SLOVENSKI STANDARD
SIST-TS CEN/TS 19103:2022

01-februar-2022

Evrokod 5: Projektiranje lesenih konstrukcij - Projektiranje sovprežnih konstrukcij iz lesa in betona - Splošna pravila in pravila za stavbe

Eurocode 5: Design of Timber Structures - Structural design of timber-concrete composite structures - Common rules and rules for buildings

Eurocode 5: Berechnung und Konstruktion von Holzbauten - Bemessung und Berechnung von Holz-Beton-Verbundbauteilen - Allgemeine Regeln und Regeln für den Hochbau

Eurocode 5 : Conception et calcul des structures en bois - Calcul des structures mixtes bois-béton - Règles communes et règles pour les bâtiments

Ta slovenski standard je istoveten z: CEN/TS 19103:2021

ICS:

91.010.30	Tehnični vidiki	Technical aspects
91.080.20	Lesene konstrukcije	Timber structures
91.080.40	Betonske konstrukcije	Concrete structures

SIST-TS CEN/TS 19103:2022 en,fr,de

TECHNICAL SPECIFICATION

SPÉCIFICATION TECHNIQUE

TECHNISCHE SPEZIFIKATION

CEN/TS 19103

November 2021

ICS 91.010.30; 91.080.40

English Version

Eurocode 5: Design of Timber Structures - Structural design of timber-concrete composite structures - Common rules and rules for buildings

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Ref. No. CEN/TS 19103:2021 E

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European foreword

This document (CEN/TS 19103:2021) 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.

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This document has 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 this document.

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

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0 Introduction

0.1 Introduction to the Eurocodes

The Structural Eurocodes comprise 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;

— 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 Eurocodes under development.

0.2 Introduction to EN 1995 (all parts)

(1) EN 1995 (all parts) 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 given in EN 1990.

(2) EN 1995 (all parts) is concerned only with requirements for mechanical resistance, serviceability, durability and fire resistance of timber structures. Other requirements concerning thermal or sound insulation, for example, are not considered.

(3) EN 1995 (all parts) is subdivided into various parts:

— EN 1995-1 *General*;

— EN 1995-2 *Bridges*.

(4) EN 1995-1 "General" in itself does not exist as a physical document, but comprises the following two separate parts:

— EN 1995-1-1 *General – Common rules and rules for buildings*;

— EN 1995-1-2 *General – Structural fire design*.

EN 1995-2 refers to the General rules in EN 1995-1-1.

This document supplements EN 1995.

0.3 Verb forms used in this Technical Specification

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 may 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.

0.4 National annex for CEN/TS 19103

This document provides values within notes, indicating where national choices can be made. Therefore, a national document implementing CEN/TS 19103 can have a National Annex containing all Nationally Determined Parameters to be used for the assessment of buildings and civil engineering works in the relevant country.

National choice is allowed in CEN/TS 19103 through the following subclauses:

- 4.3.1.2(5) Average timber moisture content due to the environmental conditions
- 4.4.1.1 Partial factor for shrinkage action
- 4.4.1.2 Partial factor for temperature action
- 4.4.1.2 Partial factor for moisture content action
- 4.4.2 Partial factor for connection shear strength

National choice is allowed in CEN/TS 19103 on the application of the following informative annexes:

- Annex A Yearly variations of moisture content averaged over the timber cross-section for timber-concrete composite structures in variable environmental conditions

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 CEN/TS 19103

(1) CEN/TS 19103 gives general design rules for timber-concrete composite structures.

(2) It provides requirements for materials, design parameters, connections, detailing and execution for timber-concrete composite structures. Recommendations for environmental parameters (temperature and moisture content), design methods and test methods are given in the Annexes.

(3) It includes rules common to many types of timber-concrete composite, but does not include details for the design of glued timber-concrete composites, nor for bridges.

NOTE For the design of glued timber-concrete composites or bridges alternative references are available.

(4) It covers the design of timber-concrete composite structures in both quasi-constant and variable environmental conditions. For ease of use, it provides simple design rules for quasi-constant environmental conditions and more complex rules for variable environmental conditions.

1.2 Assumptions

(1) The general assumptions of EN 1990 apply.

(2) CEN/TS 19103 is intended to be used in conjunction with EN 1990, EN 1991 (all parts), EN 1992 (all parts), EN 1994 (all parts), EN 1995 (all parts), EN 1998 (all parts) when timber structures are built in seismic regions, and ENs for construction products relevant to timber structures.

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. in 'should' clauses), permissions ('may' clauses), possibilities ('can' clauses), and in notes.

EN 1990:2002[1)], *Eurocode - Basis of structural design*

EN 1991 (all parts), *Eurocode 1: Actions on structures*

EN 1991-1-5:2003, *Eurocode 1: Actions on structures - Part 1-5: General actions - Thermal actions*

EN 1992-1-1:2004[2)], *Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for buildings*

EN 1993-1-8, *Eurocode 3: Design of steel structures - Part 1-8: Design of joints*

EN 1994-1-1:2004, *Eurocode 4: Design of composite steel and concrete structures - Part 1-1: General rules and rules for buildings*

1) As impacted by EN 1990:2002/A1:2005.

2) As impacted by EN 1992-1-1:2004/A1:2014.

EN 1994-2:2005, *Eurocode 4 - Design of composite steel and concrete structures - Part 2: General rules and rules for bridges*

EN 1995-1-1:2004[3)], *Eurocode 5: Design of timber structures - Part 1-1: General - Common rules and rules for buildings*

EN 14592, *Timber structures - Dowel-type fasteners - Requirements*

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 1995-1-1 and the following apply.

3.1.1
continuous fastener
fastener that is continuous along the length of the timber component

3.1.2
connection
any device or system formed of connected parts and an associated fastener or fasteners as well as, where applicable, notches, which resists slip and transfers the related shear force at the interface between timber and concrete

Note 1 to entry: Examples include dowel-type fasteners of any material, notches, plates and continuous fasteners, any of which can be either mechanically fixed or bonded.

Note 2 to entry: Staples fall beyond the scope of this standard.

3.1.3
inelastic strain
strain which is caused not by stresses but by shrinkage, swelling or thermal expansion, for example

3.1.4
moisture content
mass of water in wood, expressed as a percentage of its oven-dry mass

3.1.5
quasi-constant environmental conditions
environmental conditions where

— timber is installed close to its expected moisture content in use mc_{use} and

— for softwood timber, the variation of average moisture content in use (Δmc, see Formula (4.5)) does not exceed 6 % and

— the temperature variations of the air do not exceed 20 °C

Note 1 to entry: The indoor conditions of a heated building are a typical example of quasi-constant conditions.

3) As impacted by EN 1995-1-1:2004/A1:2008 and EN 1995-1-1:2004/A2:2014.

3.1.6
shrinkage of concrete
decrease in dimension of a piece of concrete due to the hardening process

3.1.7
shrinkage of timber
decrease in dimension of a piece of timber due to reduction of moisture content

3.1.8
swelling of timber
increase in dimension of a piece of timber due to increase of moisture content

3.1.9
thermal expansion
linear thermal expansion between given temperatures

3.1.10
variable environmental conditions
conditions that do not comply with quasi-constant environmental conditions

Note 1 to entry: Typical examples where variable environmental conditions can be experienced are balconies, unheated roof spaces and outdoor covered and uncovered spaces.

3.2 Symbols and abbreviations

For the purposes of this document, the symbols given in EN 1995-1-1 and the following apply.

Latin upper-case letters

A_1	Area of cross-section 1
A_2	Area of cross-section 2
A_b	Area of longitudinal reinforcement in concrete flange
$A_{conc,ef}$	Effective area of the concrete cross-section
A_s	Area of longitudinal reinforcement in concrete flange
A_{sf}	Area of transverse reinforcement in concrete flange
A_{tim}	Area of the timber cross-section
$C_{J,sls}$	Coefficient which considers the interaction between vertical load q_d and inelastic strains in terms of slip in the joint
$C_{p,sls}$	Coefficient which correlates the inelastic strains with a fictitious load
E_1	Modulus of elasticity of cross-section 1
E_2	Modulus of elasticity of cross-section 2
E_{conc}	Modulus of elasticity of concrete
$E_{conc,fin}$	Effective long-term modulus of elasticity of concrete
E_k	Characteristic combination of actions
$E_{q,per}$	Quasi-permanent combination of actions

E_u	Fundamental combination of actions
E_s	Design value of the modulus of elasticity of the steel reinforcement as given in EN 1992-1-1:2004, 3.2.7
E_{tim}	Mean modulus of elasticity of timber parallel to the grain
$E_{tim,fin}$	Effective long-term modulus of elasticity of timber parallel to the grain
$(EI)_i$	Bending stiffness of the cross-section *i*
$(EI)_{ef,EC5\text{-}AnnexB}$	Effective bending stiffness according to EN 1995-1-1:2004, Annex B
$(EI)_{ef,sls}$	Modified effective bending stiffness according to EN 1995-1-1:2004, Annex B, which accounts for the interaction between vertical load and inelastic strains
$F_{ax,Rk}$	Characteristic axial withdrawal capacity of the fastener
F_{est}	Estimated load-carrying capacity as defined in accordance with EN 26891 and used in determining the mean slip modulus for ultimate limit states
F_{max}	Characteristic load-carrying capacity in an Annex C test, as determined in accordance with EN 26891
F_{Rd}	Design load-carrying capacity for a notched connection
$F_{t,Ed}$	Design tensile force between the timber and the concrete cross-section
$F_{v,Ed}$	Design shear force per connection
$F_{v,Rd}$	Design load-carrying capacity per connection
$F_{v,Rk}$	Characteristic connection shear strength
$F_{v,R,t_c,k}$	Characteristic load-carrying capacity in shear per connection at time t_c
I_1	Moment of inertia of cross-section 1
I_2	Moment of inertia of cross-section 2
I_{tim}	Moment of inertia of the timber cross-section
K	Stiffness of the connection
K_{max}	Maximum stiffness of the connection
K_{min}	Minimum stiffness of the connection
K_{ref}	Reference stiffness of connection
K_{ser}	Slip modulus for serviceability limit states
$K_{ser,fin}$	Final slip modulus
K_{ser,t_c}	Mean slip modulus for serviceability at time t_c
K_u	Instantaneous slip modulus of the connection for ultimate limit states
$K_{u,fin}$	Final slip modulus for ultimate limit states
K_{u,t_c}	Slip modulus for ultimate limit states at time t_c

L	Span of the beam
$M(q_d + 0.8p_{sls})$	Resulting bending moment due to external loads and part (80 %) of the fictitious load equivalent to inelastic strains
$M(q_d)$	Resulting bending moment due to external load only
M_i	Bending moment of component *i*
$M_{max,2}$	Maximum bending moment in cross-section 2
M_{tim}	Bending moment in the timber cross-section
N_i	Axial force in cross-section *i*
$N_{max,2}$	Maximum axial force in cross-section 2
N_{tim}	Axial force in the timber cross-section
$T_{0,conc}$	Initial average temperature in the concrete at time t_c
$T_{0,tim}$	Initial average temperature in the timber at time t_c
$T_{max,conc}$	Maximum temperature in the concrete (averaged over the cross-section)
$T_{max,tim}$	Maximum temperature in the timber (averaged over the cross-section)
$T_{min,conc}$	Minimum temperature in the concrete (averaged over the cross-section)
$T_{min,tim}$	Minimum temperature in the timber (averaged over the cross-section)
V_{max}	Effective maximum shear force
$V(q_d)$	Resulting shear force due to external load
V_u	Ultimate slip determined in an Annex C test in accordance with EN 12512
X_d	Design value of a strength property of timber or a wood-based product

Latin lower-case letters

a	Distance
a_1	spacing of fasteners parallel to the grain
$a_{1\leftrightarrow c}$	Distance from the centroid of cross-section 1 to the centroid of the effective composite cross-section
a_{3c}	Distance between the fastener and the unloaded edge
a_{3t}	Distance between the fastener and the loaded edge
a_4	spacing of fasteners perpendicular to the grain
a_s	Cross-sectional area of the transverse reinforcement of the concrete flange when checking in-plane shear in the concrete
a_b	Cross-sectional area of the longitudinal reinforcement of the concrete flange when checking in-plane shear in the concrete
b_{conc}	Width of the concrete
$b_{conc,ef}$	Effective width of the concrete

b_n	Notch width
b_{tim}	Width of the timber
b_w	Width of the timber element (in verification of concrete for in-plane shear)
$c_{min,dur}$	Minimum concrete cover for durability of steel reinforcement
c_{nom}	Nominal concrete cover
d	Fastener diameter or rebar diameter
d_g	Diameter of the aggregate
d_r	Diameter of the concrete reinforcement bar diameter
f_{cd}	Design value of the compressive strength of concrete
f_{ck}	Characteristic compressive cylinder strength of the concrete at 28 days
f_{ctd}	Design value of the tensile strength of concrete
$f_{c,h,2,k}$	characteristic embedment strength of the concrete member for evaluation of the load-carrying capacity based on the Johansen models
f_{vcd}	Effective design shear strength for the concrete
$f_{v,t,d}$	Design shear strength of the timber member
f_{yd}	Design value of the yield strength of steel reinforcement
$h_{s,conn}$	Nominal height of the connector
h_f	Thickness of the concrete flange
h_n	Notch depth
k_{def}	Deformation factor of timber
k_{def}'	Deformation factor for connections between concrete and timber
k_{mod}	Modification factor for duration of load and moisture content for timber strength
k_{mod}'	Modification factor for duration of load and moisture content for the strength of connections between concrete and timber
k_s	Mean slip modulus for serviceability limit states, determined from Annex C tests in accordance with EN 26891
k_{tc}	Coefficient for concrete, taking into account the effect of high sustained loads on compressive strength
l_n	Notch length
l_s	Distance between notches
l_v	Length of timber in front of the notch
mc	Moisture content of timber (averaged over the timber cross-section)
mc_0	Moisture content of timber at time t_c

mc_{max}	Maximum moisture content of timber during annual cycles
mc_{min}	Minimum moisture content of timber during annual cycles
mc_{use}	Expected moisture content of timber in use (mean over the year, averaged over the timber cross-section)
mc_{var}	Variation in moisture content over an annual cycle
p_{sls}	Fictitious vertical load which represents the effects of inelastic strains on the structure
s_{ef}	Effective spacing of the connections
s_{f}	Spacing of the transverse reinforcement bars in the concrete slab when checking in-plane actions in the concrete
s_{l}	Longitudinal spacing of the fasteners when checking in-plane shear in the concrete
s_{max}	Maximum spacing of the connections
s_{min}	Minimum spacing of the connections
s_{t}	Transverse spacing of the fasteners when checking in-plane shear in the concrete
t	A point in time
t_0	The time when the concrete achieves the design strength or the time when the design-imposed load is applied to the composite structure, whichever is the earlier
t_∞	Time for design for long-term condition
t_c	Time according to EN 13670:2009, 8.5(6) when curing and protection of the concrete are complete
t_p	Time of removal of props
t_s	Age of concrete at which drying shrinkage begins according to EN 1992-1-1:2004, 3.1.4(6)
q_d	Design value of the external loads
$u_{u,tc}$	Mean ultimate slip
w_k	Crack width in concrete
w_{max}	Recommended maximum crack width in concrete EN 1992-1-1:2004, Table 7.1N
z	Distance between the centres of gravity of the cross-sections

Greek upper-case letters

ΔF_d	Design longitudinal shear over a certain length of beam in verification of concrete for in-plane shear (including diaphragm actions)
Δmc	Total change over the annual cycle of the average timber moisture content due to environmental conditions
Δmc^-	Reduction in average moisture content in timber over the annual cycle with respect to the expected moisture content in use mc_{use}
Δmc^+	Increase in average moisture content in timber over the annual cycle with respect to the expected moisture content in use mc_{use}