



**NSAI**  
Standards

Irish Standard  
I.S. EN 1999-1-5:2007+NA:2010

# Eurocode 9 - Design of aluminium structures - Part 1-5: Shell structures (Including Irish National Annex)

## I.S. EN 1999-1-5:2007+NA:2010

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Eurocode 9: Bemessung und Konstruktion  
von Aluminiumtragwerken - Teil 1-5:  
Schalentragwerke

This corrigendum becomes effective on 4 November 2009 for incorporation in the three official language versions of the EN.

Ce corrigendum prendra effet le 4 novembre 2009 pour incorporation dans les trois versions linguistiques officielles de la EN.

Die Berichtigung tritt am 4. November 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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**1) Modification to A.1.3.1**

Paragraph "(3)", replace "meridional" with "circumferential".

**2) Modifications to A.1.3.2**

Paragraph "(1)", replace "meridional" with "circumferential".

Paragraph "(1)", Equation "(A.12)", replace:

$$\alpha_{\theta} = \frac{1}{1 + 0,2(1 - \alpha_{\theta,ref})(\bar{\lambda}_{\theta} - \bar{\lambda}_{\theta,0}) / \alpha_{\theta,ref}^2} \quad \text{but } \alpha_{\theta} \leq 1,00 \quad (\text{A.12})$$

with:

$$\alpha_{\theta} = \frac{1}{1 + 0,2(1 - \alpha_{\theta,ref})(\bar{\lambda}_{\theta} - \bar{\lambda}_{\theta,0}) / \alpha_{\theta,ref}^2} \quad \text{but } \alpha_{\theta} \leq 1,00 \quad (\text{A.12}).$$

Paragraph "(3)", replace "meridional" with "circumferential".

**3) Modification to A.1.4.2**

Paragraph "(3)", replace "meridional" with "shear".

## I.S. EN 1999-1-5:2007

### National Foreword

This Irish Standard is the official English language version of EN 1999-1-5:2007, prepared by Technical Committee CEN TC 250 "Structural Eurocodes". This document supersedes ENV 1999-1-1:1998, ENV 1999-1-2:1998 and ENV 1999-2:1998.

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 1999-1-5 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 1999-1-5:2007 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 1999-1-5:2007 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
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English Version

## Eurocode 9 - Design of aluminium structures - Part 1-5: Shell structures

Eurocode 9 - Calcul des structures en aluminium - Partie 1-5 : Coques

Eurocode 9: Bemessung und Konstruktion von Aluminiumtragwerken - Teil 1-5: Schalentragwerke

This European Standard was approved by CEN on 11 October 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 CEN Management Centre 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 CEN Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, 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 1999-1-5:2007) has been prepared by Technical Committee CEN/TC250 « 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 August 2007, and conflicting national standards shall be withdrawn at the latest by March 2010.

CEN/TC 250 is responsible for all Structural Eurocodes.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard:

Austria, Bulgaria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italia, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the 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 agreement<sup>1</sup> 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
EN 1998	Eurocode 8:	Design of structures for earthquake resistance
EN 1999	Eurocode 9:	Design of aluminium structures

<sup>1</sup> 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).

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 No.1 – Mechanical resistance and stability, and Essential Requirement No 2 – Safety in case of fire
- as a basis for specifying contracts for the execution of construction works and related engineering services
- as a framework for drawing up harmonised technical specifications for construction products (EN's and ETA's)

The Eurocodes, as far as they concern the construction works themselves, have a direct relationship with the Interpretative Documents<sup>2</sup> referred to in Article 12 of the CPD, although they are of a different nature from harmonised product standards<sup>3</sup>. 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 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.

### Links between Eurocodes and harmonised technical specifications (EN's and ETA's) for products

There is a need for consistency between the harmonised technical specifications for construction products and the technical rules for works<sup>4</sup>. Furthermore, all the information accompanying the CE Marking of the construction products, which refer to Eurocodes, shall clearly mention which Nationally Determined Parameters have been taken into account.

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

<sup>3</sup> According to Art. 12 of the CPD the interpretative documents shall :

- 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.

<sup>4</sup> 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 1999-1-5**

This European 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 1999-1-5 should have a National Annex containing all Nationally Determined Parameters to be used for the design of aluminium shell structures to be constructed in the relevant country.

National choice is allowed in EN 1999-1-5 through clauses:

- 2.1 (3)
- 2.1 (4)

# 1 General

## 1.1 Scope

### 1.1.1 Scope of EN 1999

(1)P EN 1999 applies to the design of buildings and civil engineering and structural works in aluminium. 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.

(2)P EN 1999 is only concerned with requirements for resistance, serviceability, durability and fire resistance of aluminium structures. Other requirements, e.g. concerning thermal or sound insulation, are not considered.

(3) EN 1999 is intended to be used in conjunction with:

- EN 1990 Basis of structural design
- EN 1991 Actions on structures
- European Standards for construction products relevant for aluminium structures
- EN 1090-1 Execution of steel structures and aluminium structures – Part 1: Requirements for conformity assessment of structural components<sup>5</sup>
- EN 1090-3 Execution of steel structures and aluminium structures – Part 3: Technical requirements for aluminium structures<sup>5</sup>

(4) EN 1999 is subdivided in five parts:

EN 1999-1-1 Design of Aluminium Structures: General structural rules.

EN 1999-1-2 Design of Aluminium Structures: Structural fire design.

EN 1999-1-3 Design of Aluminium Structures: Structures susceptible to fatigue.

EN 1999-1-4 Design of Aluminium Structures: Cold-formed structural sheeting.

EN 1999-1-5 Design of Aluminium Structures: Shell structures.

### 1.1.2 Scope of EN 1999-1-5

(1)PEN 1999-1-5 applies to the structural design of aluminium structures, stiffened and unstiffened, that have the form of a shell of revolution or of a round panel in monocoque structures.

(2) The relevant parts of EN 1999 should be followed for specific application rules for structural design.

(3) Supplementary information for certain types of shells are given in EN 1993-1-6 and the relevant application parts which include:

- Part 3-1 for towers and masts;
- Part 3-2 for chimneys;
- Part 4-1 for silos;
- Part 4-2 for tanks;
- Part 4-3 for pipelines.

(4) The provisions in EN 1999-1-5 apply to axisymmetric shells (cylinders, cones, spheres) and associated circular or annular plates and beam section rings and stringer stiffeners where they form part of the complete structure.

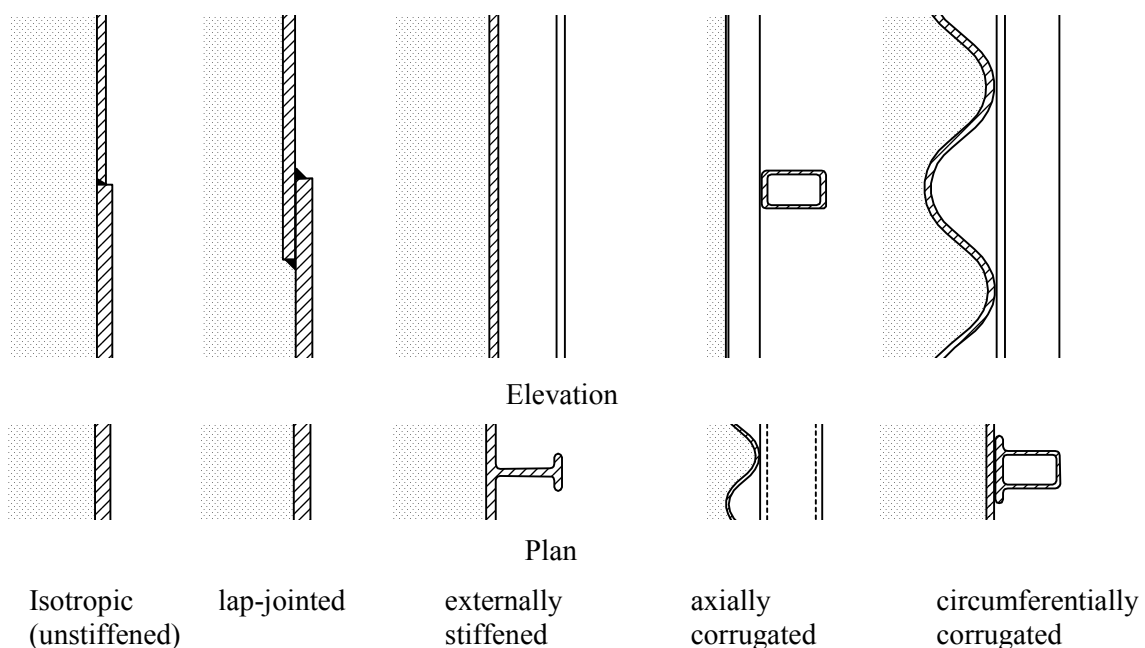
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<sup>5</sup> To be published

(5) Single shell panels (cylindrical, conical or spherical) are not explicitly covered by EN 1999-1-5. However, the provisions can be applicable if the appropriate boundary conditions are duly taken into account.

(6) Types of shell walls covered in EN 1999-1-5 can be, see Figure 1.1:

- shell wall constructed from flat rolled sheet, termed 'isotropic';
- shell wall with lap joints formed by connecting adjacent plates with overlapping sections, termed 'lap-jointed';
- shell wall with stiffeners attached to the outside, termed 'externally stiffened' irrespective of the spacing of the stiffeners;
- shell wall with the corrugations running up the meridian, termed 'axially corrugated';
- shell wall constructed from corrugated sheets with the corrugations running around the shell circumference, termed 'circumferentially corrugated'.



**Figure 1.1 - Illustration of cylindrical shell forms**

(7) The provisions of EN 1999-1-5 are intended to be applied within the temperature range defined in EN 1999-1-1. The maximum temperature is restricted so that the influence of creep can be neglected. For structures subject to elevated temperatures associated with fire see EN 1999-1-2.

(8) EN 1999-1-5 does not cover the aspects of leakage.

## 1.2 Normative references

(1) EN 1999-1-5 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 if incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 1090-1 Execution of steel structures and aluminium structures – Part 1: Requirements for conformity assessment of structural components<sup>5</sup>

EN 1090-3 Execution of steel structures and aluminium structures – Part 3: Technical requirements for aluminium structures<sup>5</sup>

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