RAND WATER

# FUNCTIONAL DESIGN SPECIFICATION:

# CHAMBERS

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## 1. PURPOSE

The purpose of this document is to provide guidelines and recommendations for the design and construction of Reinforced Concrete Chambers.

## 2. SCOPE

This design and construction procedure adheres to the methods and standards as set out in the SANS codes and standard specification for the design and construction of reinforced concrete structures.

## 3. APPLICABLE STANDARDIZED SPECIFICATIONS

Although not bound in or issued with this document, the following SANS 1200 Standardized Specification for Civil Engineering Construction as approved by the Council of the South African Bureau of Standards shall apply to this Contract. The Contractor shall be in possession of these Standardized Specifications and their related SANS 1200 Code of Practice which apply equally and shall keep a copy of each on site for reference by him and the Engineer for the duration of the Contract. It should be noted that the list is not exhaustive, and it remains the contractor's responsibility to equip themselves with all necessary information to undertake a sound design.

| | | |
|---|---|---|
| SANS 1200 A - 1986 | : | General |
| SANS 1200 AA – 1986 | : | General (small works) |
| SANS 1200 D - 1988 | : | Earthworks |
| SANS 1200 G - 1982 | : | Concrete (structural) |
| SANS 1200 HA - 1990 | : | Structural Steelwork (Sundry items) |

Copies of SANS 1200 Standardised Specifications are available from the South African Bureau of Standards, Private Bag X191, Pretoria, 0001.

## 4. APPLICABLE TECHNICAL SPECIFICATIONS*

| NO | DOCUMENT TITLE | DOCUMENT NUMBER |
|---|---|---|
| 1 | The structural use of concrete Part 1: Design | SANS 10100-1 |
| 2 | The structural use of concrete Part 2: Materials and execution of work | SANS 10100-2 |
| 3 | Detailing for steel reinforcement for concrete | SANS 10144 |
| 4 | Welding | SANS 10044 |

| | | |
|---|---|---|
| 5 | The general procedures and loadings to be adopted in the design of buildings | SANS 10160 |
| 6 | The design of foundations for buildings | SANS 10161 |
| 7 | The structural use of masonry Part 1: Unreinforced masonry walling | SANS 10164-1 |
| 8 | The structural use of steel | SANS 10162 PART 1 |
| 9 | Bending dimensions of scheduling of steel reinforcement for concrete | SANS 282 |
| 10 | Code of practice for design of concrete structures for retaining aqueous liquids | BS 8007 |
| 11 | Specification for flexible polyvinyl chloride waterstops | CKS 389 |
| 12 | Electrical work | SANS 10142-1 |
| 13 | General Electrical Specification for building, Lighting and Small Power Installations | RW-00320-AS-500 |

* Where applicable

## 5. DESIGN REQUIREMENTS

### 5.1.1. Design Objective

5.1.1.1. Provide a water tight reinforced concrete structure, to house, protect and anchor valves and critical pipework connections, as well as automation equipment (where applicable).

5.1.1.2. Provide construction joints at the center of the main pipe levels, thereafter at a maximum 2.4m intervals

5.1.1.3. Provide sufficient space inside chamber for valves, pipe connections, pipe or valve supports, cat ladders and steel platforms and operations staff to access valves and conduct routine maintenance.

5.1.1.3.1. The minimum space required for valves and/or pipe diameters less than an equal to 600mm is listed below:

5.1.1.3.1.1. From any boundary/wall/floor slab including the outermost part of a valve, pipes and bypasses is 600mm.

5.1.1.3.2. The minimum space required for valves and/or pipe diameters greater than 600mm is listed below:

5.1.1.3.2.1. From any boundary/wall/floor slab including the outermost part of a valve, pipes and bypasses is 800mm.

5.1.1.3.3. The minimum space required for butterfly valves (in the up & down stream) must be greater than or equal to 800mm with the valve in the open position.

5.1.1.4. Roof slabs within the station:

5.1.1.4.1. The roof slab must be completely removable where the entire slab is divided into removable panels not exceeding 3tonnes except for the last panel which accommodates the access manhole.

5.1.1.4.2. Removable “U” type steel roof covers may be used if the minimum requirements are satisfied as per Dwg. No.: A14854

5.1.1.5. Roof slabs outside the station:

5.1.1.5.1. The roof slab must be designed monolithically with the walls which must accommodate a removable panel\s over the main valve\s together with downstand beams if informed by the design (for the removable panels). All openings for removable panels must have a minimum 300mm clearance all around the outer edges of the valves.

5.1.1.5.2. For butterfly valves, all openings for removable panels must have a minimum 300mm clearance all around the outer edges of the valve in the opened position.

5.1.1.6. Cater for electrical, automation, chemical dosing and monitoring equipment based on the purpose and requirements of the valves and pipework fitted inside the chamber.

5.1.1.7. Ensure the safety of the public and operations personnel and adhere to all applicable acts, codes and standards.

5.1.1.8. Provide a design life adequate with the required life of the structure or system service life as stipulated by Rand Water.

5.1.1.9. The contractor should ensure compliance with the requirements of the Occupational Health and Safe Act 85 of 1993 (the OHS Act) and any relevant Regulations derived from the OHS Act.

5.1.1.10. The design of the chamber should take into account the requirement that the chamber should be stable against floating (buoyancy check), sliding, overturning and any other relevant serviceability requirement which may not be explicitly stated herein.

5.1.1.11. Chambers are to be design to be water tight (water retaining and/or excluding) with a maximum crack width of 0.2mm at SLS (due to flexure, moisture, expansion etc).

5.1.1.12. In addition to the requirements of 5.1.1.7 above, Chambers are to be design to stresses of founding materials imposed by the chamber under serviceability loading conditions does not exceed the bearing capacity of the foundation material.

### 5.1.2. Planning

5.1.2.1. The purpose, available space, special requirements or requests as forwarded by Rand Water projects or Rand Water operations, should all be taken into account before proceeding with structural design of the valve chamber.

5.1.2.2. Overall size and depth of the chamber define the depth of sections and reinforcing required. The chosen style of chamber should be based on balancing structural strength, stability during service, durability and economic viability.

5.1.2.3. Construction joints must be placed at center of the pipe entry all around the chamber, thereafter at maximum 2.4m intervals.

5.1.2.4. Top of chamber walls must protrude by a minimum 500mm above natural ground level.

### 5.1.3. Design Specifications

#### 5.1.3.1 CONCRETE

5.1.3.1.1. Concrete cube strength minimum requirements at 28 days:

- Chamber roof: 60Mpa (for chambers that fall outside of a Rand Water enclosed station, otherwise 35 MPa shall be used)
- Chamber walls and base: 35Mpa
- Site Blinding: 15Mpa

5.1.3.1.2. All exposed sharp concrete edges above ground level to have 20 X 20mm chamfers.

5.1.3.1.3. Concrete mix design to ensure the structure is water tight

5.1.3.1.4. All levels are given in meters above M.S.L and are to be confirmed on site.

5.1.3.1.5. Concrete finishes to floor and roof to have a smooth wood floated finishes.

5.1.3.1.6. All levels of existing pipework to be confirmed on site.

5.1.3.1.7. All cast in Items to be supplied by contractor unless otherwise stipulated

5.1.3.1.8. The valve chamber shall be water tight, with the usage of concrete – as such the chamber should be designed to the requirements of BS 8007.

5.1.3.1.9. The roof of the chamber is to have a fall from the centre (either by a screed or shaping the concrete) to allow for drainage of water away from the roof.

5.1.3.1.10. Access onto the chamber roof is to be provided by means of either an external catladder or mass concrete steps (RWs preference is site specific and where clarity is not provided upfront the contractor is to engage with the Project Manager before detailed drawings are produced. As a general rule catladders may be used only within a RW protect station/site, whereas mass concrete steps may be used for both outside and inside a RW station.)

5.1.3.1.11. Provide construction joints at the center of the main pipe levels, thereafter at a maximum 2.4m intervals

#### 5.1.3.2 REINFORCEMENT

5.1.3.2.1. Roof Slabs

- Maximum spacing of reinforcement (top layer): 100mm center to center (each way) – only applicable to chambers that fall outside of a Rand Water protected site.

### 5.1.3.3 LAYER WORKS

Layer works are to be as per geotech requirements. The Contractor's engineer is required to ensure that they are satisfied with on site or engineered layers and their construction. The Contractor is required to do their own geotechnical investigations.

### 5.1.3.4 STEELWORK

5.1.3.4.1 No through ties to be used.

5.1.3.4.2 All structural steel work to be grade S355JR to SANS 50025.

5.1.3.4.3 Fixings of structural components to the concrete should be done using either mechanical or chemical anchors that can work with cracked concrete.

5.1.3.4.4 All dimensions to be confirmed on site prior to fabrication of steelwork and grating.

5.1.3.4.5 All steel work to be of welded construction (unless otherwise indicated) with 6mm continuous fillet weld all round.

5.1.3.4.6 Welding shall comply with SANS 10044 and shall be continuous, free from pin holes and weld slag. Stitch and spot weld is not permitted on articles to be galvanized.

5.1.3.4.7 Handrail and stanchions shall be "Andrew Mentis" ball type galvanized or approved equivalent all handrail stanchions to be side mounted "gooseneck" type stanchions are not permitted, where chambers are inside a Rand Water station.

Where chambers are outside of a protected station, then fibre reinforced plastic handrails, stanchions and grating should be used – this requirement also applies to all chlorine dosing chambers.

5.1.3.4.8 All parts to be clearly marked for erection purposes.

5.1.3.4.9 All steel work to be hot dipped galvanized to SANS 121-2011 (heavy duty) by a sabs approved galvanizer.

5.1.3.4.10 All shop detail drawings of structural steelwork and fibre reinforced plastic to be submitted to Rand Water for approval prior to fabrication.

5.1.3.4.11 The contractor is responsible for measuring up on site prior to manufacture.

5.1.3.4.12 Cat ladders and grab rails to be supplied and installed by contractor (refer to drawing numbers A7406 and A9858) – further to 5.1.3.4.7 above, fibre reinforced plastic handrails should be used as per the requirements of 5.1.3.4.7 where applicable.

5.1.3.4.13 Construction of structural steel should conform to SANS 2001-CS1

5.1.3.4.14 The Contractor is required to supply the Rand Water Civil Consultant Engineer with a design for the grating, handrails and connections for review, the design should be

signed by a competent person (registered as a Professional Engineering Technologist or Professional Engineer with the Engineering Council of South Africa)

#### 5.1.3.5 FIBRE REINFORCED PLASTIC WORKING PLATFORMS

Fibre reinforced plastic access platforms are to be used for chlorine dosing chambers. The specification for the material making up the grating shall be submitted by the contractor to RW (Consultant Process Engineer – Design) for approval, whereas the design and drawings (design, construction and shop drawings) are to be submitted to RW (Consultant Civil Engineer – Design) for approval.

RW only approves the functional requirements of the design to be undertaken by the contractor.
It remains the contractor's responsibility to sign off (by a Pr. Eng. Tech. or Pr. Eng. both in Civil) their design and drawings (as another other accompanying documents).

#### 5.1.3.6 CHAMBER ACCESS

Access onto the roof of the chamber is required to meet the requirements of the building regulation.
A guideline on providing for such access, where it may be required, is given in Rand Water standard drawing RA 27329

## 6. WATER TIGHTNESS TESTING FOR VALVE CHAMBERS

For testing of liquid retention, the chamber should be cleaned and initially filled to the normal maximum level with the specified liquid (water) at a uniform rate of not greater than 2m (two meters) in 24 hours.
When first filled, the liquid level should be maintained by the addition of further liquid for a stabilizing period while absorption and autogenous healing take place. The stabilizing period must be 21 days for the for the valve chamber design crack width of 0.2mm. After the stabilizing period the level of the liquid surface should be recorded at 24 hour intervals for a test period of 7 days. During the 7-day test period the total permissible drop in level, after allowing for evaporation and rainfall, should not exceed 1/500th of the average water depth of the full tank or 10mm.
Notwithstanding the satisfactory completion of the test, any evidence of seepage of the liquid to the outside faces of the valve chamber walls should be assessed against the requirements of the specification. Any necessary remedial treatment of the concrete, cracks, or joints should, where practical, be carried out from the liquid face.
Should the structure not satisfy the 7-day test, then after the completion of the remedial work it should be refilled and if necessary left for a further stabilizing period; a further test of 7days' duration should then be undertaken in accordance with this clause
It is the contractors' responsibility to take care of the surrounding structures, services, erosion of the natural ground and environment when pumping out the water from the chamber. Any damages inflicted on the existing

structures, services, natural ground and environment from the emptying of the valve chamber must be repaired by the contractor at his own cost.

***The contractor must make necessary arrangements and allocate sufficient time to his construction program such that the valve chambers are tested without the valves being submerged.***

## 7. LIST OF STANDARD DRAWINGS

Below is a list of standard drawings for the chamber which may be obtained from Rand Water if they do not accompany this document.

| DRAWING NUMBER | DRAWING TITLE |
|---|---|
| A8879 | Details of cast in frame for valve chamber sumps |
| A9858 | Details of grab rails at access manhole |
| 11860 | Steelfibre concrete manhole cover and support frame |
| A7406 | Standard galvanized cat ladder details wall mounted |
| RA21953 | Standard external cat ladder details wall mounted |
| RA26695 | Details of gate valve access steel platform |
| RA27329 | Details of External Mass Concrete Access Steps |
| A14854 | 'U' type steel roof covers to valve chambers |