SLOVENSKI PREDSTANDARD

SIST ENV 1993-1-1/A2

prva izdaja
julij 2001

**Eurocode 3: Projektiranje jeklenih konstrukcij - Del 1-1: Splošno - Splošna pravila in pravila za stavbe
(prevzeto dopolnilo ENV 1993-1-1:1992/A2:1998 z metodo platnice)**

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 génerales et règles pour les bâtiments

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

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

ICS 91.040.00; 91.080.10

Referenčna številka
SIST ENV 1993-1-1:2001 ((sl),en)

Nadaljevanje na straneh od II do IV in od 1 do 121

NACIONALNI UVOD

Dopolnilo SIST ENV 1993-1-1/A2 ((sl),en), Eurocode 3: Projektiranje jeklenih konstrukcij - Del 1-1: Splošno - Splošna pravila in pravila za stavbe, prva izdaja, 2001, ima status slovenskega dopolnila in je z metodo platnice prevzeto evropsko dopolnilo evropskega predstandarda ENV 1993-1-1/A2 (en), Eurocode 3: Design of steel structures - Part 1-1: General - General rules and rules for buildings, October 1998.

NACIONALNI PREDGOVOR

Dopolnilo evropskemu predstandardu ENV 1993-1-1:1992/A2:1998 je pripravil tehnični odbor Evropskega komiteja za standardizacijo CEN/TC 250 Konstrukcijski evrokodi.

Pripravo tega dopolnila predstandardu sta CEN poverila Evropska komisija in Evropsko združenje za prosto trgovino.

Odločitev za prevzem tega dopolnila po metodi platnice je sprejela delovna skupina USM/TC KON/WG 3 Jeklene konstrukcije, ki je pripravila tudi nacionalni dokument za uporabo v Sloveniji, potrdil pa tehnični odbor USM/TC KON Konstrukcije.

To slovensko dopolnilo se lahko uporablja samo v skladu z nacionalnim dokumentom, ki je sestavni del SIST ENV 1993-1-1:1996/A2:2001.

Ta slovenski predstandard je dne 2000-12-04 odobril direktor USM.

Rok veljavnosti tega predstandarda je do izdaje evropskega standarda EN 1993-1-1.

ZVEZE S STANDARDI

S prevzemom tega evropskega predstandarda veljajo za omejeni namen referenčnih standardov vsi standardi, navedeni v izvirniku, razen tistih, ki so že sprejeti kot nacionalni standardi:

SIST ENV 1991-1:1998	((sl),en)	Eurocode 1: Osnove projektiranja in vplivi na konstrukcije - 1. del: Osnove projektiranja
SIST ENV 1991-2-1:1998	((sl),en)	Eurocode 1: Osnove projektiranja in vplivi na konstrukcije - Del 2-1: Vplivi na konstrukcije - Gostote, lastna teža in koristne obtežbe
SIST ENV 1991-2-3:1998	((sl),en)	Eurocode 1: Osnove projektiranja in vplivi na konstrukcije - Del 2-3: Vplivi na konstrukcije - Obtežbe snega
SIST ENV 1991-2-4:1998	((sl),en)	Eurocode 1: Osnove projektiranja in vplivi na konstrukcije - Del 2-4: Vplivi na konstrukcije - Vplivi vetra
SIST ENV 1993-1-1:1996	((sl),en)	Eurocode 3: Projektiranje jeklenih konstrukcij - Del 1-1: Splošna pravila in pravila za stavbe
SIST ENV 1993-1-1:1996/A1:1996	((sl),en)	Projektiranje jeklenih konstrukcij - Del 1-1: Splošna pravila in pravila za stavbe - Dodatka D in K
SIST ENV 1993-1-2:1999	((sl),en)	Projektiranje jeklenih konstrukcij - Del 1-2: Splošna pravila - Projektiranje požarnovarnih konstrukcij
SIST ENV 1993-1-3:2001	((sl),en)	Projektiranje jeklenih konstrukcij - Del 1-3: Splošna pravila - Dodatna pravila za hladno oblikovane tankostenske profile in pločevine
SIST ENV 1993-1-4:2001	((sl),en)	Projektiranje jeklenih konstrukcij - Del 1-4: Splošna pravila - Dodatna pravila za nerjavna jekla
SIST ENV 1993-1-5:2001	((sl),en)	Projektiranje jeklenih konstrukcij - Del 1-5: Splošna pravila - Dodatna pravila za ravninske pločevinaste konstrukcije

		(ortotropne plošče) brez prečne obremenitve
SIST ENV 1993-1-6:2001	((sl),en)	Projektiranje jeklenih konstrukcij - Del 1-6: Splošna pravila - Dodatna pravila za lupinaste konstrukcije
SIST ENV 1993-1-7:2001	((sl),en)	Projektiranje jeklenih konstrukcij - Del 1-7: Splošna pravila - Dodatna pravila za ravninske pločevinaste konstrukcije (ortotropne plošče), obremenjene s prečno obtežbo
SIST ENV 1993-2:2001	((sl),en)	Projektiranje jeklenih konstrukcij – 2. del: Jekleni mostovi
SIST ENV 1993-3-1:2001	((sl),en)	Projektiranje jeklenih konstrukcij – Del 3-1: Stolpi, jambori in dimniki - Stolpi in jambori
SIST ENV 1993-3-2:2001	((sl),en)	Projektiranje jeklenih konstrukcij – Del 3-2: Stolpi, jambori in dimniki - Dimniki
SIST ENV 1993-4-1:2001	((sl),en)	Projektiranje jeklenih konstrukcij - Del 4-1: Silosi, rezervoarji in cevovodi - Silosi
SIST ENV 1993-4-2:2001	((sl),en)	Projektiranje jeklenih konstrukcij - Del 4-2: Silosi, rezervoarji in cevovodi - Rezervoarji
SIST ENV 1993-4-3:2001	((sl),en)	Projektiranje jeklenih konstrukcij - Del 4-3: Silosi, rezervoarji in cevovodi - Cevovodi
SIST ENV 1993-5:2001	((sl),en)	Projektiranje jeklenih konstrukcij – 5. del: Piloti in zagatne stene
SIST ENV 1993-6:2001	((sl),en)	Projektiranje jeklenih konstrukcij – 6. del: Žerjavne proge

OPOMBI

- Povsod, kjer se v besedilu dopolnila predstandardu uporablja izraz “evropski predstandard”, v SIST ENV 1993-1-1:1996/A2:2001 to pomeni “slovenski predstandard”.

- Nacionalni uvod in nacionalni predgovor nista sestavni del dopolnila predstandarda.

VSEBINA **Stran**

Nacionalni dokument za uporabo v Sloveniji IV
ENV 1993-1-1:1992/A2:1998 1

Nacionalni dokument za uporabo v Sloveniji

Z dopolnilom ENV 1993-1-1: 1992/A2: 1998 je bil dopolnjen evropski predstandard ENV 1993-1-1, Projektiranje jeklenih konstrukcij – Splošna pravila in pravila za stavbe.

Dopolnilo obsega pet dodatkov:

- Dodatek G (informativni dodatek): Projektiranje na torzijsko odpornost (nov dodatek),
- Dodatek H (informativni dodatek): Modeliranje konstrukcij stavb za numerično analizo (nov dodatek),
- Dodatek J (normativni dodatek): Stiki v okvirnih konstrukcijah stavb (popravljena verzija dodatka J iz ENV 1993-1-1),
- Dodatek N (informativni dodatek): Odprtine v stojinah (nov dodatek),
- Dodatek E (informativni dodatek): Določanje projektne nosilnosti na osnovi preskusov (nov dodatek).

Za vrednosti parametrov, podanih v okvirih (večinoma delni varnostni faktorji odpornosti ali zunanjih vplivov), se v SIST ENV 1993-1-1: 1996/A2:2001 privzamejo priporočene vrednosti, podane v ENV 1993-1-1: 1992/A2:1998.

EUROPEAN PRESTANDARD

PRÉNORME EUROPÉENNE

EUROPÄISCHE VORNORM

ENV 1993-1-1:1992/A2

October 1998

ICS

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

This amendment A2 modifies the European Prestandard ENV 1993-1-1:1992; it was approved by CEN on 28 April 1998 as a prospective standard for provisional application.

The period of validity of this amendment is limited to the period of validity of the ENV (three years). After two years the members of CEN will be requested to submit their comments, particularly on the question whether the ENV can be converted into a European Standard.

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, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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

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

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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 the methods of testing their performance is available, some of the Structural Eurocodes cover some of these aspects in informative annexes.

Background of 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.

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 structures.

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

(9) This amendment A2 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/SC 3 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 (NADs)

(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 definitive values for safety elements, referencing compatible supporting standards and providing national guidance on the 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.

Matters specific to this Prestandard

(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 ENV 1993-1-1.

(17) This amendment A2 to ENV 1993-1-1 comprises five separate annexes, G, H, J, N and Z.

(18) Annex J in this amendment A2 is a revised extended version. It supersedes the original version of annex J in ENV 1993-1-1 : 1992, which is hereby replaced and withdrawn.

(19) The extension of annex J includes angle cleats, an improved method for predicting rotational stiffness and additional types of joints.

(20) Due to the extension of annex J to cover additional types of joints, its title has been modified to "Joints in building frames".

(21) In annex N two different symbols b_w and d_w have been used for web depth. In section 5 of ENV 1993-1-1 the symbol d is used, however in 5.3 d is the clear depth between root radii or web-to-flange welds, whereas in 5.6 d is the overall depth between flanges. Annex N involves both these dimensions, so for clarity b_w has been used for the clear depth and d_w for the overall depth.

(22) In relation to annex Z, it is recognised that there remain differences between the views of experts in the field of structural reliability. However the contents of annex Z are consistent with those of annexes A and D of ENV 1991-1 and compatible with ISO 2394 : 1986 "General principles on reliability of structures". They also represent the procedures actually used in calibrating most of the provisions of ENV 1993-1-1 and many of those of ENV 1994-1-1.

Annex G [informative]

Design for torsion resistance

G.1 Scope

(1) This annex gives application rules for the design of members subjected to torsion in building structures, following the principles given in section 5.

(2) This annex provides application rules and information for:

a) determining the torsion resistance of I, H, channel or structural hollow section members;

b) determining torsion constants and warping constants for hot-rolled open sections for use in:

- determining torsion resistances;
- calculating elastic torsional deformations;
- lateral-torsional buckling verifications.

c) verifying the resistance of members subject to combined torsion and bending or axial force.

(3) The rules given in this annex apply to members with Class 1, Class 2 or Class 3 cross-sections, with webs that have proportions such that they are not susceptible to shear buckling.

(4) The determination of the torsional moment in a particular section due to loading and support is not part of this annex G.

NOTE: For the effects of torsion and distortion in bridges see ENV 1993-2.

G.2 Basis

(1) When a member is subject to torsion it will twist about its longitudinal axis, which passes through the shear centre of the cross-section. However, torsion will not occur if the resultant of the external applied loading passes through the shear centre of the cross-section. In practical design situations, torsion should preferably be avoided by applying the loads such that their resultant passes through the shear centre.

(2) Generally it may be assumed that the load transfer through the connections applying the loads to the members ensures that the loads are effectively applied through the shear centre. This may also be assumed for loads from floor slabs supported on the top flanges of beams, even for those with channel cross-sections, provided that deformation can occur only in the direction perpendicular to the plane of the slab.

(3) Designing to resist loads by means of torsion is not usually an efficient method of load transfer. It should be avoided wherever practicable.

(4) Where it is not possible to avoid torsion, care should be taken to arrange the framing so as to minimise its effects. Attention to detail, particularly when considering how loads are actually transferred to members, can minimise or eliminate many potential difficulties associated with torsional effects.

(5) Where significant torsional eccentricity is unavoidable, consideration should be given to the use of box girders, comprising either a lattice girder fully triangulated on all faces or hollow rolled or plated sections.

(6) Where the torsional resistance of members is necessary to maintain equilibrium with the applied loads, these members should be modelled as torsionally restrained for elastic global analysis. However the connections should normally be modelled without any restraint of warping, unless appropriate provision can be made in the connection details to resist the resulting warping bi-moments.

(7) The resulting torsional moments should be taken into account in the design of the connections, together with the other internal forces and moments, including any warping bi-moments.

(8) In building structures subject to predominantly static loading, where appropriate a connection may be modelled for elastic global analysis as torsionally pinned as well as free to warp, independently of whether that connection is modelled as pinned, rigid or semi-rigid in respect of its resistance to bending moments.

(9) In the case described in (8), account should nevertheless be taken of the possible effects of torsional deformations of the steel members on other building components at serviceability limit states.

(10) In all cases, it should be ensured that the details of the joints are consistent with the assumptions made in the global analysis.

G.3 Torsional properties

G.3.1 Torsion constant

(1) For welded I or H sections with parallel flanges, see figure G.1, the torsion constant I_t should be determined from:

$$I_t = \frac{1}{3}\sum_{i=1}^{3} b_i t_i^3 \qquad \text{... (G.1)}$$

where:

b_i is the width of plate i of the cross-section;

t_i is the thickness of plate i of the cross-section.

(2) For hot rolled sections with parallel flanges, see figure G.2, the torsion constant I_t should be determined from the following:

- for an I or H section:

$$I_t = 2 I_1 + I_2 + 2 k_1 D_1^4 \qquad \text{... (G.2)}$$

- for a channel section:

$$I_t = 2 I_1 + I_2 + 2 k_2 D_2^4 \qquad \text{... (G.3)}$$

- for a T section:

$$I_t = I_1 + I_3 + k_1 D_1^4 \qquad \text{... (G.4)}$$

with:

$$I_1 = \left(b - 0{,}630\, t_f\right) t_f^3 / 3 \qquad \text{... (G.5)}$$

$$I_2 = \left(h - 2\, t_f\right) t_w^3 / 3 \qquad \text{... (G.6)}$$

$$I_3 = \left(h - t_f - 0{,}315\, t_w\right) t_w^3 / 3 \qquad \text{... (G.7)}$$

$$k_1 = -0{,}0420 + 0{,}2204\, t_w / t_f + 0{,}1355\, r / t_f - 0{,}0865\, r\, t_w / t_f^2 - 0{,}0725 \left(t_w / t_f\right)^2 \qquad \text{... (G.8)}$$

$$k_2 = -0{,}0908 + 0{,}2621\,t_w/t_f + 0{,}1231\,r/t_f - 0{,}0752\,r\,t_w/t_f^2 - 0{,}0945\left(t_w/t_f\right)^2 \quad \text{... (G.9)}$$

$$D_1 = \frac{\left(r + t_f\right)^2 + t_w\left(r + t_w/4\right)}{2\,r + t_f} \quad \text{... (G.10)}$$

$$D_2 = 2\left(3\,r + t_f + t_w - \sqrt{2\left(2\,r + t_f\right)\left(2\,r + t_w\right)}\right) \quad \text{... (G.11)}$$

(3) For hot rolled sections with taper flanges, see figure G.3, with a slope not exceeding 1:6 the torsion constant I_t should be determined from the following:

- for an I or H section:

$$I_t = 2\,I_4 + I_5 + 2\,k_3\,D_3^4 \quad \text{... (G.12)}$$

- for a channel section:

$$I_t = 2\,I_6 + I_5 + 2\,k_4\,D_4^4 \quad \text{... (G.13)}$$

with:

$$I_4 = \left(b - t_w\right)\left(t_1 + t_2\right)\left(t_1^2 + t_2^2\right)/12 + t_w\,t_2^3/3 - 2\,v_1\,t_1^4 \quad \text{... (G.14)}$$

$$I_5 = \left(h - 2\,t_2\right)t_w^3/3 \quad \text{... (G.15)}$$

$$I_6 = \left(b - t_w\right)\left(t_1 + t_2\right)\left(t_1^2 + t_2^2\right)/12 + t_w\,t_2^3/3 - v_2\,t_1^4 - 0{,}105\,t_2^4 \quad \text{... (G.16)}$$

$$k_3 = \alpha_1 + 6\,s_1\left(\alpha_2 - \alpha_1\right) \quad \text{... (G.17)}$$

$$k_4 = \alpha_3 + 6\,s_2\left(\alpha_4 - \alpha_3\right) \quad \text{... (G.18)}$$

$$\alpha_1 = -0{,}0420 + 0{,}2204\,t_w/t + 0{,}1355\,r/t - 0{,}0865\,r\,t_w/t^2 - 0{,}0725\left(t_w/t\right)^2 \quad \text{... (G.19)}$$

$$\alpha_2 = -0{,}0836 + 0{,}2536\,t_w/t_2 + 0{,}1268\,r/t_2 - 0{,}0806\,r\,t_w/t_2^2 - 0{,}0858\left(t_w/t_2\right)^2 \quad \text{... (G.20)}$$

$$\alpha_3 = -0{,}0908 + 0{,}2621\,t_w/t + 0{,}1231\,r/t - 0{,}0752\,r\,t_w/t^2 - 0{,}0945\left(t_w/t\right)^2 \quad \text{... (G.21)}$$

$$\alpha_4 = -0{,}1325 + 0{,}3015\, t_w/t_2 + 0{,}1400\, r/t_2 - 0{,}1070\, r\, t_w/t_2^2 - 0{,}0956\left(t_w/t_2\right)^2 \quad \text{... (G.22)}$$

$$t = \left(t_1 + t_2\right)/2 \quad \text{... (G.23)}$$

$$D_3 = \frac{\left(m_1 + t_3\right)^2 + t_w\left(r + t_w/4\right)}{m_1 + r + t_3} \quad \text{... (G.24)}$$

$$D_4 = 2\left(3\, r + m_2 + t_w - \sqrt{2\left(2\, r + m_2\right)\left(2\, r + t_w\right)}\right) \quad \text{... (G.25)}$$

$$v_1 = 0{,}10504 + 0{,}10000\, s_1 + 0{,}08480\, s_1^2 + 0{,}06746\, s_1^3 + 0{,}05153\, s_1^4 \quad \text{... (G.26)}$$

$$v_2 = 0{,}10504 + 0{,}10000\, s_2 + 0{,}08480\, s_2^2 + 0{,}06746\, s_2^3 + 0{,}05153\, s_2^4 \quad \text{... (G.27)}$$

$$s_1 = 2\left(t_3 - t_1\right)/b \quad \text{... (G.28)}$$

$$s_2 = \left(t_2 - t_1\right)/\left(b - t_w\right) \quad \text{... (G.29)}$$

$$m_1 = r\, s_1\left(\sqrt{1 + \left(1/s_1\right)^2} - 1 - 0{,}5\, t_w/r\right) \quad \text{... (G.30)}$$

$$m_2 = t_2 - r\left(s_2 + 1 - \sqrt{1 + s_2^2}\right) \quad \text{... (G.31)}$$

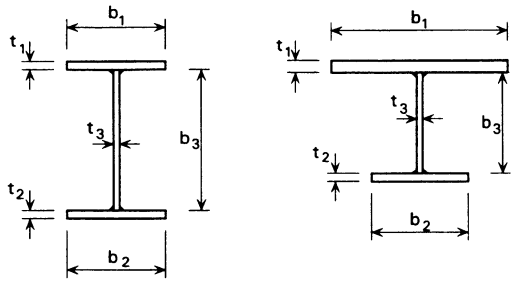

Figure G.1: Welded I and H sections with parallel flanges

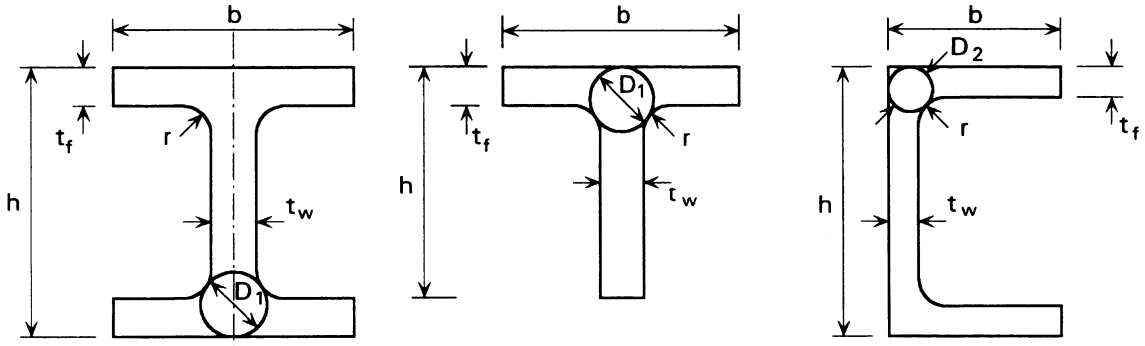

Figure G.2: Hot rolled sections with parallel flanges

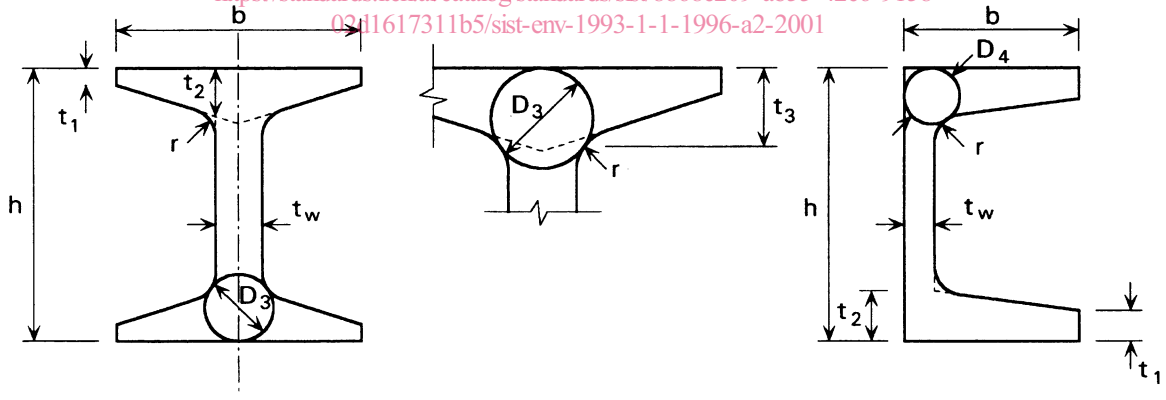

Figure G.3: Hot rolled sections with taper flanges