

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

TENDER NO 054/2024/PMID/MCWAP2/RFB

**PART C3.1
SPECIFICATION**

SECTION 20

CONCRETE WORKS (STRUCTURAL)

PART C3.1 SPECIFICATION

SECTION 20 CONCRETE WORKS (STRUCTURAL)

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SECTION 20

CONCRETE WORKS (STRUCTURAL)

20.1 SCOPE

This Section deals with the structural use of plain, reinforced, pre-stressed and precast concrete to be used in the Works and gives amendments and additions to the South African National Standard SANS 2001, Part CC1: Concrete Works (Structural) which shall form part of the Contract. Clause headings are followed by numeric characters which refer to the sub-clause of the Standard. Sub-clauses are numbered sequentially. The clause reference, to which a sub-clause refers, either amends or adds to the sub-clause in the Standard. Where the sub-clause is an addition and there is no appropriate clause in the Standard to which it can be linked, no clause reference is given in the heading.

Should any requirement of this Section conflict with any requirement of the Standard, the requirement of this Section shall prevail.

20.2 NORMATIVE REFERENCES

The applicable national and international standards as listed in Clause 2, Normative References of SANS 2001 CC1, shall apply to this Contract, with due cognisance of the provisions of Clause 1.14.1.

20.3 DEFINITIONS, ABBREVIATIONS AND REFERENCES

20.3.1 Definitions

(a) Specification Data (Sub-clause 3.1.11)

References to *Project Specification*, *Specification Data* and *Works Specification* shall mean references to this Section 20 - Concrete Works (Structural).

(b) Additives

Additives enhance the properties of concrete for a specific purpose. This could be setting time, viscosity, porosity, mechanical resistance, etc. There are generally nine types of additives: accelerators, retarders, plasticizers, flow promoters, air-entraining agents, anti-freezers, water-repellents and curing agents.

(c) Cementitious extenders

Portland cement extenders are cementitious materials used with ordinary portland cement and must never be used on their own. In the South African context these extenders are ground granulated blast furnace slag, fly ash and silica fume.

(d) Construction Joint

“Construction Joint” shall be a joint required on account of constraints or convenience in the method of construction and that is not a movement, contraction or expansion joint.

(e) Designated Joints

“Designated Joints” means joints that are shown on the Drawings consisting of movement, contraction or expansion joints.

Construction joints that are required by the Contractor as a result of his construction constraints or for any other reason, whether approved by the Engineer or not, shall not be considered to be designated joints.

20.3.2 Abbreviations

BS	:	British Standard
CEM	:	Calcium-Enriched Mixture
CQC	:	Construction Quality Control
CSF	:	Condensed Silica Fume
FA	:	Fly Ash also known as Pulversised Fuel Ash (PFA)
GGBS	:	Ground Granulated Blast-Furnace Slag
GGCS	:	Ground Granulated Core Slag
HD	:	Holding Down
MPa	:	Megapascal
MQC	:	Manufacturing Quality Control
OPC	:	Ordinary Portland Cement
RHPC	:	Rapid-Hardening Portland Cement
RPM	:	Revolutions Per Minute
SANS	:	South African National Standard
SANAS	:	South African National Accreditation System
UFC	:	Ultra Fine Cement
UCS	:	Unconfined Compressive Strength

20.3.3 References

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

20.4 REQUIREMENTS

20.4.1 General

20.4.1.1 Sprayed Concrete

Sprayed concrete is specified in Specification 13 – Rock Support Materials.

20.4.1.2 Concrete Work Samples

At least 28 days before commencement of concrete work the Contractor shall supply, at his own cost, full details and representative samples to the Engineer of the materials he intends using, together with certificates from approved SANAS accredited laboratories indicating that the materials comply with the requirements of this Section as well as the mix design for each type of concrete specified on the project. In the case of ready-mix equipment, equipment capacity and equipment calibration should be verified and the equipment will be inspected by the Engineer. All materials used for the concrete shall be from a consistent source.

No concrete shall be placed in the Works until the Engineer has approved the materials and the mix designs the Contractor intends using. For each mix design, the cube results as well as shrinkage test results must be included.

After approval, these samples shall be taken as the standard for the agreed materials. If at any time during the course of the Contract there is a deviation from the approved standard or the source of material or if the Engineer considers that there has been a deviation, the Contractor shall submit further tested samples of the new materials to the Engineer for approval.

20.4.1.3 Brand Name Products

In addition to the requirements of this Section the conditions and the methods specified by manufacturers of specified or approved brand name products shall be strictly adhered to.

The Contractor shall confirm and submit to the Engineer at least 28 days prior to the commencement of any specific section of the Works, samples, specification and performance data, as applicable of all the products he intends to use.

20.4.1.4 Cementitious Binders (Clause 4.2.1)

(a) Cement Extenders

Cement extenders shall only be used where specified and approved by the Engineer. An approved cement extender shall only be blended with CEM I or CEM II Portland Cement.

(b) Conformity Criteria

The test results conducted to evaluate the conformity of cement in terms of SANS 50197-1, Clause 9, shall be made available to the Engineer before the materials are incorporated into the Works.

(c) Fly Ash Concrete

The cementitious material for fly ash concrete shall consist of a blend of CEM I or CEM II Portland Cement. The ratio of fly ash to cement may be varied by the Engineer before or during the Contract. Fly ash to comply with SANS 1491-2, Portland cement extenders- Part 2: Fly ash.

The fly ash and the Portland cement shall be added separately at the batching equipment where they shall be intimately mixed in the concrete mixer.

For structural concrete, the maximum total fly ash content by weight shall be 30%. For large mass concrete elements such as mass concrete retaining walls and weir, the maximum fly ash content by weight may be increased to 60%.

20.4.1.5 Water (Clause 4.2.2)

Mixing water for concrete shall comply with the requirements of SANS 51008. The water from the boreholes at the farm Mooivallei should be suitable for use in concrete but shall be tested for confirmation.

Untreated water from the river may not be used for mixing. It may possibly be used for curing but should be tested for confirmation.

20.4.1.6 Aggregates (Clause 4.2.3)**(a) General**

All aggregate shall be of a consistent quality and from a consistent source. Fine aggregate (sand) and coarse aggregate (stone) shall be obtained from an approved commercial source.

(b) Interpretation

The nominal stone size specified in the concrete class or grade is given by the figure after the oblique. For example, 30 MPa/40 mm shall mean stone conforming to the grading specified in SANS 1083 for the nearest equivalent size, i.e. 40 mm which means stone that complies with SANS 1083 for 37.5 mm size.

(c) Fine Aggregate

The fineness modulus sand delivered to the mixer shall lie between 1.7 and 3.0 and the standard deviation of fineness moduli of samples of sand that is delivered to the mixer shall be not more than 0.1 per aggregate batch.

(d) Use of Plums (Sub-clause 4.3.2.4 and 4.7.10.11)

The use of plums will not be permitted for structural elements. For large mass concrete pours such as in the weir and mass concrete retaining walls, the use of plums may be approved by the engineer.

(e) Tests Required (Sub-clause 4.2.3.5)

The following tests are required on concrete used in the Contract:

- i) Drying shrinkage on fine and coarse aggregates;
- ii) Drying shrinkage of concrete (maximum shrinkage 0.040%);
- iii) Flakiness index of the stone; and
- iv) Alkali-aggregate reaction (per SANS 6245:2006).

20.4.1.7 Admixtures, Air-entrainment Agents and Curing Agents (Clause 4.2.4)

Admixtures shall comply with SANS 50934 Parts 1 to 6 for admixtures (2011-2012). Admixtures are permitted, provided that the results of trial tests which demonstrate their suitability and the following are made available to the Engineer for Approval:

- i) The trade name of the admixture, its source and the manufacturer's recommended method of use;
- ii) The chemical names of the main active ingredients in the admixture;
- iii) Typical dosages and possible detrimental effects of under or over dosages;
- iv) Whether compounds that are likely to cause corrosion of the reinforcement or deterioration of the concrete (such as those containing chloride, in any form, as an active ingredient) are present and, if so, the chloride content of the admixtures, expressed as a mass fraction of chloride ions or expressed as an equivalent mass fraction of anhydrous calcium chloride; and
- v) The average expected air content of the freshly mixed concrete containing an admixture that causes air to be entrained when the admixture is used at the manufacturer's recommended dosage.

20.4.1.8 Reinforcement (Clause 4.2.5)**(a) Welded Steel Fabric (Sub-clause 4.2.5.2)**

The wire of welded steel fabric shall be hard-drawn steel wire of round cross-section, having a surface that is plain.

20.4.1.9 Grade of Concrete (Clause 4.2.6)**(a) Classification**

The grade of concrete shall be as specified on the Drawings and Bill of Quantities by a compound number:

A/B C (e.g. 30 MPa/19 mm F20)

Where

A = the 28-day characteristic strength (MPa)

B = the nominal maximum aggregate size e.g. 19 mm

C = the cement extender as a % of total cementitious material e.g.:

F20 = 20% of Fly Ash (FA)

C5 = 5% of Condensed Silica Fume (CSF)

G30 = 30% of Ground Granulated Blast-furnace Slag (GGBS)

20.4.1.10 Tendons (Clause 4.2.8)

(a) Characteristic Strength of the Steel (Sub-clause 4.2.8.2)

The characteristic strength of the steel shall not be less than 1860 MPa.

20.4.1.11 Joint Fillers, Sealants, Waterstops, Bearings and Accessories (Clause 4.2.11)

The following prescribed products or brand name products, or equivalent materials subject to the written approval of the Engineer, shall be used:

(a) Joint Fillers (Sub-clause 4.2.11.1)

Joint filler material shall be Flexcell closed cell expanded polyethylene of minimum density 110 kg/m³ or equivalent approved.

Fillers shall be pre-cut to suit the application with a tear-out strip forming the specified recess for the sealant. If required the filler shall be glued into position with approved glue.

(b) Bond Breakers (Sub-clause 4.2.11.2)

The bond breaker at the bottom of a joint, if specified or where the sealant is not backed by a joint filler, shall be self-adhesive PVC tape (or equivalent approved material) with the same width as the joint recess which it is to be supplied to.

The bond breaker between the blinding layer or soil and the underside of ground floor slabs or surface beds shall be 250 micron polyethylene sheeting that complies with SANS 952, i.e. USB Green co ex 250 ® or equivalent approved.

(c) Sealants (Sub-clause 4.2.11.1)

SikaFlex® Pro-3WF 1-part, moisture cured, high mechanical resistant polyurethane sealant, or equivalent approved, shall be used for all watertight and water retaining structures including pump stations, valve chambers, and inlet and outlet structures.

SikaFlex® PRO-2HP 1-part, moisture cured, soft elastic polyurethane sealant, or equivalent approved, shall be used for building structures above ground floor level.

(d) Water stops (Sub-clause 4.2.11.1)

Water stops shall be Durajoint extruded plasticized PVC compound supplied by and applied in accordance with the recommendation of ABE Construction Chemicals or equivalent approved.

The Water stops shall comply with the requirements of CKS 389:1973 and have an elongation at break of 300%.

(e) Bearings (Sub-clause 4.2.11.1)

Bearings, where indicated on the Drawings, shall consist of Kilcher Resilient, Limitgliss or Teflon Sliding bearings or Laminated Elastometric bearings, supplied by Freyssinet Posten, or equivalent approved.

20.4.1.12 Colour Mitigation

The Contractor shall supply and apply concrete colouring at the locations as specified on the Drawings or indicated by the Engineer.

The colouring material shall be landscape varnish which shall be aqueous containing salts and iron and manganese and other trace elements including copper and zinc. The material shall be manufactured as a concentrate that can be diluted with water to achieve the desired colour intensity. The material shall contain no caustic or alkaline chemicals.

The colouring material shall be PERMEON or equivalent approved.

20.4.2 Formwork**20.4.2.1 General (Clause 4.3.1)****(a) Earth Cuts (Sub-clause 4.3.1.5)**

Earth cuts may be used as forms for vertical surfaces only if dictated by the Design and indicated on the Drawings or approved by the Engineer on Site.

Concrete used in pipe trenches for encasement may be cast against the side of the excavation.

Concrete for thrust / anchor blocks shall be cast directly against the side of the excavation as shown on the Drawings.

(b) Approval by Authority (Sub-clause 4.3.1.6)

Liaison with the authority controlling the service is required before commencing with the design of formwork over an existing service i.e. pipe lines, roads, streets, railways, etc. The design shall be approved by the authority.

(c) Surface Finish of Formed Surfaces (Sub-clause 4.3.1.8)

- i) The formed surfaces of sections of the work shall be as specified in Sub-clause 4.3.1.8.
- ii) The degree of accuracy for formed surfaces shall be Degree II (SANS 2001:CC1 Table 11).
- iii) Special off-form surface finishes / exposed aggregate finishes shall be as shown on the Drawings and, where they are required, listed in the Bill of Quantities.

(d) Chamfers and Fillets

All exposed external angles in concrete work shall have 20 mm x 20 mm chamfers unless otherwise specified on the Drawings or ordered by the Engineer, but the top edge of a slab that is to receive an applied finish shall not be chamfered.

Internal corners in concrete work need not have fillets unless such fillets have been specified on the Drawings or ordered by the Engineer.

20.4.2.2 Design and Construction of Formwork and Falsework (Clause 4.3.2)**(a) Design of Formwork (Sub-clause 4.3.2.1.4)**

Where approval is required in terms of Sub-clause 4.3.1.6, by a controlling authority, the design and drawings for formwork and falsework shall be submitted to the Engineer for review before being submitted to the authority for approval.

20.4.2.3 Formwork Accessories (Clause 4.3.3)**(a) Formwork Ties (Sub-clause 4.3.3.1)**

All steel ties used for wall and other formwork shall run through a sleeve in order for the ties to be completely removed after the formwork has been struck. The sleeves shall be removed by drilling or any other appropriate method leaving a clean inner surface suitable for caulking / grouting.

The Contractor shall thoroughly caulk any tie holes left in the concrete and be accountable for the water tightness thereof. The details of the method and materials he intends using for caulking the tie holes shall be submitted to the Engineer for review and approval.

20.4.2.4 Temporary Openings (Clause 4.3.4)**(a) Casting Pipes and Specials in Concrete**

Refer to Sub-clause 4.6.3.

20.4.2.5 Removal of Formwork (Clause 4.3.8)**(a) Removal of Falsework and Supporting Formwork on Reinforced Concrete Structures (Sub-clause 4.3.8.3)**

Where a continuously reinforced concrete structure will be constructed in stages, the Contractor shall submit to the Engineer for his review and approval, at least 28 days prior to the commencement of the work, full details of the manner in which the falsework and supporting frame work will be removed.

(b) Removal of Falsework and Supporting Formwork for Pre-stressed Concrete Structures (Sub-clause 4.3.8.4)

Where the falsework and supporting formwork in pre-stressed structures will be removed, prior to the full pre-stressing force relating to the particular stage of construction being applied, the Contractor shall submit to the Engineer for his review and approval, at least 28 days prior to the commencement of the work, full details of the manner in which the falsework and supporting frame work will be removed.

20.4.3 Reinforcement**20.4.3.1 Bending (Clause 4.4.1)****(a) Hot Bending (Sub-clause 4.4.1.3)**

Bars shall not be bent hot.

20.4.3.2 Fixing (Clause 4.4.2)**(a) Welding of Bars (Sub-clause 4.4.2.2 b)**

Welding of bars will not be permitted.

(b) Spacers (Sub-clause 4.4.2.3)

Concrete spacer blocks manufactured on Site shall not be used. All spacer blocks shall be concrete, of the same strength as the structure. No plastic cover blocks will be allowed.

20.4.3.3 Cover (Clause 4.4.3)**(a) Exposure Conditions**

The exposure conditions for the various structural members / surfaces are severe unless otherwise noted.

(b) Cover (Sub-clause 4.4.3.1)

The concrete cover over reinforcement shall be as given in Table 3, but shall not be less than 40 mm for any given class of concrete.

20.4.4 Holes, Chases and Fixing Blocks**20.4.4.1 Fixtures (Clause 4.5.1)**

Fixtures to be embedded in the concrete shall be embedded into the concrete as shown on the Drawings.

20.4.4.2 Ferrules (Clause 4.5.3)

Refer to Clause 20.4.3.3(a).

20.4.5 Embedded Items**20.4.5.1 Waterstops (Clause 4.6.2)****(a) General**

Factory-made junction pieces shall be properly corner-mitred and jointed at intersections, shall be formed in accordance with the manufacturer's instructions to approval and shall have a tensile strength across the joint of not less than 75% of that of the original material. Junction pieces shall be made so that all ribs in the original cross-section are maintained continuously and the joints are dense, homogeneous, free of all porosity and each leg of the junction having a minimum length of 300 mm. Intersections of waterstops with dissimilar pattern (i.e. "rearguard centre bulb" type, with "internal dumbbell" type) shall be made using specially-made junction pieces which accommodate the transition between patterns.

On site joints shall comply with the requirements for factory-made joints as specified above.

The Contractor shall test, in the presence of the Engineer, joints made in waterstops of each type of material used.

20.4.5.2 Pipes, Conduits and Ducts (Clause 4.6.3)**(a) Casting in of Pipes and Pipe Specials in Concrete**

The Contractor shall be responsible for the installation, positioning, alignment and concreting in of all pipes and pipe specials regardless of whether or not these have been supplied by him.

The Contractor shall submit to the Engineer for his review and approval, at least 28 days prior to the commencement of any specific section of the Works, a schedule indicating all the pipes and pipe specials he intends to cast in directly and the items for which he intends to provide box-outs.

Where it is a requirement that a pipe or pipe special be anchored to resist longitudinal forces and it is provided with anchor flanges, details of the box-out and special reinforcement around the anchor flange(s) shall be as shown on the Drawings and Reinforcement Schedules. Reinforcement shown at box-outs shall not be cut and will generally have been detailed to run through the formwork, but not through the opening itself. Reinforcement shall be added around the anchor flanges to tie in with protruding reinforcement before the pipe or pipe special is concreted in.

Where it is not a requirement that a pipe or pipe special be anchored to resist longitudinal forces, the reinforcement shall not initially be cut and will generally have been detailed to run through the formwork and through the opening itself. Reinforcement shall only be cut and/or bent out of the way at a later stage to suit the item to be cast in. After installation of the item, the remaining reinforcement shall be bent back in position as directed by the Engineer.

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During the installation, positioning and concreting in of any item in an opening the Contractor shall:

- i) Remove all formwork remaining in the box-out;
- ii) Make any alterations required to the position and shape of the opening;
- iii) Thoroughly prepare the sides of the opening so as to obtain a satisfactory bond surface for the new concrete in accordance with Sub-clause 4.7.12.1.3;
- iv) Install, position and align the item to be cast;
- v) Bend back and/or fix reinforcement around the item as directed by the Engineer or as shown on the Drawings;
- vi) Install formwork as required for the concreting in operation; and
- vii) Carry out final surface preparation in accordance with Sub-clause 4.7.12.1.3 before concreting.

20.4.6 Quality of Concrete

20.4.6.1 General (Clause 4.7.1)

The cementitious content of a binder for any class of concrete shall not exceed 450 kg/m³ of concrete.

20.4.6.2 Consistency (Clause 4.7.2)

(a) Slump (Sub-clause 4.7.2.1)

The minimum slump for vibrated concrete shall be 50mm and the maximum slump shall be 100 mm. For pumped mixes the maximum slump can be increased to 125 mm. Due to the expected low slump of the mix for the large mass concrete structures, slump testing may not be feasible in which case consistency shall be measured using VeBe testing as described in Clause 20.5.1.1.

Hand-compacted concrete will not be permitted.

20.4.6.3 Workability (Clause 4.7.3)

(a) Pumping of Concrete (Sub-clause 4.7.3.2 and 4.7.10.15)

Pumping of concrete will be permitted.

20.4.6.4 Chloride and Sulphate Content (Clause 4.7.4)

(a) Chloride Content (Sub-clause 4.7.4.1)

The maximum chloride ion content for mass concrete shall be as given in Table 5; and for reinforced concrete shall be 0.2%.

Efflorescence will not be acceptable on any exposed concrete surface.

(b) Sulphate Content (Sub-clause 4.7.4.2)

The total water-soluble sulphate content of a concrete mix shall not exceed a mass fraction of 4% of the cementitious binder content of the mix.

20.4.6.5 Prescribed-mix Concrete (Clause 4.7.6)**(a) Water Retaining Structures (Sub-clause 4.7.6.1)**

Any mix to be used in the wall, floor or roof of a water retaining or excluding structure shall have a water / binder ratio not exceeding 0.53, shall have a cementitious content of not less than 325 kg/m³ of concrete and the proportions of the various aggregates shall be such as to produce a density of at least 2 400 kg/m³. The cementitious material shall consist of a blend of CEM I or CEM II Portland Cement with a maximum total fly ash content by weight of 30%. The ratio of fly ash to cement may be varied by the Engineer before or during the Contract.

(b) Mass Concrete Structures (Sub-clause 4.7.6.1)

For large mass concrete structures such as retaining walls and weir, it is proposed to use a grade 15 CEM:Fly Ash blend, with fly ash contents up to 60%, with a water:binder ratio around 0.8. This mix shall be achieved by using the lowest possible overall binder content. Consideration should also be given to 'grout enrichment' of the exposed faces of the weir, for durability. Larger coarse aggregate size and adequate fines content, resulting in a cohesive and workable low slump mix, are recommended. Contractor to submit mix design for approval. Contractor to consider the use of a retarder.

20.4.6.6 Mixing (Clause 4.7.8)

All concrete shall be mixed on the site in the area allocated using a site batching equipment. Ready-mixed concrete will only be permitted for smaller or remote structures as approved by the Engineer.

(a) Ready-mixed Concrete (Sub-clause 4.7.8.2)

Ready-mixed concrete will only be permitted for smaller or remote structures and shall be mixed in accordance with the requirements of SANS 878.

20.4.6.7 Placing (Clause 4.7.10)**(a) Under Water (Sub-clause 4.7.10.13)**

Concrete may be placed under water if dictated by the design and indicated on the Drawings, or as approved by the Engineer on Site. A mix design for this concrete shall be submitted for approval.

(b) Placing of Large Mass Concrete Sections

Placing of concrete for large mass concrete structures such as retaining walls and weir shall be such that vertical joints are avoided, except where indicated on the drawings. Plate vibrators may be used on these sections, supplemented by poker vibrators.

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For mass concrete retaining walls and weir, the concrete shall be placed continuously as far as possible. Already-placed horizontal surfaces or 'joints' shall be kept "live" over the period until the placing of the next horizontal lift using continuous light fog spray, i.e. the surface is to be kept moist, not flooded. For interruptions of more than 24 hours, the surface shall still be kept moist, but additional treatment of the surface may be required such as hydro-jetting or brooming, to the approval of the engineer.

Maximum lift height cast per day is 1000 mm.

20.4.6.8 Compaction (Clause 4.7.11)**(a) Method (Sub-clause 4.7.11.3)**

Compaction shall only be achieved by means of mechanical vibration.

20.4.6.9 Joints (Clause 4.7.12)**(a) Construction Joints****(i) Location (Sub-clause 4.7.12.1.1)**

Construction joints will be required.

The location and details of planned construction joints, not indicated on the Drawings, shall be submitted to the Engineer for review and approval.

(ii) Proprietary Bonding Compounds (Sub-clause 4.7.12.1.2)

No proprietary bonding compounds may be used between old and new concrete.

(b) Sealing of Joints (Sub-clause 4.7.12.4)

The sealing of joints shall be undertaken in accordance with the requirements of the details as shown on the Drawings. In addition to the requirements of this Section the conditions and methods specified by the manufacturers of the specified or approved brand name products shall be strictly adhered to.

20.4.6.10 Curing and Protection (Clause 4.7.13)**(a) Curing Compound (Sub-clause 4.7.13.2.e)**

Curing through ponding (horizontal surfaces) is preferred where possible.

The use of membrane curing compounds will be considered on vertical surfaces or inclined surfaces of cast in situ members of a structure. Approval of their use shall be subject to the Contractor producing sufficient, satisfactory cube crushing strength test results of cubes which have been cured with the proposed curing membrane and left exposed to the elements. These test results shall be compared with those of an equal number of water cured cubes. For the use of the membrane to be considered, the crushing strength of the cubes cured with the proposed membrane shall be at least 85% of the crushing strength of the water-cured cubes (using 150 mm cubes).

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Before any membrane curing compound is used, each batch of compound shall be tested on a trial surface to ensure that it forms a satisfactory membrane, and any batch which is unsatisfactory, in the opinion of the Engineer, shall be rejected. Curing membranes shall be disallowed if it causes permanent discolouration of the concrete to take place. Surfaces where curing membranes are used shall be treated in such a manner that the final concrete texture and colour blends in with the rest of the concrete work. Furthermore, the Engineer will, at his discretion, require the Contractor immediately to adopt an effective alternative means of curing any area of the structure to which a membrane has been applied which, in the opinion of the Engineer, is unsatisfactory. The curing compound used shall be to the approval of the Engineer. Wax based curing compounds will not be permitted.

The curing compound shall be applied immediately as formwork is progressively stripped or, in the case of unformed surfaces, when the concrete has taken its initial set. The compound shall preferably be applied by spraying and the rate of application shall be strictly in accordance with manufacturer's recommendations. A method of monitoring the area to which the curing compound has been applied, and the application rate, shall be approved by the Engineer and rigidly adhered to by the Contractor.

Surfaces of joint rebates, where elastomeric sealant is to be applied, shall be protected from contamination by curing compound by the use of masking tape.

The use of membrane curing compounds on surfaces that are to be coloured will not be permitted. In this instance, effective alternative means of curing shall be used.

The use of plastic sheets or intermittent spray / sprinkle as method of curing will not be permitted.

20.4.6.11 Adverse Weather Conditions (Clause 4.7.14)**(a) Prevention and Repair of Plastic Shrinkage Cracks**

The Contractor shall take whatever measures are necessary to prevent plastic shrinkage cracking in the concrete. Particularly on dry windy days or hot sunny days the Contractor shall make provision for fine spraying of the concrete surface within one hour of casting, or immediately covering the concrete with white plastic sheeting. Erection of wind breaks may also be required. If plastic shrinkage cracking occurs, it may be necessary to change the aggregates or the concrete mix proportions. In order to combat shrinkage cracking it may also be necessary to change the time at which, or the manner in which, power floating in terms of Clause 20.4.6.12(f) is carried out.

If plastic shrinkage cracks occur, after floating of the concrete in accordance with Sub-clause 4.7.15.1 (a), the cracks shall be closed up by re-vibrating the concrete with a poker vibrator. Because the setting time of most concrete involves some uncertainty, re-vibration should commence well before first set (approximately one hour of placement and initial vibration) and it should continue if needed at intervals until the concrete clearly approaches initial set.

Once the cracks have been closed, and after the completion of the specified or scheduled surface finish, the concrete shall be kept thoroughly wet, or covered with plastic sheeting for at least a further three hours.

(b) Ambient Temperatures and Heat of Hydration

The Contractor shall take cognizance of the high ambient temperatures as well as large cross-sectional areas in some of the structures and shall consider mitigating measures in terms of mixing and placing of concrete to accommodate high ambient temperatures as well as heat of hydration of the concrete sections. The mitigation such as water chilling plants shall be submitted in a method statement for approval.

The maximum casting temperature of the concrete for structural elements, mass concrete retaining walls and weir shall be a target of 25 degrees C with a maximum of 30 degrees C. The temperature shall be measured and recorded for every truck at point of placement.

For large concrete pours (structural or mass concrete) the Engineer may order measurement of in-situ concrete temperatures as an additional control.

20.4.6.12 Concrete Surfaces (Clause 4.7.15)**(a) Exposed Surfaces (Sub-clause 4.7.15.1)**

Exposed surfaces of concrete not cast against formwork shall be finished in accordance with Sub-clause 4.7.15.1.

For large mass concrete sections, concrete shall be carefully poked vibrated for up to 300 mm from the shuttered face to render a smooth, durable surface finish.

(b) Non-skid Surfaces (Sub-clause 4.7.15.2)

Exposed surfaces requiring a non-skid finish will be indicated on the Drawings and/or in the Bill of Quantities.

(c) Screeded Finish (Sub-clause 4.7.15.1 a)

In addition to Sub-clause 4.7.15.1 (a) no mortar shall be added during the screeding operation, and noticeable surface irregularities caused by the displacement of coarse aggregate shall be made good by re-screeding after displaced aggregate has been removed or tamped.

(d) Wood-floated Finish (Sub-clause 4.7.15.1 b)

Where wood-floating is specified, the surface shall first be given a finish as specified in Sub-clause 4.7.15.1 (a) and, after the concrete has hardened sufficiently, the surface shall be wood-floated, either by hand or machine, only sufficiently to produce a uniform surface free from screeding marks.

(e) Steel-floated Finish (Sub-clause 4.7.15.1 c)

Where steel-floating is specified, the surface shall first be given a finish as specified in Sub-clause 4.7.15.1 (b). When the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, the screeded surface shall be finished through a combination of wood-floating, followed by steel floating under firm pressure to produce a dense, smooth, uniform surface free from trowel marks.

(f) Power Float Finish

Where power floating is specified, the surface shall be treated as specified in Sub-clause 4.7.15.1 (a). When the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, the surface shall be power floated to produce a dense, smooth and uniform surface free of trowel marks. In corners and areas of restricted access the concrete surface shall be finished by steel floating in accordance with Sub-clause 20.4.6.12(e).

The timing of power-floating is critical to its success. Power-floating shall not commence until the concrete can support the weight of a person with minimum indentation or when a footprint is barely perceptible and until the moisture sheen has disappeared. Thus several hours may have to elapse after concreting has been completed before this operation can commence, depending on ambient temperature and relative humidity and the type of concrete mix used. Night work may therefore be required.

(g) Broom-swept Finish (Sub-clause 4.7.15.2)

Where broom-swept finish is specified, the surface shall be wood floated as specified in Sub-clause 4.7.15.1 (b) and thereafter swept with a stiff bristle broom to produce an approved non-skid surface.

(h) Colour Mitigation – Application

Surfaces to be coloured shall be free of curing compounds or other material that may prevent direct contact with the colouring.

The colouring shall be applied directly to clean concrete surfaces at locations as specified or directed by the Engineer. Dark patches that may develop shall be controlled or avoided by custom blending of the basic technique, amending the dilution rate of the colour concentrate with water or a combination of these.

If required the Contractor shall apply the colouring to a test section to be reviewed by the Engineer. Upon approval of both the test section and application procedures by the Engineer, the Contractor may proceed using the approved application procedures.

Rock colouring material shall be applied only by licensed applicators approved by the manufacturer. Variegated patinas that develop shall be controlled by custom blending of the rock colouring material and/or varying the application techniques.

(i) Concrete Topping (screed)

Before placing any concrete topping (screed), the base concrete shall be chipped to expose the aggregate over 100% of the area to be screeded, and then soaked with water for at least 24 hours to achieve a saturated surface-dry substrate

Before laying the screed, the concrete shall be thoroughly cleaned by scrubbing, and all standing water removed after soaking. A 1:2 cement / sand grout shall then be brushed on to the prepared surface, and topping laid before the grout sets. The topping shall be of the driest feasible consistency with a slump not exceeding 50 mm and shall be formed true to profile and shape as required and shown on the Drawings. Before fresh topping is placed against existing, adjacent topping the edge of the latter shall be prepared by chipping back to firm material, wire brushing the exposed surface and brushing it with grout as for the base concrete.

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Topping (screed) shall be compacted to remove all air and shall be screeded and steel trowel finished to a degree of accuracy II.

The trowelling shall be carried out in the following stages:

- i) 1st – as soon as the topping has been compacted and screeded.
- ii) 2nd – after 2 hours to close the surface and remove laitance.
- iii) 3rd – after a further 4 hours.

These time intervals are appropriate to normal temperature conditions and shall be varied by the Contractor according to the temperature to ensure a smooth dense finish.

Toppings shall be cured as specified in Clause 4.7.13 but shall additionally be protected from direct sunlight and drying winds as it is being placed.

All screeding necessary to accommodate mechanical equipment shall be done under the equipment supplier's supervision and strictly in accordance with his instructions. Screeding shall commence as soon as the equipment supplier gives notice on completion of erection and shall be finished expeditiously.

The Contractor shall make good any damage to the mechanical equipment resulting from his personnel not following the supplier's instructions. Any spillage on the equipment shall be cleaned off immediately.

20.4.6.13 Watertight Concrete (Clause 4.7.16)

The following structures shall be regarded as watertight structures:

- i) Pumping stations;
- ii) Diversion works;
- iii) Sedimentation works;
- iv) Valve chambers; and
- v) Inlet and outlet Works at reservoirs.

The tests in Sub-clauses 5.1.6.1 and 5.1.6.2 will not be required for these structures, except for the sedimentations works where the tests will be required to confirm water tightness. Contractor to allow sufficient time in the program for water tightness testing of the sedimentation works.

However, should any section of the concrete Works show any sign of water leakage or penetration, irrespective of the source, that section shall be deemed to be defective and the necessary remedial work shall be carried out in accordance with Sub-clause 5.1.6.3.

20.4.6.14 Grouting (Clause 4.7.18)

(a) Holding-down Bolts, Column Bases and Mechanical Equipment Bedplates

The mortar grout for holding-down bolts, column bases and mechanical equipment bedplates shall be a proprietary grout ready mixed in sealed packets as supplied by the manufacturer, and mixed and placed in accordance with the manufacturer's instructions.

The following prescribed products or brand name products, or equivalent materials subject to the written approval of the Engineer, shall be used:

SikaGrout® 212, high performance cementitious grout.

20.4.6.15 Defects (Clause 4.7.19)

(a) General

Defects shall be repaired as soon as possible after formwork has been removed and the Engineer has inspected the concrete. A statement of the method to be used for each repair shall be submitted to the Engineer for his approval before any work is carried out. The Engineer may prohibit the further placing of concrete in the particular structure concerned until he is satisfied that the repair has been satisfactorily executed.

20.4.6.16 Units that have Architectural Finishes (Clause 4.8.6)

(a) Samples of Concrete (Sub-clause 4.8.6.1)

Samples of precast concrete units that have architectural finishes shall be prepared for approval prior to construction. The approved samples shall be retained throughout the contract as reference.

Samples of concrete units, not having architectural finishes shall also be prepared to establish quality before full-scale production is commenced.

20.4.7 Pre-stressed Concrete

20.4.7.1 Tendons (Clause 4.9.2)

(a) Solvents (Sub-clause 4.9.2.1.1)

Solvents may be used for cleaning.

(b) Pre-stressing Force Diagram (Sub-clause 4.9.2.5.1)

Pre-stressing force diagrams will be shown on the Drawings.

(c) Order of Loading and Magnitude (Sub-clause 4.9.2.5.8)

The order of loading and magnitude of the load for each component of the tendon shall be as indicated on the Drawings.

20.4.7.2 Grouting of Sheaths (Clause 4.9.3)

(a) Tests (Sub-clause 4.9.3.1.2)

Bleeding tests and grouting trials will be required.

20.4.7.3 Permanent Protection and Bonding of External Tendons (Clause 4.9.4)**(a) Tests (Sub-clause 4.9.4.2)**

Preliminary tests shall be undertaken on the proposed encasement materials.

(b) Protection (Sub-clause 4.9.4.3)

The protection and bonding of the tendons shall be effected within 7 days after final tensioning of the tendon(s).

20.4.8 Handling and Erection of Precast Concrete Units**20.4.8.1 Handling and Transportation (Clause 4.10.1)****(a) Lifting (Sub-clause 4.10.1.3)**

The position of lifting and supporting points, the method of lifting, the type of equipment and the type of transport to be used shall be determined by the Contractor in liaison with the Engineer. The agreed system layout shall be submitted to the Engineer (for review, detailed design and reinforcement detailing) 28 days before the construction Drawings and Reinforcement Schedules are required by the Contractor.

20.4.8.2 Assembly and Erection (Clause 4.10.2)**(a) Methodology (Sub-clause 4.10.2)**

At least 28 days before commencement of the work, the Contractor shall submit to the Engineer a Method Statement including proposed methods of assembly and erection for review and approval by the Engineer.

20.4.8.3 Forming Structural Connections (Clause 4.10.4)**(a) Design (Sub-clause 4.10.4.1)**

The design requirements for the structural connections will be indicated on the Drawings.

20.5 COMPLIANCE WITH THE REQUIREMENTS**20.5.1 Testing****20.5.1.1 General (Clause 5.1.1)****(a) Slump testing (Sub-clause 5.1.1.2)**

For the weir and mass concrete retaining walls, slump tests may not be feasible due to aggregate size and low slump. For such mixes, slump tests to be replaced by VeBe testing in accordance with SANS 5862-3:2006 to determine consistency. The recommended VeBe time is 10 +/- 3 seconds.

(b) Cube testing (Sub-clause 5.1.1.4)

For the weir and mass concrete retaining walls, cubes shall be tested for acceptance at 56 days after placing. Intermediate cube control testing will be required at intervals proposed by the Contractor. These earlier-age test results can be calibrated with the 56-day test results, and used for mix control at earlier ages.

(c) Ready-mix Production (Sub-clause 5.1.1.7)

The tests results from a ready-mix production facility, that form part of its quality control system, will not be accepted as valid test data.

(d) Alkali-aggregate Reaction (Sub-clause 5.1.1.8)

The test for the percentage of alkali-aggregate shall be Petrography ASTM C 295 and Accelerated Mortar-bar test SANS 6245:2006.

20.5.1.2 Acceptance of Strength Concrete (Clause 5.1.2)**(a) Assessment (Sub-clause 5.1.2.3)**

The test results will be assessed statistically.

20.5.1.3 Frequency of Sampling (Clause 5.1.3)

The frequency of sampling shall be indicated in the method statement for approval by the Engineer.

20.5.1.4 Individual Load Tests on Precast Units and Pre-stressed Units (Clause 5.1.4)

The following load test values will be as indicated on the Drawings:

(a) Deflection (Sub-clause 5.1.4.2.1)

The maximum deflection.

(b) Load (Sub-clause 5.1.4.3)

The ultimate design load.

(c) Special Tests (Sub-clause 5.1.4.4)

Any special tests required.

20.5.1.5 Tests on Pre-stressed Structures (Clause 5.1.5)**(a) Tests Requirements (Sub-clause 5.1.5.1.1)**

Particular requirements for pre-stressed structures will be indicated on the Drawings.

(b) Acceptance Criteria (Sub-clause 5.1.5.4 and Table 10)

The acceptance criteria for pre-stressed structures in extreme exposure conditions will be indicated on the Drawings.

(c) Class (Sub-clause 5.1.5.4 a)

The class of pre-stressed structure will be indicated on the Drawings.

(d) Deflection (Sub-clause 5.1.5.4 c)

The deflection measured immediately after application of the test load for deflection shall not exceed the values indicated on the Drawings.

20.5.1.6 Tests for Water tightness (Clause 5.1.6)**(a) Requirements (Sub-clause 5.1.6.1)**

Water shall be used as the liquid for test purposes.

The stabilizing period is 7 days for a maximum design crack width of 0.1 mm and 21 days for a maximum design crack width of 0.2 mm.

The total permissible drop in level is 10 mm or 1/500th of the average water depth, whichever is the lesser value.

20.5.2 Tolerances**20.5.2.1 General (Clause 5.2.1)****(a) Degree of Accuracy (Sub-clause 5.2.1.1)**

The degree of accuracy is II.

(b) Floated Finishes (Sub-clause 5.2.1.2)

The degree of accuracy for floated finishes is II.

(c) Tolerances not stated (Table 11)

The tolerances for bow, camber and twist in slipform / precast concrete shall be as indicated on the Drawings.

20.6 MEASUREMENT AND PAYMENT

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

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20.6.1 Measurement and Rates**20.6.1.1 Formwork**

Formwork, other than formwork covered below, will be measured as the net area of the face of the concrete to be supported during the placing of concrete. No deduction will be made for fillets and splays of size up to 50 mm x 50 mm or for openings of diameter up to 0.7 m or of area up to 0.5 m². Formwork in continuous lengths of narrow widths and of fillets or splays over 50 mm x 50 mm will be measured by length, the width or range of widths being stated in the schedule.

Boxing-out, the forming of holes, and other such operations will be measured by number, basic dimensions, perimeters, or drawing references, as stated in the schedule.

Separate items will be scheduled:

- a) For each class of finish required on the formed concrete.
- b) For the different angles of inclination of formwork given below:

DESCRIPTION OF FORMWORK	ANGLE OF INCLINATION FROM THE VERTICAL
Horizontal	Exceeding 85° and not exceeding 95°
Sloping	Exceeding 10° and not exceeding 85°
Battered	Not exceeding 10°
Vertical	0°

- c) For each inclination of each type of structural element, such as walls and beams, and for different prop heights for beams and slabs, and for formwork to curved (singly and double curvature), curved in plan only, arched, domical, specially moulded, and other types of work.
- d) For depths of openings required in the formed concrete, as follows:
 - i) Not exceeding 0.5 m;
 - ii) Exceeding 0.5 m but not exceeding 1.0 m;
 - iii) Exceeding 1.0 m but not exceeding 1.5 m;
 - iv) Exceeding 1.5 m but not exceeding 2.0 m;
 - v) Exceeding 2.0 m; and
 - vi) Measured perpendicular to the surface.
- e) For large and small voids classified as follows:

DESCRIPTION	MAXIMUM CROSS-SECTION	
	CIRCULAR VOIDS, DIAMETER, M	OTHER VOIDS, AREA, M ²
Large	Exceeding 0.35 and not exceeding 0.7	Exceeding 0.1 and not exceeding 0.5
Small	Not exceeding 0.35	Not exceeding 0.1

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Where a special smooth finish is specified and scheduled such that it requires more extensive operations to be carried out after striking than are specified in Sub-clause 5.2.1(b), payment will become due when the finish has been achieved as specified.

Where a special finish (see Sub-clause 5.2.1(c)) is specified and scheduled, payment will become due when the finish has been achieved as specified.

The unit rate shall cover the cost of all parts of formwork in contact with the concrete (including forming fillets or splays up to 20 mm x 20 mm) and the necessary bearers, struts, and other supports plus the labour and equipment necessary to erect and strike such formwork.

20.6.1.2 Reinforcement

- a) Steel for normal reinforced concrete will be measured net by mass of all bars, including supporting steel detailed on the reinforcing schedules. The mass will be computed from the nominal bar size and the nominal mass per unit length. Rates shall include for cutting, waste, spacer devices (materials other than steel bars), and binding wire as well as costs for testing per SANS 920:2011.

Separate items will be scheduled for:

- i) Each steel section where rails and other steel sections are used; and
- ii) Steel to be fixed in different parts of the work where this could materially influence the pricing of the work.

Steel reinforcement for precast concrete units will not be measured unless so scheduled (see Clause 20.017).

Steel off-cuts resulting from the cutting and bending of reinforcement in accordance with the bending schedule shall be deemed to be the property of the Contractor.

- b) The total mass of all round and square steel bars will be scheduled as bars of nominal size 25 mm (diameter or side, as relevant) for the purpose of obtaining a basic contract price, and the bars of all sizes actually used will be subject to the terms of the Conditions of Contract covering valuation of variations.

Welded mesh will be scheduled separately for each type and mass per square metre of mesh.

- c) Welded mesh will be scheduled separately for each type and mass per square metre of mesh. The mesh will be measured by the net area shown on the Drawings, and the rate must allow for cutting, waste, laps, or deduction for end cover. The areas measured will be those of the concrete floor or slab reinforced by means of mesh. In the case of continuous units partly reinforced by mesh, the area will be computed from the outside dimensions of the area covered by mesh regardless of whether additional reinforcing steel is present in the same area.
- d) The unit rates for steel bars of nominal size 25 mm shall cover the cost of supply, cutting, bending, placing in position, and fixing of the reinforcing and supporting steel scheduled, and the provision of all spacer devices and binding wire, as well as the cost of tests in terms of SABS 920.
- e) The extra-over rates for bars of all nominal sizes other than 25 mm shall cover any differences in cost arising from any or all of the operations set out in (b) above in respect of bars of such other sizes.

20.6.1.3 Concrete

- a) Concrete will be measured net to the dimensions shown on the Drawings or to the dimensions cast, whichever are the smaller. However, structural elements that are undersized will be measured for payment only if they are accepted by the Engineer.
- b) No allowance will be made for concrete required to make up overbreak in soft excavation, but payment will be made for additional concrete or formwork, ordered in writing by the Engineer to replace unsuitable material or overbreak in hard rock or in intermediate excavation (see (d) below).
- c) Blinding layers will be measured to the plan size of the concrete structure resting on the carpet, or the plan size of the excavation where additional excavation is provided to facilitate erection of forms. Where the concrete is scheduled by volume it will be measured on the mean thickness as cast, provided that the Engineer is satisfied that the excavation has not at any point been taken deeper or wider than necessary (see (b) above).
- d) Where concrete is placed directly against the sides or bottoms of excavations in hard rock or in intermediate excavation, an item may be included in the Bill of Quantities for any additional concrete placed in overbreak. Such additional concrete will be measured on the basis of the superficial area of the sides or bottom, or both, as applicable, of the theoretical net excavation in rock that is overbroken and in contact with the concrete.
- e) Separate items will be scheduled, as applicable, for each type and each grade of concrete, for each type of cement and each type of aggregate, and for each unit of the Works or each element of a structure, where these could materially influence the pricing of the work and where the cost of placing concrete is affected by its position in the Works or by the conditions of placing, such as:
 - Slabs that are sloping, conical, or horizontal, and those of different thicknesses;
 - Concrete placed under water or between tides, the levels of demarcation being stated;
 - Small quantities each less than 0.5 m³ of formed concrete; and
 - Different surface finishes (other than striking-off and levelling) such as wood-floated or steel-floated finishes and topping or mortar screeds.
- f) The unit rates shall cover the cost of the design of the mix in the case of strength concrete, the provision of concrete (made with ordinary Portland cement unless otherwise scheduled), mixing and batching, mitigation for heat of hydration in large pours, testing, placing, compacting, the forming of stop-ends and unforeseen construction joints, striking-off or levelling as applicable, and curing and repairing where necessary.
- g) Floor slabs, where placed on sub-foundation carpets or directly on the prepared ground surface, will be measured to the net thickness dimensioned on the Drawings.
- h) Concrete in a column supporting a reinforced concrete beam or slab structure will be measured between the top surface of the foundation, beam, or slab on which the foot of the column is standing and the underside of the beam or slab supported by the column.
- i) No deduction or addition will be made for nosings, bolt holes, chamfers or splays of size up to 50 mm x 50 mm, grooves or chases not exceeding 0.015 m³ each in volume, or holding-down bolts, rails, steel sections, and reinforcement cast in the concrete.

20.7 SCHEDULED FORMWORK ITEMS

20.001 Rough **Unit: square metre (m²)**

The surfaces to be so formed will be identified in the Bill of Quantities.

20.002 Smooth **Unit: square metre (m²)**

The surfaces to be so formed will be identified in the Bill of Quantities.

20.003 Special smooth, repaired and rubbed **Unit: square metre (m²)**

The surfaces to be so formed will be identified in the Bill of Quantities.

20.004 Special off-form **Unit: square metre (m²)**

The surfaces to be so formed will be identified in the Bill of Quantities.

20.005 Narrow widths (up to mm wide) **Unit: metre (m)**

The constant width, if in excess of 300 mm, or the range of widths if up to 300 mm, or width and depth in the case of grooves or chases, will be stated in the Bill of Quantities.

20.006 Box-out holes/Form voids

Items will be scheduled as set out below:

- a) Small, circular, of diameter up to and including 0.35 m**

	Over	and	Up to and including	
i)	0 m deep		0.5 m deep	Unit: No.
ii)	0.5 m		1.0 m deep	Unit: No.
iii)	1.0 m		1.5 m deep	Unit: No.
iv)	1.5 m		2.0 m deep	Unit: No.
v)	2.0 m		- deep	Unit No.
- b) Small, other than circular, areas up to and including 0,1 m²** **Unit: No.**

Depths as in a) above.
- c) Large, circular, of diameter over 0.35 m up to and including 0.7 m** **Unit: No.**

Depths as in a) above.

- d) Large, other than circular, areas over 0.1 m² and up to and including 3 m² Unit: No.**
Depths as in a) above.

20.8 SCHEDULED REINFORCEMENT ITEMS

20.007 Steel bars

- a) Steel bars irrespective of grade and diameter Unit: tons (t)**

Members to be identified in the Bill of Quantities.

- b) Extra over for bars of nominal sizes larger than 25mm Unit: tons (t)**

Members to be identified in the Bill of Quantities.

20.008 High-tensile welded mesh Unit: square metre (m²)

The type reference will be stated.

20.009 Rails or other steel sections used as reinforcement Unit: tons (t)

20.9 SCHEDULED CONCRETE ITEMS

20.010 Prescribed mix concrete Unit: cubic metre (m³) or meter square (m²)

The proportions and the positions or elements in the Works will be stated.

20.011 Blinding layer in Concrete

Either of the following will be stated:

- a) Minimum thickness and proportions or grade Unit: square metre (m²)**

- b) Proportions or grade Unit: cubic metre (m³)**

20.012 Strength concrete, grade Unit: cubic metre (m³)

The grade and positions or elements in the Works will be stated. Except where ordinary Portland cement is required, the type of cement will be stated.

20.013 Unformed surface finishes**Unit: square metre (m²)**

Where better than rough surface finishes are required, items will be scheduled for each class or type of finish, i.e.:

- a) **Wood-floated finish;**
- b) **Steel-floated finish;**
- c) **Power-floated finish; or**
- d) **Other special finish.**

20.014 Aggregate (where measured separately)**Unit: cubic metre (m³)**

The rate shall cover the cost of supplying at the point of use and using the aggregate in the manner specified.

20.015 Cement (where measured separately)**Unit: tons (t)**

The rate shall cover the cost of supplying at the point of use and using the cement in the manner specified.

20.016 Joints**Unit: metre (m)**

Separate items will be scheduled for contraction and expansion joints of different types and sizes and involving different types, sizes, and qualities of water bars, soft board, sealers, etc.

The unit rate shall cover the cost of all materials and labour for the construction of each joint as specified or shown on the Drawings, including the cost of formwork, testing, and making good.

20.017 Manufacture (or supply) and erect precast elements**Unit: number (No.) or
cubic meter (m³) or
meter (m)**

Separate items will be scheduled for:

- a) **Different qualities of concrete**
- b) **Different types and sizes of units**
- c) **Small units not exceeding 0.5 m³ of formed concrete**
- d) **Different positions of units for erection purposes**

Except where separate items are scheduled for specific operations or materials, the rates shall cover the cost of supply of all materials, equipment, and labour for the concrete and reinforcement

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in the elements including the cost of moulds for forming the element, special finishes, curing, transport, handling to Site, erecting or building in or fixing, and grouting.

20.018 Grouting**a) Under bases (or beds)****Unit: cubic metre (m³)**

Grouting under structural steel column bases or members or under pumps, motors, or other machinery will be measured by the volume of grout (before the edges are trimmed at 45° from the bottom edges of bedplates) necessary to fill the voids and pockets between the underside of the metalwork and the top of the concrete. No deduction will be made for bolts, packers, and baseplate shear keys protruding into the grout space.

b) HD bolts, etc. (see Item 20.019)**Unit: cubic metre (m³)**

Separate items will be scheduled for HD bolts or pockets, as applicable, of different diameters, lengths, and types, and for bearings and miscellaneous metal work of different types. The quantity will be measured by the volume of grout necessary to fill the voids in the concrete. No deduction will be made for bolts and packers protruding into the grout space.

The rates for a) and b) above shall cover the cost of scabbling, cleaning, and preparing the concrete surfaces, providing an approved grout, placing and ramming it solidly into all voids and pockets, and mitring the outside edges to a true wood-floated surface. Formwork, if any, will be measured separately in terms of Clause 20.7

20.019 HD bolts and miscellaneous metal work**Unit: tonnes or metre (t / m)**

Whether the item is to be supplied by the Contractor or by others will be stated. Separate items will be scheduled as specified in Item 20.018 (b).

The rate shall cover the cost of supplying and delivering or taking delivery (as applicable), fixing or casting into concrete, and all cleaning, preparation, and finishing.

20.020 Colour Mitigation**Unit: square metre (m²)**

Measurement shall be on the plane projection along the exposed planes of the area being coloured.

The rate shall cover full compensation for all labour, materials, operation of equipment, tools, supplies and incidentals necessary to complete the work specified or as directed by the Engineer.

20.021 Miscellaneous items**a) Polythene sheeting under concrete****Unit: square metre (m²)**

Polythene sheeting shall comply with SANS 952, Type B, 0.25 mm thick. The rate shall cover supply and installation of the sheeting and shall include 250 mm overlap between sheets where required.

b) Testing for water tightness**Unit: Sum**

The tendered amount shall include full compensation for the provision of labour, equipment and materials necessary for testing the structure for water tightness as specified, as well as for the installation and removal of any temporary plugs to blank off pipes, to the satisfaction of the Engineer.

c) Other items

These items will be measured in metre, square metre, number or sum as per the schedule.

Where a sum is measured, the rate shall cover supply, installation and casting in of the item as depicted on the relevant drawings.