Irish Standard
I.S. EN 1995-1-2:2005

Eurocode 5: Design of timber structures - Part 1-2: General - Structural fire design (Including Irish National Annex)

I.S. EN 1995-1-2:2005

Incorporating amendments/corrigenda issued since publication:

EN 1995-1-2:2004/AC:2009
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I.S. xxx: Irish Standard – national specification based on the consensus of an expert panel and subject to public consultation.

S.R. xxx: Standard Recommendation - recommendation based on the consensus of an expert panel and subject to public consultation.

SWiFT xxx: A rapidly developed recommendatory document based on the consensus of the participants of an NSAI workshop.

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I.S. EN 1995-1-2:2005

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 1995-1-2:2004/AC

March 2009
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English version
Version Française
Deutsche Fassung

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

This corrigendum becomes effective on 11 March 2009 for incorporation in the three official language versions of the EN.

Ce corrigendum prendra effet le 11 mars 2009 pour incorporation dans les trois versions linguistiques officielles de la EN.

Die Berichtigung tritt am 11.März 2009 zur Einarbeitung in die drei offiziellen Sprachfassungen der EN in Kraft.

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

Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No.:EN 1995-1-2:2004/AC:2009 D/E/F

1.2 Normative references

Paragraph (1)P, delete:

"

EN 520	Gypsum plasterboards - Specifications - Test methods

"

and replace with:

"

EN 520	Gypsum plasterboards – Definitions, requirements and test methods

"

2.4.2 Member analysis

Paragraph (3), delete:

"

ψ_{fi} is the combination factor for frequent values of variable actions in the fire situation, given either by $\psi_{1,1}$ or $\psi_{2,1}$, see EN 1991-1-2:2002;

"

and replace with:

"

ψ_{fi} is the combination factor for frequent values of variable actions in the fire situation, given either by $\psi_{1,1}$ or $\psi_{2,1}$, see EN 1991-1-1;

"

3.4.2 Surfaces unprotected throughout the time of fire exposure

Paragraph (5), delete:

"

For surfaces of timber, unprotected throughout the time of fire exposure, design charring rates β_0 and β_n are given in table 3.1.

"

and replace with:

"

For surfaces of timber and wood-based materials, unprotected throughout the time of fire exposure, design charring rates β_0 and β_n are given in table 3.1.

"

5.2 Analysis of load-bearing function

Paragraph (1), delete:

"

(1) Non-separating load-bearing constructions shall be designed for fire exposure on both sides at the same time.

"

and replace with:

"

(1)P Non-separating load-bearing constructions shall be designed for fire exposure on both sides at the same time.

"

6.2.2.1 Unprotected connections

Paragraph (1), modify to read as follows:

"(1) The rules for bolts and dowels are valid where the thickness of the side plate is equal or greater than t_1, in mm:".

Paragraph (3), modify to read as follows:

"

The design fire resistance of the unprotected connection loaded by the design effect of actions in the fire situation, see 2.4.1, should be taken as:

$$t_{d,fi} = -\frac{1}{k} \ln \frac{\eta_{fi}\ \eta_0\ k_{mod}\ \gamma_{M,fi}}{\gamma_M\ k_{fi}} \tag{6.7}$$

where:

k is a parameter given in table 6.3;

η_{fi} is the reduction factor for the design load in the fire situation, see 2.4.2 (2);

η_0 is the degree of utilisation at normal temperature;

k_{mod} is the modification factor from EN 1995-1-1, subclause 3.1.3;

γ_M is the partial factor for the connection, see EN 1995-1-1, subclause 2.4.1;

k_{fi} is a value according to 2.3 (4);

$\gamma_{M,fi}$ is the partial safety factor for timber in fire, see 2.3(1).

"

A2 Charring rates and charring depths

Equation (A.6), modify to read as follows:

"

$$d_{char} = \begin{cases} \beta_{par} t & \text{for } t \le t_0 \quad \text{(a)} \\ \beta_{par}\left(1{,}5t - \dfrac{t^2}{4t_0} - \dfrac{t_0}{4}\right) & \text{for } t_0 < t \le 3t_0 \quad \text{(b)} \\ 2\beta_{par} t_0 & \text{for } 3t_0 < t \le 5t_0 \quad \text{(c)} \end{cases} \tag{A.6}$$

"

B2 Thermal properties

Paragraph (1), delete:

"

(1) For standard fire exposure, values of thermal conductivity, specific heat and the ratio of density of softwood may be taken as given in figures B1 to B3 and tables B1 and B2.

"

and replace with:

"

For standard fire exposure, values of thermal conductivity, specific heat and the ratio of density to dry density of softwood may be taken as given in figures B1 to B3 and tables B1 and B2.

"

Delete Table B2 and replace with:

"

Table B2 – Specific heat capacity and ratio of density to dry density of softwood for service class 1

Temperature °C	**Specific heat capacity** kJ kg^{-1} K^{-1}	**Ratio of density to dry density**[a]
20	1,53	1 + ω
99	1,77	1 + ω
99	13,60	1 + ω
120	13,50	1,00
120	2,12	1,00
200	2,00	1,00
250	1,62	0,93
300	0,71	0,76
350	0,85	0,52
400	1,00	0,38
600	1,40	0,28
800	1,65	0,26
1200	1,65	0
[a] ω is the moisture content		

"

D2 Charring rates

Modify to read as follows:

"

(1) 3.4.3.2(1), (2), (4) and (5) apply.

"

E1 General

Paragraph (1), modify to read as follows:

"The fixing of the panel on the side of the assembly not exposed to fire should be secured into unburnt timber."

E2.1 General

Paragraph (1), delete:

"

The relevant number of layers should be determined from table E1 and figure E2.

"

and replace with:

"

The relevant number of layers should be determined from table E1 and figure E1.

"

E2.3 Position coefficients

Modify to read as follows:

"

(1) For walls with single layered claddings, the position coefficient for panels on the exposed side of walls should be taken from table E3, and for panels on the unexposed side of walls from table E4, utilising the following expressions:

$$k_{pos} = \min \begin{cases} 0{,}02\, h_p + 0{,}54 \\ 1 \end{cases} \quad \text{(E.9)}$$

$$k_{pos} = 0{,}07\, h_p - 0{,}17 \quad \text{(E.10)}$$

where h_p is the thickness of the panel on the exposed side.

Where the exposed panel is made of materials other than gypsum plasterboard type F, the position coefficient, k_{pos}, for a void cavity and an insulation layer should be taken as 1,0. Where the exposed panel is made of gypsum plasterboard type F, the position coefficient should be taken as:

- k_{pos} = 1,5 for a void cavity, or a cavity filled with rock fibre insulation;
- k_{pos} = 2,0 for a cavity filled with glass fibre insulation.

"

Replace Tables 3 and 4 with the following:

"

Table E3 — Position coefficients k_{pos} for single layered panels on the exposed side

Panel on the exposed side	*Thickness* mm	**Position coefficient for panels backed by**	
		rock or glass fibre insulation	**void**
Plywood with characteristic density ≥ 450 kg/m^3	9 to 25	Expression (E.9)	0,8
Particleboard, fibreboard with characteristic density ≥ 600 kg/m^3	9 to 25		
Wood panelling with characteristic density ≥ 400 kg/m^3	15 to 19		
Gypsum plasterboard type A, H, F	9 to 15		

Table E4 — Position coefficients k_{pos} for single layered panels on the unexposed side

Panel on the exposed side	*Thickness of panel on unexposed side* mm	**Position coefficient for panels preceded by**				
		Glass fibre	*Rock fibre of thickness*[a]			**Void**
			45 to 95	*145*	*195*	
Plywood with density ≥ 450 kg/m^3	9 to 25	Expression (E.10)	***1,5***	***3,9***	***4,9***	***0,6***
Particleboard and fibreboard with density ≥ 600 kg/m^3	9 to 25	Expression (E.10)				0,6
Wood panelling with density ≥ 400 kg/m^3	15 19	0,45 0,67				0,6
Gypsum plasterboard type A, H, F	9 to 15	Expression (E.10)				0,7
[a] For intermediate values, linear interpolation may be applied.						

"

E2.4 Effect of joints

Table E.4, first row, second column, delete:

"Thickness of panel on unexposed side"

and replace with:

"Thickness of panel on exposed side*".*

Eurocodes National Foreword

This Irish Standard is the official English language version of EN 1995-1-2:2004, prepared by Technical Committee CEN TC 250 "Structural Eurocodes". This document supersedes ENV 1995-1-2:1994.

This standard forms part of a package of 58 Eurocodes, which covers the basis of structural design, actions (loadings), the main structural materials, geotechnical design and design provisions for earthquakes. The European Commission document – Guidance Paper L – Application and Use of Eurocodes provides guidance on the elaboration, implementation and use of Eurocodes.

Where a normative part of this EN allows for a choice to be made at the national level the range and possible choices are given in the normative text and a Note will qualify it as a Nationally Determined Parameter (NDP).
To enable EN 1995-1-2:2004 to be used in Ireland the Nationally Determined Parameters will be published in a National Annex after public consultation has taken place.

Until the National Annex is available, publication of this European Standard is solely for educational/training purposes and this standard should not be used in project design until the relevant National Annex is available.

Note: For use of this European standard after publication of the Irish National Annex.

I.S. EN 1995-1-2:2004 may now be used in Ireland. The Nationally Determined Parameters, which have been prepared by the NSAI National Eurocode Advisory Committee, are included as an informative annex to the standard.

The National Annex to I.S. EN 1995-1-2:2004 is also available as a separate publication as recommended in Guidance Paper L.

In line with international standards practice the decimal point is shown as a comma (,) throughout this document.

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I.S. EN 1995-1-2:2005

EUROPEAN STANDARD **EN 1995-1-2**

NORME EUROPÉENNE

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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.

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

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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

[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.

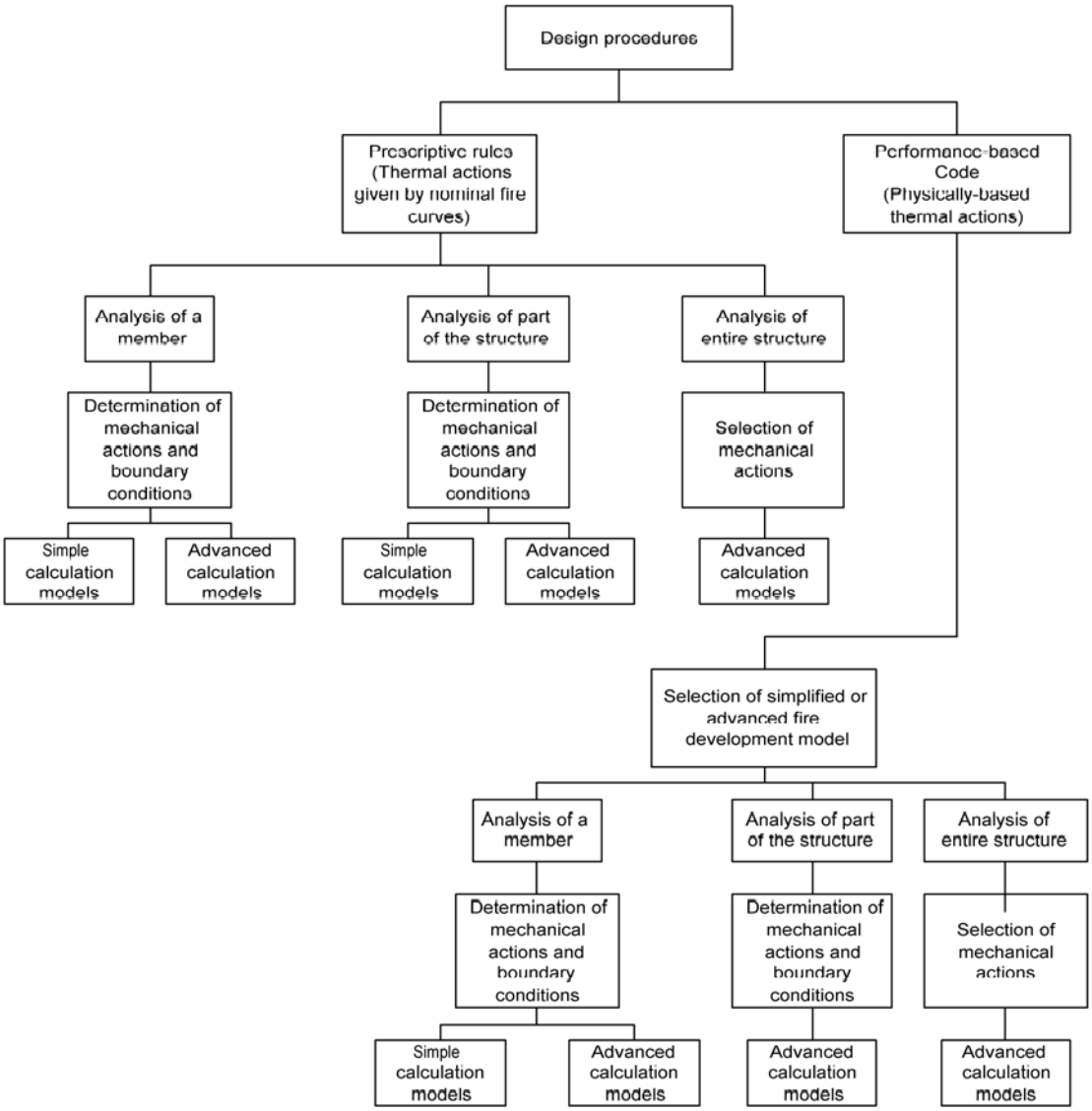

Figure 1 – Alternative design procedures

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.