SLOVENSKI STANDARD
oSIST prEN 1992-1-2:2021

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Evrokod 2: Projektiranje betonskih konstrukcij - 1-2. del: Splošna pravila - Projektiranje požarnovarnih konstrukcij

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

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

Eurocode 2: Calcul des structures en béton - Partie 1-2: Règles générales - Calcul du comportement au feu

Ta slovenski standard je istoveten z: **prEN 1992-1-2**

ICS:

13.220.50	Požarna odpornost gradbenih materialov in elementov	Fire-resistance of building materials and elements
91.010.30	Tehnični vidiki	Technical aspects
91.080.40	Betonske konstrukcije	Concrete structures

oSIST prEN 1992-1-2:2021 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 1992-1-2

September 2021

ICS 91.010.30; 91.080.40

Will supersede EN 1992-1-2:2004

English Version

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

Eurocode 2: Calcul des structures en béton - Partie 1-2: Règles générales - Calcul du comportement au feu

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

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 250.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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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.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (prEN 1992-1-2:2021) has been prepared by Technical Committee CEN/TC 250 "Structural Codes", the secretariat of which is held by BSI. CEN/TC 250 is responsible for all Structural Eurocodes and has been assigned responsibility for structural and geotechnical design matters by CEN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 1992-1-2:2004 and its amendments and corrigenda.

The first generation of EN Eurocodes was published between 2002 and 2007. This document forms part of the second generation of the Eurocodes, which have been prepared under Mandate M/515 issued to CEN by the European Commission and the European Free Trade Association.

The Eurocodes have been drafted to be used in conjunction with relevant execution, material, product and test standards, and to identify requirements for execution, materials, products and testing that are relied upon by the Eurocodes.

The Eurocodes recognize the responsibility of each Member State and have safeguarded their right to determine values related to regulatory safety matters at national level through the use of National Annexes.

0 Introduction

0.1 Introduction to the Eurocodes

The Structural Eurocodes comprise the following standards generally consisting of a number of Parts:

— EN 1990, *Eurocode: Basis of structural and geotechnical 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*

— 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*

— <New parts>

The Eurocodes are intended for use by designers, clients, manufacturers, constructors, relevant authorities (in exercising their duties in accordance with national or international regulations), educators, software developers, and committees drafting standards for related product, testing and execution standards.

NOTE Some aspects of design are most appropriately specified by relevant authorities or, where not specified, can be agreed on a project-specific basis between relevant parties such as designers and clients. The Eurocodes identify such aspects making explicit reference to relevant authorities and relevant parties.

0.2 Introduction to EN 1992 Eurocode 2

(1) EN 1992 applies to the design of buildings, bridges and civil engineering structures in plain, reinforced and prestressed concrete. It complies with the principles and requirements for the safety and serviceability of structures, the basis of their design and verification that are given in prEN 1990:2021 *Basis of structural and geotechnical design*.

(2) EN 1992 is only concerned with the requirements for resistance, serviceability, durability and fire resistance of concrete structures. Other requirements, e.g. concerning thermal or sound insulation, are not considered.

(3) EN 1992 is subdivided into the following parts:

— *Part 1-1: General rules and rules for buildings, bridges and civil engineering structures*

— *Part 1-2: Structural fire design*

— *Part 4: Fastenings*

0.3 Introduction to prEN 1992-1-2

(1) prEN 1992-1-2 describes the requirements and rules for the structural design of buildings exposed to fire.

(2) prEN 1992-1-2 is intended for clients (e.g. for the formulation of their specific requirements), designers, contractors and relevant authorities.

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

(4) The fire parts of the Structural Eurocodes deal with specific aspects of passive fire protection in terms of designing structures and parts thereof for adequate load bearing resistance and for limiting fire spread as relevant.

(5) Required functions and levels of performance can be specified either in terms of nominal (standard) fire resistance rating, generally given in national fire regulations or by referring to fire safety engineering for assessing passive and active measures, see prEN 1991-1-2.

(6) Supplementary requirements concerning, e.g.:

— 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 standard, because they are subject to specification by the competent authority.

0.4 Verbal forms used in the Eurocodes

The verb “shall" expresses a requirement strictly to be followed and from which no deviation is permitted in order to comply with the Eurocodes.

The verb “should” expresses a highly recommended choice or course of action. Subject to national regulation and/or any relevant contractual provisions, alternative approaches could be used/adopted where technically justified.

The verb “may” expresses a course of action permissible within the limits of the Eurocodes.

The verb “can” expresses possibility and capability; it is used for statements of fact and clarification of concepts.

0.5 National annex for prEN 1992-1-2

National choice is allowed in this standard where explicitly stated within notes. National choice includes the selection of values for Nationally Determined Parameters (NDPs).

The national standard implementing prEN 1992-1-2 can have a National Annex containing all national choices to be used for the design of buildings and civil engineering works to be constructed in the relevant country.

When no national choice is given, the default choice given in this standard is to be used.

When no national choice is made and no default is given in this standard, the choice can be specified by a relevant authority or, where not specified, agreed for a specific project by appropriate parties.

National choice is allowed in prEN 1992-1-2 through the following clauses:

— 4.5 (1)

— 4.7 (1)

— 9.2 (1)

— 10 (10)

The National Annex can contain, directly or by reference, non-contradictory complementary information for ease of implementation, provided it does not alter any provisions of the Eurocodes.

1 Scope

1.1 Scope of prEN 1992-1-2

(1) This document deals with the design of concrete structures for the accidental situation of fire exposure and is intended to be used in conjunction with prEN 1992-1-1 and prEN 1991-1-2. This document identifies differences from, or supplements to, normal temperature design.

(2) This document applies to concrete structures required to fulfil a loadbearing function, separating function or both.

(3) This document gives principles and application rules for the design of structures for specified requirements in respect of the aforementioned functions and the levels of performance.

(4) This document applies to structures, or parts of structures, that are within the scope of prEN 1992-1-1 and are designed accordingly.

(5) The methods given in this document are applicable to normal weight concrete up to strength class C100/115 and lightweight concrete up to strength class LC50/60.

1.2 Assumptions

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

— the choice of the relevant design fire scenario is made by appropriate qualified and experienced personnel or is given by the relevant national regulation;

— any fire protection measure taken into account in the design will be adequately maintained.

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.

NOTE See the Bibliography for a list of other documents cited that are not normative references, including those referenced as recommendations (i.e. in 'should' clauses), permissions ('may' clauses), possibilities ('can' clauses), and in notes.

EN 1363-2, *Fire resistance tests — Part 2: Alternative and additional procedures*

prEN 1990:2021, *Eurocode: Basis of structural and geotechnical design*

prEN 1991-1-2:2021, *Eurocode 1: Actions on structures — Part 1-2: General actions — Actions on structures exposed to fire*

prEN 1992-1-1:2021, *Eurocode 2: Design of concrete structures — Part 1.1: General rules and rules for buildings*

EN 1991-1-7:2006[1], *Eurocode 1: Actions on structures — Part 1-7: General actions — Accidental actions*

1) Under revision.

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in prEN 1990, prEN 1991-1-2 and prEN 1992-1-1 and the following apply.

3.1.1
axis distance
distance between the axis of the reinforcing bar and the nearest edge of concrete

3.1.2
critical temperature of reinforcement
temperature of reinforcement at which loadbearing failure of the member in fire situation is expected to occur at a given stress level

3.1.3
maximum stress level
for a given temperature, the stress level at which the stress-strain relationship of steel is truncated to provide a yield plateau

3.1.4
part of structure
isolated part of a structure with appropriate support and boundary conditions

3.1.5
fire protection material
any material or combination of materials applied to a structural member for the purpose of increasing its fire resistance

3.1.6
reduced cross-section
cross-section of the member used in structural fire design when parts of the cross-section with assumed zero strength and stiffness are removed

3.1.7
spalling
fire induced spalling of concrete consists of the breaking off of layers or fragments of concrete from the surface of a structural element

Note 1 to entry: Depending on the severity of the phenomenon, it may or may not influence the performance of the structural member.

3.2 Symbols

For the purposes of this document, the following symbols and units apply.

3.2.1 Latin upper case letters

		Refer to
A_{s0}	Cross-sectional area of longitudinal reinforcement at axis distance *a* from the column's most compressed side	7.3.4.2 (4), Annex B
A_{s1}	Cross sectional area of longitudinal reinforcement at axis distance *a* from the column's tensile/least compressed side	7.3.4.2 (4), Annex B
$A_{st,prov}$	Provided cross-sectional area of longitudinal reinforcement in the tension chord	7.3.3.2 (4)
$A_{st,req}$	Required cross-sectional area of longitudinal reinforcement in the tension chord for the design at ambient temperature according to prEN 1992-1-1	7.3.4.2 (4)
$A_{s,prov}$	Required cross-sectional area of reinforcement for ultimate limit state according to prEN 1992-1-1	6.2 (3)
$A_{s,req}$	Provided area of reinforcement	6.2 (3)
$E_{d,fi}$	Design effect of actions in fire situation	
$E_{s,\theta}$	Slope of the linear elastic range in the stress-strain relationship of reinforcing steel	5.3.2.1
$E_{p,\theta}$	Slope of the linear elastic range in the stress-strain relationship of prestressing steel	5.3.3.1
$F_{sd,0,fi}$	Resisting compression force of longitudinal reinforcement at axis distance *a* from the column's most compressed side	7.3.4.2 (4)
$F_{sd,1t,fi}$	Resisting tensile force of longitudinal reinforcement at axis distance *a* from the column's tensile side	7.3.4.2 (4)
$F_{sd,1c,fi}$	Resisting compression force of longitudinal reinforcement at axis distance *a* from the column's least compressed side	7.3.4.2 (4)
$M_{0Ed,fi}$	Design value of first order moment in fire situation including the effect of imperfections	6.3.2 (2)
$M_{d,fi}$	Design value of the bending moment under fire conditions	7.3.4.2 (5)
$N_{Ed.fi}$	Design value of the axial load under fire conditions	6.3.1 (2), 7.3.4.2 (5)
R	Fire resistance time	6.3.2 (3)
R_{fi}	Design resistance for the load-bearing criterion under fire conditions	7.3.2

3.2.2 Latin lower case letters

		Refer to
a	Nominal axis distance measured between the centre of the reinforcement and the exposed surface	
a_c	Dimension of corner zone affected by two-sided heat transfer	7.2.3
A_{cij}	Elemental concrete area for refined assessment of members subjected to bending and axial load	7.3.4.3, Figure 7.9
a_{fi}	Reduced axis distance of the reinforcement	7.3.4.2 (2)

a_{eff}	Increased nominal axis distance	6.6.1 (6),
a_{sd}	Nominal axis distance measured between the centre of the reinforcement and lateral surface exposed to fire	Table 6.7, Table 6.8, Table 6.12, Table 6.13
a_z	Thickness of rim zone used to define a strength-equivalent cross-section for simplified design methods	7.3.2
b_{fi}	Overall reduced width of a cross-section under fire conditions	7.3.2 (2)
b_{min}	Minimum member width/minimum beam width	6.5 (3), 6.6.1 (5), 6.6.1 (6), 6.6.1 (7), Table 6.6, Table 6.7, 7.3.3.2 (2), 7.3.3.3 (1)
c_p	Specific heat of concrete	5.2.3
d_{eff}	Effective height of the bottom flange of I-shaped beams	6.6.1 (5), 6.6.1 (6)
d_{fi}	Reduced effective depth of a cross-section under fire conditions	7.3.4.2 (2)
e_d	Maximum distance between the compression resultant and the deformed axis of the compression member	7.3.4.2 (6)
$e_{thermal}$	Eccentricity attributed to thermal effects	7.3.4.2 (6), 7.3.3.2 (7)
$f_{c,\theta}$	Characteristic value of compressive strength of concrete at temperature θ	5.3.1.1
$f_{ct,\theta}$	Characteristic value of tensile strength of concrete at temperature θ	5.3.1.2
$f_{sp,\theta}$	Proportionality limit of reinforcing steel at temperature θ	5.3.2.1
$f_{sy,\theta}$	Maximum stress level of reinforcing steel at temperature θ	5.3.2.1
$f_{se,\theta}$	Strength between the proportional limit and the yield strength at temperature θ	5.3.2.1
$f_{pp,\theta}$	Proportionality limit of prestressing steel at temperature θ	5.3.3.1
$f_{py,\theta}$	Maximum stress level of prestressing steel at temperature θ	5.3.3.1
$f_{pe,\theta}$	Strength between the proportional limit and the yield strength at temperature θ	5.3.3.1
h'	Depth of T-beam and I-beam webs for the evaluation of shear resistance	
h_{fi}	Overall reduced depth of a cross-section used under fire conditions	7.3.2 (2)
k	Coefficient for one-dimensional heat transfer	7.2.2
$l_{0,fi}$	Effective length of a column or wall for the fire design situation	6.3.1, 6.4.2
l_x and l_y	Spans of a two-way slab (two directions at right angles) where l_y is the longer span	Table 6.9
n_{sc}	Number of effective reinforcing bars in the compression zone	7.3.4.2 (4)
n_{st}	Number of effective reinforcing bars in the tension reinforcing layer	7.3.3.2 (4), 7.3.4.2 (7)
u	Moisture content	5.2.3
w	Reduced cross-section depending on the fire exposure	7.3.2

x_{fi}	Reduced depth of concrete in compression under fire conditions	7.3.3.3 (4), Figure 7.7, 7.3.4.2 (2), Figure 7.8, 7.3.4.2 (4)
$x_{e,fi}$	Effective depth of concrete in compression under fire conditions	7.3.3.3 (4), Figure 7.7, 7.3.4.2 (2), Figure 7.8
y_{ij}	Horizontal coordinate of centroid of elemental concrete area for refined assessment of members subjected to bending and axial load	7.3.4.3, Figure 7.9
y'	Local coordinate for evaluating the temperature at corners of sections exposed to fire on two sides	7.2.3, Figure 7.3
y_{fi}	Distance of centroid of compression zone of concrete to neutral axis under fire conditions	7.3.3.3 (4), Figure 7.7, 7.3.4.2 (2), Figure 7.8
z_{ij}	Vertical coordinate of centroid of elemental concrete area for refined assessment of members subjected to bending and axial load	7.3.4.3, Figure 7.9
z'	Local coordinate for evaluating the temperature at corners of sections exposed to fire on two sides	7.2.3, Figure 7.3

3.2.3 Greek lower case letters

		Refer to
ε_{c0}	Concrete strain at the member's most compressed side	7.3.3.3 (4), Figure 7.7, 7.3.4.2 (2), Figure 7.8
$\varepsilon_c(\theta_c)$	Concrete thermal strain due to thermal elongation	5.3.1.3
$\varepsilon_{c1,\theta}$	Concrete strain at maximum stress at temperature θ	5.3.1.1
$\varepsilon_{cu1,\theta}$	Ultimate limit concrete strain at temperature θ	5.3.1.1
$\varepsilon_p(\theta_p)$	Prestressing steel thermal strain due to thermal elongation	5.3.3.2
$\varepsilon_s(\theta_s)$	Reinforcing steel thermal strain due to thermal elongation	5.3.2.2
ε_{s0}	Compressive strain in the longitudinal reinforcement in the compression zone	7.3.4.2 (4)
ε_{s1}	Compressive strain in the longitudinal reinforcement in the tension zone or in the compression zone	7.3.4.2 (4)
$\varepsilon_{sp,\theta}$	Steel strain corresponding to the proportional limit at temperature θ	5.3.2.1
$\varepsilon_{sy,\theta}$	Steel strain corresponding to the maximal stress level at the beginning of the plastic plateau at temperature θ	5.3.2.1
$\varepsilon_{st,\theta}$	Steel strain corresponding to the maximal stress level at the end of the plastic plateau at temperature θ	5.3.2.1
$\varepsilon_{su,\theta}$	Ultimate steel strain at temperature θ	5.3.2.1
$\varepsilon_{pp,\theta}$	Prestressing steel strain corresponding to the proportional limit at temperature θ	5.3.3.1
$\varepsilon_{py,\theta}$	Prestressing steel strain corresponding to the maximal stress level at the beginning of the plastic plateau at temperature θ	5.3.3.1
$\varepsilon_{pt,\theta}$	Prestressing steel strain corresponding to the maximal stress level at the end of the plastic plateau at temperature θ	5.3.3.1

$\varepsilon_{pu,\theta}$	Ultimate prestressing steel strain at temperature θ	5.3.3.1
$\varepsilon_{s,fi}$	Strain of reinforcing steel in cross-sectional analysis	
$\gamma_{s,fi}$	Partial factor for reinforcing or prestressing steel under fire conditions	7.3.3.2 (4)
η_{fi}	Reference load level	4.7 (1), 6.2 (1)
λ_c	Thermal conductivity of concrete	5.2.2
μ_{fi}	Degree of utilisation in the fire situation	6.3.1 (2)
θ_c	Temperature in concrete	5.2.2, 5.2.3, 5.2.4, 5.3.1
$\theta_{c,max}$	Maximum temperature in concrete	5.3.1.1
θ_s	Temperature of reinforcement (reinforcing steel and prestressing steel)	5.3.2, 5.3.3
θ_1	Temperature increase in rectangular sections exposed to fire on one side	7.2.2
θ_2	Temperature increase in rectangular sections exposed to fire on two sides	7.2.3
$\Delta\theta$	Local temperature increase at corners of members expose on two sides	7.2.3
$\Delta\theta_M$	Temperature increase in circular sections	7.2.3
θ_i	Average temperature of each parallel zone	7.3.2 (4),
θ_{ij}	Average temperature of each zone	7.3.2 (5),
θ_M	Temperature in the centroid of the cross-section	7.3.2 (4), 7.3.2 (5)
θ_{sc}	Average temperature of all effective reinforcing bars in the compression zone	7.3.4.2 (4)
θ_{st}	Average temperature of all effective reinforcing bars in the tension zone	7.3.4.2 (7)
θ_P	Concrete temperature in the reference point P	
θ_T	Concrete temperature in the reference point T	7.3.4.2 (7)
$\sigma_{s,fi}$	Steel stress for actions in fire situation	6.2 (4)
$\varnothing_{sl}$	Diameter of a reinforcing bar in longitudinal direction	Annex B
ω_{mod}	Modified mechanical reinforcement degree	Annex B

3.2.4 Units

Stresses and material strengths	For unit dependent formulae, MPa is used
Geometric data	For unit dependent formulae, mm is used
Relative humidity	%
Time	Days, unless otherwise stated
Temperature	°C and °K
Angle	Degrees