

## **Eurocode 4 - Design of composite steel and concrete structures - Part 2: General rules and rules for bridges**

Eurocode 4 - Design of composite steel and concrete structures - Part 2: General rules and rules for bridges

## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

<p>Käesolev Eesti standard EVS-EN 1994-2:2005 sisaldab Euroopa standardi EN 1994-2: 2005 ingliskeelset teksti.</p> <p>Käesolev dokument on jõustatud 25.11.2005 ja selle kohta on avaldatud teade Eesti standardiorganisatsiooni ametlikus väljaandes.</p> <p>Standard on kättesaadav Eesti standardiorganisatsioonist.</p>	<p>This Estonian standard EVS-EN 1994-2:2005 consists of the English text of the European standard EN 1994-2: 2005.</p> <p>This document is endorsed on 25.11.2005 with the notification being published in the official publication of the Estonian national standardisation organisation.</p> <p>The standard is available from Estonian standardisation organisation.</p>
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<p><b>Käsitlusala:</b> Eurocode 4 applies to the design of composite structures and members for buildings and civil engineering works.</p>	<p><b>Scope:</b> Eurocode 4 applies to the design of composite structures and members for buildings and civil engineering works.</p>
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**ICS** 91.010.30, 91.080.10, 91.080.40, 93.040

**Võtmesõnad:**

English Version

**Eurocode 4 - Design of composite steel and concrete structures  
- Part 2: General rules and rules for bridges**

Eurocode 4 - Calcul des structures mixtes acier-béton -  
Partie 2: Règles générales et règles pour les ponts

Eurocode 4 - Bemessung und konstruktion von  
Verbundtragwerken aus Stahl und Beton - Teil 2:  
Allgemeine Bemessungsregeln und Anwendungsregeln für  
Brücken

This European Standard was approved by CEN on 7 July 2005.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

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<b>Contents</b>	<b>Page</b>
<b>Foreword</b> .....	<b>7</b>
<b>Section 1 General</b> .....	<b>11</b>
1.1 Scope.....	11
1.1.1 Scope of Eurocode 4.....	11
1.1.2 Scope of Part 1-1 of Eurocode 4.....	11
1.1.3 Scope of Part 2 of Eurocode 4.....	12
1.2 Normative references.....	12
1.2.1 General reference standards.....	12
1.2.2 Other reference standards.....	12
1.2.3 Additional general and other reference standards for composite bridges .....	13
1.3 Assumptions.....	13
1.4 Distinction between principles and application rules.....	14
1.5 Definitions.....	14
1.5.1 General.....	14
1.5.2 Additional terms and definitions used in this Standard.....	14
1.5.2.1 Composite member.....	14
1.5.2.2 Shear connection.....	14
1.5.2.3 Composite behaviour.....	14
1.5.2.4 Composite beam.....	14
1.5.2.5 Composite column.....	14
1.5.2.6 Composite slab.....	14
1.5.2.7 Composite frame.....	14
1.5.2.8 Composite joint.....	15
1.5.2.9 Propped structure or member.....	15
1.5.2.10 Un-propped structure or member.....	15
1.5.2.11 Un-cracked flexural stiffness.....	15
1.5.2.12 Cracked flexural stiffness.....	15
1.5.2.13 Prestress.....	15
1.5.2.14 Filler beam deck.....	15
1.5.2.15 Composite plate.....	15
1.6 Symbols .....	15
<b>Section 2 Basis of design</b> .....	<b>22</b>
2.1 Requirements.....	22
2.2 Principles of limit states design.....	22
2.3 Basic variables.....	22
2.3.1 Actions and environmental influences.....	22
2.3.2 Material and product properties.....	22
2.3.3 Classification of actions.....	22
2.4 Verification by the partial factor method.....	23
2.4.1 Design values.....	23
2.4.1.1 Design values of actions.....	23
2.4.1.2 Design values of material or product properties.....	23
2.4.1.3 Design values of geometrical data.....	23
2.4.1.4 Design resistances .....	23
2.4.2 Combination of actions.....	24
2.4.3 Verification of static equilibrium (EQU).....	24

<b>Section 3 Materials</b>	<b>24</b>
3.1 Concrete	24
3.2 Reinforcing steel for bridges	24
3.3 Structural steel for bridges	24
3.4 Connecting devices	24
3.4.1 General	24
3.4.2 Headed stud shear connectors	24
3.5 Prestressing steel and devices	25
3.6 Tension components in steel	25
<b>Section 4 Durability</b>	<b>25</b>
4.1 General	25
4.2 Corrosion protection at the steel-concrete interface in bridges	25
<b>Section 5 Structural analysis</b>	<b>25</b>
5.1 Structural modelling for analysis	25
5.1.1 Structural modelling and basic assumptions	25
5.1.2 Joint modelling	25
5.1.3 Ground-structure interaction	26
5.2 Structural stability	26
5.2.1 Effects of deformed geometry of the structure	26
5.2.2 Methods of analysis for bridges	26
5.3 Imperfections	26
5.3.1 Basis	26
5.3.2 Imperfections for bridges	27
5.4 Calculation of action effects	27
5.4.1 Methods of global analysis	27
5.4.1.1 General	27
5.4.1.2 Effective width of flanges for shear lag	28
5.4.2 Linear elastic analysis	29
5.4.2.1 General	29
5.4.2.2 Creep and shrinkage	29
5.4.2.3 Effects of cracking of concrete	30
5.4.2.4 Stages and sequence of construction	31
5.4.2.5 Temperature effects	31
5.4.2.6 Pre-stressing by controlled imposed deformations	32
5.4.2.7 Pre-stressing by tendons	32
5.4.2.8 Tension members in composite bridges	32
5.4.2.9 Filler beam decks for bridges	33
5.4.3 Non-linear global analysis for bridges	34
5.4.4 Combination of global and local action effects	34
5.5 Classification of cross-sections	34
5.5.1 General	34
5.5.2 Classification of composite sections without concrete encasement	35
5.5.3 Classification of sections of filler beam decks for bridges	36
<b>Section 6 Ultimate limit states</b>	<b>36</b>
6.1 Beams	36
6.1.1 Beams in bridges - General	36
6.1.2 Effective width for verification of cross-sections	36

6.2 Resistances of cross-sections of beams.....	36
6.2.1 Bending resistance.....	36
6.2.1.1 General.....	36
6.2.1.2 Plastic resistance moment $M_{pl,Rd}$ of a composite cross-section.....	37
6.2.1.3 Additional rules for beams in bridges.....	38
6.2.1.4 Non-linear resistance to bending.....	38
6.2.1.5 Elastic resistance to bending.....	40
6.2.2 Resistance to vertical shear.....	40
6.2.2.1 Scope.....	40
6.2.2.2 Plastic resistance to vertical shear.....	41
6.2.2.3 Shear buckling resistance.....	41
6.2.2.4 Bending and vertical shear.....	41
6.2.2.5 Additional rules for beams in bridges.....	41
6.3 Filler beam decks.....	42
6.3.1 Scope.....	42
6.3.2 General.....	43
6.3.3 Bending moments.....	43
6.3.4 Vertical shear.....	43
6.3.5 Resistance and stability of steel beams during execution.....	44
6.4 Lateral-torsional buckling of composite beams.....	44
6.4.1 General.....	44
6.4.2 Beams in bridges with uniform cross-sections in Class 1, 2 and 3.....	44
6.4.3 General methods for buckling of members and frames.....	46
6.4.3.1 General method.....	46
6.4.3.2 Simplified method.....	46
6.5 Transverse forces on webs.....	46
6.5.1 General.....	46
6.5.2 Flange-induced buckling of webs.....	46
6.6 Shear connection.....	46
6.6.1 General.....	46
6.6.1.1 Basis of design.....	46
6.6.1.2 Ultimate limit states other than fatigue.....	47
6.6.2 Longitudinal shear force in beams for bridges.....	47
6.6.2.1 Beams in which elastic or non-linear theory is used for resistances of cross-sections.....	47
6.6.2.2 Beams in bridges with some cross-sections in Class 1 or 2 and inelastic behaviour.....	48
6.6.2.3 Local effects of concentrated longitudinal shear force due to introduction of longitudinal forces.....	49
6.6.2.4 Local effects of concentrated longitudinal shear force at sudden change of cross-section.....	51
6.6.3 Headed stud connectors in solid slabs and concrete encasement.....	52
6.6.3.1 Design resistance.....	52
6.6.3.2 Influence of tension on shear resistance.....	53
6.6.4 Headed studs that cause splitting in the direction of the slab thickness.....	53
6.6.5 Detailing of the shear connection and influence of execution.....	53
6.6.5.1 Resistance to separation.....	53
6.6.5.2 Cover and concreting.....	53
6.6.5.3 Local reinforcement in the slab.....	54
6.6.5.4 Haunches other than formed by profiled steel sheeting.....	54

6.6.5.5 Spacing of connectors.....	54
6.6.5.6 Dimensions of the steel flange.....	55
6.6.5.7 Headed stud connectors.....	55
6.6.6 Longitudinal shear in concrete slabs.....	56
6.6.6.1 General.....	56
6.6.6.2 Design resistance to longitudinal shear.....	56
6.6.6.3 Minimum transverse reinforcement.....	57
6.7 Composite columns and composite compression members.....	57
6.7.1 General.....	57
6.7.2 General method of design.....	59
6.7.3 Simplified method of design.....	59
6.7.3.1 General and scope.....	59
6.7.3.2 Resistance of cross-sections.....	60
6.7.3.3 Effective flexural stiffness, steel contribution ratio and relative slenderness.....	62
6.7.3.4 Methods of analysis and member imperfections.....	63
6.7.3.5 Resistance of members in axial compression.....	64
6.7.3.6 Resistance of members in combined compression and uniaxial bending.....	66
6.7.3.7 Combined compression and biaxial bending.....	66
6.7.4 Shear connection and load introduction.....	67
6.7.4.1 General.....	67
6.7.4.2 Load introduction.....	67
6.7.4.3 Longitudinal shear outside the areas of load introduction.....	70
6.7.5 Detailing Provisions.....	71
6.7.5.1 Concrete cover of steel profiles and reinforcement.....	71
6.7.5.2 Longitudinal and transverse reinforcement.....	71
6.8 Fatigue.....	72
6.8.1 General.....	72
6.8.2 Partial factors for fatigue assessment of bridges.....	72
6.8.3 Fatigue strength.....	72
6.8.4 Internal forces and fatigue loadings.....	73
6.8.5 Stresses.....	73
6.8.5.1 General.....	73
6.8.5.2 Concrete.....	74
6.8.5.3 Structural steel.....	74
6.8.5.4 Reinforcement.....	74
6.8.5.5 Shear connection.....	75
6.8.5.6 Stresses in reinforcement and prestressing steel in members prestressed by bonded tendons.....	75
6.8.6 Stress ranges.....	75
6.8.6.1 Structural steel and reinforcement.....	75
6.8.6.2 Shear connection.....	76
6.8.7 Fatigue assessment based on nominal stress ranges.....	76
6.8.7.1 Structural steel, reinforcement and concrete.....	76
6.8.7.2 Shear connection.....	77
6.9 Tension members in composite bridges.....	78

<b>Section 7 Serviceability limit states</b>	<b>78</b>
7.1 General	78
7.2 Stresses	79
7.2.1 General	79
7.2.2 Stress limitation for bridges	79
7.2.3 Web breathing	79
7.3 Deformations in bridges	80
7.3.1 Deflections	80
7.3.2 Vibrations	80
7.4 Cracking of concrete	80
7.4.1 General	80
7.4.2 Minimum reinforcement	81
7.4.3 Control of cracking due to direct loading	83
7.5 Filler beam decks	84
7.5.1 General	84
7.5.2 Cracking of concrete	84
7.5.3 Minimum reinforcement	84
7.5.4 Control of cracking due to direct loading	84
<b>Section 8 Precast concrete slabs in composite bridges</b>	<b>85</b>
8.1 General	85
8.2 Actions	85
8.3 Design, analysis and detailing of the bridge slab	85
8.4 Interface between steel beam and concrete slab	85
8.4.1 Bedding and tolerances	85
8.4.2 Corrosion	85
8.4.3 Shear connection and transverse reinforcement	85
<b>Section 9 Composite plates in bridges</b>	<b>86</b>
9.1 General	86
9.2 Design for local effects	86
9.3 Design for global effects	86
9.4 Design of shear connectors	87
<b>Annex C (Informative) Headed studs that cause splitting forces in the direction of the slab thickness</b>	<b>89</b>
C.1 Design resistance and detailing	89
C.2 Fatigue strength	90

## Foreword

This document (EN 1994-2:2005), Eurocode 4: Design of composite steel and concrete structures, Part 2: General rules and rules for bridges, has been prepared on behalf of 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 April 2006, and conflicting national standards shall be withdrawn at the latest by March 2010.

This document supersedes ENV 1994-2:1994.

CEN/TC 250 is responsible for all Structural Eurocodes.

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, the Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

## Background of 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 1980s.

In 1989, the Commission and the Member States of the EU and EFTA decided, on the basis of an agreement<sup>1</sup> between the Commission and CEN, to transfer the preparation and the publication of the Eurocodes to 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).

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

<sup>1</sup> 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).

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 Documents<sup>2</sup> referred to in Article 12 of the CPD, although they are of a different nature from harmonised product standards<sup>3</sup>. Therefore, technical aspects arising from the 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.

<sup>2</sup> According to Art. 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.

<sup>3</sup> According to Art. 12 of the CPD the interpretative documents shall :

- 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 ;
- indicate methods of correlating these classes or levels of requirement with the technical specifications, *e.g.* methods of calculation and of proof, technical rules for project design, etc. ;
- 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.

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.

It may also contain

- decisions on the use of informative annexes, and
- 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 works<sup>4</sup>. 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.

### **Additional information specific to EN 1994-2**

EN 1994-2 describes the Principles and requirements for safety, serviceability and durability of composite steel and concrete structures, together with specific provisions for bridges. It is based on the limit state concept used in conjunction with a partial factor method.

EN 1994-2 is intended for use by:

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

EN 1994-2 contains the general rules from EN 1994-1-1 and specific rules for the design of composite steel and concrete bridges or composite members of bridges.

EN 1994-2 is intended to be used with EN 1990, the relevant parts of EN 1991, EN 1993 for the design of steel structures and EN 1992 for the design of concrete structures.

Numerical values for partial factors and other reliability parameters are recommended 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. When EN 1994-2 is used as a base document by other CEN/TCs the same values need to be taken.

<sup>4</sup> see Art.3.3 and Art.12 of the CPD, as well as clauses 4.2, 4.3.1, 4.3.2 and 5.2 of ID 1.

## National annex for EN 1994-2

This standard gives alternative procedures, values and recommendations for classes with notes indicating where national choices may have to be made. Therefore, the National Standard implementing EN 1994-2 should have a National annex containing all Nationally Determined Parameters to be used for the design of bridges to be constructed in the relevant country.

National choice is allowed in the general rules coming from EN 1994-1-1: 2004 through the following clauses:

- 2.4.1.1(1)
- 2.4.1.2(5)
- 6.6.3.1(1)

National choice is allowed for the specific rules for bridges through the following clauses:

- 1.1.3(3)
- 2.4.1.2(6)
- 5.4.4(1)
- 6.2.1.5(9)
- 6.2.2.5(3)
- 6.3.1(1)
- 6.6.1.1(13)
- 6.8.1(3)
- 6.8.2(1)
- 7.4.1(4)
- 7.4.1(6)
- 8.4.3(3)

## Section 1 General

### 1.1 Scope

#### 1.1.1 Scope of Eurocode 4

(1) Eurocode 4 applies to the design of composite structures and members for buildings and civil engineering works. It complies with the principles and requirements for the safety and serviceability of structures, the basis of their design and verification that are given in EN 1990: 2002 – Basis of structural design.

(2) Eurocode 4 is concerned only with requirements for resistance, serviceability, durability and fire resistance of composite structures. Other requirements, e.g. concerning thermal or sound insulation, are not considered.

(3) Eurocode 4 is intended to be used in conjunction with:

EN 1990 Basis of structural design

EN 1991 Actions on structures

ENs, hENs, ETAGs and ETAs for construction products relevant for composite structures

EN 1090 Execution of steel structures and aluminium structures

EN 13670 Execution of concrete structures

EN 1992 Design of concrete structures

EN 1993 Design of steel structures

EN 1997 Geotechnical design

EN 1998 Design of structures for earthquake resistance

(4) Eurocode 4 is subdivided in various parts:

Part 1-1: General rules and rules for buildings

Part 1-2: Structural fire design

Part 2: General rules and rules for bridges.

#### 1.1.2 Scope of Part 1-1 of Eurocode 4

(1) Part 1-1 of Eurocode 4 gives a general basis for the design of composite structures together with specific rules for buildings.

(2) 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 states

Section 7: Serviceability limit states

Section 8: Composite joints in frames for buildings

Section 9: Composite slabs with profiled steel sheeting for buildings

### 1.1.3 Scope of Part 2 of Eurocode 4

(1) Part 2 of Eurocode 4 gives design rules for steel-concrete composite bridges or members of bridges, additional to the general rules in EN 1994-1-1. Cable stayed bridges are not fully covered by this part.

(2) The following subjects are dealt with in Part 2:

- Section 1: General
- Section 2: Basis of design
- Section 3: Materials
- Section 4: Durability
- Section 5: Structural analysis
- Section 6: Ultimate limit states
- Section 7: Serviceability limit states
- Section 8: Decks with precast concrete slabs
- Section 9: Composite plates in bridges

(3) Provisions for shear connectors are given only for welded headed studs.

**NOTE:** Reference to guidance for other types of shear connectors may be given in the National Annex.

## 1.2 Normative references

The following normative documents contain provisions which, through references in this text, constitute provisions of this European standard. For dated references, subsequent amendments to or revisions of any of these publications do not apply. However, parties to agreements based on this European standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references the latest edition of the normative document referred to applies.

### 1.2.1 General reference standards

- |                         |   |
|-------------------------|---|
| EN 1090-2 <sup>1)</sup> | Execution of steel structures and aluminium Structures-Part 2: Technical requirements for the execution of steel structures |
| EN 1990: 2002           | Basis of structural design.   |

### 1.2.2 Other reference standards

- |                          |  |
|--------------------------|--|
| EN 1992-1-1: 2004        | Eurocode 2: Design of concrete structures- Part 1-1: General rules and rules for buildings     |
| EN 1993-1-1: 2005        | Eurocode 3: Design of steel structures – Part 1-1: General rules and rules for buildings       |
| EN 1993-1-3 <sup>1</sup> | Eurocode 3: Design of steel structures – Part 1-3: Cold-formed thin gauge members and sheeting |
| EN 1993-1-5 <sup>1</sup> | Eurocode 3: Design of steel structures- Part 1-5: Plated structural elements                   |

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<sup>1</sup> To be published

EN 1993-1-8: 2005	Eurocode 3: Design of steel structures – Part 1-8: Design of joints
EN 1993-1-9: 2005	Eurocode 3: Design of steel structures – Part 1-9: Fatigue strength of steel structures
EN 1993-1-11 <sup>1</sup>	Eurocode 3: Design of steel structures – Part 1-11: Design of structures with tension components
EN 10025-1: 2004	Hot-rolled products of structural steels - Part 1: General delivery conditions
EN 10025-2: 2004	Hot-rolled products of structural steels - Part 2: Technical delivery conditions for non-alloy structural steels
EN 10025-3: 2004	Hot-rolled products of structural steels - Part 3: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels
EN 10025-4: 2004	Hot-rolled products of structural steels - Part 4: Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels
EN 10025-5: 2004	Hot-rolled products of structural steels – Part 5: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance
EN 10025-6: 2004	Hot-rolled products of structural steels – Part 6: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition
EN 10326: 2004	Continuously hot-dip coated strip and sheet of structural steel - Technical delivery conditions
EN 10149-2: 1995	Hot-rolled flat products made of high yield strength steels for cold-forming - Part 2: Delivery conditions for thermomechanically rolled steels
EN 10149-3: 1995	Hot-rolled flat products made of high yield strength steels for cold-forming – Part 3: Delivery conditions for normalised or normalised rolled steels
EN ISO 13918: 1998	Studs and ceramic ferrules for arc stud welding
EN ISO 14555: 1998	Arc stud welding of metallic materials

### 1.2.3 Additional general and other reference standards for composite bridges

EN 1990: Annex 2 <sup>1</sup>	Basis of structural design: Application for bridges
EN 1991-1-5: 2003	Actions on structures. Part 1-5: General actions – Thermal actions
EN 1991-1-6: 2005	Actions on structures. Part 1-6: General actions – Actions during execution
EN 1991-2: 2003	Actions on structures: Part 2: Traffic loads on bridges
EN 1992-2 <sup>1</sup>	Design of concrete structures. Part 2 – Bridges
EN 1993-2 <sup>1</sup>	Design of steel structures. Part 2 – Bridges

### 1.3 Assumptions

- (1) In addition to the general assumptions of EN 1990: 2002 the following assumptions apply:
- those given in clauses 1.3 of EN1992-1-1: 2004 and EN1993-1-1: 2005.