SLOVENSKI STANDARD
SIST ENV 1994-2:2004

01-september-2004

Eurocode 4: Projektiranje sovprežnih konstrukcij iz jekla in betona – 2. del Sovprežni mostovi

Eurocode 4: Design of composite steel and concrete structures - Part 2: Composite bridges

Eurocode 4: Bemessung und Konstruktion von Verbundtragwerken aus Stahl und Beton - Teil 2: Verbundbrücken

Eurocode 4: Calcul des structures mixtes acier-béton - Partie 2: Ponts mixtes

Ta slovenski standard je istoveten z: **ENV 1994-2:1997**

ICS:

91.010.30	Tehniļ ni vidiki	Technical aspects
91.080.99	Druge konstrukcije	Other structures
93.040	Gradnja mostov	Bridge construction

SIST ENV 1994-2:2004 **en**

EUROPEAN PRESTANDARD
PRÉNORME EUROPÉENNE
EUROPÄISCHE VORNORM

ENV 1994-2

December 1997

ICS 91.010.30; 91.080.10; 91.080.40; 93.040

Descriptors: civil engineering, concrete structure, steel construction, bridges, design, building codes, computation

English version

Eurocode 4: Design of composite steel and concrete structures - Part 2: Composite bridges

Eurocode 4: Calcul des structures mixtes acier-béton - Partie 2: Ponts mixtes

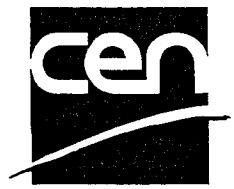
Eurocode 4: Bemessung und Konstruktion von Verbundtragwerken aus Stahl und Beton - Teil 2: Verbundbrücken

This European Prestandard (ENV) was approved by CEN on 11 August 1997 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 a European Standard.

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, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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

Contents

Foreword

rep.

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 harmonised 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.

Background to the Eurocode Programme

(4) The Commission of the European Communities (CEC) initiated the work of establishing a set of harmonised 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/TC 250 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 of structures for earthquake resistance
EN 1999	Eurocode 9	Design of aluminium alloy structures

(8) A separate sub-committee has been formed by CEN/TC250 for each of the Eurocodes listed above.

(9) This Part of ENV 1994 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 submission of comments.

(11) After approximately two years CEN members will be invited to submit formal comments on this Prestandard to be taken into account in determining future action.

(12) Meanwhile feedback and comments on this Prestandard should be sent to the Secretariat of Sub-committee CEN/TC250/SC4 at the following address :

National Standards Authority of Ireland, Glasvenin, Dublin 9, Ireland
Telephone international 353 1 807 38 00
Fax international 353 1 807 38 38

or to your national Standards Organisation.

National Application Documents

(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 review the "boxed values" and may substitute alternative definitive values for these safety elements for use in national application.

(14) Some of the necessary 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 any mandatory values to be substituted for "boxed" values, referencing compatible supporting Standards and providing guidance on the national application of this Prestandard, will be issued by each member country or its Standards Organisation.

(15) It is intended that this Prestandard will be used in conjunction with the particular NAD valid in the country in which the bridge is to be located.

Matters specific to this prestandard

(16) The scope of Eurocode 4 is defined in clause 1.1 of ENV 1994-1-1:1992 and the scope of this part of Eurocode 4 is defined in 1.1.2.

(17) Bridges are essentially public works, for which :

- the European Directive 93-37/CEC on Public Procurement is particularly relevant, and
- public authorities have responsibilities as owners.

Within this context this Prestandard has been established with two main objectives :

- to be sufficiently precise and comprehensive for contractual use,
- to be sufficiently flexible to allow the intervening parties fully to exert their technical responsibilities.

(18) Because of the responsibilities of relevant authorities for bridges, it has been anticipated that, for the application of this Part, it will be supplemented by :

- general complementary rules and options to be provided by National Application Documents (NAD - see (14)) and
- complementary and/or modifying specifications for particular projects.

Wherever this Prestandard mentions "unless otherwise specified", it is intended that the relevant authorities (to be identified, if relevant, in the particular NADs) will remain free to intervene at each of these two levels. It is the same where this Prestandard refers to the "client", if the client is not the relevant authority itself.

(19) Concerning the treatment of γ_M for structural steel, 0.5.2 of ENV 1994-1-1:1992 is applicable.

(20) The framework and structure of this Part 2 correspond to ENV 1994-1-1:1992. However, ENV 1994-2:1997 contains Principles and Application Rules which are specific to composite bridges.

(21) Some Principles and Application Rules in ENV 1994-1-1:1992 are modified or replaced. The new provisions are identified by the symbols *mod.* or *rep.*, respectively.

(22) Where a new Principle or Application Rule is added, it is identified by the symbol *add.*

(23) Any clause, subclause, or paragraph of ENV 1994-1-1:1992 that is neither modified or replaced, is applicable. These provisions are not repeated in this ENV 1994-2:1997.

(24) For the application of this Part 2 it is assumed that the intervening parties :

- select from ENV 1991-3:1995 the relevant traffic load models and take the necessary complementary decisions about actions;

- define, with regard to the type of bridge under consideration (see 1.1.2) and the environmental conditions of exposure, the verification criteria for the serviceability limit states.

1. General

1.1 Scope

1.1.2. Scope of ENV 1994-2:1997

rep.

(1) P ENV 1994-2:1997 gives a general basis for the design of composite bridges.

(2) P In addition ENV 1994-2:1997 gives a specific basis for the design of composite structures and members for bridges such as road, railway, and pedestrian bridges, and detailed rules for composite bridge structures such as beam and slab bridge decks, box girders , trusses and columns that support bridge decks.

(3) No application rules are given for the use of unbonded tendons or for cable stayed bridges.

(4) P For the use of composite slabs in bridges, see 7.1.1.

(5) P For the use of filler beam decks, see annex K.

(6) P Provisions for the design of high strength cables, bearings and expansion joints are given in annexes A, B and E of ENV 1993-2:1997.

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

(8) For the execution of steel structures, reference should be made to ENV 1090-5.

1.1.3 Further Parts of ENV 1994

Clause 1.1.3 does not apply.

1.2 Distinction between principles and application rules

(3) P The principles are identified by the letter P following the paragraph number.
mod.

(6) In this Part, Application Rules have only a paragraph number, e.g. as this paragraph.
mod.

NOTE : Tables and figures have the same status as the paragraphs to which they relate.

1.3 Assumptions

rep.

(1) P The assumptions given in clause 1.3(1) of ENV 1992-1-1:1991 and 1993-1-1:1992 are applicable.

(2) P The design procedures are valid only when the requirements for execution and workmanship given in Section 9 are also complied with.

(3) P For numerical values identified by □ , see Foreword paragraph (13).

1.4 Definitions

1.4.2 Special terms used in this Part

rep.

1.4.2.1 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.

1.4.2.2 Filler beam deck : see K.1.(1) P

1.4.2.3 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.

1.4.2.4 Composite bridge : A bridge in which at least some of the principal members are composite members.

1.4.2.5 Propped structure or member : A structure or member where the weight of concrete elements is applied to the steel elements which are supported within the span, or is carried independently until the concrete elements are able to resist stresses.

1.4.2.6 Unpropped structure or member : A structure or member in which the weight of concrete elements is applied to the steel elements which are unsupported within the span.

1.4.2.7 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.

NOTE : The concept of partial shear connection as used in ENV 1994-1-1:1992 is not applicable to bridges.

Except as provided in 4.8.2 and annex K shear connection means mechanical shear connection that does not rely on bond or adhesion at interfaces between steel and concrete.

1.4.2.8 Composite column : A composite member subjected mainly to compression and bending. Only columns with cross-sections of the types defined in 4.8.1 are treated in this Eurocode.

1.4.2.9 Composite beam : A composite member subjected mainly to bending.

1.4.2.10 Continuous composite beam : A beam with three or more supports, in which the steel section is either continuous over internal supports or is jointed by full-strength and rigid connections, with connections between the beam and each support such that it can be assumed that the support does not transfer significant bending moment to the beam.

1.4.2.11 Global analysis : The determination of a consistent set of internal forces and moments in a structure which are in equilibrium with a particular defined set of actions on the structure, and are based on the properties of the materials.

1.4.2.12 Clearance gauge : The maximum height authorised for vehicles running under a bridge.

1.4.2.13 Composite plate : Composite member subjected mainly to bending, consisting of a flat plate connected to a concrete slab, in which both the length and width are much greater than the thickness.

1.4.3 Other definitions

add.

(1) P The definitions of clause 1.4 of ENV 1991-3:1995 apply.

(2) P The definitions of clause 1.4 of ENV 1992-2:1996 apply.

(3) P The definitions of clause 1.4 of ENV 1993-2:1997 apply.

(4) P For the verifications relating to fatigue, the definitions given in 9.1.5 of ENV 1993-1-1:1992 apply.

(5) P The definitions of clause 1.4 of ENV 1993-1-5:1997 apply.

(6) For isostatic effects and hyperstatic effects of shrinkage and differential temperature, see 2.2.2.1(4) of ENV 1994-1-1 : 1992.

1.5 S.I. Units

(2) For calculations, the following units are recommended :

mod.

- Forces and loads : kN or MN units
- unit mass : kg/m^3
- unit weight : kN/m^3
- stresses and strengths : N/mm^2 (= MN/m^2 or MPa)
- moments (bending .....) : kNm or MNm

1.6 Symbols used in Part 2

rep.

1.6.1 General

(1) Only the main symbols are defined in this Section. Symbols which are used only in small parts of this Eurocode are defined where they appear.

NOTE : The following list of symbols include the principal combinations of symbols and subscripts in this Eurocode. The list does not include symbols used in one place only, nor those symbols used in ENV 1992-2:1996, ENV 1993-2:1997 and ENV 1993-1-5:1997 but not directly in this Part.
NOTE : The notation used is based on ISO 3898:1987.

1.6.2 Latin upper case letters

A Accidental action; Area
C Fixed value; Factor
E Effect of actions; Modulus of elasticity
F Action; force
G Permanent action; shear modulus
I Second moment of area
K Stiffness factor (*I/L*)

L Length; Span; System length
M Moment in general; Bending moment
M_{Rd} Design value of the resisting bending moment
M_{Sd} Design value of the applied internal bending moment
N Axial force; Number of shear connectors, Number of cycles
P Prestressing
P_R Shear resistance of a shear connector
Q Variable action
R Resistance
S Internal forces and moments (with subscripts d or k)
V Shear force
W Section modulus
X Value of a property of a material

1.6.3 Greek upper case letters

Δ Difference in ..... (precedes main symbol)

1.6.4 Latin lower case letters

a Constant; Distance; Geometrical data; Constant
b Width; Breadth
c Distance; Outstand; Thickness of concrete cover
d Diameter; Depth
e Eccentricity
f Strength (of a material)
f_{ck} Characteristic compressive strength of concrete
f_{sk} Characteristic tensile yield strength of reinforcement
f_u Specified ultimate tensile strength of the material of a stud, a bolt, a rivet ...
f_y Nominal tensile yield strength of structural steel
f_{yp} Characteristic (nominal) tensile yield strength of profiled steel sheeting
h Height
i Radius of gyration
k Coefficient; Factor
l (or ℓ or L) Length; Span; Buckling length (Note : l can be replaced by L or by ℓ (handwritten) for certain lengths or to avoid confusion with 1 (numeral).)
m Factor for composite slabs; Slope constant of fatigue strength curve
n Modular ratio
r Radius
s Spacing; Distance
v Longitudinal shear force per unit length
w Crack width
xx, yy, zz Rectangular axes

1.6.5 Greek lower case letters

α Angle; Ratio; Coefficient of linear thermal expansion; Factor
β Angle; Ratio; Factor
γ Partial safety factor (always with appropriate subscript : e.g., F, G, Q, A, M, Ma, a, ap, c, s, v, Rd)
δ Steel contribution ratio; Deflection
ε Strain; Coefficient