

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

iTeh STANDARD PREVIEW

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

oSIST prEN 1993-1-1:2020

Ta slovenski standard je istoveten z log/stanprEN 1993 1212b7-4dfe-9f27-0b62968828a3/osist-pren-1993-1-1-2020

ICS:

91.010.30 Tehnični vidiki Technical aspects 91.080.13 Jeklene konstrukcije Steel structures

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

oSIST prEN 1993-1-1:2020

iTeh STANDARD PREVIEW (standards.iteh.ai)

oSIST prEN 1993-1-1:2020 https://standards.iteh.ai/catalog/standards/sist/7cc3bbe9-c2b7-4dfe-9f27-0b62968828a3/osist-pren-1993-1-1-2020

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.

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.

CEN members are the national standards bodies of 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, Turkey and United Kingdom.

0b62968828a3/osist-pren-1993-1-1-2020

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.

Warning: This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.



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

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

Contents		Page			
Europ	European foreword5				
Introduction		6			
1	Scope	9			
1.1	Scope of EN 1993-1-1				
1.2	Assumptions	9			
2	Normative references	9			
3	Terms, definitions and symbols	9			
3.1	Terms and definitions	9			
3.2	Symbols and abbreviations				
3.2.1	Latin upper-case symbols				
3.2.2	Latin lower-case symbols				
3.2.3	Greek upper-case symbols				
3.2.4	Greek lower-case symbols	18			
3.3	Conventions for member axes	20			
4	Basis of design				
4.1	General rules	23			
4.1.1	Basic requirements iTeh STANDARD PREVIEW	23			
4.1.2	Structural reliability	23			
4.1.3	Robustness (Stanuarus.Itell.al)	23			
4.1.4	Design service life for buildings OurabilityoSIST.prFN 1993-1-1:2020	23			
4.1.5	DurabilityoSIST.prFN 1993-1-12020	23			
4.2	Principles of limit state designitehai/catalog/standards/sist/7cc3bbe9-c2b7-4dfe-9f27-	24			
4.3	Basic variables				
4.3.1	Actions and environmental influences				
4.3.2	Material and product properties and geometrical data				
4.4	Verification by the partial factor method				
4.4.1	Design values of actions				
4.4.2	Design values of material properties				
4.4.3 4.4.4	Design values of geometrical data Tolerances				
4.4.4 4.4.5	Design resistances				
4.4.5 4.5	Design resistances Design assisted by testing				
5	Materials				
5.1	General				
5.2	Structural steel				
5.2.1	Material properties				
5.2.2	Ductility requirements				
5.2.3	Fracture toughness				
5.2.4	Through-thickness properties				
5.2.5	Values of other material properties				
5.3	Connecting devices				
5.3.1	Fasteners				
5.3.2 5.4	Welding consumables Other prefabricated products in buildings				
6	Durability	30			

7	Structural analysis	31
7.1	Structural modelling for analysis	31
7.1.1	Basic assumptions	31
7.1.2	Joint modelling	31
7.2	Global analysis	31
7.2.1	Consideration of second order effects	
7.2.2	Methods of analysis for ultimate limit state design checks	
7.3	Imperfections	
7.3.1	Basis	
7.3.2	Sway imperfections for global analysis of frames	
7.3.3	Equivalent bow imperfection for global and member analysis	
7.3.4	Combination of sway and equivalent bow imperfections for global analysis of frames.	
7.3.5	Imperfections for analysis of bracing systems	
7.3.6	Imperfection based on elastic critical buckling modes	
7.3.0 7.4	Methods of analysis considering material non-linearities	
7. 4 7.4.1	General	
7.4.1 7.4.2	Elastic global analysis	
7.4.2 7.4.3	Plastic global analysis	
7.4.3 7.5	Classification of cross-sections	
7.5 7.5.1	Basis	
7.5.1 7.5.2		
	Classification	
7.6	Cross-section requirements for plastic global analysis	
8	Ultimate limit states S.T.A.N.D.A.R.D. P.R.E.V.I.E.W.	54
8.1	Partial factors	54
8.2	Resistance of cross-sections and ards. iteh.ai)	54
8.2.1	General	
8.2.2	Section properties SIST AFN 1003-1-1-2020	
8.2.3	Tension https://standards.iteh.ai/catalog/standards/sist/7cc3bbe9-c2b7-4dfs-9f27-	
8.2.4	Compression	
8.2.5	Bending	
8.2.6	Shear	
8.2.7	Torsion	
8.2.8	Combined bending and shear	
8.2.9	Combined bending and axial force	
	Combined bending, shear and axial force	
	Resistance to transverse forces	
8.3	Buckling resistance of members	
8.3.1	Uniform members in compression	
8.3.2	Uniform members in bending	
8.3.3	Uniform members in bending and axial compression	
8.3.4	General method for lateral and lateral torsional buckling of structural components	
8.3.5	Lateral torsional buckling of members with plastic hinges in buildings	
0.3.3 8.4	Uniform built-up compression members	
o.4 8.4.1	Assumptions and constructional details	
	•	
8.4.2	Design forces for components	
8.4.3	Resistance of components of laced compression members	
8.4.4	Resistance of components of battened compression members	
8.4.5	Closely spaced built-up members	99
9	Serviceability limit states	100
9.1	General	
9.2	Deformations and dynamic effects for buildings	
10	Fatigue	100

Annex	X A (normative) Selection of Execution Class	102
A.1	Use of this Annex	102
A.2	Scope and field of application	102
A.3	Execution Class	102
A.4	Selection process	102
A.5	Execution class and partial factors	103
Annex	B (normative) Design of semi-compact sections	104
B.1	Scope and field of application	104
B.2	Elasto-plastic section modulus	104
B.3	Resistance of cross-sections	105
B.4	Buckling resistance of members	106
Annex	C (normative) Additional rules for uniform members with mono-symmetric cross- sections and for members in bending, axial compression and torsion	107
C.1	Additional rules for uniform members with mono-symmetric cross-section	107
C.2	Additional rules for uniform members in bending, axial compression and torsion	108
Annex	D (normative) Continuous restraint of beams in buildings	111
D.1	Scope and field of application STANDARD PREVIEW	111
D.2	Continuous lateral restraints (standards.iteh.ai)	111
D.3	Continuous torsional restraints	112
Annex	oSIST prEN 1993-1-1:2020 E (informative) Basis for the calibration of partial factors	114
E.1	Use of this informative annex 0b62968828a3/osist-pren-1993-1-1-2020	114
E.2	Scope and field of application	114
E.3	Calibration	114
Biblio	graphy	117

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.

iTeh STANDARD PREVIEW (standards.iteh.ai)

oSIST prEN 1993-1-1:2020 https://standards.iteh.ai/catalog/standards/sist/7cc3bbe9-c2b7-4dfe-9f27-0b62968828a3/osist-pren-1993-1-1-2020

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 D PREVIEW
- New parts are under development, e.g. Eurocode for design of structural glass

0.2 Introduction to EN 1993 (all parts) oSIST prEN 1993-1-1:2020

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 throughthickness 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. (Standards.iteh.a)

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)
- -4.3(3)
- A.3 (4)

iTeh STANDARD PREVIEW (standards.iteh.ai)

oSIST prEN 1993-1-1:2020 https://standards.iteh.ai/catalog/standards/sist/7cc3bbe9-c2b7-4dfe-9f27-0b62968828a3/osist-pren-1993-1-1-2020

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).

iTeh STANDARD PREVIEW
EN 1090-2, Execution of steel structures and aluminium structures - Part 2: Technical requirements for steel structures
(standards.iteh.ai)

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

0b62968828a3/osist-pren-1993-1-1-2020

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 iTeh STANDARD PREVIEW

buckling length

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

oSIST prEN 1993-1-1:2020

3.1.8

https://standards.iteh.ai/catalog/standards/sist/7cc3bbe9-c2b7-4dfe-9f27-

equivalent member 0b62968828a3/osist-pren-1993-1-1-2020

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

 $A_{\rm c}$ area of the equivalent compression flange

 $A_{\rm ch}$ cross-sectional area of one chord of a built-up column

 $A_{\rm d}$ cross-sectional area of one diagonal of a built-up column

 $A_{\rm eff}$ effective area of a cross-section

 $A_{\rm f}$ area of one flange

 $A_{\rm i}$ cross-sectional area for the calculation of the characteristic resistance to an axial force

 A_{net} net area of a cross-section

 $A_{\rm n}$ cross-sectional area of one post (or transverse element) of a built-up column

 $A_{\rm t}$ area of the tension flange

A_{t,net} net area of the tension flange rich STANDARD PREVIEW

A_v shear area (standards.iteh.ai)

 $A_{\rm w}$ area of a web

 A_0 original cross-sectional area 1993-1-12020

https://standards.iteh.ai/catalog/standards/sist/7cc3bbe9-c2b7-4dfe-9f27-

 $B_{\rm Ed}$ design value of the bimomentst-pren-1993-1-1-2020

 $B_{\rm Rd}$ design value of the bimoment resistance

 B_{Rk} characteristic value of the bimoment resistance

 $C_{\rm D}$ rotational stiffness provided by stabilizing continuum and connections

 $C_{\rm D,A}$ rotational stiffness of the connection between the beam and the stabilizing continuum

 $C_{\rm D,B}$ 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_{mv} , C_{mz} , C_{mLT} equivalent uniform moment factors

E modulus of elasticity

 $EI \Big|_{\eta_{cr,m}^{"}}\Big|$ absolute value of the bending moment due to $\eta_{cr,m}$ at the critical cross-section m

 $F_{\rm cr,ns}$ minimum elastic critical flexural buckling load for either the in-plane or out-of-plane

member (non-sway) buckling mode

 $F_{cr.sw}$ elastic critical in-plane flexural buckling load for a global (sway) buckling mode

 $F_{\rm d}$ design value of the load on the structure

design value of transverse force $F_{z,Ed}$ design value of the resistance to transverse force $F_{\rm z.Rd}$ Gshear modulus characteristic value of the effect of permanent actions $G_{\mathbf{k}}$ Н height of the structure H_{Ed} total design horizontal load fictitious horizontal load $H_{\mathbf{f}}$ storey height $H_{\rm st}$ Ι moment of inertia $I_{\rm b}$ in-plane moment of inertia of a batten in-plane moment of inertia of a chord $I_{\rm ch}$ effective moment of inertia of a built-up member $I_{\rm eff}$ torsion constant I_{T} warping constant $I_{\rm w}$ moment of inertia about y-y axis and z-z axis, respectively $I_{\rm v}, I_{\rm z}$ moment of inertia about 2-z axis of two flanges 1. ai) $I_{z,fl}$ equivalent moment of inertia of a battened built-up member I_1 lateral rigidity of a storey obs2968828a3/osist-pren-1993-1-1-2020 $K_{\rm st}$ K_{v} factor for considering the type of verification in evaluating torsional restraints factor for considering the moment distribution in evaluating torsional restraints K_{Θ} L length (member length, span length, etc.) length between two consecutive lateral restraints $L_{\rm c}$ buckling length of chord in a built-up member $L_{\rm ch}$ buckling length $L_{\rm cr}$ length of a diagonal in a built-up member $L_{\rm d}$ stable length of segment L_{st} effective length for the resistance to transverse force $L_{\rm v}$ design value of the buckling resistance of a member in bending $M_{\rm b,Rd}$ design value of the reduced resistance to bending moment making allowance for the $M_{\rm B.V.Rd}$ presence of shear force and bimoment design value of the reduced resistance to bending moment making allowance for the $M_{\rm c.B.Rd}$ presence of bimoment

elastic critical moment for lateral torsional buckling

 $M_{\rm cr}$

 $M_{\rm c,Rd}$ design value of the resistance to bending moment about one principal axis of a cross-

section

 $M_{\rm Ed}$ design bending moment

 $M_{\rm Ed}^{\rm I}$. design value of the maximum first order moment in the middle of a built-up member

 $M_{\rm el,Rd}$ design value of the elastic moment resistance

 $M_{\rm ep,Rd}$ design value of the elasto-plastic bending moment resistance

 $M_{\rm h}$ hogging moment at member ends

 $M_{\rm N,ep,Rd}$ design value of the elasto-plastic bending moment resistance making allowance for the

presence of axial force

 $M_{\rm N,Rd}$ sign value of the reduced resistance to bending moment making allowance for the

presence of axial force

 $M_{\rm pl,Rd}$ design value of the plastic moment resistance

 $M_{\rm Rk}$ characteristic value of the resistance to bending moment

 $M_{\rm Rk.m}$ characteristic value of the moment resistance of the critical cross-section m

 $M_{\rm V,Rd}$ design value of the reduced plastic resistance to bending moment making allowance for

the presence of shear force ARD PREVIEW

 $M_{\rm v,Ed}$ design value of the bending moment about y-y axis

 $M_{\rm v,Rd}$ design value of the resistance to bending moment about y-y axis

 $M_{\rm v,Rk}$ 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

 $M_{\rm z,Rk}$ 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

 $N_{\rm b,Rd}$ design value of the buckling resistance of a member in compression

 $N_{\rm c.Rd}$ design value of the resistance to axial force of the cross-section for uniform

 $N_{\rm ch,Ed}$ design value of the axial force in a chord, in the middle of a built-up member

 $N_{\rm cr}$ elastic critical axial force for the relevant buckling mode based on the gross cross-

sectional properties

 $N_{\rm cr.c.z}$ elastic critical axial force for flexural buckling of the equivalent compression flange

 $N_{\rm cr,m}$ elastic critical axial force in the cross-section m

 $N_{\rm cr,T}$ elastic critical axial force for torsional buckling

 $N_{\rm cr.TF}$ elastic critical axial force for torsional-flexural buckling

 $N_{\rm cr.V}$ effective critical axial force of a built-up member including the effect of its shear stiffness