

SLOVENSKI PREDSTANDARD

SIST ENV 1993-1-1/A1

prva izdaja
november 1996

**Eurocode 3: Projektiranje jeklenih konstrukcij - Del 1-1: Splošna
pravila in pravila za stavbe
(prevzeto dopolnilo ENV 1993-1-1:1992/A1:1994 z metodo platnice)**

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

iTeh STANDARD PREVIEW

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

SIST ENV 1993-1-1:1996/A1:1996

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

Deskriptorji: stavbe, jeklene konstrukcije, računanje, predpisi za stavbe, pravila
dimenzioniranja

ICS 91.040.00 * 91.080.10

Referenčna številka
SIST ENV 1993-1-1:1996/A1:1996 ((sl),en)

Nadaljevanje na straneh od II do IV in od 1 do 62

UVOD

Dopolnilo SIST ENV 1993-1-1:1996/A1:1996 (en), Eurocode 3: Projektiranje jeklenih konstrukcij - Del 1-1: Splošna pravila in pravila za stavbe - Dopolnilo A1, ima status slovenskega predstandarda in je z metodo platnice prevzeto dopolnilo evropskemu predstandardu ENV 1993-1-1:1992/A1:1994, Eurocode 3: Design of steel structures - Part 1-1: General rules and rules for buildings, v angleškem jeziku.

NACIONALNI PREGOVOR

Dopolnilo evropskemu predstandardu ENV 1993-1-1:1992/A1:1994 je pripravil tehnični odbor Evropske organizacije za standardizacijo CEN/TC 250 Konstrukcije, pododbor SC 3 Projektiranje jeklenih konstrukcij.

Odločitev za prevzem tega dopolnila po metodi platnice je sprejela delovna skupina USM/TC KON/WG 3 Jeklene konstrukcije, potrdil pa tehnični odbor USM/TC KON Konstrukcije.

To dopolnilo se v Sloveniji lahko uporablja samo v skladu z nacionalnim dokumentom, ki je sestavni del SIST ENV 1993-1-1:1996.

To dopolnilo slovenskemu predstandardu je dne 1996-11-08 odobril direktor USM.

Rok veljavnosti dopolnila je tri leta od njegove izdaje oziroma do izdaje evropskega standarda EN 1993-1-1.

iTeh STANDARD PREVIEW

OSNOVA ZA IZDAJO STANDARDA (standards.iteh.ai)

- Prevzem dopolnila ENV 1993-1-1:1992/A1:1994

[SIST ENV 1993-1-1:1996/A1:1996](https://standards.iteh.ai/catalog/standards/sist/44d3f0e4-3048-423d-a82e-5109ecea831d/sist-env-1993-1-1-1996-a1-1996)

OPOMBI

<https://standards.iteh.ai/catalog/standards/sist/44d3f0e4-3048-423d-a82e-5109ecea831d/sist-env-1993-1-1-1996-a1-1996>

- Povsod, kjer se v besedilu dopolnila predstandardu uporablja izraz "evropski predstandard", v SIST ENV 1993-1-1:1996/A1:1996 to pomeni "slovenski predstandard".

- Uvod in nacionalni predgovor nista sestavni del dopolnila predstandardu.

VSEBINA

Stran

Nacionalni dokument za uporabo v Sloveniji.....	IV
ENV 1993-1-1:1992/A1:1994	1

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST ENV 1993-1-1:1996/A1:1996
<https://standards.iteh.ai/catalog/standards/sist/44d3f0e4-3048-423d-a82e-5109ecea831d/sist-env-1993-1-1-1996-a1-1996>

Nacionalni dokument za uporabo v Sloveniji

Z dopolnilom ENV 1993-1-1:1992/A1:1994 je bil popravljen in dopolnjen evropski predstandard ENV 1993-1-1, Projektiranje jeklenih konstrukcij - Splošna pravila in pravila za stavbe.

Dopolnilo obsega dva normativna dodatka:

- Dodatek D: Uporaba jekel visoke trdnosti kakovosti S 460 in S 420 (novi dodatek)
- Dodatek K: Stikovanje votlih prerezov v paličjih (popravljena verzija Dodatka K iz ENV 1993-1-1).

Vrednost parametrov, ki določajo stopnjo varnosti in zanesljivosti konstrukcij (okvirjene vrednosti) za uporabo SIST ENV 1993-1-1:1996/A1:1996:

- Parcialni varnostni faktor za nosilnost vozlišč pri stikovanju votlih profilov $\gamma_{Mj} = 1.10$. Vrednost je enaka priporočeni vrednosti iz ENV 1993-1-1:1992.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST ENV 1993-1-1:1996/A1:1996](https://standards.iteh.ai/catalog/standards/sist/44d3f0e4-3048-423d-a82e-5109ecea831d/sist-env-1993-1-1-1996-a1-1996)

<https://standards.iteh.ai/catalog/standards/sist/44d3f0e4-3048-423d-a82e-5109ecea831d/sist-env-1993-1-1-1996-a1-1996>

EUROPEAN PRESTANDARD

ENV 1993-1-1:1992/A1

PRÉNORME EUROPÉENNE

EUROPÄISCHE VORNORM

December 1994

ICS 91.040.00; 91.080.10

Descriptors: Buildings, steel structures, computation, building codes, rules of calculation

English version

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

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

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

(standards.iteh.ai)

[SIST ENV 1993-1-1:1996/A1:1996](https://standards.iteh.ai/catalog/standards/sist/44d3f0e4-3048-423d-a82e-5109ecea831d/sist-env-1993-1-1-1996-a1-1996)

<https://standards.iteh.ai/catalog/standards/sist/44d3f0e4-3048-423d-a82e-5109ecea831d/sist-env-1993-1-1-1996-a1-1996>

This amendment 1 modifies the European Prestandard ENV 1993-1-1:1992.

This amendment was approved by CEN on 1993-06-04 as a prospective standard for provisional application. The period of validity of this amendment is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the amendment can be converted into an European Standard (EN).

CEN members are required to announce the existence of this ENV in the same way as for an EN and to make the ENV available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the ENV) until the final decision about the possible conversion of the ENV into an EN is reached.

CEN members are the national standards bodies of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Contents	Page
Foreword	4
Annex D [normative] The use of steel grades S 460 and S 420	8
D.1 Scope	8
D.2 Contents	8
D.3 Materials	8
D.3.1 Structural steel	8
D.3.2 Welding consumables	9
D.4 Serviceability limit states	11
D.5 Ultimate limit states	11
D.5.1 General	11
D.5.2 Flexural buckling	11
D.5.3 Crippling resistance	15
D.6 Connections subject to static loading	16
D.6.1 General	16
D.6.2 Design resistance of a fillet weld	16
D.6.3 Beam-to-column connections	16
D.6.4 Hollow section lattice girder connections	16
D.7 Fabrication of EN 10113 steels	16
D.7.1 General	16
D.7.2 Forming	17
D.7.3 Cutting	18
D.7.4 Welding	18
D.8 Design assisted by testing	20
D.9 Fatigue	20
Annex K [normative] Hollow section lattice girder connections	21
K.1 General	21
K.1.1 Scope	21
K.1.2 General requirements	21
K.2 Definitions and symbols	21
K.3 Field of application	27

K.4	Design	27
K.4.1	General	27
K.4.2	Analysis	28
K.4.3	Buckling lengths of hollow sections in lattice structures	30
K.4.4	Failure modes for hollow section connections	30
K.5	Welds	35
K.5.1	Design resistance	35
K.5.2	Welding in cold-deformed zones	37
K.6	Welded joints between CHS members	38
K.6.1	General	38
K.6.2	Uniplanar joints	38
K.6.3	Multiplanar joints	45
K.7	Welded joints between CHS or RHS brace members and RHS chord members	46
K.7.1	General	46
K.7.2	Uniplanar joints	47
K.7.3	Multiplanar joints	58
K.8	Welded joints between CHS or RHS brace members and I or H section chords	59
K.9	Bolted connections	62

ITeH STANDARD PREVIEW
(standards.iteh.ai)

[SIST ENV 1993-1-1:1996/A1:1996](https://standards.iteh.ai/catalog/standards/sist/44d3f0e4-3048-423d-a82e-5109ecea831d/sist-env-1993-1-1-1996-a1-1996)

<https://standards.iteh.ai/catalog/standards/sist/44d3f0e4-3048-423d-a82e-5109ecea831d/sist-env-1993-1-1-1996-a1-1996>

Foreword

Objectives of the Eurocodes

- (1) The “Structural Eurocodes” comprise a group of standards for the structural and geotechnical design of buildings and civil engineering works.
- (2) They cover execution and control only to the extent that is necessary to indicate the quality of the construction products, and the standard of the workmanship, needed to comply with the assumptions of the design rules.
- (3) Until the necessary set of harmonized technical specifications for products and for methods of testing their performance is available, some of the Structural Eurocodes cover some of these aspects in informative annexes.

Background to the Eurocode programme

- (4) The Commission of the European Communities (CEC) initiated the work of establishing a set of harmonized technical rules for the design of building and civil engineering works which would initially serve as an alternative to the different rules in force in the various member states and would ultimately replace them. These technical rules became known as the “Structural Eurocodes”.
- (5) In 1990, after consulting their respective Member States, the CEC transferred the work of further development, issue and updating of the Structural Eurocodes to CEN, and the EFTA Secretariat agreed to support the CEN work.

- (6) CEN Technical Committee CEN/TC 250 is responsible for all Structural Eurocodes.

[SIST ENV 1993-1-1:1996/A1:1996](https://standards.iteh.ai/catalog/standards/sist/44d3f0e4-3048-423d-a82e-5109ecea831d/sist-env-1993-1-1-1996-a1-1996)

<https://standards.iteh.ai/catalog/standards/sist/44d3f0e4-3048-423d-a82e-5109ecea831d/sist-env-1993-1-1-1996-a1-1996>

Eurocode programme

- (7) Work is in hand on the following Structural Eurocodes, each generally consisting of a number of parts:

- EN 1991 Eurocode 1 Basis of design and 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 provisions for earthquake resistance of structures;
- EN 1999 Eurocode 9 Design of aluminium alloy structures.

- (8) Separate sub-committees have been formed by CEN/TC 250 for the various Eurocodes listed above.

- (9) This amendment A1 affects Part 1.1 of Eurocode 3 which has been published by CEN as a European Prestandard (ENV) in April 1992 with an initial life of three years.

- (10) This prestandard is intended for experimental application and for the submission of comments.

(11) After approximately two years CEN members will be invited to submit formal comments to be taken into account in determining future actions.

(12) Meanwhile feedback and comments on this prestandard should be sent to the secretariat of CEN/TC 250/SC3 at the following address:

BSI Standards
British Standards House
389 Chiswick High Road
London W4 4AL
England

or to your national standards organisation.

National Application Documents (NAD's)

(13) In view of the responsibilities of the authorities in member countries for safety, health and other matters covered by the essential requirements of the Construction Products Directive (CPD), certain safety elements in this ENV have been assigned indicative values which are identified by ("boxed values"). The authorities in each member country are expected to review the "boxed values" and may substitute alternative definitive values for these safety elements for use in national application.

(14) Some of the supporting European or International Standards might not be available by the time this Prestandard is issued. It is therefore anticipated that a National Application Document (NAD) giving any substitute definitive values for safety elements, referencing compatible supporting standards and providing guidance on the national application of this Prestandard, will be issued by each member country or its Standards Organisation.

(15) It is intended that this Prestandard is used in conjunction with the NAD valid in the country where the building or civil engineering works is located.

Scope

(16) The scope of Eurocode 3 is defined in 1.1.1 of ENV 1993-1-1. Additional Parts of Eurocode 3 which are planned are indicated in 1.1.3 of Part 1.1.

Status

(17) This amendment A1 to ENV 1993-1-1 comprises two separate annexes, D and K, which each have a different status.

(18) Annex D is an addition to the previously existing text. It extends the application of Part 1.1 to two higher strength grades of steel, as foreseen in 3.2.2.1(5).

(19) Annex K in this amendment A1 is a revised extended version. It supersedes the original version of Annex K in ENV 1993-1-1 : 1992 which is hereby replaced and withdrawn.

(20) In addition, this amendment A1 modifies the title of Part 1.1 of ENV 1993. It is henceforth "Part 1.1 General rules, General rules and rules for buildings".

Internal cross-references

(21) This amendment A1 to ENV 1993-1-1 has been prepared following current CEN editorial style, including the special derogations agreed for Structural Eurocodes. This style differs from that used in the 1992 edition of ENV 1993-1-1. One of the changes is the terminology used to describe the various levels of sub-division, such as sections and clauses. This has affected some of the cross-references in this amendment, as follows:

Example of numbering	Term used in amendment A1	Term used in 1992 edition
1	section	chapter
1.1	clause	section

Steel grade designations

(22) During the transition to CEN European Standards, besides those in national standards, three different designation systems have been in use at a European level for designating structural steel strength grades and toughness qualities.

(23) For hot rolled products of non-alloy steels these are:

Euronorm 25-72	European Standard EN 10025: 1990	European Standard EN 10025: 1993 *)
Fe 360 A	-	-
Fe 360 B	Fe 360 B	S 235 JR
Fe 360 C	Fe 360 C	S 235 J0
Fe 360 D	Fe 360 D	S 235 J2
Fe 430 A	-	-
Fe 430 B	Fe 430 B	S 275 JR
Fe 430 C	Fe 430 C	S 275 J0
Fe 430 D	Fe 430 D	S 275 J2
Fe 510 B	Fe 510 B	S 355 JR
Fe 510 C	Fe 510 C	S 355 J0
Fe 510 D	Fe 510 D	S 355 J2
Fe 510 DD	Fe 510 DD	S 355 K2

*) These designations are in accordance with EN 10027 and ECIS/IC 10.

(24) For hot rolled products in weldable fine grain steels the corresponding designations are:

Euronorm 113-72	Draft European Standard pr EN 10113	European Standard EN 10113: 1993 *)
FeE275KGN	FeE275KGN	S275N
FeE275KTN	FeE275KTN	S275NL
FeE275KGT M	FeE275KGT M	S275M
FeE275KT M	FeE275KT M	S275ML
FeE355KGN	FeE355KGN	S355N
FeE355KTN	FeE355KTN	S355NL
FeE355KGT M	FeE355KGT M	S355M
FeE355KT M	FeE355KT M	S355ML
FeE420KGN	FeE420KGN	S420N
FeE420KTN	FeE420KTN	S420NL
FeE420KGT M	FeE420KGT M	S420M
FeE420KT M	FeE420KT M	S420ML
FeE460KGN	FeE460KGN	S460N
FeE460KTN	FeE460KTN	S460NL
FeE460KGT M	FeE460KGT M	S460M
FeE460KT M	FeE460KT M	S460ML

*) These designations are in accordance with EN 10027 and ECIS/IC 10.

(25) In the 1992 edition of ENV 1993-1-1 the designations according to EN 10025: 1990 and pr EN 10113 were used. However in Annex D, added by this amendment A1 to ENV 1993-1-1, the current designations in accordance with EN 10025: 1993 and EN 10113: 1993 are used.

Annex D [normative]

The use of steel grades S 460 and S 420

D.1 Scope

(1)P This annex extends the application of ENV 1993-1-1 to steel grades S 460 and S 420 of EN 10113 and steel grade S 460 of EN 10137.

D.2 Contents

(1)P D.3 to D.9 extend the corresponding sections, together with the related annexes, as follows:

- D.3 Materials: Section 3 and annexes B and C;
- D.4 Serviceability limit states: Section 4;
- D.5 Ultimate limit states: Section 5 and annexes E and F;
- D.6 Connections subject to static loading: Section 6 and annexes J, K, L and M;
- D.7 Fabrication of EN 10113 steels: Section 7;
- D.8 Design assisted by testing: Section 8 and annex Y;
- D.9 Fatigue: Section 9.

NOTE: D.7 is finally intended to cover steels to both EN 10113 and EN 10137 but to include only those fabrication provisions that are relevant for design. At the present stage of development, pending the availability of provisions for high strength steels in EN 1090 'Execution of steel structures', D.7 temporarily also contains provisions concerning fabrication of EN 10113 steels but does not cover steel to EN 10137. It is expected that in the future EN 1090 will contain appropriate provisions for both EN 10113 and EN 10137 steels which will supersede these temporary provisions.

(2)P The provisions of sections 1 and 2 apply, without change, to steel grades S 460 and S 420.

D.3 Materials

D.3.1 Structural steel

(1)P The material properties given in this clause are nominal values to be adopted as characteristic values in design calculations only.

(2)P Other properties are given in EN 10113 and EN 10137.

(3)P The nominal values of the yield strength f_y and the ultimate tensile strength f_u are given in table D.1 for steel grades S 460 and S 420 to EN 10113 and steel grade S 460 to EN 10137.

(4)P The nominal values in table D.3.1 may be adopted as characteristic values in calculations.

(5)P As an alternative the minimum values specified in EN 10113 for a larger range of thicknesses may be used.

Table D.1: Nominal values of yield strength f_y and ultimate tensile strength f_u

Nominal steel grade to EN 10113	Thickness t mm ¹⁾			
	$t \leq 40$		$40 \text{ mm} < t \leq 100 \text{ mm}$ ²⁾	
	f_y (N/mm ²)	f_u (N/mm ²)	f_y (N/mm ²)	f_u (N/mm ²)
S 460 N	460	550	430	550
S 460 M	460	530	430	530
S 420 N	420	520	390	520
S 420 M	420	500	390	500

Nominal steel grade to EN 10137	Thickness t mm ¹⁾					
	$t \leq 50 \text{ mm}$		$50 \text{ mm} < t \leq 100 \text{ mm}$		$100 \text{ mm} < t \leq 150 \text{ mm}$	
	f_y (N/mm ²)	f_u (N/mm ²)	f_y (N/mm ²)	f_u (N/mm ²)	f_y (N/mm ²)	f_u (N/mm ²)
S 460 Q	460	550	440	550	400	500

1) t is the nominal thickness of the element.
 2) $40 \text{ mm} < t \leq 63 \text{ mm}$ for plates and other flat products in steels of delivery condition M to EN 10113-3.

ITeh STANDARD PREVIEW

(standarditeh.ai)

(6)P Similar values may be adopted for structural hollow sections to EN 10210 and EN 10219.

(7)P The material shall have sufficient fracture toughness to avoid brittle fracture at the lowest service temperature expected to occur within the intended life of the structure.

(8) In normal cases of welded or non-welded members in building structures subject to static loading or fatigue loading (but not dynamic loading), no further check against brittle fracture is necessary if the conditions given in table D.2 are satisfied.

(9) For all other cases reference should be made to annex C.

(10) In annex C the base value of the lower yield strength f_{y0} should be taken as 460 N/mm² for steel grade S 460 and 420 N/mm² for steel grade S 420.

(11)P When steel grade S 460 or S 420 to EN 10113 or steel grade S 460 to EN 10137 is used, plastic analysis may be utilised in the global analysis of structures or their elements.

D.3.2 Welding consumables

(1)P All welding consumables shall conform with Reference Standard 4, see annex B.

(2)P The specified yield strength, ultimate tensile strength, elongation at failure and minimum Charpy V-notch energy value of the filler metal shall all be either equal to, or better than, the corresponding values specified for the steel grade being welded.

Table D.2: Maximum thickness for statically loaded structural elements without reference to annex C

Steel grade and quality	Maximum thickness (mm) for lowest service temperature of:					
	0 °C		-10 °C		-20 °C	
Service condition	S1	S2	S1	S2	S1	S2
EN 10113: ¹⁾						
S 460 ²⁾	179	53	150	38	99	28
S 460 L ³⁾	250	150	250	101	250	69
S 420 ²⁾	250	70	162	50	140	36
S 420 L ³⁾	250	172	250	145	250	94
EN 10137: ⁴⁾						
S 460 Q	126	34	86	25	61	18
S 460 QL	150	86	150	61	150	44
S 460 QL1	150	150	150	150	150	119

Service conditions: ⁵⁾

S1 Either:

- non-welded, or
- in compression.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

S2 As welded, in tension.

[SIST ENV 1993-1-1:1996/A1:1996](https://standards.iteh.ai/catalog/standards/sist/44d3f0e4-3048-423d-a82e-11e6-3122-312231223122)

[https://standards.iteh.ai/catalog/standards/sist/44d3f0e4-3048-423d-a82e-](https://standards.iteh.ai/catalog/standards/sist/44d3f0e4-3048-423d-a82e-11e6-3122-312231223122)

In both cases this table assumes 1) loading rate R1 and 3) consequences of failure condition C2, see annex C.

1) For steels of delivery condition N to EN 10113-2 over 100 mm thick for steel grade S 460 and over 150 mm thick for steel grade S 420, and for steels of delivery condition M to EN 10113-3 over 150 mm thick for long products and over 63 mm thick for flat products, the minimum Charpy V-notch energy specified in EN 10113 is subject to agreement. Up to 150 mm thick, a minimum value of 27 J is required and 23 J over 150 mm thick up to 250 mm. The test temperature should be -30 °C for steel qualities S 460 and S 420 and -50 °C for steel qualities S 460 L and S 420 L.

2) For steel qualities S 460 and S 420 the specified minimum values of Charpy V-notch energy in EN 10113 only go down as far as 40 J at -20 °C. The entries in this row assume an equivalent value of 27 J at -30 °C.

3) For steel qualities S 460 L and S 420 L the specified minimum value of Charpy V-notch energy in EN 10113 is 27 J at -50 °C.

4) In EN 10137-2 the maximum thickness specified for quenched and tempered steels is 150 mm. The specified minimum value of Charpy V-notch energy is 30 J in the longitudinal direction and 27 J in the transverse direction at test temperatures of -20 °C, -40 °C and -60 °C for qualities Q, QL and QL1 respectively. The values in this table are based on 27 J at the respective temperature for each quality.

5) For full details of service conditions, refer to annex C.

D.4 Serviceability limit states

(1)P The serviceability limit states requirements given in sections 2 and 4 also apply to steelwork of steel grades S 460 and S 420.

(2) The recommendations given in the application rules in section 4 are also valid for steel grades S 460 and S 420.

D.5 Ultimate limit states

D.5.1 General

(1)P The provisions given in section 5 also apply to steel grades S 460 and S 420 except where special provisions are given in D.5.2 or D.5.3.

D.5.2 Flexural buckling

(1)P For flexural buckling the appropriate buckling curve for steel grades S 460 and S 420 only shall be determined from table D.3.

(2)P Sections not contained in these tables shall be classified analogously.

(3)P The imperfection factor α corresponding to the appropriate buckling curve shall be obtained from table D.4.

Table D.4: Imperfection factors

Buckling curve	a	b	c	d	
Imperfection factor α	0,13	0,21	0,34	0,49	0,76

(4)P Values of the reduction factor χ for the appropriate generalised slenderness $\bar{\lambda}$ may be obtained from table D.5.

(5)P Tapered members and members with changes of cross-section within their length may be analysed using second order theory, incorporating the appropriate design value of the equivalent initial bow imperfection $e_{o,d}$ given in figure D.1 corresponding to the relevant buckling curve, depending on the method of analysis and type of cross-section verification.