SLOVENSKI STANDARD
oSIST prEN 1994-2:2024

01-junij-2024

Evrokod 4 - Projektiranje sovprežnih konstrukcij iz jekla in betona - 2. del: Mostovi

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

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

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

Ta slovenski standard je istoveten z: prEN 1994-2

ICS:

91.010.30	Tehnični vidiki	Technical aspects
91.080.13	Jeklene konstrukcije	Steel structures
91.080.40	Betonske konstrukcije	Concrete structures
93.040	Gradnja mostov	Bridge construction

oSIST prEN 1994-2:2024 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 1994-2

March 2024

ICS 91.010.30; 91.080.13; 91.080.40; 93.040

Will supersede EN 1994-2:2005

English Version

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

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

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

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 250.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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

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Ref. No. prEN 1994-2:2024 E

Contents

European foreword

This document (prEN 1994-2:2024) has been prepared by Technical Committee CEN/TC 250 “Structural Eurocodes”, the secretariat of which is held by BSI. CEN/TC 250 is responsible for all Structural Eurocodes and has been assigned responsibility for structural and geotechnical design matters by CEN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 1994-2:2005.

The first generation of EN Eurocodes was published between 2002 and 2007. This document forms part of the second generation of the Eurocodes, which have been prepared under Mandate M/515 issued to CEN by the European Commission and the European Free Trade Association.

The Eurocodes have been drafted to be used in conjunction with relevant execution, material, product and test standards, and to identify requirements for execution, materials, products and testing that are relied upon by the Eurocodes.

The Eurocodes recognize the responsibility of each Member State and have safeguarded their right to determine values related to regulatory safety matters at national level through the use of National Annexes.

The main changes compared to the previous edition are listed below:

- This document does not repeat rules that are already contained in EN 1994-1-1. Instead, reference is made to EN 1994-1-1.
- New rules for shear connectors under tension and under combined tension and shear in the case of fatigue have been added.

0 Introduction

0.1 Introduction to the Eurocodes

The Structural Eurocodes comprise of the following standards generally consisting of a number of Parts:

- EN 1990, Eurocode — Basis of structural and geotechnical 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
- New parts are under development, e.g. Eurocode for design of structural glass

The Eurocodes are intended for use by designers, clients, manufacturers, constructors, relevant authorities (in exercising their duties in accordance with national or international regulations), educators, software developers, and committees drafting standards for related product, testing and execution standards.

NOTE Some aspects of design are most appropriately specified by relevant authorities or, where not specified, can be agreed on a project-specific basis between relevant parties such as designers and clients. The Eurocodes identify such aspects making explicit reference to relevant authorities and relevant parties.

0.2 Introduction to EN 1994 (all parts)

EN 1994 (all parts) applies to the design of steel-concrete composite structures and members for buildings and civil engineering works. It complies with the rules for the safety and serviceability of structures, the basis of their design and verification that are given in EN 1990.

EN 1994 (all parts) is concerned only with requirements for resistance, serviceability, durability and fire resistance of steel-concrete composite structures. Other requirements, e.g. concerning thermal or sound insulation, are not considered.

EN 1994 is subdivided in various parts:

EN 1994-1-1, *Eurocode 4 — Design of composite steel and concrete structures — Part 1 1: General rules and rules for buildings*;

EN 1994-1-2, *Eurocode 4 — Design of composite steel and concrete structures — Part 1 2: Structural fire design;*

EN 1994-2, *Eurocode 4 — Design of composite steel and concrete structures — Part 2: Bridges.*

0.3 Introduction to EN 1994-2

EN 1994-2 refers to the rules for safety, serviceability and durability of composite steel and concrete structures, as described in EN 1994-1-1, and provides specific provisions for the design of steel-concrete composite bridges and composite members of bridges. It is based on the limit state concept used in conjunction with a partial factor method.

Numerical values for partial factors and other reliability parameters are provided as basic values that provide an acceptable level of reliability. They have been selected assuming that an appropriate level of workmanship and of quality management applies.

0.4 Verbal forms used in the Eurocodes

The verb “shall” expresses a requirement strictly to be followed and from which no deviation is permitted in order to comply with the Eurocodes.

The verb “should” expresses a highly recommended choice or course of action. Subject to national regulation and/or any relevant contractual provisions, alternative approaches could be used/adopted where technically justified.

The verb “may” expresses a course of action permissible within the limits of the Eurocodes.

The verb “can” expresses possibility and capability; it is used for statements of fact and clarification of concepts.

0.5 National Annex for EN 1994-2

National choice is allowed in this standard where explicitly stated within notes. National choice includes the selection of values for Nationally Determined Parameters (NDPs).

The national standard implementing EN 1994-2 can have a National Annex containing all national choices to be used for the design of bridges to be constructed in the relevant country.

When no national choice is given, the default choice given in this standard is to be used.

When no national choice is made and no default is given in this standard, the choice can be specified by a relevant authority or, where not specified, agreed for a specific project by appropriate parties.

National choice is allowed in EN 1994-2 through notes to the following clauses:

4.4.1.2(1)	4.4.1.2(2)	7.4.4(2)	8.2.2(2)
8.6.1(1)	8.7.1(3)	8.7.7.2(1)	8.7.7.2(3)
9.4.1(4)			

National choice is allowed in EN 1994-2 on the application of the following informative annexes:

None.

The National Annex can contain, directly or by reference, non-contradictory complementary information for ease of implementation, provided it does not alter any provisions of the Eurocodes.

1 Scope

1.1 Scope of EN 1994-2

EN 1994-2 gives design rules for steel-concrete composite bridges or members of bridges, supplementary to the general rules given in EN 1994-1-1.

1.2 Assumptions

(1) The assumptions of EN 1990 apply to this document.

(2) In addition to the general assumptions of EN 1990, the assumptions given in 1.2 to EN 1992-1-1, EN 1993-1-1 and EN 1994-1-1 apply to this document.

(3) EN 1994-2 is intended to be used in conjunction with EN 1990, EN 1991 (all parts), EN 1992 (all parts), EN 1993 (all parts), EN 1994-1-1, EN 1997 (all parts), EN 1998 (all parts) when steel-concrete composite structures are built in seismic regions), EN 1090-1, EN 1090-2 and EN 13670.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE See the Bibliography for a list of other documents cited that are not normative references, including those referenced as recommendations (i.e. through 'should' clauses) and permissions (i.e. through 'may' clauses).

EN 1990:2023,[1] *Eurocode — Basis of structural and geotechnical design*

EN 1991-1-6, *Eurocode 1 — Actions on structures — Part 1-6: Actions during execution*

EN 1991-2:2023, *Eurocode 1 — Actions on structures — Part 2: Traffic loads on bridges and other civil engineering works*

EN 1992 (all parts), *Eurocode 2 — Design of concrete structures*

EN 1992-1-1:2023, *Eurocode 2 — Design of concrete structures — Part 1-1: General rules and rules for buildings, bridges and civil engineering structures*

EN 1993 (all parts), *Eurocode 3 — Design of steel structures*

EN 1993-1-1:2022, *Eurocode 3 — Design of steel structures — Part 1-1: General rules and rules for buildings*

prEN 1993-1-11:2024, *Eurocode 3 — Design of steel structures — Part 1-11: Tension components*

prEN 1993-2:2024, *Eurocode 3 — Design of steel structures — Part 2: Bridges*

prEN 1994-1-1:2024, *Eurocode 4 — Design of composite steel and concrete structures — Part 1-1: General rules and rules for buildings*

[1] As impacted by EN 1990:2023/prA1:2024.

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1990, EN 1992-1-1, EN 1993-1-1, EN 1994-1-1 and the following apply.

3.1.1
filler beam deck
deck consisting of a reinforced concrete slab and partially concrete-encased hot-rolled or welded steel beams, having their bottom flange on the level of the slab bottom

3.1.2
composite plate
composite member consisting of a flat bottom steel plate connected to a concrete slab, in which both the length and width are much larger than the thickness of the composite plate

3.2 Symbols and abbreviations

For the purposes of this document, the symbols given in EN 1990, EN 1992-1-1, EN 1993-1-1, EN 1993-2 and EN 1994-1-1 and the following apply.

Latin upper-case letters

$A_{c,eff}$	effective area of concrete
$A_{s,min}$	minimum longitudinal top reinforcement per filler beam
$(EA_s)_{eff}$	effective longitudinal stiffness of the cracked concrete tension member
F_d	component in the direction of the steel beam of the design force of a bonded or unbonded tendon applied after the shear connection has become effective
I_{eff}	effective second moment of area of filler beams
L_{A-B}	length of inelastic region, between points A and B, corresponding to $M_{el,Rd}$ and $M_{Ed,max}$, respectively
L_v	length of shear connection
$M_{Ed,max}$	total design bending moment applied to the steel and composite member
$M_{Ed,max,f}$	maximum bending moment or internal force due to fatigue loading
$M_{Ed,min,f}$	minimum bending moment due to fatigue loading
$M_{s,Rd}$	design plastic moment of resistance of the reinforcement
N_{cd}	design compressive force in concrete slab corresponding to $M_{Ed,max}$
$N_{Ed,serv}$	normal force of concrete tension member for SLS
$N_{Ed,ult}$	normal force of concrete tension member for ULS
$N_{pl,a}$	design value of the plastic resistance of the structural steel section to normal force
N_R	number of stress-range cycles
$N_{s,el}$	tensile force in cracked concrete slab corresponding to $M_{el,Rd}$ taking into account the effects of tension stiffening
P_{Ed}	longitudinal force on a connector at distance x from the nearest web
V_L	longitudinal shear force, acting along the steel-concrete flange interface

$V_{L,Ed}$	longitudinal shear force acting on length L_{A-B} of the inelastic region

Latin lower-case letters

a_w	steel flange projection outside the web of the beam
c_{st}	concrete cover above the steel beams of filler beam decks
d_{eff}	effective thickness of concrete
e_d	either of $2e_h$ or $2e_v$
e_h	lateral distance from the point of application of force F_d to the relevant steel web, if F_d is applied to the concrete slab
e_v	vertical distance from the point of application of force F_d to the plane of shear connection concerned, if F_d is applied to the steel element
f_{pd}	limiting stress of prestressing tendons according to EN 1992-1-1:2023, 3.2.2
f_{pk}	characteristic value of yield strength of prestressing tendons
n_{0G}	modular ratio (shear moduli) for short-term loading
n_{tot}	reference should be made to 11.4
n_{LG}	modular ratio (shear moduli) for long term loading
n_w	reference should be made to 11.4
$k_{M,s}$	calibration factor for validity of Miner's rule in case of headed studs
s_f	clear distance between the upper flanges of the steel beams of filler beam decks
s_w	spacing of webs of steel beams of filler beam decks
$v_{L,Ed}$	design longitudinal shear force per unit length at the interface between steel and concrete
$v_{L,Ed,max}$	maximum design longitudinal shear force per unit length at the interface between steel and concrete
x	distance of a shear connector from the nearest web
z_s	lever arm of the reinforcement

Greek upper-case letters

$\Delta\sigma$	stress range
$\Delta\sigma_c$	reference value of the fatigue strength at 2 million cycles
$\Delta\sigma_{c,ten}$	reference value of the fatigue strength at 2 million cycles for headed studs subjected to tensile forces
$\Delta\sigma_E$	equivalent constant amplitude stress range
$\Delta\sigma_{E,glob}$	equivalent constant amplitude stress range due to global effects
$\Delta\sigma_{E,loc}$	equivalent constant amplitude stress range due to local effects
$\Delta\sigma_{E,2}$	equivalent constant amplitude stress range related to 2 million cycles
$\Delta\sigma_{E,2,ten}$	equivalent constant amplitude tensile stress range related to 2 million cycles
$\Delta\sigma_s$	increase of stress in steel reinforcement due to tension stiffening of concrete
$\Delta\sigma_{s,equ}$	damage equivalent stress range
$\Delta\sigma_{ten}$	nominal stress range caused by the tension force