SLOVENSKI STANDARD

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Eurocode 6 - Design of masonry structures - Part 1-2: General rules - Structural fire design

Eurocode 6 - Bemessung und Konstruktion von Mauerwerksbauten - Allgemeine Regeln -Teil 1-2: Tragwerksbemessung für den Brandfall

Eurocode 6 - Calcul des ouvrages en maçonnerie - Partie 1-2: Regles générales - Calcul du comportement au feu

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ICS:

13.220.50	Požarna odpornost gradbenih materialov in elementov	Fire-resistance of building materials and elements
91.010.30	Tehniļ ni vidiki	Technical aspects
91.080.30	Zidane konstrukcije	Masonry

SIST EN 1996-1-2:2005 **en**

EUROPEAN STANDARD

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Eurocode 6 - Design of masonry structures - Part 1-2: General rules - Structural fire design

Eurocode 6 - Calcul des ouvrages en maçonnerie - Partie 1-2: Règles générales - Calcul du comportement au feu

Eurocode 6 - Bemessung und Konstruktion von Mauerwerksbauten - Teil 1-2: Allgemeine Regeln - Tragwerksbemessung für den Brandfall

This European Standard was approved by CEN on 4 November 2004.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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Foreword

This document (EN 1996-1-2:2005) has been prepared by Technical Committee CEN/TC 250 "Structural Eurocodes", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2005 and conflicting national standards shall be withdrawn at the latest by March 2010.

This document supersedes ENV 1996-1-2:1995.

CEN/TC 250 is responsible for all Structural Eurocodes.

Background of the Eurocode programme

In 1975, the Commission of the European Community decided on an action programme in the field of construction, based on article 95 of the Treaty. The objective of the programme was the elimination of technical obstacles to trade and the harmonisation of technical specifications.

Within this action programme, the Commission took the initiative to establish a set of harmonised technical rules for the design of construction works which, in a first stage, would serve as an alternative to the national rules in force in the Member States and, ultimately, would replace them.

For fifteen years, the Commission, with the help of a Steering Committee with Representatives of Member States, conducted the development of the Eurocodes programme, which led to the first generation of European codes in the 1980's.

In 1989, the Commission and the Member States of the EU and EFTA decided, on the basis of an agreement[1] between the Commission and CEN, to transfer the preparation and the publication of the Eurocodes to the CEN through a series of Mandates, in order to provide them with a future status of European Standard (EN). This links *de facto* the Eurocodes with the provisions of all the Council's Directives and/or Commission's Decisions dealing with European standards (e.g. the Council Directive 89/106/EEC on construction products - CPD - and Council Directives 93/37/EEC, 92/50/EEC and 89/440/EEC on public works and services and equivalent EFTA Directives initiated in pursuit of setting up the internal market).

The Structural Eurocode programme comprises the following standards generally consisting of a number of Parts:

EN 1990	Eurocode :	Basis of Structural Design
EN 1991	Eurocode 1:	Actions on structures
EN 1992	Eurocode 2:	Design of concrete structures
EN 1993	Eurocode 3:	Design of steel structures
EN 1994	Eurocode 4:	Design of composite steel and concrete structures

[1] Agreement between the Commission of the European Communities and the European Committee for Standardisation (CEN) concerning the work on EUROCODES for the design of building and civil engineering works (BC/CEN/03/89).

EN 1995	Eurocode 5:	Design of timber structures
EN 1996	Eurocode 6:	Design of masonry structures
EN 1997	Eurocode 7:	Geotechnical design
EN 1998	Eurocode 8:	Design of structures for earthquake resistance
EN 1999	Eurocode 9:	Design of aluminium structures

Eurocode standards recognise the responsibility of regulatory authorities in each Member State and have safeguarded their right to determine values related to regulatory safety matters at national level where these continue to vary from State to State.

Status and field of application of Eurocodes

The Member States of the EU and EFTA recognise that EUROCODES serve as reference documents for the following purposes:

- as a means to prove compliance of building and civil engineering works with the essential requirements of Council Directive 89/106/EEC, particularly Essential Requirement N°1 – Mechanical resistance and stability – and Essential Requirement N°2 – Safety in case of fire;

- as a basis for specifying contracts for construction works and related engineering services;

- as a framework for drawing up harmonised technical specifications for construction products (ENs and ETAs)

The Eurocodes, as far as they concern the construction works themselves, have a direct relationship with the Interpretative Documents[2] referred to in Article 12 of the CPD, although they are of a different nature from harmonised product standards[3]. Therefore, technical aspects arising from the Eurocodes work need to be adequately considered by CEN Technical Committees and/or EOTA Working Groups working on product standards with a view to achieving full compatibility of these technical specifications with the Eurocodes.

The Eurocode standards provide common structural design rules for everyday use for the design of whole structures and component products of both a traditional and an innovative nature. Unusual forms of construction or design conditions are not specifically covered and additional expert consideration will be required by the designer in such cases.

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[2] According to Art. 3.3 of the CPD, the essential requirements (ERs) shall be given concrete form in interpretative documents for the creation of the necessary links between the essential requirements and the mandates for harmonised ENs and ETAGs/ETAs.

[3] According to Art. 12 of the CPD the interpretative documents shall :

a) give concrete form to the essential requirements by harmonising the terminology and the technical bases and indicating classes or levels for each requirement where necessary ;

b) indicate methods of correlating these classes or levels of requirement with the technical specifications, e.g. methods of calculation and of proof, technical rules for project design, etc. ;

c) serve as a reference for the establishment of harmonised standards and guidelines for European technical approvals.

The Eurocodes, *de facto*, play a similar role in the field of the ER 1 and a part of ER 2.

National Standards implementing Eurocodes

The National Standards implementing Eurocodes will comprise the full text of the Eurocode (including any annexes), as published by CEN, which may be preceded by a National title page and National foreword, and may be followed by a National Annex.

The National Annex may only contain information on those parameters which are left open in the Eurocode for national choice, known as Nationally Determined Parameters, to be used for the design of buildings and civil engineering works to be constructed in the country concerned, *i.e.* :

- values and/or classes where alternatives are given in the Eurocode,
- values to be used where a symbol only is given in the Eurocode,
- country specific data (geographical, climatic, etc.), e.g. snow map,
- the procedure to be used where alternative procedures are given in the Eurocode,

and it may also contain

- decisions on the application of informative annexes,
- references to non-contradictory complementary information to assist the user to apply the Eurocode.

Links between Eurocodes and products harmonised technical specifications (ENs and ETAs)

There is a need for consistency between the harmonised technical specifications for construction products and the technical rules for works[4]. Furthermore, all the information accompanying the CE Marking of the construction products which refer to Eurocodes should clearly mention which Nationally Determined Parameters have been taken into account.

This European Standard is part of EN 1996 which comprises the following parts:

EN 1996-1-1: Common rules for reinforced and unreinforced masonry structures.

EN 1996-1-2: General Rules - Structural Fire Design.

EN 1996-2: Design, Selection of materials and execution of masonry

EN 1996-3: Simplified calculation methods and simple rules for masonry structures

EN 1996-1-2 is intended to be used together with EN 1990, EN 1991-1-2, EN 1996-1-1, EN 1996-2 and EN 1996-3

[4] see Art.3.3 and Art.12 of the CPD, as well as clauses 4.2, 4.3.1, 4.3.2 and 5.2 of ID 1.

Additional information specific to EN 1996-1-2

The general objectives of fire protection are to limit risks with respect to the individual and society, neighbouring property, and where required, directly exposed property, in the case of fire.

The Construction Products Directive 89/106/EEC gives the following essential requirement for the limitation of fire risks:

"The construction works must be designed and built in such a way that, in the event of an outbreak of fire

- the load bearing resistance of the construction can be assumed for a specified period of time

- the generation and spread of fire and smoke within the works are limited

- the spread of fire to neighbouring construction works is limited

- the occupants can leave the works or can be rescued by other means

- the safety of rescue teams is taken into consideration".

According to the Interpretative Document No 2 "Safety in Case of Fire" the essential requirement may be observed by following various possibilities for fire safety strategies prevailing in the Member States like conventional fire scenarios (nominal fires) or 'natural' (parametric) fire scenarios, including passive and/or active fire protection measures.

The fire parts of Structural Eurocodes deal with specific aspects of passive fire protection in terms of designing structures and parts thereof for adequate load bearing resistance that could be needed for safe evacuation of occupants and fire rescue operations and for limiting fire spread as relevant.

Required functions and levels of performance are generally specified by the national authorities - mostly in terms of a standard fire resistance rating. Where fire safety engineering for assessing passive and active measures is acceptable, requirements by authorities will be less prescriptive and may allow for alternative strategies.

This Part 1-2, together with EN 1991-1-2, Actions on structures exposed to fire, supplements EN 1996-1-1, so that the design of masonry structures can comply with normal and fire requirements.

Supplementary requirements concerning, for example

- the possible installation and maintenance of sprinkler systems

- conditions on occupancy of building or fire compartment

- the use of approved insulation and coating materials, including their maintenance

are not given in this document, as they are subject to specification by the competent authority.

A full analytical procedure for structural fire design would take into account the behaviour of the structural system at elevated temperatures, the potential heat exposure and the beneficial effects of active fire protection systems, together with the uncertainties associated with these three features and the importance of the structure (consequences of failure).

At the present time it is possible to perform a calculation procedure for determining adequate performance which incorporates some, if not all, of these parameters and to demonstrate that the structure, or its components, will give adequate performance in a real building fire. However the principal current procedure in European countries is one based on results from standard fire resistance tests. The grading system in regulations, which call for specific periods of fire resistance, takes into account (though not explicitly), the features and uncertainties described above.

Due to the limitations of the test method, further tests or analyses may be used. Nevertheless, the results of standard fire tests form the bulk of input for calculation procedures for structural fire design. This standard therefore deals principally with the design for the standard fire resistance.

Application of this Part 1-2 of Eurocode 6 with the thermal actions given in EN 1991-1-2, is illustrated in figure 0.1. For design according to this part, EN 1991-1-2 is required for the determination of temperature fields in structural elements, or when using general calculation models for the analysis of the structural response.

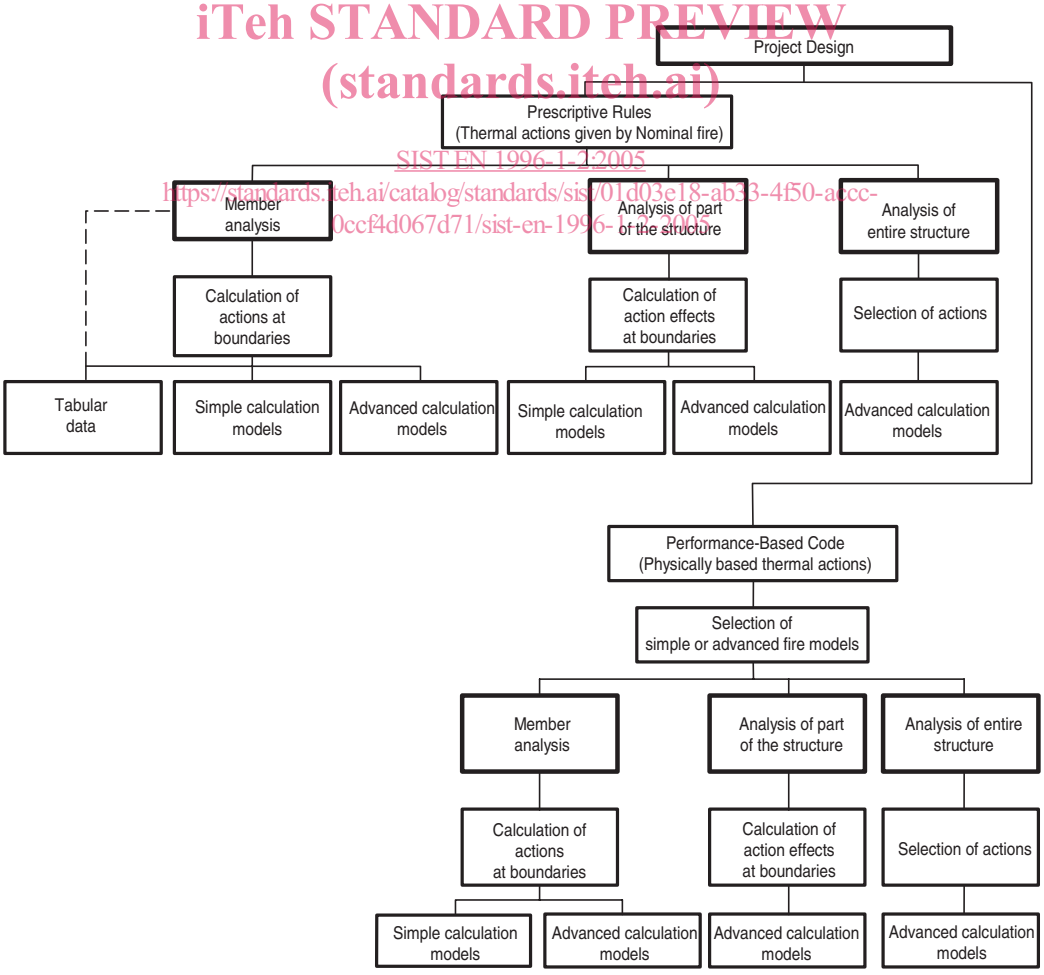

Figure 0.1 : Design procedures

Where simple calculation models are not available, the Eurocode fire parts give design solutions in terms of tabular data (based on tests or general calculation models), which may be used within the specified limits of validity.

National Annex for EN 1996-1-2

This standard gives alternative procedures, values and recommendations for classes, with notes indicating where national choices may have to be made. Therefore the National Standard implementing EN 1996-1-2 should include a National annex which contains all Nationally Determined Parameters to be used for the design of buildings and civil engineering works constructed in the relevant country.

National choice is allowed in EN 1996-1-2 through clauses:

- 2.2 (2) Actions;
- 2.3 (2) Design values of material properties;
- 2.4.2 (3) Member analysis;
- 3.3.3.1(1) Thermal elongation;
- 3.3.3.2 (1) Specific heat;
- 3.3.3.3 Thermal conductivity;
- 4.5(3) Value of γ_{Glo};
- Annex B Tabulated values of fire resistance of masonry walls;
- Annex C Values of constant c.

Section 1. General

1.1 Scope

(1)P This Part 1-2 of EN 1996 deals with the design of masonry structures for the accidental situation of fire exposure, and is intended to be used in conjunction with EN 1996-1-1, EN 1996-2, 1996-3 and EN 1991-1-2. This part 1-2 only identifies differences from, or supplements to, normal temperature design.

(2)P This Part 1-2 deals only with passive methods of fire protection. Active methods are not covered.

(3)P This Part 1-2 applies to masonry structures which, for reasons of general fire safety, are required to fulfil certain functions when exposed to fire, in terms of:

- avoiding premature collapse of the structure (load bearing function)
- limiting fire spread (flames, hot gases, excessive heat) beyond designated areas (separating function)

(4)P This Part 1-2 gives principles and application rules for designing structures for specified requirements in respect of the aforementioned functions and levels of performance.

(5)P This Part 1-2 applies to structures, or parts of structures, that are within the scope of EN 1996-1-1, EN 1996-2 and EN 1996-3 and are designed accordingly.

(6)P This Part 1-2 does not cover masonry built with Natural Stone units to EN771-6

(7)P This Part 1-2 deals with the following:

- non-loadbearing internal walls.
- non-loadbearing external walls.
- loadbearing internal walls with separating or non-separating functions.
- loadbearing external walls with separating or non-separating functions.

1.2 Normative references

This European standard incorporates by dated or undated references, provisions from other publications. These Normative references are cited at appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to, or revisions of, any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies (including amendments).

EN 771-1 Specification for masonry units - Part 1: Clay masonry units.

EN 771-2 Specification for masonry units - Part 2: Calcium silicate masonry units

EN 771-3 Specification for masonry units - Part 3: Aggregate concrete masonry units (dense and light-weight aggregates)

EN 771-4 Specification for masonry units - Part 4: Autoclaved aerated concrete masonry units

EN 771-5 Specification for masonry units - Part 5: Manufactured stone masonry units

EN 771-6 Specification for masonry units - Part 6 : Natural stone units

EN 772-13 Methods of test for masonry units - Part 13: Determination of net and gross dry density of masonry units (except for natural stone)

EN 998-1 Specification for mortar for masonry - Part 1: Rendering and plastering mortar

EN 998-2 Specification for mortar for masonry - Part 2: Masonry mortar.

EN 1363 Fire resistance
Part 1: General requirements
Part 2: Alternative and additional requirements

EN 1364 Fire resistance tests of non-loadbearing elements.
Part 1 Walls

EN 1365 Fire resistance tests of loadbearing elements.
Part 1 Walls

EN 1365 Fire resistance tests of loadbearing elements.
Part 4 Columns

EN 1366 Fire resistance tests for service installations.

Part 3 Penetration seals

EN 1990 Basis of design for Structural Eurocodes

EN 1991 Basis of design and actions on structures:
Part 1-1: General actions - Densities, self-weight, imposed loads for buildings
Part 1-2: Actions on structures exposed to fire;

EN 1996 Design of masonry structures:
Part 1.1: Common rules for reinforced and unreinforced masonry structures
Part 2: Design, selection of materials and execution of masonry
Part 3: Simplified and simple rules for masonry structures

prEN 12602 Prefabricated reinforced components of autoclaved aerated concrete
Annex C – Resistance to fire design of AAC components and structures

EN 13279-1 Gypsum and gypsum-based building plaster - Part 1: Definitions and requirements

1.3 Assumptions

(1) P In addition to the general assumptions of EN 1990 the following assumptions apply:

- Any passive fire protection systems taken into account in the design will be adequately maintained.
- The choice of the relevant design fire scenario is made by appropiately qualified and experienced personnel.

1.4 Distinction between Principles and application Rules

(1) The rules given in EN 1990 clause 1.4 apply.

1.5 Definitions

For the purposes of this Part 1-2 of EN 1996, the definitions of EN 1990 and of EN 1991-1-2 apply with the following additional definitions:

1.5.1 Special terms relating to fire design in general

1.5.1.1
Fire protection material
Any material or combination of materials applied to a structural member for the purpose of increasing its fire resistance

1.5.1.2
Fire wall
A wall separating two spaces (generally two fire compartments or buildings) which is designed for fire resistance and structural stability, including resistance to mechanical impact (Criterion M) such that, in the case of fire and failure of the structure on one side of the wall, fire spread beyond the wall is avoided (so that a Fire wall is designated REI-M or EI-M)

NOTE: In some countries a fire wall has been defined as a separating wall between fire compartments without a requirement for resistance to mechanical impact; the definition above should not be confused with this more limited one. Fire walls may have to fulfil additional requirements not given in this part 1-2, these being given in the regulations of each country

1.5.1.3
Loadbearing wall
A flat, membrane-like component predominantly subjected to compressive stress, for supporting vertical loads, for example floor loads, and also for supporting horizontal loads, for example wind loads.

15.1.4
Non-loadbearing wall
A flat membrane-like building component loaded predominantly only by its dead weight, and which does not provide bracing for loadbearing walls. It may however, be required to transfer horizontal loads acting on its surface to loadbearing building components such as walls or floors.

1.5.1.5
Separating wall
A wall exposed to fire on one side only.

1.5.1.6
Non-separating wall
A loadbearing wall exposed to fire on two or more sides.

1.5.1.7
Normal temperature design
The ultimate limit state design for ambient temperatures in accordance with Part 1-1 of EN 1992 to 1996 or ENV 1999

1.5.1.8
Part of structure
The isolated part of an entire structure with appropriate support and boundary conditions.

1.5.2 Special terms relating to calculation methods

1.5.2.1
Ineffective cross section
The area of a cross section that is assumed to become ineffective for fire resistance purposes.

1.5.2.2.
Effective cross section
The cross section of a member used in structural fire design, obtained by removing parts of the cross section with assumed zero strength and stiffness.

1.5.2.3.
Residual cross section
That part of the cross section of the original member which is assumed to remain after deduction of the thickness which is ineffective for fire-resistance purposes.

1.5.2.4
Structural failure of a wall in the fire situation
When the wall loses its ability to carry a specified load after a certain period of time

1.5.2.5
Maximum stress level
For a given temperature, the stress level at which the stress-strain relationship of masonry is truncated to a yield plateau.

1.6 Symbols

For the purpose of this Part 1-2, the following symbols apply, in addition to those given in EN 1991-1-1 and EN 1991-1-2:

E 30 or E 60,. . ., member meeting the integrity criterion, E, for 30, or 60 .. minutes in standard fire exposure.

I 30 or I 60,. . ., member meeting the thermal insulation criterion, I, for 30, or 60 .. minutes in standard fire exposure.

M 90 or M 120,. . ., member meeting the mechanical resistance criterion, M, for 90, or 120 .. minutes after standard fire exposure when mechanical impact applied .

R 30 or R 60,. . ., member meeting the load bearing criterion, R, for 30, or 60 .. minutes in standard fire exposure,

A total area of masonry

A_m surface area of a member per unit length;

A_p area of the inner surface of the fire protection material per unit length of the member;

A_{θ_1} area of masonry up to temperature θ_1;

A_{θ_2} area of masonry between temperatures θ_1 and θ_2;