Irish Standard
I.S. EN 1993-1-5:2006&AC:2009&A1:2017

Eurocode 3 - Design of steel structures - Part 1-5: Plated structural elements

I.S. EN 1993-1-5:2006&AC:2009&A1:2017

Incorporating amendments/corrigenda/National Annexes issued since publication:

EN 1993-1-5:2006/A1:2017 EN 1993-1-5:2006/AC:2009

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NOTE: The date of any NSAI previous adoption may not match the date of its original CEN/CENELEC document.

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NSAI
1 Swift Square,
Northwood, Santry
Dublin 9

T +353 1 807 3800
F +353 1 807 3838
E standards@nsai.ie
W NSAI.ie

Sales:
T +353 1 857 6730
F +353 1 857 6729
W standards.ie

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National Foreword

I.S. EN 1993-1-5:2006&AC:2009&A1:2017 is the adopted Irish version of the European Document EN 1993-1-5:2006, Eurocode 3 - Design of steel structures - Part 1-5: Plated structural elements

NSAI adopts all Eurocodes as Irish Standards.

Eurocodes permit certain design parameters to be selected nationally. In Ireland, the selection of National Design parameters (NDP's) is the responsibility of the Eurocodes Consultative Committee (NSAI TC 015). National Annexes are developed in accordance with CEN and NSAI procedures and include a public consultation process.

Where NSAI TC 015 considers it appropriate, NDP's are agreed and listed in Irish National Annexes to Eurocodes.

Eurocodes must always be used in conjunction with the accompanying National Annex (NA), where available. For example, I.S. EN 1991-1-4, Eurocode 1: Actions on structures – Part 1-4: General actions – Wind actions is to be used in conjunction with NA to I.S. EN 1991-1-4.

National annexes are reviewed as necessary e.g. when a new edition, an amendment or a corrigendum to a Eurocode is issued. The national annex identifies what amendments/corrigenda are addressed. The user should check that the National Annex addresses the latest changes to the Eurocode. Previews of all documents are available on www.standards.ie. Any questions should be directed to NSAI.

Where an Irish National Annex to a Eurocode has not been prepared, the user must make sure that the general requirements of I.S. EN 1990 and the accompanying Irish National Annex are complied with.

Where a Eurocode has been changed (revised/amended/corrected) and the National Annex has yet to be revised to account for the change(s), the National Annex for the previous version is available. Engineering judgement must be applied if using guidance contained therein. Where no National Annex exists, and NSAI TC 015 considers it appropriate to develop one, NDP's will be agreed and listed in new Irish National Annexes to Eurocodes. In the interim, Engineering Judgement must be applied e.g. when selecting appropriate parameters for NDP's..

Information on Eurocodes and the related national annexes is available from www.nsai.ie.

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In line with international standards practice the decimal point is shown as a comma (,) throughout this document.

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EUROPEAN STANDARD

NORME EUROPÉENNE

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EN 1993-1-5:2006/A1

April 2017

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English Version

Eurocode 3 - Design of steel structures - Part 1-5: Plated structural elements

Eurocode 3 - Calcul des structures en acier - Partie 1-5 : Plaques planes

Eurocode 3 - Bemessung und Konstruktion von Stahlbauten - Teil 1-5: Plattenförmige Bauteile

This amendment A1 modifies the European Standard EN 1993-1-5:2006; it was approved by CEN on 17 January 2017.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for inclusion of this amendment into the relevant national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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European foreword

This document (EN 1993-1-5:2006/A1:2017) has been prepared by Technical Committee CEN/TC 250 “Structural Eurocodes”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2018, and conflicting national standards shall be withdrawn at the latest by April 2018.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

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EUROPEAN STANDARD

NORME EUROPÉENNE

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EN 1993-1-5:2006/AC

April 2009
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English version
Version Française
Deutsche Fassung

Eurocode 3 - Design of steel structures - Part 1-5: Plated structural elements

Eurocode 3 - Calcul des structures en acier - Partie 1-5: Plaques planes

Eurocode 3 - Bemessung und Konstruktion von Stahlbauten - Teil 1-5: Plattenförmige Bauteile

This corrigendum becomes effective on 1 April 2009 for incorporation in the three official language versions of the EN.

Ce corrigendum prendra effet le 1 avril 2009 pour incorporation dans les trois versions linguistiques officielles de la EN.

Die Berichtigung tritt am 1.April 2009 zur Einarbeitung in die drei offiziellen Sprachfassungen der EN in Kraft.

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

Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No.:EN 1993-1-5:2006/AC:2009 D/E/F

1) Modification to Subclause 1.4

Change the definition for "b_w" *into:* "clear width between welds for welded sections or between ends of radii for rolled sections".

2) Modification to Subclause 2.3

Paragraph '(2)'*, change* "if the condition in 3.1 is fulfilled" *into:* "if the condition in 2.2(5) is fulfilled".

3) Modification to Subclause 2.6

Paragraph '(1)'*,* 'NOTE'*, delete:* "plate".

4) Modifications to Subclause 3.2.1

Title of the subclause, change "Effective width" *into:* "Effective[s] width".

Paragraph '(1)'*, change in the last sentence* "This effective width may" *into:* "This effective[s] width may".

5) Modification to Subclause 3.2.2

Paragraph '(1)'*,* 'Figure 3.3'*, change* "with the effective width" *into:* "with the effective[s] width".

6) Modifications to Subclause 3.2.3

Paragraph '(1)'*, Equation* '(3.2)'*, change* "$a_{st,l}$" *into:* "$a_{st,1}$".

Paragraph '(1)'*, Equation* '(3.2)'*, first line of the paragraph beginning with* 'where:'*, change* "area of the stiffeners smeared" *into:* "area of the directly loaded stiffeners divided".

Paragraph '(1)'*, Equation* '(3.2)'*, 2nd sentence under* 'where:'*, change* "This may be taken, conservatively, as the area of the stiffeners divided by the spacing s_{st};" *into:* "This may be taken as the area of a stiffener smeared over the length of the spacing s_{st};".

Paragraph '(1)'*, Equation* '(3.2)'*, add to the list under* 'where:'*:*

"

s_e is the length of the stiff bearing;

s_{st} is the spacing of stiffeners;

".

7) Modification to Subclause 4.2

Paragraph '(1)'*, change* "using the effective areas" *into:* "using the effective[p] areas".

8) Modification to Subclause 4.3

Paragraph '(6)'*, entry* 'b)'*, delete:* "(rather than f_{yw})".

9) Modifications to Subclause 4.4

Paragraph '(2)', *Equation* '(4.2)', *change* " $\bar{\lambda}_p \leq 0{,}673$ " *into:* " $\bar{\lambda}_p \leq 0{,}5+\sqrt{0.085-0.055\psi}$ ".

Paragraph '(2)', *Equation* '(4.2)', *change* " $\bar{\lambda}_p > 0{,}673$ " *into:* " $\bar{\lambda}_p > 0{,}5+\sqrt{0.085-0.055\psi}$ ".

Paragraph '(2)', *Equation* '(4.2)', *delete:* ", where $(3+\psi) \geq 0$ ".

'Table 4.1', *second row from the bottom, change* "-1 > ψ > -3" *into:* "-1 > ψ $\geq$ -3".

10) Modifications to Subclause 4.5.1

Paragraph '(2)', *last line, change* " ρ " *into:* " ρ_c ".

Paragraph '(3)', *change* "section areas" *into:* "section area".

11) Modification to Subclause 4.5.3

Paragraph '(3)', 'NOTE', *change* "b_{s11}" *into:* " $b_{s\ell,1}$ ".

12) Modifications to Subclause 4.6

Paragraph '(1)', *change* "for uniaxial bending" *into:* "for compression and uniaxial bending".

Paragraph '(1)', 'NOTE', *change* "e_{yN}" *into:* "$e_{y,N}$".

Paragraph '(1)', 'NOTE', *change* "e_{zN}" *into:* "$e_{z,N}$".

13) Modifications to Subclause 5.3

Paragraph '(3)', *first line, change* "slenderness parameter" *into:* "modified slenderness".

Paragraph '(3)', 'NOTE 2', *change* "slenderness parameter" *into:* "modified slenderness".

Paragraph '(5)', *change two times* "slenderness parameter" *into:* "modified slenderness".

14) Modifications to Subclause 6.5

Paragraph '(3)', *change* "equations (6.11), (6.12) and (6.13)" *into:* "equations (6.11) and (6.12)".

Paragraph '(3)', *Equation* '(6.13)', *add before* 'l_e = ...(6.13)' *the word:* "where".

15) Modification to Subclause 6.6

Paragraph '(1)', *change the reference to* "6.2(2)" *into:* "6.2(1)".

16) Modification to Subclause 7.1

Paragraph '(1)', *add after the equation for* '$\overline{\eta_3}$ ': "for $V_{bw,Rd}$ see expression (5.2)."

17) Modification to Subclause 9.2.4

'Figure 9.4', *change* "$\leqslant \frac{h_s}{4}$" *into:* "$\leq \frac{h_s}{4}$".

18) Modifications to Clause 10

Paragraph '(3)', *change* "plate slenderness" *into:* "modified plate slenderness".

Paragraph '(5)', *entry* 'a)', *change* "slenderness" *into:* "modified plate slenderness".

Paragraph '(5)', *entry* 'a)', *change reference to* "5.2(1)" *into:* "5.3(1)".

Paragraph '(6)', *below Equation* '(10.6)', *change* "$\tau_{cr,\tau}$" *into:* "τ_{cr}".

Paragraph '(6)', *below Equation* '(10.6)', *change* "$\tau_{\tau,Ed}$" *into:* "τ_{Ed}".

19) Modifications to Clause A.1

Paragraph '(2)', 'NOTE 3', *change* "the width b in" *into:* "the width *b* in".

Paragraph '(2)', *below Equation* '(A.2)', *change* "$\delta = \frac{\Sigma A_{sl}}{A_p}$" *into:* "$\delta = \frac{A_{sl}}{A_p}$".

Paragraph '(2)', *below Equation* '(A.2)', *under* "where:", *change* "$= \frac{bt^3}{12(1-\upsilon^2)} = \frac{bt^3}{10,92}$" *into:* "$= \frac{bt^3}{12(1-\nu^2)} = \frac{bt^3}{10,92}$".

Paragraph '(2)', *below Equation* '(A.2)', *under* "where:", *change* "ΣA_{sl}" *into:* "A_{sl}".

Paragraph '(2)', 'Figure A.1', *change in the top right text* "stiffeners" *into:* "stiffener".

Paragraph '(2)', 'Figure A.1', *change in the top right text* "columns" *into:* "column".

Paragraph '(2)', 'Figure A.1', *change in the figure* "$b_{s1,1}$" *into:* "$b_{s\ell,1}$".

20) Modifications to Subclause A.2.1

Paragraph '(6)', 'Figure A.2', *change* "$A_{sl,1}$" *into:* "$A_{s\ell,1}$".

Paragraph '(7)', *list entry* 'a)', *change* "I_{sl}" *into:* "$I_{s\ell}$".

21) Modification to Subclause A.2.2

Paragraph '(1)', *Equation* '(A.4)', *second line of the equation, change* "$a \leq a_c$" *into:* "$a < a_c$".

Paragraph '(1)', *delete the final* 'NOTE'.

22) Modification to Clause A.3

Paragraph '(1)'*, below Equation* '(A.5)'*, under* "where:"*, change* "For webs with two or more" *into:* "For webs with"*.*

23) Modifications to Clause B.2

Paragraph '(1)'*, change* " α_{crit} " *into:* " α_{cr} "*.*

Paragraph '(1)'*, definition of* " α_{cr} "*, change* "elastic critical resistance" *into:* "elastic critical loading"*.*

24) Modification to Clause D.1

'Figure D.1'*, left-hand sketch, delete symbol* "b_t"*.*

25) Modifications to Subclause D.2.1

Paragraph '(1)'*, first line, and Equation* '(D.1)'*, change two times* "M_{Rd}" *into:* "$My_{,Rd}$"*.*

Paragraph '(2)'*, change* "The buckling factor k_σ should be taken as the larger of:" *into:* " The buckling factor k_σ should be taken as the larger of a) and b):"*.*

Paragraph '(2)'*, list entry* 'b)'*, delete* "where $b = \frac{b_1}{2}$ "*.*

26) Modifications to Subclause D.2.2

Paragraph '(1)'*, first line and Equation* '(D.4)'*, change* "V_{Rd}" *into:* "$V_{bw,Rd}$"*.*

Equations '(D.6)' *and* '(D.9)'*, change* "f_y" *into:* "f_{yw}"*.*

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EUROPEAN STANDARD

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Eurocode 3 - Calcul des structures en acier - Partie 1-5: Plaques planes

Eurocode 3 - Bemessung und konstruktion von Stahlbauten - Teil 1-5: Plattenbeulen

This European Standard was approved by CEN on 13 January 2006.

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EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 1993-1-5:2006: E

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Foreword

This European Standard EN 1993-1-5,, Eurocode 3: Design of steel structures Part 1.5: Plated structural elements, has been prepared by Technical Committee CEN/TC250 « Structural Eurocodes », the Secretariat of which is held by BSI. CEN/TC250 is responsible for all Structural Eurocodes.

This European Standard shall be given the status of a National Standard, either by publication of an identical text or by endorsement, at the latest by April 2007 and conflicting National Standards shall be withdrawn at latest by March 2010.

This Eurocode supersedes ENV 1993-1-5.

According to the CEN-CENELEC Internal Regulations, the National Standard Organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

National annex for EN 1993-1-5

This standard gives alternative procedures, values and recommendations with notes indicating where national choices may have to be made. The National Standard implementing EN 1993-1-5 should have a National Annex containing all Nationally Determined Parameters to be used for the design of steel structures to be constructed in the relevant country.

National choice is allowed in EN 1993-1-5 through:

- 2.2(5)
- 3.3(1)
- 4.3(6)
- 5.1(2)
- 6.4(2)
- 8(2)
- 9.1(1)
- 9.2.1(9)
- 10(1)
- 10(5)
- C.2(1)
- C.5(2)
- C.8(1)
- C.9(3)
- D.2.2(2)

1 Introduction

1.1 Scope

(1) EN 1993-1-5 gives design requirements of stiffened and unstiffened plates which are subject to in-plane forces.

(2) Effects due to shear lag, in-plane load introduction and plate buckling for I-section girders and box girders are covered. Also covered are plated structural components subject to in-plane loads as in tanks and silos. The effects of out-of-plane loading are outside the scope of this document.

NOTE 1: The rules in this part complement the rules for class 1, 2, 3 and 4 sections, see EN 1993-1-1.

NOTE 2: For the design of slender plates which are subject to repeated direct stress and/or shear and also fatigue due to out-of-plane bending of plate elements (breathing) see EN 1993-2 and EN 1993-6.

NOTE 3: For the effects of out-of-plane loading and for the combination of in-plane effects and out-of-plane loading effects see EN 1993-2 and EN 1993-1-7.

NOTE 4: Single plate elements may be considered as flat where the curvature radius r satisfies:

$$r \geq \frac{a^2}{t} \tag{1.1}$$

where a is the panel width

t is the plate thickness

1.2 Normative references

(1) This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 1993-1-1 *Eurocode 3 :Design of steel structures: Part 1-1: General rules and rules for buildings*

1.3 Terms and definitions

For the purpose of this standard, the following terms and definitions apply:

1.3.1
elastic critical stress
stress in a component at which the component becomes unstable when using small deflection elastic theory of a perfect structure

1.3.2
membrane stress
stress at mid-plane of the plate

1.3.3
gross cross-section
the total cross-sectional area of a member but excluding discontinuous longitudinal stiffeners

1.3.4
effective cross-section and effective width
the gross cross-section or width reduced for the effects of plate buckling or shear lag or both; to distinguish between their effects the word “effective” is clarified as follows:
“effective^{p}“ denotes effects of plate buckling