
Bases for design of structures — Accidental actions

Bases du calcul des constructions — Actions accidentelles



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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).

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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 98, *Bases for design of structures*, Subcommittee SC 3, *Loads, forces and other actions*.

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.

Introduction

This document provides requirements and guidelines for the design and assessment of structures in relation to the possible occurrence of accidental actions induced by human activities. Fire and man-made earthquake, however, are not included.

This document is fully aligned with ISO 2394 and gives information for risk informed decision making and semi-probabilistic design and assessment. Like in most modern codes nowadays, attention is given to explicit modelling of hazard scenarios as well as to more implicit safety measurements following from robustness requirements.

This document aims at promoting harmonization of design practice internationally and unification between the respective codes and standards such as for actions and resistance for the respective structural materials.

The principles and appropriate instruments to ensure adequate levels of reliability provide for special classes of structures or projects where the common experience base need to be extended in a rational manner.

The informative annexes included in this document provide support for the interpretation and the use of the principles contained in the normative clauses.

Bases for design of structures — Accidental actions

1 Scope

Accidental actions can be subdivided into accidental actions with a natural cause and accidental actions due to human activities. This document applies to reliability based and risk informed decision making for the design and assessment of structures subject to accidental actions due to human activities. However, fires and human-made earthquakes are not included.

The information presented in this document is intended for buildings and civil engineering works, regardless of the nature of their application and the use or combination of materials. The application of this document can require additional elements or elaboration in special cases.

This document is intended to serve as a basis for those committees that are responsible for the task of preparing International Standards, national standards or codes of practice in accordance with given objectives and context in a particular country. Where relevant, it can also be applied directly to specific cases.

This document describes how the principles of risk and reliability can be utilized to support decisions related to the design and assessment of structures subject to accidental actions and systems involving structures during all the phases of their service life. For the general principles of risk informed design and assessment, it is intended that ISO 2394 be considered.

The application of this document necessitates knowledge beyond that which it contains. It is the responsibility of the user to ensure that this knowledge is available and applied.

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 editions cited here apply. For undated references, the latest editions of the referenced documents (including any amendments) apply.

ISO 2394:2015, *General principles on reliability for structures*

ISO 8930, *General principles on reliability for structures — Vocabulary*

3 Terms and definitions

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

For the purposes of this document, the terms and definitions given in ISO 2394 and ISO 8930 and the following apply.

3.1

barriers and shock absorbers

objects or structural devices intended to absorb part of the impact energy in order to protect the structure

3.2

burning velocity

rate of flame propagation relative to the velocity of the unburned dust, gas or vapour that is ahead of it

3.3
deflagration

propagation of a combustion zone at a velocity that is lower than the speed of sound in the unreacted medium

3.4
detonation

propagation of a combustion zone at a velocity that is greater than the speed of sound in the unreacted medium

3.5
dynamic load

time variant load or action that causes significant dynamic effects in the structure or in structural elements

Note 1 to entry: This means that the acceleration is not negligible; as a consequence, equations of motion should be used instead of equations of equilibrium.

Note 2 to entry: In the case of impact, the dynamic load represents a force on an associated contact area at the point of impact.

3.6
equivalent static load

alternative and usually conservative representation of a *dynamic load* (3.6) suitable for a static structural analysis

3.7
explosion

physical and/or chemical process of abrupt release of energy leading to short pressure waves of very high intensity

3.8
flame propagation

speed of a flame front relative to a fixed reference point

3.9
impact

event occurring when one object comes into contact with another one, where the contact force is of short duration

3.10
impacting object

vehicle, ship, etc. colliding with a structure

3.11
key element

structural member upon which the stability of a part of remainder of the structure depends

3.12
local damage

localised failure of a part of a structure that is severely disabled by an accidental event

3.13
unidentified action

accidental action or event that is unknown or unforeseen and cannot be considered by explicit analysis in the design or assessment

3.14**venting panel**

non-structural part of the enclosure (wall, floor, ceiling) with limited resistance that is intended to relieve the developing pressure from *deflagration* (3.4) in order to reduce pressure on other parts of the building

4 Symbols and abbreviated terms**4.1 General**

The symbols listed in this clause are used generally throughout the document. Symbols which are used only in one section are explained there and not listed here. All the symbols are based on ISO 3898.

4.2 Latin upper case letters

A	accidental action, (cross sectional) area
A_d	design value of an accidental action
D	diameter
E	modulus of elasticity, action effect, energy
E_{kin}	kinetic energy
E_{def}	deformation energy
F	action, load in general, collision force
F_R	frictional impact force
H	height
K_G	deflagration index of a gas cloud
K_{St}	deflagration index of a dust cloud
L	length
P	probability
P_f	probability of failure
P_{ft}	target probability of failure
P_s	probability of survival
R	resistance
T	temperature, period of time
T_e	period of time to be considered in a damaged situation
T_{ref}	reference period of time
U	severity (magnitude) of the source of an action

4.3 Latin lower case letters

a	acceleration, geometric parameter
b	geometric parameter
c	wave propagation speed
f	the event of failure, material strength parameter
$f_X(x)$	probability density function of X with dummy variable x
$g(X, t)$	limit state function
h	height
h_a	height of the application area of a collision force
i	impulse per unit of area resulting from explosion
k	stiffness
l	length
m	mass
p	momentum (impulse); pressure
p_{stat}	static activation pressure that activates a vent opening when the pressure is increased slowly
r	distance parameter
r_F	reduction factor
t	time
u	displacement;
u_o	maximum possible displacement (crumble length of impacting object)
v	velocity

4.4 Greek letters

Δ	interval
β	reliability index
β_t	target reliability index
ε	strain
γ	partial factor
γ_f	partial factors for actions
λ	rate of relevant events