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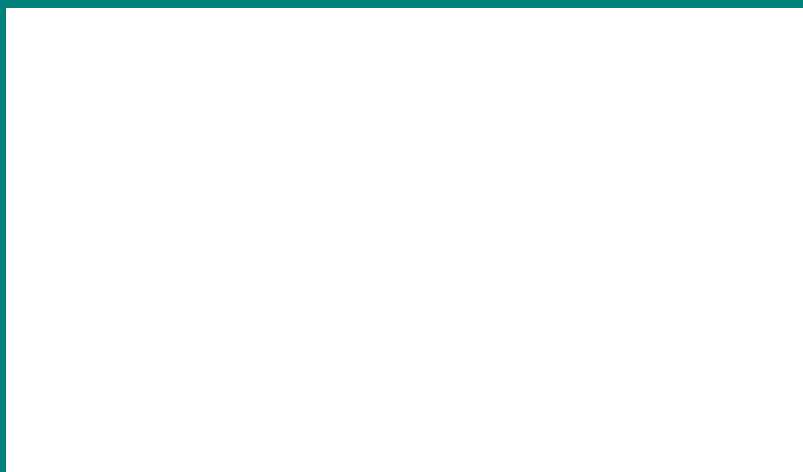
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Eurokod 4: Dimensionering av samverkanskonstruktioner i stål och betong – Del 1-1: Allmänna regler och regler för byggnader

Eurocode 4: Design of composite steel and concrete structures – Part 1-1: General rules and rules for buildings



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SS-EN 1994-1-1:2005, utgåva 1 och SS-ENV 1994-1-1, utgåva 1, gäller parallellt längst till 2010-03-30.

The European Standard EN 1994-1-1:2004 has the status of a Swedish Standard. This document contains the official English version of EN 1994-1-1:2004.

SS-EN 1994-1-1:2005 edition 1 and SS-ENV 1994-1-1 edition 1 run parallel longest to 2010-03-30

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

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December 2004

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Supersedes ENV 1994-1-1:1992

English version

Eurocode 4: Design of composite steel and concrete structures - Part 1-1: General rules and rules for buildings

Eurocode 4: Calcul des structures mixtes acier-béton -
Partie 1-1: Règles générales et règles pour les bâtiments

Eurocode 4: Bemessung und Konstruktion von
Verbundtragwerken aus Stahl und Beton - Teil 1-1:
Allgemeine Bemessungsregeln und Anwendungsregeln für
den Hochbau

This European Standard was approved by CEN on 27 May 2004.

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.

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Foreword

This document (EN 1994-1-1:2004), Eurocode 4: Design of composite steel and concrete structures: Part 1-1 General rules and rules for buildings, has been prepared on behalf of 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 June 2005, and conflicting national standards shall be withdrawn at the latest by March 2010.

This document supersedes ENV 1994-1-1:1992.

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, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, 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 agreement¹ 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 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:

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 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.

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 standards³. 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.

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.

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.*:

- values and/or classes where alternatives are given in the Eurocode,
- 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 use of informative annexes, and
- 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 technical rules for works⁴. 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.

Additional information specific to EN 1994-1-1

EN 1994-1-1 describes the Principles and requirements for safety, serviceability and durability of composite steel and concrete structures, together with specific provisions for buildings. It is based on the limit state concept used in conjunction with a partial factor method.

For the design of new structures, EN 1994-1-1 is intended to be used, for direct application, together with other Parts of EN 1994, Eurocodes EN 1990 to 1993 and Eurocodes EN 1997 and 1998.

EN 1994-1-1 also serves as a reference document for other CEN TCs concerning structural matters.

EN 1994-1-1 is intended for use by:

- committees drafting other 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.

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.

Numerical values for partial factors and other reliability parameters are recommended 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 1994-1-1 is used as a base document by other CEN/TCs the same values need to be taken.

National annex for EN 1994-1-1

This standard gives values with notes indicating where national choices may have to be made. Therefore the National Standard implementing EN 1994-1-1 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 1994-1-1 through the following clauses:

- 2.4.1.1(1)
- 2.4.1.2(5)
- 2.4.1.2(6)
- 2.4.1.2(7)
- 3.1(4)
- 3.5(2)
- 6.4.3(1)(h)
- 6.6.3.1(1)
- 6.6.3.1(3)
- 6.6.4.1(3)
- 6.8.2(1)
- 6.8.2(2)
- 9.1.1(2)
- 9.6(2)
- 9.7.3(4)
- 9.7.3(8)
- 9.7.3(9)
- B.2.5(1)
- B.3.6(5)

Section 1 General

1.1 Scope

1.1.1 Scope of Eurocode 4

(1) Eurocode 4 applies to the design of composite structures and members for buildings and civil engineering works. 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) Eurocode 4 is concerned only with requirements for resistance, serviceability, durability and fire resistance of composite structures. Other requirements, e.g. concerning thermal or sound insulation, are not considered.

(3) Eurocode 4 is intended to be used in conjunction with:

EN 1990 Eurocode: Basis of structural design

EN 1991 Eurocode 1: Actions on structures

ENs, hENs, ETAGs and ETAs for construction products relevant for composite structures

EN 1090 Execution of steel structures and aluminium structures

EN 13670 Execution of concrete structures

EN 1992 Eurocode 2: Design of concrete structures

EN 1993 Eurocode 3: Design of steel structures

EN 1997 Eurocode 7: Geotechnical design

EN 1998 Eurocode 8: Design of structures for earthquake resistance, when composite structures are built in seismic regions.

(4) Eurocode 4 is subdivided in various parts:

Part 1-1: General rules and rules for buildings

Part 1-2: Structural fire design

Part 2: Bridges.

1.1.2 Scope of Part 1-1 of Eurocode 4

(1) Part 1-1 of Eurocode 4 gives a general basis for the design of composite structures together with specific rules for buildings.

(2) The following subjects are dealt with in Part 1-1:

Section 1: General

Section 2: Basis of design

Section 3: Materials

Section 4: Durability

Section 5: Structural analysis

Section 6: Ultimate limit states

Section 7: Serviceability limit states

Section 8: Composite joints in frames for buildings

Section 9: Composite slabs with profiled steel sheeting for buildings

1.2 Normative references

The following normative documents contain provisions which, through references 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.

1.2.1 General reference standards

EN 1090-2 ¹	Execution of steel structures and aluminium structures - Technical rules for the execution of steel structures
EN 1990: 2002	Basis of structural design.

1.2.2 Other reference standards

EN 1992-1-1 ¹	Eurocode 2: Design of concrete structures: General rules and rules for buildings
EN 1993-1-1 ¹	Eurocode 3: Design of steel structures: General rules and rules for buildings
EN 1993-1-3 ¹	Eurocode 3: Design of steel structures: Cold-formed thin gauge members and sheeting
EN 1993-1-5 ¹	Eurocode 3: Design of steel structures: Plated structural elements
EN 1993-1-8 ¹	Eurocode 3: Design of steel structures: Design of joints
EN 1993-1-9 ¹	Eurocode 3: Design of steel structures: Fatigue strength of steel structures
EN 10025-1: 2002	Hot-rolled products of structural steels: General delivery conditions
EN 10025-2: 2002	Hot-rolled products of structural steels: Technical delivery conditions for non-alloy structural steels
EN 10025-3: 2002	Hot-rolled products of structural steels: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels
EN 10025-4: 2002	Hot-rolled products of structural steels: Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels
EN 10025-5: 2002	Hot-rolled products of structural steels: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance

¹ To be published

EN 10025-6: 2002	Hot-rolled products of structural steels: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition
EN 10147: 2000	Continuously hot-dip zinc coated structural steels strip and sheet: Technical delivery conditions
EN 10149-2: 1995	Hot-rolled flat products made of high yield strength steels for cold-forming: Delivery conditions for thermomechanically rolled steels
EN 10149-3: 1995	Hot-rolled flat products made of high yield strength steels for cold-forming: Delivery conditions for normalised or normalised rolled steels

1.3 Assumptions

(1) In addition to the general assumptions of EN 1990 the following assumptions apply:

- those given in clauses 1.3 of EN1992-1-1 and EN1993-1-1.

1.4 Distinction between principles and application rules

(1) The rules in EN 1990, 1.4 apply.

1.5 Definitions

1.5.1 General

(1) The terms and definitions given in EN 1990, 1.5, EN 1992-1-1, 1.5 and EN 1993-1-1, 1.5 apply.

1.5.2 Additional terms and definitions used in this Standard

1.5.2.1 Composite member

a structural member with components of concrete and of structural or cold-formed steel, interconnected by shear connection so as to limit the longitudinal slip between concrete and steel and the separation of one component from the other

1.5.2.2 Shear connection

an interconnection between the concrete and steel components of a composite member that has sufficient strength and stiffness to enable the two components to be designed as parts of a single structural member

1.5.2.3 Composite behaviour

behaviour which occurs after the shear connection has become effective due to hardening of concrete

1.5.2.4 Composite beam

a composite member subjected mainly to bending

1.5.2.5 Composite column

a composite member subjected mainly to compression or to compression and bending

1.5.2.6 Composite slab

a slab in which profiled steel sheets are used initially as permanent shuttering and subsequently combine structurally with the hardened concrete and act as tensile reinforcement in the finished floor

1.5.2.7 Composite frame

a framed structure in which some or all of the elements are composite members and most of the remainder are structural steel members

1.5.2.8 Composite joint

a joint between a composite member and another composite, steel or reinforced concrete member, in which reinforcement is taken into account in design for the resistance and the stiffness of the joint

1.5.2.9 Propped structure or member

a structure or member where the weight of concrete elements is applied to the steel elements which are supported in the span, or is carried independently until the concrete elements are able to resist stresses

1.5.2.10 Un-propped structure or member

a structure or member in which the weight of concrete elements is applied to steel elements which are unsupported in the span

1.5.2.11 Un-cracked flexural stiffness

the stiffness $E_a I_1$ of a cross-section of a composite member where I_1 is the second moment of area of the effective equivalent steel section calculated assuming that concrete in tension is un-cracked

1.5.2.12 Cracked flexural stiffness

the stiffness $E_a I_2$ of a cross-section of a composite member where I_2 is the second moment of area of the effective equivalent steel section calculated neglecting concrete in tension but including reinforcement

1.5.2.13 Prestress

the process of applying compressive stresses to the concrete part of a composite member, achieved by tendons or by controlled imposed deformations

1.6 Symbols

For the purpose of this Standard the following symbols apply.

Latin upper case letters

A	Cross-sectional area of the effective composite section neglecting concrete in tension
A_a	Cross-sectional area of the structural steel section
A_b	Cross-sectional area of bottom transverse reinforcement
A_{bh}	Cross-sectional area of bottom transverse reinforcement in a haunch
A_c	Cross-sectional area of concrete
A_{ct}	Cross-sectional area of the tensile zone of the concrete
A_{fc}	Cross-sectional area of the compression flange
A_p	Cross-sectional area of profiled steel sheeting