

Eurocode 6:
Design of masonry structures
Part 1-1: General rules for reinforced and
unreinforced masonry structures

Eurokoodeks 6:
Kivikonstruktsioonide projekteerimine
Osa 1-1: Üldreeglid sarrustatud ja sarrustamata
kivikonstruktsioonide projekteerimiseks

EESTI STANDARDI EESSÕNA**NATIONAL FOREWORD**

See Eesti standard EVS-EN 1996-1-1:2005+NA:2008 sisaldab Euroopa standardi EN 1996-1-1:2005 ingliskeelset teksti ning Eesti rahvuslikku lisa NA:2008.	This Estonian Standard EVS-EN 1996-1-1:2005+NA:2008 consists of the English text of the European Standard EN 1996-1-1:2005 and the Estonian National Annex NA:2008.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonide poolt rahvuslikele liikmetele Euroopa standardi kättesaadavaks tegemise kuupäev on 02.11.2005.	Date of Availability of the European standard is 02.11.2005.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from Estonian Centre for Standardisation.

ICS 91.010.30; 91.080.30

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English Version

**Eurocode 6 - Design of masonry structures - Part 1-1: General
rules for reinforced and unreinforced masonry structures**

Eurocode 6 - Calcul des ouvrages en maçonnerie - Partie
1-1: Règles communes pour ouvrages en maçonnerie
armée et non armée

Eurocode 6 - Bemessung und Konstruktion von
Mauerwerksbauten - Teil 1-1: Allgemeine Regeln für
bewehrtes und unbewehrtes Mauerwerk

This European Standard was approved by CEN on 23 June 2005.

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Foreword

This document EN 1996-1-1 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of an identical text or by endorsement, at the latest by May 2006, and conflicting national standards shall be withdrawn at the latest by March 2010.

CEN/TC 250 is responsible for all Structural Eurocodes.

This document supersedes ENV 1996-1-1:1995 and ENV 1996-1-3:1998.

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 the United Kingdom.

Background to 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 1980's.

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).

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 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.

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

2) According to Article 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 Article 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

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 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

and 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 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.

This European Standard is Part of EN 1996 which comprises the following Parts:

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.

4) see Article 3.3 and Article 12 of the CPD, as well as clauses 4.2, 4.3.1, 4.3.2 and 5.2 of ID 1.

Part 1-1: General - *Rules for reinforced and unreinforced masonry*

NOTE This Part combines ENV 1996-1-1 and ENV 1996-1-3.

Part 1-2: General rules - *Structural fire design*.

Part 2: *Design considerations, selection of materials and execution of masonry*.

Part 3: *Simplified calculation methods for unreinforced masonry structures*

EN 1996-1-1 describes the Principles and requirements for safety, serviceability and durability of masonry structures. It is based on the limit state concept used in conjunction with a partial factor method.

For the design of new structures, EN 1996-1-1 is intended to be used, for direct application, together with ENs 1990, 1991, 1992, 1993, 1994, 1995, 1997, 1998 and 1999.

EN 1996-1-1 is intended for use by:

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

National Annex for EN 1996-1-1

This standard gives some symbols and some alternative methods for which a National value or choice needs to be given; notes under the relevant clauses indicate where national choices may have to be made. The National Standard implementing EN 1996-1-1 in a particular country 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 that country.

National choice is allowed in EN 1996-1-1 through clauses:

- 2.4.3(1)P Ultimate limit states;
- 2.4.4(1) Serviceability limit states;
- 3.2.2(1) Specification of masonry mortar;
- 3.6.1.2(1) Characteristic compressive strength of masonry other than shell bedded;
- 3.6.2(3), (4) and (6) Characteristic shear strength of masonry;
- 3.6.3(3) Characteristic flexural strength of masonry;

- 3.7.2(2) Modulus of elasticity;
- 3.7.4(2) Creep, moisture expansion or shrinkage and thermal expansion;
- 4.3.3(3) and (4) Reinforcing steel;
- 5.5.1.3(3) Effective thickness of masonry walls;
- 6.1.2.2(2) Slenderness ratio λ_c below which creep may be ignored;
- 8.1.2 (2) Minimum thickness of wall;
- 8.5.2.2(2) Cavity walls;
- 8.5.2.3(2) Double-leaf walls.
- 8.6.2 (1) Vertical chases and recesses;
- 8.6.3 (1) Horizontal and inclined chases

Section 1 General

1.1 Scope

1.1.1 Scope of Eurocode 6

(1)P Eurocode 6 applies to the design of buildings and civil engineering works, or parts thereof, in unreinforced, reinforced, prestressed and confined masonry.

(2)P Eurocode 6 deals only with the requirements for resistance, serviceability and durability of structures. Other requirements, for example, concerning thermal or sound insulation, are not considered.

(3)P 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 made in the design rules.

(4)P Eurocode 6 does not cover the special requirements of seismic design. Provisions related to such requirements are given in Eurocode 8 which complements, and is consistent with Eurocode 6.

(5)P Numerical values of the actions on buildings and civil engineering works to be taken into account in the design are not given in Eurocode 6. They are provided in Eurocode 1.

1.1.2 Scope of Part 1-1 of Eurocode 6

(1)P The basis for the design of buildings and civil engineering works in masonry is given in this Part 1-1 of Eurocode 6, which deals with unreinforced masonry and reinforced masonry where the reinforcement is added to provide ductility, strength or improve serviceability. The principles of the design of prestressed masonry and confined masonry are given, but application rules are not provided. This Part is not valid for masonry with a plan area of less than 0,04 m².

(2) For those types of structures not covered entirely, for new structural uses for established materials, for new materials, or where actions and other influences outside normal experience have to be resisted, the principles and application rules given in this EN may be applicable, but may need to be supplemented.

(3) Part 1-1 gives detailed rules which are mainly applicable to ordinary buildings. The applicability of these rules may be limited, for practical reasons or due to simplifications; any limits of applicability are given in the text where necessary.

(4)P 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 State;
- section 7 : Serviceability Limit State;
- section 8 : Detailing;
- section 9 : Execution;

(5)P Part 1-1 does not cover:

- resistance to fire (which is dealt with in EN 1996-1-2);
- particular aspects of special types of building (for example, dynamic effects on tall buildings);
- particular aspects of special types of civil engineering works (such as masonry bridges, dams, chimneys or liquid-retaining structures);
- particular aspects of special types of structures (such as arches or domes);
- masonry where gypsum, with or without cement, mortars are used;
- masonry where the units are not laid in a regular pattern of courses (rubble masonry);
- masonry reinforced with other materials than steel.

1.1.3 Further Parts of Eurocode 6

(1) Part 1-1 of Eurocode 6 will be supplemented by further Parts as follows:

- Part 1-2: General rules - Structural fire design.

- Part 2: Design, selection of materials and execution of masonry.
- Part 3: Simplified calculation methods for unreinforced masonry structures.

1.2 Normative references

1.2.1 General

(1)P 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).

1.2.2 Reference standards

The following standards are referenced in this EN 1996-1-1:

- EN 206-1, *Concrete — Part 1: Specification, performance, production and conformity*;
- EN 771-1, *Specification for masonry units — Part 1: Clay masonry units*;
- EN 771-2, *Specification for masonry units — Part 2: Calcium silicate masonry units*;
- EN 771-3, *Specification for masonry units — Part 3: Aggregate concrete masonry units (Dense and light-weight aggregates)*;
- EN 771-4, *Specification for masonry units — Part 4: Autoclaved aerated concrete masonry units*;
- EN 771-5, *Specification for masonry units — Part 5: Manufactured stone masonry units*;
- EN 771-6, *Specification for masonry units — Part 6: Natural stone masonry units*;
- EN 772-1, *Methods of test for masonry units — Part 1: Determination of compressive strength*;
- EN 845-1, *Specification for ancillary components for masonry — Part 1: Ties, tension straps, hangers and brackets*;
- EN 845-2, *Specification for ancillary components for masonry — Part 2: Lintels*;
- EN 845-3, *Specification for ancillary components for masonry — Part 3: Bed joint reinforcement of steel meshwork*;
- EN 846-2, *Methods of test for ancillary components for masonry — Part 2: Determination of bond strength of prefabricated bed joint reinforcement in mortar joints*;
- EN 998-1, *Specification for mortar for masonry — Part 1: Rendering and plastering mortar*;
- EN 998-2, *Specification for mortar for masonry — Part 2: Masonry mortar*;

- EN 1015-11, *Methods of test for mortar for masonry — Part 11: Determination of flexural and compressive strength of hardened mortar*;
- EN 1052-1, *Methods of test for masonry — Part 1: Determination of compressive strength*;
- EN 1052-2, *Methods of test for masonry — Part 2: Determination of flexural strength*;
- EN 1052-3, *Methods of test for masonry — Part 3: Determination of initial shear strength*;
- EN 1052-4, *Methods of test for masonry — Part 4: Determination of shear strength including damp proof course*;
- EN 1052-5, *Methods of test for masonry — Part 5: Determination of bond strength by bond wrench method*;
- EN 1990, *Basis of structural design*;
- EN 1991, *Actions on structures*;
- EN 1992, *Design of concrete structures*;
- EN 1993, *Design of steel structures*;
- EN 1994, *Design of composite steel and concrete structures*;
- EN 1995, *Design of timber structures*;
- EN 1996-2, *Design, selection of materials and execution of masonry*;
- EN 1997, *Geotechnical design*;
- EN 1999, *Design of aluminium structures*;
- EN 10080, *Steel for the reinforcement of concrete - Weldable reinforcing steel*;
- prEN 10138, *Prestressing steels*;
- EN ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods*.

1.3 Assumptions

(1)P The assumptions given in 1.3 of EN 1990:2002 apply to this EN 1996-1-1.

1.4 Distinction between principles and application rules

(1)P The rules in 1.4 of EN 1990:2002 apply to this EN 1996-1-1.