ISO/FDIS 22932-3:20XX(E)

ISO/TC 82/WG 8

Secretariat: DIN

Date: 2023-02-17

Mining — Vocabulary —

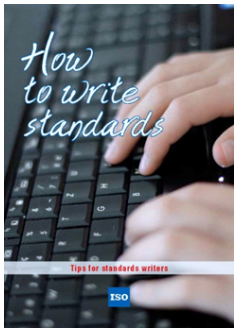
Part 3: Rock Mechanics mechanics

DIS

Warning for DIS

This document is not an ISO International Standard. It is distributed for review and comment. It is subject to change without notice and may not be referred to as an International Standard.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.



To help you, this guide on writing standards was produced by the ISO/TMb and is available at http://www.iso.org/iso/how-to-write-standards.pdf

FDIS stage

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: + 41 22 749 01 11
Email E-mail: copyright@iso.org
Website: www.iso.orgwww.iso.org

Published in Switzerland.

Contents

			Page
Foreword			iv
Introduction			v
1	Scope		1
2	Normative references		1
3	Terms and definitions		1
	3.1	General terms	1
	3.2	Stress	2
	3.3	Strain	9
	3.4	Both stress and strain	11
	3.5	Rock mass	14
	3.6	Discontinuity	20
	3.7	Anisotropy and inhomogeneity	31
	3.8	Mechanical behaviour of rock	32
	3.9	Physical properties of rock	38
Bibliography			46
Bibliography			47

Contents

Foreword vi
Introduction vii
Part 3: Rock mechanics 1
1 Scope 1
2 Normative references 1
3 Terms and definitions 1
3.1 General terms 1
3.2 Stress 2
3.3 Strain 8
3.4 Both stress and strain 10
3.5 Rock mass 13
3.6 Discontinuity 18
3.7 Anisotropy and inhomogeneity 27
3.8 Mechanical behaviour of rock 28
3.9 Physical properties of rock 34
Bibliography 40
Index 42

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 of 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 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 22932 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Field Code Changed

Introduction

The ISO 22932 series has been prepared in order to standardize and to co-ordinatecoordinate the global use of technical terms and definitions in mining, for the benefit of the experts working on different types of mining activities.

The need for the ISO 22932 series arose from the widely varying interpretation of terms used within the industry and the prevalent use of more than one synonym.

Mining —– Vocabulary —

Part 3:
Rock mechanics

1 Scope

This document specifies the ~~Rock Mechanics~~rock-mechanics terms commonly used in mining. Only those terms that have a specific meaning in this field are included.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

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

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

3.1 General terms

3.1.1
abrasion
rubbing and wearing away

[SOURCE: Reference [1~~ISRM~~], 235]

3.1.2
angle of repose
maximum angle with respect to the horizontal plane that the surface of a pile of a loose material will assume

[SOURCE: Reference [1~~ISRM~~], 3]

3.1.3
erosion
process whereby soil or *rock mass* (3.5.25~~(3.5.25)~~) is loosened or dissolved and removed from any part of the earth's surface

Note 1 to entry: It includes *weathering* (3.1.8~~(3.1.8),~~), solution and transportation.

[SOURCE: IS 11358:1987 ~~(Reaffirmed 2005),~~ 2.109, modified — Note 1 to entry was originally part of the definition]

3.1.4
incompetent rock
rock (3.1.5~~(3.1.5)~~) incapable of standing in underground opening or steep slopes at the surface without support

[SOURCE: IS 11358:1987 ~~(Reaffirmed 2005),~~ 2.155]

3.1.5
rock
solid material forming as part of the earths' crust

3.1.6
rock material
smallest element of *rocks* [3.1.5](3.1.5) not cut by any *fracture* [3.6.20](3.6.20)

Note 1 to entry: There are always some micro-fractures in the *rocks* [3.1.5](3.1.5) material.

[SOURCE: IS 11358:1987 (Reaffirmed 2005), 2.253, modified — Note 1 to entry was originally part of the definition.]

3.1.7
rock mechanics
theoretical and applied science of the mechanical behaviour of *rock* [3.1.5](3.1.5)

[SOURCE: Reference [1ISRM], 9]

3.1.8
weathering
process of disintegration and decomposition as a consequence of exposure to the atmosphere, to chemical action, and to the action of frost, water, and heat

[SOURCE: Reference [1ISRM], 99]

3.2 Stress

3.2.1
biaxial compression
compression caused by the application of *normal stresses* [3.2.20](3.2.20) in two perpendicular directions

[SOURCE: Reference [1ISRM], 20]

3.2.2
biaxial state of stress
state of *stress* [3.2.29](3.2.29) in which one of the three principal *stresses* [3.2.29](3.2.29) is zero

[SOURCE: Reference [1ISRM], 33]

3.2.3
coefficient of friction
μ
relating *normal stress* [3.2.20](3.2.20) and the corresponding critical *shear stress* [3.2.27](3.2.27) at which *sliding* [3.8.36](3.8.36) starts between two surfaces as follows:

$$\tau = \mu \cdot \sigma$$

where

- τ is the shear stress;
- μ is the coefficient of friction;
- σ is the normal stress.

[SOURCE: Reference [1ISRM], 1]

3.2.4
cohesion
<stress> shear resistance at zero *normal stress* (3.2.20~~(3.2.20)~~)

Note 1 to entry: An equivalent term in *rock mechanics* (3.1.7~~(3.1.7)~~) is intrinsic shear *strength* (3.9.31~~(3.9.32).~~).

Note 2 to entry: Compare with *cohesion* (3.9.8~~(3.9.8).~~).

[SOURCE: Reference [1~~ISRM~~], 72, modified — Note 1 to entry was originally part of the definition.]

3.2.5
competent ground
rock mass (3.5.25~~(3.5.25) -~~)*strength* (3.9.31~~(3.9.32)~~) which is higher than the ground *stresses* (3.2.29~~(3.2.29)~~) imposed

Note 1 to entry: See Reference [4~~[4].~~].

3.2.6
compressive stress
normal stress (3.2.20~~(3.2.20)~~) tending to shorten the body in the direction in which it acts

[SOURCE: Reference [1~~ISRM~~], 50]

3.2.7
critical stress
maximum and minimum *compressive stress* (3.2.6~~(3.2.6)~~) on the boundary of an opening

[SOURCE: IS 11358:1987 ~~(Reaffirmed 2005),~~ 2.75]

3.2.8
cyclical stress
stress (3.2.29~~(3.2.29)~~) produced by repeated stressing and de-stressing

[SOURCE: IS 11358:1987 ~~(Reaffirmed 2005),~~ 2.82, modified — The phrase "stress produced" has been added and "of material" was originally part of the definition~~].~~]

3.2.9
dilatancy
property of volume increase under loading

[SOURCE: Reference [1~~ISRM~~], 75]

3.2.10
effective stress
pore water pressure (3.9.20~~(3.9.20)~~) in *rock* (3.1.5~~(3.1.5)~~) as a factor affecting *rock* (3.1.5~~(3.1.5)~~)*strength* (3.9.31~~(3.9.32)~~)

Note 1 to entry: The effective *normal stress* (3.2.20~~(3.2.20)~~) is generally taken equal to the difference between normal stress ~~(3.2.20)~~ and the pore water pressure ~~(3.9.20).~~

Note 2 to entry: This is strictly valid only where pores, *cracks* (3.6.11~~(3.6.11)~~) and *fractures* (3.6.20~~(3.6.20)~~) are interconnected.

[SOURCE: IS 11358:1987 ~~(Reaffirmed 2005),~~ 2.107, modified — Notes 1 and 2 to entry were originally part of the definition.]

3.2.11
finite element
one of the regular geometrical shapes into which a figure is subdivided for the purpose of numerical *stress* (3.2.29~~(3.2.29)~~) analysis

[SOURCE: Reference [1ISRM], 17]

3.2.12
hydraulic fracturing
method to measure the principal *stress* (3.2.29(3.2.29)) situation by fracturing of the *rock* (3.1.5(3.1.5)) surrounding a section of a drill hole

Note 1 to entry: The *fracture* (3.6.20(3.6.20)) is obtained using increasing water pressure.

Note 2 to entry: See Reference [4[4].].

3.2.13
hydrostatic pressure
state of *stress* (3.2.29(3.2.29)) in which all the principal *stresses* (3.2.29(3.2.29)) are equal (and there is no *shear stress* (3.2.27(3.2.27))

[SOURCE: Reference [1ISRM], 48]

3.2.14
incompetent ground
overstressed *rock masses* (3.5.25(3.5.25))

Note 1 to entry: See Reference [4[4].].

3.2.15
inelastic deformation
portion of *deformation* (3.8.13(3.8.13)) under *stress* (3.2.29(3.2.29)) that is not annulled by removal of *stress* (3.2.29(3.2.29))

[SOURCE: Reference [1ISRM], 67]

3.2.16
keelformed overbreak
characteristic shape of overbreak caused by high, anisotropic *rock* (3.1.5(3.1.5))*stress* (3.2.29(3.2.29))

Note 1 to entry: See Reference [4[4].].

3.2.17
Kirsch's equation
equation, which may be used for evaluating the tangential *stresses* (3.2.29(3.2.29)) around tunnels and other underground openings

Note 1 to entry: See Reference [4[4].].

3.2.18
k-value
ratio between horizontal and vertical *stresses* (3.2.29(3.2.29)) within the *rock mass* (3.5.25)

Note 1 to entry: See Reference [4[4].].

3.2.19
Mohr's envelope
envelope of a sequence of Mohr's circles representing *stress* (3.2.29(3.2.29)) conditions at *failure* (3.6.15(3.6.15)) for a given material

[SOURCE: Reference [1ISRM], 12]

3.2.19.1
angle of internal friction
angle of shear resistance

angle, ϕ, (degrees) between the axis of *normal stress* [3.2.20{3.2.20}] and the tangent to the *Mohr's envelope* [3.2.19{}3.2.19] at a point representing a given *failure* [3.6.15{3.6.15}-]-*stress* [3.2.29{3.2.29}] condition for solid material

[SOURCE: Reference [1ISRM], 2]

3.2.20
normal stress
stress [3.2.29{3.2.29}] in a *rock* [3.1.5{3.1.5}] perpendicular to the *shear stress* [3.2.27{3.2.27}]

[SOURCE: IS 11358:1987 {Reaffirmed 2005}, 2.203, modified — The phrase "(normal)" was removed of the definition]

3.2.21
primary state of stress
state of *stress* [3.2.29{3.2.29}] in a geological formation before it is disturbed by an opening

Note 1 to entry: Adapted from Reference [1[SOURCE: ISRM adapted]

1.1.1
], 46.

3.2.22
primitive stress
virgin rock stress
ground which is in a state of equilibrium before excavation of a tunnel or any underground opening

Note 1 to entry: At this stage, the *stresses* [3.2.29{3.2.29}] at any point within the ground are termed as "primitive", "primary" or "pre-excavation" *stresses* [3.2.29{3.2.29}].

[SOURCE: IS 11358:1987 {Reaffirmed 2005}, 2.234, modified — Note 1 to entry was originally part of the definition.]

3.2.23
plasticity
property of a material to continue to deform indefinitely while sustaining a constant *stress* [3.2.29{3.2.29}]

[SOURCE: Reference [1ISRM], 94]

3.2.24
relaxation
rate of reduction of *stress* [3.2.29{3.2.29}] in a material due to *creep* [3.8.10{3.8.10}]

Note 1 to entry: An alternate term is *stress* [3.2.29{3.2.29}] relaxation.

[SOURCE: IS 11358:1987 {Reaffirmed 2005}, 2.240, modified — Note 1 to entry was originally part of the definition.]

3.2.25
residual stress
stress [3.2.29{3.2.29}] remaining in a solid under zero external *stress* [3.2.29{3.2.29}] after some process that causes the dimensions of the various parts of the solid to be incompatible under zero *stress* [3.2.29{3.2.29}]

EXAMPLE 1 *Deformation* [3.8.13{3.8.13}] under the action of external *stress* [3.2.29{3.2.29}] when some parts of the body suffer *permanent strain* [3.3.7{3.3.7}].

EXAMPLE 2 Heating or cooling of a body in which the thermal expansion coefficient is not uniform throughout the body.

[SOURCE: Reference [1~~ISRM~~], 49, modified — ~~Notes~~EXAMPLES 1 and 2 to entry were originally part of the definition.]

3.2.26
secondary state of stress
resulting state of *stress* (3.2.29~~(3.2.29)~~) in the *rock* (3.1.5~~(3.1.5)~~) around an opening

[SOURCE: Reference [1~~ISRM~~], 47, adapted]

3.2.27
shear stress
stress (3.2.29~~(3.2.29)~~) directed parallel to the surface element across which it acts

[SOURCE: Reference [1~~ISRM~~], 51]

3.2.28
stability
condition of a structure or a mass of material when it is able to support the applied *stress* (3.2.29~~(3.2.29)~~) for a long time without suffering any significant *deformation* (3.8.13~~(3.8.13)~~) or movement that is not reversed by the release of stress ~~(3.2.29)~~

[SOURCE: Reference [1~~ISRM~~], 15]

3.2.29
stress
force acting across a given surface element, divided by the area of the element as follows:

$$\sigma=\frac{F_{\mathrm{v}}}{A}$$

$$\tau=\frac{F_{\mathrm{h}}}{A}$$

~~where~~

~~σ is the normal stress;~~

~~τ is the shear stress;~~

~~F_{v} is the vertical force;~~

~~F_{h} is the horizontal force;~~

~~A is the area of element.~~

where

- σ is the *normal stress* (3.2.20);
- τ is the *shear stress* (3.2.27);
- F_{v} is the vertical force;
- F_{h} is the horizontal force;
- A is the area of element.

[SOURCE: Reference [1~~ISRM~~], 66]

3.2.30
stress concentration factor
ratio of tangential *stress* (3.2.29~~(3.2.29)~~) at a particular point along the periphery and the initial stress ~~(3.2.29)~~ before excavation at that point

Note 1 to entry: Stress (3.2.29) concentration takes place when a cavity is excavated in a *rock mass* (3.5.25(3.5.25).).

Note 2 to entry: The higher the stress (3.2.29) concentration factor, the greater are the chances of *failure* (3.6.15(3.6.15)) of the rock mass (3.5.25) or *rock burst* (3.8.30(3.8.30).).

[SOURCE: IS 11358:1987 (Reaffirmed 2005),, 2.311, modified — Notes 1 and 2 to entry were originally part of the definition.]

3.2.31
stress ellipsoid
representation of the state of *stress* (3.2.29(3.2.29)) in the form of an ellipsoid whose semi-axes are proportional to the magnitudes of the principal stresses (3.2.29) and lie in the principal directions

Note 1 to entry: The coordinates of a point *P* on this ellipse are proportional to the magnitudes of the respective components of the stress (3.2.29) across the plane normal to the direction *OP*, where *O* is the centercentre of the ellipsoid.

[SOURCE: Reference [1ISRM], 5, modified — Notes 2Note 1 to entry was originally part of the definition.]

3.2.32
tensile stress
normal stress (3.2.20(3.2.20)) tending to lengthen the body in the direction in which it acts

[SOURCE: Reference [1ISRM], 52]

3.2.33
thermal stress
internal *stress* (3.2.29(3.2.29),), caused in part by uneven heating

[SOURCE: IS 11358:1987 (Reaffirmed 2005),, 2.327]

3.2.34
triaxial compression
compression caused by the application of *normal stresses* (3.2.20(3.2.20)) in three perpendicular directions

[SOURCE: Reference [1ISRM], 21]

3.2.35
triaxial state of stress
state of *stress* (3.2.29(3.2.29)) in which none of the three principal stresses (3.2.29) is zero

[SOURCE: Reference [1ISRM], 24]

3.2.36
uniaxial compression
unconfined compression
compression caused by the application of *normal stress* (3.2.20(3.2.20)) in a single direction

[SOURCE: Reference [1ISRM], 19]

3.2.37
uniaxial state of stress
state of *stress* (3.2.29(3.2.29)) in which two of the three principal stresses (3.2.29) are zero

[SOURCE: Reference [1ISRM], 22]