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Compiled by	**Approved by**	**Authorised by**
RDL		
R van Dyk	**K Vilonel**	**T. Naidoo**
Structural Engineer	**Chief Structural Engineer**	**Manager – Structural Design CoE**
Date: 23/03/2015	Date: 23/03/2015	Date: 23/03/2015

Supported by SCOT CTC

G Dudenska

Civil TC Chairperson

Date: 23/03/2015

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TABLES

1. INTRODUCTION

This document is a Standard for Structural Design and Engineering.

2. SUPPORTING CLAUSES

2.1 SCOPE

This standard specifies requirements and gives recommendations for the structural design and engineering of buildings and other structures for the supporting of vessels, machinery, stacks, tanks, piping etc.

It shall be used in conjunction with other standards (listed in Section 2.2.1), procedures or design codes relevant to structural design and engineering.

2.1.1 Purpose

This document is intended for use in power generating, distribution, transmission and administrative facilities.

2.1.2 Applicability

The distribution of this document is confined to companies undertaking designs on behalf of Eskom Enterprises Division – Capital Expansion Department or managed by them and to Contractors nominated by them.

2.2 NORMATIVE/INFORMATIVE REFERENCES

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

[1] SANS 2001 – CC1: 2007

[2] 240 – 54937450: Fire Protection and Life Safety Design Standard

[3] 240 – 53113685: Design Review Procedure

[4] 240 – 56364535: Architectural Design and Green Building Compliance Manual

[5] 240 – 57127953: Execution of Site Preparation and Earthworks Specifications

[6] 240 – 53573084: Process Control Manual for Perform Structures and Buildings Engineering

[7] SANS 10100 – 1: The Structural use of Concrete Part 1 Design

[8] SANS 10100 – 2: The Structural use of Concrete Part 2: Materials and execution of work

[9] SANS 10161: The Design of Foundations for Buildings

[10] SANS 10162 – 1: The Structural Use of Steel Part 1: Limit State Design of Hot-rolled Steelwork

[11] SANS 10162 – 2: The Structural Use of Steel Part 2: Cold Formed Steel Structures

[12] SANS 10164 – 1: The Structural Use of Masonry Part 1: Unreinforced Masonry Walling

[13] SANS 10164 – 2: The Structural Use of Masonry Part 2: The Structural Design and Requirements for Reinforced and Pre-stressed Masonry

[14] SANS 10144: Detailing of steel reinforcement for concrete

[15] SANS 10160 – Part 1: Basis of Structural Design

[16] SANS 10160 – Part 2: Self-weight and Imposed Loads

[17] SANS 10160 – Part 3: Wind Actions

[18] SANS 10160 – Part 4: Seismic Actions and General Requirements for Buildings

[19] SANS 10160 – Part 5: Basis for Geotechnical Design and Actions

[20] SANS 10160 – Part 6: Actions Induced by Cranes and Machinery

[21] SANS 10160 – Part 7: Thermal Actions

[22] SANS 10160 – Part 8: Actions During Execution

[23] SANS 10400: The Application of the National Building Regulations

[24] SANS 10109 – 1: 2009 Concrete Floors Part 1: Basis to Concrete Floors

[25] SANS 10109 – 2: 2004 Concrete Floors Part 2: Finishes to Concrete Floors

[26] SANS 1200: Standardised Specification for Civil Engineering Construction

[27] SANS 10155: 2009 Accuracy in Buildings

[28] SANS 1491 – 1: 2005 Portland Cement Extenders Part 1: Ground Granulated Blast-Furnace Slag

[29] SANS 1491 – 2: 2005 Portland Cement Extenders Part 2: Fly Ash

[30] SANS 1491 – 3: 2006 Portland Cement Extenders Part 1: Silica Fume

[31] SANS 878: 2004 Ready-Mixed Concrete

[32] SANS 1083: 2006 Aggregates from Natural Sources – Aggregates for Concrete

[33] SANS 201:2008 Sieve Analysis, Fines Content and Dust Content of Aggregates

[34] SANS 197: 2006 Preparation of Test Samples of Aggregates

[35] SANS 202: 2006 Chloride Content of Aggregates

[36] SANS 3310 – 1: 2000 / ISO 3310 – 1:2000

[37] SANS 3310 – 2: 1999 / ISO 3310 – 2:1999

[38] SANS 50197 – 1: 2000 / EN 197 – 1: 2000

[39] SANS 50197 – 2: 2000 / EN 197 – 2: 2000

[40] SANS 5832: 2006 Organic Impurities in Fine Aggregates

[41] SANS 5833: 2006 Detection of Sugar in Fine Aggregates

[42] SANS 5841: 2008 Aggregate Crushing Value of Coarse Aggregates

[43] SANS 5842: 2006 FACT Value of Coarse Aggregates

[44] SANS 5847: 2008 Flakiness Index of Course Aggregates

[45] SANS 6243: 2008 Deleterious Clay Content of the Fines in Aggregate

[46] SANS 6244: 2006 Particles of Diameter not Exceeding 20µm and not Exceeding 5 µm and Smaller

[47] SANS 1200: Standardised Specification for Civil Engineering Construction

[48] 240 – 54937450 Fire Protection and Life Safety Design Standard

[49] SANS 10094: The Use of High-strength Friction-grip Bolts

[50] SANS 10143: Building Drawing Practice

[51] SANS 10238: Welding and Thermal Cutting Processes - Health and safety

[52] SANS 1150: Glass-reinforced Polyester (GRP) Laminated Sheets (profiled or flat)

[53] SANS 1556: ISO Metric Screw Threads

[54] SANS 1700-16-2: Fasteners Part 16: Washers Section 2: Plain Washers - Normal Series - Product Grade A

[55] SANS 1700-16-3: Fasteners Part 16: Washers Section 3: Plain washers, Chamfered - Normal series - Product Grade A

[56] SANS 3575: Continuous Hot-dip Zinc-coated Carbon Steel Sheet of Commercial and Drawing Qualities

[57] SANS 4998: Continuous Hot-dip Zinc-coated Carbon Steel Sheet of Structural Quality

[58] SANS 50025: The South African Standard for Structural Steel

[59] SANS 121: Hot Dip Galvanized Coatings on Fabricated Iron and Steel Articles - Specifications and Test Methods

[60] Red Book: Southern African Steel Construction Handbook

[61] Green Book: Structural Steel Connections

[62] Yellow Book: Structural Steel Detailing

[63] TMH7 Parts 1 & 2: Code of Practise for the Design of Highway Bridges and Culverts in South Africa

[64] EN 1991: Eurocode 1: Actions on Structures

[65] BS EN 1992: Eurocode 2: Design of Concrete Structures

[66] EN 1993: Eurocode 3: Design of Steel Structures

[67] EN 1994: Eurocode 4: Design of Composite Steel and Concrete Structures

[68] EN 1997: Eurocode 7: Geotechnical Design

[69] EN 1998: Eurocode 8: Design of Structures for Earthquake Resistance

[70] CICIND Model Code for Concrete Chimneys Part A, B, C and GPR Linings

[71] BS EN 1991 – 4 : 2006 Eurocode 1 – Action on Structures – Part 4 : Silos and Tanks

[72] ACI 307: Design and Construction of Reinforced Concrete Chimneys

[73] AS 3774- 1996: Loads on Bulk Solids Containers

[74] AWS D1.1 : Structural Welding Code - Steel

[75] BD 28/87 Early Thermal Cracking of Concrete

[76] Occupational Health and Safety Act, 1993 (Act 85 of 1993)

[77] Mine Health and Safety Act of 1996

[78] Factories, Machinery and Building Work Act, 1941 (Act 22 of 1941)

[79] ISO 7919 – 3:1996(E)

[80] 0.00/2901 Standard Drawing – Details of Steel Staircases, Walkways and Platforms

[81] OHSA – General Safety Regulations

2.2.2 Informative

None

2.3 DEFINITIONS

“The Contractor” is the party, if required, who carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project, or operation or maintenance of a facility. The Principal may undertake all or part of the duties of the Contractor.

“The Manufacturer/Supplier” is the party which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

“The Principal” is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word “shall” indicates a requirement.

The word “should” indicates a recommendation.

2.3.1 Classification

a. **Controlled Disclosure:** Controlled Disclosure to External Parties (either enforced by law, or discretionary).

2.4 ABBREVIATIONS

Abbreviation	Description
AAR/ASR	Alkali-Aggregate Reaction/Alkali-Silica Reaction
ACI	American Concrete Institute
AS	American Standard
ASTM	American Society for Testing and Materials
BD	Bridge Design
BS	British Standard
Cl	Chlorine
CoE	Centre of Excellence
Dnom	Nominal diameter
EN	European Standard
FP	Fireproofed
GRP	Glass Reinforced Polyester
ISO	International Standards Organization
kg	Kilogram
m	Metric Metre

Mg	Magnesium
mm	Metric Millimetre
NH4	Ammonium
PCM	Process Control Manual
PFA	Pulverised fuel ash
pH	Power of hydrogen
PvC	Polyvinyl Chloride
SANS	South African National Standard
SCOT	Study Committee of Technology
SLS	Serviceability Limit State
SO_4	Sulphate
TC	Technical Committee
ULS	Ultimate Limit State
W/C	Water cement ratio
WGS	World Geodetic System

2.5 ROLES AND RESPONSIBILITIES

2.5.1 MINIMUM REQUIREMENTS

The minimum technical requirements as laid down in this manual shall be applied to the design, materials selected, planning and execution of structural design.

Supplementary to these requirements, work shall be carried out in accordance with recognized and accepted theories, methods, codes of practice, standards and good engineering practice.

As a rule, the requirements of this manual shall be adhered to.

All designs should be carried out in accordance with national or local regulations, unless otherwise stated by the principal.

2.6 PROCESS FOR MONITORING

None

2.7 RELATED/SUPPORTING DOCUMENTS

240-86973501: Engineering Drawing Standard – General Requirements

3. STRUCTURAL DESIGN AND ENGINEERING

The design and calculations of structures shall be based on the codes listed in Section 2.2. The following structures and cases are not covered in SANS, for this case the use of Eskom approved international standards are permitted:

- Actions due to fire

- Actions of structures subject to internal pressures from the contents (for example bunkers, silos or water tanks)
- Actions due to hydrodynamic effects
- Actions on chimneys, towers and masts
- Actions on bridges
- Actions on special industrial structures
- Actions due to internal or external explosion
- Buildings or structures that are higher than 100m
- Dynamic effects and design of dynamically sensitive structures for the case of wind loading
- Structures and buildings with unusual shapes
- High risk structures
- Structures which do not comply with section 8.4.3 of SANS 10160 Part 4 [18]

3.1 LOADING DATA

3.1.1 GENERAL

The loads which shall be taken into account in the design of structures are described below. The various combinations of these loads to be used in the calculations shall be in accordance with SANS 10160 [15].

Structures shall be designed to withstand the worst case load combination for ultimate limit state (ULS) and serviceability limit state (SLS), in accordance with SANS 10160 [15] to [22].

3.1.2 STRUCTURAL PERMANENT LOADS

The permanent load of the structure shall be all the loads deemed to be constantly acting on the structure for the duration of the structure's life. Any load deemed to be intermittently applied shall not be considered permanent.

3.1.3 ROTATING AND STATIC EQUIPMENT

3.1.3.1 Weight of Vibrating and Static Equipment

The supplier shall provide all the relevant information necessary for the design of the foundation, see 3.1.9.

Sections 3.1.9 and 3.1.15 defines the loads of vibrating and static equipment which shall be included in load combination calculations.

3.1.3.2 Hydrostatic Test Load

When hydrostatic pressure testing of hydraulic equipment, such as pumps etc., is required at site, the weight of this equipment completely filled with water shall be incorporated in the design of the supporting structure.

When more than one piece of equipment is supported by one structure, the structure need only be designed on the basis that one piece of equipment will be tested and the others either empty or in operation i.e. two cases.

3.1.4 CRANE INDUCED LOADS

Crane loads shall be taken at their maximum lifting capacity, as well as the maximum horizontal loads caused by braking or acceleration of the crane or crab.

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Structural elements supporting cranes must be designed for the most unfavourable position of the crane whilst static or moving. For moving loads, an appropriate impact factor shall be applied according to the following guideline:

Loads applied due to cranes and moving sources shall not be less than that given in SANS 10160 [20]. This code shall be used in conjunction with SANS 10160 [15].

3.1.5 TRANSPORT INDUCED LOADS

The following shall be designed for the maximum expected loading condition caused by transportation of heavy equipment:

- At least one road leading to the power island
- All roads on the power island
- Bridges and culverts
- Other underground facilities

3.1.6 IMPOSED LOADS

The following imposed loads shall be taken into account:

- For floors and platforms used for operational/maintenance purposes, the loads shall be as per SANS 10160 [15] & [16] or as per the loads specified by the Supplier or Principal whichever is greater.
- For floors, platforms, walkways and staircases used for access only, loads shall be designed as per SANS 10160 [15] & [16] or as specified by the Principal, whichever is greater.
- For accessible roofs the imposed loads shall not be less than 2kN/m². Greater imposed loads shall be investigated when HVAC components are located in the roof. For roofs of one storey buildings, the imposed load shall never be less than 5kN/m².
- Loading on hand railings shall be designed in accordance with SANS 10160 [15] & [16].
- For buildings refer to SANS 10160 [16].

Note: Where applicable, due regard shall be given to allowable reduction of imposed loads for multi-storey buildings, or open structures under maximum wind load conditions.

For the design of each structural element, the imposed loads shall be applied in the most unfavourable pattern (checkerboard-type loading).

3.1.7 WIND LOADS

Wind loads shall be determined in accordance with SANS 10160 [17]. For a structure with a height greater than 100m, like chimneys, solar towers and other similar structures, SANS 10160 [17] is not suitable, therefore ACI 307-08 [72] or the CICIND [70] shall be used.

3.1.8 SEISMIC LOADS

Seismic loads shall be determined in accordance SANS 10160 [18]. Seismic loads shall be taken into account for all structures. For a structure above 60m in height, the seismic analysis shall be carried out with a spectral analysis in accordance with the Eurocode 8 [69]. The greater of the wind action, seismic and notional horizontal loads (where applicable) shall be applied to the structure.

3.1.9 DYNAMIC LOADS

At a minimum, the following information (where it is applicable to the type of equipment) shall be needed from a manufacturer in order to design for dynamic loads:

- Weight of the equipment
- Maximum permitted amplitude of vibration of the bearings
- Coordinates of the centre of gravity of the equipment(s) from a reference point
- Mass moment of inertia of the equipment(s)
- Out of balance forces and their points of application
    - If this information is not available, then the masses of the rotating parts and their static or dynamic eccentricity
- Operating frequency (ies) of the equipment
- Coordinates of the bearings
- Minimum foundation footprint and minimum thickness.
- A geotechnical investigation shall be conducted where soil conditions and relevant parameters are not known.
- A detailed design and vibration analysis shall be made in accordance with the requirements defined in the sections that follow:

3.1.9.2 Static Deformation and Soil Bearing Stresses

The static deformation for a block foundation supporting rotating equipment shall be calculated and shown to be within the limits stated by the Supplier of the equipment.

- For block foundations, the static bearing pressure should not exceed half of the permissible. The dynamic plus the static bearing pressure should not exceed 75% the permissible.
- For foundations on piles, the maximum static capacity of the pile shall be reduced to 30% when calculating the required number of piles. The pile applied load, including the dynamic load, should not exceed 50% the total capacity of the piles. Pile group effect shall be taken into consideration in the calculations.

The centre of gravity of the combined machine plus foundation must not deviate by more than 5% from the centroid of the foundation footprint in any direction.

3.1.9.3 Vibration Analysis

The amplitude of vibration for foundations supporting a vibrating machine shall be checked at the bearing for the conditions listed below:

- The maximum allowable values stated by the Manufacturer of the equipment

- Be within Zone A of Fig. A.1 of ISO 7919–3:1996(E) [1] for the case where the Manufacturer's limits are not given
- The velocity $2\pi f * (amplitude\ of\ vibration)$ shall be checked and compared with the appropriate charts
- The acceleration $2\pi^2 f^2 * (amplitude\ of\ vibration)$ shall be carried out if the velocity check fails.

The amplitude of vibrations shall be checked at the furthest distance from the centre of gravity of the foundation for human response. Hence foundations shall be isolated. Foundations subject to vibration shall, in principle, be properly isolated from adjacent structures. Special consideration must be given to transmissibility through the founding material.

3.1.9.4 Exciting Force

For the vibration analysis of structures and foundations supporting rotating equipment, the out-of-balance forces shall be specified by the Supplier. If the Supplier of the equipment does not supply the exciting force, then this shall be calculated from the weight of the rotor and its static or dynamic eccentricity.

As an initial assessment, the block foundation shall be at least 2 to 3 times heavier than that of the mass of the machine or 25 times heavier than the rotor mass for a centrifugal machine. For a reciprocating machine, the foundation shall be 4 to 5 times heavier than the weight of the machine. The foundation thickness for a centrifugal machine should be at least 600mm, while for a reciprocating machine; the thickness should be at least 1.10m. The foundation width shall be at least 1 to 1.5 times the vertical distance from the top of the base to the machine centreline. The final dimensions will be dictated by the analysis. The foundation should protrude above the finished floor level by at least 300mm.

For block foundations on piles, the above apply with the exception that pile cap shall be 1.5 to 2.5 times heavier than the centrifugal machines and 2.5 to 4 times heavier than the reciprocating machines.

REINFORCEMENT

The block foundation as well as the piled foundations, notwithstanding the amount of reinforcement required for shrinkage or to resist the applied loads in the top, bottom and sides of the member, shall not be less than Y20 @ 250 centres in both directions.

3.1.9.5 Frequencies

All natural frequencies shall not be less than 25% below the operating frequencies or 25% above the operating frequencies.

3.1.9.6 Magnification and Transmissibility Factor

The magnification factor shall be not greater than 1.5.

The transmissibility factor for machines mounted on springs shall be less than 1. The transmissibility factor for block foundations on soil can be greater than 1 (dynamic forces are amplified).

3.1.10 EXPLOSION AND IMPACT LOADS

Explosion and impact loads shall be included in the design, if required.

Note: Impact loads may be due to explosions or collisions.

3.1.11 THERMAL EFFECTS

3.1.11.1 Thermal loads

When thermal expansion results in friction between equipment and supports, the friction force shall be taken as the operating load on the support multiplied by the applicable friction coefficient. The friction coefficients used in the design shall be agreed upon and accepted by the Principal.

In the design of pipe supporting beams, the horizontal slip forces exerted by expanding or contracting pipes on steel or concrete pipe racks shall be included in the design of the support structures.

3.1.11.2 Thermo-mechanical Forces and Stresses

All structures which are subjected to thermo-mechanical effects shall be designed for the thermal loads and for any temperature difference that may occur.

The material strength of structures subjected to high temperatures during operation shall be investigated and reduced accordingly if necessary.

3.1.12 LOADS DURING ERECTION AND MAINTENANCE

The Contractor shall be responsible for the design of all temporary structures during construction. Calculations for temporary works shall be submitted to the Principal for review. Method statements for the erection of the temporary works shall also be included.

Structures shall be designed for all imposed loads in accordance with SANS 10160 or as specified by the Principal including any uniformly distributed or point loads during maintenance.

3.1.13 WATER LOADS

Loads due to rainwater accumulation shall be taken into account.

Note: The maximum rainwater accumulation load with the drains pipes or down spouts blocked shall be assessed.

3.1.14 DIFFERENTIAL SETTLEMENT

The variability of the soil strata may result in differential settlement. The resulting bending moments, shear and axial forces shall be considered. For structures that cannot sustain any settlements or very minimal settlements, special foundations maybe required.

3.1.15 LOAD COMBINATIONS

All structures shall be designed for worst case load combinations in accordance with SANS 10160 [15] or the appropriate international standard where required.

4. SITE INVESTIGATION AND FOUNDATION ENGINEERING

A site investigation shall be carried out to determine the character and variability of the soil strata underlying the foundations of the proposed structures.

Reference is made to the procedure for Site Preparation and Earthworks Specification [5] which contains guidelines for the determination of the extent and scope of site investigations and associated reports.

The selection of foundation types (i.e. whether piled, soil bearing, etc.) shall be based on the results of a site investigation. The geotechnical aspects of foundation design and engineering are covered in the specification for geotechnical and foundation engineering.

4.1 PREPARATORY WORK

4.1.1 Setting Out

All work shall be set out accurately from datum and benchmarks. During execution, the correct position, level and alignment of all parts of the work shall be ensured at all times. Setting out shall meet the requirements of SANS 2001 – CC1: 2007 [1].

4.1.2 Piling and Soil Improvement

Piling and soil improvement, if required, shall be in accordance with the geotechnical and foundation design requirements.

4.1.3 Site Preparation, Excavation, Backfill and Temporary Drainage

Site preparation, excavation, backfill and temporary drainage shall be in accordance with the Execution of Site Preparation and Earthworks Specification [5].

4.1.4 Blinding Concrete

A layer of blinding concrete of 50 mm minimum thickness shall be placed under foundations. The blinding layer shall be laid immediately after excavation, draining and compacting of the bed area, in order to avoid disturbance of soil by rain or groundwater.

4.1.5 Polyethylene Sheets

, Heavy-duty polyethylene sheets of at least 0.25 mm thickness shall be laid directly on the soil below concrete ground slabs in the longest length and widest width available. The overlap shall not be less than 150 mm at all joints and intersections.

4.2 PLACING OF REINFORCEMENT

The placing of reinforcement shall be in accordance with SANS 10144 [14]. Additional stools for long spans (above 4m) shall be provided to prevent sagging and to maintain the required design concrete cover.

4.3 CRACK WIDTH CONTROL

Crack width control shall satisfy the requirements of BS EN 1992 – 3 (2006): Eurocode 2: Design of Concrete Structures – Part 3: Liquid Retaining and Containment Structures [65] and BS EN 1992 – 1 – 1 (2004): Eurocode 2: Design of Concrete Structures – Part 1 – 2: General Rules and Rules for Buildings [65] in conjunction with BD 28/87 Early Thermal Cracking of Concrete [75] depending on the degree of restraint.

4.4 SHRINKAGE REINFORCEMENT

When walls or slabs are not cast monolithically (restraint condition), attention shall be given to reinforcement required due to differential shrinkage.

Shrinkage reinforcement shall be calculated in accordance with one of the following codes depending on the degree of restraint; BS EN 1992 – 3 (2006): Eurocode 2: Design of Concrete Structures – Part 3: Liquid Retaining and Containment Structures [65] and BS EN 1992 – 1 – 1 (2004): Eurocode 2: Design of Concrete Structures – Part 1 – 2: General Rules and Rules for Buildings [65] in conjunction with BD 28/87 Early Thermal Cracking of Concrete [75].

4.5 FOUNDATIONS FOR SMALL EQUIPMENT

Foundations for small pumps, etc. may be placed on reinforced concrete slabs or yard paving, provided that they are properly connected to the slabs or ground slab and that cable trench locations are fixed. If required, slabs or paving shall be strengthened locally. A minimum check should be carried out on the ratio of machine weight/foundation weight

5. SPECIAL CONCRETE STRUCTURES

5.1 LIQUID-RETAINING STRUCTURES

In addition to all other requirements for the design of structures, special precautions shall be taken regarding the liquid-tightness of liquid-retaining structures, refer to Eurocode 2 [65]. All liquid-retaining structures shall be water tested under atmospheric pressure conditions, unless otherwise stated.

5.2 REINFORCED CONCRETE STACKS

Reference shall be made to the technical specification for the design of concrete stacks.

5.3 BOX-OUTS

All holes in slabs that have equipment underneath shall be closed after installation of piping, equipment, etc. to prevent fire to propagate to the adjacent room.

5.4 EXPOSURE CONDITIONS

The environment to which concrete is exposed in service can be classified into four levels of severity: mild, moderate, severe and very severe, as described in SANS 2001 – CC1: 2007 [1].

5.5 FIRE

Design for fire must satisfy fire regulations stipulated in SANS 10100 Part 1 [7] or international codes as specified in Section 2.2.

5.6 PROTECTION OF CURING CONCRETE

In addition to a curing compound, concrete must be covered for protection for a minimum period of 3 days. Mass pours must be cured with mist spray and should be accompanied with a detailed methodology for the mass pours. Thermocouples are to be used to measure temperatures.

5.7 ACCESS TO EQUIPMENT

Designs must make allowance for access for installation and maintenance of equipment.

5.8 GROUTING

Grouting refers to all work to be carried out to properly fill the space between concrete surfaces and base plates of equipment, steel structures or concrete prefabricated elements with mortar in order to achieve adequate transfer of horizontal and vertical forces, and to inject pre-stressed systems (tendons).

5.8.1 Types of Grout

Grout material may be either cement-based non-shrink grout, or special proprietary grout depending on the circumstances

Special proprietary grout shall be used for the following installations, provided that surface temperatures local to the grout are < 60 °C:

- Vibrating machinery (not skid-mounted) and other installations where impact and/or pounding actions are to be expected during normal operation;
- All internal combustion engines;
- All sole plate mounted equipment, except vertical close-coupled pumps.

For rotating equipment installations not covered by the above categories, cement-based non-shrink grout shall be used.

5.8.2 Sand-cement grout

The use shall be limited to grouting of minor steel structures (e.g. instrument stands) only. The grout shall have a minimum crushing strength of the concrete. The sand aggregate shall be capable of freely passing a filter mesh of 1.5 mm.

5.8.3 Non-shrink grout

A grout is regarded as non-shrink if its volume is not less than the initial volume, after hardening for 28 days. During this period, the test specimens shall have been completely protected against drying, evaporating, carbonation and exposure to temperatures outside the range 23 °C ± 3 °C.

The type and brand of non-shrink grout shall, after approval, be indicated on the drawings and/or specification for concrete work.

In general, one of the following types of non-shrink grout shall be used:

- Cement-based non-shrink grout, shall not be less than the strength of the concrete
- Special proprietary non-shrink or expansive grout shall not be less than the strength of the concrete

5.8.4 Shims

The following shall apply for shims that will remain in place after grouting:

The shim shall be embedded in a mortar bed such that the top of the shim is level in all planes.

- Shim plates shall be installed so that they will be fully embedded in and surrounded by the grout to be installed later; the minimum cover to shim sides shall be 50 mm.
- All shims shall be circular
- Shims shall not be fabricated using timber or any other degradable material.

5.8.5 Application

5.8.5.1 Grouting of vibrating equipment

Exposed cement-based grout surfaces shall be coated (with an epoxy-based product) if future contamination with lubricants is possible.

5.8.5.2 Grouting of steel structures and stationary equipment

The installation of the grout shall be carefully supervised as specified in SANS 2001 – CC1: 2007 [1] and SANS 10100 Part 2 [8].

5.9 CHEMICAL - RESISTANT CONSTRUCTION

Protection against chemicals, even very dilute solutions, shall be provided either by suitable chemical resistant bricks or tiles, or by a monolithic epoxy compound, as per SANS 10100 Part 2 [8].

5.10 AGGRESSIVITY OF THE ENVIRONMENT AND RECOMMENDATIONS FOR MIX DESIGN

5.10.1 Test Criteria and Classification

5.10.1.1 Classification

In order to classify the severity of chemical attack to concrete, the exposure classification shall be in accordance with Table 1.

Table 1: Exposure Classification

Exposure Class	Exposure/Environmental Conditions
1	Dry
2 (a and b)	Humid (without and with frost)
3	Humid in combination with de-icing agents
4 (a and b)	Sea water (with and without frost)
5 (a, b, c and d)	Aggressive (weak, moderate, severe or very severe)

The relation between the exposure classes and the various aggressivity criteria is shown in Table 5, Table 6 and Table 7.

5.10.1.2 Groundwater

Ground water should be tested to establish if it is aggressive to concrete. The aggressivity to concrete, depending on the concentration of chemicals present in water, is shown in Table 2, which gives the limiting values of deleterious substances in water of predominantly natural composition for the assessment of the severity of chemical attack. Flowing soft water can also attack the concrete and steel, anaerobic water can also attack steel

Table 2: Limiting Values for Assessment of Deleterious Substances in Groundwater

Criterion of Exposure Class	Degree of Severity (Refer to Note 1)			
	5a	**5b**	**5c**	**5d**
pH value	6.5 to 5.5	5,5 to 4.5	4.5 to 4.0	< 4
Carbonic acid dissolving lime in mg/l determined by marble test Heyer	15 to 30	30 to 60	60 to 100	> 100
Ammonium (NH_4^+) in mg/l	15 to 30	30 to 60	60 to 100	> 100
Magnesium (Mg^{2+}) in mg/l	100 to 300	300 to 1 500	1 500 to 3 000	> 3 000
Sulphate ($S0_4^{2-}$) in mg/l	200 to 600	600 to 3 000	3 000 to 6 000	> 6 000

Note:

1. The degree of severity is valid for stationary or slowly moving water under moderate climatic conditions. For other locations, where more severe environmental conditions exist, Table 5 shall be used only as a guide. It is dependent upon the highest degree of severity even if it is only reached by one of the five criteria listed in lines 1 to 5. If two or more values are found to lie **in** the upper quarter of a zone (in the case of the pH in the lower quarter), then **the** degree of severity is deemed **to** be raised by one step. This increase does not, however, apply to sea water.

5.10.1.3 Soil

The aggressivity of soil to concrete is shown in Table 4.

Table 3: Aggressivity of Soil to Concrete

Criterion of Exposure Classes	Limiting Values for the Assessment of the Deleteriousness of Soils		
	Degree of Severity (Refer to Note 1)		
	5a	**5b**	**5c/5d**
pH value > 5.5			
Sulphate ($S0_4^{2-}$) in mg per kg of air-dry soil	2 000 to 6 000	6 000 to 12 000	> 12 000

Note:

1. The degree of severity is valid for soils which are saturated at frequent intervals. It can be reduced with decreasing permeability of the soil. If the content of sulphur from sulphides exceeds 100 mg S^{2-}per kg air-dry soil (more than 0.01% S^{2-}) or if dumps of industrial waste products are concerned, the deleteriousness should be assessed by a soil consultant. The chemical attack is expected to be more severe at higher temperatures and at higher pressures, or if the concrete is additionally exposed to mechanical abrasion due to fast flowing water or to alternating freezing and thawing. The severity can be assumed to be lower if the water temperature is consistently low, or if the quantities of water are small and the water is almost motionless, as for example in soils with a permeability factor $k < 10^{-5}$ m/s,

5.10.2 Requirements for Concrete Exposed to Chemical and Soft Water Attack

Depending on the aggressivity of groundwater and soil, measures shall be taken to adequately protect the concrete against deterioration. The resistance of concrete to chemical attack largely depends on the cement content, type of cement and permeability of the hardened concrete.

To achieve an adequate level of impermeability, the Water/Cement (W/C) ratio shall be kept as low as practicable and shall not exceed the values given in Table 4. The concrete shall be carefully cured and protected, preferably by wet curing for a minimum of seven days according to SANS 2001 – CC1: 2007 [1].

Table 4: Minimum Water Cement Ratios

Concrete Class (Cube Strength in MPa/Nominal Stone Size in mm)	**Water Cement Ratio**
15 / 38	0.55
30 / 19	0.45
35 / 19	0.42
40 / 19	0.42

5.10.2.1 Chemical attack

In case of aggressive conditions, it shall be proven on samples derived from trial mixes that the water penetration, determined in accordance with the Rilem Method' as described in ISO/DIS 7031, is less than the values shown in Table 5; SANS 10100 - 2 [8].

Table 5: Water Penetration

Degree of Severity	**W/C Ratio**	**Minimum Cement Content Aggr. Dnom. = 40 mm (1)**	**Rilem Test**	**Coating**
3 and 4	< 0.50	300 kg/m^3	< 50 mm	No
5a	< 0A5	300 kg/m^3 (2)	< 50 mm	No
5b	< 0.45	350 kg/m^a (3)	< 30 mm	No
5c	< 0.45	350 kg/m^a (3)	< 30 mm	Yes (4)
5d	< 0.40	350 kg/m^a (3)	< 30 mm	Yes (4)

Note:

1. For nominal maximum size of aggregate, Dnom = 20 mm, the cement content shall be increased by 10%. However, in no case shall the cement content be < 280 kg/m^3 or > 400 kg/m^3.
2. If weak aggressivity is caused by the presence of sulphates, the limiting values shall be as follows:

SO_4^{-2} (mg/l)	**W/C Ratio**	**Type of Cement**	**Minimum Cement Content**
200 - 400	< 0.50	OPC	330 kg/m^a
400 - 600	< 0.45	OPC	350 kg/m^a
	< 0.40	SRPC	350 kg/m^a

3. If moderate or severe aggressivity is caused by the presence of sulphates, the type of cement to be used shall be sulphate-resisting Portland cement.

In all cases of severe or very severe aggressivity, the selection of the coating and/or lining systems shall be done by specialists and in consultation with Eskom.

5.10.2.2 Chloride attack

In order to protect the reinforcement against chloride attack, the following measures shall be taken if concrete is exposed to a concentration of Cl > 100 mg/l.

a. a. Foundations and structures on land:
   i. Cement content: 320 kg/m^3 by D_{nom} = 40 mm.
   ii. Type of cement: blast furnace cement with PFA content up to 30%.
   iii. W/C ratio: < 0.40.
   iv. Limit crack widths in accordance with SANS 10100-1 [7] and SANS 10100-2 [8] or BD28/87 [75] where applicable. For pre-stressed concrete, the crack width shall be < 0.1 mm.

b. b. Structures in contact with or above sea water:
   i. Cement content: 400 kg/ m^3 by D_{nom} = 40 mm.
   ii. Type of cement: blast furnace cement with a slag content of > 65% or Portland cement type 11 (ASTM C-150).
   iii. W/C ratio < 0.40.

Crack width in accordance with BD28/87 [75] and BS EN 1992 – 3 (2006) [1]. For pre-stressed concrete, the crack width shall be < 0.1 mm.

6. CONCRETE MIXES

The concrete mix design shall take into account the type of foundations, structures, elements, etc. for which it is intended. The cement, aggregates, sand and water shall comply with requirements of SANS 2001 – CC1: 2007 [1] and SANS 10100 Part 2 [8]. Tests for drying shrinkage of aggregates and concrete and AAR/ASR must be done at all times and complied with. Furthermore, the concrete mix shall be chosen for durability, taking full account of the environment to which it will be subjected. The concrete class shall be selected on the minimum characteristic strengths indicated in Table 6, at 28 days:

Table 6: Concrete Class Minimum Characteristic Strengths[1]

Description	Concrete Class (Cube strength in MPa / Nominal stone size in mm)
Blinding concrete and Mass concrete	15 / 19
All reinforced concrete structures, except jetties and special structures	35 / 19 or 38
Special structures[2]	40 / 19 or 38
Pre-stressed concrete structures and reinforced concrete of marine structures	50 / 19

[1]Aggregate size dependent on mix design

[2]Special structures include chimneys, silos, cooling towers, turbine foundations, or according to the structures and cases listed in Section 3.

7. STRUCTURAL STEEL

7.1 STEEL STRUCTURES DESIGN

7.1.1 General

The design of a steel structure shall take into account:

1. The properties of the materials of construction,
2. The calculated forces and resulting stresses in the members,
3. The prevailing conditions of the local environment and requirements of the site,
4. The details of construction and the methods of fabrication and erection,
5. And the effect on cost and construction time,

in order to achieve a safe and economic design.

7.1.2 Design Requirements

7.1.2.1 Fatigue due to vortex shedding or other cyclic loads

Structures subjected to considerable cycles of repetitive loads, causing either reversal of stresses or variation of stress within the stress field shall be checked for fatigue failure. The effects of fatigue shall be verified to be in compliance with recognised international standards including SANS 10162 [1] and SANS 10160 [1]

The Palmgren-Miner's rule shall be applied to judge the combined effect of various types of cyclic loading, in compliance with recognised international standards. The design shall ensure adequate safety against damage within the planned life of the structure under the applicable loading.

The method of analysis shall be agreed with the Principal. A detailed fatigue analysis may not be necessary when the design is based on previous and satisfactory experience, which is strictly comparable

7.1.2.2 Allowable Deflection Criteria

Allowable deflections for different structural members shall be as governed by SANS 10162 [1] and Red Book [1].

7.1.2.3 Slenderness

Unless otherwise specified, the ratio of effective length to the appropriate radius of gyration shall not exceed:

- 200 for elements in compression
- 300 for elements in tension

7.1.2.4 Temperature range

For structures subject to considerable temperature variation, consideration should be given to the effects of expansion and contraction and its secondary effects.

7.1.3 Construction Materials

Steel to be used for structures such as bridges, buildings, towers etc., shall be in accordance with SANS 50025 [1]. Steel to be used for special structures such as large diameter pipes, special bridges, tanks etc., shall be chosen in conjunction with the supply mill specifications. All special steel shall be selected taking into consideration its use and weld ability and it shall be approved by Eskom's Corporate Metallurgic Specialist.

7.1.4 Construction Details

7.1.4.1 General

Structures shall be designed and constructed such that the joints/nodes are accessible for proper inspection, cleaning and painting.
Pockets or depressions that could hold water shall have drain holes or shall be otherwise protected.

7.1.4.2 Structural Members

For open steel structures the thickness of any parts of structural members shall not be < 5 mm.

Gusset plates shall be designed for purpose, but shall never be less than the member thickness +1.00 or 6mm whichever is the greatest. Structural box thickness must never be less than 4mm, and shall be hot rolled steel members.

For overhead runway beams with under hung cranes, joists with inside tapered flanges are preferred. The bottom flange shall be checked separately for distortion, and reinforced if required.

Purlins shall be fixed to the roof beams or trusses by means of angle cleats.

7.1.4.3 Bolting

In general, bolts, nuts and threads shall comply with SANS 1700. Grade 10.9 and 10.9S bolts shall only be used with the written permission of the Principal. High-strength friction-grip bolts shall be used as in accordance with SANS 2001 [1] and SANS 10094 [1]. Galvanized bolts shall be avoided as far as possible.

Washers shall be used in all bolted connections. Plain material washers shall be provided according to SANS 1700-16-2 [1]and through-hardened washers shall comply with SANS 1700-16-3 **Error! Reference source not found.**.

Certification of bolts and washers shall take place in accordance with SANS 1556 [1].

7.1.4.4 Walkways, platforms, staircases, ladders and hand railing

All walkways, platforms, staircases, ladders and hand railing must comply with OHSA – General Safety Regulations [1].

The minimum width of walkways, platforms and staircases shall be at minimum 750 mm. The minimum headroom for platforms and walkways shall be 2 100 mm.

The width of walkways over ground level pipe tracks shall be 600 mm, and the walkways and steps shall be fitted with handrails of not less than 1000mm in height on both sides (except where there is an adjacent wall present).

For design criteria and details of staircases, refer to Standard Drawing 0.00/2901 [80]. All grating and stair treads shall be mechanically interlocked or of welded construction and shall have serrated non-slip bearer bars/non-skid nosing. All metal grating, stair treads and fasteners shall be hot dipped galvanized to SANS 4998 [1]

In an aggressive environment, 304 Stainless-steel shall be used or 3CR12 as appropriate.

GRP or aluminum stair treads shall not be used unless approved by the Principal.

Ladders may be installed instead of staircases if the ladders are only required for occasional use and not escape routes.

Where hand railing is installed, floors, platforms and walkways shall be provided with kick plates 100 mm x 6 mm.

On platforms, the distance to a stair or ladder shall not exceed 25 m.

7.1.4.5 Flooring and grating

Open flooring shall be used. Solid flooring shall not be used unless approved by the Principal. If used, it shall be made out of checkered floor plate of which the thickness shall exceed 6mm below checker thread.

Grating and fixing material shall be hot-dip galvanized GRP or aluminum grating shall not be applied unless approved by the Principal.

7.1.4.6 Anchor bolts

Anchor bolts can be made of Grade 4.8 or Grade 8.8 (preferred). They should be designed to resist tension and shear. The minimum diameter shall be not less than 16mm. Anchor bolts can also be chemical anchored bolts; in this case they shall be designed in accordance with the manufacturer’s instructions.

7.1.4.7 Accessories

7.1.4.7.1 Rainwater downpipes and roof gutters

Rainwater downpipes and roof gutters shall be made either of 1.5 mm thick steel sheet, hot-dip galvanized after construction, or of rigid PVC or equivalent. The bottom 2 m of exposed downpipe shall be of galvanized steel. Rainwater downpipes and roof gutters shall be installed in accordance with the recommendations as set out in Red Book: South African Steel Construction Handbook [1].

7.1.4.7.2 Roof and wall sheets

If the supply of roof and wall sheets is included in the order for the steel structure, the type required shall be stated. Only galvanized steel sheets or pre-coated sheeting shall be used. Coating shall provide maximum protection against the local climate and other environmental factors. The color of coating shall be selected in consultation with the Principal.

All hot dip galvanizing of coated carbon steel sheets shall be in accordance with the specifications as set out in SANS 3575 [1] and SANS 4998 [1]

7.1.4.7.3 Translucent sheet

Translucent sheeting shall be of the same size and profile as the adjacent wall cladding and/or roof sheeting.

The translucent sheets shall be of glass fibre reinforced polyester resin of self-extinguishing quality, with a resin rich external surface to prevent ageing. All GRP laminated sheets to comply with SANS 1150 [1]

7.1.5 Fireproofing of Steel Structures

The method and extent of fireproofing of the steel structure and parts thereof shall be approved by the Principal.

7.1.6 Structural Steel Drawing Specification

Part of the information/data supplied by the Principal may be in the form of one or more instruction drawings.

Only steel sizes and grades manufactured in South Africa should be specified unless otherwise specified by the Principal.

7.1.6.1 General arrangement drawings

This drawing shall show the complete structure to be supplied. All main dimensions and the section to be used shall be included.

All members to be fireproofed shall be marked FP.

The fireproofing zone shall be indicated on the general arrangement drawing.

7.1.6.2 Base plate drawing

This drawing shall show all dimensions and details of the base plate including holding-down bolts, which shall be taken into account in the design of the (concrete) foundation. Holding down bolt details and positions shall be shown on the foundation/concrete drawings.

When the need for a slight adjustment of the holding-down bolts during erection is expected, this shall be indicated on the drawing.

The scale for details shall be at least 1:10.

7.1.6.3 Construction drawings

These drawings shall clearly show all constructional details of the structure to be supplied.

The location of the various parts in the structure shall be indicated.

7.1.6.4 Scale of drawings

Drawings shall be made on an appropriate scale.

7.1.6.5 Mark drawing

On this drawing each part of the structure shall be properly marked for identification purposes.

7.1.7 Bills of material

Bills of material shall show the weights of all large members, for the purposes of transportation and erection at site, and also the total weight of the structure.

7.2 FABRICATION AND ERECTION

The designer shall at all times during his design consider the constructability of the design. Designs should be constructible and must include consideration of the manufacturing process and transportation to site.

8. DESIGN AND CALCULATIONS

8.1.1 CONCEPT DESIGN

Prior to starting the basic design, a concept design shall be made consisting of:

- Concept design drawings (8.1.1.1)
- Assumptions list (8.1.1.2)
- Cost estimation (8.1.1.3)
- Concept design report (8.1.1.4)

8.1.1.1 Concept Design Drawing

The drawings shall show the layout of the proposed structures and indicate the size and functional requirement.

8.1.1.2 Assumptions List

A list of both verified and unverified assumptions used during the concept design shall be populated to form part of the concept design report.

8.1.1.3 Cost Estimation

A high level cost estimation of the concept design shall be done to form part of the concept design.

8.1.1.4 Concept Design Report

The design report shall combine all concept design elements and provide a recommendation of the preferred design that should be developed in more detail during the basic design.

8.1.2 BASIC DESIGN

Prior to starting detailed design, a basic design shall be made consisting of:

- Basic design drawings (8.1.2.1),
- Calculation files (8.1.2.2),
- Stability check (8.1.2.3), and
- Main structural members (8.1.2.4).

8.1.2.1 Basic Design Drawings

The drawings shall show the proposed structure (in perspective and/or a series of cross sections).Structural members may be shown as single lines.

The drawings shall include the concrete layout of foundations, and also which part(s) of the structure will be steel and which part(s) concrete.

8.1.2.2 Basic Design Report

The design report shall include all calculations used to perform the design as appendices. Additionally, the design report shall provide a design philosophy/approach to clearly describe how the designer approached the design and what factors were taken into consideration.

The design report shall include a summary of the analysis performed (for the case where an analysis was performed) on the structure, therewith stating the loads in the main structural members (axial loads, bending moments, shear and if applicable, torsion), and the loads on the foundation (load per pile or per unit of area).

The calculations shall take into account the soil investigation report.

If any computer programs are to be used for the detailed design, these shall be identified during the basic design stage and all required documentation shall be supplied to demonstrate their accuracy and applicability.

8.1.2.3 Stability Check

The stability of structures shall be checked for the different load cases as specified in SANS 10160 and the necessary stability ratios shall be used in the calculations.

8.1.2.4 Main Structural Members

In the assessment of the sizes and dimensions of the main structural members, the most critical load combination shall be considered.

Structural details, such as connections of steel beams and columns or details of reinforcing steel over the full length of a reinforced concrete beam need not be shown. However, when prefabricated concrete elements are used the connections between the various elements shall be shown.

8.1.3 DETAILED DESIGN

The detailed design shall be an extension of the basic design.

The calculation shall clearly indicate:

a. The table of contents

b. **Design Criteria Statement / General Information**

   i. Design philosophy
   ii. Applicable Codes and literature with published dates, formulas, graphs and tables
   iii. Occupancy Category
   iv. Statement of Building(s) basic main force resisting systems (gravity and lateral), where applicable
   v. List of all assumptions made. (Unverified/verified)

c. **Calculation of Loads** (List and/or Calculate the following loads that are used / input into the structural analysis model)

   i. Permanent load

   - More detail/calculations about where and how the loads are applied (point loads, line loads, area loads, etc.)

   ii. Variable load

   - Imposed loads on roof, structure and platforms
   - Wind load calculations
     – Provide calculations showing the development of wind pressures for the main wind force resistance design
     – Provide calculation of total base shear from wind loading that a structure will experience (indicate if load factors are included or not included)
   - Coal loads
   - Dynamic loads
   - Crane Induced loads
   - Transportation induced loads

   iii. Seismic load

   Temperature loads and (friction loads where applicable)

   iv. Accidental load

   v. Other applicable loads as required

d. Load combinations

   i. All load combinations shall be considered according to SANS 10160 Part 1: Basis of Structural Design.

e. **Primary Superstructure Design** (Design Input and Output for structural analysis models: This is the data that would be produced from a structural analysis model. Any information that can be supplemented by a graphical image is preferred and beneficial)

   i. Design criteria input to the model

   ii. End fixity conditions

   iii. Member input

   - Unbraced lengths and factors
   - Type of members used, i.e. beam tension member, plates, etc.

   iv. Report on the reactions, deflections, member forces, moments and stresses in the structure

   v. Other important input or output

f. **Secondary Design** (Secondary calculations are completed to size secondary members that are not included in the structural analysis model. These could be hand calculations, machine aided calculations, or software developed calculations.)

   i. Wall girts

   ii. Purlins

   iii. Cladding

   iv. Brickwork and Blockwork

   v. Other secondary and miscellaneous items as required

g. **Crack width calculation checks:** Done in accordance with BS8007: Code of practise for design of concrete structures, for water retaining structures, and BD28/87: Early thermal cracking of concrete, for thermal cracking.

h. Bending and shear design calculations

i. Connection design and details

j. Baseplates and anchor rods

k. Dynamic analysis and design (if applicable)

l. Foundation design

   i. Applicable soil information must be recorded

   ii. The following checks must be in the design report:

   - Stability and soil verifications
     - Soil bearing capacity
     - Overturning safety
     - Sliding safety
     - Foundation settlements
     - Rotational stiffness

   iii. Structural calculations

   - Bending and shear design
   - Crack verification
   - Fatigue verification

   iv. Dynamic analysis and design (if applicable)

Calculations shall follow a logical sequence. It shall be illustrated how values were logically derived.

m. Detailed Design Drawings

   i. Detailed design drawings shall accompany the detailed design report.

8.2 DRAWINGS AND RELATED DOCUMENTS

8.2.1 GENERAL

Drawings shall be of the standard sizes e.g. A0, A1, A2, etc. They shall be suitably prepared to facilitate electronic storage and incorporate a revision numbering and indication system provided by the Principal.

Dimensions on the drawings shall be in the SI system.

Levels shall be indicated in metres, all other dimensions in millimetres.

All survey data shall be in accordance with the WGS84 coordinate system unless otherwise specified or agreed upon.

Layout drawings shall show the highest point of grade, 0.00, and the reference of this level to the local datum level.

All text shall be in English.

Each drawing shall bear the following information, in the bottom right-hand corner:

- Order number of the Principal
- Name of plant
- Name of unit
- Name of part of the unit

Only drawings marked "Issued for construction" shall be used at the site.

This mark "Issued for construction" can be given only by the Principal.

Drawings shall be submitted together with the relevant complete calculations, including those required for submission to local authorities.

Claim to all drawings prepared by the Contractor under any order placed by the Principal shall be vested in the Principal, and the latter shall have the right to use these drawings for any purpose without any obligation to the Contractor.

The Contractor shall not disclose or issue to third parties without written consent of the Principal any documents, drawings, etc., placed at his disposal by the Principal or any documents prepared by himself in connection with enquiries and orders for purposes other than the preparation of a quotation or carrying out these orders.

All drawings issued by the Contractor shall be signed by a professionally registered engineer; this signature shall be accompanied by the engineer’s professional registration number.

All drawings shall have Eskom numbers.

8.2.2 STRUCTURAL CONCRETE

8.2.2.1 Plan drawing

On this drawing the general information/data shall be shown as General Notes on the right-hand side of the drawing.

The general notes shall state that:

a. Levels are expressed in metres, with reference to the highest point of grade
b. Specify the type of coordinate system used on the drawings
c. Dimensions are expressed in millimetres
d. Bar diameters are expressed in millimetres

Furthermore, the general notes shall list:

e. The grade and finishes of concrete*
f. The grade of steel reinforcing bars*
g. The type of cement to be used*
h. Minimum formwork striking times*

* Including an indication for which part(s) each quality is to be used.

i. Concrete blinding (location, quality and thickness)

j. Polyethylene sheeting, if applicable (location and quality)

k. The concrete cover on bars (type of construction, location and thickness)

l. The list of reference drawings and related documents stating their titles and numbers

8.2.2.2 Detail drawings

On each of the detail drawings, the following information/data shall be listed:

a. For general notes, see Drawing No. ______

b. This detail drawing refers to Drawing No. ______

c. For bar bending schedule(s), see No. ______, sheet 1 to ______

8.2.2.3 Bending schedules

These schedules shall always be made, unless explicitly stated otherwise. The schedules shall preferably be prepared on separate sheets.

8.2.2.4 Scale of drawings

Plan drawings shall be made to a scale of 1:50 and detail drawings to a scale of 1:20.

9. APPROVAL AND AUTHORISATION

This document has been seen and accepted by:

Name	Designation
D Odendaal	Document Approved by TDAC ROD 13 February 2013
G Dudenska	Document Approved By CTC

10. REVISIONS

Date	Rev.	Compiler	Remarks
November 2012	0	J.P Vilonel	Draft Document for review
June 2013	1	J.P Vilonel	Final Document for Publication
February 2015	1.1	R van Dyk	Revised updated Draft Document
February 2015	1.2	R van Dyk	Final Draft for Comments Review
March 2015	1.3	R van Dyk	Updated Final Draft after Comments Review
March 2015	2	R van dyk	Final Rev 2 for Authorisation and Publication

11. DEVELOPMENT TEAM

The following people were involved in the development of this document:

- Corporate Specialist – Bruno Marrai
- Chief Structural Engineer – Kobus Vilonel
- Chief Structural Engineer – Leko Xulu
- Engineer – Alet Appelo
- Engineer – Jeandré le Roux
- Engineer – Riaan van Dyk
- Structural Design CoE Manager – Tejas Naidoo
- Specialist Consultant (Nyeleti Pty Ltd) – Piet Willemse

This document was sent out to all the Power Station Engineering Managers, who were requested to send it to Civil and Structural Engineers on site.

12. ACKNOWLEDGEMENTS

None