



NSAI
Standards

Irish Standard
I.S. EN 1993-3-1:2006+NA:2010

Eurocode 3 - Design of steel structures - Part 3-1: Towers, masts and chimneys - Towers and masts (Including Irish National Annex)

I.S. EN 1993-3-1:2006+NA:2010

Incorporating amendments/corrigenda issued since publication:

EN 1993-3-1:2006/AC:2009

NA to I.S. EN 1993-3-1:2006

This document replaces:
ENV 1993-1-3:1996

This document is based on:
EN 1993-3-1:2006+NA:2010
ENV 1993-1-3:1996

Published:
25 October, 2006
17 April, 1996

This document was published
under the authority of the NSAI
and comes into effect on:
25 March, 2010

ICS number:
91.010.30

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I.S. EN 1993-3-1:2006

EUROPEAN STANDARD

EN 1993-3-1:2006/AC

NORME EUROPÉENNE

July 2009

EUROPÄISCHE NORM

Juillet 2009

Juli 2009

ICS 91.010.30; 91.080.10

English version
Version Française
Deutsche Fassung

Eurocode 3 - Design of steel structures - Part 3-1: Towers, masts and chimneys - Towers and masts

**Eurocode 3 - Calcul des structures en acier
- Partie 3-1: Tours, mâts et cheminées -
Pylônes et mâts haubanés**

**Eurocode 3 - Bemessung und Konstruktion
von Stahlbauten - Teil 3-1: Türme, Maste
und Schornsteine - Türme und Maste**

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

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

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



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

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Ref. No.: EN 1993-3-1:2006/AC:2009 D/E/F

1) Modifications to "National Annex for EN 1993-3-1"

2nd paragraph, list, delete the line:

"- B.2.3(3)".

2nd paragraph, list, replace "D.1.1(1)" with "D.1.1(2)".

2) Modification to 1.1.2

Paragraph "(1)", replace "Provisions for self-supporting and guyed cylindrical towers" with "Provisions for self-supporting and guyed cylindrical and conical towers".

3) Modification to 1.5.12

Replace "(See Annex A and Annex B.)" with "(See Annex B.)".

4) Modification to 2.3.2

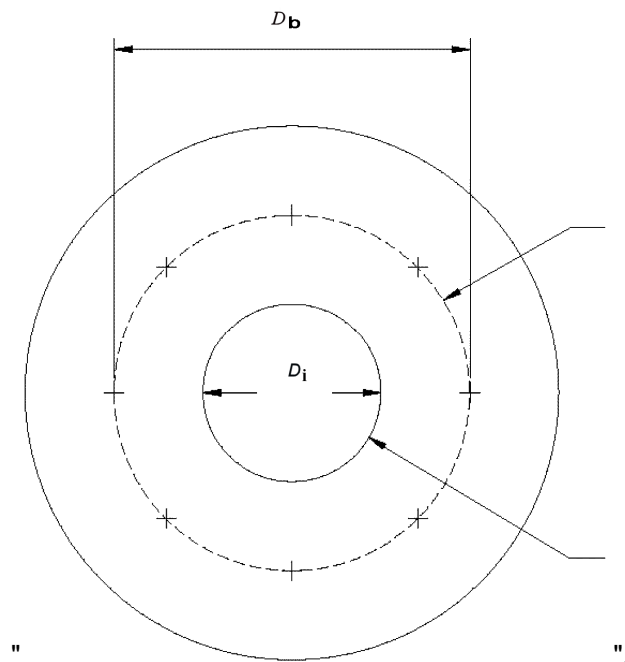
Paragraph "(1)", "NOTE", replace "for actions on towers and masts" with "for wind and ice on towers and masts".

5) Modification to 6.2.2

Paragraph "(1)", replace "given in 3.10.3 of EN 1993-1-8 (if bolted) or 4.13 (if welded)" with "given in EN 1993-1-8 clauses 3.10.3 (if bolted) or 4.13 (if welded)".

6) Modifications to 6.4.2

Paragraph "(2)", replace "Figure 6.1" with the following one:



Paragraph "(2)", delete the last sentence from the "NOTE".

7) Modification to Clause 8

Paragraph "(2)", "NOTE", replace "given in Annex C to EN 1993-3-2" with "given in Annex D of EN 1993-3-2".

8) Modification to 9.2.1

Paragraph "(1)", replace the whole paragraph "(1)" including the "NOTE" with the following text:

"(1) Fatigue loading of lattice towers due to in-line vibrations (without cross-wind vibrations) induced by gusty wind need not be determined.

NOTE: For guyed masts provided that the detail category of the structural details are greater than 71 N/mm², the fatigue life of these structures subject to in-line vibrations only (without cross-wind vibrations) induced by gusty wind may be assumed to be greater than 50 years."

9) Modifications to B.2.1.3

Paragraph "(1)", 1st line, replace " c_f " with " $\sum c_f$ ".

Paragraph "(1)", Equation "(B.1)", replace " c_f " with " $\sum c_f$ ".

10) Modifications to B.2.2.1

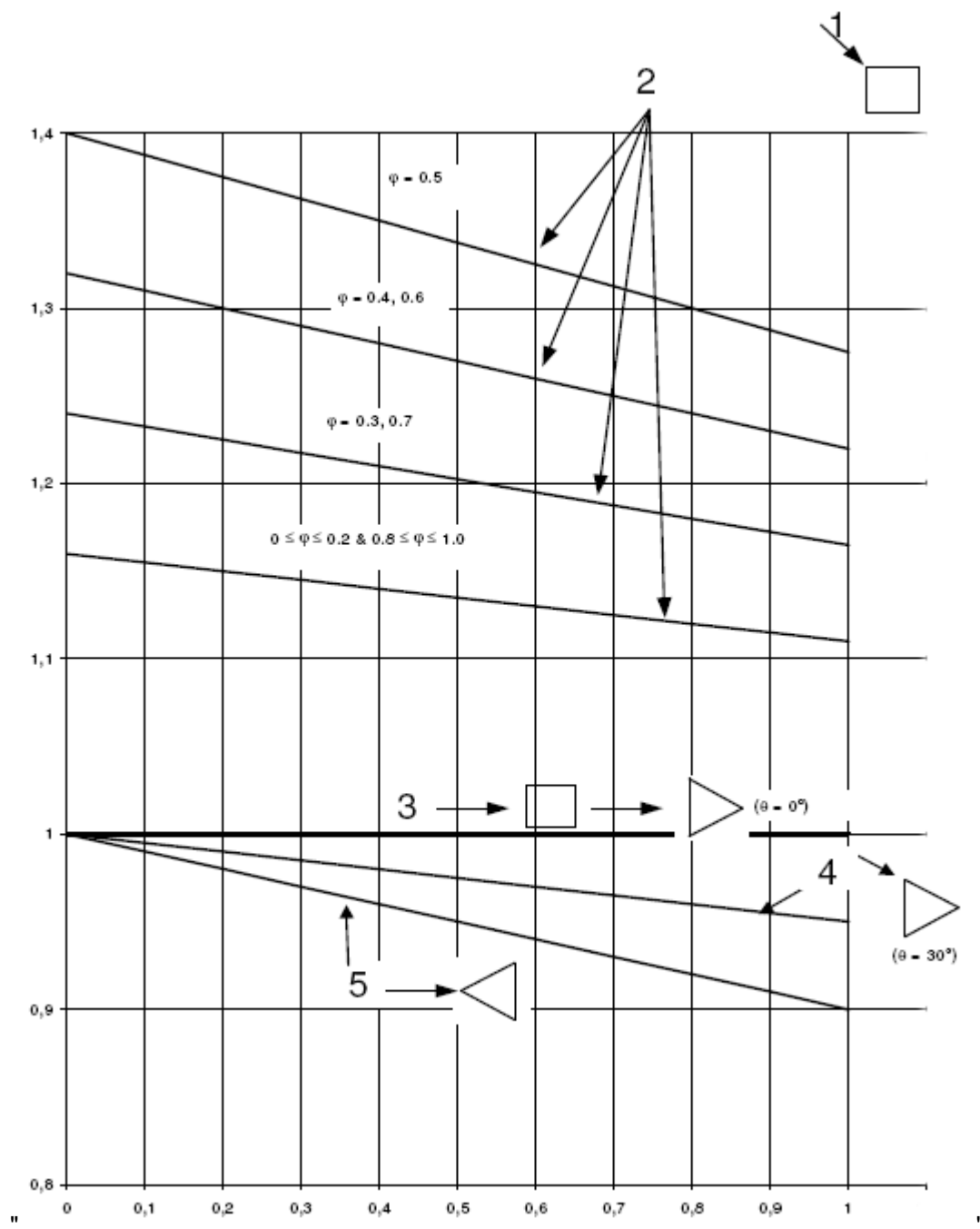
Paragraph "(1)", replace " c_f " with " $c_{f,S}$ ".

Paragraph "(1)", replace equation "(B.2)" with " $c_{f,S} = K_\theta \cdot c_{f,S,0} \cdot \frac{A_s}{\sum A}$ ".

Paragraph "(1)", list under "where:...", add the following elements:

- " A_s is the total area projected normal to the face of the structural components, including those ancillaries treated as structural elements, of the considered face within one section height at the level concerned (see Figure B.2.1) and including icing where appropriate;
- \sum^A is taken as A_{ref} in 5.3(2) of EN 1991-1-4 and can be taken as any notional value (say unity) as long as A_{ref} is taken as the same value."

Paragraph "(6)", "Figure B.2.2", replace the figure with the following one:



11) Modifications to B.2.3

Paragraph "(1)", replace "Equation (B.6)" with " $c_{f,A} = K_A \cdot c_{f,A,0} \cdot \sin^2 \psi \cdot \frac{A_A}{\sum A}$ ".

Paragraph "(1)", list under "where:...", add the following elements:

" A_A " is the area of the part visible when viewed in the wind direction including icing when appropriate. For cylinders with strakes, the value of A_A should be based on the overall width including twice the strake depth;

" $\sum A$ " as defined in B.2.2.1(1)."

Paragraph "(2)", list entry "b)", replace "figure B.2.1" with "Figure B.2.1".

Paragraph "(2)", "Table B.2.1", 1st row at the top (table heading), 3rd column, replace " $c_{f,G}$ " with " $c_{f,G,0}$ ".

12) Modification to B.2.5

Paragraph "(1)", replace:

"where: $c_{f,G}$ is..."

with:

"where: $c_{f,G,0}$ is..."

13) Modification to B.2.7.1

Paragraph "(2)", between the paragraph beginning with " $c_{f,A1}$ to $c_{f,A4}$ " and the one beginning with " η_1 and η_2 ", add:

" ΣA is to be taken as A_{ref} as in clause 5.3(2) of EN 1991-1-4 and can be taken as any notional value (say unity) as long as A_{ref} is taken as the same value."

14) Modification to B.3.1

Paragraph "(3)", Equation "(B.12)", replace " c_{fT} " with " $c_{f,T}$ ".

15) Modification to B.3.2.1

Paragraph "(1)", replace the two occurrences of "resistance" with "wind force"; then replace reference to "B.2.2" with "B.2".

16) Modifications to B.3.2.2.1

Paragraph "(2)", Equation "(B14a)", replace " A_{rcf} " with " A_{ref} ".

Paragraph "(3)", under "where:...", replace " c_0 " with " $c_0(z_m)$ ".

17) Modifications to B.3.2.2.2

Paragraph "(1)", replace:

"where: S_W ..."

with:

"where: $S_{m,W}$...".

Paragraph "(1)", under "where:...", add:

" $c_0(z_m)$ is defined in B.3.2.2.1(3)."

18) Modifications to B.3.2.2.6

Paragraph "(4)", list entry "c)", just before "NOTE 1", add:

" Σc_f according to B.2.1.3 (1).".

Paragraph "(5)", below Equation "(B.20)", add:

"where: $S_{m,cw}$ is the mean load effect on the cables derived from the load component in (B.16);

S_{cables} is the fluctuating load effect on the cables derived from the fluctuating component in (B.16).".

19)Modification to B.4.2

Paragraph "(3)", list entry "c)", replace the definition of "R" with: "the average total of the product of the force coefficient c_f times the reference area ΣA as defined in B.2.2.1(1);".

20)Modifications to B.4.3.2.1

Paragraph "(1)", Equation "(B.22)", replace " $F_{m,W}$ " with " $F_{m,W}(z)$ "; then replace " A " with " A_{ref} ".

Paragraph "(1)", last line, replace the reference to "B.4.2" with "B.2.1.3".

Paragraph "(3)", 1st line, replace " F_{GW} " with " $F_{GW}(z)$ ".

Paragraph "(3)", Equation "(B.23)", replace " F_{GW} " with " $F_{GW}(z)$ "; then replace " $c_G(z)$ " with " $c_{f,G}(z)$ ".

Paragraph "(3)", replace:

"where: $c_G(z)$..."

with

"where: $c_{f,G}(z)$...".

Paragraph "(4)", replace "should be taken as" with "should be based on".

21)Modifications to B.4.3.2.2

Paragraph "(2)", Equation "(B.24)", replace " F_{PW} " with " $F_{PW}(z)$ ", and replace " A " with " A_{ref} ".

Paragraph "(2)", replace:

" k_s is a scaling factor;"

with:

" k_s is a scaling factor which defines the probability of occurrence;".

22)Modifications to B.4.3.2.3

Paragraph "(1)", 1st line, replace " F_{PG} " with " $F_{PG}(z)$ ".

Paragraph "(1)", Equation "(B.25)", replace " F_{PG} " with " $F_{PG}(z)$ ".

Paragraph "(1)", Equation "(B.25)" and two lines below the equation, replace the two occurrences of " $c_G(z)$ " with " $c_{f,G}(z)$ ".

23)Modification to B.4.4

Paragraph "(2)", replace "(See B.4.3.2) using $k_S=3,5$." with "(see B.4.3.2). The value of k_S should be taken as $k_S=2,95$ ".

24)Modification to C.5

Paragraph "(1)", replace "one lane of the top guy level" with "the guy or guys in one lane of the top guy level"; then replace "two lanes of the top guy level" with "the guy or guys in two lanes of the top guy level".

25)Modification to C.6

Replace the number of paragraph "(3)" with "(2)".

26)Modification to F.2

Paragraph "(3)", replace reference to "EN 1993-1-1" with "EN 1090-2"; then replace "(see 4.2.2)" with "(see F.4.2)".

27)Modifications to G.2

Paragraph "(1)", "Table G.1", 1st column on the left, row about "Case (c)", replace "Secondary bending at both ends" with "Secondary bracing at both ends".

Paragraph "(1)", "Table G.2", part "(b)", 1st row of the table, last column on the right, replace " $K^{(3)(5)}$ " with " $k^{(3)(5)}$ ".

Paragraph "(1)", "Table G.2", part "(b)", last row of the table, "NOTE 3" and "NOTE 5", replace "K" with "k".

28)Modification to H.3.2

"Figure H.1", bottom row of the figure, left-hand side, cell about "IA", add into the cell: "Single lattice".

29)Modification to H.4

Paragraph "(5)", 4th line, replace "when the primary force is smaller" with "when the primary force is smaller than the notional force".

I.S. EN 1993-3-1:2006

National Foreword

This Irish Standard is the official English language version of EN 1993-3-1:2006, prepared by Technical Committee CEN TC 250 "Structural Eurocodes". This document supersedes ENV 1993-3-1:1997.

This standard forms part of a package of 58 Eurocodes, which covers the basis of structural design, actions (loadings), the main structural materials, geotechnical design and design provisions for earthquakes. The European Commission document – Guidance Paper L – Application and Use of Eurocodes provides guidance on the elaboration, implementation and use of Eurocodes.

Where a normative part of this EN allows for a choice to be made at the national level the range, possible choices are given in the normative text, and a Note will qualify it as a Nationally Determined Parameter (NDP).

To enable EN 1993-3-1:2006 to be used in Ireland the Nationally Determined Parameters will be published in a National Annex after public consultation has taken place.

Until the National Annex is available, publication of this European Standard is solely for education/training purposes and this standard should not be used in project design until the relevant National Annex is available.

Note: For Use of this European Standard after publication of the Irish National Annex

I.S. EN 1993-3-1:2006 may now be used in Ireland. The Nationally Determined Parameters, which have been prepared by the NSAI National Eurocode Advisory Committee, are included as an informative annex to the standard.

The National Annex to I.S. EN 1993-3-1:2006 is also available as a separate publication as recommended in Guidance Paper L.

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

I.S. EN 1993-3-1:2006

EUROPEAN STANDARD

EN 1993-3-1

NORME EUROPÉENNE

EUROPÄISCHE NORM

October 2006

ICS 91.010.30; 91.080.10

Supersedes ENV 1993-3-1:1997

English Version

Eurocode 3 - Design of steel structures - Part 3-1: Towers, masts and chimneys - Towers and masts

Eurocode 3 - Calcul des structures en acier - Partie 3-1:
Tours, mâts et cheminées - Pylônes et mâts haubannés

Eurocode 3 - Bemessung und Konstruktion von
Stahlbauten - Teil 3-1: Türme, Maste und Schornsteine -
Türme und Maste

This European Standard was approved by CEN on 9 January 2006.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard 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 Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of 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.



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Foreword

This European Standard EN 1993-3-1, Eurocode 3: Design of steel structures: Part 3.1: Towers, masts and chimneys – Towers and masts, 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 1993-3-1.

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.

Background of the Eurocode programme

In 1975, the Commission of the European Community decided on an action programme in the field of construction, based on article 95 of the Treaty. The objective of the programme was the elimination of technical obstacles to trade and the harmonisation of technical specifications.

Within this action programme, the Commission took the initiative to establish a set of harmonised technical rules for the design of construction works which, in a first stage, would serve as an alternative to the national rules in force in the Member States and, ultimately, would replace them.

For fifteen years, the Commission, with the help of a Steering Committee with Representatives of Member States, conducted the development of the Eurocodes programme, which led to the first generation of European codes in the 1980s.

In 1989, the Commission and the Member States of the EU and EFTA decided, on the basis of an agreement¹ between the Commission and CEN, to transfer the preparation and the publication of the Eurocodes to the CEN through a series of Mandates, in order to provide them with a future status of European Standard (EN). This links *de facto* the Eurocodes with the provisions of all the Council's Directives and/or Commission's Decisions dealing with European standards (e.g. the Council Directive 89/106/EEC on construction products – CPD – and Council Directives 93/37/EEC, 92/50/EEC and 89/440/EEC on public works and services and equivalent EFTA Directives initiated in pursuit of setting up the internal market).

The Structural Eurocode programme comprises the following standards generally consisting of a number of Parts:

EN 1990	Eurocode 0:	Basis of structural 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

¹ Agreement between the Commission of the European Communities and the European Committee for Standardisation (CEN) concerning the work on EUROCODES for the design of building and civil engineering works (BC/CEN/03/89).

EN 1998 Eurocode 8: Design of structures for earthquake resistance

EN 1999 Eurocode 9: Design of aluminium structures

Eurocode standards recognise the responsibility of regulatory authorities in each Member State and have safeguarded their right to determine values related to regulatory safety matters at national level where these continue to vary from State to State.

Status and field of application of Eurocodes

The Member States of the EU and EFTA recognise that Eurocodes serve as reference documents for the following purposes :

- as a means to prove compliance of building and civil engineering works with the essential requirements of Council Directive 89/106/EEC, particularly Essential Requirement N°1 - Mechanical resistance and stability - and Essential Requirement N°2 - Safety in case of fire;
- as a basis for specifying contracts for construction works and related engineering services;
- as a framework for drawing up harmonised technical specifications for construction products (ENs and ETAs)

The Eurocodes, as far as they concern the construction works themselves, have a direct relationship with the Interpretative Documents² referred to in Article 12 of the CPD, although they are of a different nature from harmonised product standard³. Therefore, technical aspects arising from the Eurocodes work need to be adequately considered by CEN Technical Committees and/or EOTA Working Groups working on product standards with a view to achieving a full compatibility of these technical specifications with the Eurocodes.

The Eurocode standards provide common structural design rules for everyday use for the design of whole structures and component products of both a traditional and an innovative nature. Unusual forms of construction or design conditions are not specifically covered and additional expert consideration will be required by the designer in such cases.

National Standards implementing Eurocodes

The National Standards implementing Eurocodes will comprise the full text of the Eurocode (including any annexes), as published by CEN, which may be preceded by a National title page and National foreword, and may be followed by a National annex (informative).

The National Annex (informative) may only contain information on those parameters which are left open in the Eurocode for national choice, known as Nationally Determined Parameters, to be used for the design of buildings and civil engineering works to be constructed in the country concerned, i.e. :

- values for partial factors and/or classes where alternatives are given in the Eurocode,
- values to be used where a symbol only is given in the Eurocode,
- geographical and climatic data specific to the Member State, e.g. snow map,
- the procedure to be used where alternative procedures are given in the Eurocode,
- references to non-contradictory complementary information to assist the user to apply the Eurocode.

² According to Art. 3.3 of the CPD, the essential requirements (ERs) should be given concrete form in interpretative documents for the creation of the necessary links between the essential requirements and the mandates for hENs and ETAGs/ETAs.

³ According to Art. 12 of the CPD the interpretative documents should :

- a) give concrete form to the essential requirements by harmonising the terminology and the technical bases and indicating classes or levels for each requirement where necessary ;
- b) indicate methods of correlating these classes or levels of requirement with the technical specifications, e.g. methods of calculation and of proof, technical rules for project design, etc. ;
- c) serve as a reference for the establishment of harmonised standards and guidelines for European technical approvals.

The Eurocodes, *de facto*, play a similar role in the field of the ER 1 and a part of ER 2.

Links between Eurocodes and product harmonized technical specifications (ENs and ETAs)

There is a need for consistency between the harmonised technical specifications for construction products and the technical rules for works⁴. Furthermore, all the information accompanying the CE Marking of the construction products which refer to Eurocodes should clearly mention which Nationally Determined Parameters have been taken into account.

Additional information specific to EN 1993-3-1 and EN 1993-3-2

EN 1993-3 is the third part of six parts of EN 1993 - Design of Steel Structures - and describes the principles and application rules for the safety and serviceability and durability of steel structures for towers and masts and chimneys. Towers and masts are dealt with in Part 3-1; chimneys are treated in Part 3-2.

EN 1993-3 gives design rules in supplement to the generic rules in EN 1993-1.

EN 1993-3 is intended to be used with Eurocodes EN 1990 - Basis of design, EN 1991 - Actions on structures and the parts 1 of EN 1992 to EN 1998 when steel structures or steel components for towers and masts and chimneys are referred to.

Matters that are already covered in those documents are not repeated.

EN 1993-3 is intended for use by

- committees drafting design related product, testing and execution standards;
- clients (e.g. for the formulation of their specific requirements);
- designers and constructors;
- relevant authorities.

Numerical values for partial factors and other reliability parameters in EN 1993-3 are recommended as basic values that provide an acceptable level of reliability. They have been selected assuming that an appropriate level of workmanship and quality management applies.

Annex B of EN 1993-3-1 has been prepared to supplement the provisions of EN 1991-1-4 in respect of wind actions on lattice towers and guyed masts or guyed chimneys.

As far as overhead line towers are concerned all matters related to wind and ice loading, loading combinations, safety matters and special requirements (such as for conductors, insulators, clearance, etc.) are covered by the CENELEC Code EN 50341, that can be referred to for the design of such structures.

The strength requirements for steel members given in this Part may be considered as 'deemed to satisfy', rules to meet the requirements of EN 50341 for overhead line towers, and may be used as alternative criteria to the rules given in that Standard.

Part 3.2 has been prepared in collaboration with Technical Committee CEN/TC 297: Free standing chimneys.

Provisions have been included to allow for the possible use of a different partial factor for resistance in the case of those structures or elements the design of which has been the subject of an agreed type testing programme.

⁴ See Art.3.3 and Art.12 of the CPD, as well as clauses 4.2, 4.3.1, 4.3.2 and 5.2 of ID 1.

National Annex for EN 1993-3-1

This standard gives alternative procedures, values and recommendations for classes with notes indicating where national choices may have to be made. Therefore the National Standard implementing EN 1993-3-1 should have a National Annex containing all Nationally Determined Parameters to be used for the design of buildings and civil engineering works to be constructed in the relevant country.

National choice is allowed in EN 1993-3-1 through paragraphs:

- 2.1.1(3)P
- 2.3.1(1)
- 2.3.2(1)
- 2.3.6(2)
- 2.3.7(1)
- 2.3.7(4)
- 2.5(1)
- 2.6(1)
- 4.1(1)
- 4.2(1)
- 5.1(6)
- 5.2.4(1)
- 6.1(1)
- 6.3.1(1)
- 6.4.1(1)
- 6.4.2(2)
- 6.5.1(1)
- 7.1(1)
- 9.5(1)
- A.1(1)
- A.2(1)P (2 places)
- B.1.1(1)
- B.2.1.1(5)
- B.2.3(1)
- B.2.3(3)
- B.3.2.2.6(4)
- B.3.3(1)
- B.3.3(2)
- B.4.3.2.2(2)
- B.4.3.2.3(1)
- B.4.3.2.8.1(4)
- C.2(1)
- C.6.(1)
- D.1.1(1)
- D.1.2(2)
- D.3(6) (2 places)

EN 1993-3-1:2006 (E)

I.S. EN 1993-3-1:2006

- D.4.1(1)
- D.4.2(3)
- D.4.3(1)
- D.4.4(1)
- F.4.2.1(1)
- F.4.2.2(2)
- G.1(3)
- H.2(5)
- H.2(7)

1 General

1.1 Scope

1.1.1 Scope of Eurocode 3

See 1.1.1 of EN 1993-1-1.

1.1.2 Scope of Part 3.1 of Eurocode 3

(1) This Part 3.1 of EN 1993 applies to the structural design of lattice towers and guyed masts and to the structural design of this type of structures supporting prismatic, cylindrical or other bluff elements. Provisions for self-supporting and guyed cylindrical towers and chimneys are given in Part 3.2 of EN 1993. Provisions for the guys of guyed structures, including guyed chimneys, are given in EN 1993-1-11 and supplemented in this Part.

(2) The provisions in this Part of EN 1993 supplement those given in Part 1.

(3) Where the applicability of a provision is limited, for practical reasons or due to simplifications, its use is explained and the limits of applicability are stated.

(4) This Part does not cover the design of polygonal and circular lighting columns, which is covered in EN 40. Lattice polygonal towers are not covered in this Part. Polygonal plated columns (monopoles) may be designed using this Part for their loading. Information on the strength of such columns may be obtained from EN 40.

(5) This Part does not cover special provisions for seismic design, which are given in EN 1998-3.

(6) Special measures that might be necessary to limit the consequences of accidents are not covered in this Part. For resistance to fire, reference should be made to EN 1993-1-2.

(7) For the execution of steel towers and masts, reference should be made to EN 1090.

NOTE: Execution is covered to the extent that is necessary to indicate the quality of the construction materials and products that should be used and the standard of workmanship on site needed to comply with the assumptions of the design rules.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this European Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this European Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

EN 40	<i>Lighting columns</i>
EN 365	<i>Personal protective equipment against falls from a height. General requirements for instructions for use, maintenance, periodic examination, repair, marking and packaging</i>
EN 795	<i>Protection against falls from a height. Anchor devices. Requirements and testing</i>
EN 1090	<i>Execution of steel structures and aluminium structures</i>
EN ISO 1461	<i>Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods</i>
EN ISO 14713	<i>Protection against corrosion of iron and steel in structures. Zinc and aluminium coatings. Guidelines</i>
ISO 12494	<i>Atmospheric icing of structures</i>
EN ISO 12944	<i>Corrosion protection of steel structures by protective paint systems.</i>

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