SLOVENSKI STANDARD
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Nadomešča:
SIST EN 1993-1-5:2007
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Evrokod 3 - Projektiranje jeklenih konstrukcij - 1-5. del: Elementi pločevinaste konstrukcije

Eurocode 3 - Design of steel structures - Part 1-5: Plated structural elements

Eurocode 3 - Bemessung und Konstruktion von Stahlbauten - Teil 1-5: Plattenförmige Bauteile

Eurocode 3 - Calcul des structures en acier - Partie 1-5: Plaques planes

Ta slovenski standard je istoveten z: **EN 1993-1-5:2024**

ICS:

91.010.30	Tehnični vidiki	Technical aspects
91.080.13	Jeklene konstrukcije	Steel structures

SIST EN 1993-1-5:2024 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 1993-1-5

March 2024

ICS 91.010.30; 91.080.13

Supersedes EN 1993-1-5:2006

English Version

Eurocode 3 - Design of steel structures - Part 1-5: Plated structural elements

Eurocode 3 - Calcul des structures en acier - Partie 1-5 : Eléments structuraux constitués de plaques

Eurocode 3 - Bemessung und Konstruktion von Stahlbauten - Teil 1-5: Plattenförmige Bauteile

This European Standard was approved by CEN on 1 January 2024.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

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 CEN-CENELEC Management Centre has the same status as the official versions.

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 1993-1-5:2024) has been prepared by Technical Committee CEN/TC 250 “Structural Eurocodes”, 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 matters by CEN.

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 September 2027, and conflicting national standards shall be withdrawn at the latest by March 2028.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1993-1-5:2006 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.

The main changes compared to the previous edition are listed below:

— the torsional stiffness of closed-section stiffeners has been taken into consideration;

— the procedure for interpolation between column-like and plate-like behaviour has been revised;

— the scope has been extended to non-rectangular panels;

— the presence of longitudinal stiffeners with a low stiffness is neglected for the verification to direct stresses;

— rules for patch loading resistance have been revised;

— the interaction formulae have been revised and extended;

— rules for the verification of the transverse stiffeners have been revised;

— rules for the verification of flange-induced buckling have been revised;

— reduced stress method has been extended to bi-axial loading;

— rules for corrugated webs have been extended.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

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

0.2 Introduction to the EN 1993 series

The EN 1993 series 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 and geotechnical design.

The EN 1993 series 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: 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: Sandwich panels (under preparation).*

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 steel structures;*

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: Plate assemblies with elements under transverse loads;*

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

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

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

EN 1993-1-11, *Design of Steel Structures — Part 1-11: Tension components;*

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 1993-1-5

EN 1993-1-5 gives design requirements for unstiffened and stiffened plates that are subject to in-plane forces. It also covers plated structural elements like I-section girders or box girders, as well as plated components used in tanks and silos.

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 1993-1-5

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 1993-1-5 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 1993-1-5 through notes to the following clauses:

4.6(2) 6.4.1(10) 7.1(2)

National choice is allowed in EN 1993-1-5 on the application of the following informative annexes:

Annex A Annex B

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 1993-1-5

(1) This document provides rules for structural design of stiffened and unstiffened nominally flat plates which are subject to in-plane forces.

(2) Non-uniform stress distributions due to shear lag, in-plane load introduction and plate buckling are covered. The effects of out-of-plane loading are outside the scope of this document.

NOTE 1 The rules in this part complement the rules for class 1, 2, 3 and 4 sections, see EN 1993-1-1.

NOTE 2 For the design of slender plates which are subject to repeated direct stress and/or shear and also fatigue due to out-of-plane bending of plate elements ("breathing"), see EN 1993-2 and EN 1993-6.

NOTE 3 For the effects of out-of-plane loading and for the combination of in-plane effects and out-of-plane loading effects, see EN 1993-2 and EN 1993-1-7.

(3) Single plate elements are considered as nominally flat where the curvature radius r in the direction perpendicular to the compression satisfies, as illustrated in Figure 1.1:

$$r \geq \frac{b^2}{t} \tag{1.1}$$

where

b is the panel width;

t is the plate thickness.

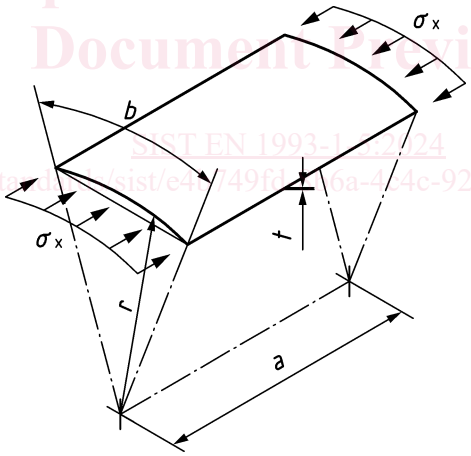

Figure 1.1 — Definition of plate curvature

1.2 Assumptions

(1) Unless specifically stated, EN 1990, the EN 1991 series and EN 1993-1-1 apply.

(2) The design methods given in EN 1993-1-5 are applicable if

— the execution quality is as specified in EN 1090-2 and

— the construction materials and products used are as specified in the relevant parts of the EN 1993 series or in the relevant material product specifications.

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 1990, *Eurocode — Basis of structural and geotechnical design*

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

EN 1993-1-1:2022, *Eurocode 3 — Design of steel structures — Part 1-1: General rules and rules for buildings*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 Terms

3.1.1
plate
structural element that, in general, has two large dimensions a and b and a uniform much smaller dimension t, and is shaped such that the two large dimensions lie in a single plane

3.1.2
elastic critical stress
stress in a component at which the component becomes unstable when using small deflection elastic theory of a perfect structure

3.1.3
membrane stress
stress at mid-plane of the plate

3.1.4
gross cross-section
total cross-sectional area of a member but excluding discontinuous longitudinal stiffeners

3.1.5
effective cross-section and effective width
gross cross-section or width reduced to account for non-uniform stress distributions due to plate buckling, shear lag or both

Note 1 to entry: To distinguish between the different effects, the word "effective" is clarified as follows:

— "effective^{p}" denotes effects of plate buckling;

— "effective^{s}" denotes effects of shear lag;

— "effective" denotes effects of plate buckling and shear lag.

3.1.6
plated structural element
structural element built up from nominally flat plates which are connected together

Note 1 to entry: The plates can be stiffened or unstiffened.

3.1.7
stiffener
flat plate or prismatic section attached to a plate to resist buckling or to strengthen the plate

Note 1 to entry: A stiffener is denoted:

— longitudinal if its direction is parallel to the member constituted of the assembled plates;

— transverse if its direction is perpendicular to the member constituted of the assembled plates.

3.1.8
stiffened plate
plate with transverse or longitudinal stiffeners or both

3.1.9
subpanel
unstiffened plate portion surrounded by flanges and/or stiffeners

3.1.10
hybrid girder
girder with flanges and web(s) made of different steel grades

3.1.11
direct stresses
normal stresses acting in the direction of the longitudinal axis of the member

3.1.12
patch loading
local introduction of in-plane forces

3.1.13
plate buckling behaviour
buckling of a plate where second order tensile stresses develops in the direction perpendicular to the loaded direction with a favourable effect on the resistance

3.1.14
column buckling behaviour
buckling of a plate where no tensile stresses develop in the direction perpendicular to the loaded direction. This leads to a situation similar to the buckling of a column

3.1.15
local buckling
buckling of an unstiffened plate or of the part of a stiffened plate between two stiffeners or between an edge and a stiffener

3.1.16
global buckling
buckling of stiffened plate where the instability also involves a displacement of the stiffeners