SLOVENSKI STANDARD

SIST EN 1995-1-2:2005

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SIST ENV 1995-1-2:2000

Evrokod 5: Projektiranje lesenih konstrukcij - 1-2. del: Splošna pravila - Projektiranje požarnovarnih konstrukcij

Eurocode 5: Design of timber structures - Part 1-2: General - Structural fire design

Eurocode 5: Bemessung und Konstruktion von Holzbauten - Teil 1-2: Allgemeine Regeln - Tragwerksbemessung für den Brandfall

Eurocode 5: Conception et Calcul des structures en bois - Part 1-2: Généralités - Calcul des structures au feu

Ta slovenski standard je istoveten z: **EN 1995-1-2:2004**

ICS:

13.220.50	Požarna odpornost gradbenih materialov in elementov	Fire-resistance of building materials and elements
91.010.30	Tehniļni vidiki	Technical aspects
91.080.20	Lesene konstrukcije	Timber structures

SIST EN 1995-1-2:2005 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

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EN 1995-1-2

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Supersedes ENV 1995-1-2:1994

English version

Eurocode 5: Design of timber structures - Part 1-2: General - Structural fire design

Eurocode 5: Conception et Calcul des structures en bois - Part 1-2: Généralités - Calcul des structures au feu

Eurocode 5: Entwurf, Berechnung und Bemessung von Holzbauten - Teil 1-2: Allgemeine Regeln - Bemessung für den Brandfall

This European Standard was approved by CEN on 16 April 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.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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Ref. No. EN 1995-1-2:2004: E

Contents

Foreword

This European Standard EN 1995-1-2 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 1995-1-2:1994.

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 1980’s.

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 the 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
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.

It may also contain

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[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 1995-1-2

EN 1995-1-2 describes the principles, requirements and rules for the structural design of buildings exposed to fire, including the following aspects.

Safety requirements

EN 1995-1-2 is intended for clients (e.g. for the formulation of their specific requirements), designers, contractors and relevant authorities.

The general objectives of fire protection are to limit risks with respect to the individual, society, neighbouring property, and where required, directly exposed property, in the case of fire.

Construction Products Directive 89/106/EEC gives the following essential requirement for the limitation of fire risks:
"The construction works must be designed and built in such a way, that in the event of an outbreak of fire

– the load-bearing resistance of the construction can be assumed for a specified period of time;
– the generation and spread of fire and smoke within the works is limited;
– the spread of fire to neighbouring construction works is limited;
– the occupants can leave the works or can be rescued by other means;
– the safety of rescue teams is taken into consideration".

According to the Interpretative Document "Safety in Case of Fire[5]" the essential requirement may be observed by following the various fire safety strategies prevailing in the Member States like conventional fire scenarios (nominal fires) or natural fire scenarios (parametric fires), including passive and/or active fire protection measures.

The fire parts of Structural Eurocodes deal with specific aspects of passive fire protection in terms of designing structures and parts thereof for adequate load-bearing resistance and for limiting fire spread as appropriate.

Required functions and levels of performance can be specified either in terms of nominal (standard) fire resistance rating, generally given in National fire regulations, or by referring to the fire safety engineering for assessing passive and active measures.
Supplementary requirements concerning, for example

– the possible installation and maintenance of sprinkler systems;
– conditions on occupancy of building or fire compartment;
– the use of approved insulation and coating materials, including their maintenance

are not given in this document, because they are subject to specification by a competent authority.

[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.
[5] see clauses 2.2, 3.2(4) and 4.2.3.3

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

Design procedure

A full analytical procedure for structural fire design would take into account the behaviour of the structural system at elevated temperatures, the potential heat exposure and the beneficial effects of active fire protection systems, together with the uncertainties associated with these three features and the importance of the structure (consequences of failure).

At the present time it is possible to undertake a procedure for determining adequate performance which incorporates some, if not all, of these parameters, and to demonstrate that the structure, or its components, will give adequate performance in a real building fire. However, where the procedure is based on a nominal (standard) fire the classification system, which calls for specific periods of fire resistance, takes into account (though not explicitly), the features and uncertainties described above.

Options for the application of Part 1-2 of EN 1995 are illustrated in figure 1. The prescriptive and performance-based approaches are identified. The prescriptive approach uses nominal fires to generate thermal actions. The performance-based approach, using fire safety engineering, refers to thermal actions based on physical and chemical parameters.

For design according to this part, EN 1991-1-2 is required for the determination of thermal and mechanical actions acting on the structure.

Design aids

It is expected that design aids based on the calculation models given in EN 1995-1-2, will be prepared by interested external organisations.

The main text of EN 1995-1-2 includes most of the principal concepts and rules necessary for direct application of structural fire design to timber structures.

In an annex F (informative), guidance is given to help the user select the relevant procedures for the design of timber structures.

National annex for EN 1995-1-2

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 1995-1-2 should have a National annex containing all Nationally Determined Parameters to be used for the design of buildings and civil engineering works to be constructed in the relevant country.

National choice is allowed in EN 1995-1-2 through clauses:
2.1.3(2) Maximum temperature rise for separating function in parametric fire exposure;
2.3(1)P Partial factor for material properties;
2.3(2)P Partial factor for material properties;
2.4.2(3) Reduction factor for combination of actions;
4.2.1(1) Method for determining cross-sectional properties.

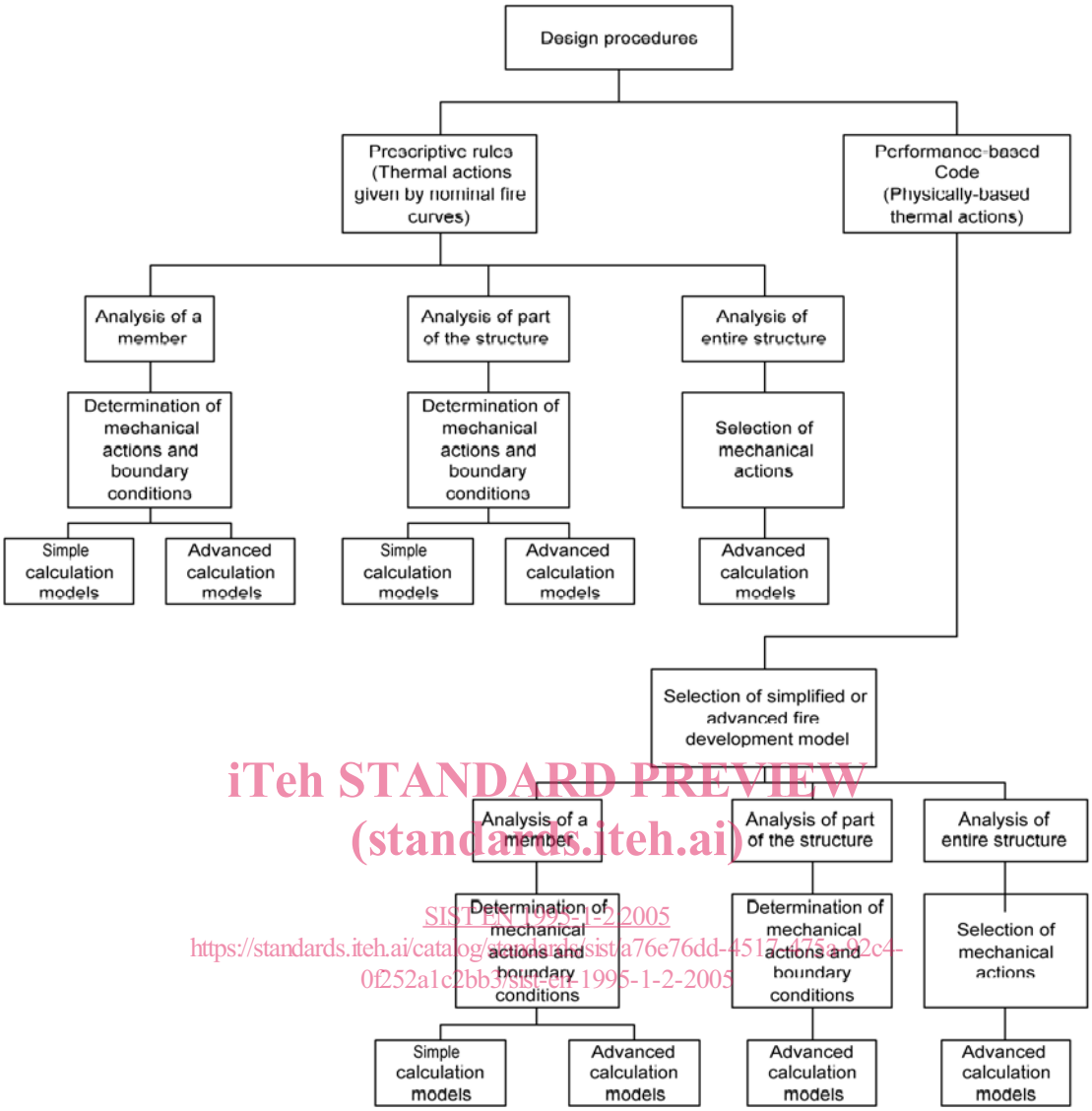

Figure 1 – Alternative design procedures

Section 1 General

1.1 Scope

1.1.1 Scope of Eurocode 5

(1)P Eurocode 5 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 1990:2002.

(2)P Eurocode 5 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) Eurocode 5 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) Eurocode 5 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

(6) EN 1995-2 refers to the General rules in EN 1995-1-1. The clauses in EN 1995-2 supplement the clauses in EN 1995-1.

1.1.2 Scope of EN 1995-1-2

(1)P EN 1995-1-2 deals with the design of timber structures for the accidental situation of fire exposure and is intended to be used in conjunction with EN 1995-1-1 and EN 1991-1-2:2002. EN 1995-1-2 only identifies differences from, or supplements normal temperature design.

(2)P EN 1995-1-2 deals only with passive methods of fire protection. Active methods are not covered.

(3)P EN 1995-1-2 applies to building structures that are required to fulfil certain functions when exposed to fire, in terms of
– avoiding premature collapse of the structure (load-bearing function)
– limiting fire spread (flames, hot gases, excessive heat) beyond designated areas (separating function).

(4)P EN 1995-1-2 gives principles and application rules for designing structures for specified requirements in respect of the aforementioned functions and levels of performance.

(5)P EN 1995-1-2 applies to structures or parts of structures that are within the scope of EN 1995-1-1 and are designed accordingly.

(6)P The methods given in EN 1995-1-2 are applicable to all products covered by product standards made reference to in this Part.

1.2 Normative references

(1)P This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

European Standards:

EN 300	Oriented strand boards (OSB) – Definition, classification and specifications
EN 301	Adhesives, phenolic and aminoplastic for load-bearing timber structures; classification and performance requirements
EN 309	Wood particleboards – Definition and classification
EN 313-1	Plywood – Classification and terminology. Part 1: Classification
EN 314-2	Plywood – Bonding quality. Part 2: Requirements
EN 316	Wood fibreboards – Definition, classification and symbols
EN 520	Gypsum plasterboards - Specifications - Test methods
EN 912	Timber fasteners – Specifications for connectors for timber
EN 1363-1	Fire resistance tests – Part 1: General requirements
EN 1365-1	Fire resistance tests for loadbearing elements – Part 1: Walls
EN 1365-2	Fire resistance tests for loadbearing elements – Part 2: Floors and roofs
EN 1990:2002	Eurocode: Basis of structural design
EN 1991-1-1:2002	Eurocode 1 Actions on structures Part 1-1: General actions – Densities, self-weight and imposed loads for buildings
EN 1991-1-2:2002	Eurocode 1: Actions on structures – Part 1-2: General actions – Actions on structures exposed to fire
EN 1993-1-2	Eurocode 3: Design of steel structures – Part 1-2: General – Structural fire design
EN 1995-1-1	Eurocode 5: Design of timber structures – Part 1-1: General – Common rules and rules for buildings
EN 12369–1	Wood-based panels – Characteristic values for structural design – Part 1: OSB, particleboards and fibreboards
EN 13162	Thermal insulation products for buildings – factory-made mineral wool (MW) products – Specifications M/103
ENV 13381-7	Test methods for determining the contribution to the fire resistance of structural members – Part 7: Applied protection to timber members
EN 13986	Wood-based panels for use in construction - Characteristics, evaluation of conformity and marking
EN 14081-1	Timber structures – Strength graded structural timber with rectangular cross section – Part 1, General requirements
EN 14080	Timber structures – Glued laminated timber – Requirements
EN 14374	Timber structures – Structural laminated veneer lumber – Requirements

1.3 Assumptions

(1) In addition to the general assumptions of EN 1990:2002 it is assumed that any passive fire protection systems taken into account in the design of the structure will be adequately maintained.

1.4 Distinction between principles and application rules

(1)P The rules in EN 1990:2002 clause 1.4 apply.

1.5 Terms and definitions

(1)P The rules in EN 1990:2002 clause 1.5 and EN 1991-1-2 clause 1.5 apply.

(2)P The following terms and definitions are used in EN 1995-1-2 with the following meanings:

1.5.1
Char-line: Borderline between the char-layer and the residual cross-section.

1.5.2
Effective cross-section: Cross-section of member in a structural fire design based on the reduced cross-section method. It is obtained from the residual cross-section by removing the parts of the cross-section with assumed zero strength and stiffness.

1.5.3
Failure time of protection: Duration of protection of member against direct fire exposure; (e.g. when the fire protective cladding or other protection falls off the timber member, or when a structural member initially protecting the member fails due to collapse, or when the protection from another structural member is no longer effective due to excessive deformation).

1.5.4
Fire protection material: Any material or combination of materials applied to a structural member or element for the purpose of increasing its fire resistance.

1.5.5
Normal temperature design: Ultimate limit state design for ambient temperatures according to EN 1995-1-1.

1.5.6
Protected members: Members for which measures are taken to reduce the temperature rise in the member and to prevent or reduce charring due to fire.

1.5.7
Residual cross-section: Cross-section of the original member reduced by the charring depth.

1.6 Symbols

For the purpose of EN 1995-1-2, the following symbols apply:

Latin upper case letters

A_r	Area of the residual cross-section
A_t	Total area of floors, walls and ceilings that enclose the fire compartment
A_v	Total area of vertical openings of fire compartment
E_d	Design effect of actions
$E_{d,fi}$	Design modulus of elasticity in fire; design effect of actions for the fire situation
$F_{Ed,fi}$	Design effect of actions on a connection for the fire situation
$F_{R,0,2}$	20 % fractile of a resistance
F_{Rk}	Characteristic mechanical resistance of a connection at normal temperature without the effect of load duration and moisture (k_{mod} = 1)
$G_{d,fi}$	Design shear modulus in fire
G_k	Characteristic value of permanent action
K_{fi}	Slip modulus in the fire situation
K_u	Slip modulus for the ultimate limit state at normal temperature
L	Height of storey
O	Opening factor
$Q_{k,1}$	Characteristic value of leading variable action

S_{05} 5 % fractile of a stiffness property (modulus of elasticity or shear modulus)at normal temperature
S_{20} 20 % fractile of a stiffness property (modulus of elasticity or shear modulus)at normal temperature
$S_{d,fi}$ Design stiffness property (modulus of elasticity or shear modulus) in the fire situation
W_{ef} Section modulus of effective cross-section
W_r Section modulus of residual cross-section

Latin lower case letters

a_0 Parameter
a_1 Parameter
a_2 Distance
a_3 Distance
a_{fi} Extra thickness of member for improved mechanical resistance of connections
b Width; thermal absorptivity for the total enclosure
b_0 Parameter
b_1 Parameter
c Specific heat
d Diameter of fastener
d_0 Depth of layer with assumed zero strength and stiffness
$d_{char,0}$ Charring depth for one-dimensional charring
$d_{char,n}$ Notional charring depth
d_{ef} Effective charring depth
d_g Gap depth
f_{20} 20 % fractile strength at normal temperature
$f_{d,fi}$ Design strength in fire
f_k Characteristic strength
$f_{v,k}$ Characteristic shear strength
h_{eq} Weighted average of heights of all vertical openings in the fire compartment
h_{ins} Insulation thickness
h_p Fire protective panel thickness
k Parameter
k_ρ Density coefficient
k_0 Coefficient
k_2 Insulation coefficient
k_3 Post-protection coefficient
k_{fi} Coefficient
k_{flux} Heat flux coefficient for fasteners
k_h Panel thickness coefficient
k_j Joint coefficient
k_{mod} Modification factor for duration of load and moisture content
$k_{mod,E,fi}$ Modification factor for modulus of elasticity in the fire situation
$k_{mod,fi}$ Modification factor for fire
$k_{mod,fm,fi}$ Modification factor for bending strength in the fire situation
k_n Notional cross-section coefficient
k_{pos} Position coefficient
k_Θ Temperature-dependent reduction factor for local strength or stiffness property
l_a Penetration length of fastener into unburnt timber
$l_{a,min}$ Minimum anchorage length of fastener
l_f Length of fastener
l_p Span of the panel
p Perimeter of the fire exposed residual cross-section
$q_{t,d}$ Design fire load density related to the total area of floors, walls and ceilings which enclose the fire compartment
t Time of fire exposure
t_0 Time period with a constant charring rate

t_1 Thickness of the side member
t_{ch} Time of start of charring of protected members (delay of start of charring due to protection)
$t_{d,fi}$ Time of the fire resistance of the unprotected connection
t_f Failure time of protection
t_{ins} Time of temperature increase on the unexposed side of the construction
$t_{ins,0,i}$ Basic insulation value of layer "i"
$t_{p,min}$ Minimum thickness of panel
t_R Time of fire resistance with respect to the load-bearing function
t_{req} Required time of fire resistance
y Co-ordinate
z Co-ordinate

Greek upper case letters

Γ Factor accounting for the thermal properties of the boundaries of the compartment
Θ Temperature

Greek lower case letters

β_0 Design charring rate for one-dimensional charring under standard fire exposure
β_n Design notional charring rate under standard fire exposure
β_{par} Design charring rate during heating phase of parametric fire curve
η Conversion factor for the reduction of the load-bearing capacity in fire
η_f Conversion factor for slip modulus
γ_{GA} Partial factor for permanent actions in accidental design situations
γ_M Partial factor for a material property, also accounting for model uncertainties and dimensional variations
$\gamma_{M,fi}$ Partial factor for timber in fire
$\gamma_{Q,1}$ Partial factor for leading variable action
λ Thermal conductivity
ρ Density
ρ_k Characteristic density
ω Moisture content
$\psi_{1,1}$ Combination factor for frequent value of a variable action
$\psi_{2,1}$ Combination factor for quasi-permanent value of a variable action
ψ_{fi} Combination factor for frequent values of variable actions in the fire situation