BRITISH STANDARD

BS EN
1990:2002

Incorporating corrigenda December 2008 and April 2010

Eurocode — Basis of structural design

ICS 91.010.30; 91.080.01

BSI
British Standards

This British Standard is the UK implementation of EN 1990:2002+A1:2005, incorporating corrigenda December 2008 and April 2010. It supersedes DD ENV 1991-1:1996 which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by [A1] ⟨A1⟩.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags. Text altered by CEN corrigendum December 2008 is indicated in the text by [AC1] ⟨AC1⟩.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags. Text altered by CEN corrigendum April 2010 is indicated in the text by [AC2] ⟨AC2⟩.

The UK participation in its preparation was entrusted by Technical Committee B/525, Building and Civil engineering structures, to Subcommittee B/525/1, Action, loadings and basis of design.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Where a normative part of this EN allows for a choice to be made at the national level, the range and possible choice will be given in the normative text, and a Note will qualify it as a Nationally Determined Parameter (NDP). NDPs can be a specific value for a factor, a specific level or class, a particular method or a particular application rule if several are proposed in the EN.

To enable EN 1990 to be used in the UK, the NDPs will be published in a National Annex which will be incorporated by amendment into this British Standard in due course, after public consultation has taken place.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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	31 July 2010	Implementation of CEN corrigendum April 2010

EUROPÄISCHE NORM

December 2005

ICS 91.010.30

Supersedes ENV 1991-1:1994
Incorporating corrigenda December 2008
and April 2010

English version

Eurocode - Basis of structural design

Eurocodes structuraux - Eurocodes: Bases de calcul des structures

Eurocode: Grundlagen der Tragwerksplanung

This European Standard was approved by CEN on 29 November 2001.

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 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 Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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Foreword

This document (EN 1990:2002) 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 October 2002, and conflicting national standards shall be withdrawn at the latest by March 2010.

This document supersedes ENV 1991-1:1994.

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

Foreword to amendment A1

This European Standard (EN 1990:2002/A1:2005) has been prepared by Technical Committee CEN/TC 250 “Structural Eurocodes”, the secretariat of which is held by BSI.

This Amendment to the EN 1990:2002 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2006, and conflicting national standards shall be withdrawn at the latest by June 2006.

According to the CEN/CENELEC Internal Regulations, the national standards 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, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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 [AC2] national provisions [AC2] 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 1980's.

In 1989, the Commission and the Member States of the EU and EFTA decided, on the basis of an agreement[1] between the Commission and CEN, to transfer the preparation and the publication of the Eurocodes to 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 [AC2] Council Directives 2004/17/EC and 2004/18/EC [AC2] 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 :	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

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.

[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).

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 Documents[2] referred to in Article 12 of the CPD, although they are of a different nature from harmonised product standards[3]. 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 ▌AC2⟩ and ETAGs ⟨AC2▐ 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 ▌AC2⟩ parts of works and structural construction ⟨AC2▐ products of both a traditional and an in-novative 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.

The National annex 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. :

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[2] 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.

[3] 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.

– values to be used where a symbol only is given in the Eurocode,
– country specific data (geographical, climatic, etc.), *e.g.* snow map,
– the procedure to be used where alternative procedures are given in the Eurocode~~,~~.

It may also contain

– decisions on the application of informative annexes,
– references to non-contradictory complementary information to assist the user to apply the Eurocode.

Links between Eurocodes and harmonised technical specifications (ENs and ETAs) for products

There is a need for consistency between the harmonised technical specifications for construction products and the [AC2] technical provisions [AC2] for works[4]. Furthermore, all the information accompanying the CE Marking of the construction products which [AC2] use the [AC2] Euro-codes shall clearly mention which Nationally Determined Parameters have been taken into account.

Additional information specific to EN 1990

EN 1990 describes the Principles and requirements for safety, serviceability and durability of structures. It is based on the limit state concept used in conjunction with a partial factor method.

For the design of new structures, EN 1990 is intended to be used, for direct application, together with Eurocodes EN 1991 to 1999.

EN 1990 also gives guidelines for the aspects of structural reliability relating to safety, serviceability and durability :

– for design cases not covered by EN 1991 to EN 1999 (other actions, structures not treated, other materials) ;
– to serve as a reference document for other CEN TCs concerning structural matters.

EN 1990 is intended for use by :

– committees drafting standards for structural design and related product, testing and execution standards ;
– clients (*e.g.* for the formulation of their specific requirements on reliability levels and durability) ;
– designers and constructors ;
– relevant authorities.

EN 1990 may be used, when relevant, as a guidance document for the design of structures outside the scope of the Eurocodes EN 1991 to EN 1999, for :

– assessing other actions and their combinations ;
– modelling material and structural behaviour ;
– assessing numerical values of the reliability format.

[4] see Art.3.3 and Art.12 of the CPD, as well as 4.2, 4.3.1, 4.3.2 and 5.2 of ID 1.

as basic values that provide an acceptable level of reliability. They have been selected assuming that an appropriate level of workmanship and of quality management applies. When EN 1990 is used as a base document by other CEN/TCs the same values need to be taken.

National annex for EN 1990

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 1990 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.

〖AC2〗National choice is allowed in EN 1990 Annex A1 through;〈AC2〉

- A1.1(1)
- A1.2.1(1)
- A1.2.2 (Table A1.1)
- A1.3.1(1) (Tables A1.2(A) to (C))
- A1.3.1(5)
- A1.3.2 (Table A1.3)
- A1.4.2(2)

〖AC2〗National choice is allowed in EN 1990 Annex A2 through:

General clauses

Clause	Item
A2.1 (1) NOTE 3	Use of Table 2.1 : Design working life
A2.2.1(2) NOTE 1	Combinations involving actions which are outside the scope of EN 1991
A2.2.6(1) NOTE 1	Values of ψ factors
A2.3.1(1)	Alteration of design values of actions for ultimate limit states
A2.3.1(5)	Choice of Approach 1, 2 or 3
A2.3.1(7)	Definition of forces due to ice pressure
A2.3.1(8)	Values of γ_P factors for prestressing actions where not specified in the relevant design Eurocodes
A2.3.1 Table A2.4(A) NOTES 1 and 2	Values of γ factors
A2.3.1 Table A2.4(B)	- NOTE 1 : choice between 6.10 and 6.10a/b - NOTE 2 : Values of γ and ξ factors - NOTE 4 : Values of γ_{Sd}

〈AC2〉

A2.3.1 Table A2.4(C)	Values of γ factors
A2.3.2(1)	Design values in Table A2.5 for accidental designs situations, design values of accompanying variable actions and seismic design situations
A2.3.2 Table A2.5 NOTE	Design values of actions
A2.4.1(1) NOTE 1 (Table A2.6) NOTE 2	Alternative γ values for traffic actions for the serviceability limit state Infrequent combination of actions
A2.4.1(2)	Serviceability requirements and criteria for the calculation of deformations

Clauses specific for road bridges

Clause	Item
A2.2.2 (1)	Reference to the infrequent combination of actions
A2.2.2(3)	Combination rules for special vehicles
A2.2.2(4)	Combination rules for snow loads and traffic loads
A2.2.2(6)	Combination rules for wind and thermal actions
A2.2.6(1) NOTE 2	Values of $\psi_{1,infq}$ factors
A2.2.6(1) NOTE 3	Values of water forces

Clauses specific for footbridges

Clause	Item
A2.2.3(2)	Combination rules for wind and thermal actions
A2.2.3(3)	Combination rules for snow loads and traffic loads
A2.2.3(4)	Combination rules for footbridges protected from bad weather
A2.4.3.2(1)	Comfort criteria for footbridges

Clauses specific for railway bridges

Clause	Item
A2.2.4(1)	Combination rules for snow loading on railway bridges
A2.2.4(4)	Maximum wind speed compatible with rail traffic
A2.4.4.1(1) NOTE 3	**Deformation and vibration requirements for temporary railway bridges**
A2.4.4.2.1(4)P	Peak values of deck acceleration for railway bridges and associated frequency range
A2.4.4.2.2 – Table A2.7 NOTE	Limiting values of deck twist for railway bridges

A2.4.4.2.2(3)P	Limiting values of the total deck twist for railway bridges
A2.4.4.2.3(1)	Vertical deformation of ballasted and non ballasted railway bridges
A2.4.4.2.3(2)	Limitations on the rotations of non-ballasted bridge deck ends for railway bridges
A2.4.4.2.3(3)	Additional limits of angular rotations at the end of decks
A2.4.4.2.4(2) – Table A2.8 NOTE 3	Values of α_i and r_i factors
A2.4.4.2.4(3)	Minimum lateral frequency for railway bridges
A2.4.4.3.2(6)	Requirements for passenger comfort for temporary bridges

Section 1 General

1.1 Scope

(1) EN 1990 establishes Principles and requirements for the safety, serviceability and durability of structures, describes the basis for their design and verification and gives guidelines for related aspects of structural reliability.

(2) EN 1990 is intended to be used in conjunction with EN 1991 to EN 1999 for the structural design of buildings and civil engineering works, including geotechnical aspects, structural fire design, situations involving earthquakes, execution and temporary structures.

NOTE For the design of special construction works (*e.g.* nuclear installations, dams, etc.), other provisions than those in EN 1990 to EN 1999 might be necessary.

(3) EN 1990 is applicable for the design of structures where other materials or other actions outside the scope of EN 1991 to EN 1999 are involved.

(4) EN 1990 is applicable for the structural appraisal of existing construction, in developing the design of repairs and alterations or in assessing changes of use.

NOTE Additional or amended provisions might be necessary where appropriate.

1.2 Normative references

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 (including amendments).

NOTE The Eurocodes were published as European Prestandards. The following European Standards which are published or in preparation are cited in normative clauses :

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