



**SLOVENSKI STANDARD**  
**oSIST prEN 1993-1-13:2022**  
**01-maj-2022**

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**Evrokod 3 - Projektiranje jeklenih konstrukcij - 1-13. del: Pravila za nosilce z velikimi mrežnimi odprtinami**

Eurocode 3 - Design of steel structures - Part 1-13: Rules for beams with large web openings

Eurocode 3: Bemessung und Konstruktion von Stahlbauten - Teil 1-13: Regeln für Träger mit großen Stegöffnungen

Eurocode 3 - Calcul des structures en acier - Partie 1-13 : Règles pour les poutres avec grandes ouvertures d'âme

**Ta slovenski standard je istoveten z: prEN 1993-1-13**

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91.080.13	Jeklene konstrukcije	Steel structures

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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**DRAFT**  
**prEN 1993-1-13**

March 2022

ICS 91.010.30; 91.080.13

English Version

## Eurocode 3 - Design of steel structures - Part 1-13: Rules for beams with large web openings

Eurocode 3: Bemessung und Konstruktion von  
Stahlbauten - Teil 1-13: Regeln für Träger mit großen  
Stegöffnungen

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.

This draft European Standard was established by CEN 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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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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**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

<b>Contents</b>	<b>Page</b>
European foreword .....	3
Introduction .....	4
1 Scope.....	7
2 Normative references.....	9
3 Terms, definitions and symbols .....	10
3.1 Terms and definitions .....	10
3.2 List of symbols.....	11
4 Basis of design.....	16
4.1 General.....	16
4.2 Verifications.....	16
4.3 Methods of design for <i>Vierendeel</i> bending.....	17
4.4 Tolerances .....	17
5 Materials .....	17
5.1 General.....	17
5.2 Welding.....	17
6 Durability.....	17
7 Structural Analysis.....	18
7.1 Methods of analysis.....	18
7.2 Member stiffness for global structural analysis .....13:2022.....	18
7.3 Serviceability..... <a href="https://standards.iteh.ai/catalog/standards/cist/35d1f325">https://standards.iteh.ai/catalog/standards/cist/35d1f325</a>	19
7.4 Classification for global bending..... <a href="https://standards.iteh.ai/catalog/standards/cist/802db0755215/osist-pr-en-1993-1-13">https://standards.iteh.ai/catalog/standards/cist/802db0755215/osist-pr-en-1993-1-13</a>	19
7.5 Section classification of Tees subject to <i>Vierendeel</i> bending .....	20
7.6 Section classification of longitudinal stiffeners.....	21
8 Ultimate Limit State .....	21
8.1 General Requirements for all openings.....	21
8.2 Shear resistance at web opening positions .....	22
8.3 Bending resistance of a beam with web openings .....	23
8.4 Resistance of the Tees in <i>Vierendeel</i> bending.....	24
8.5 Web buckling next to widely spaced openings .....	26
8.6 Rules for closely spaced openings .....	28
8.7 Longitudinally stiffened openings .....	32
8.8 Requirements for other cases .....	34
8.9 Alternative method for <i>Vierendeel</i> bending for circular openings .....	35
8.10 Alternative method for stability of web-post between circular openings .....	36
8.11 Alternative method for sinusoidal openings .....	39
8.12 Lateral torsional buckling .....	41
9 Serviceability limit state .....	41
Bibliography .....	43

## European foreword

This document (prEN 1993-1-13:2022) 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 design matters by CEN.

This document is currently submitted to the CEN Enquiry.

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.

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## 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

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 and geotechnical 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 1993-1-12 to EN 1993-1-14 treat general topics that are independent from the structural type like 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 like 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 1993-1-13

prEN 1993-1-13 gives guidance and recommendations for the design of beams with large web openings.

### 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.

**prEN 1993-1-13:2022 (E)****0.5 National Annex for prEN 1993-1-13**

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 1993-1-13 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 1993-1-13 through notes to the following:

1.1.3(1)                      8.1.2(1)                      8.1.3(2)                      9(5)

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.

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# 1 Scope

## 1.1 Scope of prEN 1993-1-13

### 1.1.1 General

(1) This document gives supplementary provisions that extend the application of EN 1993-1-1 and EN 1993-1-5 to the design of rolled and welded steel sections with various shapes of web openings. The following cases are considered:

- rolled or welded beams with widely spaced web openings;
- rolled or welded beams with closely spaced web openings;
- cellular beams with circular openings made by cutting and re-welding two parts of steel sections that may be different in dimensions;
- beams with hexagonal and sinusoidal openings made by cutting and re-welding two parts of steel sections that may be different in dimensions.

(2) This document applies to uniform members with I or H profiles, which are symmetric about the weak axis. It does not apply to non-prismatic or curved beams although the same principles can apply.

(3) This document applies to steel beams with web openings that are subjected to sagging (positive) and to beams that are also subjected to hogging (negative) bending moments.

(4) This document covers the verification of the resistance at the openings and their effect on the global behaviour of the beam, including lateral torsional buckling.

(5) Alternative methods are presented for beams with circular openings and with sinusoidal openings in which the forces and resistances are calculated by increments around or along the openings and which are suitable for computer methods.

(6) This document applies to web slenderness,  $h_w/t_w$ , not exceeding  $121\varepsilon$ . The local checks at and between adjacent openings apply to web slenderness up to this limit. Tension field action of plate girders is not part of the scope.

NOTE The limit of  $121\varepsilon$  corresponds to the section classification for a symmetric steel section and is used as a convenient limit for the application of this document, including asymmetric sections. The material parameter  $\varepsilon$  is defined in prEN 1993-1-1:2020, 5.2.5 (2).

(7) This document does not cover fatigue. In case of fatigue, EN 1993-1-9 applies.

(8) This document does not cover fire design. For the design in case of fire, EN 1993-1-2 applies.

(9) This document does not cover the buckling verification of members with web openings under axial force.

### 1.1.2 Shapes of openings

(1) The different shapes of openings that are considered in this document are shown in Figure 1.1.

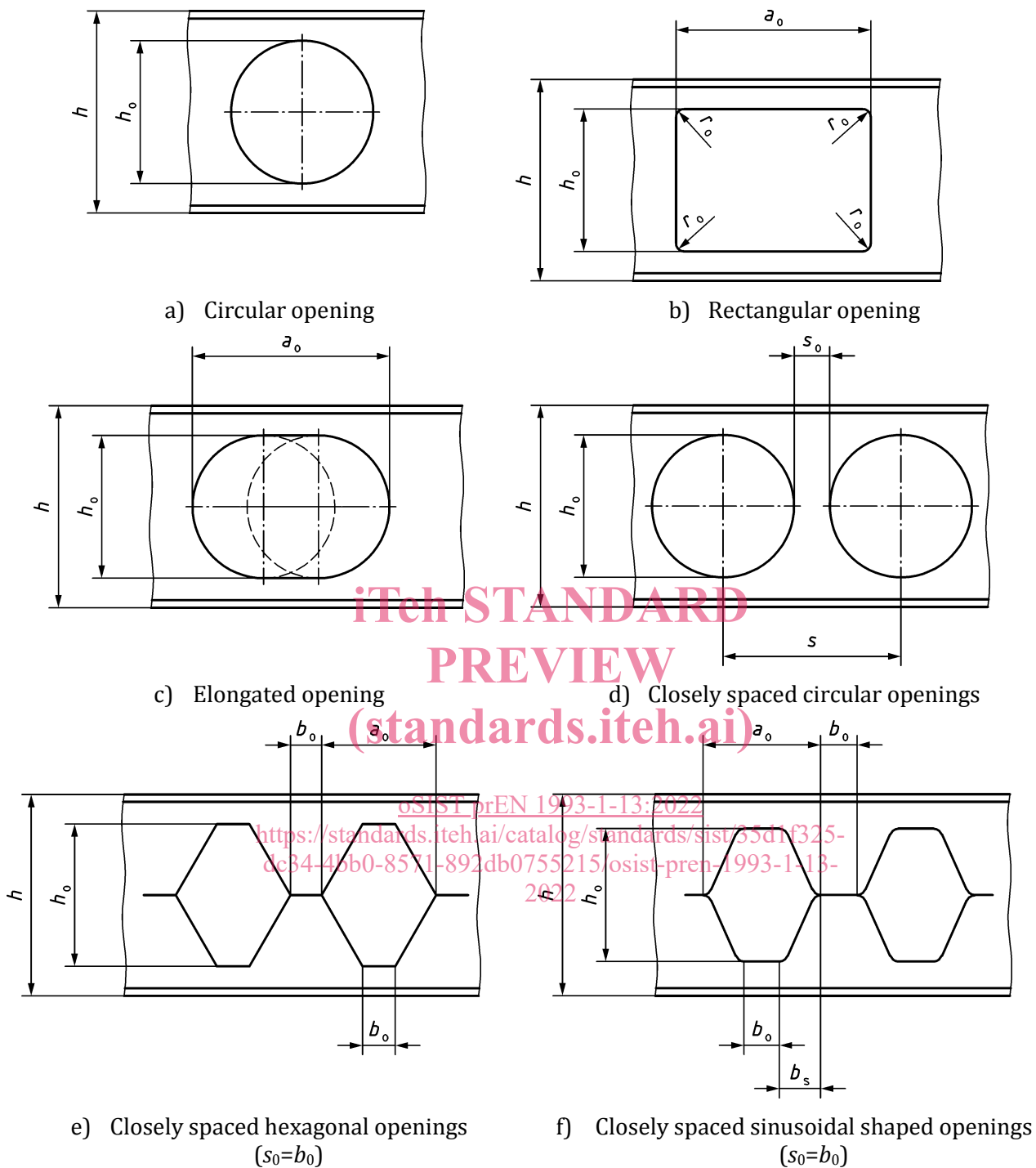
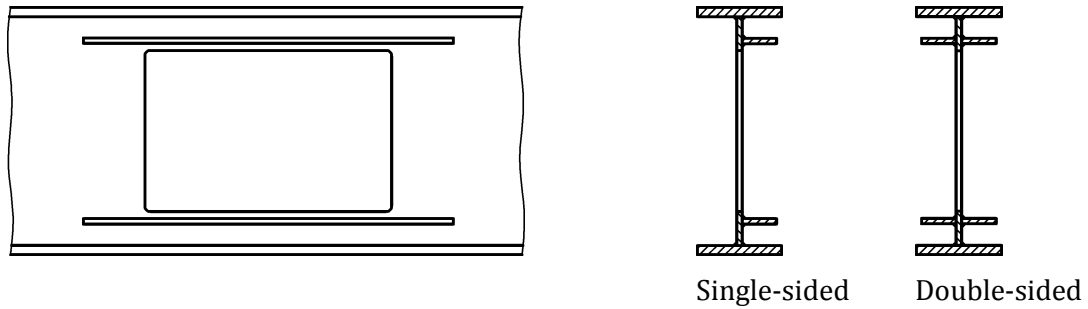


Figure 1.1 — Different shapes of openings in steel beams

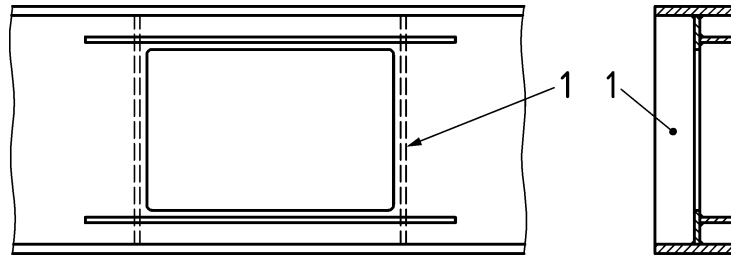
### 1.1.3 Stiffened openings

(1) This document also covers openings in the web of beams that are reinforced by longitudinal stiffeners and/or transverse stiffeners on one or both sides of the web, see Figure 1.2.

NOTE The National Annex can give rules for alternative types of stiffener.



a) Longitudinal stiffeners on one or both sides of the web



b) Transverse stiffeners combined with longitudinal stiffeners on opposite sides of the web

#### Key

- 1 transverse stiffener

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Figure 1.2 – Stiffening of openings in beam webs

## 1.2 Assumptions

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

(2) The design methods given in EN 1993-1-13 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.

## 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 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*

prEN 1993-1-1:2020, *Eurocode 3: Design of Steel Structures - Part 1.1: General rules and rules for buildings*

### 3 Terms, definitions and symbols

#### 3.1 Terms and definitions

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

##### 3.1.1

##### **asymmetric section**

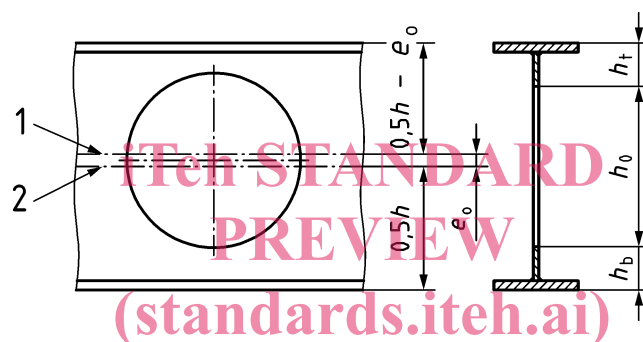
steel section with different dimensions of the top and bottom Tees

##### 3.1.2

##### **eccentricity of opening**

distance  $e_o$  of the centre-line of the opening from the centre-line of the steel section, as shown in Figure 3.1

Note 1 to entry:  $e_o$  is positive when the centre-line of the opening is above the centre-line of the section and is negative below the centre-line of the section.



##### **Key**

- 1 centre-line of the opening
- 2 centre-line of the beam

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**Figure 3.1 — Definition of eccentricity of opening position**

##### 3.1.3

##### **Tee**

combined web and flange section above or below the opening

##### 3.1.4

##### **Vierendeel bending**

local bending of Tees caused by the transfer of shear force across the opening

##### 3.1.5

##### **web-post**

part of the web between adjacent openings, as shown in Figure 3.2

##### 3.1.6

##### **end-post**

end-post is located between the opening and the adjacent support, as shown in Figure 3.2

##### 3.1.7

##### **widely spaced web openings**

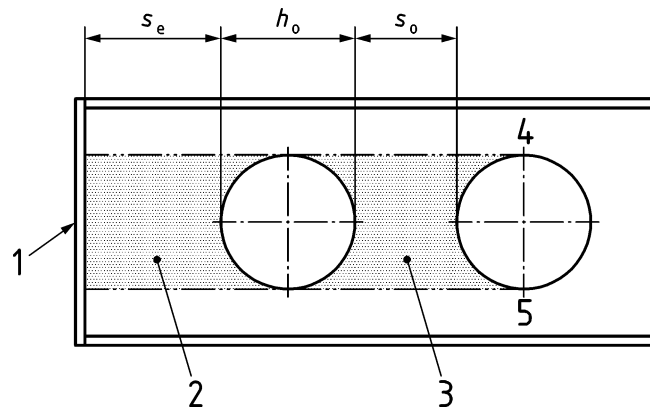
openings where web buckling next to the openings is not influenced by adjacent openings

**3.1.8****closely spaced web openings**

openings where web buckling is influenced by the adjacent openings, as defined in 8.6.1

**3.1.9****stiffened Tee**

Tees with longitudinal stiffeners welded to the Tee section and with suitable anchorage on both sides of the opening

**Key**

- 1 end plate
- 2 end-post
- 3 web-post
- 4 top Tee
- 5 bottom Tee

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**Figure 3.2 — Definition of web-post and end-post for the case of circular openings**

**3.1.10****significant load**

load at or adjacent to the opening that exceeds 15 % of the shear resistance of the loaded Tee

**3.2 List of symbols**

$a_{eff}$	Effective length of an opening for buckling and deflection calculations
$a_{eq}$	Equivalent length of an opening for <i>Vierendeel</i> bending
$a_o$	Overall length of an opening
$a_v$	Anchorage length of stiffener past an opening
$A_{bT}$	Cross-sectional area of bottom Tee
$A_s$	Cross-sectional area of stiffener
$A_{tT}$	Cross-sectional area of top Tee
$A_{V,bT}$	Shear area of bottom Tee
$A_{V,tT}$	Shear area of top Tee
$b_o$	Width of horizontal part of opening in hexagonal or sinusoidal openings, see Figure 1.1