Company letterhead).
5. Detailed description of intended work (on Company letterhead).
6. List of all Personal Protective Equipment issued to employees (company letterhead).
7. List of ALL employees on site (on company letterhead).
8. Detailed Health and Safety Plan (on company letterhead).
9. Comprehensive Risk Assessment (Qualification and Contact details of Risk Assessor).
10. Public Liability and Commercial Insurance Certificate.
11. All related statutory appointments.
12. Certificates of relevant Training.

The above list represents the minimum content of a safety file in terms of the Construction Regulations, 2014 (the regulations) as promulgated in Government Gazette No 37307 and Regulation Gazette No 10113 of 7 February 2014.

C9.1.1.1 Services and facilities provided by the Employer

(a) Water sources

The Contractor shall comply with all prevailing legislation in respect of drawing water from natural and other sources and shall, when required by the Engineer, produce proof of such compliance. The distribution of water shall be carried out by the Contractor strictly in accordance with the applicable laws and regulations.

All water provided by the Contractor shall be clean, free from undesirable concentrations of deleterious salts and other materials and shall comply with any further relevant specifications of the Contract. The Contractor shall, whenever reasonably required by the Engineer, produce test results demonstrating such compliance. Water provided by the Contractor for human consumption shall be healthy and potable to the satisfaction of the health authorities in the area of the Site.

(b) Electricity supply

The Contractor shall make all arrangements in connection therewith, strictly in accordance with the applicable laws and regulations.

(c) Site establishment

The contractor, in his site establishment, may under no circumstances violate or transgress the governing authority regulations.

The Contractor shall not use the area nor allow it to be used for any purposes not directly associated with the execution of the Contract. The Contractor shall store materials and equipment for which he is responsible in an orderly manner and shall keep the Site free from debris and obstructions.

Further, the Contractor shall be responsible to obtain all the **Permits and Way Leaves** required under this Contract.

(d) Excrement disposal

The Contractor shall, at his own expense, be responsible for safely and hygienically dealing with and disposing of all human excrement and similar matter generated on the Site during the course of the Contract, to the satisfaction of the responsible health authorities in the area of the Site and the Engineer. All such excrement shall be removed from the Site and shall not be disposed of by the Contractor on the Site.

C9.1.1.2 Features requiring special attention

(a) Site maintenance

During progress of the work and upon completion thereof, the Site of the Works shall be kept and left in a clean and orderly condition. The Contractor shall store materials

and equipment for which he is responsible in an orderly manner and shall keep the Site free from debris and obstructions.

(b) Testing and quality control

(i) Contractor to Engage Services of an Independent Laboratory

The Contractor shall be responsible for arranging with the independent testing laboratory for the timeous carrying out of all such testing specified in the Contract, at not less than the frequencies and in the manner specified. The Contractor shall promptly provide the Engineer with copies of the results of all such testing carried out by the independent laboratory.

(ii) Additional Testing Required by the Engineer

In addition to the provisions of sub clause C5.2.3(b)(i), Contractor to engage services of an independent laboratory, the Engineer shall be entitled at times during the Contract to require that the Contractor arrange with the independent laboratory to carry out any such tests, additional to those described in sub clause C5.2.3(b)(i), at such times and at such locations in the Works as the Engineer shall prescribe. The Contractor shall promptly and without delay arrange with the independent laboratory for carrying out all such additional testing as required by the Engineer, and copies of the test results shall be promptly submitted to the Engineer.

(c) Subcontractors

All matters pertaining to subcontractors (including Nominated Subcontractors) and the work executed by them shall be dealt with directly between the Engineer and the Contractor in the context of all subcontract work being an integral part of the Works for which the Contractor is responsible.

The Engineer will not liaise directly with any subcontractors nor will he issue instructions concerning the subcontract works directly to any subcontractor.

All matters arising from the subcontract agreements shall be dealt with directly between the Contractor and the subcontractors and the Engineer will not become involved.

(e) Dust suppression

All working surfaces and haul roads shall be wetted regularly so as to keep the creation of dust to a minimum. To this end the contractor shall have a water cart on site at all times.

(k) Notices, signs, barricades and advertisements

All, as well as advertisements, may be used only if approved by the Engineer. The Contractor shall be responsible for their supply, erection, maintenance and ultimate removal of notices, signs and barricades.

The Engineer shall have the right to instruct the Contractor to move any sign, notice or advertisement to another position, or to remove it from the Site of the Works if in his opinion it is unsatisfactory, inconvenient or dangerous.

(l) Opening up and closing down of designated borrow pits

Measurement and payment for opening up and closing down designated borrow pits, including removing and stockpiling overburden and restoring the Site, shall be made under item 8.3.4 of SANS 1200 D.

This item applies to all borrow material required under this Contract. The requirements of subclause 5.2.2.2 of SANS 1200 D regarding the opening up, maintenance and closing down of borrow pits shall be adhered to.

(m) Workmanship and quality control

The Contractor's attention is drawn to the provisions of the various Standardized Specifications regarding the minimum frequency of testing required. The Contractor shall, at his own discretion, increase this frequency where necessary to ensure adequate control.

On completion and submission of every part of the work to the Engineer for examination and measurement, the Contractor shall furnish the Engineer with the results of the relevant tests, measurements and levels to demonstrate the achievement of compliance with the Specifications.

C9.1.1.3 SAFE WORKING CONDITIONS

General

The Contractor shall, at all times, observe adequate safety precautions on Site to ensure the safety of the public as well as of his own staff and other persons engaged in or about the Works. In this respect, he shall observe all laws, ordinances and regulations pertaining to his work.

When work is carried out within a road reserve, the road surfaces not affected by the work and which remain open to traffic, shall be kept clean at all times so that gravel and debris will not be thrown up by passing vehicles, causing possible injury to persons and damage to property and other vehicles.

The contractor's attention is specifically drawn to the following Acts and Regulations, and particularly to the relevant regulations under each Act, copies of which shall at all times be kept by the contractor on the Site:

- The Occupational Health and Safety Act, 1993 (Act 85 of 1993) and its Regulations
- The Explosives Act 2003, (Act 15 of 2003)
- The Explosives Regulations, 2002
- The Mine Health and Safety Act, 1996 (Act 29 of 1966)

Should the work so require, the Contractor shall comply with the safety precautions set out in the following publications, copies of which shall also be kept by him on the Site:

- The latest edition of the Code of Practice relating to the safety of persons working in small diameter shafts and test pits for Civil Engineering purposes, obtainable from the Secretary, SA Institution of Civil Engineers.
- The latest edition of the Operation of Wastewater Treatment Works Handbook, Chapter 25, Safety, obtainable from WISA.

Occupational Health and Safety Act

The Contractor shall comply with the Occupational Health and Safety Act (Act 85 of 1993) and its Regulations.

In particular the Construction Regulations, 2003 (Government Gazette No 25207) shall be adhered to at all times.

The Employer or his Agent shall inspect the works from time to time to monitor the contractor's compliance with the above legislation.

Where any such investigations reveal, or where it comes to the Engineer's attention that the contractor is in any way in breach of the requirements of the above legislation, the engineer shall in accordance with the Conditions of contract, be entitled to suspend construction of the works, or any part thereof, until such time as the breach has been rectified to the satisfaction of the Engineer.

The Contractor shall have no grounds for a claim against the Employer for extension of time and/or additional costs if the construction of the works or any part thereof is suspended by the Engineer in terms of the conditions of contract

The Contractor shall, in terms of the contract, remain fully liable for the payment of penalties for late completion should the Contractor fail to complete the works within the time for completion as a consequence of the suspension of construction for the above reason.

Health and safety plan

The health and safety plan required by the Act and supporting Regulations shall include, but not limited to, the following:

- Occupational health and safety policy
- Administrative requirements
- Risk identification and assessment including maintenance of all registers
- Training
- Incident and accident reporting

- Incident and accident investigation
- First aid
- Occupational health and safety representatives
- Occupational health and safety committees
- Permits
- Certificates of competence and compliance Permits
- Audits and inspections

Health and Safety file

Every Contractor shall ensure that a health and safety file, which shall include all documentation required in terms of the provisions of the Act and the relevant Regulations, is kept on site and made available to the client, agent or inspectors on request.

A Principal Contractor shall hand over a consolidated health and safety file to the client upon completion of the construction work and shall, in addition to the documentation referred to in the regulations, include a record of all drawings, designs, materials used and other similar information concerning the completed works.

A Principal Contractor shall ensure that in addition to the documentation required in the health and safety file as determined in the regulations, a comprehensive and updated list of all sub-contractors on site accountable to the principal contractor, the agreements between the parties and the type of work being done are included and available.

Safety Officer

The Contractor shall in accordance with the act and supporting regulations upon having considered the size of the project, the degree of dangers likely to be encountered or the accumulation of hazards or risks on the site, appoint a full-time or part-time construction safety officer with the necessary competencies and resources to assist him in the control of all safety related aspects on the site.

Health and safety training

The Contractor shall provide employees with the necessary information and training or supervision that is necessary to enable them to perform their work safely and without risk to health, and shall ensure that every employee becomes familiar with work-related hazards and risks and the measures that must be taken to eliminate, control and minimize those hazards and risks.

Personal protective clothing and equipment (PPE)

All employees employed on the construction site and visitors shall wear clothing and equipment as prescribed in the site hazard analysis.

The Contractor shall identify tasks requiring protective clothing and equipment and issue the necessary to employees on site.

Employees shall maintain all PPE in a safe, clean condition.

Personnel not wearing PPE where PPE is prescribed will be disciplined in accordance with the company's disciplinary code of conduct

Provision of safety fences, signs and barricades

The contractor shall in accordance with the act and supporting regulations erect fences and/or barricades to protect the public passing by or entering the construction area.

The Contractor shall, in accordance with the act and supporting regulations, erect Notices and Signs at entrances and along perimeters of the construction site indicating "No Unauthorized Entry" and "Visitors to report to Site Office". Notices and Signs at the construction site entrance instructing visitors and non- employees what to do, where to go, and where to report to on entering the site shall also be erected.

Where necessary, or as instructed by the Engineer, the Contractor shall employ security guards to safeguard safety fences, signs and barricades from theft or vandalism.

C9.1.1.4 SAFETY EQUIPMENT

Prior to commencement of work, the following safety equipment must be availed. This equipment must be in good working order and available throughout the duration of the job on an as needed basis.

1. Hard hats and work gloves for all personnel (rubber gloves when working with wet solid).
 2. Appropriate work shoes/boots.
 3. Appropriate acid resistant overall.
 4. Appropriate eye protection if need be.
 5. First aid kit.
 6. Fire extinguishers: Multi-purpose dry UL Class 20A-20B/C for extinguishing Class A, B and C fires will be kept within 6m of all excavations.
 7. "No Smoking" signs posted at surface
 8. Parachute-type harness (2) and safety lines (for use at heights and in excavations, manholes, and installation, etc.).
 9. Ladders for easy ingress and egress from excavations, structures, etc.
 10. Barricades.
 11. Safety screen for excavations, sufficient to support a weight of 200 Kg.
- Further, the best way to protect workers from the dangers of hazardous gases is through the use of four safeguard measures:
1. Test the atmosphere
 2. Ventilate confined spaces
 3. Use the appropriate safety equipment

4. Provide back-up safety personnel

C9.1.1.5 EXISTING SERVICES

C9.1.1.6.12 Treatment of existing services

The Contractor shall take all necessary steps to ascertain the location of existing services before commencing any section of the Works and shall exercise the greatest care when working in the vicinity of such services.

The Contractor needs to establish all information indicating the approximate positions of these services and the Contractor will be expected to locate and expose these by hand excavation before any excavation operations commence. Any problems encountered shall be immediately brought to the attention of the Engineer.

In addition, certain items of work require to be connected to existing works. The new work must therefore be co-ordinated and arranged in such a manner so as to cause minimum interference with the existing work and must also be carried out so as to match and blend in with the existing work.

Where existing services are either indicated on drawings supplied to the Contractor or indicated on Site, or in the course of excavation the Contractor shall lay bare any water mains, pipes, cables, telegraph cables or telephone poles, or any existing structures, these shall be severally shored, strutted or slung and sufficiently protected to ensure that no damage shall be done to them until filling has been placed around them. In the case of electric and telephone cables, if these shall be exposed in the course of excavation, the Contractor shall not refill the excavation around such cables until the cables have been inspected and passed as intact by their respective owners. The costs of exposing these services, protecting, maintaining and repairs necessitated by damage caused by the Contractor must be included in the rates measured as specified in Sub-Clause 8.3.2(a) of SANS 1200 DB.

C9.1.1.6.3 Damage to services

The Contractor shall take all necessary steps to protect any existing works whatsoever against damage which may arise as a result of his operations on Site. The Contractor shall bear the cost of the repair of damage to any service the possible existence of which could reasonably have been ascertained by him in good time.

C9.1.1.6.4 Reinstatement of services and structures as damaged during construction

Where the Contractor is responsible for the cost of repairs carried out by the Employer or an outside authority, the costs will be recovered by means of a

deduction from the Contractor's monthly Payment Certificates. The Employer will attend to the payment of monies due to outside authorities.

PS9.5 - WORKER SAFETY PRECAUTIONS

- A. In addition to providing safe work conditions, Contractors must follow all safety procedures. Some of the more important procedures are:
1. No drinking alcoholic beverages or being under the influence of drugs while working on any site.
 2. Hard hats should be worn when working in construction areas, at heights, near drilling equipment or in excavations.
 3. Inhalation of landfill gases should be avoided as far as practicable. Such gases may cause nausea and dizziness, which could lead to an accident.
 4. Avoid a person working alone when working more than 1.2m below the surface of the landfill.

ANNEXURE C9.2

RISK MANAGEMENT

Risk procedure has been developed to serve the following purposes;

- To ensure that the outcomes of all risks identifying activities are reviewed, non-conformances rectified through the implementation of appropriate corrective action and recurrences prevented;
- To ensure a consistent approach for implementing and documenting such corrective action throughout project.

1. Project Risk Management Procedures

Risk Management should also describe procedures for the following processes.

- **New Risk/Issue Identification**- New risks/issues can be identified at identified intervals and at Projects Risk Forum meetings. Project Manager(s) should promote a 'risk aware' culture and ensure that people are encouraged to raise new risks and identify countermeasures. All risks/issues identified should be added to the register, even if they are closed swiftly.
- **Escalation** - This is a process for raising awareness of the risk so that it can be considered at Project Technical Committee/ Board level. If a risk can be contained within the Project, it does not need to be escalated unless it is likely to have a big impact on the whole Project and the countermeasures cannot prevent this. For the system to work, the Project Team and the Project Manager must understand the process and use it. The Assistant Project Manager is key to ensuring that risks are appropriately escalated and managed coherently across the Project.
- **PCC Involvement** – The Project Manager should raise the key Project risks at all Project Coordinating Committee meeting(s). These risks and progress on the countermeasures should be discussed during these meetings. The PCC must also be made aware of all new risks, those that are closing and those that have changed significantly. The PCC should also be made aware of contingency plans, particularly where these have an impact across the Programme, and should be invited to review all risks periodically.
- **Risk Review** - Risks must be reviewed regularly. An assessment should be made on the current probability and impact for the risk. A Risk Review will result in the risk being identified as:
 - Unchanged - consider whether additional action is required. Is the counter-measures working?

- Changed probability or impact
- No longer a risk - perhaps the threat has gone away and if so, the risk can be closed by Management

It is recommended that the more severe risks (High Impact/High Probability) be reviewed weekly, and that the Assistant Project Manager is kept informed on the progress for mitigation of the risk.

There are two stages in the process of Project Risk Management. They are:

- Risk Assessment; and
- Risk Control.

2. Risk Management Plan

Effective management of the school's infrastructure project is supported by full understanding of the existing infrastructure, the type and magnitude of hazards and risks, a practical understanding of managing such risks and communication amongst all the role-players.

The multi-disciplinary project team produced the risk management Plan as follows:

➤ System Assessment:

- Mobilisation of the team
- Evaluation and documentation of the status of school's infrastructure
- Collation of information/data and drawings then review and document the respective school's infrastructure

Evaluation and documentation of the status of school's infrastructure

- Collation of information/data and drawings then review and document the respective school's infrastructure

➤ Risk Assessment

- Conduct risk assessment by an operational walkthrough of the system
- Identify individual hazards and determine the associated risks
- the risk origins from the design, operation, maintenance, management, or other
- Use a weighted risk matrix to score each risk by considering the 3 risk factors of severity, likelihood, and urgency
- Identify control measures for each risk (inherent risk)
- Score the value of the residual risk that would remain after the implementation of the corrective measure
- Identify the necessary control measures to ensure effective abatement of inherent risks
- Compile a detailed risk assessment workplan which allows for responsible persons, timeframes and resource allocations for each risk and per risk category

- Verify the achievement of value of the abated risk via establishment of appropriate control measures
- Monitor the success of the corrective measures via quality assurance and control measures
- Establish management procedures e.g. Incident Management Protocol, Monitoring Plans, Staff Development and Training, etc
- Establish documentation and communication procedures
- Review the infrastructure schedule and update the infrastructure

This will also help identify any new risks that may emerge during implementation of the project. Each risk is weighted and rated against its likelihood (Probability) of occurrence, severity of its consequence and the requisite urgency. This as per the table in item 11.3 below.

This Risk Management Plan will be reviewed and updated on a regular basis. The Programme Manager should be given the responsibility for overseeing the implementation of the risk management plan.

3. Risk Probability and Impact Matrix

The risk assessment will be carried out in accordance with the **table 5** below.

Table 5: Risk Probability and Impact Matrix

Assessment	Probability		Impact in Quality	Impact in Time (ET)	Impact in Cost/Money (EM)
1	<10%	Rarely occurs (once in 5 years)	Insignificant (No impact – or non-serious Economic or Environmental Impact) – ie system can re-establish itself in a relatively short time frame	>5 years	<R5 million
2	10% to 25%	Low (Unlikely, once per year)	Medium or minor effect to large population or minor Economic or Environmental Impact) = Needs Follow-up eg supervision	3 - 5 years	R5 – 10 million
3	26% to 50%	Medium/Moderate (once per month)	High effect = moderate impact to large population (or moderate Economic or Environmental Impact). Needs Control like formal checks	1-3 years	R10.1 – 50 million
4	51%-80%	Real Chance	Major - (Population significant illness exposure; significant Economic, Environmental Impact) – eg major export crop loss, seriously polluted river	3-12 months	R50-100 million

			and require interventions		
5	81% - 100%	Almost certain (Regular or permanent feature)	Catastrophic (Death expected from exposure – hazmat situation	Immediate intervention required (<3 months)	>R100 million

These values will then be used to calculate the risk score thus:

Risk score = Probability x Maximum impact per table below.

Probability = “how often’ or “how likely” a hazard or a hazardous event can or has historically occurred

Consequence/Impact = the severity of the results of the hazard/hazardous event and the seriousness or intensity of the impact of the hazard

Time urgency = how urgent the municipality rate the risk to be addressed

The product of the three risk elements can be compared to the **table 6** below to identify the Risk Profile as **low, medium or high risk**

Table 6: Risk Profile Schedule

SCORE		RISK PROFILE				
Risk Score Table						
Risk Score		Impact (Time, Money, Quality)				
		1	2	3	4	5
Probability	1	1	2	3	4	5
	2	2	4	6	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
	5	5	10	15	20	

Major risks are those with risk scores of 10 or higher. A high score implies that a bigger risk of a hazardous event occurring exists and will therefore be prioritized.

5.4 Risk Register (All disciplines)

The identified risks will then be transferred to the risk register with a proper assignment of the key risks to relevant parties. **Table 7** below depicts typical arrangement of the risk register and a risk example.

Table 7: Risk Register

Objective Setting		Risk Identification			Risk Severity	Current Mitigation Strategy	Opportunities	Due Date of Implementation
Key Function	Objectives	Risk Event	Cause	Impact	Impact	Responsible Person	Implementation or Enhancement of Existing Controls	Implementation date for mitigation measure
Client	Funding Adequacy	Inadequate available funding	Change or depletion of budget	Delayed service delivery	Low	Client	PSP to report regularly	On-going and as it occurs

ANNEXURE C9.3:

KZN DOE : STANDARD ELECTRICAL SPECIFICATIONS



DEPARTMENT OF EDUCATION: PROVINCE OF KWAZULU-NATAL

ELECTRICAL STANDARD SPECIFICATIONS

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1.1 STANDARD SPECIFICATIONS, ACTS, REGULATIONS AND BY-LAWS

Wherever any reference is made to the South African National Standard (SANS) and the British Standard specification (BS) in either of the General Specification (Section 1), Project Specification (Section 2) and Quality Specification (GP/E5/2 Rev 0, March 2003) this reference shall be deemed to read "SANS or equivalent standard" and "BS or equivalent standard" respectively.

The following shall apply to this contract:

- (a) The latest issue of "SANS 10142-1:2003: The wiring of premises, Part 1: Low-voltage installations", hereafter called the "Wiring Code".
- (b) The Occupational Health & Safety Act, Act 85 of 1993.
- (c) The Municipal By-Laws and any special requirements of the local Supply Authorities.
- (d) The local Fire Office Regulations.

1.2 NOTICES AND FEES

The contractor shall make all arrangements and give all notices required by, and pay all necessary fees, including any inspection fees, due to the local Supply Authority relating to the connection, alteration, or upgrade of the electricity supply to the premises.

The actual net amounts paid will be refunded to the contractor upon receipt of proof of payment.

Amounts to cover these costs are allowed for in the Bill of Quantities and an allowance is made for the tenderers to price for attendance, profit and all incidental costs relating to this requirement.

1.3 SCHEDULE OF FITTINGS

In all instances where schedules of lights, socket outlets and power points are attached or included on the drawings, these schedules are to be regarded as forming part of the specification.

1.4 QUALITY OF MATERIALS

Only new, unused equipment and materials of prescribed quality shall be used, and all materials shall be subject to the approval of the Employer's Agent.

Wherever applicable material is to comply with the relevant South African National Standard specifications, or to British Standard Specifications, where no SANS specifications exist.

Materials must be of South African manufacture wherever possible.

1.5 DELAY

If the electrical sub-contractor's work should cause any delay to the building operations, he will be held responsible for any claims arising out of such delay.

1.6 MAINTENANCE PERIOD AND RETENTION MONEY

The maintenance period mentioned in the Conditions of Contract (see Part A of the tender document) will also apply to the work covered by this Part B, calculated from the date the installation has been taken over by the Employer.

Payment of the retention money mentioned in the Conditions of Contract (if applicable) will be effected after the lapse of the maintenance period stated provided the installation has been in satisfactory working order during this period.

1.7 **CONDUIT AND CONDUIT ACCESSORIES**

The indoor installation may be in black enamelled conduit or PVC conduit. All conduits shall be concealed in the building work where possible. Black enamelled conduit shall be screwed or plain end.

Should for some reason it not be possible to conceal conduit in the building work requiring the conduit to be surface mounted, only steel conduit may be used, secured neatly in vertical and horizontal positions by means of galvanised steel spacer saddles.

Steel conduit exposed to damp or weather conditions shall be galvanised to SANS 121.

Galvanised draw wires must be provided in all conduits provided for other services.

All steel conduit joints in concrete slabs and all running joints must be painted.

No chasing by hammer and chisel will be accepted. Slots for conduits must be cut by using power cutting disk tools where necessary.

Bushes on metal conduit shall be of brass only.

All outlet box cover plates must be metal and steel outlet boxes must be hot-dipped galvanized to SANS 121.

Where cavity walls or face brick walls are encountered deep back-to-back (one end closed) wall boxes must be used.

Blank cover plates on round outlet boxes must be fixed with flat head brass screws and a gasket to seal the box.

Blank cover plates on 100 x 100 mm outlet boxes must be fixed with two countersunk chrome screws.

Where outlet boxes or draw boxes are mounted on finished surfaces the electrical contractor shall take care that such outlets are mounted symmetrically. It will not be sufficient to scale the position of any outlet off the drawings. No extra payment will be allowed where the outlets are not mounted symmetrically and have to be changed.

Unless other methods of installation are specified for certain circuits, the installation shall be in conduit throughout. No open wiring in roof spaces or elsewhere will be permitted.

The conduit and conduit accessories shall comply fully with the Quality Specifications (GP/E5/2 Rev 0, March 2003) or latest edition.

All PVC conduits shall be installed in accordance with Appendix C of SANS 950 as well as SANS 10142-1.

Non-metallic conduit or conduit boxes shall not support luminaries and other fittings. These fittings shall be secured to the surrounding structure in a way that is acceptable to the Employer's Agent.

Surface mounted conduit shall be supported and fixed with saddles with a maximum spacing of 1,5 m, even in roof spaces. (Refer to SANS 10142-1).

The contractor shall supply and install all additional supporting timbers required.

It shall be possible to rewire the completed installation in the future without undue difficulty.

Non-metallic conduit and fittings shall not be used under the following conditions:

- (a) Outside a building (unless protected, or sheltered under eaves).
- (b) For mechanical load bearing.
- (c) Where it may be subjected to temperatures below -10°C or above 70°C for prolonged periods.

- (d) As primary electrical insulation.
- (e) In areas where it may be subject to mechanical damage.
- (f) For applications other than those for which it is designed.

Painting of Conduits

Exposed conduit may be painted with normal oil or PVA paints, but care must be taken to ensure that the paint used does not contain any component that will soften or have any other detrimental effect on the materials from which the conduit and fittings are manufactured.

Connecting of Conduit to Metal Equipment/Components

When any part of a non-metallic conduit system has to be connected to metal equipment or components (e.g. switchboard, surface socket-outlet or switch box, existing metallic conduit system, etc.) fittings and couplings manufactured specifically for this purpose must be used. Non-metallic conduit must not be threaded to fit metallic connectors.

Bends

The technique applied in bending conduit shall result in a smoothly bent conduit without conduit surface ripple, cracking or flattening of the conduit. Suitable bending tools shall be applied to achieve this where manual methods are inadequate. Bends shall comply with SANS 10142-1. Conduits shall be secured immediately following bending.

Adhesive Joints

All adhesive joints must be made in a clean dry area. The surfaces of all components to be bonded must be dry and clean. The technique applied in jointing conduit shall ensure that a mechanically sound and watertight joint with an insertion depth equal to half the length of the coupling is achieved, and that no excess jointing adhesive is squeezed into the conduit or accessory.

NOTE: Solvent adhesives containing highly volatile liquids and their containers should not be left open.

Cutting of Conduit

A fine-tooth hacksaw shall be used to cut conduit to the required length. Each cut end shall be square and free from swarf, burrs and loose material. When determining the length of conduit to be cut, allowance must be made for the length of couplings or accessories attached to the conduit. Incorrect determination will cause bulging of the conduit or insufficient joint length.

1.8 CONDUIT IN ROOF SPACES

In roof spaces, the conduit shall be installed in such a manner as to allow for all wiring to be executed from below the ceilings.

Conduit shall be secured at intervals not exceeding 1,5 m by means of saddles fixed to the roof timbers by means of screws or acceptable clout nails.

In the case of repairs and renovations, conduit runs from a distribution board shall, where possible, terminate in fabricated sheet steel draw boxes installed directly above or in close proximity to the boards.

1.9 WIRING

Except where otherwise specified in Section 2 of the specification or indicated on the drawings, wiring shall be carried out in conduit throughout. Only one circuit per conduit will be permitted.

No wiring shall be drawn into conduit until the conduit installation has been completed and all conduit ends provided with bushes. All conduit is to be clear of moisture and debris before wiring is commenced.

Wiring of the installation shall be carried out in accordance with the latest edition of the Wiring Code (SANS 10142). It is a specific requirement of this contract that earth conductors be provided and drawn into the conduit with the main conductors to all points, including all lighting points throughout the installation, irrespective of the type of conduit used.

Wiring for lighting circuits is to be carried out with 2,5 mm² conductor and a 2,5 mm² earth conductor. For socket outlet circuits the wiring shall comprise 2,5 mm² and a 2,5 mm² earth conductor. In certain instances, as will be directed in Section 2 of this specification or shown on the drawings, the sizes of the aforementioned conductors may have to be increased for specified circuits.

Sizes of conductors to be drawn into conduits in all other instances, such as feeders to distribution boards, power points etc, shall be as specified elsewhere in this specification or indicated on the drawings. Sizes of conductors not specified must be in accordance with the Wiring Code.

The stipulations concerning the installation of earth conductors to a certain maximum length for a given size of conductor as set out in the "Wiring Code" are to be strictly applied.

The loop-in system shall be followed throughout, and no joints of any description will be permitted.

The wiring shall be done in PVC insulated 300/500V grade cable to SANS 1507.

Where cable ends connect to switches, fittings, etc. the end strands must be neatly and tightly twisted together and firmly secured. Cutting away of wire strands of any cable will not be allowed.

Insulated heat-resistant wiring shall be used to connect totally enclosed luminaires and other fittings where excessive temperatures are likely to occur.

1.10 SWITCHES AND SOCKET OUTLETS

All switches and switch socket outlet combination units shall be of the same manufacture and pattern throughout the installation and shall comply with the Quality Specification (GP/E5/2 Rev 0, March 2003) and must be approved by the Employer's Agent.

No other than 16A 3 pin sockets are to be used unless other special purpose types are distinctly specified or shown on the drawings.

All light switches shall be installed with the centre line at 1,4 m above finished floor level and all socket outlets with the centre line at 300mm above finished floor level or, where applicable, between a worktop and window sill in such manner that it is either totally within or totally above any tiled area unless a specific mounting height is indicated on the drawings or specified in the Project Specification (Section 2).

Screws longer than 30mm to affix light switch or switch socket cradles the draw box will not be accepted.

1.11 SWITCHGEAR

Switchgear, which includes circuit breakers, metal-clad switches, interlocked switch-plug units, contactors, time switches, etc., is to comply with the Quality Specification (GP/E5/2 Rev 0, March 2003).

1.12 DISTRIBUTION BOARDS

General

All boards shall be in accordance with the types as specified, be constructed according to the detail or type drawings and must be approved by the Employer's Agent before installation.

In all instances where provision is to be made on boards for the Supply Authority's main switch and/or metering equipment the contractor must ensure that all requirements of the authorities concerned in this respect are met.

Two spare 25mm dia. and three spare 20mm dia conduits must be supplied from all distribution boards to roof spaces.

Three sets of factory drawings on all distribution boards must be submitted for approval before manufacture of the distribution boards commence.

The Employer's Agent must be notified at least two weeks in advance of the completion of the distribution boards in order that an inspection may be carried out before delivery.

Construction

The construction must comply with the specification contained in the Quality Specification (GP/E5/2 Rev 0, March 2003).

Apparatus and requirements by the Supply Authority are not indicated on the distribution board diagrams and schedules. It is expected of the Electrical Contractor to install all such apparatus, accessories and systems as may be required by the Supply Authority, as part of the electrical contract price.

Busbar stubs must be provided where more than one conductor terminates on equipment.

Installation

All distribution boards shall be supplied and installed in the positions shown on the drawings.

All distribution boards must be flush mounted unless otherwise indicated, and are to be installed with the top of the board 2,0 m above the finished floor level.

The distribution boards must be placed in such a way that it can be built into the walls where applicable. Special provision must be made that the distribution board tray is not damaged or distorted while being built in.

Where boards have to be installed in walls of single brick width an expanded mesh shall be affixed to the rear of the board tray to provide support to plaster. All distribution boards must be installed level.

Where a sleeve to provide cable entry into a flush board is required, the distribution board tray shall be set back into the wall to permit the sleeve to terminate below the tray for its full diameter. Facebrick facets shall in such instances be used to conceal the sleeve. Slots in the wall with a cover plate will not be permitted unless specifically approved by the Employer's Agent.

Earth conductors must be fastened with screws and/or lugs to earth bars.

Cables must be mounted with compression glands to the distribution board tray. Earth rings and glands must be used to earth cable armouring inside distribution boards

Labelling

Circuit breakers that do not feed any load must be marked "SPARE" on the distribution boards.

Labels indicating the source of supply and size of the supply cable must be provided on each distribution board.

Where switchboards are positioned behind doors of the building structure i.e. built-in cupboards, a suitable approved electrical danger sign as well as the applicable distribution board designation label must be supplied and fitted in a suitable position on the outside top section of one of the entrance doors at each such location.

1.13 WORKMANSHIP AND STAFF

All employees employed on the service must be under the constant supervision of a registered accredited person.

The workmanship shall be of the highest grade and to the satisfaction of the Employer's Agent.

All inferior work shall, on indication by the Employer's Agent, be removed immediately and rectified by and at the expense of the electrical contractor.

1.14 EARTHING OF INSTALLATION

The type of main earth provided must be as required by the Supply Authority, in addition to any requirements indicated by the Employer's Agent, who may require additional earthing to achieve desired results.

Earth rods or trench earths will be required as specified or directed by the Employer's Agent.

Installations shall be effectively earthed in accordance with the Wiring Code.

All hot and cold water and waste pipes are to be effectively bonded by means of 12,5 mm x 1,6 mm solid or perforated copper tape (not wire), clamped by means of brass bolts and nuts. The tape is to be fixed to walls by means of rounded brass screws at intervals not exceeding 150 mm.

Provision must be made for conduit to be installed in the wall for all earthing requirements. Main earth copper tapes / wires must be installed in these conduits. Where provision was not made as stipulated above, 20 mm diameter galvanised steel conduit must be installed from below ground level to 3 m above ground level. This conduit must be securely fixed to the walls. Corrugated iron roofs and guttering must be effectively earthed with copper tape and brass bolts with nuts at intervals not exceeding 2m. Self-tapping screws are not acceptable as a means of securing earth conductors.

Connection from the main earth bar on the main board must be made at the cold water main, the incoming service earth conductor, if any, and the local earth electrode by means of 12,5 mm x 1,60 mm solid or perforated copper tape or 16 mm² stranded (not solid) bare copper wire or such conductor as the Employer's Agent may direct.

1.15 LIGHTNING PROTECTION

The buildings shall be protected against lightning by way of 40mm x 4mm aluminium strip secured to the roof tiles along the ridges. Fixing shall be done in such manner that no tile is penetrated or cracked, using M7 concrete anchors at every second tile edge.

The aluminium strip shall be installed perfectly straight without weaving or twisting.

At the roof edges the strip shall be bonded to a down conductor consisting of 10mm² bare copper earth wire contained in a 20dia PVC conduit, running from a point close to the roof edge to the earth pegs below.

A 100 x 100mm draw box with cover shall be provided 300mm above floor level and another above ceiling level to facilitate installation.

Bonding shall be by means of M8 stainless steel bolts washers and nuts.

1.16 MOUNTING AND POSITIONING OF LIGHT FITTINGS

The electrical contractor must note that in the case of board and acoustic tile ceilings, i.e. as opposed to concrete slabs, close co-operation with the building

contractor is necessary to ensure that as far as possible, the light fittings are symmetrically positioned with regard to the ceiling pattern.

The layout of the fittings as indicated on the drawings must be adhered to as far as possible, but the exact positions must be confirmed with the Employer's Agent.

Fluorescent fittings installed against concrete ceilings shall be screwed to the outlet boxes and in addition 2 x 6mm expansion or other approved type fixing bolts are to be provided. The bolts are to be $\frac{3}{4}$ of the length of the fittings apart.

Fluorescent fittings to be mounted on board ceilings shall be secured by means of two 40 mm x No. 10 round head screws and washers and in turn secured to the ceiling brading. The fittings shall also be bonded to the circuit conduit by means of locknuts and brass bushes. The fixing screws are to be placed $\frac{3}{4}$ of the length of the fitting apart. The use of Butterfly clips to secure the light fittings will not be acceptable.

Incandescent fittings are to be screwed directly to outlet boxes in concrete slabs. Against board ceilings, the fittings shall be secured to the brading or joints by means of two 40 mm x No. 8 round head screws and also to the outlet boxes.

1.17 VARIATIONS IN EXTENT OF CONTRACT

The Employer reserves the right to instruct the contractor to carry out variations to the contract either in terms the Conditions of Contract or in accordance with prices quoted by the contractor in the Price Schedule for Variations or Bill of Quantities, whichever is applicable.

For variations not provided for in the Price Schedule or Bill of Quantities the Employer may call on the contractor to submit a separate written quotation.

Labour and material shall be based on the Conditions of Contract, and no payment will be made for the transport of labour and material to and from the service.

The Employer, however, reserves the right to execute any alterations or additions that may be necessary by others.

Before the Contractor orders any light fittings, the Employer's Agent must approve the manufacture and types of these fittings.

The Employer reserves the right to omit the supply of light fittings, cooking appliances, air conditioners and hot-water cylinders from the contract in whole or in part, and to deliver such material to the contractor by others.

1.18 DEPARTMENTAL MATERIAL

When the Employer supplies certain materials to the contractor for installation, the contractor must arrange for taking delivery and providing safe storage of these materials.

The contractor will be held responsible for all damage to or loss of such material while it is in his custody.