SLOVENSKI STANDARD
oSIST prEN 1993-1-7:2023

01-maj-2023

Evrokod 3 - Projektiranje jeklenih konstrukcij - 1-7.del: Sklop plošč z elementi pod prečnimi obremenitvami

Eurocode 3 - Design of steel structures - Part 1-7: Plate assemblies with elements under transverse loads

Eurocode 3 - Bemessung und Konstruktion von Stahlbauten - Teil 1-7 : Aus Blechen zusammengesetzte Bauteile unter Querbelastung

Eurocode 3 - Calcul des structures en acier - Partie 1-7 : Structures en plaques avec éléments sous charges transversales

Ta slovenski standard je istoveten z: **prEN 1993-1-7**

ICS:

91.010.30	Tehnični vidiki	Technical aspects
91.080.13	Jeklene konstrukcije	Steel structures

oSIST prEN 1993-1-7:2023 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 1993-1-7

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ICS 91.010.30; 91.080.13

Will supersede EN 1993-1-7:2007

English Version

Eurocode 3 - Design of steel structures - Part 1-7: Plate assemblies with elements under transverse loads

Eurocode 3 - Calcul des structures en acier - Partie 1-7 : Ensemblages de plaques avec elements sous charges transversales

Eurocode 3 - Bemessung und Konstruktion von Stahlbauten - Teil 1-7 : Plattenanordnungen mit Elementen unter Querbelastung

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

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

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European foreword

This document (prEN 1993-1-7:2023), has been prepared by Technical Committee CEN/TC250 “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 design matters by CEN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 1993-1-7:2007 and its amendments.

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

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 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 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: Design of 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: Design of structures with 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[1], *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[2] 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 prEN 1993-1-7

prEN 1993-1-7 gives supplementary rules for plate assemblies with elements under transverse loads.

1 Under preparation.

2 Under preparation.

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 1993-1-7

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 1993-1-7 can have a National Annex containing all national choices to be used for the design of steel structures 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 1993-1-7 through the following clauses:

4.1(5) 4.6(2) 9.2.2.2(5)

National choice is allowed in prEN 1993-1-7 on the application of the following informative annexes:

Annex A Annex B Annex C

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 1993-1-7

(1) prEN 1993-1-7 provides rules for the structural design of assemblies of unstiffened and stiffened steel plates whose elements are under predominantly distributed transverse loads.

(2) prEN 1993-1-7 is applicable to containment structures such as silos, tanks, digesters and lock gates, where the external actions chiefly act transversely on their individual plates or panels. Where a plate or panel under bending is additionally subject to membrane forces that have a significant effect on the resistance, this document covers assessment of the resistance through its computational analysis procedures.

(3) prEN 1993-1-7 is applicable to structures with rectangular, trapezoidal or triangular component plate segments, each with one axis of symmetry.

(4) prEN 1993-1-7 does not apply to plates or panels where the dominant structural resistance requirement relates to membrane forces in the plates (for these, see EN 1993-1-5).

(5) prEN 1993-1-7 does not apply to plates or panels whose curvature (out of flatness) exceeds that defined in 1.1 (14). For such curved plates, see EN 1993-1-6.

(6) prEN 1993-1-7 does not apply to circular or annular plates. For such plates, see EN 1993-1-6.

(7) prEN 1993-1-7 does not apply to cold-formed sheeting. For such plates, see EN 1993-1-3.

(8) This document is only concerned with the requirements for design of plates and plate assemblies against the ultimate limit states of:

— plastic failure;

— cyclic plasticity;

— buckling;

— fatigue.

(9) Overall equilibrium of the structure (sliding, uplifting, or overturning) is not included in this document. Special considerations for specific applications are available in the relevant applications parts of EN 1993.

(10) The rules in this document refer to plate assemblies that are fabricated using unstiffened or stiffened plates or panels. The document is also applicable to the design of individual plates or panels that are predominantly subject to actions transverse to the plane of each plate. Both frictional actions on the plate surface and forces imposed by adjacent components of the plate assembly also induce in-plane actions in each plate.

(11) This document gives algebraic rules and guidance to account for bending with small membrane forces in the individual plates or panels. Where an unstiffened or stiffened plates or panels is subject to significant magnitudes of both bending and in-plane forces, the computational analysis procedures of this document apply.

(12) Where no application part defines a different range, this document applies to structures within the following limits:

— design metal temperatures within the range −50 °C to +100 °C;

— the geometry of individual plate segments is limited to rectangular, triangular and trapezoidal shapes with b/t greater than 20, or b_1/t greater than 20, as appropriate (see Figure 3.2);

— Single plate elements are treated as flat where the deviation from flatness e_0 meets the condition $e_0/t \leq 0,750$ (see Figure 9.1). Where this criterion is not met, it is appropriate to treat the plate as a shell panel (see EN 1993-1-6).

1.2 Assumptions

(1) Unless specifically stated, the provisions of EN 1990, EN 1991 (all parts) and EN 1993 (all parts) apply.

(2) The design methods given in prEN 1993-1-7 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 EN 1993 (all parts), or in the relevant material and product specifications.

(3) The provisions in this document apply to materials that satisfy the brittle fracture provisions given in EN 1993-1-4 and EN 1993-1-10.

(4) In this document, it is assumed that wind loading, seismic actions and bulk solids flow can, in general, be treated as quasi-static actions.

(5) Dynamic effects are treated in other relevant application parts of EN 1993 or EN 1998, including the consequences for fatigue. The stress resultants arising from dynamic behaviour are treated in this part as quasi-static.

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, *Basis of structural and geotechnical design*

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

EN 1993 (all parts), *Eurocode 3: Design of steel structures*

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

3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions given in EN 1990, EN 1993-1-1, ISO 8930 and the following apply.

3.1 Terms and definitions

3.1.1 Structural forms and geometry

3.1.1.1
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 (flat plate)

Note 1 to entry: In this standard, the ratios a/t and b/t are required to exceed the value 20 (except as noted below). Where the boundary conditions and geometry are such that the plate only bends in a single direction, its treatment is not the principal role of this standard, but the provisions given here can be used.

Note 2 to entry: In special circumstances (e.g. the edge b_2 of a trapezoidal plate), the smaller dimension b can be less than $20t$.

Note 3 to entry: A plate for which the above restrictions apply is termed a thin plate.

Note 4 to entry: Typical generic forms of plate assemblies considered by this standard are illustrated in Figures 3.1 and 3.3. These are categorised as assemblies of plates of rectangular, trapezoidal or triangular shape, each plate element having at least one axis of symmetry.

3.1.1.2
plate assembly
structure that is assembled from flat plates which are joined together (see Figure 3.1) in such a way that the assembly has at least one axis of symmetry

Note 1to entry:The individual plates may be unstiffened or stiffened

Note 2 to entry: The coordinate system indicated in Figure 3.2 only serves to indicate directions. The origin can be chosen by the user to be at any suitable location.

Note 3 to entry: The dimensions a, b and c shown in Figure 3.1 relate to the complete plate assembly to give clarity to the usage in this standard for common orientations of plate. Where an individual plate is described elsewhere in the standard, the dimension a is the longer side and the shorter side is always b, even if in the global system it is defined as c.

3.1.1.3
plate geometry
geometries of individual plates that are defined as rectangular, trapezoidal or triangular

Note 1to entry:. Where the shape is rectangular, the larger side length is defined as the dimension a. Where the shape is other than rectangular, the side(s) parallel to the axis of symmetry are defined by the dimension a (see Figure 3.2). Trapezoidal and triangular plates are only covered by this standard where they have an axis of symmetry.

3.1.1.4
panel
flat plate which may be unstiffened or stiffened

Note 1to entry:. A panel can be regarded as an individual part of a plate assembly (see Figure 3.1). The term can also be used for stiffened plates with transverse and longitudinal stiffeners, which delimit sub-panels (see 3.1.1.11).

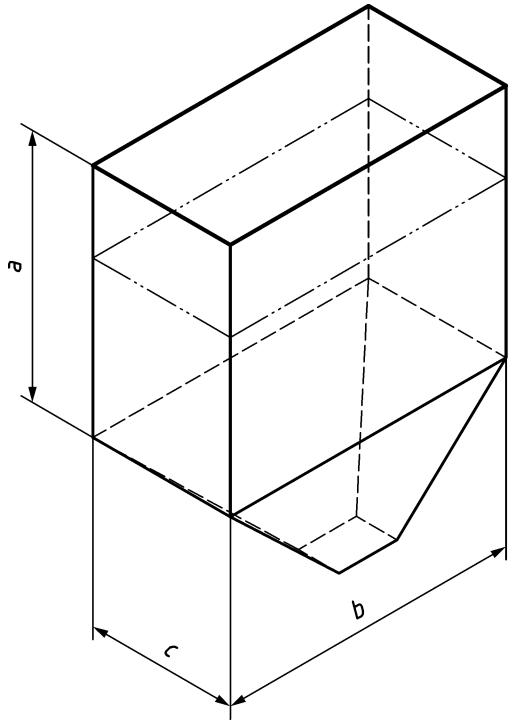


Figure 3.1 — Typical arrangement of a plate assembly, composed of individual panels, that is unstiffened or stiffened plates

3.1.1.5
aspect ratio
ratio of the shorter side length to the longer side length ($\psi = b/a \leq 1{,}0$) for a rectangular plate or panel

3.1.1.6
stiffener
flat plate or prismatic member attached to a panel for the purpose of increasing its bending resistance

Note 1 to entry: It can also be used to reinforce the member to support local loads.

3.1.1.7
longitudinal stiffener
stiffener on a rectangular panel in which the stiffener longitudinal axis is aligned with the longer dimension *a* of the panel (see Figure 6.8)

3.1.1.8
transverse stiffener
stiffener on a rectangular panel in which the stiffener longitudinal axis is aligned with the shorter dimension *b* of the panel (see Figure 6.8)

Note 1 to entry: The term "transverse stiffener" is commonly used in plates that are subject only to membrane forces to refer to stiffeners that are orthogonal to the direction of a main membrane force. By contrast, in this standard the terminology of 3.1.1.7 and 3.1.1.8 defines the longitudinal and transverse directions only in terms of the shape of the plate, since these plates are principally subject to bending in both directions.

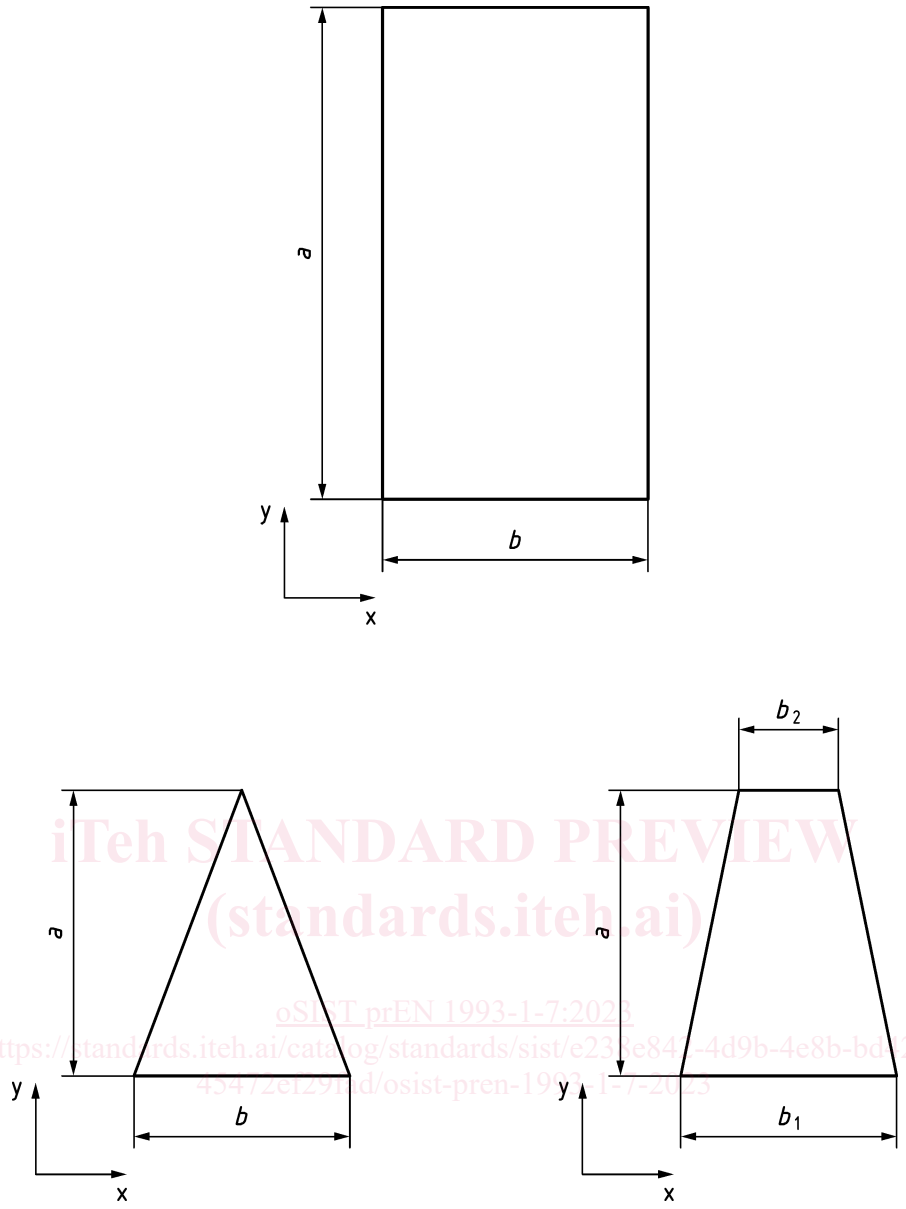


Figure 3.2 — Dimensions and local coordinate systems for rectangular, triangular and trapezoidal plates

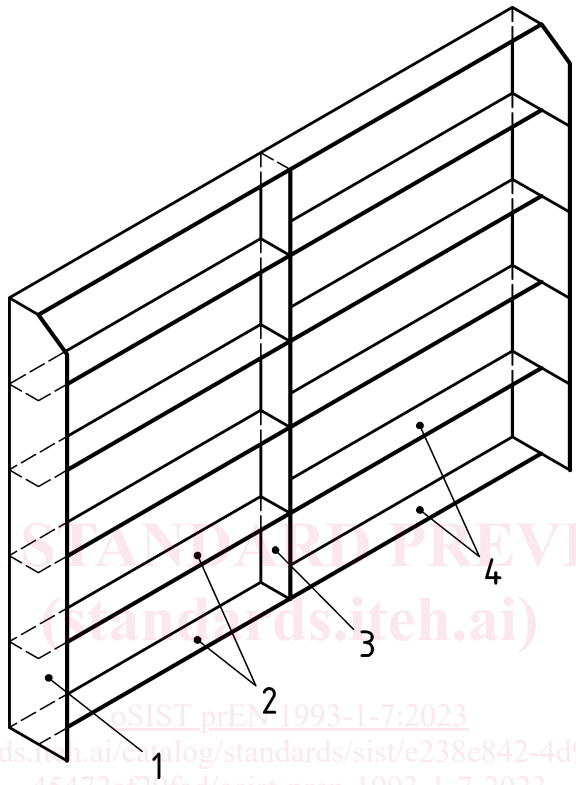
3.1.1.9
uni-directionally stiffened plate
rectangular plate that has parallel stiffeners attached to it with their longitudinal axis in one direction

Note 1 to entry: The direction can be longitudinal or transverse.

3.1.1.10
bi-directionally stiffened plate
rectangular plate that has two sets of parallel stiffeners in the two principal directions attached to it with their longitudinal axes in orthogonal directions

3.1.1.11
sub-panel
part of a stiffened plate that lies between stiffeners, and so is locally an unstiffened plate bounded by stiffeners

Note 1 to entry: The design of sub-panels is covered within the rules of this standard in 6.6 and Clauses 9 and 10, where stiffened plates are treated.



Key
1 transverse end stiffener
2 longitudinal stiffeners
3 transverse intermediate stiffener
4 sub-panels

Figure 3.3 — Example of a rectangular stiffened plate

3.1.2 Failure mechanisms

3.1.2.1
buckling
ultimate limit state where the stability of the structure is lost under compression and/or shear

3.1.2.2
cyclic plasticity
ultimate limit state in which repeated cycles of loading lead to repeated plastic straining

Note 1 to entry: Two distinct failure modes can arise: ratcheting and low-cycle fatigue.