PLANT AND MATERIALS WORKMANSHIP & STRANDARDS

Civil Engineering Works – Structures

Scope

The scope covers the structural works related to the construction of all new reinforced concrete and associated concrete works requirements for the proposed upgrade of the North Groyne Promenade as mentioned below:

- New Concrete Ramp (Retaining Walls, reinforced concrete strip footing foundations, concrete slab for ramp).
- New concrete Terracing (Reinforced concrete staircases).

General Specifications

The SANS Standardized Specification for Civil Engineering Construction as approved by the Council of the South African Bureau of Standards shall apply to this Contract. The *Contractor* shall be in possession of these Standardized Specifications and their related documents that apply equally and shall keep a copy of each on site for reference by him and the *Project Manager* for the duration of the Contract.

The following standard specifications are applicable to this contract: -

Specification	**Year**	**Description**
SANS 121	2011	Hot-dip galvanized coating on fabricated iron and steel articles –specifications and test methods
SANS 1700		Fasteners (all relevant sections and parts)
SANS 1921		Construction and management requirements for works contracts (all relevant sections and parts)
SANS 2001: BE1	2008	Construction works – Part BE1: Earthworks (general)

Specification	Year	Description
SANS 2001: BS1	2008	Construction works – Part BS1: Site clearance
SANS 2001: CC1	2012	Construction works – Part CC1: Concrete works (Structural)
SANS 2001: CC2	2007	Construction works – Part CC2: Concrete works (minor works)
SANS 2001: CM1	2012	Construction works – Part CM1: Masonry walling
SANS 2001: CM2	2011	Construction works – Part CM2: Strip footings, pad footings and slab-on-the-ground foundations for masonry walling
SANS 2001: CS1	2017	Construction works – Part CS1: Structural steelwork
SANS 2001: CT1	2011	Construction works – Part CT1: Structural timberwork (flooring)
SANS 2001: CT2	2011	Construction works – Part CT2: Structural timberwork (roofing)
SANS 2001: DP2	2010	Construction works – Part DP2: Medium pressure pipelines
SANS 2001: DP3	2010	Construction works – Part DP3: Cable ducts

Specification	Year	Description
SANS 2001: DP4	2010	Construction works – Part DP4: Sewers
SANS 2001: DP5	2010	Construction works – Part DP5: Stormwater drainage
SANS 2001: DP6	2012	Construction works – Part DP6: Below-ground water installations
SANS 2001: DP7	2021	Construction works – Part DP7: Sewers for buildings
SANS 2001: EM1	2007	Construction works – Part EM1: Cement plaster
SANS 10400		The application of the National Building Regulations (all relevant sections and parts)
SANS 10100-2	2014	The structural use of concrete – Part 2: Materials and execution of work
SANS 50197-1	2013	Cement – Part 1: Composition, specifications and conformity criteria for common cements
SANS 50197-2	2017	Cement – Part 2: Conformity evaluation
SANS 50197-5	2023	Cement – Part 5: Portland-composite cement CEM II/C-M and Composite cement CEM VI

Particular Specifications

- S420 : Specification for concrete work

Earthworks and Backfilling

Please read in conjunction with the Geotechnical Investigation Report (2123361-ENG-GEO-RPT-0001).

Excavation is required where the *Contractor* installs the foundations. Safety of excavations should be followed as per SANS 2001.

The *Contractor* shall monitor stability on a daily 24-hour basis and arrange appropriate trench protection measures and stabilisation against risk of collapse, where the stability of the adjacent soil body is at risk. In this case, shoring shall be designed to withstand the full earth pressure and the effects of surcharge.

To ensure over break limitation it is required that all stabilised surface layers be excavated with care.

Trench Excavation

All trench excavations deeper than 1.0 m is either properly shored as per SANS 2001 the sides are battered back to a safe angle as determined by the strength of the soil and any other safety specifications applicable.

No work is carried out in deep excavations. The shoring is also suitable for the protection of any structures adjoining the excavation, where applicable.

All shoring is removed on completion of the construction work.

Protection of Excavations

All drainage related excavations are protected as required in the Occupational Health and Safety Act, Act 85 of 1993. These protection measures are inspected and maintained on a daily basis until the backfill and final layer works are complete. The *Contractor* is responsible to ensure excavations are free of water.

Materials

Hard and soft material

Hard material is defined as material proven to the *Supervisor* to be irremovable by a 30t excavator, fitted with a rock bucket, and requires to be broken by a woodpecker or jack hammers prior to removal. Any stabilised or other solid surface layer is excluded from this definition. Subject to drainage not being restricted and the geo-fabric blanket not being damaged, rock protrusions are permitted to encroach a maximum of 100mm into the design class B layer, whilst

competent un-fractured and continuous layers of rock are allowed to encroach the entire class B layer.

Furthermore, all excavations are classified as hard or soft. Hard excavation comprises material that can only be removed with pneumatic tools or by blasting. All other excavations are classified as soft. Health and Safety requirements shall be followed when removing material with pneumatic tools or by blasting. The *Contractor* must inform the *Supervisor* and *Project Manager* prior to any such works to ensure safety of excavations.

If the material at founding level differs from that shown on the drawings, or is not approved, the *Supervisor* shall instruct the *Contractor* to do one of the following:

- Over-excavate to the depth required by the *Supervisor* and re-compact the in-situ material at founding level in layers not exceeding 150 mm until a density of at least 95% MOD AASHTO for cohesive materials and 100% MOD AASHTO for non-cohesive materials is attained to the founding level.
- Excavate the unapproved material to the depth instructed by the *Supervisor* and found at this level.
- Excavate the unapproved material to the depth instructed by the *Supervisor* and fill to the level instructed, either with mass concrete or approved backfill, as directed.

Exposed rock founding surfaces are roughened to provide sound bond with the foundation, brushed to remove all loose material, and flushed with water if so instructed. Surplus water is removed before concreting.

The *Supervisor* is notified as soon as possible if suitable material is encountered before reaching the designed level.

Where the *Contractor* makes the excavations larger or deeper than directed, the *Contractor* replaces the over break in the floor of the excavation with concrete of strength as directed or, if authorized, with approved backfill.

Dewatering

All foundation concrete is poured in the dry. The *Contractor* provides all shoring, pumps, other equipment or material to ensure the stability of excavations and to

keep them dry. No water may be discharged into the sea. When discharging a permit is required.

Backfilling

After completion of concrete work, or when so directed, the *Contractor* shall restore the original ground level by backfilling with approved material. Where the material from excavations is not suitable for backfill, the *Contractor* shall provide approved material, from borrow pits or other sources, as directed. Material may only be sourced from a licensed borrow pit proof of any licensing must be obtained. Backfilling compaction shall be in layers not exceeding 150 mm until a density of at least 95% MOD AASHTO for cohesive materials and 100% MOD AASHTO for non-cohesive materials is attained to the founding level.

Falsework, Formwork and Concrete Finish

The *Contractor* shall take full responsibility for the design, manufacturing, and installation of all falsework. Temporary platform, as well as hand railing shall be fully cladded with non-conducting wooden board of sufficient thickness to safely support any incidental load that may be applied during construction. The hand railing/ balustrade must be a minimum of 1500mm high.

Securing of formwork

Forms are provided with adequate devices for secure setting so that, when in place, they withstand, without visible spring or settlement, the impact of the vibration of the compacting and finishing equipment.

Formwork ends

The ends of abutting forms lock tightly and securely together.

Damaged formwork

Forms that are out of tolerance, bent, twisted or broken, or which have battered top surfaces, are not used. Forms are at all times kept clean and free from rust and adhesions so as to ensure clean stripping. The use of rough and dirty forms is not permitted.

Deflection of formwork

The spacing of supports for formwork is such that the deflection of the formwork under load of wet concrete does not exceed 3 mm. The supports are adjustable by means of screw jacks or wedges, both of which are secured.

Temporary beams used to support formwork shall be designed to ensure that the deflection under the weight of wet concrete does not exceed 2,5 mm/m of clear span, or in the case in the case of reinforced concrete.

If placement of concrete in stages is specified or approved, the top barrel formwork must be fully supported by the falsework until all stages are completed. The stiffness of temporary trusses or beams used to support formwork must be such that the deflection under wet concrete placed during the first stage does not exceed 2,5 mm/m of clear span of the permanent structure, or such lesser figure as specified, multiplied by the ratio of first stage concrete to total deck concrete exclusive of parapets.

The false work is adjusted to ensure that the finished soffit has an upward camber of between 0 and 2 mm/m of clear span after removal of false work, under permanent loading due to parapets, surfacing and/or track.

Unless shown otherwise on the drawings or directed by the *Supervisor*, false work for all spans is kept in position until, in the case of concrete structures, the concrete of the last pour reaches the appropriate minimum age given in SANS 2001.

The alignment and levels of all formwork is checked and accepted by the *Supervisor* prior to placing concrete.

Forms are fixed in position not later than 48 hours prior to the day on which concreting takes place, in order for the *Supervisor* to inspect them.

Void formers

The following applies: -

- Void formers used in permanent work are ARMCO or similar/equivalent accepted by the *Supervisor*.
- Void formers are manufactured from material that will not leak, tear or be damaged during the course of construction, and are of such tight construction as to prevent undue loss of the mortar component of the concrete through leakage. The units are sufficiently rigid so as not to deform during handling or under the pressure of the wet concrete.
- Void formers must be 990mm diameter.

Braced void formers

- 0,8 mm for diameters exceeding 800 mm and up to 1000 mm.
- 1,0 mm for diameters exceeding 1000 mm and up to 1200 mm.
- 1,2 mm for diameters exceeding 1200 mm.

The thickness specified for braced void formers applies to formers internally braced with timber or equivalent braces. The braces are at spacings not exceeding 2,0 m and not further than 1,0 m from the end of each unit. Timber cross braces consist of members with cross sectional dimensions of at least 50 mm x 50 mm.

Vibrators

Internal (poker) and surface vibrators are capable of fully compacting each layer of concrete where compaction by vibration is used. At least one standby vibrator is available for every three (or smaller number of) internal vibrators necessary to maintain the rate of placement.

Formwork and concrete finishes

All concrete surfaces require a finish to a degree of accuracy II as specified in SANS 2001 as follows: -

1. Rough finish

The following surfaces may have a rough finish: -

- Top of ramp slab (Where exposed surfaces are not finished against forms and are required, in terms of the scope of work, to have a non-skid surface, the surface shall be given a broom finish. The corrugations so produced shall be approximately 1 mm deep, uniform in appearance and width and shall be perpendicular to the centre line of the slab).

2. Smooth finish

The following surfaces have a smooth finish: -

- Top surfaces of concrete seating
- Top surfaces of concrete retaining walls supporting ramp

The *Contractor* takes particular care to ensure that formwork joints are tight enough to prevent leakage of cement mortar. Shutters that are damaged will leave a poor surface and they shall be deemed as unacceptable. The *Supervisor* shall request the *Contractor* to remove and repaired or discarded.

Concrete is not deposited in the forms until the *Supervisor* inspects the accuracy of alignment and dimensions of forms and the positioning of end blocks, reinforcement, anchorages, pre-stressing tendons and of the ducts, and gives his acceptance thereof on the concrete pour release certificate.

Dismantling and removal of formwork

Tie-rods or their removable parts are extracted without damage to the concrete and remaining holes shall be filled with mortar. No permanently embedded metal parts of tie-rods *shall* have less than 40 mm cover to the finished concrete surface.

Steel for Structures

Reinforcement for Structures

All reinforcing shall be in accordance with SANS 920. High tensile steel Reinforcing to have a minimum characteristic strength of 450MPa. Reinforcement shall be fixed to comply with tolerances specified in SANS 2001.

Welded mesh fabric

Welded mesh fabric complies with the requirements of SANS 1024-1991.

Dowels

Dowel bars will be high tensile steel reinforcement and installed with an approved epoxy grout where specified.

Stainless Steel

3Cr12 stainless steel complies with Euronorm Standards EN 10088 and EN 10028.

Grade 316 and 316L stainless steel complies with AISI.

Galvanizing of steel

Galvanizing complies with SANS 121 (SABS ISO 1461). The coating thickness is 25% greater than the standard and in accordance with SABS Specific Permit Conditions 1336/2494.

Concrete material for Structure

Slab Preparation

The concrete slabs shall be constructed over secure and approved formwork. The formed formwork is cleaned of any dirt of loose material using compressed air. There shall be no free-standing water at the time of pouring.

Cement

The *Contractor* shall submit a Concrete mix design to the *Project Manager* for acceptance at least 6 weeks prior to construction. Cement used for concrete work shall comply with SANS ENV 197-1. Cement extenders used for concrete work comply with SANS 1491. The cement types given below are acceptable for use in the *works*, however, the proportion of extenders of factory blended cement should conforms to the requirements of SANS 1491, clause 12.5.3.4. On no account are masonry cements used for concrete work, even if the strength designations are the same as for ordinary cement.

Acceptable cement types: -

CEM 1 42,5	Portland cement
CEM 1 42,5R	Portland cement, rapid hardening.
CEM 11/B-V	Portland fly ash cement.
CEM 11/B-W	Portland fly ash cement.
CEM 111/A	Blast furnace cement.

Aggregates

Fine and coarse aggregates shall comply with SANS 1083.

Where aggregates have constituents which, in the opinion of the *Supervisor*, may give rise to damage due to alkali-aggregate reactions; the *Supervisor* shall request the *Contractor* to provide material data sheets and calculations for the total alkali-silica reaction to the *Project Manager* and *Supervisor* for acceptance prior to casting of concrete. Alkali-aggregate reaction is not permitted. This information will be required at least four weeks before concreting commences. Submission of material data sheets is at least six weeks before concreting commences.

Admixtures

Admixtures containing chlorides are not permitted in reinforced concrete.

Curing compound

In all cases where a concrete curing compound is specified, the curing compound is grey or white-pigmented membrane forming material shall comply with ASTM

specification C309, except that the maximum permissible water loss in the test is 0,40 kg/m^3.

Before any curing compound is used, the *Contractor* shall submit a one-litre sample of the compound, with full technical details, to the *Supervisor* for acceptance.

Technical details referred to include a recent SANS report showing the following: -

- Compliance with ASTM C-309.
- The relative density of the compound.
- The infrared spectrum of the compound.
- Alternatively, the concrete curing compound is 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, clause 6.6I.

In addition:

- Clear curing compound is applied to all concrete surfaces except to barrel top surface as soon as bleed water have evaporated from unformed surfaces.
- White pigmented curing compound is applied to the wood floated portion of the top surface of the barrel.
- The rough screeded central portion of the top surface of the barrel that is to receive the track slab is moist cured.
- Where curing by retention of formwork is used as the only method of curing the concrete, it must be left in place for the minimum period specified but in no instance shall it be less than 7 days.
- The materials used for formwork shall take into account properties such as thermal insulation and moisture absorption when assessing the suitability of the material, to the acceptance of the *Project Manager*.
- If impermeable curing membranes are to be used as a curing method, they shall be installed at the same time as formwork is removed and no portion of a concrete surface may be left unprotected for a period in excess of 2 hours. If the surface is an unformed finish e.g., top of slab, then the surface must be protected immediately by appropriate methods accepted by the *Project Manager* after it is finished, without damage to that surface, since it is

vulnerable to plastic shrinkage cracking due to high rates of evaporation while the concrete is still in a plastic state. Plastic shrinkage and settlement shall not be permitted on any of the structural elements since it compromises the durability of the concrete.

Concrete Alkali

Alkali reactive concrete

Alkali reactive aggregates are not used in this project. The equivalent Na2O content of the concrete does not exceed 2,0 kg/m3, where % Na2O equivalent = % Na2O+ (0,658 x % K2O).

Concrete Quality

Before the start of concrete work on site, the *Contractor* shall submit a quality assurance plan to ensure compliance with specifications, and to provide acceptable documentary proof that all specified operations are carried out satisfactorily.

Potential heat generation

Measures, subject to the acceptance of the *Supervisor*, are applied to reduce heat development in concrete of which the minimum dimension to be placed during a single pour is larger than 600 mm, and the cement content exceeds the values given in the table below.

Structural element	**Cement types I and III/A (kg/m^3)**	**Cement types II/B-V and II/B-W (kg/m^3)**
Reinforced concrete	400	450

Durability

In order to enhance durability, and notwithstanding strength considerations, the concrete mixes satisfy one of the mixes given in the table below. Prior written acceptance for the mix is obtained from the *Supervisor*.

Concrete type	Cement type and % content	Extender type and % content	Minimum cement plus extender content kg/m³	Maximum water/cement ratio
Steel reinforced	CEM 1 50% - 60%	GGBS 40% - 50%	420	0.40
Steel reinforced	CEM 1 70% - 75%	FA 25% - 30%	420	0.40
Plain	CEM 1 100%	Nil	340	0.50
Plain	CEM 1 75%	FA < 25%	340	0.50
Plain	CEM 1 35% - 65%	GGBS 35% - 65%	340	0.50
Plain	CEM 1 65% - 74%	FA 26% - 35%	300	0.55

Note: -

- CEM 1 may be CEM 1 42, 5 or 42, 5 R.
- GGBS – Ground Granulated Blast-furnace Slag.
- FA – Fly Ash.
- Factory blended cements (CEM 11/B-V, CEM 11/B-W or CEM 111/A) are accepted provided that they conform to one of the blends specified in the table. The *Contractor* supplies certification thereof.
- Water-reducing admixtures may be used to improve workability. The water cement ratio includes the water content of admixtures.

Blends of CEM 1 and condensed silica fume (CSF) are not acceptable for steel reinforced concrete. Ternary blends such as CSF with CEM 1 and FA or GGBS are considered provided that they are shown to be equivalent in durability to the

mixes given. The onus is on the *Contractor* to prove to the *Supervisor* the adequacy of the blend.

Concrete Strength of mix

The strength of the concrete mixes as specified on the drawings or given in the particular specifications for the works, conforms to the following requirements, as class x/y, where:

- X = minimum 28 days crushing strength in Mpa
- And y = maximum aggregate size in mm.
- Concrete shall be grade 40 MPa/19 mm stone and mass concrete 15/19. The concrete cover is 50mm for exposed surfaces to moisture.
- Reinforcing shall be high tensile steel in accordance with SANS 920.

Placing

Inspection of excavation: The size, shape and depth of any excavation are accepted by the *Supervisor* before concrete is placed.

Inspection of reinforcement: Unless otherwise permitted by the *Supervisor*, no concrete is placed prior to acceptance of fixed reinforcement by the *Supervisor*.

The *Supervisor 's* written acceptance is obtained before any concrete is cast.

In addition, the following applications should be done by the *Contractor*:

1. **Batching**

   All aggregates are precisely measured by mass using approved precision weigh batching equipment, unless otherwise permitted by the *Supervisor*.

   Should any variation in the composition of the aggregate become apparent, the *Supervisor* is notified, and a further sample of the aggregate submitted immediately to him for acceptance.

2. **Blinding layers**

   To facilitate the placing of reinforcement and erection of formwork, a blinding layer of grade 15/19 concrete is provided below foundations.

   The thickness of the blinding layer is not less than 75 mm. Payment for blinding in excess of the specified thickness will not be made, unless instructed by the *Project Manager* in writing.

3. **Control of concreting operations (1200G: 5.5.3)**

No relaxation regarding the provision of continuous supervision by a technician at the mixer is allowed and where the point of placing of the concrete is more than 150 m from the mixer, continuous supervision by a technician is also provided at the point of placing. Supervision at the point of placing applies in cases where ready-mix concrete is used.

4. Ready-mixed concrete

The use of ready-mixed concrete is permissible. Concrete test results obtained from the production facility are acceptable – provided that the tests are carried out in accordance with the specifications. However, Sampling and testing requirements for any ready-mix concrete used on site shall still be caried out by the *Contractor* in accordance with clause 1.1.10.2.

Where concrete is delivered to site ready mixed, the requirements of SANS 878 apply.

5. Construction joints

The joint surface of the concrete is roughened while still green by means of brush and water spray to expose the coarse aggregate. Retarders may be used on stop-ends, which are removed after 12 hours for green cutting. Mechanical roughening of hardened concrete using power tools is not permitted.

All surfaces are cleaned and kept continuously wet for 24 hours before pouring of the adjoining cast.

Stub-columns, stub-walls and stays on footings are cast integrally with the footings and not afterwards, even where another class of concrete is being used.

Joint lines are so arranged that they coincide with features of the finished work.

6. Curing

All water for curing must be clean, fresh water.

The curing period for concrete containing CEM 1 only is seven days. The curing period for concrete's containing CEM 1 plus cement extenders (GGBS, FA) is ten days. The period starts on completion of the concrete pour, and for formed surfaces include the time for which forms are still in place after the pour.

The *Supervisor's* prior written acceptance of the curing method to be used is obtained before any concrete is cast.

In addition, the following curing methods are permissible, except where otherwise specified: -

- **For plain concrete: -**
    - Retaining of forms in place on vertical surfaces, provided they are made of non-absorbent facing materials.
    - Ponding of water on horizontal surfaces. Curing water must be fresh and not be more than 10°C cooler than the concrete on which it is to be applied, in order to avoid surface cracking.
    - Covering with sand, earth, straw, sawdust, cotton, jute, burlap or evelli or similar moisture retaining materials. The materials are kept continually moist and not allowed to dry out as alternate wetting and drying is detrimental to the curing process. The material is free of harmful amounts or substances such as sugar or fertilizer that may harm the concrete or cause discoloration.
    - Sprinkling or spraying with water. This is done at frequent intervals such that the concrete surface remains continuously moist and is not allowed to dry out between wettings. Erosion of the fresh concrete surface is avoided.
    - Covering with plastic sheeting, waterproof or other curing paper. The covering material is firmly and continuously held in place along its edges such that the concrete surface is not allowed to dry out. Care is taken not to tear, puncture or otherwise disrupt the continuity of the curing film. Plastic film is not black and preferably not white or clear.
    - Liquid membrane-forming curing compounds. Only resin type compounds are permitted. The formulation is such as to form a moisture retentive film shortly after being applied and is not harmful to Portland cement paste. White or grey pigments or dyes are incorporated to enable the compound to be visible on the surface for inspection purposes.

  For unformed surfaces, the compound is applied after finishing and as soon as the free water on the surface disappears and no water sheen is visible, but not so late that the liquid curing compound will be absorbed into the concrete. For formed surfaces, when forms are removed, the exposed

concrete surface is wetted with water immediately and kept moist until the curing compound is applied.

Application of the compound is started immediately after the concrete has reached a uniformly damp appearance with no free water on the surface. The compound is applied at a uniform rate with two applications at right angles to each other to ensure complete coverage and may be applied by hand or power sprayer. Pigmented compounds are adequately stirred to assure even distribution of the pigment during application, unless the formulation contains a thixotropic agent which prevents settlement.

The *Contractor* supplies a certificate confirming compliance and that the manufacturer's directions with respect to preparation and application, are strictly adhered to.

The total application rate is as specified by the manufacturer, or 0,90 litres per square meter, whichever is the greater.

In the case 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.

When the wind velocity exceeds 5 m/s and/or the ambient temperature is above 25℃ and/or the relative humidity is below 60%, the initial 24 hour curing of concrete surfaces not covered by formwork is carried out by ponding, covering with constantly wetted sand or mats, or continuous spraying in accordance with SANS 2001, unless otherwise permitted by the *Supervisor*.

- **For steel reinforced concrete:**
  - Covering with burlap or evelli or similar moisture retaining materials, as in clause 1 above for the wall base.
  - Sprinkling or spraying with water, as in clause 1 above.
  - Releasing the forms slightly and allowing a flow of water between the form and the concrete.
  - Curing methods using sealing materials such as plastic or liquid membrane forming compounds is not allowed for steel reinforced concrete structures due to the low W/C ratio of the concrete mix.

7. Concrete surfaces

All exposed concrete surfaces have a neat, smooth, even and uniform finish, free from any honeycombing and blow holes.

8. Concrete placing

Acceptance of aggregates

The *Contractor* shall submit 40 kg samples for acceptance at least six weeks before concrete construction is commenced. No aggregate is delivered for use in the works until the *Supervisor* gives acceptance. In addition, evidence of compliance of the aggregates with the requirements is furnished at least four weeks before concreting commences.

Inspection of excavations

The size, shape and depth of any excavation are approved by the *Supervisor* before concrete is placed.

Inspection of reinforcement

Unless otherwise permitted, no concrete is placed until the fixed reinforcement has been accepted by the *Supervisor* and confirmed in writing by way of a release certificate.

Trimming of excavations

In addition to requirements of SANS 2001, excavated surfaces that will act as forms for concrete works are trimmed so that concrete cover is not less than the cover stated on the drawings or 80 mm, whichever is greater.

9. Compaction of concrete

The *Supervisor* approves the methods used to vibrate the concrete. The vibrating is done with care and in such a manner as to avoid displacement of reinforcement, tendons or ducts.

Each layer of concrete is thoroughly compacted before the next layer is placed and is covered by the next layer within 30 minutes of completion of compaction.

If more than 30 minutes have elapsed since completion of compaction of a layer, concreting may not be resumed unless the concrete in place is still soft enough to be penetrated by the vibrator. If the vibrator can penetrate, a layer of fresh concrete not exceeding 150 mm in thickness is placed over the concrete already placed and the vibrator passed through the fresh concrete into the concrete previously placed so that both are vibrated, and a knitting of fresh and older concrete is satisfactorily achieved. If the concrete already placed has hardened so that a vibrator will not penetrate, concreting is stopped, and instructions are obtained from the *Supervisor*.

Stub-columns, stub-walls or kickers on footings are cast integrally with the footings and not afterwards, even when a different class of concrete is used.

10. Removal of excess mortar

After concrete is brought to the correct level and struck off, the surface is smoothed by means of a Steel- or wood-float. The thickness of the mortar cover over particles of coarse aggregate is then measured by light scraping of a few representative areas. If this thickness exceeds 1,5 mm, the surplus mortar is removed by scraping with a rubber-edged squeegee approximately 750 mm wide.

11. Final finishing (delayed power-trowel finishing)

Where specified, this operation is performed only:

- after bleeding of the concrete has ceased and
- After bleed water has evaporated or has been removed from the surface of the concrete, and the concrete has stiffened appreciably (to the extent that a footprint will barely show).

Allowance is, therefore, made for a delay period of two to three hours or more, especially in cold weather, after bull nosing or wood floating, before finishing operations can start.

Trowelling continues at intervals until an even surface with a slightly matt texture is obtained.

In addition to the requirements of 1200G, clause 5.5.15, two specific documents are used to assist in the control of concreting operations.

- The concrete pour release certificate is completed by the *Contractor*'s agent prior to any checking of formwork and reinforcement by the *Supervisor*. Only after the *Contractor*'s agent has personally checked all aspects of the shuttering and reinforcement and levelling the document in the relevant spaces, is it submitted it to the *Supervisor*.
- The concrete placing record

The *Contractor* maintains the following daily records for every part of the concrete structure and makes these available at all times during the progress of the work for inspection by the *Supervisor*: -

- The date and times during which concrete is placed.
- Identification of the part of the structure in which the concrete is placed.
- The mix proportions and specified strength.
- The type and brand of cement.
- The slump of the concrete.
- The identifying marks of test cubes made.
- Curing procedure applied to concrete placed.
- The times when shuttering is stripped, and props are removed.
- The date of dispatch of the cubes to the testing laboratory.
- The test results.
- Weather Conditions

The records are delivered to the *Supervisor* each week except in the case of sub-standard concrete, when the *Supervisor* is informed immediately.

Tolerances

Tolerances are within the limits listed in SANS 2001 for degree of accuracy II, unless stated otherwise on drawings.

Joints

Neoprene compression seal

The neoprene compression seal complies with the requirements of ASTM 1056, Type 2, Class B, Grade 2 or AASHTO T-42-84 Modified.

Joint fillers

The *Contractor* furnishes details and specifications of joint fillers he proposes to use, for acceptance. Jointex or similar joint filler must be durable and non-extruding, composed of closed-cell expanded polyethylene and comply with AASHTO 153 modified as follows: -

Minimum density	25 kg/m^3
Load causing compression to 50% of volume	100 to 150 kPa
Minimum recovery after compression to 50% of volume	To 80% of original volume
Maximum water absorption after immersion of	3% by volume 28 days

Polystyrene joint fillers consist of closed-cell foam and have the following properties: -

Adequate rigidity for handling
Minimum density of 16 kg/m3
An increase in density of not more than 1% when a cement slurry is rubbed into exposed surfaces.
An accuracy of ± 2 mm on specified thickness.
Dimensional stability at a temperature of 40° C.
Vaporization only when in contact with a flame
Compression to not less than 50% of its original thickness under a load not exceeding 240 kPa after saturation with cement slurry and curing for 14 days.

Joint filler sheeting is used in the longest lengths possible. Joints are neatly butted and sealed with waterproof adhesive tape.

Joint fillers are attached to the concrete previously cast in such a manner that it will neither displace during concreting or thereafter if the filler is to remain

permanently in the joint. On the side to be concreted, polystyrene is lined to ensure that the joint surfaces are formed without defect.

After removal of formwork, mortar fouling the chamfers is taken out neatly and the joint filler removed to a depth of 20 mm beyond the chamfer depth, or as shown on the drawings. Polystyrene may be removed by flame evaporation

Joint sealing

Preformed elastomeric compression joint seals: -

- Comply with SANS 1023 for Type 1 and 2 seals
- Are supplied in the longest lengths possible.
- A 2 m long sample of each size and type of seal, which the *Contractor* proposes to use, is submitted for acceptance.
- Adhesive used with compression seals is as recommended by the manufacturer of the seal and has lubricating qualities.

Bolt Group

Dowels and tie-bars

Any required Dowels and ties are accurately set and firmly held in position parallel to the finished surface and to the longitudinal joints at mid-slab depth and at the spacing specified.

Testing Material and Workmanship

Concrete

Before the start of any concrete work on the site, the *Contractor* supplies the *Supervisor* with a statement of the mix proportions which he proposes to use, and the target strength for each grade of concrete.

All testing shall conform to the relevant clauses in SANS 2001.

Where required, the two-point loading method of the flexural strength tests, as described in SANS Method 5864 (1994) is used.

Frequency of sampling

Frequency of sampling and testing is as specified in SANS 2001, subject to the testing of:

- A set of six cubes must be made for every pour of concrete poured on a specific day, 3 of the cubes must be tested at seven days, and the balance must

be available for testing at 28 days to ensure strength results are achieved. Cube tests to be done by independent laboratory and accepted by the *Supervisor*.

Acceptance criteria

Acceptance criteria are as specified in SANS 2001. If the *Contractor* disputes test results on concrete cubes, the concrete represented by the cubes are considered acceptable if the *Contractor*, at his own cost, proves to the satisfaction of the *Supervisor* that the estimated actual strength of the cores taken from the structure, determined in accordance with SANS Method 5856 (SABS Standard Method SM 856), is not less than the specified strength.

If the strength of concrete fails to meet the acceptance criteria stipulated, the *Supervisor* may in his sole discretion, and in addition to the options listed in SANS Method 5864 and 5856: -

- accept the concrete subject to approved remedial measures being undertaken by the *Contractor* or
- Permit the concrete to remain subject to the payment of a penalty.

The penalty is determined as follows: -erratic

- Penalty = V x R x F

Where:

- V = Volume of concrete of unsatisfactory strength represented by the test result.
- R = Relevant schedule rate.
- F = $$1 - \sqrt{\frac{Average\ strength\ of\ unsatisfactory\ concrete}{Specified\ strength\ +\ 6\ MPa}}$$

  Where the relevant scheduled rate (R) includes the cost of formwork or
- F = $$1 - \frac{Average\ strength\ of\ unsatisfactory\ concrete}{Specified\ strength\ +\ 6\ MPa}$$

  Where the relevant scheduled rate (R) excludes the cost of formwork or where no formwork was involved.

Testing Methods

During the progress of the work tests are conducted on concrete and soil materials and workmanship to ensure compliance with the requirements of the specifications.

All tests are conducted in accordance with the standard methods specified in the following, in order of precedence:

- Standard methods for testing road construction materials (TMH1 and TMH6) and for calibration (TMH2), compiled by the Committee of State Road Authorities (CSRA) and published by the Department of Transport as part of the series Technical Methods for Highways.
- South African National Standards specifications, test methods, codes of practice and co-ordinating specifications (abbreviated as SANS and CKS).
- British Standards Institute Specifications (abbreviated as BS).
- The specifications of the American Society for Testing and Materials (abbreviated as ASTM).
- The specifications of the American Association of State Highway and Transportation Officials (abbreviated as AASHTO).
- In addition to the above standard methods of testing, standards specifications or test methods of other bodies may also be referred to in these specifications, or test methods may be described where no acceptable standard methods exist.

Cost of testing

1. Process Control

The cost of testing undertaken by the *Contractor* in terms of his obligations under the contract for purposes of process control, including the taking of samples, reinstating where samples have been taken and all testing equipment, labour, materials, etc., is included in the rates tendered for the various items of work supplied and will not be paid for separately.

2. Producing certificates

Where the properties of materials or manufactures products are required in these specifications to comply with specified specifications published by a standards authority, the *Contractor* must produce certificates from the manufacturer confirming that the materials or products supplied comply with

the relevant specifications. The cost of providing such certificates is borne by the *Contractor*. Where it is specified that a product complies with a SANS specification, it means that the product shall have been tested and evaluated in accordance with the requirements of the relevant SANS specification. Where the SANS mark is specified, a certificate is required.

3. Testing materials and products covered by certificates

The *Supervisor* is entitled to take samples (as per clause 1.1.10.2) of and order tests to be made on products and materials in respect of which certificates of compliance may be required as described in section 3(b) above.

Construction Sequence Planning

Prior to construction start, the *Contractor* should plan the complete construction and erection sequence, as per the Works Information.

The planning process for construction sequence should be documented as part of the work method statement. The following should be taken into account

- Establish site limitations.
- Local street access for plant machinery and cranes
- Casting Sequence
- Overhead obstructions including overhead powerlines
- Proximity to railway and roadway
- Requirements for road and railway occupation or use
- Temporary works
- Applicable authorities' regulations
- Height access and safe working platforms
- Occupational health and safety requirements for maximum work and rest periods
- Contingency plan for worst case scenarios
- Erection stages providing flexibility to promptly discontinue works if required
- Site emergency planning and notification to relevant local authorities
- Work Plan for working near or over water and rail

The *Contractor* should submit a construction method statement and detailed construction sequence to the Engineer for acceptance.

List of Drawings

Drawings issued by the *Employer*

This is the list of drawings issued by the *Employer* at or before the Contract Date and which apply to this contract.

Note: Some drawings may contain both Works Information and Site Information.

Sh. No	Title
XDNE025-1-000-S-LA-0001-01	Durban Harbour Entrance – North Groyne Promenade Terracing and Carpark Upgrade: Concrete Ramp Layout, Sections and Details
XDNE025-1-000-S-LA-0002-01	Durban Harbour Entrance – North Groyne Promenade Terracing and Carpark Upgrade: Concrete Ramp & Terrace End Foundations and Details
XDNE025-1-000-S-LA-0003-01	Durban Harbour Entrance – North Groyne Promenade Terracing and Carpark Upgrade: General Layout, Terracing Details and Sections