SLOVENSKI STANDARD
oSIST prEN 1993-1-1:2020

01-november-2020

Evrokod 3 - Projektiranje jeklenih konstrukcij - 1-1. del: Splošna pravila in pravila za stavbe

Eurocode 3 - Design of steel structures - Part 1-1: General rules and rules for buildings

Eurocode 3 - Bemessung und Konstruktion von Stahlbauten - Teil 1-1: Allgemeine Bemessungsregeln und Regeln für den Hochbau

Eurocode 3 - Calcul des structures en acier - Partie 1-1 : Règles générales et règles pour les bâtiments

Ta slovenski standard je istoveten z: prEN 1993-1-1

ICS:

91.010.30	Tehnični vidiki	Technical aspects
91.080.13	Jeklene konstrukcije	Steel structures

oSIST prEN 1993-1-1:2020 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 1993-1-1

September 2020

ICS 91.010.30; 91.080.13

Will supersede EN 1993-1-1:2005

English Version

Eurocode 3 - Design of steel structures - Part 1-1: General rules and rules for buildings

Eurocode 3 - Calcul des structures en acier - Partie 1-1 : Règles générales et règles pour les bâtiments

Eurocode 3 - Bemessung und Konstruktion von Stahlbauten - Teil 1-1: Allgemeine Bemessungsregeln und Regeln für den Hochbau

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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COMITÉ EUROPÉEN DE NORMALISATION
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Ref. No. prEN 1993-1-1:2020 E

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European foreword

This document (prEN 1993-1-1:2020) 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 1993-1-1:2005 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.

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 are under development, e.g. Eurocode for design of structural glass

0.2 Introduction to EN 1993 (all parts)

EN 1993 (all parts) applies to the design of buildings and civil engineering works in steel. 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 EN 1990 – Basis of structural design.

EN 1993 (all parts) is concerned only with requirements for resistance, serviceability, durability and fire resistance of steel structures. Other requirements, e.g. concerning thermal or sound insulation, are not covered.

EN 1993 is subdivided in various parts:

EN 1993-1, *Design of Steel Structures — Part 1: General rules and rules for buildings;*

EN 1993-2, *Design of Steel Structures — Part 2: Steel bridges;*

EN 1993-3, *Design of Steel Structures — Part 3: Towers, masts and chimneys;*

EN 1993-4, *Design of Steel Structures — Part 4: Silos and tanks;*

EN 1993-5, *Design of Steel Structures — Part 5: Piling;*

EN 1993-6, *Design of Steel Structures — Part 6: Crane supporting structures;*

EN 1993-7, *Design of steel structures — Part 7: Design of sandwich panels.*

EN 1993-1 in itself does not exist as a physical document, but comprises the following 14 separate parts, the basic part being EN 1993-1-1:

EN 1993-1-1, *Design of Steel Structures — Part 1-1: General rules and rules for buildings;*

EN 1993-1-2, *Design of Steel Structures — Part 1-2: Structural fire design;*

EN 1993-1-3, *Design of Steel Structures — Part 1-3: Cold-formed members and sheeting;*

NOTE Cold formed hollow sections supplied according to EN 10219 are covered in EN 1993-1-1.

EN 1993-1-4, *Design of Steel Structures — Part 1-4: Stainless steels;*

EN 1993-1-5, *Design of Steel Structures — Part 1-5: Plated structural elements;*

EN 1993-1-6, *Design of Steel Structures — Part 1-6: Strength and stability of shell structures;*

EN 1993-1-7, *Design of Steel Structures — Part 1-7: Strength and stability of planar plated structures transversely loaded;*

EN 1993-1-8, *Design of Steel Structures — Part 1-8: Design of joints;*

EN 1993-1-9, *Design of Steel Structures — Part 1-9: Fatigue strength of steel structures;*

EN 1993-1-10, *Design of Steel Structures — Part 1-10: Selection of steel for fracture toughness and through-thickness properties;*

EN 1993-1-11, *Design of Steel Structures — Part 1-11: Design of structures with tension components made of steel;*

EN 1993-1-12, *Design of Steel Structures — Part 1-12: Additional rules for steel grades up to S960;*

EN 1993-1-13, *Design of Steel Structures — Part 1-13: Beams with large web openings;*

EN 1993-1-14, *Design of Steel Structures — Part 1-14: Design assisted by finite element analysis.*

All subsequent parts EN 1993-1-2 to EN 1993-1-14 treat general topics that are independent from the structural type such as structural fire design, cold-formed members and sheeting, stainless steels, plated structural elements, etc.

All subsequent parts numbered EN 1993-2 to EN 1993-7 treat topics relevant for a specific structural type such as steel bridges, towers, masts and chimneys, silos and tanks, piling, crane supporting structures, etc. EN 1993-2 to EN 1993-7 refer to the generic rules in EN 1993-1 and supplement, modify or supersede them.

0.3 Introduction to EN 1993-1-1

EN 1993-1-1 gives general design rules for steel structures. It also includes supplementary design rules for steel buildings. The focus in EN 1993-1-1 is on design methods and design rules for individual members (beams, columns and beam-columns) and skeletal structures (frames) regarding resistance and stability.

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 EN 1993-1-1

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 EN 1993-1-1 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 EN 1993-1-1 through the following clauses:

— 4.4.3 (2)

— 5.1 (2)

— 5.2.1 (1)

— 5.2.2 (1)

— 5.2.3 (1)P

— 7.2.1 (4)

— 7.2.2 (9)

— 7.3.3.1 (2)

— 7.3.3.2 (1)

— 7.4.1(3)

— 8.1 (1)

— 8.3.2.3 (1)

— 8.3.2.4 (1)B

— 8.3.2.4 (3)B

— 8.3.3 (2)

— 8.3.4 (1)

— 9.2 (2)B

— A.3 (2)

— A.3 (3)

— A.3 (4)

National choice is allowed in EN 1993-1-1 on the application of the following informative annexes:

— Annex E (informative) – Basis for the calibration of partial factors

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 EN 1993-1-1

(1) EN 1993-1-1 gives basic design rules for steel structures.

(2) It also gives supplementary provisions for the structural design of steel buildings. These supplementary provisions are indicated by the letter "B" after the paragraph number, thus ( )B.

1.2 Assumptions

(1) The assumptions of EN 1990 apply to EN 1993-1-1.

(2) EN 1993 is intended to be used in conjunction with EN 1990, EN 1991 (all parts), the parts of EN 1992 to EN 1999 where steel structures or steel components are referred to within those documents, EN 1090-2, EN 1090-4 and ENs, EADs and ETAs for construction products relevant to steel structures.

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. through 'should' clauses) and permissions (i.e. through 'may' clauses).

EN 1090-2, *Execution of steel structures and aluminium structures - Part 2: Technical requirements for steel structures*

EN 1090-4, *Execution of steel structures and aluminium structures - Part 4: Technical requirements for cold-formed structural steel elements and cold-formed structures for roof, ceiling, floor and wall applications*

EN 1990:—[1], *Eurocode — Basis of structural and geotechnical design*

EN 1991 (all parts), *Eurocode 1 — Actions on structures*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1990 and the following apply.

3.1.1
frame
whole or a portion of a structure, comprising an assembly of directly connected structural elements, designed to act together to resist load

Note 1 to entry: This term refers to both moment-resisting frames and triangulated frames; it covers both plane frames and three-dimensional frames.

1) Under preparation. Current stage: prEN 1990:2020.

3.1.2
sub-frame
frame that forms part of a larger frame, but is treated as an isolated frame in a structural analysis

3.1.3
semi-continuous framing
framing in which the structural properties of the members and joints need explicit consideration in the global analysis

3.1.4
continuous framing
framing in which only the structural properties of the members need to be considered in the global analysis

3.1.5
simple framing
framing in which the joints are not designed to resist moments

3.1.6
system length
distance in a given plane between two adjacent points at which a member is braced against lateral displacement in this plane, or between one such point and the end of the member

3.1.7
buckling length
system length of an otherwise similar member with pinned ends, which has the same critical buckling load as a given member or segment of member

3.1.8
equivalent member
simply supported single span member of uniform cross-section with constant compressive axial force used for buckling verification

Note 1 to entry: Its length, cross-section and axial force are equal to the appropriate buckling length, cross-section and axial force at the investigated position in the structure.

3.1.9
shear lag effect
non-uniform stress distribution in wide flanges due to shear deformation

3.1.10
capacity design
design method for achieving the plastic deformation capacity of a member by providing additional strength in its connections and in other parts connected to it

3.1.11
uniform built-up member
built-up member made of parallel chords with nominally constant cross-section along their whole length, connected by regularly spaced lacings or battens

3.1.12
uniform member
member with a nominally constant cross-section along its whole length

3.2 Symbols and abbreviations

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

3.2.1 Latin upper-case symbols

A	cross-sectional area
A_{c}	area of the equivalent compression flange
A_{ch}	cross-sectional area of one chord of a built-up column
A_{d}	cross-sectional area of one diagonal of a built-up column
A_{eff}	effective area of a cross-section
A_{f}	area of one flange
A_{i}	cross-sectional area for the calculation of the characteristic resistance to an axial force
A_{net}	net area of a cross-section
A_{p}	cross-sectional area of one post (or transverse element) of a built-up column
A_{t}	area of the tension flange
$A_{\mathrm{t,net}}$	net area of the tension flange
A_{v}	shear area
A_{w}	area of a web
A_0	original cross-sectional area
B_{Ed}	design value of the bimoment
B_{Rd}	design value of the bimoment resistance
B_{Rk}	characteristic value of the bimoment resistance
C_{D}	rotational stiffness provided by stabilizing continuum and connections
$C_{\mathrm{D,A}}$	rotational stiffness of the connection between the beam and the stabilizing continuum
$C_{\mathrm{D,B}}$	rotational stiffness deduced from an analysis of the distortional deformations of the beam cross sections
$C_{\mathrm{D,C}}$	rotational stiffness provided by the stabilizing continuum to the beam assuming a stiff connection to the member
C_{my}, C_{mz}, C_{mLT}	equivalent uniform moment factors
E	modulus of elasticity
$EI\left\|\eta''_{\mathrm{cr,m}}\right\|$	absolute value of the bending moment due to $\eta_{\mathrm{cr,m}}$ at the critical cross-section m
$F_{\mathrm{cr,ns}}$	minimum elastic critical flexural buckling load for either the in-plane or out-of-plane member (non-sway) buckling mode
$F_{\mathrm{cr,sw}}$	elastic critical in-plane flexural buckling load for a global (sway) buckling mode
F_{d}	design value of the load on the structure

$F_{z,Ed}$	design value of transverse force
$F_{z,Rd}$	design value of the resistance to transverse force
G	shear modulus
G_k	characteristic value of the effect of permanent actions
H	height of the structure
H_{Ed}	total design horizontal load
H_f	fictitious horizontal load
H_{st}	storey height
I	moment of inertia
I_b	in-plane moment of inertia of a batten
I_{ch}	in-plane moment of inertia of a chord
I_{eff}	effective moment of inertia of a built-up member
I_T	torsion constant
I_w	warping constant
I_y, I_z	moment of inertia about y-y axis and z-z axis, respectively
$I_{z,fl}$	moment of inertia about z-z axis of two flanges
I_1	equivalent moment of inertia of a battened built-up member
K_{st}	lateral rigidity of a storey
K_v	factor for considering the type of verification in evaluating torsional restraints
K_θ	factor for considering the moment distribution in evaluating torsional restraints
L	length (member length, span length, etc.)
L_c	length between two consecutive lateral restraints
L_{ch}	buckling length of chord in a built-up member
L_{cr}	buckling length
L_d	length of a diagonal in a built-up member
L_{st}	stable length of segment
L_y	effective length for the resistance to transverse force
$M_{b,Rd}$	design value of the buckling resistance of a member in bending
$M_{B,V,Rd}$	design value of the reduced resistance to bending moment making allowance for the presence of shear force and bimoment
$M_{c,B,Rd}$	design value of the reduced resistance to bending moment making allowance for the presence of bimoment
M_{cr}	elastic critical moment for lateral torsional buckling

$M_{c,Rd}$	design value of the resistance to bending moment about one principal axis of a cross-section
M_{Ed}	design bending moment
M^{I}_{Ed} .	design value of the maximum first order moment in the middle of a built-up member
$M_{el,Rd}$	design value of the elastic moment resistance
$M_{ep,Rd}$	design value of the elasto-plastic bending moment resistance
M_{h}	hogging moment at member ends
$M_{N,ep,Rd}$	design value of the elasto-plastic bending moment resistance making allowance for the presence of axial force
$M_{N,Rd}$	sign value of the reduced resistance to bending moment making allowance for the presence of axial force
$M_{pl,Rd}$	design value of the plastic moment resistance
M_{Rk}	characteristic value of the resistance to bending moment
$M_{Rk,m}$	characteristic value of the moment resistance of the critical cross-section m
$M_{V,Rd}$	design value of the reduced plastic resistance to bending moment making allowance for the presence of shear force
$M_{y,Ed}$	design value of the bending moment about y-y axis
$M_{y,Rd}$	design value of the resistance to bending moment about y-y axis
$M_{y,Rk}$	characteristic value of the resistance to bending moment about y-y axis
$M_{z,Ed}$	design value of the bending moment about z-z axis
$M_{z,Rd}$	design value of the resistance to bending moment about z-z axis
$M_{z,Rk}$	characteristic value of the resistance to bending moment about z-z axis
M_{0}	sagging moment at mid-span of a member
N	number of stress cycles during the design service life
$N_{b,Rd}$	design value of the buckling resistance of a member in compression
$N_{c,Rd}$	design value of the resistance to axial force of the cross-section for uniform
$N_{ch,Ed}$	design value of the axial force in a chord, in the middle of a built-up member
N_{cr}	elastic critical axial force for the relevant buckling mode based on the gross cross-sectional properties
$N_{cr,c,z}$	elastic critical axial force for flexural buckling of the equivalent compression flange
$N_{cr,m}$	elastic critical axial force in the cross-section m
$N_{cr,T}$	elastic critical axial force for torsional buckling
$N_{cr,TF}$	elastic critical axial force for torsional-flexural buckling
$N_{cr,V}$	effective critical axial force of a built-up member including the effect of its shear stiffness