SLOVENSKI STANDARD
SIST ENV 1992-1-5:2004

01-september-2004

Eurocode 2: Projektiranje betonskih konstrukcij - 1-5. del: Splošna pravila za konstrukcije z nepovezanimi in zunanjimi prednapetimi kabli

Eurocode 2: Design of concrete structures - Part 1-5: General rules - Structures with unbonded and external prestressing tendons

Eurocode 2: Planung von Stahlbeton- und Spannbetontragwerken - Teil 1-5: Allgemeine Regeln - Tragwerke mit Spanngliedern ohne Verbund

Eurocode 2: Calcul des structures en béton - Partie 1-5: Règles générales - Structures précontraintes par armatures extérieures ou non adhérentes

Ta slovenski standard je istoveten z: **ENV 1992-1-5:1994**

ICS:

91.010.30	Tehniļ ni vidiki	Technical aspects
91.080.40	Betonske konstrukcije	Concrete structures

SIST ENV 1992-1-5:2004 **en**

EUROPEAN PRESTANDARD

PRÉNORME EUROPÉENNE

EUROPÄISCHE VORNORM

ENV 1992-1-5

October 1994

ICS 91.040.00; 91.080.40

Descriptors: bâtiments, ouvrages en béton, calcul, codes applicables au bâtiment, règles de calcul

English version

Eurocode 2: Design of concrete structures - Part 1-5: General rules - Structures with unbonded and external prestressing tendons

Eurocode 2: Calcul des structures en béton - Partie 1-5: Règles générales - Structures précontraintes par armatures extérieures ou non adhérentes

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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 existance 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

Contents

Foreword

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 1-5 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
fax: (+49) 30 - 26 01 - 12 31

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 1992-1-5, the following additional sub-clauses apply:

(22) This Part 1-5 of Eurocode 2 complements ENV 1992-1-1 for the particular aspects of structures with unbonded and external tendons.

(23) The framework and structure of this Part 1-5 correspond to ENV 1992-1-1. However, Part 1-5 contains Principles and Application Rules which are specific to structures with unbonded and external tendons.

(24) Where a particular sub-clause of ENV 1992-1-1 is not mentioned in this ENV 1992-1-5, 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.

(26) Prestressing with unbonded tendons, being the subject of this ENV 1992-1-5, brings forward two distinct technologies:

- prestressing with small tendons, generally monostrands, installed in a plastic sheath of a small diameter embedded in concrete;

- prestressing with larger tendons, located outside the concrete, generally inside a box-girder or between the webs of multiple girder structures.

(27) The former are normally used in floors for buildings, while the specific field of application of the second technology is in bridge construction. However, their use is not restricted, since on the one hand certain road bridge decks may be reinforced with unbonded internal tendons and, on the other hand, external prestressing has often been implemented in the construction of beams made of prefabricated segments for industrial buildings.

(28) Attention is drawn to the specific characteristics of external prestressing. Certain calculation models which are referred to in ENV 1992-1-1 must be discarded and replaced by new models, the validity of which has to be established. Where necessary, relevant indications are given in this Part 1-5 of ENV 1992.

1 INTRODUCTION

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

1.1 SCOPE

1.1.2 SCOPE OF PART 1-5 OF EUROCODE 2

Addition after Principle P(5):

P(106) This Part 1-5 of Eurocode 2 gives a general basis for the design of reinforced concrete components provided with unbonded tendons placed within or outside the concrete. In addition, this Part 1-5 gives design rules which are mainly applicable to buildings. This Part 1-5 does not apply to structures subjected to significant fatigue under variable loads. It does also not apply to structures with tendons temporarily ungrouted during construction [see ENV 1992-1-1, Clauses 1.4.2 P(2) and 2.5.4.1(4)].

This ENV 1992-1-5 does not apply to members prestressed by tendons located outside the envelope of the concrete structure.

P(107) This Part 1-5 applies to concrete cast in situ or to precast units. Joints may be either reinforced crossed by reinforcement or unreinforced with or without glueing or sealing compound.

P(108) All clauses of ENV 1992-1-1 are generally applicable to the structures covered by this Part 1-5 provided that the relevant detailing provisions are fulfilled and the actions of the tendons are considered as external forces.

P(109) For the design of members with unreinforced joints, the design models shall take into account the geometrical and mechanical consequences of the opening of the joints.

1.4 DEFINITIONS

1.4.2 SPECIAL TERMS USED IN PART 1-5 OF EUROCODE 2

Addition after Principle P(2):

P(103) External tendon: A post-tensioned tendon situated outside the concrete section but inside the envelope of the concrete structure, only connected to the structure by anchorages and deviators.

P(104) Deviator: A device (e.g. concrete block, steel assembly or cross beam) round which a tendon is bent and where the tendon exerts a radial force on the structure.

P(105) Internal unbonded tendon: A cast-in post-tensioned tendon, fabricated from sheathed prestressing strands or steels, connected to the structure by anchorages only.

P(106) Sheathed prestressing strand: Grease coated prestressing strand inside a tube-like plastic sheathing, in which it can move freely in the longitudinal direction (monostrand).

1.7 **SPECIAL SYMBOLS USED IN THIS PART 1-5 OF EUROCODE 2**

1.7.3 **LATIN LOWER CASE SYMBOLS**

r Radius of the outline of a curved unbonded prestressing tendon

t Thickness of a steel tube used as sheathing

1.7.4 **GREEK SYMBOLS**

μ Coefficient of friction between an unbonded tendon and ducts

φ_1 Unintentional angular displacement (per unit length) related to the profile of the unbonded tendons

ϕ Outer diameter of the sheathing of the unbonded prestressing tendon

2 BASIS OF DESIGN

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

2.3 **DESIGN REQUIREMENTS**

2.3.2 **ULTIMATE LIMIT STATES**

2.3.2.2 **Combination of actions**

Replacement of Principle P(1) by:

P(101) For each load case, design values E_d for the effects of actions shall be determined from combination rules involving design values of actions as identified by table 2.1 in ENV 1992-1-1.

The combinations of actions given in clause 2.3.2.2 of ENV 1992-1-1 apply also to structures with unbonded and external prestressing tendons.

2.5 **ANALYSIS**

2.5.3 **CALCULATION METHODS**

2.5.3.1 **Basic considerations**

Addition after Application Rule (5):

P(106) The methods of analysis given in clause 2.5.3 of ENV 1992-1-1 may be applied under the following restrictions:

- if reinforcement is needed to ensure the structural ductility, the unbonded tendons shall not be taken into account and their effect shall be considered as an external force;

- no redistribution of moments and forces is permitted for structures composed of prefabricated segments with unreinforced contact joints.

(107) It is convenient to determine the effects of prestressing by replacing each tendon by a set of physical forces it exerts on the concrete as follows: