UNIVERSITY OF THE WITWATERSRAND
CAMPUS DEVELOPMENT AND PLANNING
ESRU BUILDING
RAHIMA MOOSA MOTHER AND CHILD HOSPITAL
PROJECT SPECIFICATIONS
FOR
STRUCTURAL AND CIVIL WORKS
JANUARY 2015

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DOCUMENT NO: 2719/H7354
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PART C3: PROJECT SPECIFICATION

C3.1 STANDARD SPECIFICATION

C3.1.1 Applicable SABS 1200 Specifications

For the purposes of these works the following Standardized Specifications, as set out in the South African Bureau of Standards Standardized Specifications for Civil Engineering Construction, shall apply:

- SABS 1200D: Earthworks
- SABS 1200 DB: Earthworks (Pipe Trenches)
- SABS 1200 DM: Earthworks (Road, Subgrade)
- SABS 1200 G: Concrete (Structural)
- SABS 1200H: Structural Steelwork
- SABS 1200HB: Cladding and Sheeting
- SABS 1200HC: Corrosion Protection of Structural Steelwork
- SABS 1200L: Medium Pressure Pipelines
- SABS 1200LB: Bedding (Pipes)
- SABS 1200LD: Sewers
- SABS 1200 LE: Stormwater Drainage
- SABS 1200M: Roads (General)
- SABS 1200ME: Subbase
- SABS 1200MJ: Segmented Paving
- SABS 1200 MK: Kerbing and Channeling
- SABS 1200 MM: Ancillary Roadworks

The SABS specifications as indicated above shall be the latest revision of the relevant standard or the corresponding SANS replacement thereof.

In addition to the above, the following Special Specifications form part of the contract and shall be read in conjunction with the Standardized Specifications:

- Structural Masonry

C3.2 VARIATIONS AND ADDITIONS TO THE APPLICABLE SABS 1200 SPECIFICATIONS

The variations and additions to the specifications listed in Clause C3.1.1 are as follows:

Clause 8, Measurement and Payment, of the applicable Standardised Specification shall not be applicable.
C3.3  EARTHWORKS (SABS 1200 D)

C3.3.1  INTERPRETATIONS

C3.3.1.1  Definitions (Clause D2.3)

Where a slope or batter is given in the Specifications or on the Drawings as a ratio, the first figure refers to the vertical e.g. 1,5 : 1 means 1,5 vertical to 1 horizontal.

C3.3.2  MATERIALS

C3.3.2.1  Physical Properties (Clause D3.2)

The imported material (gravel) should after compaction comply with the relevant requirements of SABS 1083.

Imported Backfill Material (Selected layers)

The maximum dimension of aggregate may not exceed two thirds of the thickness of the compacted layer.

The material used for the sub base is typically a C4 material.

C3.3.2.2  Stabilising Agent

General

The stabilising agent should be one or more of the following in accordance with the Bill of Quantities:

a) Road lime that complies with the relevant requirements for lime in SABS 824.

b) Portland Cement that complies with the relevant requirements of SABS 471.

c) Portland Blast furnace Cement that complies with the relevant requirements of SABS 626.

d) Granulated Blast furnace Slag mixed with Portland Cement or lime in the specified or recommended mass ratio, in such a manner that the part retained on a sieve with a nominal opening size of 90 mm is not more than 10% according to mass.

Stockpiling

Separate stockpiling facilities must be supplied on site for every type of stabilising agent that is used.

Stabilising agents that are stockpiled on site must be covered in such a way that it is protected against moisture and other worsening factors.

The area provided for stockpiling and the quantity of stabilising agent that is stockpiled must be sufficient to ensure that the work can continue without any stoppages. Except in the case of lime, if approved, no stabilising agent may be stockpiled on site for longer than 3 months.

Weakened or contaminated stabilising agent may not be used in the works and must be removed from the site immediately.
C3.3.2.3 Water

Only approved water of good quality may be used. Sea water and water that contains a high salt content or water with impurities that will have a negative effect on the stabilising agent will not be approved.

C3.3.2.4 Selection (Clause D3.3)

General Selection (Clause D3.3.1)
The Contractor is responsible for the finding of adequate sources of material that will ensure that the material from these sources will be in accordance with the requirements of 2.1.

Approval must also be obtained from the Engineer:

a) Before construction is started.

b) During construction, if the physical properties of the material in the borrow pit or from commercial sources differ from the properties of the material that was approved previously.

Selection for Mechanical Modification

If material that complies with the relevant requirements of 2.1 is not available within an economical transport distance, the Engineer may require the mechanical modification of two or more materials from different sources.

C3.3.2.5 Replacing Overbreak in Excavations for Foundations (Clause D3.2.2)

Under no circumstances are foundations or other supports to be founded on earthfill or rockfill or made up ground of any description without the written approval of the engineer. Where instructed by the engineer, the contractor shall replace overbreak with mass concrete of the grade as directed, at his own expense.

C3.3.2.6 Backfill Below Surface Beds

Unless otherwise specified, fill or backfill material below surface beds shall be in accordance with the requirements of SABS 1200D Clause D3.2.2 i.e. Material Suitable for Replacing Overbreak in Excavations for Foundations.

C3.3.3 CONSTRUCTION

C3.3.3.1 Existing Services (Clause DA5.1.3)

If existing services are not indicated on the Drawings, the Contractor shall inform the Engineer of the lack of data concerning existing services and he shall request the Engineer to point out known existing services, before commencing excavation. Should the Contractor fail to do so, he shall rectify and repair any damaged services at his own expense.

C3.3.3.2 Safety and Traffic Control (Clause D5.1.1 and D5.1.6)

The contractor shall control the access by the general public to the site in collaboration with and as approved by the engineer. No unauthorized persons may enter the construction site.

Where trenches cross roads, the contractor shall so arrange his work that at least one free flowing traffic lane is available at all times and he shall direct traffic at such points until the full roadway has been reinstated. No excavations across roads shall be left open at night and access to private
property shall be maintained at all times.

C3.3.3.3 Safeguarding of Excavations (Clause D5.1.1.2)

The contractor shall provide shoring to all excavations exceeding 1.5 metres deep required in terms of the Occupational Health and Safety Act.

C3.3.3.4 Explosives (Clause D5.1.1.3)

The contractor shall use explosives for blasting in connection with the Works only where approved by the engineer. Such approval, however, shall not relieve the contractor of his responsibilities in terms of the contract.

The contractor shall submit to the engineer for his approval, before any blasting preparation on Site is commenced, details of his proposed blasting programme, the methods to be used and the precautions to be adopted. The contractor shall use only moderate charges of explosives at any time and the utmost care shall be taken to avoid unnecessary shattering of rock or disturbance of the ground.

Blasting will not be permitted in any situation or position where, in the opinion of the engineer, it is likely to endanger any existing foundations, structures, pipelines, power and telephone lines or other services and in such situations the rock shall be excavated by drilling and wedging or by other suitable methods other than blasting, approved by the engineer.

The prior consent for blasting given by the engineer shall in no way relieve the contractor of any of his obligations under this contract and the engineer shall have the power to withdraw his consent for blasting and order other means or methods of excavation in rock.

C3.3.3.5 Detection, Location and Exposure of Services (Clause D5.1.2.2)

If existing services are not indicated on the Drawings, the contractor shall inform the engineer of the lack of data concerning existing services and he shall request the engineer to point out known existing services, before commencing excavation. Should the contractor fail to do so, he shall rectify and repair any damaged services at his own expense.

C3.3.3.6 Damage to Roads or Services and Reinstatement (Clause D5.1.2.4 and D5.1.5)

Where the contractor is required to rectify or repair damaged services or roadwork, such repair work shall be carried out in such a manner that all road layers or services are reinstated to their previous condition in all respects and to the satisfaction of the engineer.

C3.3.3.7 Negligence (Clause D5.1.2.4)

Should the contractor damage any of the existing services either through negligence or in the opinion of the engineer through lack of reasonable precautions, the contractor shall repair the service to the satisfaction of the engineer.

C3.3.3.8 Surplus Excavated Material (Clause D5.1.4.3)

Surplus excavated material which is suitable for later use in the Works shall be stockpiled on the Site in a position indicated by the engineer.

Unsuitable surplus excavated material shall be removed from the Site and disposed of at the contractor's discretion.
All surplus excavated material, which is suitable for later use, shall be dumped in one area only, unless otherwise approved or directed. The contractor shall be responsible for the location of suitable disposal sites for this material.

C3.3.3.9 Excavation (Clause D5.2.2.1 c)

Where permanent structural concrete or a blinding layer is to be cast on or against an excavated surface the allowable tolerance for a projection into the excavation profile shall be ± 10mm.

C3.3.3.10 Borrow Pits (Clause D5.2.2.2.2)

The contractor shall be responsible for the identification of suitable sources of imported materials and he shall provide the engineer with the results of Atterberg Tests on the proposed materials at the least, three weeks prior to the commencement of importation of material from these sources.

The contractor shall construct and maintain, at his own expense, any access tracks to borrow pits which may be required.

C3.3.3.11 Backfilling Around structures (Clause D5.2.3.2)

Unless otherwise directed or indicated, backfilling around structures shall be compacted to at least 95% Modified AASHTO maximum density.

The use of heavy compaction plant adjacent to structures is subject to the approval of the engineer but such approval shall not relieve the contractor of his obligations in terms of the contract and the contractor shall remain fully responsible for the safety of the structure.

C3.3.3.12 Compaction of Surfaces in footing Excavations

The surface exposed by restricted excavation in footings shall be thoroughly wetted and the upper 150mm layer within the excavation compacted by vibratory plate, or approved suitable compacting equipment, to 95% Modified AASHTO maximum density prior to the casting of the blinding layer. The engineer shall inspect and approve the compacted surface prior to the casting of any blinding.

C3.3.3.13 Placing and Compaction (Clause D5.2.3)

Placing

The material must be placed and spread out over the full width of the layer shown on the drawings to a depth that will give the required layer thickness after compaction. The surface of the layer must be in accordance with the specified level and slope.

Spreading

The material must be spread in such a manner that the separation of the different sizes of aggregate in the material is restricted to a minimum.

Wetting of material

To increase the moisture content to the optimum for the material to obtain the required density, only the correct quantity of water may be added to the material that will be compacted. The water must be mixed thoroughly with the material to obtain a homogeneous mix.

Compaction

Material that is too wet must be allowed to dry out to the correct moisture content before compaction is started. The compaction must be a continuous operation over the full width and length of
the area that is compacted until the specified density is obtained. During compaction the required profile must be maintained and all holes, depressions and dips must be corrected. The top of the compacted layer must be hard and uniform.

Any bad patches found during the compaction process must be removed and repaired at the cost of the Contractor.

**C3.3.3.14 Stabilising**

**Preparation of Layer**

The material that needs to be stabilised must be spread out as specified in C3.7.3.13.

The layer must be shaped in accordance with the specified line, slope and cross section.

**Application of Stabilising Agent**

The stabilising agent must be spread out over the full width of the prepared layer at the specified application rate. If the stabilising agent is spread out by hand, it must be done systematically from pre-arranged bags of stabilising agent.

**Mixing in of Stabilising Agent, Wetting and Compaction**

Immediately after the application of the stabilising agent, it must be mixed to the full depth with the material that will be stabilised. The procedure must be done with care to prevent the disturbing of the underlying compacted layers. Mixing of the stabilising agent deeper than the required depth must be prevented.

The mixing process must be continued as long as is necessary to ensure a uniform mix. The uniform-ness must be the same for the total area and required depth of the material that must be treated.

Immediately after the mixing in of the stabilising agent, the moisture content of the mix must be determined, and water must be added if necessary.

The material should then be compacted as specified. And the stabilising process must be completed within the applicable period.

During the compaction process the loss of water through evaporation must be compensated for by additional water application. Every application of water must be mixed into the material in order to prevent a concentration of water on the surface and to prevent that water flows over the surface of the layer.

Any part of the works that is saturated with water after the stabilising agent have been applied and before the mix have been compacted will not be approved. This part of the works must be allowed to dry out until the tolerance as specified in sub-clause 6.2 of SABS 1200D is reached. The material should then, at the cost of the Contractor, be scarified, re-stabilised, re-compacted and re-shaped.

**Curing**

Except during wet weather the stabilised layer should within the first 7 days after completion, or before the material is spread out for the next layer, be protected against drying out by keeping it wet. The wetting process should be done between one hour before sunrise and one hour before sun set with intervals of two hours. The material for the next layer may not be spread out before four days after the compaction of the previous layer have elapsed.
Construction Restrictions

The stabilising agent may only be applied to a manageable area to ensure that all the processing, wetting, compaction and finishing can be completed within the applicable time set in Table 1.

TABLE 1 – TIME FOR COMPLETION OF STABILISING

<table>
<thead>
<tr>
<th>Stabilising Agent</th>
<th>Maximum time for completion after stabilising agent has come in contact with the material that must be stabilised. (8h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland cement</td>
<td>10</td>
</tr>
<tr>
<td>PBFC</td>
<td></td>
</tr>
<tr>
<td>Cement/slag</td>
<td></td>
</tr>
<tr>
<td>Cement/fly ash</td>
<td></td>
</tr>
<tr>
<td>Lime/slag</td>
<td></td>
</tr>
<tr>
<td>Lime/fly ash</td>
<td></td>
</tr>
<tr>
<td>Lime</td>
<td>48</td>
</tr>
</tbody>
</table>

No stabilising agent may be applied if the moisture content of the material that must be stabilised is more than 2% above the optimum moisture content for the compaction plant that the Contractor is intending to use.

Stabilising may not be done in wet weather or if the force of the wind can be detrimental to the stabilising work according to the judgement of the Engineer. If rain falls on the work area during the stabilising process, the Engineer can instruct that the affected parts be repaired at the cost of the Contractor.

If a lime stabilised layer does not reach the specified density, the layer may be re-compacted within 48 hours of the requirements as set out in Table 1.

REMARK:

Traffic or plant that is not used in the processing of the layers will not be allowed to move over the fresh spread layers. Only the plant that is necessary for the curing or wetting of the layers during the specified period will be allowed to move over the area.

C3.3.3.15 Pitching of Surfaces (Clause D5.2.4.4)

Stone for pitching shall be sound, tough and durable, with no stone less than 150mm in minimum dimension, except that smaller pieces may be used for filling spaces between the larger stones. All stone intended for use on any particular pitching job shall receive the prior approval of the Engineer.

Cement and sand shall comply with the requirements specified in SABS 471 and SABS 718.

The slopes to be pitched shall first be thoroughly cleaned and compacted where necessary to ensure that no subsequent settlement shall occur.

Commencing at the toe of the slope, the stone shall be laid and firmly bedded into the slope and against adjoining stones. The stones shall be laid with their longitudinal axes at right angles to the slope and with their surfaces in contact so as to break joint. The stones shall be well rammed into the bank or surface to be protected and the spaces between the stones shall be filled with cement mortar composed of 1 part cement to 3 parts sand.

Before the mortar is applied the surfaces of the stones shall be thoroughly wetted. The mortar shall be
worked into the pitching so as to ensure that all spaces or voids between the stones are completely filled with mortar and to the depth of stone pitching. The grouted pitching shall be cured for a period of not less than 4 days after grouting with wet sacking or other approved wet cover and shall not be subjected to loading until sufficient strength has been developed.

The finished surface of the pitching shall present an even, tight and neat appearance. The thickness of the pitching, measured at right angles to the surface, shall not be less than 150mm.

The unit of measurement for pitching shall be the square metre of pitching in place. The tendered price shall include for furnishing all materials excavation, trimming of areas, placing of stones, grouting and all other work necessary to complete the pitching as specified.

No extra payment shall be made for any compaction of surfaces to be pitched, nor for excavations of surfaces or for founding trenches or other excavation, which forms an integral phase of the pitching operations.

C3.3.3.16 Overhaul

No overhaul on the disposal of surplus excavated material will be applicable to the Works.

The transportation of imported material of filling material from borrow pits located by the Contractor shall be deemed to be freehaul.

C3.3.4 TOLERANCES

Position, Dimensions, Levels, etc (Clause D6.1)

The Works shall be finished to Degree of Accuracy I and the permissible deviations shall be within the limits given in Clause 6.1 of SABS 1200D for Degree of Accuracy I.

Moisture Content and Density (Clause D6.2)

Degree of Accuracy I will be applicable to the Works.

C3.3.5 TESTING

Taking and Testing of Samples

The results of all tests carried out by the contractor shall be made available to the engineer as soon as possible after the tests have been carried out. All compaction tests for his own construction quality control shall be at the expense of the contractor.

Control tests by the engineer shall be paid for separately from the provisional amount provided for this purpose.
C3.4 EARTHWORKS (PIPE TRENCHES) (SABS 1200DB)

C3.4.1 MATERIALS

C3.4.1.1 Treatment of Excavated Material (Clause DB3.7)

Where excavated material can be rendered suitable for backfilling by screening, or other treatment and where no suitable material within a freehaul distance of 0.5 km from the point of placing is available, the Engineer may require the Contractor to treat the excavated material to render the same suitable for backfilling provided that at least 60% by volume of the material is recovered after treatment. Where otherwise suitable excavated material from a trench is, in the opinion of the Engineer, contaminated due to the Contractor's method of working, the abovementioned treatment shall be carried out at the Contractor's expense.

C3.4.2 CONSTRUCTION

C3.4.2.1 Water in Trenches (Clause DB5.1.2)

Water in pipe trenches may cause movement of the pipes due to flotation and backfilling must therefore be carried out as soon as possible. Should movement of pipes occur the Contractor shall, unless otherwise directed by the Engineer, remove the pipes from the trench and relay the same, in accordance with the Specification, all at his own expense.

C3.4.2.2 Minimum Trench Base Width (Clause DB5.2)

Bedding is required for pipes of external diameter less than 125 mm and the minimum trench base width for pipes smaller than 125mm, and laid at a depth not exceeding 1.5 m, shall be 600 mm.

C3.4.2.3 Over excavation of Trenches (Clause DB5.5)

Where pipe trenches are excavated by the Contractor to depths in excess of those specified, directed or indicated on the Drawings, such over excavation shall be backfilled with suitable approved selected material in layers not exceeding 150 mm uncompacted thickness and compacted to the density of the adjacent undisturbed material or as directed by the Engineer.

Where the Engineer deems this method of backfilling inadequate he may require the over excavation, or parts thereof, to be filled with mass concrete of the grade as directed.

All backfilling of over excavation shall be at the Contractor's expense.

C3.4.2.4 Backfilling (Clause DB5.6)

The requirements of Clause C3.13.1.1 shall also apply.

Surplus excavated material, which complies with the requirements of Clause 3.2.1 of SABS 1200D, shall be used as compacted backfill material under the paving included in the Works.

Excavated material which does not comply with the above requirements shall be carted off Site and dumped at the Contractor's discretion.

C3.4.2.5 Compaction (Clause DB5.7)

Pipe trenches shall be backfilled and compacted to 95% Mod AASHTO maximum density up to the final finished ground level or underside of sub-base level, as the case may be. No waste material shall be left on Site.
C3.4.2.6 Reinstatement of Paved Areas (Clause DB5.9.5.1)

Where trenches are to be excavated through existing concrete paved areas which are to be reinstated, the existing concrete shall be neatly saw cut. The saw cut joints shall be so spaced to allow for the specified width of the trench excavation to be carried out. Due care shall be taken during excavation, and any subsequent operations, to avoid any damage to the paved areas which remain.

After backfilling of the trench is completed, the concrete paving shall be reinstated. The thickness of the concrete paving shall be identical to that of the existing and the surface finish shall match the texture of the surrounding existing concrete surface.

C3.4.2.7 Excavation in all Materials for Pipes (Clause DB5.4)

Trench excavation for the sewer pipeline shall be conducted by hand methods as not to damage any existing services or structures and shall include the complete excavation of the trench including the exposure of the connection point at existing services. Material from trench excavation shall be treated if necessary and re-used as backfill material which shall be compacted as stated in the Schedule of Quantities.

Any damage to existing structures or services shall be the responsibility of the Contractor and shall be fixed to the satisfaction of the Engineer and paid for by the Contractor himself.

C3.4.2.8 Protection and Support of Existing Structures and Services (New Clause)

Any structures or services in the way of trench excavations shall only be moved with written authorization from Engineer. Excavation shall take place where possible around these and shall be carefully done so as not to cause any damage to the structures or services and they shall be so supported that the new services can be installed without any damage / removal of / to the existing structure and services. The Contractor shall be held responsible for any damage to existing services and structures.

C3.4.3 TESTING

Testing (Clause DB7.1)

All compaction tests for his own construction quality control shall be at the expense of the Contractor.

Control tests by the Engineer shall be paid for separately from the Provisional Amount provided for this purpose.
C3.5 EARTHWORKS (ROADS, SUBGRADE)

C3.5.1 SCOPE

C3.5.1.1 Gravel Road Surfaces (Clause DM1.1)

The construction of gravel road surfaces shall be set out under SABS 1200ME.

C3.5.2 MATERIALS

C3.5.2.1 Fill and selected layer (Clause DM3.2.2 and DM3.2.3)

The material used for filling and in the selected layer shall comply with the requirements of the material classification specified on the drawings.

C3.5.3 CONSTRUCTION

C3.5.3.1 Safety and Traffic Control (Clause D5.1.1 and D5.1.6)

The Contractor shall control the access by the general public to the Site in collaboration with and as approved by the Engineer. No unauthorized persons may enter the construction area.

Where trenches cross roads, the Contractor shall so arrange his work that at least one free flowing traffic lane is available at all times and he shall direct traffic at such points until the full roadway has been reinstated. No excavations across roads shall be left open at night and access to private property shall be maintained at all times.

C3.5.3.2 Backfilling of Overexcavations (Clause DM5.2.2.2)

The material used for backfilling of overexcavations shall comply to the requirements of the selected layer as per Clause c3.5.2.1 and shall be compacted to 93% Modified AASHTO maximum density for material other than sand and to 100% density for sand.

C3.5.3.3 Preparation and Compaction of Road-bed (Clause DM5.2.3.3)

Any portion of the road-bed that lies within the selected layer and that is, in the opinion of the Engineer, suitable for use in place shall be scarified to a depth of 150mm and compacted to 90% Modified AASHTO maximum density.

C3.5.3.4 Placing and Compaction (Clause DM5.2.4.2 and 5.2.5)

The side slopes of cuts and fill as well as cambers, shall be as shown on the Drawings or as directed by the Engineer. Fill material placed behind kerbs and next to road formation must be compacted at 93% mod. AASHTO max. density.

C3.5.3.5 Finishing (Clause DM5.2.4.3)

The side slopes of cuts and fill as well as cambers, shall be as shown on the Drawings or as directed by the Engineer.

The surface of the selected layer be free of potholes, corrugations, ruts, loose patches or other
imperfections before subsequent layers are placed.

No topsoiling or grassing required.

**C3.5.3.6 Selected Layer (Clause DM5.2.5)**

The selected layer shall consist of imported material.

The compaction and thickness of the selected layers, after compaction, shall be as indicated on the Drawings.

**C3.5.3.7 Stabilization (Clause DM5.2.7)**

No stabilization is required for the selected layer.

**C3.5.3.8 Freehaul (Clause DM5.2.8.1)**

All movement of cut and fill materials will be regarded as freehaul.
C3.6 CONCRETE (STRUCTURAL) (SABS 1200 G)

C3.6.1 MATERIALS

C3.6.1.1 Cement (Clause G3.2)

Only Ordinary Portland Cement shall be used in the Works, unless otherwise indicated or directed by the Engineer.

Cement shall not be older than 12 weeks before being used.

C3.6.1.2 Aggregates (Clause G3.4)

The use of plums in concrete work will not be permitted.

C3.6.1.3 Admixtures (Clause G3.5)

a. Admixtures may be used subject to the following conditions :-

b. All information regarding the admixtures to be used is to provided in terms of Sub-clause G3.5.1.

c. The beneficial results to be expected from the use of the admixture shall be clearly stated.

a. Proof is submitted that these results will be obtained with the particular concrete in the Works under the conditions expected on the Works.

d. The use of the admixture shall not adversely affect the durability or any other property of the concrete.

e. The admixture shall conform with the applicable A.S.T.M. or other relevant specification.

f. The admixture shall be used in strict conformity with the manufacturers instructions.

C3.6.1.4 Air-entraining Agents (Clause G3.5.2)

The use of air-entraining agents shall not be permitted.

C3.6.1.5 Joint Fillers and Sealers (New Clause)

Joint filling material to contraction joints in the water retaining structures shall be 15 mm thick closed cell high density polyethylene joint filler

Joint filling material to isolation joints in surface beds shall be 10 mm thick closed cell high density joint filler.

Joint filling material to saw cut joints in surface beds shall be 12 x 12 mm closed-cell polyethylene joint sealant back-up cord.

Joint sealing material to contraction joints in the water retaining structures shall be 15 x 15 mm polysulphide sealant and shall be applied in accordance with the manufacturer's requirements and to the approval of the Engineer.

Joint sealing material to isolation and sawcut joints in surface beds shall be polysulphide sealant and shall be applied in accordance with the manufacturer's requirements and to the approval of the Engineer.
An approved separator shall be provided between the joint filling and sealing materials in all joints to avoid bonding of the joint filling and sealing materials.

C3.6.1.6 ondbreaker (New Clause)

Material for the debonding of adjacent concrete elements shall be "Ravenol" bituminous paint or equal approved material.

C3.6.1.7 rout (New Clause)

All grouting must be carried out using a pre-packaged non shrink cement based product which is chloride-free.

C3.6.2 PLANT

C3.6.2.1 Formwork (Clause G4.5)

Formwork shall be provided for all concrete surfaces sloping more than 30° with the horizontal, unless otherwise approved or directed by the Engineer.

Wire connectors through concrete shall not be allowed. All ferrules or other fastening devices shall present a neat, uniform and tidy pattern.

All holes created by the removal of shutter fixing devices shall be thoroughly grouted with sand/cement grout of the same colour as the surrounding concrete. The ratio of cement to sand in the grout shall be the same as that used in the concrete. The concrete surface at the holes shall be made flush and neat to the satisfaction of the Engineer. In underground or water retaining structures, the grouting operation shall render the structure watertight.

All exposed corners of concrete structures shall be splayed with 20 mm x 20 mm fillets unless otherwise indicated or directed by the Engineer. No sharp corners will be allowed.

The use of old, buckled, twisted or otherwise damaged steel or timber shutters on off-shutter concrete will not be permitted and all formwork shall be approved by the Engineer before concreting is commenced.

Should the soil conditions on site not be suitable for the casting of footings and foundations against excavated faces, the Engineer shall instruct the Contractor to utilise rough vertical formwork.

If requested by the Engineer, the Contractor shall submit to the Engineer the design and details of the formwork for approval before any work is commenced.

C3.6.3 CONSTRUCTION

C3.6.3.1 Reinforcement (Clause G5.1)

Welding of reinforcement will not be permitted.

C3.6.3.2 Formwork (Clause G5.2)

The finish to concrete where smooth formwork is specified shall be to Grade I Degree of Accuracy as defined in Clause 6 and shall be rubbed down with carborundum blocks at a time approved by the Engineer.
Concrete used in the Works, shall be strength concrete of the following grades:

<table>
<thead>
<tr>
<th>GRADE</th>
<th>SPECIFIED 28 DAY COMPR STRENGTH MPa</th>
<th>NOMINAL AGGREGATE SIZE mm</th>
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<tbody>
<tr>
<td>40/20</td>
<td>40</td>
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</table>

The grades of concrete to be utilised in various parts of the Works shall be as indicated on the Drawings or as directed by the Engineer.

All mix proportions for strength concrete shall be subject to the approval of the Engineer, but such approval shall not relieve the Contractor of his responsibilities in terms of the Contract. The proposed mix designs shall be submitted to the Engineer prior to the commencement of concreting operations.

Changes in plant, aggregate or mix proportions shall only be made with the prior approval of the Engineer.

Unless otherwise specifically agreed to by the Engineer in writing, all concrete shall be produced at the site of construction. If the use of ready mixed concrete is allowed, such concrete shall be in accordance with the requirements of the Specifications.

Unless otherwise indicated or directed by the Engineer, all foundation surfaces, excluding surface beds and brickwall foundations, shall be covered with a blinding layer before reinforcement is placed, in accordance with the details shown on the Drawings or as indicated by the Engineer. All foundation surfaces shall be inspected and approved by the Engineer before blinding layers or other concrete is placed. All shuttering and fixed reinforcement must also be inspected and approved by the Engineer before concreting.

At least 48 hours notice is required by the Engineer in respect of all such inspections.

The use of curing compounds shall be subject to the prior approval of the Engineer.

Construction joints shall only be allowed at positions indicated on the Drawings or approved by the Engineer. Where construction joints are unavoidable, suspended slabs shall be stopped off at 45° adjacent to and past columns. Walls shall be stopped off at right angles.

The Contractor shall prepare two trial mixes for each grade of concrete specified in the Works no later than 1 month prior to the commencement of casting of concrete on the Works. The aggregates and plant, as erected and approved on the Site, shall be utilised for this purpose. The Contractor shall make and test six 150 mm concrete cubes for each of the trial mixes. Three cubes of each trial mix shall be tested at 7 days and the remaining three tested at 28 days.

Concrete Surfaces (Clause G5.5.10)

Except where otherwise specified or indicated, all exposed unshuttered concrete surfaces shall, immediately after placing of the concrete, be levelled and shall be floated after the surface has set sufficiently. Floating shall be performed in one direction and float marks shall be parallel and of good appearance. Under no circumstances must it be relied upon to finish-off the exposed unshuttered concrete surfaces with a separate cement-sand screed.
Where a wood floated concrete surface is shown on the Drawings or directed by the Engineer, hand floating of the surface shall first be completed and after the hand floated surface has hardened sufficiently, wood floating shall be performed to produce a dense, uniform surface free of any marks.

Where a steel floated concrete surface is shown on the Drawings or directed by the Engineer, hand floating of the surface shall first be completed and after the hand floated surface has hardened sufficiently, power floating shall be performed to produce a dense, uniform surface free of any marks.

**C3.6.3.5 Joint Fillers and Sealers (New Clause)**

All joint fillers and sealers shall be installed in accordance with the manufacturer’s requirements, to the approval of the Engineer. The joint sealer shall be applied to form a homogenous unit without discontinuities or openings and shall be finished to a neat level surface and aligning with the faces of the joints.

**C3.6.4 TOLERANCES**

**C3.6.4.1 General (Clause G6.1.1)**

The Contractor shall construct all exposed shutter finish concrete surfaces to Degree of Accuracy I. All other Concrete Works shall be constructed to Degree of Accuracy II.

The Contractor shall remedy or remove and replace at his own expense, all concrete work which does not satisfy the prescribed tolerances, as directed or approved by the Engineer.

**C3.6.5 TESTS**

**C3.6.5.1 Testing (Clause G7.2)**

The Contractor shall be responsible for testing of cubes at approved laboratories for his own construction quality control, at his own expense, and he shall mould and cure the same.

Control tests by the Engineer shall be paid for separately from the Provisional Amount provided for this purpose.

The Engineer shall require six concrete test cubes for each individual concreting operation. Three of these cubes shall be tested at 7 days and three at 28 days.

Should 7 day strengths be obtained at any stage, which indicate, in the opinion of the Engineer, that the specified characteristic strength will not be achieved, the Engineer may stop concreting operations until 28 day strengths of such concrete are available, without compensation for losses or delays.

**C3.6.5.2 Testing of Water Retaining Structures (New Clause)**

On completion of the water retaining structures, the same shall be thoroughly cleaned by removing all rubble, stones, etc. The structures shall then be hosed down thoroughly with clear water from a high velocity nozzle and the cleaning operation shall be carried out in such a manner that all undesirable matter is removed through the drainage outlet. No stones and the like shall be flushed into the drainage outlet.

After cleaning of the structure, it shall be filled with water and shall be kept full for at least 24 hours. Water shall be added, if required. During this period the Engineer shall inspect the structure, in the presence of the Contractor, for any visible signs of leakage or other defects. After the said period has lapsed, the water level shall be recorded. Further level readings shall then be taken every 24 hours for a period of three days. The structure will be considered to be watertight if the water loss from the structure during this period does not exceed the evaporation loss.
Where required by the Engineer, the Contractor shall search for and shall be responsible for repairing any leaks or other defects to the satisfaction of the Engineer and all costs in connection therewith shall be borne by the Contractor.
C3.7 STRUCTURAL STEELWORK (SABS 1200 H)

C3.7.1 MATERIALS

C3.7.1.1 Structural Steel (Clause H3.1)
All steel used for the fabrication of structural steel components shall comply with the requirements of SABS 1431 for Grade 300WA steel unless otherwise stated.

C3.7.1.2 Welding Consumables (Clause H3.5)
General purpose electrodes, complying with SABS 455, shall be used for welding, unless otherwise agreed to by the Engineer in writing. All fillet weld sizes indicated relate to the weld throat thickness.

C3.7.2 CONSTRUCTION

C3.7.2.1 Design Drawings (Clause H5.1.1)
The Engineer shall provide the Contractor with drawings indicating the general arrangement of the structure including the structural sizing and connections. The drawings shall be sufficient for the design of all connections. Should the Contractor become aware of any discrepancies concerning the dimensions on drawings, these must immediately be drawn to the Engineer's attention. Before any shop details or fabrication is commenced, the Contractor shall check the dimensions on Site, in particular where any new structure extends from any existing structure or where new profiles are to be added to existing members. Again, should any discrepancies exist between the dimensions on the drawings and those pertaining to the existing structures on Site, these discrepancies shall immediately be brought to the Engineer's attention before the commencement of shop details in order to finalise the dimensions of the new structure.

C3.7.2.2 Contractor Provides Shop Details (Clause H5.1.2)
The making of the shop drawings shall not be sublet without the permission of the Engineer. These drawings shall give all the necessary information for the fabrication, erection and corrosion protection of the structure and shall be in accordance with SABS 0162-1-1993 - The Structural Use of Steel.

C3.7.2.3 Fabrication (Clause H5.2)
The Grade of structural steel shall remain positively identifiable at all stages of fabrication.
All cladding rails, purlins and crane beams shall be fabricated in sections continuous over two spans.

C3.7.2.4 Cutting (Clause H5.2.3)
The edges of flame cut plates shall be dressed to remove notches.

C3.7.2.5 Holes for Fasteners (Clause H5.2.4)
The punching of holes is not acceptable and all holes shall be drilled.
All new holes required for fasteners in the existing elements shall be drilled. Under no circumstances will flame cutting of holes be allowed.

C3.7.2.6 Welding (Clause H5.3.4)
All welding shall be carried out in accordance with BS5135 and SABS 044, Parts I, II, and III (Chapter 1). Where the BS and SABS Specifications are contradictory, the SABS Clause shall apply.
Field welding shall be carried out with a direct current welding machine and shall only be allowed for secondary structural elements.

For all important welds the Contractor shall compile welding procedures, prepare samples and have welding procedure tests carried out by the SABS, in accordance with SABS044 - Part III (Chapter 1), all at his own expense.

Surfaces to be welded shall be free of filings, rust, grease, paint and other materials which may be detrimental to the quality of the weld. Mill scale which cannot be removed by brushing may remain on the metal.

Elements shall remain in alignment and be free of warps and bends on completion of the welding and all weld splash shall be removed.

The welders shall be coded for these particular Works in accordance with SABS 044 - Part IV.

C3.7.2.7 Setting-Out (Clause H5.4)

The Contractor shall check the positions and levels of all existing components of the existing structures within one week of the Site being made available for the erection of the structural steelwork, and he shall ensure that the erection of the new steelwork may take place without any difficulty and problems.

In addition to the above, the requirements of Clause PSH2.1 shall be strictly adhered to.

The accuracy of all anchor bolts in individual foundations shall be such that they may be adjusted to their correct positions within the space of the recesses provided in the stub columns.

The levels of the stub columns and the positions and levels of anchor bolts shall be within the tolerances set out in C3.9.4 of this Specification.

The Contractor shall check the levels, positions and dimensions of all existing bolt holes in the existing structure where the new steelwork is to connect to the existing structure. This shall be done as soon as possible after the Site has been made available to the Contractor for construction.

C3.7.3 TOLERANCES

C3.7.3.1 Other Tolerances (Clause H6.2.2)

Grade II Degree of Accuracy shall apply and the overall fabrication and assembly tolerance shall be ± 2 mm in line and level.

C3.7.4 TESTING

C3.7.4.1 Testing of Welds (Clause H7.3)

The SABS shall act in conjunction with the Engineer as the inspection authority in accordance with SABS 044 Part III with regard to weld tests and inspections. The Contractor shall lodge an order with the SABS for the testing of welds at the Engineer’s request only, as soon as he is instructed by the Engineer to do so. All inspection slips issued by the SABS shall be forwarded to the Engineer.
C3.8 CLADDING AND SHEETING (SABS 1200 HB)

C3.8.1 MATERIALS

C3.8.1.1 Thickness of Sheeting (Clause HB3.1)

New roof sheeting and side cladding shall be galvanized steel box ribbed sheeting with a nominal thickness of 0.6mm. Flashings shall be of similar materials with a nominal thickness of 0.6mm.

C3.8.1.2 Steel Sheeting (Clause HB3.2)

Roof sheeting and side cladding shall be box-ribbed sheeting.

C3.8.1.3 GRP Laminated Sheeting

GRP laminated sheeting shall be of box ribbed profile with a light transmission factor of 40% and a nominal mass per unit area of 2.40kg/m². Surface protection shall be applied to the external face. All fixings shall be accommodated on or within the narrow flutes.

C3.8.1.4 Fasteners (Clause HB3.7)

Fasteners are to be fully specified in Schedule No 5 -Technical Data. The fixing of items is to be carried out in accordance with the Manufacturer's requirements.

C3.8.1.5 Rainwater Goods (Clause HB3.8)

Rainwater downpipes shall be fabricated in galvanized steel sheet of 0.8 mm nominal thickness with G275 spelter.

The external faces of downpipes and gutters shall be treated with Plascon GIC Galvanized Iron Cleaner and coated with Plascon High Sheen Acrylic RP series finishing coat with a dry film thickness 60 micron or approved equivalent. The colour of the finishing coat shall be in accordance with the Engineer's instructions.

C3.8.2 CONSTRUCTION

C3.8.2.1 Installation of Sheeting (Clause HB5.5)

All sheeting shall be erected and fixed in accordance with Manufacturer's requirements.

The roof sheeting shall be laid with one corrugation side lap, narrow flutes outermost. All fixings shall be accommodated on the narrow flutes.

The side cladding shall be laid with one corrugation side lap, broad flutes outermost. All fixings shall be accommodated within the narrow flutes.

End laps to roof sheeting shall not be less than 300 mm and to side cladding not less than 150 mm.

C3.8.3 TOLERANCES

C3.8.3.1 Sheeting and Cladding (Clause HB6.2.2)

The allowable misalignment of end and side laps, roof edges, at gutters and the extremities of roofs, and gables shall be ± 5mm at any point on a straight edge of 3m length. There shall be no instantaneous change in alignment in excess of ± 1 mm, eg. at laps.

The allowable misalignment of all flashings and fascias shall be ± 5 mm.
C3.9 CORROSION PROTECTION OF STRUCTURAL STEELWORK (SABS 1200 HC)

C3.9.1 CONSTRUCTION

C3.9.1.1 General (Clause HC5.4.1)

All steelwork surfaces shall be prepared by hand or power tool cleaning at the fabricator’s shop.

C3.9.1.2 Cleaning by Hand or with Power Tools (Clause HC5.4.3.2)

The Standard of hand or power tool cleaning shall be Grade St 2 in accordance with the Swedish Standard SIS 05 59 00 -1967.

C3.9.1.3 Coating System (Clause HC5.7)

One coat of zinc phosphate primer shall be applied as soon as possible after the surface preparation of the steelwork. The primer shall comply with the requirements of SABS 1319. The minimum dry film thickness of the coat shall be 30 micron. Any damage to the prime coat during handling or erection shall be repaired and any rust and undesirable material removed and the damaged portions repainted to the prescribed film thickness. The primer shall be applied in the fabricator’s shop to elements not requiring on-Site welding and on the Site, after erection, to members welded on-Site.

After erection of new structural steelwork, two coats of alkyd base resin paint for structural steelwork, complying with the requirements of SABS 684 Type B, shall be applied in accordance with the manufacturer’s recommendations. Each coat shall have a minimum dry film thickness of 30 micron. The paint colour shall match that of the existing structural steelwork.

All existing structural steelwork to which new profiles have been attached by welding shall be cleaned by hand brushing to a sound base, primed as above and coated with one coat of alkyd base resin paint for structural steelwork, complying with the requirements of SABS 684 Type B. This coat shall have a dry film thickness of 30 micron.

C3.9.1.4 Application of Paint Coatings (Clause HC5.8)

Stripe coating shall be applied to all metal edges, upstands, welds, bolts and nuts after initial priming.

Steelwork embedded in concrete shall be coated with the full specified coating systems for the full depth of the embedment. In the case of surface beds, the steelwork shall be treated with one additional finishing coat for the total depth of the embedment plus 150 mm above the finished surface bed level.

All fasteners embedded in concrete shall be coated with the full specified coating systems.

Friction-grip areas shall remain untreated after the initial cleaning of the steel surfaces. After installation of the bolts, the exposed areas shall be re-cleaned by hand or power tools and coated with the full specified coating system.

C3.9.1.5 Paint Coating to Re-used Profiles

All existing structural steel profiles which are re-used, and which can be moved to the fabricator’s shop, shall be cleaned in accordance with Clause C3.12.1.2 and shall receive the full coating system specified in Clause C3.12.1.3.
C3.9.2 TESTING

Testing by the Contractor (Clause HC7.1)

The tests, as specified in Clause HC7.3, shall be carried out after the application of each intermediate coat.
C3.10 MEDIUM-PRESSURE PIPELINE (SABS 1200 L)

C3.10.1 SCOPE

This specification covers steel, uPVC and HDPE pipes and accessories with a working pressure as shown on Drawings.

C3.10.2 INTERPRETATIONS

C3.10.2.1 Abbreviations (Clause L2.4)

uPVC : Unplasticised Polyonyl Chloride
FC : Fiber cement.
HDPE : High Density Polyethylene

C3.10.3 MATERIALS

C3.10.3.1 General (Clause L3.1)

The Contractor shall be fully responsible for transporting pipes, valves, specials and fittings to the point of installation, in good condition. Approved end-caps shall be provided for pipes. All materials such as rubber rings and the like must be protected against direct sunlight. Any material which, in the opinion of the Engineer, is damaged in any way shall be removed from Site without delay.

uPVC pipes shall be stored under cover and shall be suitably stacked and supported to prevent deflection or deformation.

C3.10.3.2 Steel Pipes (Clause L3.4)

All steel pipes of diameter smaller than 150 mm diameter shall be of medium class galvanised, in accordance with SABS 62, with threaded ends and couplings, unless otherwise indicated.

All steel pipes 150 mm diameter and larger shall comply with the requirements of Grade X42 pipes in accordance with API 5L, with flexible couplings, flanged or continuous welded steel. Wall thickness varies from 10mm to 4.5mm as indicated in the Schedule of Quantities.

All pipes and fittings, which are cast into water retaining structures, shall be provided with puddle flanges with a minimum thickness of 15mm for pipes greater than 150 mm diameter and 6 mm for pipes of 150 mm diameter and smaller. The puddle flanges shall also act as an anchor flange. These flanges to pipe connections shall be continuously welded to transmit the full load and for water tightness. These flanges shall be at least 75 mm wide.

Adapter couplings shall be used.

C3.10.3.3 Steel Pipe Fittings and Couplings

Unless otherwise indicated on the Drawings, all galvanised steel pipes smaller than 150mm diameter shall be connected by threaded sockets. Pipes from 150mm diameter up, to be connected with flanges or flexible couplings. The sockets, flanges and fittings shall be of approved make and shall be suitable to sustain the specified test pressure.

Exposed threaded sections at pipe connections, where galvanising has been removed by threading, shall be treated with an approved cold galvanising preparation after installation on Site.

Scour Tees must be flanged with a flanged branch as indicated on the drawing. The invert level of the branch must be the same as the pipe. Flange drilling must be according to the pressure rating of the pipe.
Air Valve Tees must be flanged with an equal Tee flanged branch, 300mm long. Flange drilling must be according to the pressure rating of the pipe.

All bends shall be long radius bends with 500 mm extension pieces both sides.

**C3.10.3.4 uPVC Pipes, Fittings and Specials (Clause L3.7.1)**

All uPVC pipes shall comply with the requirements of SABS 966.

Fittings and specials for uPVC pipes shall be either of uPVC or cast iron construction with spigot and socket rubber ring joints and suitable to withstand the working pressure specified for the pipes.

All bends shall be long radius bends, unless otherwise indicated on the Drawings.

uPVC Pipes shall be suitable for a working pressure of 9 bar.

**C3.10.3.5 HDPE Pipes (Clause L3.7.2)**

HDPE Pipe (class 10) to be used and shall comply with the requirements as stipulated in SABS 533 Part II. Pipe fittings and couplings shall be o-ring screw type compression fittings in accordance with the requirements of SABS 533.

**C3.10.3.6 Loose Flanges (Clause L3.8.4)**

Bolts and nuts shall be in accordance with SABS 136 unless otherwise approved by the Engineer.

**C3.10.3.7 Corrosion Protection (Clause L3.9)**

Galvanized steel pipes and fittings shall be galvanised by the hot-dip process. All galvanized steel pipes in the ground must be wrapped with dense tape or similar approved.

All cast-iron specials and couplings shall be painted with one coat of approved bituminous paint before delivery to Site and exposed parts shall receive a further coat of similar paint after installation of Site. The protection as mentioned above must suit the existing on site.

All steel pipes (where not galvanized) and fittings shall be treated against corrosion with an epoxy coating on the inside as specified in SABS 1200L to a minimum thickness of 250 micrometer. On the outside the pipe, where not encased in concrete, must be wrapped with a double layer of bitumen-impregnated glass fibre complying with the requirements for Type 1 of SABS 1130 to form a coating of average thickness 5 mm and of minimum 4,5 mm, on completion of the coating. At pipe ends and flexible couplings an anti-corrosion tape such as Denso tape or similar approved must be applied in accordance with the supplier’s specifications. Steel pipes encased in concrete must be treated on the outside with one coat of zinc phosphate primer. The primer shall comply with the requirements of SABS1319 with a minimum dry film thickness of 30 micron.

**C3.10.3.8 Protection of Bolts, Nuts and Washers (Clause L3.9.5)**

Bolts, nuts and washers shall be zinc coated by the hot-dipped process.

**C3.10.3.9 Corrosive Soil (Clause L3.9.6)**

No special corrosive protection shall be required for this purpose.
C3.10.3.10  Valves

**Gate Valves (New Clause)**

All gate valves shall be suitable for a working pressure as indicated on Drawings. All gate valves of 75 mm diameter and larger shall be of SG iron construction with gunmetal fittings and rising stainless steel spindles. The valves shall be supplied with standard SG iron valve caps or hand wheels as shown on the drawings or specified by the Engineer and shall be closed clockwise with the direction of closing permanently indicated on the caps and hand wheels.

Valves must be suitable for closing and opening at unbalanced pressures equal to the specified working pressure and where specified or shown on the drawings valves should be equipped with approved 1:3 reduction gearboxes.

All valves shall comply with the requirements of SABS 664.

All valves shall be supplied complete with packings, bolts and nuts. Flanges must be in accordance with pipe flanges as specified.

Valves of diameter less than 75 mm diameter shall be approved, screwed, ball type isolating valves suitable for the working pressure as specified for adjacent pipes.

All SG-iron valves shall be thoroughly cleaned after testing at the factory and shall be treated with two coats of epoxy or other approved paint. After installation of the valves on Site, they shall be treated externally with a further coat of epoxy.

**Air Valves (New Clause)**

The air release valves shall be suitable for a working pressure as indicated on Drawings and shall have flanged or screwed inlets as specified and shall incorporate an integral shut down valve and shall be of the following types, as specified:

(a) **Type I**: Conventional kinetic double orifice air valves:

These are required for the release of larger volumes of air during the filling of pipelines and the admission of air at low pressure during draining or scouring and for the admission of large quantities of air to prevent the formation of vacuum in flexible wall pipelines during the break of or negative pressure induced by water hammer/separation. A small orifice must be included for the release of entrained air under normal pipeline operation. The large orifice of the valve shall not close dynamically before all the air is discharged from the pipeline.

(b) **Type III**: Single small orifice air valves:

These are for the release of small volumes of air during operation of the pipeline. It shall be of the cylindrical barrel type incorporating a cylindrical float mechanism and must have either screwed or flanged inlets as specified.

**General Requirements**

The size of the valve/outlet shall be the diameter of the inlet branch and the air valves shall be mounted on a isolating valve with a pressure rating similar to that of the air valve.

12 mm Cast steel needle valves or chrome plated brass P T F E seated ball valves shall be fitted to drain valve bodies when isolated from the pipeline and for the attachment of pressure gauges to valve bodies.

The pressure rating of these valves shall be the same as for the air valve it is attached to.
Valves shall not exhibit leaks or weeping of liquid past the seal at operating pressure of 0.3 bar to twice rated pressure.

Valve design shall incorporate an over pressure safety feature that will fail without an explosive effect, such as is normally the case when highly compressed air is suddenly released. The control floats shall not distort when subjected to closed end tests for material strength and soundness, nor shall they be damaged by the possible corrosive effects of the water, not under any condition of frequent operation.

All air valves shall be provided with a separate isolating valve as indicated on the Drawings which is coupled to the air valve in such a manner to allow the removal of the air valve without removing the isolating valve.

All air valves shall be able to operate at the specified working pressures and flange drilling must be in accordance with the specified working pressure to BS4504.

All air valves shall be mounted on a steel extension pipe, which varies in length, according to the pipeline depth. For Tender purposes a length of 500 mm shall be assumed.

The inlet diameters of air valves shall be 25 mm for single air valves and 50 or 80 mm, as specified or shown on the Drawings, for double air valves.

**Level Control Valves (New Clause)**

Level control valves shall be suitable for a working pressure as indicated on Drawings and shall open wide when the water level drops below a specific level and shall gradually close as the water level rises, closing fully at the full supply level. The friction loss in the valve shall not exceed 2 m.

The level control valves shall be of steel or cast-iron construction and shall be protected against corrosion as specified for gate valves.

**Non-Return Valves (New Clause)**

Non-return valves shall be suitable for a working pressure as indicated on Drawings. All metal components shall be protected against corrosion as specified for gate valves.

**Butterfly Valves**

Butterfly valves shall be S.M.S or equally approved double offset design. The valve gearbox shall be of an approved design, enabling the valve to be operated against the working pressure at a full differential pressure. The valve will be droplet from both directions. The valve disc shall have a stainless steel retaining ring securing a NBR moulded continuous ring of the R-configuration. Seals which are glued shall not be acceptable. The retaining ring shall have stainless steel cap screws for adjustment of seal, as well as leveling grub screws to ensure that the retaining ring is parallel at all times. The body seat will be weld deposit stainless steel machined.

The valve will be coated internally and externally as specified for gate valves. Pressure test and material certificates must be provided.

**C3.10.3.11 Manholes and Surface Boxes**

Manholes, surface boxes and the like shall be constructed of the materials as shown on the Drawings and not as shown on the Figures contained in SABS 1200L.
C3.10.3.12 Electrolytic Corrosion (Clause L3.9.3)

Protection against electrolytic corrosion is required. The steel pipeline must be electrically continuous over its entire length. All pipes with joints must be bridged using a 16mm copper wire and welded to both pipe ends, as well as the coupling.

C3.10.4 PLANT

C3.10.4.1 Transportation and Storing (Clause L4.1)

The Contractor shall be fully responsible for transporting pipes, valves, specials and fitting to the point of installation, in good condition. Approved end-caps shall be provided for pipes. All materials such as rubber rings and the like must be protected against direct sunlight. Any material which, in the opinion of the Engineer, is damaged in any way shall be removed from Site without delay.

uPVC pipes shall be stored under cover and shall be suitable stacked and supported to prevent deflection or deformation.

C3.10.5 CONSTRUCTION

C3.10.5.1 Depth and Cover (Clause L5.1.4)

The depths of pipes below ground level shall be as indicated on the Drawings.

C3.10.5.2 Valve Chambers (Clause L5.6)

Valve chambers shall be constructed in accordance with the details shown on the Drawings and not as shown on the Figures contained in SABS 1200L.

C3.10.5.3 Manholes (Clause L5.7)

Manholes shall be constructed in accordance with the details shown on the Drawings and not as shown on the Figures contained in SABS 1200L.

C3.10.6 TESTING

C3.10.6.1 Radiographic Examination (Clause L7.2.2)

No radiographic examination is required.

C3.10.6.2 Test Pressures (Clause L7.3.1)

The test section shall be subject to a pressures test, at pressures not less than 75% and not exceeding 100% of the appropriate allowable maximum working pressure for the class of pipes, for the highest and lowest point respectively of the section being tested. This pressure shall be obtained by continuous pumping so as to ensure a gradual increase of pressure until the specified value is obtained.

C3.10.6.3 Final Inspection of Pipelines and other Items of Equipment (New Clause)

After the entire piping system has been laid and all parts thereof have been tested to the satisfaction of the Engineer and backfilled, the system will be put into operation and the Contractor shall inspect the same in the presence of the Engineer, to ensure that all valves and other equipment are operating satisfactorily and to check that all pipe supports, brackets and the like are capable of withstanding the loads imposed on them.

Any faults or defects which are detected during this inspection shall be repaired by the
Contractor, or where necessary, the defective parts or materials shall be replaced by the Contractor, to the satisfaction of the Engineer, all at the Contractor's expense.

All items of equipment not specifically mentioned in the Specifications, shall be inspected during the commissioning period for proper operation and to verify that these items comply with the requirements of the Specification.
C3.11 BEDDING (PIPES) (SABS 1200LB)

C3.11.1 MATERIALS

C3.11.1.1 Bedding (Clause LB3.3)

The bedding for all pipes shall be Class B bedding as indicated on the Drawings.

C3.11.1.2 Treatment of Excavated Material (Clause LB3.4)

Where excavated material can be rendered suitable for bedding by screening, washing or other treatment and where no suitable material is available within a freehaul distance of 0.5 km from the point of placing, the Engineer may require the Contractor to treat the excavated material to render the same suitable for bedding provided that at least 60% by volume of the material is recovered after treatment. Where otherwise suitable excavated material from a trench is, in the opinion of the Engineer, contaminated due to the Contractor's methods of working, the abovementioned treatment shall be carried out at the Contractor's expense.

C3.11.2 CONSTRUCTION

Concrete Encasing of Pipes (Clause LB5.4)

Where the specified cover over the pipes cannot be maintained at road crossings, at river crossings where scouring may occur or otherwise where directed, concrete encasing of pipes may be required by the Engineer.

C3.11.3 TOLERANCES

Moisture Content and Density (Clause LB6.1)

Class II degree accuracy is required.
C3.12 SEWERS (SABS 1200 LD)

C3.12.1 MATERIALS

C3.12.1.1 Pipes, Fittings and Pipe Joints (Clause LD3.1)

The pipes to be used here shall be 110mm diameter “Superlite CL41” and “Soil and Vent” uPVC pipes including all fittings and joints as manufactured by “Main Industries” or similar approved pipes including all fittings and joints to comply with SABS 1601 and SABS 967.

C3.12.1.2 Manholes, Chambers, Etc (Clause LD3.5)

Manholes, chambers and the like shall be constructed of the materials as shown on the Drawings and not as shown on the Figures contained in SABS 1200LD.

C3.12.2 CONSTRUCTION

C3.12.2.1 Alignment (Clause LD5.2.2)

The pipes shall be laid to the lines and gradients as indicated on the Drawings.

C3.12.2.2 Manholes, Chambers, etc (Clause LD5.6)

Manholes, chambers and the like shall be constructed in accordance with the details shown on the Drawings and not as shown on the Figures contained in SABS 1200LD.

C3.12.2.3 Connecting Sewers (Clause LD5.9)

Connecting sewers shall be constructed in accordance with the details shown on the Drawings. At the connection to the existing network in use the Contractor shall give written notice to the Engineer prior to connection to the existing network in use.

C3.12.3 TESTING

C3.12.3.1 Tests and Acceptance/Rejection Criteria (Clause LD7.2)

Prior to any air or water test, the interior of each pipeline section between two points of access shall be inspected throughout its length with a mirror and a source of light, so that when looking into the pipe at one point of access (with the aid of the mirror if necessary) and placing the light source at the other point of access, a full circle appears to the observer and the pipe section shall be seen to be unobstructed.

All pipeline sections, which fail to pass this test shall be cleaned, relaid or repaired and re-tested as before by the Contractor, to the satisfaction of the Engineer, all at the Contractor's expense.

C3.12.3.2 Watertightness of Manholes (Clause LD7.2.6)

The Contractor shall with completion, but before backfilling, of each manhole test for watertightness of manhole. This shall be accomplished by filling the manhole to below cover frame with water. All pipes connecting to manhole must be blocked during this test.

The manhole must be left standing for one hour so that absorption of water can take place. After the hour water must be added to original level and be left standing for one more hour. The water level may not drop more than 20mm within the hour.
The Contractor shall be responsible for removing the water, after the test, by means of an approved method.

The Engineer may at any time choose to test certain or specific manholes.
C3.13 STORMWATER DRAINAGE

C3.13.1 MATERIALS

C3.13.1.1 Culvert Units and Pipes (Clause LE3.1)

Stormwater pipes shall be Class 75D reinforced concrete pipes with Ogee (interlocking) joints, manufactured in accordance with SABS 677 type SC. Sizes and positions of pipes shall be as indicated on the Drawings.

C3.13.1.2 Skewed-End Culverts (Clause LE3.1(d))

Skew culvert ends may be cut on Site provided that a smooth and neat finish is obtained to the satisfaction of the Engineer.

C3.13.1.3 Manholes, Catchpits and Accessories (Clause LE3.4)

Manholes, catchpits, connection boxes and the like shall be constructed of the materials as shown on the Drawings and not as shown on the Figures contained in SABS 1200LE.

C3.13.2 CONSTRUCTION

C3.13.2.1 Manholes, Catchpits and Accessories (Clause LE5.5)

Manholes, catchpits, connection boxes and the like shall be constructed in accordance with the details shown on the Drawings and not as shown on the Figures contained in SABS 1200LE.
C3.14 SUBBASE (GRAVEL WEARING COURSE)

C3.14.1 MATERIALS

C3.14.1.1 Physical Properties (Clause ME3.2.1)

The regional factor as obtained from Drawing ME-2 is 0.6.

C3.14.1.2 CONSTRUCTION

C3.14.2.1 Thickness of Subbase (Gravel Wearing Course) (Clause ME5.4)

The thickness of the road subbase, after compaction, shall be as indicated on the Drawings.
C3.15  SEGMENTED PAVING

C3.15.1  MATERIALS

C3.15.1.1  Class and Type (Clause MJ3.1.2)

60 mm and 80mm segmental block paving type S-A. Colour to Architect specification.

Concrete block paving to comply with the Specifications as set out by the Concrete Masonry association, Publication ISBN-0-620-05721-2, second addition.

C3.15.1.2  Joining Sand (Clause MJ3.3)

The sand shall be free of all soluble salts or contaminants likely to cause efflorescence or staining.

C3.15.1.3  Infill Mortar

Where infill mortar is required, such mortar shall be a cement mortar having proportions of 1:3 portland cement to sand, of good quality mortar sand as per SABS 1200GA.

C3.15.2  CONSTRUCTION

C3.15.2.1  Handling and Stacking of Blocks

The Contractor shall handle, lift and stack the blocks in such a way that they do not become discoloured and are protected from damage.

C3.15.2.2  Sand Bedding (Clause MJ5.3)

An approved weed killer shall be applied before the sand bedding is placed.

C3.15.2.3  Laying of Units (Clause MJ5.4)

Concrete Blocks to be laid in herringbone pattern.

Areas requiring infilling, which exceed 25% of a full block size shall be filled with closure units of special size or cut or part units split from whole units using a mechanical or hydraulic guillotine or angle grinder. Infill areas constituting less than 25% of a full block area and of 25mm minimum dimension shall be filled with concrete. Smaller areas shall be filled with infill mortar.

C3.15.2.4  Joint Filling (Clause MJ5.7)

During the filling of the joints an approved weedkiller shall again be applied together with the sand.

C3.15.3  TOLERANCES

C3.15.3.1  Permissible Deviations and Final Surface (Clause MJ6.2)

The final surface shall present a neat appearance without rough patches, cracks, bleeding, sand deficiencies or other surface defects. The height of all drainage works and kerbing shall be adjusted accurately to the final surface.
C3.16  KERBING AND CHANNELLING

C3.16.1  MATERIALS

C3.16.1.1  Materials, Shape and Dimensions (Clause MK3)

The materials used for kerbing or channelling and the shape and dimensions thereof shall be as indicated on the Drawings.

C3.16.1.2  Expansion Joint Sealant (Clause MK3.5)

No sealant is required for kerbing.

C3.16.1.3  Bedding Material (Clause MK3.9)

The bedding material used for kerbing and channelling shall be as indicated on the Drawings.

C3.16.2  CONSTRUCTION

C3.16.2.1  Bedding (Clause MK5.1 and MK5.2)

Bedding shall be constructed to the dimensions and details as shown on the Drawings and the excavations shall allow for the placing of the bedding as indicated.

C3.16.3  TOLERANCES

C3.16.3.1  Tolerances of Kerbing, Channelling and Chutes (Clauses MK6.1 and MK6.2)

The Degree of Accuracy of II is required.

C3.16.4  TESTING

C3.16.4.1  Costs of Testing (Clause MK7.3)

All costs of preparing test specimens, testing and making good shall be borne by the Contractor irrespective of whether the test samples comply with the requirements of the Specification, or not.
C3.17  ANCILLARY ROADWORKS

C3.17.1  MATERIALS

C3.17.1.1  Road Traffic Signs and Marks

Road traffic signs and marks according to the Road traffic signs manual (1993 edition).

C3.17.2  CONSTRUCTION

C3.17.2.1  Erection of Regulatory & Danger Plates (Clause MM5.2.4)

The Contractor shall erect the road signs in positions as shown on the Drawings.

The poles must be founded in 300 x 300 x 750 deep Grade 20/20 concrete in the ground.
PART C4: SPECIAL SPECIFICATIONS

C4.1 STRUCTURAL MASONRY

C4.1.1 SCOPE

This Specification covers the materials and construction of masonry of a structural nature as well as loadbearing masonry. Reference is made to applicable SABS Standards and finishing standards and quality of materials are prescribed.

C4.1.2 MATERIALS

C4.1.2.1 Mortar

All mortar to structural masonry as well as for normal loadbearing applications, parapets, balustrades, retaining structures, and freestanding and garden walls, and other walls exposed to severe dampness shall be Class II mortar in accordance with SABS 0164 Part 1 Clause 3.4.1 with a compressive strength of 7 MPa at 28 days.

The approximate limiting proportions for Class II mortar is 0-40 litres lime and 200 litres sand, measured loose and damp, to each 50kg ordinary Portland Cement.

No admixtures or plasticizers may be used without the written approval of the Engineer.

Cement and sand for mortar shall comply with the requirements laid down for cement and sand for concrete work, but the sand shall be of a grading which is suitable for mortar.

Cement and lime shall be stored above ground in a dry, weatherproof structure such that inspection, as well as the handling of material during delivery, may take place unhindered. Cement or lime which has been exposed to dampness shall not be used in the Works.

Sand shall be stored, separately according to type, such that contamination shall not occur.

C4.1.2.2 Masonry Units

All clay masonry units shall comply with the requirements of SABS 227 with a minimum compressive strength of 17 MPa.

Calcium silicate masonry units shall comply with the requirements of SABS 285 with a minimum compressive strength of 14 MPa.

Solid cement brick masonry units shall comply with the requirements of SABS 987 with a minimum compressive strength of 14 MPa.

Concrete building block masonry units shall comply with the requirements of SABS 527 with a minimum compressive strength of 14 MPa.

All masonry units delivered to Site shall be carefully unloaded by hand or crane and shall be stored on prepared areas free of clinker, ash and sulphate bearing soils. The units shall be stored in separate stacks according to strength, or other classification, and shall be marked accordingly. The stacks shall be protected from rain and shall be so arranged to allow free circulation of air. Suitable precautions shall be taken to prevent overloading and excessive deflection prior to the placing of stacks of preformed packs of units directly onto reinforced concrete floor slabs.
C4.1.3 CONSTRUCTION

C4.1.3.1 Mortar Bedding

All masonry units shall be laid on a full bed of mortar without furrowing. Single-frogged bricks shall be laid frog uppermost and double-frogged bricks shall be laid with the deeper frog uppermost. All frogs shall be filled with mortar. All cross and collar joints (those parallel to the outside face) shall be solidly filled and the thickness of the bed shall not exceed 13 mm.

Perforated structural units, with the exception of special types such as divided joints bricks and blocks, shall be laid on a full-width mortar bed.

The mortar bed for hollow blocks units shall extend over the width and lengths of all constituent parts forming the blocks.

Perforations shall not be filled except where filling is specified by the Engineer. The Works shall be covered during rain to prevent the perforations filling with water.

C4.1.3.2 Jointing and Pointing

- General
  Mortar beds shall be finished by jointing to ensure a constant strength of mortar across the whole of the stressed bed. Where pointing is used as an alternative, care shall be taken to ensure that the strength of the mortar used matches that of the bedding mortar.

- Jointing
  The faces of the joints shall be worked to the specified profile while the mortar is still green.

- Pointing
  Where indicated on the Drawings, the face joints shall be raked out to depth not less than 13 mm and not more than 20 mm, and subsequently refined and formed to the required profile with mortar of the same mix proportions as the original bedding mortar. Under no circumstances may joints be so formed to expose any perforations in the units.

- Raked Out joints
  Joints shall not be raked out to provide a key for plastering or rendering without the written consent of the Engineer.

- Movement joints
  Movement joints shall be formed in the positions and in accordance with the details indicated on the Drawings. Care shall be taken to ensure that the gap remains free of debris when construction takes place in the specified material. On no account may the edge be pointed with mortar.

C4.1.3.3 Masonry Units

Masonry units of clay and calcium silicate having an initial rate of absorption exceeding 1.8 kg/m²/minute shall be wetted prior to laying to reduce the absorption rate to between 0.7 and 1.8 kg/m²/minute. This shall be determined in accordance with Clause 6.6 of SABS 0164 Part 1.

Cutting of masonry shall be kept to a minimum. When cutting is necessary, a bolster shall be used in preference to a trowel. When masonry units cannot be satisfactorily cut by a bolster, a carborundum wheel shall be used.
C4.1.3.4  Cavity Walls

Cavity walls shall be of the overall thickness specified and shall be formed of two leaves of masonry tied together by staggered wall ties uniformly spaced in accordance with SABS 0164:Part 1 Clause 5.2.1.4. Additional ties shall be provided within 150 mm of the edges of openings, one for each 300 mm of height. Ties shall be placed as the work proceeds and set either level or with a slight downward slope towards the outer leaf. As the wall is being built, one leaf shall not be built higher than 500 mm above the other. The cavity shall be kept clear of mortar and debris as the work proceeds by using laths. Mortar droppings reaching the base of the cavity shall be removed daily through temporary openings. After the final cleaning of the cavity, the openings shall be closed with bricks that are properly bedded and jointed.

C4.1.3.5  Non-Loadbearing walls

Brick cladding, indicated as being non-loadbearing shall, when constructed at the same time as the loadbearing wall, be finished with a layer of at least 10 mm of easily compressible material between the top of the wall and the soffit of any beam or slab. If the joint is exposed, it shall be sealed with a non hardening mastic.

C4.1.3.6  Block Bonding

Block bonding of loadbearing walls with other walls and partitions shall not be permitted without the written approval of the Engineer or as indicated on the Drawings. Vertical joints shall be installed at all such connections.

C4.1.3.7  Coursing

Coursing of masonry shall be in accordance with the Drawings. The height of walling built in a day shall not exceed 1,3 m without the prior approval of the Engineer.

C4.1.3.8  Bond

Walls shall be built in stretcher bond. Partial or cut structural units, closers, or special shapes may be used as necessary to maintain a true and regular bond with perpends correctly aligned.

C4.1.3.9  Pallet Slips

Timber pallet slips shall be used in vertical joints only and shall be treated with a preservative. Timber, and other material intended for fixing, shall not be built into walls without the written approval of the Engineer.

C4.1.3.10  Forming of Chases and Holes

Sleeves, chases, and holes shall, as far as possible, be provided during the erection of the masonry. Alternatively, purpose-made chased units shall be built-in in positions approved by the Engineer. Chasing of complete walls or the formation of holes shall be carried out only with the written approval of the Engineer and only with a tool designed to cut the units cleanly. Horizontal or diagonal chases will be subject to the Engineer's approval.

C4.1.3.11  Weather

During any interruption due to inclement weather, and at the completion of each day's bricklaying, freshly laid brickwork shall be protected by means of plastic sheets or other approved means.
C4.1.4 TOLERANCES

C4.1.4.1 General

Notwithstanding the tolerances given below, the accuracy of building shall be such as to enable other building components to be built into the masonry.

C4.1.4.2 Alignment and Levels

All load bearing masonry shall be built to the tolerances given below:

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<thead>
<tr>
<th>Length:</th>
<th>±</th>
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<tbody>
<tr>
<td>Up to and including 5m:</td>
<td>10mm</td>
</tr>
<tr>
<td>Over 5m, up to and including 10m:</td>
<td>15mm</td>
</tr>
<tr>
<td>Over 10m:</td>
<td>20mm</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Height:</th>
<th>±</th>
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<tbody>
<tr>
<td>Up to and including 3m:</td>
<td>5mm</td>
</tr>
<tr>
<td>Over 3m, up to and including 6m:</td>
<td>15mm</td>
</tr>
<tr>
<td>Over 6m:</td>
<td>20mm</td>
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<table>
<thead>
<tr>
<th>Straightness:</th>
<th>±</th>
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<tbody>
<tr>
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<tr>
<th>Verticality:</th>
<th>±</th>
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<tbody>
<tr>
<td>In any 1m (not cumulative):</td>
<td>5mm</td>
</tr>
<tr>
<td>In any 3m (not cumulative):</td>
<td>10mm</td>
</tr>
</tbody>
</table>

Load bearing masonry walls shall not deviate more than 15 mm from the vertical over their full height.

C4.1.4.3 Method of Measurement of Tolerance

Any deviation from flatness of a plane surface or any abrupt change in a continuous surface shall be measured as the maximum deviation of the surface from any straight line of length 3 m joining two points on the surface, determined by means of a straight-edge, the ends of which are supported on identical blocks of suitable thickness placed on each of the points.