

ANNEXURE B: CIVIL ENGINEERING WORKS & DESIGN SPECIFICATION

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1. STANDARD CONDITIONS:

1.1 Scale

The scale to which the drawings are prepared is not to be made use of, even when no figured dimensions are given, either on the drawings or in the specification. Figured dimensions are always to be followed even though they may not coincide with the scale of the drawings. Where no figured dimensions are found, the Project Manager is to be informed, in writing.

1.2 Units of Measurements

Units of measurements have been standardized in accordance with "System International "Units" (SI).

1.3 Interpretation of Drawings

Should any part of the drawings, specification or Bills of Quantities not be clearly intelligible to the Contractor or that the Materials or articles to be used in the execution of the works be considered insufficiently described, the Project Manager is to be requested by the Contractor, in writing, to make clear, also in writing, his requirements, failing which the Contractor is liable to make, at his own expense, any alterations or substitutions rendered necessary through incorrect interpretation of such drawings, specification or Bills of Quantities.

1.4 Standards

The Contractor shall adhere to all South African National Standards (SANS) and codes of practice, as stated in this Works Information. (In all cases the latest publication, revision or amendment applies.)

The following interpretations and meanings shall apply:

In case of any conflict in interpretation, ambiguity or discrepancy between any SANS Specification (whether standard or written as a particular project specification) contained in the Works Information and the conditions of contract, the conditions of contract take precedence within the ECC3 contract.

In case of any conflict in interpretation, ambiguity or discrepancy between any SANS Specification (whether standard or written as a particular project specification) contained in this paragraph 4.3 of the Employer's Works Information and specific statements contained elsewhere in C3.1 Employer's Works Information, the specific statements contained elsewhere shall prevail, without prejudice to the Project Manger's express duty to resolve any ambiguity or inconsistency in the Works Information under ECC3 Clause 17.1.

Variations to the standardized specifications

Within SANS 1200 A: GENERAL, the following amendments and interpretations shall apply:

Where the word or expression "Engineer" is used, read "Project Manager" or "Supervisor" as the context requires.

Where the word or expression “schedule of quantities” is used, this is deleted in entirety. Assessment and payment are in accordance with the conditions of contract (and the ECC3 main and secondary options stated therein).

Within SANS 1200 A: GENERAL 2.3 DEFINITIONS, the following apply:

“Acceptable. “Approved (Approval)” is interpreted as either a Project Manager or a Supervisor communication or instruction in relation to Works Information compliance, consistent with the conditions of contract as the context requires.

“Adequate” is deleted. The Project Manager notifies the Contractor where the Contractor has not complied with the Works Information.

“Measurement and payment” and the further definitions contained within 6.3 c) are deleted. Assessment and payment are in accordance with the conditions of contract (and the ECC3 main and secondary options stated therein);

Within SANS 1200 A: GENERAL 2.6; *APPROVAL*, the following applies:

“Approval” by either the Project Manager and/or the Supervisor is without prejudice to ECC3 Clause 14.1 and, inter alia, ECC3 Clauses 13.1, 14.3 and 27.1.

SANS 1200 A: GENERAL 2.8; *ITEMS IN SCHEDULE OF QUANTITIES*, is deleted in entirety. Assessment and payment are in accordance with the conditions of the contract (and the ECC3 main and secondary options stated therein).

Within SANS 1200 A: GENERAL 4; *PLANT*, the following applies:

Where the word or expression “Plant” is used, read “Equipment”.

SANS 1200 A: GENERAL 4.2; *CONTRACTOR’S OFFICES, STORES AND SERVICES*, applies but the Project Manager resolves any inconsistency with statements included within paragraph 3.1.22 to 3.1.28 of C3.1 Employer’s Works Information.

SANS 1200 A: GENERAL 5.1 *SURVEY*, applies only to the extent that it is consistent with paragraph 3.1.30 to 3.1.32 of C3.1 Employer’s Works Information.

Within SANS 1200 A: GENERAL 5.2; *WATCHING, BARRICADING, LIGHTING AND TRAFFIC CROSSINGS*, the following applies:

Where the word or expression “specification” is used, read “Works Information”.

SANS 1200 A: GENERAL 5.4; *PROTECTION OF OVERHEAD AND UNDERGROUND SERVICES* applies only to the extent that it is consistent with the specific statements made elsewhere in C3.1 Employer’s Works Information and in any case and always consistent with the conditions of contract.

Within SANS 1200 A: GENERAL 7; *TESTING*, the following applies:

Where the word or expression “Engineer” is used, read “Supervisor”.

SANS 1200 A: GENERAL 8; *MEASUREMENT AND PAYMENT*, is deleted in entirety. Assessment and payment are in accordance with the conditions of the contract (and the ECC3 main and secondary options stated therein).

The principles, meanings and interpretation stated and established within paragraphs 6.3.1 to 6.3.15 with respect to SANS 1200 series and to SANS 1200 A: GENERAL equally apply to the other SANS 2001 specification referenced.

2. CIVIL PORTION OF THE WORKS

2.1 Extent of the Works:

The civil engineering scope which will be covered in this document comprises:

- Site locality planning and setting out.
- Site clearance and earthworks.
- Protection of existing services, and where required, relocation of services.
- Routing of electrical and communications ducts and chambers.
- This section shall be read in conjunction with:

Specifications / Guidelines	
SANS 1200 A	General
TMH 11	Standard Survey Guidelines

The extent of the works is divided up into the following areas within the Port of Cape Town:

- A-Berth high mast lighting
 - 2 no. of new High Mast Lights (HML)
 - 100m of trench excavations and pipe bedding
 - 100m of 2x 160dia. Electrical sleeves
 - 3 no. electrical chambers
- Rail Marshalling yard high mast lighting
 - 2 no. of HML to be removed for refurbishment (electrical scope).
 - 2 no. of new HML
 - Holes for foundations
 - Installation of 4 HML in total.
 - 140m of trench excavations and pipe bedding
 - 140m of 2x 160dia. Electrical sleeves
 - 1 no. electrical chamber

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- iii. Road lighting along Duncan Road
 - 66 no. of new road lights.
 - 29 no of old road lights to be removed.
 - Holes for foundations
 - 100m of trench excavations and cable bedding
 - 3 no. electrical chambers of various sizes
 - iv. Road lighting along Heerengracht street
 - 3 no. of new road lights.
 - no of old road lights to be removed.
 - Holes for foundations
 - 30m of excavations and pipe bedding
 - v. Road lighting along M-berth
 - 7 no. of new road lights.
 - 9 no of old road lights to be removed.
 - Holes for foundations
 - 20m of trench excavations and cable bedding
 - vi. Road lighting along Tanker basin and Eastern Mole
 - 14 no. of new road lights.
 - Holes for foundations
 - 200m of trench excavations and cable bedding.
 - 40m of 2x 160dia. Electrical sleeves

vii. Survey control and setting out:

The co-ordinate system is based on Hartebeesthoek94 (WGS 84 Ellipsoid). Setting out of the works is in accordance with this co-ordinate system. The Project Manager is to point out landmarks and reference points in the Port Levels are given relative to Mean Sea Level.

The site surveys and plans to be in accordance with the Standard Survey Guidelines: TMH 11 as amended in 2013.

2.2 Site Clearance and Earthworks (General):

This section shall be read in conjunction with:

Specifications / Guidelines

SANS 2001-BS1	Site Clearance
SANS 2001-BE1	Earthworks (General)
SANS 1200-DM	Earthworks – Roads and subgrades
SANS 1200-M	Roads
SANS 1200-MF	Base (Roads)
SANS 1200-ME	Subbase (Roads)
SANS 1921-1	Construction and management requirements for works contracts Part 1: General engineering and construction works

viii. Site clearance

Site clearance shall be carried out in accordance with SANS 2001-BS1. Work shall be carried out in the areas designated for the positioning of manholes, concrete bases and cable ducts as indicated on the respective drawings.

Clear site for the whole area of the ground to be built upon, up to a distance of at least 1 m beyond the perimeter of the proposed structures, conduit routes. This operation is deemed to include the digging up and removal of rubbish, debris, vegetation, hedges, shrubs, and small trees (up to 200 mm girth), bush, etc. as well as the digging up of topsoil and examining for and removal of all dead roots and other organic matter likely to provide food for termites.

The depth of removal is as set out in SANS 2001-BS for clearing and grubbing activities. In some instances, breaking up of hardened surfaces will be necessary. Where concrete pavements are to be broken up for the installation of cable trenches and other structures, a depth of 400mm applies. Where asphalt surfaces are encountered, a depth of 60mm applies.

All vegetation, trees, etc. resulting from site clearance shall be removed off site to a disposal dump to be selected by the contractor. The haulage, dump costs and any levies etc. shall be deemed to be included in the tendered rates. Burning of materials on site shall not be permitted.

ix. Removal of streetlights

Part of the scope includes demolition works. Where streetlights are demarcated for removal, the concrete basis will be demolished, and the material shall be removed off site and disposed

of by the contractor at an appropriate dumping site. The streetlights will be returned to Transnet as set out in the Electrical Engineers scope.

x. Excavations

The requirements of general earthworks as set out in SANS 2001-BE1 shall apply. Trenches and holes for foundations to be excavated to the several lengths, widths and depths shown on drawings or to such other depths as may be directed by the Project Manager. Stability of the new cutting slope (unsupported) will be ensured if it is cut to 1:2 (vertical: horizontal), or flatter. The cut slope is to be rehabilitated with topsoil and vegetation. For the purposes of uplifting of underground pipes (when required), a trench width of 1m shall be used.

The bottoms of trenches and holes are to be level, with sides trimmed vertical for the full width from top to bottom. The bottoms of trenches to be stepped as shown, if the stepping is not shown on drawings or are not otherwise directed on Site, the stepping to be of at least the thickness specified for the concrete footings and adjusted downwards to conform with an exact number of brick courses where necessary.

Any excavations taken out too deep to be made up to correct levels with Class A concrete, at the Contractor's expense. Back filling and ramming are not acceptable. The ground under solid floors is to be excavated where necessary and levelled in readiness for the laying of the surface beds.

Reusable material shall be identified by the contractor and stockpiled in the designated area. Surplus or unsuitable material shall be disposed of. Should clay material be excavated, it should either be spoiled or used in non-structural fills. Topsoil is to be stockpiled for re-use for landscaping and rehabilitation activities. It is expected that the transported silty sand underlying the topsoil will be suitable for use as selected layers in roadworks (where applicable) bedding material, and as general fill for embankment construction.

The Contractor maintains all excavated faces exceeding 1,5 m deep in accordance with Government Regulations and all excavated faces not exceeding 1,5 m deep affecting the safety of the workhand/or the workmen. The Contractor carries the risk of collapse of excavated faces whether or not he takes any precautions, the nature of which to be entirely at his own discretion.

xi. Excavations for working space

The Contractor shall determine additional excavations that may be required for working space. Descriptions of excavations for working space are deemed to include any additional risk of

collapse so incurred and the returning and compacting of the excavated Material as described. No claim to be considered for any working space for formwork to concrete.

xii. Exposing existing services

Existing services have been identified from as-built information, including raw and potable water supply, electrical, communication, storm water and sewer infrastructure; however, the Contractor will be required to prove services prior to removal. All existing services are to be treated as operational (live). The Contractor shall take the necessary precautions to ensure that the services are not damaged. Most of the construction is in a “brownfields” area. Services routed are proposed services and will be connected to existing services.

xiii. Proving Underground Services

This Clause is to be read in conjunction with the provisions and obligations as contained in SANS 1921-1. It is stressed that all services in a particular area must be proven before commencing work in that area. Where services are indicated on the drawings or where from site observations can reasonably be expected that such services are likely to exist where excavations are to take place, the Contractor shall without instructions from the Project Manager or Supervisor carefully excavate by hand to expose and prove their positions. The cost of proving trenches for known services or services assumed to be present are deemed to be included in the tendered rates for this item.

When a service is not located in its expected position the Contractor shall immediately report such circumstances to the Project Manager or Supervisor who will decide what further searching or other necessary action is to be carried out and shall instruct the Contractor accordingly. The cost of this additional searching shall be to the Employer’s cost and shall be paid for under the relevant sections of the Bills of Quantities.

Should any service be damaged by the Contractor in carrying out the works and should it be found that the procedure as laid down in this clause has not been followed then all costs in connection with the repair of the service will be to the Contractor's account.

When electrical or communication cables are not in the positions shown on drawings and cannot be found after proving trenches have been excavated, assistance may be obtained by calling a responsible official from TPT or TNPA. The contact details can be obtained from the Project Manager or Supervisor.

Proving of all services shall be completed at least two weeks in advance of the actual programmed date for commencing the protection of services work in the area (protection slabs or encasement). Proving services process entails the following, but not limited to:

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- Locate existing services / cables by hand excavation, being informed by the Drawings, Wayleaves and local area operational service provider
 - Confirm type, size, class of service / cable with responsible local area operational service provider (TPT / TNPA), having met on site with the responsible service provider persons
 - Confirm route direction of services / cables or supply origin and destination point for each service / cable in excavation trench.
 - Confirm availability of materials and lead time for the replacement, deviation of the affected services / cables
 - Receipt of new materials for services / cables relocation through commercial sources or Transnet sources

The position of these services located must be surveyed and levelled by the Contractor, and the information given in writing to the Supervisor. The requirements of this clause do not relieve the Contractor of any obligations as detailed in the Conditions of Contract or under Clause 4.17 of SANS 1921-1.

xiv. Backfilling

Imported backfill material shall be selected from the commercial sources (or cut to fill material where the in-situ material meets the criteria set out by this Works Information document) and placed in 100 – 200mm layers (or as specified by the engineer). No clay shall be used as backfill.

Filling material shall be well watered, compacted and thoroughly consolidated to at least a density of 90% Modified AASHTO (American Associations of State Highway and Transportation Officials), to be verified by the Project Manager upon having had it tested. Prior to placement, the Project Manager must accept all filling material. A 60kg sample of the proposed fill is required for this purpose and fourteen days to be allowed for initial sample testing. Each layer of fill is to be tested and accepted by the Project Manager before the next layer is placed and compacted.

xv. Filling to defined levels

Finished level or graded to falls as shown on the drawings, or as directed. Sloping banks of made-up ground to be of such angle as to maintain the stability of the ground above and be neatly trimmed. A degree of accuracy II is required in respect of position, dimensions, levels, etc.

xvi. Surplus earth

All surplus earth, topsoil and/or other materials from the excavations to be deposited and levelled on the Site, or carted away, as directed and accepted by the Project Manager. A copy of the documentation granting the Contractor permission to dump material at the identified Site/Sites and waybills, where hazardous waste is discarded, is to be made available.

xvii. Completion of excavations

The Contractor gives notice, in writing, to the Project Manager when the excavations are ready for inspection prior to any casting of concrete or placement of pipe bedding.

The next phase of the works shall not commence until the Project Manager has accepted the excavations in writing and they are not to be covered until any variation has been measured.

xviii. Reinstatement and maintenance of roads

Roadways through which trenches or other excavations have been made shall be reinstated and maintained. The road surface shall be restored to its correct level without any subsidence occurring at the site of such trench or other excavation.

xix. Thicknesses of compacted Material

Given thicknesses are those for compacted Material. The Project Manager is to keep notes on all filling supplied by the Contractor

2.3 Concrete, Formwork and Reinforcement:

The works for the concrete include the following:

- I. Encasing of pipes where required,
- II. Concrete cover slabs for protection of pipes,
- III. Concrete base layer in pavements/stacking areas,
- IV. The Contractor will be responsible for constructing electrical chambers and installing DN160 ducting from one chamber to another.

- V. And any other work concrete work arising out of or incidental to the above or required by the Contractor for the proper completion of the works in accordance with the true meaning and intent of the contract documents.

All in-situ concrete work (mass and reinforced) to comply with SANS Specification 2001-CC1 and SANS 2001-CC2, supplemented by the clauses in this section. Where the SANS

Specifications and the clauses in this section are in conflict, the clauses in this section to take precedence.

Where the term "plain concrete" appears in SANS Specification 2001-CC2, it is to be read as "mass concrete".

Specifications	
SANS 2001-CC2	Construction Works: Concrete Works (Structural)
SANS 2001-CC2	Construction Works: Concrete Works (Minor works)
SANS 282	Steel detailing code
SANS 878	Ready-mixed concrete
SANS 920	Steel bars for concrete reinforcement
SANS 1024	Welded steel fabric for reinforcement of concrete
SANS 1083	Aggregates from natural sources
SANS 1491-1	Portland cement extenders – Part 1 Ground granulated blast furnace slag
SANS 1491-2	Portland cement extenders – Part 2 Fly ash.
SANS 1491-3	Portland cement extenders – Part 3 Condensed Silica Fume
SANS 50197-1	Cement – composition, specifications and conformity criteria. Part 1: Common cements
S420 (Transnet)	Specification for Concrete Work

2.4 Cement

Cement is to be Portland cement complying with the requirements of SANS codes of practice. The Project Manager for test purposes may require samples of cement from any one consignment, or from every consignment. Cement in any consignment from which a sample has been taken for testing is not to be used until it has been accepted. Allowance to be made for possible Delay in that, tests may take up to 10 days to carry out.

Bags of cement shall be stacked in a waterproof, solidly constructed shed with a central door and a floor rendered damp-proof with a tarpaulin. The bags of cement shall be closely stacked

(but not against walls) in order to reduce air circulation in such a manner that the cement is used in the order in which it was received, i.e., first in first out.

i. Coastal Zones

In all wet applications and within one kilometer of the sea, unless otherwise specified in the project specifications, one or more of the following cementitious binders shall be used in all applications, including prestressed concrete:

- (i) Portland blastfurnace cement, Type III/A, certified as containing not less than 40% and not more than 50% milled granulated blastfurnace slag (MGBS), or a blend of Type I Portland cement with not less than 40% and not more than 50% MGBS. MGBS shall comply with SABS 1491 Part 1. (ii) Portland fly ash cement Type II/B-V or Portland fly ash cement Type II/B-W certified as containing not less than 25% and not more than 30% fly ash shall comply with SABS 1491 Part 2.
- (ii) Portland fly ash cement Type II/B-V or Portland fly ash cement Type II/B-W, certified as containing not less than 25% and not more than 30% fly ash shall comply with SABS 1491 Part 2

a. Aggregates

Fine and coarse aggregate shall comply with the relevant clauses of SANS 1083.

Where aggregates have constituents, which in the opinion of the Project Manager, may give rise to damage due to alkali-aggregate reactions, the provisions listed below shall apply.

b. Alkali reactive aggregate

If coarse aggregate known to be alkali reactive, are to be used in the proposed concrete, then one or more of the cementitious binders (i) and (ii) listed above shall be used. The equivalent Na₂O content, defined as $\% \text{Na}_2\text{O} = \% \text{Na}_2\text{O} + (0,658\% \text{K}_2\text{O})$ shall be limited as follows:

- Malmesbury Group metasediments: 2,1 kg/m³
- Table Mountain Group orthoquartzite: 2,8 kg/m³
- Cape Granite: 4,0 kg/m³

Evidence of compliance of the aggregates with the requirements shall be furnished as early as practical. No aggregate shall be delivered for use in the works until approval is given.

c. Sand (fine aggregate):

The fine aggregates shall comply with the requirements of SANS Specification 1083. Other aggregates may be approved if they have a satisfactory history and / or test results.

No aggregate may be used until it has been approved. Samples having a mass of 25kg (16.5 liters) of the proposed aggregate to be used may be required by the Supervisor for test purposes. Samples having a mass of 25kg shall be forwarded every 3 months during concrete work and if the source of supply is changed. Allowance must be made for possible delay in that the tests may take 14 days to carry out.

d. Admixtures

Admixtures containing chlorides will not be permitted in reinforced concrete.

2.5 Water

Clean, fresh water free from vegetable or organic matter, earth, clay, acid or alkaline substances either in suspension or in solution, other than those used for purification thereof by the responsible authority, is to be used throughout. Where there is any reason to suspect the presence of impurities, the Project Manager may require the Contractor to obtain a chemical analysis of the water by a competent analyst at Contractor's own cost. Should the water prove unsuitable for use the Contractor procures water of a good standard.

2.6 Cover blocks

Cover blocks used to ensure the cover to reinforcement shall be made of cement mortar. Cover blocks shall be dense and have a minimum 28 day crushing strength of 30 MPa and shall be cured in water for at least 14 days before being used.

Steeldale cover blocks or similar approved proprietary items shall be used - site made blocks will not be permitted. Cover/spacer blocks made of plastic will not be permitted.

xx. Concrete quality

Prior to the start of any concrete work on site, the Contractor shall submit a quality assurance plan which will ensure compliance with specification and provide acceptable documentary evidence that all specified operations have been carried out satisfactorily.

Where the minimum dimension to be placed during a single pour is larger than 600mm, and the cement content of the reinforced concrete exceeds the following:

Cement Types I and II/ * S : 400 kg/m³

Cement Types II/B-V and II/B-W : 450 kg/m³

The Project Manager may require that measures be instituted to reduce heat development in the concrete.

xxi. Concrete strength characteristics

Unreinforced concrete

Class A Concrete:

- Filling the cavity of hollow walls.

Unreinforced concrete cast against excavated surfaces

15 MPa/19mm Concrete

- Surface blinding under footings and bases.

Reinforced/Structural concrete

30 MPa/19mm Concrete:

- Bases.
- Foundation beams.
- Surface beds cast in panels on waterproofing.
- Walls in foundations (Provisional).
- Columns in foundations (Provisional).

xxii. Concrete Cover

Concrete cover to reinforcement, unless otherwise specified on the drawings, shall be 50mm thick.

xxiii. Batching

All cementitious binders shall be batched by full sack or by mass batching with approved precision weighing equipment.

All aggregates shall be precisely measured by mass using approved precision weigh-batching equipment, unless otherwise permitted by the Project Manager.

Should any variation in the composition of the aggregate become apparent, the Project Manager shall be notified, and a further sample of aggregate submitted immediately for his approval.

Concrete mixed by hand and concrete mixed using a backhoe-loader-tractor (“digger-loader”), will not be permitted. Ready-mixed concrete shall be mixed in accordance with the requirements of SANS 878.

The Supervisor reserves the right to take test cubes of any concrete used on the contract. The Contractor shall remove any non-conforming concrete at his own cost and shall replace it with concrete conforming to the specifications.

xxiv. Concrete placing

The size, shape and depth of any excavation shall be approved by the Project Manager before concrete is placed. The forms to be filled in shall be clean internally. All excavations and other surfaces of an absorbent nature that will come into contact with the concrete shall be dampened with water. There shall be no free water on the surfaces against which concrete is to be placed.

Unless otherwise permitted by the Project Manager, no concrete shall be placed until the fixed reinforcement has been accepted by him and confirmed in writing by way of a release certificate.

All exposed concrete to be chamfered 1mm by 19mm.

xxv. Slip Joints between Concrete and Brickwork

Slip joints shall be provided between brickwork and concrete slabs and beams by levelling up and trowelling smooth the bearing surfaces of brickwork with 3:1 cement mortar and covering the bearings before the concrete is basted, with two layers of one side smooth tempered hardboard, with the smooth sides in contact.

The ends and sides of beams and edges of concrete slabs shall be separated from the brickwork with 13mm thick bitumen impregnated soft board or expanded polyethylene strips placed vertically against the brickwork before the concrete is cast.

Similar slip joints shall be provided between brickwork and concrete lintels cast In situ, but without soft board or expanded polyethylene strips at ends.

xxvi. Movement Joints

All movement joints are to be filled in with approved bitumen impregnated soft board or expanded polyethylene strip unless otherwise specified or detailed on drawings. Descriptions (prices) of movement joints shall be deemed to include formwork.

Expansion joints with soft board between vertical concrete surfaces:

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- 12mm Joints not exceeding 300mm high.

xxvii. Grouting

25 MPa non-shrink cementitious grout:

Bedding approximately 25mm thick under base plate including chamfered edges all round.

xxviii. Curing compound

Unless otherwise directed by the Project Manager, the curing compound shall be:

An approved trafficable, resin-based, white pigmented, membrane forming material complying with specification ASTM C309, except that the maximum permissible water loss in the test shall be 0.4 kg / m². Alternatively, the curing compound shall be acceptable if the treated concrete retains 90% or more of its mixing water when subject to the test set out in BS 8110 Part 1 – Chapter 6.6.

xxix. Curing compound application

As soon as it is practicable (including the period before the formwork is removed), all concrete shall be protected from moisture loss for the period necessary for hydration of the cement and hardening of the concrete by one or more of the methods set out in SANS 22001-CC2 Section 4.7.10.2.

The total application rate of the curing compound shall be the greater of the supplier's specification or 0.50 l/m². On textured concrete surfaces, the total application rate shall be 0.90 l/m². In cases of concrete surfaces with run-off problems, it may be necessary to apply more than one coat of membrane forming curing compound to obtain the specified total or cumulative application rate.

On unformed surfaces the curing compound shall be applied after finishing and as soon as the free water on the surface has disappeared and no water sheen is visible, but not so late that the liquid curing compound will be absorbed into the concrete. On formed surfaces, the exposed concrete shall be wet with water immediately after the forms are removed and kept moist until the curing compound is applied.

Application of the curing compound shall begin once the concrete has reached a uniformly damp appearance with no free water on the surface. Application of the compound may be done by hand or power spray. The compound shall be applied at a uniform rate with two applications at right angles to each other to ensure complete coverage.

Pigmented compounds, without a thixotropic agent, shall be adequately stirred to assure even distribution of the pigment during application.

xxx. Curing period

Curing shall continue at least the appropriate period given in Table 8 of SANS 2001-CC2, or until such time that the concrete in excavations is back filled. If plastic shrinkage occurs in the concrete, while still plastic, the concrete shall be re-vibrated, floated and re-coated with curing compound as if no curing has previously taken place.

The curing period will start on completion of the concrete pour and for formed surfaces shall include the time for which forms are still in place after the pour.

xxxi. Concrete records

The Contractor shall maintain the following daily records for every part of the concrete structure and shall always make these available during the progress of the work for inspection by the Project Manager:

- The date and time during which concrete was placed
- The daily weather conditions
- Identification of the part of the structure in which the concrete was placed
- The mixed proportions and specified strength
- The slump of the concrete
- The identifying marks of test cubes made
- Curing procedure applied to concrete placed
- The times when shuttering was stripped, and props removed
- The date of dispatch of the cubes to the testing laboratory
- The test results

The records shall be delivered to the Project Manager each week except in the case of sub-standard concrete when the Project Manager shall be informed immediately.

xxxii. Tolerances

Deviations shall be within the limits listed in SANS 2001-CC1 for degree of accuracy II, unless otherwise specified.

xxxiii. Testing and Acceptance

Where concrete of a particular grade is placed, frequency of sampling and testing shall be as specified in SANS 2001-CC1 Section 5.1.

Should any valid test result obtained on concrete of a specific grade show that the strength is more than 3 MPa below the specified strength, the concrete yielding such result shall be deemed not to comply with the requirements of this part of SANS 2001.

The average of any three consecutive valid test results obtained on concrete of a specific grade shall exceed the specified strength by at least 2 MPa. Where the value of the age (in days) of such consecutive tests is at least equal to the value of the specified strength (in MPa), the concrete yielding such result shall be accepted but the mix design and standard of control shall be reviewed and adjusted if necessary to comply with the requirements of table 9.

2.7 Formwork

Formwork to include all shuttering, casing and centering of weaver Material required for the laying and forming of concrete floors, slabs, beams, lintels, walls, steps, columns, piers, pilasters and any other concrete work requiring moulds or forms and is to embrace all cleats, battens, fillets, wedges, struts, trestles, braces, props, shores and other requirements of weaver Material for keeping all in correct position. All Materials used for formwork to be suitable and substantial and all joints to be tight enough to prevent leakage of liquid matrix.

All formwork is to be designed by the Contractor and if requested to do so, they must submit fully detailed and dimensioned working drawings to the Project Manager for checking purposes. Acceptance of the proposals does not relieve the Contractor of his responsibility for the safety and stability thereof nor for any loss or damage arising out of defective design, Materials and/or workmanship. The formwork is to be so constructed that its partial removal can be carried out to the satisfaction of the Project Manager and in such stages as are required by the working conditions. As far as possible, wedges and clamps to be used in preference to nails. All formwork in its various sections for floors, beams, etc. to be so arranged that the whole may be raised or lowered either independently or together with other sections by means of wedges or other accepted methods.

Immediately before concreting is begun, the formwork in contact with the concrete to be thoroughly cleaned, wetted and kept damp whilst the concrete is being placed. Great care must be taken to keep the formwork wedged up to its correct height checked by taking levels immediately before concreting is commenced and immediately after it has been completed.

Rough formwork shall be to a degree of accuracy ii).

Rough Formwork shall apply to sides of:

-
- Strip footings.
 - Bases.
 - Walls in foundations.
 - The outer face of walls, flush with the perimeter of concrete structure.
 - Rectangular columns in foundations.
 - Edges not exceeding 300mm high.

Smooth formwork shall be to a degree of accuracy ii.

Smooth Formwork shall apply to sides of:

- Inner face of shaft walls.
- Edges not exceeding 300mm high.

i. Reinforcement (provisional)

Steel bars for concrete reinforcement shall comply with the requirements as set out in SANS 920. High tensile steel reinforcement shall be applied to structural concrete work in the various diameters and lengths indicated on the drawings. Steel bars for concrete reinforcement shall comply with the requirements as set out in SANS 920. Fabric reinforcement type as specified on structural drawings shall comply with the requirements set out in SANS 1024.

ii. Forming key to concrete for plaster and other finishes

Where rough formwork has been used, surfaces of concrete to receive plaster or other finishes, and shall immediately after the formwork has been removed, be well wetted and wire brushed whilst the concrete is still green and then shushed over with 2:1 cement grout to form a key for the finish, all to the approval of the Supervisor. The shushing is to be allowed to set hard before the finish is applied.

Where smooth formwork is used, surfaces of the concrete to receive plaster, mosaic tiles and other finishes shall be hacked, on the distinct understanding that hacking of concrete shall be at no extra cost to the Employer.

Surfaces of concrete receiving plaster or other finishes shall not be plastered or finished until the Supervisor has signified his opinion in writing that the surfaces are suitable to receive plaster or other finishes.

i. Sleeve Pieces and Ties

Where it is necessary to leave plugs or holes in beams, slabs or any other reinforced concrete, all such plugs or holes must be situated in positions accepted by the Project Manager before

concreting. Where it is necessary to carry pipes, bolts, wires or any other fittings through reinforced concrete members, accepted pipe sleeves to be provided and placed in position before concreting.

Chases formed in edges of slabs or slots are to be formed in the slabs, of sizes required, where two or more pipes pass through together. All necessary bolts, plugs, brackets, cramps, etc. are to be cast into the concrete as the work proceeds.

Where brickwork abuts against concrete, the brickwork is to be tied to the concrete with galvanized hoop-iron ties 1,6 m thick by 32 mm wide and approximately 600 mm long to every third course of brickwork with one end of each tie cast approximately 150 mm deep into the concrete. Where such fixing is impossible, i.e., where steel formwork is used, the ties are to be gun-nailed against concrete with steel nails not less than 38 mm long.

2.8 Masonry:

The masonry works include the following:

- I. Construction of electrical and comms manholes.
- II. And any other work concrete work arising out of or incidental to the above or required by the Contractor for the proper completion of the works in accordance with the true meaning and intent of the contract documents.

This section shall be read in conjunction with:

Specifications / Guidelines	
SANS 227	Burnt Clay Masonry Units
SANS 2001-CM1	Masonry Walling
SANS 2001-EM1	Cement Plaster

- i. Burnt Clay Bricks

Burnt clay bricks are to comply with the requirements of SANS Specification 227 and be equal in all respects to the selected samples. Brickwork shall be engineering Class bricks laid in English bond, header brick position to be alternated (outside to inside) every header course.

Where bricks with holes are used, the holes in such bricks are only to be filled in solid with mortar where specifically specified. All bricks that do not carry the SANS Mark, are to be tested by a SANS certificated laboratory for testing purposes.

Brickwork to be built level and plumb with mortar as specified. The bricks are to be laid on a solid bed of mortar and all joints thoroughly grouted up solid throughout the whole width of each course. The brickwork is to be carried up in a uniform manner, no one portion being raised more than 1,2 m above another at any one time.

ii. Warpage

The warpage of FBX, FBS or any engineering units shall

be within the following limits:

a) FBX units

1) the warpage of any individual unit shall not exceed 5 mm; and

2) in not more than three units shall the warpage exceed 3 mm.

b) FBS or any engineering units. The warpage of any individual unit shall not exceed 5 mm.

ii. Compressive strength

The average compressive strength of 12 units shall not be less than the nominal compressive strength and, when tested in accordance with section 6.6 of SANS 227, the individual compressive strength of units shall comply with the appropriate values relative to the nominal compressive strength given. In the case of engineering units, the compressive strength shall be 28MPa or greater.

iii. Inspection and methods of test

Inspect each unit in the sample for compliance with the requirements of class of brick, shape, appearance, texture, color, and markings.

Sampling and testing methods as set out in SANS 227 shall apply.

Test specimens

To carry out all the tests, a minimum of 59 units is required as set out in (a)-(f) below. After inspecting the required number of units and measuring 32 units for dimensions (SANS 227 section 6.4) and warpage (SANS 227 section 6.5), allocate the 59 units for submission to the remaining tests as follows:

-
- a) compressive strength test: 12
 - b) efflorescence test: 20
 - c) soundness test: 6
 - d) Water absorption test: 6
 - e) Determination and analysis of water-soluble salts test: 6
 - f) Moisture expansion test: 9

NB: all the tests as set out in (a) – (f) shall be carried out for Engineering class bricks.

2.9 Cement Mortar

Cement mortar is to be Class II (7 MPa) as per SANS 2001-CM1. The Material is to be mixed dry until of uniform color and then water added, and the mixture turned over until the ingredients are thoroughly incorporated. Cement mortar to be produced in such quantities as can be used before commencing to set as no cement mortar that has once commenced to set is to be used in any way.

Care to be taken in mixing cement mortar to remove from the mixing machine or platform any old mortar that has already set as such mortar is not be incorporated into any new batch.

i. Mortar Joints

Mortar joints to brickwork generally to be 10 mm in thickness with level bedding joints and vertical perpend. The joints in brickwork receiving plaster, tiling or similar finishes are to be raked out whilst the mortar is soft to form key for the plaster or mortar backing. The depth of the raking out depends on the condition of the bricks; the rougher the bricks on face the shallower the raking out and the smoother the bricks the deeper the raking out. The depth of the raking out of the mortar joints to be the same depth on face brick walls throughout the building.

The joints in brickwork are to be flushed off where walls are to be bagged, in readiness for the bagging.

ii. Cement plaster

The requirements as set out in SANS 2001-EM1 specification shall apply to cement plastering.

2.10 Cable Ducts:

The works for the cable ducts include the following:

- I. Excavation, bedding and backfill for cable ducts.
- II. Supply and lay cable ducts.
- III. Laying of cable duct markers.
- IV. And any other work arising out of or incidental to the above or required of the Contractor for the proper completion of the works.

This section shall be read in conjunction with:

Specifications / Guidelines	
SANS 791	Unplasticized poly (vinyl chloride) (PVC-U) sewer and drain pipes and pipe fittings
SANS 2001-DP1	Earthworks for buried pipelines and prefabricated culverts
SANS 2001-DP3	Cable Ducts
SANS 3001 (Series)	Civil Engineering test methods

i. Materials

All cable all duct pipes shall comprise uPVC pipes (class 34, homogenous solid-wall pipes) and comply with the requirements set out in SANS 791.

ii. Laying

Unless otherwise directed by the Supervisor, the ducts shall be laid to the depth and positions shown on the drawings, and to the standards specified in SANS 791. All ducts less than 800mm cover to be concrete encased. Unless otherwise stated, the concrete shall be grade 25/19.

Where one or more cable ducts are to be laid in a trench that contains other services, the cable duct(s) shall be laid along one side of the trench in suitable lengths while the other services occupy the other side. Wherever telephone cable ducts cross electricity supply cable ducts, electricity supply cable ducts shall cross below telephone cable ducts. At each crossing, a split sleeve consisting of two half-round pipe sections firmly fastened together with robust stainless-steel straps shall be installed and shall extend at least 1,0 m on each side of the

crossing and be effectively sealed at the ends.

Strict precautions and care shall be taken, and close supervision shall be given to the laying of the ducts to prevent damage to cables.

iv. Electrical cable ducts

All cable ducts are to be laid at a minimum depth of 800mm below finished surface level. The position of each duct crossing shall be indicated on site using suitable markers.

Draw wires must be provided in each duct and duct ends must be sealed with suitable stoppers. A double strand copper wire of at least 2,8mm² cross section that will serve as a screen and is to be installed approximately 200mm above all ducts over its entire length.

A single strand of galvanized iron draw wire shall be inserted through the length of duct. A surplus length of 2m, neatly coiled, shall be left at each end of the ducting.

v. Communications cable ducts

All brickwork shall be built in manhole bond i.e., stretchers only on the inside face, using cement mortar as specified. Bricks shall be well soaked before use and the previous course shall be wetted before bricks are laid thereon. All joints on the internal face (and the external face above ground) shall be half round recessed and shall be well rubbed with a standard jointing tool of suitable size to ensure that the entire exposed surface on the joint presents a smooth and polished appearance. Intersecting walls shall be properly toothed with each other and all angles levelled and plumbed. Should cement bricks be utilized, then all internal surfaces shall be plastered with a 12mm thick 3:1 cement sand mortar mix.

When brick built manholes are constructed in wet ground, the external surfaces shall be rendered with 12mm thick 3:1 cement sand mortar mix.

2.11 Bedding and compaction

i. Bedding Material

Bedding shall be for flexible pipes, and all earthworks for buried pipelines shall be in accordance with SANS 2001-DP3 unless otherwise indicated on the drawings. Subject to the requirements of SANS, and except where otherwise required in terms of the scope of work, a 100 mm thick bedding shall be placed in the bottom of the trench, and it shall be well compacted before the duct(s) are laid. The granular bedding material shall be compacted to 90% Mod AASHTO density.

Additional selected granular material shall then be placed carefully and evenly between the sides of the trench and the pipeline, in layers of uncompacted thickness approximately 100 mm. Particular care shall be exercised to prevent damage, deflection, or displacement of the pipeline.

ii. Selected fill blanket

After completion of the cradle, a 300 mm selected fill blanket shall be placed carefully in layers of 100 mm uncompacted thickness over the full width of the trench and shall then be compacted to the 90% Mod AASHTO density. Special care shall be taken when compacting over the pipeline.

iii. Testing

The material properties of bedding and fill materials shall be determined in accordance with the requirements of the SANS 3001 series.

vi. Backfilling and Compaction of trenches

The relevant requirements of SANS 2001-DP1 shall apply. The permissible deviation from OMC during field compaction is ± 2 %, and the actual density shall at no point be less than the specified density.

In areas subjected to road traffic loads and in such other areas as specified in the specification data, trenches shall be backfilled in layers of thickness (after compaction) that do not exceed 150 mm and the material shall be compacted to 93 % of modified AASHTO maximum dry density in the case of cohesive soil, or 98 % in the case of non-cohesive soil.

In all cases, the reinstatement of surfaces over the full extent of the top of the actual excavation shall comply with the applicable requirements given in SANS 2001-DP1.

2.12 Payment

The Contractor's tendered rates for the relevant items in the Bill of Quantities shall include full compensation for all possible additional costs which may arise from this, and no claims for extra payment due to inconvenience as a result of the modus operandi will be considered.

2.13 Pedestrian movement

The Contractor shall make provision for accommodating all pedestrian movements in the area of the works. Allowance shall be made in the relevant rates for any barricades, fencing and signs required.

2.14 Temporary Reinstatement

Provided always that if in the course or for the purpose of the execution of the works or any part thereof any road or way shall have been broken up, then notwithstanding anything herein contained:

(a) if the permanent reinstatement of such road or way is to be carried out by the appropriate authority or by some person other than the contractor (or any subcontractor to him), the contractor shall at his own cost and independently of any requirement of or notice from the Project Manager be responsible for the making good of any subsidence or shrinkage or other defect, imperfection or fault in the temporary reinstatement of such road or way, and for the execution of any necessary repair or amendment thereof from whatever cause the necessity arises, until the end of the period of maintenance in respect of works beneath such road or way until the authority or other person as aforesaid shall have taken possession of the site for the purpose of carrying out permanent reinstatement (whichever is the earlier), and shall indemnify and save harmless that Employer against and from any damage or injury to the Employer or to third parties arising out of or in consequence of any neglect or failure of the Contractor to comply with the foregoing obligations or any of them and against and from all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

(b) where the authority or person as aforesaid shall take possession of the site as aforesaid in sections or lengths, the responsibility of the contractor under paragraph (a) of this sub-clause shall cease in regard to any such section or length at the time possession thereof is so taken, but shall during the continuance of the said period of maintenance continue in regard to any length of which possession has not been taken and the indemnity given by the Contractor under the said paragraph shall be construed and have effect accordingly.

2.15 Accommodation of Services

Further to the paragraphs related to existing and proposed services relocation, tenderers are to note that allowance must be made under this item and / or the appropriate rates, for all costs incurred as a result of complying with these clauses. It shall also cover liaison with TPT / TNPA and accommodation of their work gangs / contractors on site.

2.16 Restriction on Compaction Equipment

The Contractor is to note that where existing watermains or sewer pipes traverse the site of the works, special care is to be taken near these services. The existing mains and connections shall be proved on site by the Contractor prior to any construction work commencing in the vicinity of the watermains.

Under no circumstances will heavy road-making equipment, other heavy plant or vibratory compaction equipment be permitted to operate within 800 mm vertically or horizontally of the existing these services. The permissible compaction plant within this restricted area shall be the equivalent of a "Bomag 90" under static compaction, or similar approved plant. When the roadworks is far enough advanced to provide a minimum of 800 mm cover to the existing mains, the above restriction will fall away.

The Contractor is to take cognisance of the above requirements when entering rates in the Bill of Quantities and in the programming of the works. No claim for additional payment based on the inability to use plant as a result of the requirements of this clause will be accepted. The Contractor will be held liable for any costs should the watermain or electrical cables be damaged during construction of the layerworks for the stack areas or roadway areas.