SLOVENSKI STANDARD
SIST EN 1995-2:2005
01-maj-2005

Evrokod 5: Projektiranje lesenih konstrukcij - 2. del: Mostovi

Eurocode 5: Design of timber structures - Part 2: Bridges

Eurocode 5: Bemessung und Konstruktion von Holzbauten - Teil 2: Brücken

Eurocode 5: Conception et calcul des structures bois - Partie 2: Ponts

Ta slovenski standard je istoveten z: EN 1995-2:2004

ICS:

91.010.30	Tehniļ ni vidiki	Technical aspects
91.080.20	Lesene konstrukcije	Timber structures
93.040	Gradnja mostov	Bridge construction

SIST EN 1995-2:2005 **en**

EUROPEAN STANDARD

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English version

Eurocode 5: Design of timber structures - Part 2: Bridges

Eurocode 5: Conception et calcul des structures bois - Partie 2: Ponts

Eurocode 5: Bemessung und Konstruktion von Holzbauten - Teil 2: Brücken

This European Standard was approved by CEN on 26 August 2004.

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

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Contents

Foreword

This European Standard EN 1995-2 has been prepared by Technical Committee CEN/TC250 "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of an identical text or by endorsement, at the latest by May 2005, and conflicting national standards shall be withdrawn at the latest by March 2010.

This European Standard supersedes ENV 1995-2:1997.

CEN/TC250 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, Luxemburg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and 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[1] 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 1990:2002	Eurocode:	Basis of Structural 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

[1] 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 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[2] referred to in Article 12 of the CPD, although they are of a different nature from harmonised product standards[3] . 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.

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;

[2] 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.
[3] 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.

- decisions on the application of informative annexes;
- 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[4] . 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 1995-2

EN 1995 describes the Principles and requirements for safety, serviceability and durability of timber bridges. It is based on the limit state concept used in conjunction with a partial factor method.

For the design of new structures, EN 1995-2 is intended to be used, for direct application, together with EN 1995-1-1 and EN1990:2002 and relevant Parts of EN 1991.

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 1995-2 is used as a base document by other CEN/TCs the same values need to be taken.

National annex for EN 1995-2

This standard gives alternative procedures, values and recommendations with notes indicating where national choices may have to be made. Therefore the National Standard implementing EN 1995-2 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 EN 1995-2 through clauses:

2.3.1.2(1)	Load-duration assignment
2.4.1	Partial factors for material properties
7.2	Limiting values for deflection
7.3.1(2)	Damping ratios

[4] 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.

Section 1 General

1.1 Scope

1.1.1 Scope of EN 1990

(1)P EN 1990 applies to the design of buildings and civil engineering works in timber (solid timber, sawn, planed or in pole form, glued laminated timber or wood-based structural products e.g. LVL) or wood-based panels jointed together with adhesives or mechanical fasteners. It complies with the principles and requirements for the safety and serviceability of structures, and the basis of design and verification that are given in EN 1990:2002.

(2)P EN 1990 is only concerned with requirements for mechanical resistance, serviceability, durability and fire resistance of timber structures. Other requirements, e.g concerning thermal or sound insulation, are not considered.

(3) EN 1990 is intended to be used in conjunction with:
EN 1990:2002 Eurocode – Basis of structural design
EN 1991 “Actions on structures”
EN´s for construction products relevant to timber structures
EN 1998 “Design of structures for earthquake resistance”, when timber structures are built in seismic regions

(4) EN 1990 is subdivided into various parts:
EN 1995-1 General
EN 1995-2 Bridges

(5) EN 1995-1 “General” comprises:
EN 1995-1-1 General – Common rules and rules for buildings
EN 1995-1-2 General – Structural Fire Design

1.1.2 Scope of EN 1995-2

(1) EN 1995-2 gives general design rules for the structural parts of bridges, i.e. structural members of importance for the reliability of the whole bridge or major parts of it, made of timber or other wood-based materials, either singly or compositely with concrete, steel or other materials.

(2) The following subjects are dealt with in EN 1995-2:
Section 1: General
Section 2: Basis of design
Section 3: Material properties
Section 4: Durability
Section 5: Basis of structural analysis
Section 6: Ultimate limit states
Section 7: Serviceability limit states
Section 8: Connections
Section 9: Structural detailing and control

(3) Section 1 and Section 2 also provide additional clauses to those given in EN 1990:2002 “Eurocode: Basis of structural design”.

(4) Unless specifically stated, EN 1995-1-1 applies.

1.2 Normative references

(1) 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.

European Standards:

EN 1990:2002	Eurocode – Basis of structural design
EN1990:2002/A1	Eurocode – Basis of structural design/Amendment A1 – Annex A2: Application to Bridges
EN 1991-1-4	Eurocode 1: Actions on structures – Part 1-4: Wind loads
EN 1991-2	Eurocode 1: Actions on structures – Part 2: Traffic loads on bridges
EN 1992-1-1	Eurocode 2: Design of concrete structures – Part 1-1: Common rules and rules for buildings
EN 1992-2	Eurocode 2: Design of concrete structures – Part 2: Bridges
EN 1993-2	Eurocode 3: Design of steel structures – Part 2: Bridges
EN 1995-1-1	Eurocode 5: Design of timber structures – Part 1-1: General – Common rules and rules for buildings
EN 10138-1	Prestressing steels – Part 1: General requirements
EN 10138-4	Prestressing steels – Part 4: Bars

1.3 Assumptions

(1) Additional requirements for execution, maintenance and control are given in section 9.

1.4 Distinction between principles and application rules

(1) See 1.4(1) of EN 1995-1-1.

1.5 Definitions

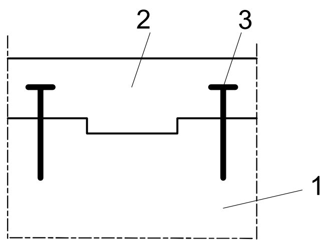
1.5.1 General

(1)P The definitions of EN 1990:2002 clause 1.5 and EN 1995-1-1 clause 1.5 apply.

1.5.2 Additional terms and definitions used in this present standard

1.5.2.1
Grooved connection
Shear connection consisting of the integral part of one member embedded in the contact face of the other member. The contacted parts are normally held together by mechanical fasteners.

NOTE: An example of a grooved connection is shown in figure 1.1.

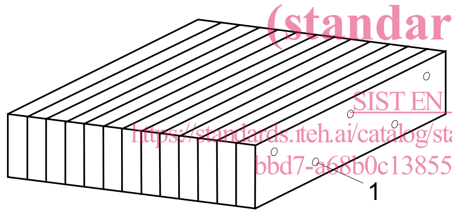


Key:
1 Timber
2 Concrete
3 Fastener

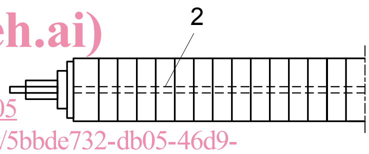
Figure 1.1 – Example of grooved connection

1.5.2.2
Laminated deck plates
Deck plates made of laminations, arranged edgewise or flatwise, held together by mechanical fasteners or gluing, see figures 1.2 and 1.3.

1.5.2.3
Stress-laminated deck plates
Laminated deck plates made of edgewise arranged laminations with surfaces either sawn or planed, held together by pre-stressing, see figure 1.2.b, c and d.



a)



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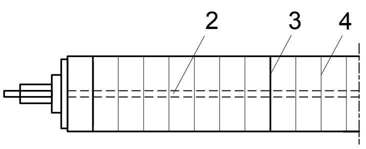

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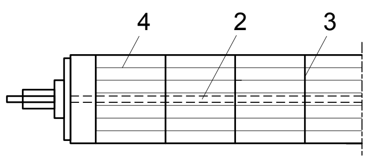

d)

Key:
1 Nail or screw
2 Pre-stressing bar or tendon
3 Glue-line between glued laminated members
4 Glue-line between laminations in glued laminated members

Figure 1.2 – Examples of deck plates made of edgewise arranged laminations
a) nail-laminated or screw-laminated
b) pre-stressed, but not glued
c) glued and pre-stressed glued laminated beams positioned flatwise
d) glued and pre-stressed glued laminated beams positioned edgewise

1.5.2.4
Cross-laminated deck plates
Laminated deck plates made of laminations in layers of different grain direction (crosswise or at different angles). The layers are glued together or connected using mechanical fasteners, see figure 1.3.

1.5.2.5
Pre-stressing
A permanent effect due to controlled forces and/or deformations imposed on a structure.

NOTE: An example is the lateral pre-stressing of timber deck plates by means of bars or tendons, see figure 1.2 b to d.

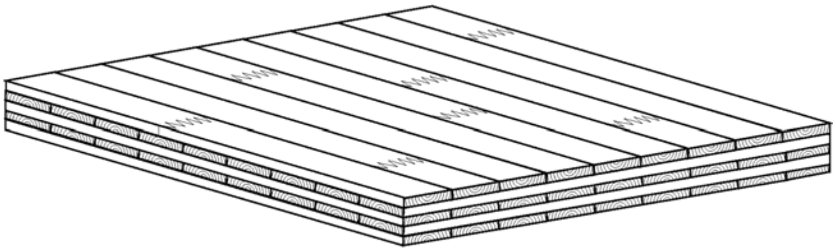

Figure 1.3 – Example of cross-laminated deck plate

1.6 Symbols used in EN 1995-2

For the purpose of EN 1995-2, the following symbols apply.

Latin upper case letters

A	Area of bridge deck
$E_{0,\text{mean}}$	Mean modulus of elasticity parallel to grain
$E_{90,\text{mean}}$	Mean modulus of elasticity perpendicular to the grain
F	Force
$F_{\text{t,Ed}}$	Design tensile force between timber and concrete
$F_{\text{v,Ed}}$	Design shear force between timber and concrete
$G_{0,\text{mean}}$	Mean shear modulus parallel to grain
$G_{90,\text{mean}}$	Mean shear modulus perpendicular to grain (rolling shear)
M	Total mass of bridge
M_{beam}	Bending moment in a beam representing a plate
$M_{\text{max,beam}}$	Maximum bending moment in a beam representing a plate
N_{obs}	Number of constant amplitude stress cycles per year
R	Ratio of stresses

Latin lower case letters

a	Distance; fatigue coefficient
$a_{\text{hor,1}}$	Horizontal acceleration from one person crossing the bridge
$a_{\text{hor,n}}$	Horizontal acceleration from several people crossing the bridge
$a_{\text{vert,1}}$	Vertical acceleration from one person crossing the bridge
$a_{\text{vert,n}}$	Vertical acceleration from several people crossing the bridge
b	Fatigue coefficient
b_{ef}	Effective width
$b_{\text{ef,c}}$	Total effective width of concrete slab
$b_{\text{ef,1}}$; $b_{\text{ef,2}}$	Effective width of concrete slab

b_{lam}	Width of the lamination
b_w	Width of the loaded area on the contact surface of deck plate
$b_{w,middle}$	Width of the loaded area in the middle of the deck plate
d	Diameter; outer diameter of rod; distance
h	Depth of beam; thickness of plate
$f_{c,90,d}$	Design compressive strength perpendicular to grain
$f_{fat,d}$	Design value of fatigue strength
f_k	Characteristic strength
$f_{m,d,deck}$	Design bending strength of deck plate
$f_{v,d,deck}$	Design shear strength of deck plate
$f_{m,d,lam}$	Design bending strength of laminations
$f_{v,d,lam}$	Design shear strength of laminations
f_{vert}, f_{hor}	Fundamental natural frequency of vertical and horizontal vibrations
$k_{c,90}$	Factor for compressive strength perpendicular to the grain
k_{fat}	Factor representing the reduction of strength with number of load cycles
k_{hor}	Coefficient
k_{mod}	Modification factor
k_{sys}	System strength factor
k_{vert}	Coefficient
ℓ	Span
ℓ_1	Distance
m	Mass; mass per unit length
m_{plate}	Bending moment in a plate per unit length
$m_{max,plate}$	Maximum bending moment in a plate
n	Number of loaded laminations; number of pedestrians
n_{ADT}	Expected annual average daily traffic over the lifetime of the structure
t	Time; thickness of lamination
t_L	Design service life of the structure expressed in years

Greek lower case letters

α	Expected percentage of observed heavy lorries passing over the bridge
β	Factor based on the damage consequence; angle of stress dispersion
γ_M	Partial factor for timber material properties, also accounting for model uncertainties and dimensional variations
$\gamma_{M,c}$	Partial factor for concrete material properties, also accounting for model uncertainties and dimensional variations
$\gamma_{M,s}$	Partial factor for steel material properties, also accounting for model uncertainties and dimensional variations
$\gamma_{M,v}$	Partial factor for shear connectors, also accounting for model uncertainties and dimensional variations
$\gamma_{M,fat}$	Partial safety factor for fatigue verification of materials, also accounting for model uncertainties and dimensional variations
κ	Ratio for fatigue verification
ρ_{mean}	Mean density
μ_d	Design coefficient of friction
$\sigma_{d,max}$	Numerically largest value of design stress for fatigue loading
$\sigma_{d,min}$	Numerically smallest value of design stress for fatigue loading
$\sigma_{p,min}$	Minimum long-term residual compressive stress due to pre-stressing;
ζ	Damping ratio