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Structures for mine shafts —

Part 3: Sinking stages

Structures de puits de mine —

Partie 3: Plates-formes de fonçage

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 82, *Mining*.

A list of all parts in the ISO 19426 series can be found on the ISO website.

Introduction

Many mining companies, and many of the engineering companies which provide designs for mines, operate globally so ISO 19426 was developed in response to a desire for a unified global approach to the safe and robust design of structures for mine shafts. The characteristics of ore bodies, such as their depth and shape, vary in different areas so different design approaches have been developed and proven with use over time in different countries. Bringing these approaches together in ISO 19426 will facilitate improved safety and operational reliability.

The majority of the material in ISO 19426 deals with the loads to be applied in the design of structures for mine shafts. Some principles for structural design are given, but for the most part it is assumed that local standards will be used for the structural design. It is also recognized that typical equipment varies from country to country, so the clauses in ISO 19426 do not specify application of the principles to specific equipment. However, in some cases examples demonstrating the application of the principles to specific equipment are provided in informative Annexes.

Structures for mine shafts —

Part 3:
Sinking stages

1 Scope

This document specifies the design loads and the design procedures for the structural design of stages and components of stages.

The loads specified in this document are not applicable for the design of stage ropes or sheaves. Rope sizes are determined in accordance with other standards.

This document does not cover matters of operational safety, or layout of the sinking stage.

This document adopts a limit states design philosophy.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 10721-1, *Steel structures — Part 1: Materials and design*

ISO 10721-2, *Steel structures — Part 2: Fabrication and erection*

ISO 19426-1, *Structures for mine shafts — Part 1: Vocabulary*

ISO 22111, *Bases for design of structures — General requirements*

ISO 2394, *General principles on reliability for structures*

EN 1999-1-1, *Eurocode 9 — Part 1: Design of aluminium structures — Part 1: General structural rules*

EN 1999-1-3, *Eurocode 9 — Part 1: Design of aluminium structures — Part 3: Structures susceptible to fatigue*

EN 1999-1-4, *Eurocode 9 — Par 1: Design of aluminium structures — Part 4: Cold-formed structural sheeting*

CEN/TS 13001-3-1, *Cranes — General design — Part 3-1: Limit states and proof competence of steel structures*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 19426-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org

4 Symbols

C	lashing unit grab capacity (m^3)
E	emergency load, or load effect (N, Nm)
e_G	stage load eccentricity factor
E_a	emergency impact load (N)
E_p	emergency impact load on a protective platform (N)
E_R	emergency rope load (N)
F	design load, or load effect (N, Nm)
G	permanent load, or load effect (N, Nm)
G_D	jumbo unit self-weight (N)
G_L	lashing unit self-weight (N)
K	weight of the kibble and full load (N)
L	span of an element or floor beam (m)
L_1	lashing unit lever arm or the VSM lashing unit grab lever arm (m)
L_2	stage jack lever arm horizontal (m)
L_3	stage jack lever arm vertical (m)
L_4	jumbo unit centre of gravity lever arm or the VSM lashing unit centre of gravity lever arm (m)
L_{5i}	hydraulic cylinder horizontal lever arm to the boom pivot point (m)
L_{6i}	hydraulic cylinder vertical lever arm to the boom pivot point (m)
M_D	jumbo unit moment about the boom pivot point (Nm)
M_L	lashing unit moment about the boom pivot point (Nm)
N_L	total number of lashing unit cycles
P	payload used during doubling-down (N)
p_D	uniformly distributed load on stage decks (N/m^2)
P_A	canopy load (N)
P_B	blast load (N)
P_C	concentrated load on stage decks (N)
P_D	total uniformly distributed imposed load on stage decks (N)
P_G	stage skid load (N)
P_H	kibble cross-head support load (N)

P_J	stage jack load (N)
P_{JA}	stage jack axial load (N)
P_{JT}	stage jack transverse load (N)
P_K	kibble guide load (N)
P_{DH}	jumbo unit horizontal load (N)
P_{DV}	jumbo unit vertical load (N)
P_{LH}	horizontal lashing unit load (N)
P_{LV}	vertical lashing unit load (N)
P_P	special load (N)
P_R	hand railing load (N/m)
P_T	temporary stage support load (N)
P_W	winch load (N)
Q_1	predominant imposed load, or load effect (N, Nm)
Q_3 to Q_n	additional independent imposed loads, or load effects (N, Nm)
V_E	predominant imposed load, or load effect (N, Nm)
W_C	weight of the kibble cross-head (N)
W_{CHi}	horizontal hydraulic cylinder loads at maximum capacity (N)
W_{CVi}	vertical hydraulic cylinder load (N)
W_G	weight of the cactus grab including the grab crosshead (N)
W_{PL}	weight of rock in the lashing unit grab (N)
W_{DL}	jumbo drilling load (N)
W_K	weight of kibble and full load (N)
W_R	rated shutter winch load (N)
W_S	weight of the shutter (N)
W_W	grab winch safe working load (N)
α_B	bellmouth impact factor
α_C	impact factor for kibble cross-head support
α_D	jumbo unit impact factor
α_E	impact factor for emergency rope load
α_H	hydraulic cylinder impact factor
α_K	kibble guide impact factor

α_L lashing unit impact factor

α_J impact factor for stage jack load

α_R winch rated load impact factor

α_S formwork weight impact factor

α_T stage support impact factor

η efficiency factor

γ_e partial load factor for emergency load

γ_{fo} partial load factor for permanent load

γ_{f1} partial load factor for the predominant imposed load

γ_{f2} to γ_{fn} partial load factors for imposed load

Ψ_2 to Ψ_n load combination factors

5 Materials

5.1 Steel

5.1.1 Structural steel grades

The materials used for structural steel members should comply with the requirements of EN 10025-1 and EN 10025-2.

5.1.2 High strength steel grades

The materials for high strength steel members should conform to the requirements of EN 10025-6, EN 10149-1, EN 10149-2, or EN 10149-3.

5.2 Aluminium alloys

The materials used for aluminium alloy members should conform to the requirements of EN 573-3, EN 485-1 to EN 485-4 and EN 755-1 to EN 755-9.

NOTE The preferred alloys include 5083 H32 for 4 mm, 6 mm and 8 mm thick plates or 6082 T651 or 6061 T651 for 10 mm, 12 mm and 15 mm thick plates and 6061 T6 or 6082 T6 for extrusions.

6 Nominal loads

6.1 Permanent load

The permanent load, *G*, shall be as given in ISO 22111 and shall include the stage and all permanent fixtures and equipment necessary for the sinking and lining of the shaft.

6.2 Imposed loads

6.2.1 Stage deck load

The imposed load, P_D or P_C, on stage decks shall be the most adverse of the following:

a) a uniformly distributed load, P_D, of 3 000 N/m^2, which shall be taken to include concrete build-up loads, unless it can be demonstrated that there will be no build-up of concrete in which case take a uniformly distributed load, P_D, of 1 500 N/m^2. P_D is the total uniformly distributed load on stage decks which shall be calculated from the uniformly distributed load multiplied by the entire stage deck area; or

b) a concentrated load, P_C, of 5 000 N, placed in the position that produces the most severe effects in the member under consideration.

No area reduction factors shall be included when deck loads from one or more decks are being combined.

Due allowance shall be made for possible eccentric application of stage deck loads. Unless it can be shown that procedures are in place to ensure concentric placement of all deck loads, it shall be assumed that one half of each stage deck carries a load of 0,75 P_D, whilst the other half of the deck carries a load of 0,25 P_D.

6.2.2 Shaft formwork winch load

The shaft formwork winch load, P_W (N), shall be the greater of:

$$P_W = \alpha_S W_S, \text{ and} \quad (1)$$

$$P_W = \alpha_R W_R \quad (2)$$

where

W_S is the weight of the shaft formwork (N);

W_R is the rated shaft formwork winch load (N);

α_S is the formwork weight impact factor, which may be taken as 2,0;

α_R is the winch rated load impact factor, which may be taken as 1,5.

The shaft formwork winch load shall be appropriately distributed between the winches assuming that any one winch can fail.

6.2.3 Kibble cross-head support load

The kibble cross-head support load, P_H (N), shall be obtained from the following:

$$P_H = \alpha_C W_C \quad (3)$$

where

α_C is the impact factor for the kibble cross-head support, which if no better information is available may be taken as 2,0;

W_C is the weight of the kibble cross-head (N).