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Standard**

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1. INTRODUCTION

This document is the standard for Design of Steel Structures in Eskom

2. SUPPORTING CLAUSES

2.1 SCOPE

This document shall be used in conjunction with the minimum requirements for structural design and engineering.

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.

This document is intended for use in power generating facilities.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this document, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent, and which combination of requirements will be acceptable regarding safety, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this document which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this document as closely as possible.

2.1.1 Purpose

This document specifies requirements and gives recommendations for the design, fabrication and erection of steel structures.

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions.

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] Eskom document: Minimum requirements for structural design and engineering
- [2] Eskom document: Design and engineering of buildings
- [3] Standard drawing 0.00/2901
- [4] SANS 135
- [5] SANS 136
- [6] SANS 1143
- [7] SANS 1200

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2.2.2 Informative

None

2.3 DEFINITIONS

Definition	Description
Contractor	The Contractor is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the
Manufacturer/Supplier	The Manufacturer/Supplier is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.
Principal	The Principal is the party that 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 authorized to act for, and on behalf of, the Principal.
Shall	The word 'shall' indicates a requirement
Should	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
GRP	Glass reinforced Polyester
PVC	Polyvinyl Chloride

2.5 ROLES AND RESPONSIBILITIES

2.5.1 Contractor

The Contractor carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility.

2.5.2 Manufacturer/Supplier

The Manufacturer/Supplier manufactures or supplies equipment and services to perform the duties specified by the Contractor.

2.5.3 Principal

The Principal:

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- Initiates the project and ultimately pays for its design and construction.
- Will generally specify the technical requirements.
- May also include an agent or consultant authorized to act for, and on behalf of, the Principal.
- May undertake all or part of the duties of the Contractor.

2.6 PROCESS FOR MONITORING

None

2.7 RELATED/SUPPORTING DOCUMENTS

None

2.8 STEEL STRUCTURES DESIGN

2.8.1.1 General

The design of a steel structure shall take into account not only the properties of the materials of construction and the calculated stresses for the members, but also the prevailing conditions of the local environment and the requirements at site, the details of construction, methods of erection and fabrication and their effect on cost, in order to achieve a safe and economic design.

2.8.1.2 Design Requirements

2.8.1.2.1 General

The design shall comply with the requirements described in the following Eskom documents:

- Minimum requirements for structural design and engineering.
- Design and engineering of buildings.

2.8.1.2.2 Fatigue due to vortex shedding or other cyclic loads

For structures sensitive to the effects of vibration, calculations shall be made for vortex shedding and/or cyclic loads from other sources. The effects of fatigue shall be verified to be in compliance with recognized international standards.

The Palmgren-Miner's rule shall be applied to judge the combined effect of various types of cyclic loading, in compliance with recognized 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.

As most of the wind loads that contribute to fatigue are of a random nature, statistical consideration will normally be required for determining the long-term distribution of fatigue loading effects.

2.8.1.2.3 Maximum allowable stresses

The maximum allowable stress on foundations for steel structures shall not exceed the following values:

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Maximum Allowable Stress	kN/m ²
On concrete: sand cement grout	4.0
Non-shrink ready mixed grout	8.0
On masonry:	1.0

2.8.1.2.4 Deflection, lifting and displacement

a. Deflection

Unless otherwise specified, the following criteria for deflection shall apply for the load combinations:

- Wall stanchions: max. 1 / 300th of the height.
- Purlins: max. 1 / 250th of the span.
- Supporting beams: max. 1 / 400th of the span.

b. Lifting applications

- Crane gantry girders: max. 1 / 600th of the span.
- Overhead runway beams: max. 1 / 500th of the span.
- Cantilevered runway beams: max. 1 / 250th of the overhang.

c. Displacement

Maximum total horizontal displacement of portal frames shall not exceed 1/150th of the height.

2.8.1.2.5 Slenderness

Unless otherwise specified, the ratio of effective length to the appropriate radius of gyration shall not exceed 180.

2.8.1.2.6 Temperature range

Additional consideration will be necessary for structures in special conditions and in locations where wide temperature ranges occur.

2.8.1.3 Construction Materials

Materials shall be selected taking weldability into consideration.

2.8.1.4 Construction Details

2.8.1.4.1 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.

2.8.1.4.2 Structural members

For open steel structures higher than 20 m, the thickness of any parts of structural members shall not be < 6 mm.

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Gusset plates shall not be thinner than the members to be connected, and shall have a thickness of at least 6 mm.

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

The flange width of purlins supporting lightweight concrete slabs shall be not be < 80 mm. For supporting roof sheeting and wall cladding, the flange width shall be not be < 50 mm.

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

2.8.1.4.3 Bolting

Bolts, nuts and threads shall comply with SANS 135 [4], SANS 136 [5] and SANS 1143 [6], respectively. High-strength friction-grip bolts may be used for appropriate applications if approved by Eskom. Washers shall be used in all bolted connections.

2.8.1.4.4 Walkways, platforms, staircases, ladders and hand railing

The minimum width of walkways, platforms and staircases shall be 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 on one side only.

For design criteria and details of staircases, refer to Standard Drawing 0.00/2901 [3].

Stair treads shall be made of hot-dip galvanized grating.

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 escape routes.

Ladders should be made with side steps.

Where hand railing is installed, floors, platforms and walkways shall be provided with toe plates 75 mm x 6 mm.

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

2.8.1.4.5 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 6 mm or 8 mm checkered floor plate.

Grating and fixing material shall be hot-dip galvanized.

GRP or aluminium grating shall not be applied unless approved by the Principal.

2.8.1.4.6 Anchor bolts

If anchor bolts are included in the supply of the steel structure, they shall be fabricated and despatched to the construction site in advance for timely installation prior to concreting the foundations.

Anchor bolts shall be de-rusted and degreased. Thread and nuts shall be oil-dipped.

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2.8.1.5 Accessories

2.8.1.5.1 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.

2.8.1.5.2 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 shall be used, and they shall have a coating giving maximum protection against the local climate and other environmental factors. The type of coating shall be selected in consultation with the Principal.

The sheets shall be fixed in accordance with the sheet manufacturer's standards.

2.8.1.5.3 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.

2.8.1.6 Fireproofing of Steel Structures

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

Cover plates for the protection of fireproofing for stanchions and beams shall be included in the supply of the steel structures.

2.8.2 FABRICATION

2.8.2.1 Material

Only new material shall be used, which shall be thoroughly straightened in the shop by methods that will not cause damage before it is laid aside or worked in any way.

All bolting material required for erection, including washers and nuts, shall be furnished by the supplier of the steel structure, who shall allow 5% for spares.

2.8.2.2 Welding and Weld Inspection

Records of all data, tests and examinations relating to all welding procedures used during construction and erection shall be made available to Eskom.

2.8.3 PROTECTION AGAINST CORROSION

Protection against corrosion shall be in accordance with SANS 1200, Section HC [7].

Structural steelwork, platform flooring and hand railing located above stainless steel piping or equipment shall not be galvanized or coated with zinc-containing paint. The flooring shall be of stainless steel and

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the paint should be zinc-free. Alternatively, a shield of steel, coated with zinc-free paint, may be fitted to protect the stainless steel equipment.

If tubular members are used, they shall be designed to prevent ingress of rainwater and shall have adequate provisions for drainage of water condensate.

Tubular members shall be protected against internal and external corrosion.

2.8.4 ERECTION

2.8.4.1 General

The method used to erect a steel structure depends upon the type of structure, the size of the structure, the risk involved, whether the structure is to be erected without interfering with other work or operations, the lifting gear available and the local conditions.

All tools, equipment and ropes used for erection shall comply with national and/or local regulations and shall be certified for the purpose intended,

2.8.4.2 By Supplier of the Structure

If specified on the requisition, e.g. for complicated structures, the Supplier shall submit to the Principal an erection plan complete with data on heavy lifts, shipping weights and the calculations involved.

If the erection of the steel structure is not to be carried out by the Supplier, it shall provide Eskom with all information essential for erection of the structure.

2.8.4.3 Field Welding

Refer to Section 3.1.2.2

2.9 PROCEDURE — MAPPING

2.9.1 Entry Criteria

Not applicable.

2.9.2 Procedure Map

Not applicable.

2.9.3 Inputs

The inputs to the activities in this document are listed in Table 2:

Table 2: Inputs

Inputs	Detail of inputs and remarks	Reference*
Technical requirements	Provided by the principle	

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2.9.4 Activities

The activities performed as part of this document are listed in Table 3:

Table 3: Activities

No.	Activities	Action by	Detail of activities and remarks	Reference
1.	Design and Engineering	Contractor and Manufacturer / Supplier	Refer to paragraph 3.1.1	[1], [2], [3], [4], [5], [6]
2.	Fabrication	Contractor and Manufacturer / Supplier	Refer to paragraph 3.1.2	-
3.	Protection against Corrosion	Contractor and Manufacturer / Supplier	Refer to paragraph 3.1.3.	[7]
4.	Erection	Contractor and Manufacturer / Supplier	Refer to paragraph 3.1.4.	-

2.9.5 Outputs

The outputs produced or modified by the activities in this document are listed in Table 4:

Table 4: Outputs

Outputs	Detail of inputs and remarks	Reference*
Steel structures		

2.9.6 Exit / Measurement Criteria

The exit/measurement criteria listed in Table 5 must be fulfilled before the procedure/process can be declared 'complete':

Table 5: Exit/Measurement Criteria

Details of Exit / Measurement Criteria
Steel structures designed, fabricated, and erected in accordance with the requirements and recommendations of this document.

2.9.7 Training Requirements

How will this procedure/process be implemented in your area? This may include training, tools, workshops, communication materials, etc.

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2.9.8 Records Control Table

Description (No. and Name) ¹	Storage location ²	Filing / Index ³	Minimum Storage Period ⁴

Notes:

1. Number or title of the record or form.
2. Identifies where the item can be found.
3. Sequence of the document.
4. Amount of time a record or document will be kept once created.

3. AUTHORISATION

This document has been seen and accepted by:

Name	Designation
	Document Approved by TDAC ROD 13 February 2013

4. REVISIONS

Date	Rev.	Compiler	Remarks
November 2012	0	JP Vilonel	Draft Document for review created from 45-203
June 2013	1	JP Vilonel	Final Document for Publication

5. DEVELOPMENT TEAM

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

- Specialist
- Discipline Manager
- Senior Manager Power Plant
- Senior Manager Power Delivery
- Senior Manager Electrical C&I
- Senior Manager Civil
- Senior Manager Engineering Support
- Process Moderator

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6. ACKNOWLEDGEMENTS

None

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