

**Samverkanskonstruktioner (stål och betong) –  
Dimensionering: Eurocode 4 –  
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**



## **Samverkanskonstruktioner (stål och betong) – Dimensionering: Eurocode 4 – 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*

Den europeiska förstandarden ENV 1994-1-1:1992 gäller som svensk standard och publiceras i form av en svensk försöksstandard, som innehåller den engelska versionen av ENV 1994-1-1:1992.

Försöksstandarden förutsätter att den tillämpas i kombination med reglerna i ett svenskt anpassningsdokument, NAD, till standarden. För utgivningen av NAD-dokumentet svarar Boverket i samråd med Banverket och Vägverket.

ENV 1994-1-1:1992 bedöms genomgå en viss omarbetning i samband med att den publiceras som europastandard, EN. Det finns f.n. inte några planer på att översätta den till svenska.

SS-ENV 1994-1-1 kommer att följas av ytterligare två delar med regler för dimensionering av samverkanskonstruktioner, dels en med regler för dimensionering m. h. t. brand, dels en med tilläggsregler för broar.

Enligt 1:5 i Boverkets Byggregler BKR 94 (BFS 1993:58) godtas metoder och konstruktionslösningar enligt denna standard som alternativ till sådana som anges i BKR 94, med de tillägg och ändringar som anges i NAD.



EUROPEAN PRESTANDARD

ENV 1994-1-1:1992

PRÉNORME EUROPÉENNE

EUROPÄISCHE VORNORM

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Descriptors: Buildings, concrete structures, steel construction, building codes, design, dimensions

English version

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

Conception et dimensionnement des structures  
mixtes acier-béton - Partie 1-1: Règles  
générales et règles pour les bâtiments

Entwurf von Verbundbauwerken aus Stahl und  
Beton - Teil 1-1: Allgemeine Regeln und Regeln  
für Hochbauten

This European Prestandard (ENV) was approved by CEN on 1992-10-23 as a prospective standard for provisional application. The period of validity of this ENV is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the ENV can be converted into an European Standard (EN).

CEN members are required to announce the existence of this ENV in the same way as for an EN and to make the ENV available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the ENV) until the final decision about the possible conversion of the ENV into an EN is reached.

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**CEN**

European Committee for Standardization  
Comité Européen de Normalisation  
Europäisches Komitee für Normung

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**O. FOREWORD**

- 0.1 OBJECTIVES OF THE EUROCODES
- 0.2 BACKGROUND TO THE EUROCODE PROGRAMME
- 0.3 EUROCODE PROGRAMME
- 0.4 NATIONAL APPLICATION DOCUMENTS
- 0.5 MATTERS SPECIFIC TO THIS PRESTANDARD
  - 0.5.1 Cross-references to other Eurocodes
  - 0.5.2 The treatment of  $\gamma_M$  for structural steel
  - 0.5.3 Notes in this Prestandard

**CHAPTER 1. INTRODUCTION**

- 1.1 SCOPE
  - 1.1.1 Scope of Eurocode 4
  - 1.1.2 Scope of Part 1.1 of Eurocode 4
  - 1.1.3 Further Parts of Eurocode 4
- 1.2 DISTINCTION BETWEEN PRINCIPLES AND APPLICATION RULES
- 1.3 ASSUMPTIONS
- 1.4 DEFINITIONS
  - 1.4.1 Terms common to all Eurocodes
  - 1.4.2 Special terms used in this Part 1.1 of Eurocode 4
- 1.5 S.I. UNITS
- 1.6 SYMBOLS USED IN PART 1.1 OF EUROCODE 4
  - 1.6.1 Latin upper case letters
  - 1.6.2 Greek upper case letters
  - 1.6.3 Latin lower case letters
  - 1.6.4 Greek lower case letters
  - 1.6.5 Subscripts
  - 1.6.6 Use of subscripts in Part 1.1 of Eurocode 4
  - 1.6.7 Conventions for member axes

**CHAPTER 2. BASIS OF DESIGN**

- 2.1 FUNDAMENTAL REQUIRMENTS
- 2.2 DEFINITIONS AND CLASSIFICATIONS
  - 2.2.1 Limit states and design situations
  - 2.2.2 Actions
  - 2.2.3 Material properties
  - 2.2.4 Geometrical data
  - 2.2.5 Load arrangements and load cases
- 2.3 DESIGN REQUIREMENTS
  - 2.3.1 General
  - 2.3.2 Ultimate limit states
  - 2.3.3 Partial safety factors for ultimate limit states
  - 2.3.4 Serviceability limit states
- 2.4 DURABILITY

**CHAPTER 3. MATERIALS**

- 3.1 CONCRETE
  - 3.1.1 General

- 3.1.2 Concrete strength classes
- 3.1.3 Shrinkage of concrete
- 3.1.4 Deformability of concrete - elastic theory
- 3.1.5 Deformability of concrete - other theories
- 3.1.6 Thermal expansion
- 3.2 REINFORCING STEEL
  - 3.2.1 General
  - 3.2.2 Types of steels
  - 3.2.3 Steel grades
  - 3.2.4 Modulus of longitudinal deformation
  - 3.2.5 Stress-strain diagram
  - 3.2.6 Thermal expansion
- 3.3 STRUCTURAL STEEL
  - 3.3.1 General and scope
  - 3.3.2 Yield strength
  - 3.3.3 Design values of other material coefficients
  - 3.3.4 Stress-strain relationship
  - 3.3.5 Dimensions, mass and tolerances
- 3.4 PROFILED STEEL SHEETING FOR COMPOSITE SLABS
  - 3.4.1 General and scope
  - 3.4.2 Yield strength
  - 3.4.3 Nominal values of other material coefficients
  - 3.4.4 Stress-strain relationship
  - 3.4.5 Coating
- 3.5 CONNECTING DEVICES
  - 3.5.1 General
  - 3.5.2 Shear connectors

#### CHAPTER 4. ULTIMATE LIMIT STATES

- 4.1 BASIS
  - 4.1.1 General
  - 4.1.2 Beams
  - 4.1.3 Composite columns, frames and connections
- 4.2 PROPERTIES OF CROSS-SECTIONS OF BEAMS
  - 4.2.1 Effective section
  - 4.2.2 Effective width of concrete flange for beams in buildings
  - 4.2.3 Flexural stiffness
- 4.3 CLASSIFICATION OF CROSS-SECTIONS OF BEAMS
  - 4.3.1 General
  - 4.3.2 Classification of steel flanges in compression
  - 4.3.3 Classification of steel webs
- 4.4 RESISTANCES OF CROSS-SECTIONS OF BEAMS
  - 4.4.1 Bending moment
  - 4.4.2 Vertical shear
  - 4.4.3 Bending and vertical shear
  - 4.4.4 Shear buckling resistance
  - 4.4.5 Interaction between bending and shear buckling
- 4.5 INTERNAL FORCES AND MOMENTS IN CONTINUOUS BEAMS
  - 4.5.1 General
  - 4.5.2 Plastic analysis
  - 4.5.3 Elastic analysis

- 4.6 LATERAL TORSIONAL BUCKLING OF COMPOSITE BEAMS FOR BUILDINGS
  - 4.6.1 General
  - 4.6.2 Check without direct calculation
  - 4.6.3 Buckling resistance moment
- 4.7 WEB CRIPPLING
  - 4.7.1 General
  - 4.7.2 Effective web in Class 2
- 4.8 COMPOSITE COLUMNS
  - 4.8.1 Scope
  - 4.8.2 General method of design
  - 4.8.3 Simplified method of design
- 4.9 INTERNAL FORCES AND MOMENTS IN FRAMES FOR BUILDINGS
  - 4.9.1 General
  - 4.9.2 Design assumptions
  - 4.9.3 Allowance for imperfections
  - 4.9.4 Sway resistance
  - 4.9.5 Methods of global analysis
  - 4.9.6 Elastic global analysis
  - 4.9.7 Rigid-plastic global analysis
- 4.10 COMPOSITE CONNECTIONS IN BRACED FRAMES FOR BUILDINGS
  - 4.10.1 General
  - 4.10.2 Classification of connections
  - 4.10.3 Connections made with bolts, rivets or pins
  - 4.10.4 Splices in composite members
  - 4.10.5 Beam-to-column connections

## CHAPTER 5. SERVICEABILITY LIMIT STATES

- 5.1 GENERAL
- 5.2 DEFORMATIONS
  - 5.2.1 General
  - 5.2.2 Calculation of maximum deflections of beams
- 5.3 CRACKING OF CONCRETE IN BEAMS
  - 5.3.1 General
  - 5.3.2 Minimum reinforcement
  - 5.3.3 Analysis of the structure for the control of cracking
  - 5.3.4 Control of cracking due to direct loading, without calculation of crack widths
  - 5.3.5 Control of cracking by calculation of crack widths

## CHAPTER 6. SHEAR CONNECTION IN BEAMS FOR BUILDINGS

- 6.1 GENERAL
  - 6.1.1 Basis of design
  - 6.1.2 Deformation capacity of shear connectors
  - 6.1.3 Spacing of shear connectors
- 6.2 LONGITUDINAL SHEAR FORCE
  - 6.2.1 Beams in which plastic theory is used for resistance of cross sections
  - 6.2.2 Beams in which elastic theory is used for resistances of one or more cross sections
- 6.3 DESIGN RESISTANCE OF SHEAR CONNECTORS
  - 6.3.1 General
  - 6.3.2 Stud connectors in solid slabs
  - 6.3.3 Headed studs used with profiled steel sheeting



- 6.3.4 Block connectors in solid slabs
- 6.3.5 Anchors and hoops in solid slabs
- 6.3.6 Block connectors with anchors or hoops in solid slabs
- 6.3.7 Angle connectors in solid slabs
- 6.4 **DETAILING OF THE SHEAR CONNECTION**
- 6.4.1 General recommendations
- 6.4.2 Stud connectors
- 6.4.3 Headed studs used with profiled steel sheeting
- 6.4.4 Block connectors
- 6.4.5 Anchors and hoops
- 6.4.6 Angle connectors
- 6.5 **FRICTION GRIP BOLTS**
- 6.5.1 General
- 6.5.2 Ultimate limit state
- 6.5.3 Serviceability limit state
- 6.5.4 Detailing of friction grip bolts
- 6.6 **TRANSVERSE REINFORCEMENT**
- 6.6.1 Longitudinal shear in the slab
- 6.6.2 Design resistance to longitudinal shear
- 6.6.3 Contribution of profiled steel sheeting
- 6.6.4 Minimum transverse reinforcement
- 6.6.5 Longitudinal splitting

## **CHAPTER 7. COMPOSITE SLABS WITH PROFILED STEEL SHEETING FOR BUILDINGS**

- 7.1 **GENERAL**
- 7.1.1 Scope
- 7.1.2 Definitions
- 7.2 **DETAILING PROVISIONS**
- 7.2.1 Slab thickness and reinforcement
- 7.2.2 Aggregate
- 7.2.3 Bearing requirements
- 7.3 **ACTIONS AND ACTION EFFECTS**
- 7.3.1 Design situations
- 7.3.2 Actions
- 7.3.3 Load combinations and load cases
- 7.4 **ANALYSIS FOR INTERNAL FORCES AND MOMENTS**
- 7.4.1 Profiled steel sheeting as shuttering
- 7.4.2 Composite slab
- 7.5 **VERIFICATION OF PROFILED STEEL SHEETING AS SHUTTERING**
- 7.5.1 Ultimate limit state
- 7.5.2 Serviceability limit state
- 7.6 **VERIFICATION OF COMPOSITE SLABS**
- 7.6.1 Ultimate limit state
- 7.6.2 Serviceability limit state

## **CHAPTER 8. FLOORS WITH PRECAST CONCRETE SLABS FOR BUILDINGS**

- 8.1 **GENERAL**
- 8.2 **ACTIONS**
- 8.3 **PARTIAL SAFETY FACTORS FOR MATERIALS**

- 8.4 DESIGN, ANALYSIS, AND DETAILING OF THE FLOOR SYSTEM
  - 8.4.1 Support arrangements
  - 8.4.2 Joints between precast elements
  - 8.4.3 Interfaces
- 8.5 JOINT BETWEEN STEEL BEAMS AND CONCRETE SLAB
  - 8.5.1 Bedding and tolerances
  - 8.5.2 Corrosion
  - 8.5.3 Shear connection and transverse reinforcement
- 8.6 CONCRETE FLOOR DESIGNED FOR HORIZONTAL LOADING

## CHAPTER 9. EXECUTION

- 9.1 GENERAL
- 9.2 SEQUENCE OF CONSTRUCTION
- 9.3 STABILITY
- 9.4 ACCURACY DURING CONSTRUCTION AND QUALITY CONTROL
  - 9.4.1 Static deflection during and after concreting
  - 9.4.2 Compaction of concrete
  - 9.4.3 Shear connection in beams and columns
  - 9.4.4 Composite slabs with profiled steel sheeting

## CHAPTER 10. DESIGN ASSISTED BY TESTING

- 10.1 GENERAL
- 10.2 TESTS ON SHEAR CONNECTORS
  - 10.2.1 General
  - 10.2.2 Testing arrangement
  - 10.2.3 Preparation of specimens
  - 10.2.4 Testing procedure
  - 10.2.5 Test evaluation
- 10.3 TESTING OF COMPOSITE FLOOR SLABS
  - 10.3.1 Parametric tests
  - 10.3.2 Specific tests

## ANNEX A. REFERENCE DOCUMENTS

- A.1 SCOPE
- A.2 STANDARDS ON MATERIALS AND PRODUCTS ASSOCIATED WITH PART 1.1 OF EUROCODE 4
  - A.2.1 Standards mentioned in EC2
  - A.2.2 Standards mentioned in EC3
  - A.2.3 Other standards mentioned in EC4
- A.3 REFERENCE DOCUMENTS FOR EXECUTION
- A.4 GENERAL STANDARDS

## ANNEX B. LATERAL-TORSIONAL BUCKLING

- B.1 METHODS BASED ON A CONTINUOUS INVERTED-U FRAME MODEL
  - B.1.1 Simplified method for calculation of slenderness ratio
  - B.1.2 Elastic critical moment
  - B.1.3 Double symmetrical steel sections
  - B.1.4 Mono-symmetrical steel sections

**ANNEX C. SIMPLIFIED CALCULATION METHOD FOR RESISTANCE OF DOUBLY SYMMETRIC COMPOSITE CROSS SECTIONS IN COMBINED COMPRESSION AND BENDING**

- C.1 SCOPE AND ASSUMPTIONS
- C.2 COMPRESSIVE RESISTANCES
- C.3 POSITION OF NEUTRAL AXIS
- C.4 BENDING RESISTANCES
- C.5 INTERACTION WITH TRANSVERSE SHEAR
- C.6 NEUTRAL AXES AND PLASTIC SECTION MODULI OF SOME CROSS SECTIONS
  - C.6.1 General
  - C.6.2 Major axis bending of encased I-sections
  - C.6.3 Minor axis bending of encased I-sections
  - C.6.4 Concrete filled circular and rectangular hollow sections

**ANNEX D. DESIGN OF COMPOSITE COLUMNS WITH MONO-SYMMETRICAL CROSS-SECTIONS - SIMPLIFIED METHOD**

- D.1 GENERAL
- D.2 SCOPE
- D.3 DESIGN FOR AXIAL COMPRESSION
- D.4 DESIGN FOR COMPRESSION AND UNIAXIAL BENDING
- D.5 LONG-TERM BEHAVIOUR OF CONCRETE

**ANNEX E. PARTIAL SHEAR CONNECTION METHOD FOR COMPOSITE SLABS**

- E.1 SCOPE
- E.2 DETERMINATION OF  $\tau_{u,Rd}$
- E.3 VERIFICATION OF THE LONGITUDINAL SHEAR RESISTANCE
- E.4 VERIFICATION OF COMPOSITE SLABS WITH END ANCHORAGE
- E.5 VERIFICATION OF COMPOSITE SLABS WITH ADDITIONAL REINFORCEMENT

**ANNEX F. CHECKLISTS OF THE INFORMATION REQUIRED IN TEST REPORTS**

- F.1 PUSH TESTS
  - F.1.1 Scope
  - F.1.2 Test specimens
  - F.1.3 Testing
  - F.1.4 Results
- F.2 TESTING OF COMPOSITE SLABS
  - F.2.1 Scope
  - F.2.2 Test specimens
  - F.2.3 Testing
  - F.2.4 Results

## **FOREWORD TO EUROCODE 4 : PART 1.1**

### **0.1 OBJECTIVES OF THE EUROCODES**

- (1) The Structural Eurocodes comprise a group of standards for the structural and geotechnical design of buildings and civil engineering works.
- (2) They are intended to serve as reference documents for the following purposes:
  - (a) As a means to prove compliance of building and civil engineering works with the essential requirements of the Construction Products Directive (CPD).
  - (b) As a framework for drawing up harmonized technical specifications for construction products.
- (3) They cover execution and control only to the extent that is necessary to indicate the quality of the construction products, and the standard of the workmanship, needed to comply with the assumptions of the design rules.
- (4) Until the necessary set of harmonized technical specifications for products and for methods of testing their performance is available, some of the Structural Eurocodes cover some of these aspects in informative annexes.

### **0.2 BACKGROUND TO THE EUROCODE PROGRAMME**

- (1) The Commission of the European Communities (CEC) initiated the work of establishing a set of harmonized technical rules for the design of building and civil engineering works which would initially serve as an alternative to the different rules in force in the various Member States and would ultimately replace them. These technical rules became known as the "Structural Eurocodes".
- (2) In 1990, after consulting their respective Member States, the CEC transferred work of further development, issue and updates of the Structural Eurocodes to CEN, and the EFTA Secretariat agreed to support the CEN work.
- (3) CEN Technical Committee CEN/TC 250 is responsible for all Structural Eurocodes.

**0.3 EUROCODE PROGRAMME**

- (1) Work is in hand on the following Structural Eurocodes, each generally consisting of a number of parts:

EN 1991 Eurocode 1	Basis of design and 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

In addition the following may be added to the programme:

EN 1999 Eurocode 9	Design of aluminium structures
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- (2) Separate sub-committees have been formed by CEN/TC 250 for the various Eurocodes listed above.
- (3) This part of the Structural Eurocode for Design of Composite Steel and Concrete Structures is being issued by CEN as a European Prestandard (ENV) with an initial life of three years.
- (4) This Prestandard is intended for experimental practical application in the design of the building and civil engineering works covered by the scope as given in 1.1.2, and for the submission of comments.
- (5) After approximately two years CEN members will be invited to submit formal comments to be taken into account in determining future action.
- (6) Meanwhile, feedback and comments on this Prestandard should be sent to the Secretariat of sub-committee CEN/TC 250/SC 4 at the following address:  
National Standards Authority of Ireland, Glasnevin, Dublin 9, Ireland  
or to your national standards organization.

## 0.4 NATIONAL APPLICATION DOCUMENTS

- (1) In view of the responsibilities of authorities in member countries for the safety, health and other matters covered by the essential requirements of the CPD, certain safety elements in this ENV have been assigned indicative values which are identified by . The authorities in each member country are expected to assign definitive values to these safety elements.
- (2) Many of the harmonized supporting standards, including the Eurocodes giving values for actions to be taken into account and measures required for fire protection, will not be available by the time this Prestandard is issued. It is therefore anticipated that a National Application Document (NAD) giving definitive values for safety elements, referencing compatible supporting standards and providing national guidance on the application of this Prestandard, will be issued by each member country or its Standards Organisation.
- (3) It is intended that this Prestandard is used in conjunction with the NAD valid in the country where the building or civil engineering works are located.

## 0.5 MATTERS SPECIFIC TO THIS PRESTANDARD

### 0.5.1 Cross-references to other Eurocodes

- (1) It is stated in 1.1.2(5) that "Part 1.1 of Eurocode 4 shall in all cases be used in conjunction with Parts 1.1 of Eurocodes 2 and 3". To assist users, many cross-references to Eurocodes 2 and 3 are given, in the general form "clause ... of EC2" (or EC3). In this Prestandard:
  - EC2 means ENV 1992-1-1 Eurocode 2: Part 1.1; revised final draft, 31 October 1990;
  - EC3 means ENV 1993-1-1 Eurocode 3: Part 1.1; edited draft, issue 5, November 1990, corrected July 1991.

[Drafting note: These definitions of EC2 and EC3 are subject to revision by CEN, to enable reference to be made to the published ENV versions of EC2 and EC3.]

It should not be assumed that cross-references are given to all relevant clauses of EC2 and EC3:

- (2) Repetitions from EC2 and EC3 are limited to material that is frequently needed for reference; for example, Table 3.1 on properties of concrete.
- (3) There are general references to Eurocode 1, but no references to specific clauses. In a few clauses (e.g., 7.3.2.1) application rules for actions are given. These apply only until the relevant Part of Eurocode 1 is available.

#### 0.5.2 The treatment of $\gamma_M$ for structural steel

The use in this Prestandard of partial safety factors for concrete and reinforcement is as in EC2. For structural steel, clause 0.5.5 of EC3 is relevant. It was not possible to reproduce the method of EC3, where factors  $\gamma_{M0}$  or  $\gamma_{M1}$  are applied to resistances of cross-sections or members, because most of the  $\gamma_M$  factors given in this Prestandard are applied to strengths of materials (clause 2.2.3.2). The symbols  $\gamma_{M0}$  and  $\gamma_{M1}$  are therefore replaced in Eurocode 4: Part 1.1 by different symbols,  $\gamma_a$  and  $\gamma_{Rd}$  respectively. The method of drafting makes possible the assignment by a national authority of definitive values such that  $\gamma_a \neq \gamma_{Rd}$ . In this respect, it is consistent with the use of factors  $\gamma_{M0}$  and  $\gamma_{M1}$  in EC3.

#### 0.5.3 Notes in this Prestandard

Two types of note are used:

- [Note: ...]. These notes should appear also in the EN version of Eurocode 4: Part 1.1.
- [ENV Note: ...]. These notes relate to other Eurocodes and Reference Standards as they are in mid-1991. They will not appear in this form in the EN version of Eurocode 4: Part 1.1.

**1. INTRODUCTION****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. The composite structures and members are made of structural steel and reinforced or prestressed concrete connected together to resist loads. Eurocode 4 is subdivided into various separate parts, see 1.1.2 and 1.1.3.
- (2) This Eurocode is only concerned with the requirements for resistance, serviceability and durability of structures. Other requirements, e.g. concerning thermal or sound insulation, are not considered.
- (3) Execution <sup>1)</sup> is covered in Chapter 9, and by reference to Eurocodes 2 and 3, to the extent that it is necessary to indicate the quality of the construction materials and products which should be used and the standard of workmanship on site needed to comply with the assumptions of the design rules. Generally, the rules related to execution and workmanship are to be considered as minimum requirements which may have to be further developed for particular types of buildings or civil engineering works <sup>1)</sup> and methods of construction <sup>1)</sup>.

[ENV Note: See also the Foreword; in the present document, execution is not covered in Chapter 9 to the extent stated above.]

- (4) Eurocode 4 does not cover the special requirements of seismic design. Provisions related to such requirements are provided in Eurocode 8 "Design of structures for earthquake resistance" <sup>2)</sup> which complements or adapts the rules of Eurocode 4 specifically for this purpose.
- (5) Numerical values of the actions on buildings and civil engineering works to be taken into account in the design are not given in Eurocode 4. They are given in Eurocode 1 "Basis of design and actions on structures" <sup>2)</sup> applicable to the various types of construction <sup>1)</sup>.

**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 and members for buildings and civil engineering works.
- (2) In addition, Part 1.1 gives for composite slabs, beams, columns and frames detailed rules which are mainly applicable to ordinary buildings. The applicability of these rules may be limited, for practical reasons or due to simplifications; their use and any limits of applicability are explained in the text where necessary.
- (3) The following subjects are dealt with in Part 1.1:
- Chapter 1 : Introduction
  - Chapter 2 : Basis of Design
  - Chapter 3 : Materials
  - Chapter 4 : Ultimate limit states
  - Chapter 5 : Serviceability limit states
  - Chapter 6 : Shear connection in beams for buildings
  - Chapter 7 : Composite slabs with profiled steel sheeting for buildings

<sup>1)</sup> For the meaning of this term, see 1.4.1 (2)

<sup>2)</sup> At present at the draft stage.



- Chapter 8 : Floors with precast concrete slabs for buildings
- Chapter 9 : Execution
- Chapter 10 : Design assisted by testing
  
- Annex A : Reference documents (Normative)
- Annex B : Lateral-torsional buckling (Normative)
- Annex C : Resistance of doubly symmetric composite cross sections in combined compression and bending (Normative)
- Annex D : Composite columns with mono-symmetrical cross section (Normative)
- Annex E : Partial shear connection method for composite slabs (Normative)
- Annex F : Checklists of the information required in test reports (Informative)

- (4) Chapter 1 and Chapter 2 are common to all Eurocodes, with the exception of some additional clauses which are required for composite construction.
- (5) Part 1.1 of Eurocode 4 shall in all cases be used in conjunction with Parts 1.1 of Eurocodes 2 and 3.
- (6) This Part 1.1 does not cover :
- resistance to fire nor, more generally, resistance at non-climatic temperatures
  - resistance to highly repeated actions liable to result in fatigue
  - resistance to dynamic actions that are not quasi-static
  - particular aspects of special types of civil engineering works (such as bridges, crane girders, masts, towers, offshore platforms, nuclear containment vessels); see 1.1.3(2)
  - particular aspects of special types of buildings (such as industrial buildings as far as fatigue would need to be considered)
  - prestressed structures
  - members the structural steel component of which has cross-sections with no axis of symmetry parallel to the plane of its web
  - members the structural concrete component of which is made of no-fines concrete, or of aerated concrete or of concrete including heavy aggregate, or has less reinforcement than the minimum values given in clause 5.4 of EC2, or contains expanding or non-shrinkage admixtures
  - composite plates consisting of a flat steel plate connected with a concrete slab
  - sway frames
  - some types of shear connectors (see Chapter 6)
  - semi-continuous frames such that rigid-plastic global analysis cannot be used (see 1.4.2(1), and in EC3 clause 5.2.2.4 and Table 5.2.1)
  - base plates beneath composite columns
  - particular aspects of composite piles for foundations
  - particular aspects of members with haunched or tapered steel components
  - particular aspects of box girders
  - particular aspects of totally or partially encased beams (see however 4.3.3.1 and Annex B)
  - and more generally particular aspects mentioned as not covered in the following chapters (relating for example to the form of cross-sections).

- (7) The implicit inclusion of a type of building or a form of structure (as defined in 1.4.1(2)) does not imply that all details of its design are covered conclusively.

### 1.1.3 Further Parts of Eurocode 4

- (1) This Part 1.1 of Eurocode 4 will be supplemented by further Parts which will complement or adapt it for particular aspects of special types of buildings and civil engineering works, special methods of construction and certain other aspects of design which are of general practical importance.
- (2) Further Parts of Eurocode 4 which, at present, are being prepared or are planned are the following: Part 1.2 Fire resistance; Part 2 Bridges.

## 1.2 **DISTINCTION BETWEEN PRINCIPLES AND APPLICATION RULES**

- (1) Depending on the character of the individual clauses, distinction is made in this Eurocode between Principles and Application Rules.
- (2) The Principles comprise :
- general statements and definitions for which there is no alternative, as well as
  - requirements and analytical models for which no alternative is permitted unless specifically stated.
- (3) *The Principles are printed in roman type.*
- (4) The Application Rules are generally recognised rules which follow the Principles and satisfy their requirements.
- (5) It is permissible to use alternative design rules different from the Application Rules given in the Eurocode, provided that it is shown that the alternative rules accord with the relevant Principles and are at least equivalent with regard to the resistance, serviceability and durability achieved by the structure if designed using the present Eurocode.
- (6) *The Application Rules are printed in italics. This is an Application Rule.*  
[Note: Tables and figures have the same status as the paragraphs to which they relate.]

## 1.3 **ASSUMPTIONS**

- (1) The assumptions given in clauses 1.3(1) of EC2 and EC3, which are identical, are applicable.
- (2) The design procedures are valid only when the requirements for execution and workmanship given in Chapter 9 are also complied with.
- (3) Numerical values identified by  are given as indications. Other values may be specified by Member States.

## 1.4 **DEFINITIONS**

### 1.4.1 Terms common to all Structural Eurocodes

- (1) Unless otherwise stated in the following, the terminology used in International Standard ISO 8930 applies.

(2) The following terms are used in common for all Structural Eurocodes with the following meanings :

- **Construction Works** : Everything that is constructed or results from construction operations <sup>1)</sup>. This term covers both building and civil engineering works. It refers to the complete construction comprising both structural and non-structural elements.
- **Execution** : The activity of creating a building or civil engineering works. The term covers work on site; it may also signify the fabrication of components off site and their subsequent erection on site <sup>4)</sup>
- **Structure** : Organized combination of connected parts designed to provide some measure of rigidity <sup>3)</sup>. This term refers to load carrying parts.
- **Type of building or civil engineering works** : Type of "construction works" designating its intended purpose, e.g. dwelling house, industrial building, road bridge <sup>4)</sup>.
- **Form of structure** : Structural type designating the arrangement of structural elements, e.g. beam, triangulated structure, arch, suspension bridge.
- **Construction material** : A material used in construction work, e.g. concrete, steel, timber, masonry.
- **Type of construction** : Indication of principal structural material, e.g. reinforced concrete construction, steel construction, timber construction, masonry construction, composite construction.
- **Method of construction** : Manner in which the construction will be carried out, e.g. cast in place, prefabricated, cantilevered.
- **Structural system** : The load bearing elements of a building or civil engineering works and the way in which these elements are assumed to function, for the purpose of modelling.

(3) The equivalent terms in various languages are given in Table 1.1.

#### 1.4.2 Special terms used in this Part 1.1 of Eurocode 4

(1) The following terms are used in Part 1.1 of Eurocode 4 with the following meanings:

- **Frame**: A structure or portion of a structure, comprising an assembly of directly connected structural members, designed to act together to resist load. This term covers both plane frames and three-dimensional frames.

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<sup>1)</sup> This definition accords with International Standard ISO 6707 Part 1.  
<sup>4)</sup> (for the English version only) ; In English "construction" may be used instead of "execution" in certain combinations of words where there is no ambiguity (e.g. "during construction").  
<sup>3)</sup> International Standard ISO 6707 Part 1 gives the same definition but adds "or a construction works having such an arrangement". In the Structural Eurocodes this addition is not used, in order to facilitate unambiguous translations.  
<sup>4)</sup> (for the English version only) : "Type of construction works" is not used in English.