



**SLOVENSKI STANDARD**  
**SIST ENV 1992-1-4:2004**  
**01-september-2004**

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**Eurocode 2: Projektiranje betonskih konstrukcij - 1-4. del: Splošna pravila za beton iz lahkega agregata z zaprto zgradbo**

Eurocode 2: Design of concrete structures - Part 1-4: General rules - Lightweight aggregate concrete with closed structure

Eurocode 2: Planung von Stahlbeton- und Spannbetontragwerken - Teil 1-4: Allgemeine Regeln - Leichtbeton mit geschlossenem Gefüge

Eurocode 2: Calcul des structures en béton - Partie 1-4: Règles générales - Béton de granulats légers a structure fermée

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**Ta slovenski standard je istoveten z: ENV 1992-1-4:1994**

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**ICS:**

91.010.30	V^@ã}ãããã	Technical aspects
91.080.40	Betonske konstrukcije	Concrete structures

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EUROPEAN PRESTANDARD

ENV 1992-1-4

PRÉNORME EUROPÉENNE

EUROPÄISCHE VORNORM

October 1994

ICS 91.040.00; 91.100.30

Descriptors: buildings, concrete structure, computation, building codes, rules of calculation

English version

**Eurocode 2: Design of concrete structures - Part  
1-4: General rules - Lightweight aggregate  
concrete with closed structure**

Eurocode 2: Calcul des structures en béton -  
Partie 1-4: Règles générales - Béton de  
granulats légers à structure fermée

Eurocode 2: Planung von Stahlbeton- und  
Spannbetontragwerken - Teil 1-4: Allgemeine  
Regeln - Leichtbeton mit geschlossenem Gefüge

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This European Prestandard (ENV) was approved by CEN on 1993-06-25 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.

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

## CEN

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

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

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<b>Foreword</b>
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**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 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.
- (3) Until the necessary set of harmonized technical specifications for products and for the methods of testing their performance are available, some of the Structural Eurocodes cover some of these aspects in informative Annexes.

**BACKGROUND OF THE EUROCODE PROGRAMME**

- (4) 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".
- (5) In 1990, after consulting their respective Member States, the CEC transferred the work of further development, issue and updating of the Structural Eurocodes to CEN, and the EFTA Secretariat agreed to support the CEN work.
- (6) CEN Technical Committee CEN/TC250 is responsible for all Structural Eurocodes

**EUROCODE PROGRAMME**

- (7) 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 provisions for earthquake resistance of structures
EN 1999 Eurocode 9	Design of aluminium alloy structures
- (8) Separate sub-committees have been formed by CEN/TC250 for the various Eurocodes listed above.

- (9) This Part 1-4 of Eurocode 2 is being published as a European Prestandard (ENV) with an initial life of three years.
- (10) This Prestandard is intended for experimental application and for the submission of comments.
- (11) After approximately two years CEN members will be invited to submit formal comments to be taken into account in determining future actions.
- (12) Meanwhile feedback and comments on this Prestandard should be sent to the Secretariat of CEN/TC250/SC2 at the following address:

Deutsches Institut für Normung e.V. (DIN)  
Burggrafenstrasse 6  
D - 10787 Berlin  
phone: (+49) 30 - 26 01 - 25 01  
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or to your national standards organization.

#### NATIONAL APPLICATION DOCUMENTS (NAD'S)

- (13) In view of the responsibilities of authorities in member countries for safety, health and other matters covered by the essential requirements of the Construction Products Directive (CPD), certain safety elements in this ENV have been assigned indicative values which are identified by [ ] ("boxed values"). The authorities in each member country are expected to assign definitive values to these safety elements.
- (14) Some of the supporting European or International standards may 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 Organization.
- (15) It is intended that this Prestandard is used in conjunction with the NAD valid in the country where the building or civil engineering works is located.

#### MATTERS SPECIFIC TO THIS PRESTANDARD

- (16) The scope of Eurocode 2 is defined in 1.1.1 of ENV 1992-1-1 and the scope of this Part of Eurocode 2 is defined in 1.1.2. Additional Parts of Eurocode 2 which are planned are indicated in 1.1.3 of ENV 1992-1-1; these will cover additional technologies or applications, and will complement and supplement this Part.
- (17) In using this Prestandard in practice, particular regard should be paid to the underlying assumptions and conditions given in 1.3 of ENV 1992-1-1.
- (18) The seven chapters of this Prestandard are complemented by four Appendices which have the same normative status as the chapters to which they relate. These Appendices have been introduced by moving some of the more detailed Principles/Application Rules, which are needed in particular cases, out of the main part of the text to aid its clarity.

- (19) As indicated in paragraph (14) of this Foreword, reference should be made to National Application Documents which will give details of compatible supporting standards to be used. For this Part of Eurocode 2, particular attention is drawn to the approved Prestandard ENV 206 (Concrete - performance, production, placing and compliance criteria), and the durability requirements given in 4.1 of this Prestandard.
- (20) The provisions of this Prestandard are based substantially on the 1978 edition of the CEB Model Code and other more recent CEB and FIP documents.
- (21) In developing this Prestandard, background documents have been prepared, which give commentaries on and justifications for some of the provisions in this Prestandard.

For ENV 1992-1-4, the following additional sub-clauses apply:

- (22) This Part 1-4 of Eurocode 2 complements ENV 1992-1-1 for the particular aspects of lightweight aggregate concrete with closed structure.
- (23) The framework and structure of this Part 1-4 correspond to ENV 1992-1-1. However, Part 1-4 contains Principles and Application Rules which are specific to structures made with lightweight aggregate concrete with closed structure. (standards.iteh.ai)
- (24) Where a particular sub-clause of ENV 1992-1-1 is not mentioned in this ENV 1992-1-4, that sub-clause of ENV 1992-1-1 applies as far as deemed appropriate in each case.

Some Principles and Application Rules of ENV 1992-1-1 are modified or replaced in this Part, in which case they are superseded.

Where a Principle or Application Rule in ENV 1992-1-1 is modified or replaced, the new number is identified by the addition of 100 to the original number. Where a new Principle or Application Rule is added, it is identified by a number which follows the last number of ENV 1992-1-1 with 100 added to it.

A subject not covered by ENV 1992-1-1 is introduced in this Part by a new sub-clause. The sub-clause number for this follows the most appropriate clause number in ENV 1992-1-1.

- (25) The numbering of equations, figures, footnotes and tables in this Part follow the same principles as the clause numbering in (24) above.



**1 INTRODUCTION**

This clause of ENV 1992-1-1 is applicable except as follows:

**1.1 SCOPE****1.1.2 SCOPE OF PART 1-4 OF EUROCODE 2**

Addition after Principle P(5):

P(106) Part 1-4 of Eurocode 2 gives a general basis for the design of buildings and civil engineering works in reinforced and prestressed concrete made with lightweight aggregate concrete with closed structure as defined in ENV 206.

For plain concrete structures made with lightweight aggregate concrete with closed structure, Part 1-6 of ENV 1992 and this Part 1-4 shall be applied analogously.

P(107) All clauses of ENV 1992-1-1 are generally applicable, unless they are substituted by special clauses of this Part 1-4.

P(108) This Part 1-4 applies to all concretes with closed structure made with natural or artificial mineral lightweight aggregates, unless reliable experience indicates that provisions different from those given can be adopted safely.

(109) This Part 1-4 does not apply to aerated concrete either autoclaved or normally cured nor to lightweight aggregate concrete with open structure.

**1.4 DEFINITIONS****1.4.2 SPECIAL TERMS USED IN PART 1-4 OF EUROCODE 2**

Addition after Principle P(2):

P(103) Lightweight aggregate concrete: concrete having a closed structure <sup>1)</sup> and an oven-dry density of not more than 2000 kg/m<sup>3</sup> consisting of or containing a proportion of artificial or natural lightweight aggregates having a particle density of less than 2000 kg/m<sup>3</sup>.

**1.7 SPECIAL SYMBOLS USED IN THIS PART 1-4 OF EUROCODE 2****1.7.2 LATIN UPPER CASE SYMBOLS**

Addition:

LC The strength classes of lightweight aggregate concrete are preceded by the symbol LC.

**1.7.4 GREEK SYMBOLS**

Addition:

$\eta$ ,  $\eta_1$ ,  $\eta_2$ ,  $\eta_3$ ,  $\eta_4$ : conversion coefficient or ratio.

1) according to ENV 206, 5.2, so made and compacted as to retain no appreciable amount of entrapped air other than entrained air.

**1.7.5 SUBSCRIPTS**

Addition:

lc Material properties of lightweight aggregate concrete are indicated by the subscript lc.

**2 BASIS OF DESIGN**

This clause of ENV 1992-1-1 is applicable except as follows:

**2.5 ANALYSIS****2.5.5 DETERMINATION OF THE EFFECTS OF TIME DEPENDENT DEFORMATION OF CONCRETE****2.5.5.1 General**

Replacement of Application Rule (13) by:

(113) Appendix 1 in Part 1-1 of ENV 1992 does not apply to lightweight aggregate concrete with closed structure.

Addition after Application Rule (13):

(114) When the influence of the time dependent deformation of concrete is considered to be of particular significance so that its evaluation requires the use of rigorous calculation procedures, reference should be made to appropriate documents in complying with P(1), P(2) and (5) in ENV 1992-1-1. In performing such calculations, a knowledge of environmental conditions and of material composition and properties is important for accurate prediction.

**3 MATERIAL PROPERTIES**

This clause of ENV 1992-1-1 is applicable except as follows:

**3.1 CONCRETE****3.1.0 NOTATION (SEE ALSO 1.7)**

Addition:

- $\eta_E$  Conversion factor for the calculation of the modulus of elasticity
- $\eta_1$  Coefficient for the determination of the tensile strength
- $\eta_2$  Ratio of the moduli of elasticity of lightweight aggregate concrete with closed structure and normal weight concrete
- $\rho$  Oven-dry density of lightweight aggregate concrete in  $\text{kg/m}^3$

**3.1.2 LIGHTWEIGHT AGGREGATE CONCRETE****3.1.2.1 Definitions**

Replacement of Principles P(1) and P(2) by:

P(101) The density of lightweight aggregate concrete is defined as the mass per unit volume after oven-drying (105°C).

P(102) The density shall be determined in accordance with ENV 206.

Addition after Principle P(2):

(103) In ENV 206, Clause 7.3.2, lightweight aggregate concrete is classified according to its density as shown in lines 1 and 2 of Table 3.105 below. In addition, Table 3.105 gives corresponding densities for plain and reinforced concrete with normal percentages of reinforcement which may be used for design purposes in calculating self-weight or imposed permanent loading.

(104) The contribution of the reinforcement to the density may alternatively be determined by calculation.

**Table 3.105: Density classes and corresponding design densities of lightweight aggregate concrete according to ENV 206**

Density class	1.0	1.2	1.4	1.6	1.8	2.0	
Oven-dry density $\rho$ (kg/m <sup>3</sup> )	901-1000	1001-1200	1201-1400	1401-1600	1601-1800	1801-2000	
Density (kg/m <sup>3</sup> )	1050	1250	1450	1650	1850	2050	
	reinforced concrete	1150	1350	1550	1750	1950	2150

### 3.1.2.3 Tensile Strength

Addition after Application Rule (4):

(105) In the absence of more accurate data, an estimate of the tensile strength can be obtained by multiplying the  $f_{ct}$ -values calculated from equations (3.2) to (3.4), or obtained from Table 3.1 in Clause 3.1.2.4 of ENV 1992-1-1 by a coefficient

$$\eta_1 = 0.40 + 0.60 \frac{\rho}{2200} \quad (3.106)$$

where  $\rho$  denotes the upper limit of the oven-dry density in line 2 of Table 3.105 (kg/m<sup>3</sup>).

### 3.1.2.4 Strength Classes of Lightweight Aggregate Concrete

Replacement of Principle P(1) and Application Rules (2) and (3) by: