



**SLOVENSKI STANDARD**  
**oSIST prEN 13381-1:2020**

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**Preskusne metode za ugotavljanje prispevka k požarni odpornosti konstrukcijskih elementov - 1. del: Vodoravne zaščitne membrane**

Test methods for determining the contribution to the fire resistance of structural members - Part 1: Horizontal protective membranes

Prüfverfahren zur Bestimmung des Beitrages zum Feuerwiderstand von tragenden Bauteilen - Teil 1: Horizontal angeordnete Brandschutzbekleidungen

Méthodes d'essai pour déterminer la contribution à la résistance au feu des éléments de construction - Partie 1 : Membranes de protection horizontales

**Ta slovenski standard je istoveten z: prEN 13381-1**

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## Test methods for determining the contribution to the fire resistance of structural members - Part 1: Horizontal protective membranes

Méthodes d'essai pour déterminer la contribution à la résistance au feu des éléments de construction - Partie 1 : Membranes de protection horizontales

Prüfverfahren zur Bestimmung des Beitrages zum Feuerwiderstand von tragenden Bauteilen - Teil 1: Horizontal angeordnete Brandschutzbekleidungen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 127.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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EUROPEAN COMMITTEE FOR STANDARDIZATION  
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EUROPÄISCHES KOMITEE FÜR NORMUNG

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

**Contents**

Page

European foreword.....	5
<b>1 Scope.....</b>	<b>7</b>
<b>2 Normative references.....</b>	<b>7</b>
<b>3 Terms and definitions, symbols and units.....</b>	<b>8</b>
3.1 Terms and definitions.....	8
3.2 Symbols and units.....	9
<b>4 Test equipment.....</b>	<b>9</b>
4.1 General.....	9
4.2 Furnace.....	9
4.3 Loading equipment.....	10
<b>5 Test conditions.....</b>	<b>10</b>
5.1 General.....	10
5.2 Support and restraint conditions.....	10
5.2.1 Standard conditions.....	10
5.2.2 Other support and restraint conditions.....	10
5.3 Loading conditions.....	10
<b>6 Test specimens.....</b>	<b>11</b>
6.1 General.....	11
6.2 Fixtures and fittings.....	11
6.3 Horizontal protective membranes.....	12
6.4 Structural building members supporting horizontal protective membranes.....	12
6.4.1 General principles.....	12
6.4.2 Standard horizontal structural building members.....	13
6.5 Properties of test materials.....	14
6.6 Verification of the test specimen.....	14
6.7 Optional and additional plate thermometers within the cavity.....	15
<b>7 Installation of the test construction.....</b>	<b>15</b>
<b>8 Conditioning.....</b>	<b>15</b>
<b>9 Application of instrumentation.....</b>	<b>15</b>
9.1 General.....	15
9.2 Instrumentation for measurement of furnace temperature.....	15
9.3 Instrumentation for measurement of specimen temperature.....	15
9.3.1 General.....	15
9.3.2 Instrumentation for measuring cavity temperature.....	16
9.3.3 Instrumentation for measuring surface temperatures.....	16
9.3.4 Optional and supplementary instrumentation for measuring temperature.....	17
9.4 Instrumentation for measurement of pressure.....	17
9.5 Instrumentation for measurement of deflection.....	18
9.6 Instrumentation for measurement of applied load.....	18
<b>10 Test procedure.....</b>	<b>18</b>
10.1 General.....	18
10.2 Furnace temperature and pressure.....	18

10.3	Application and control of load .....	18
10.4	Temperatures of test specimen .....	18
10.5	Deflection.....	18
10.6	Observations .....	18
10.7	Termination of the test.....	19
11	Test results.....	19
11.1	Acceptability of test results.....	19
11.2	Presentation of test results.....	19
12	Test report .....	20
13	Assessment.....	20
13.1	General .....	20
13.2	Assessment of loadbearing capacity.....	20
13.2.1	General .....	20
13.2.2	Characteristic temperature curve: cavity temperatures .....	21
13.2.3	Characteristic temperature curve: surface temperatures (steel beams or steel/concrete slabs).....	21
13.2.4	Application of method of limiting temperatures .....	21
13.3	Assessment of data for calculation purposes .....	22
14	Report of the assessment.....	22
15	Limits of applicability of the results of the assessment.....	23
15.1	Type of structural building member .....	23
15.2	Type of concrete.....	30
15.3	Type of steel beam.....	31
15.4	Type of steel/concrete composite structures.....	31
15.5	Type of timber structure.....	32
15.6	Height of the cavity.....	32
15.7	Exposed width of test specimen .....	32
15.8	Properties of the horizontal protective membrane.....	32
15.9	Size of panels within the horizontal protective membrane .....	32
15.10	Fixtures and fittings.....	32
15.11	Gaps between grid members and test frame or walls .....	32
Annex A	(normative) Exposure to a semi-natural fire .....	39
A.1	General .....	39
A.2	Semi-natural fire source .....	39
A.3	Test equipment.....	39
A.4	Test conditions .....	40
A.5	Test specimen .....	40
A.6	Installation of the test specimen.....	41
A.7	Conditioning .....	41
A.8	Application of instrumentation .....	41
A.9	Test procedure .....	41
A.10	Test results.....	41
A.11	Test report .....	41
A.12	The assessment .....	41

## prEN 13381-1:2019 (E)

<b>A.13</b>	<b>The assessment report.....</b>	<b>42</b>
<b>Annex B</b>	<b>(normative) Measurement of properties of horizontal protective membranes and components.....</b>	<b>43</b>
<b>B.1</b>	<b>General.....</b>	<b>43</b>
<b>B.2</b>	<b>Thickness of horizontal protective membrane and its components.....</b>	<b>43</b>
<b>B.3</b>	<b>Density of horizontal protective membranes and components thereof.....</b>	<b>44</b>
<b>B.4</b>	<b>Moisture content of horizontal protective membrane and components thereof.....</b>	<b>45</b>
<b>Annex C</b>	<b>(normative) Test method to the smouldering fire (slow heating curve).....</b>	<b>46</b>
<b>C.1</b>	<b>Introduction.....</b>	<b>46</b>
<b>C.2</b>	<b>Test equipment.....</b>	<b>46</b>
<b>C.3</b>	<b>Test specimens.....</b>	<b>46</b>
<b>C.4</b>	<b>Termination of test.....</b>	<b>46</b>
<b>C.5</b>	<b>Evaluation of the results.....</b>	<b>47</b>
<b>Bibliography</b>	<b>.....</b>	<b>49</b>

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## European foreword

This document (prEN 13381-1:2019) has been prepared by Technical Committee CEN/TC 127 “Fire safety in buildings”, the secretariat of which is held by BSI.

This document will supersede EN 13381-1:2014.

The main changes with respect to the previous edition are listed below:

Clarifications regarding the following items:

- a) determination of the characteristic surface temperature curve;
- b) limits of applicability (addition of integrity and insulation performances in the tables).
- c) assessment when the semi-natural fire test is performed (Annex A)

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This standard is one of a series of standards for evaluating the contribution to the fire resistance of structural members by applied fire protection materials. The other parts of this series are:

- *Part 2: Vertical protective membranes,*
- *Part 3: Applied protection to concrete members,*
- *Part 4: Applied passive protection to steel members,*
- *Part 5: Applied protection to concrete/profiled sheet steel composite members,*
- *Part 6: Applied protection to concrete filled hollow steel columns,*
- *Part 7: Applied protection to timber members,*
- *Part 8: Applied reactive protection to steel members.*
- *Part 9: Applied fire protection systems to steel beams with web openings.*

The fire protection capacity of the horizontal protective membrane can be nullified by the presence of combustible materials in the cavity above the membrane. The applicability of the results of the assessment is limited according to the quantity and position of such combustible materials within that cavity. The amount of combustible material permissible in the cavity is typically given in national regulations.

### Caution:

The attention of all persons concerned with managing and carrying out this fire resistance test, is drawn to the fact that fire testing can be hazardous and that there is a possibility that toxic and/or harmful smoke and gases can be evolved during the test. Mechanical and operational hazards can also arise during the construction of test elements or structures, their testing and the disposal of test residues.

**prEN 13381-1:2019 (E)**

An assessment of all potential hazards and risks to health shall be made and safety precautions shall be identified and provided. Written safety instructions shall be issued. Appropriate training shall be given to relevant personnel. Laboratory personnel shall ensure that they follow written safety instructions at all times.

The specific health and safety instructions contained within this European Standard shall be followed.

**WARNING:** When performing this test method, laboratories shall expect that there may be significant quantities of smoke released. This smoke release is expected to be very significant where the fire test involves timber and timber based components. Laboratories shall ensure that appropriate smoke extraction facilities are provided.

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## 1 Scope

This document specifies a test method for determining the ability of a horizontal protective membrane, when used as a fire resistant barrier, to contribute to the fire resistance of standard horizontal structural building members as defined in 6.4.2.

Test of horizontal protective membrane installed under a specific non-standard floor should be tested according to EN 1365-2.

This document contains the fire test which specifies the tests which are carried out whereby the horizontal protective membrane, together with the structural member to be protected, is exposed to a fire test according to the procedures defined herein. The fire exposure, to the temperature/time curve given in EN 1363-1, is applied from below the membrane itself.

The test method makes provision, through specified optional additional procedures, for the collection of data which can be used as direct input to the calculation of fire resistance according to the processes given within EN 1992-1-2, EN 1993-1-2, EN 1994-1-2 and EN 1995-1-2.

This document also contains the assessment which provides information relative to the analysis of the test data and gives guidance for the interpretation of the results of the fire test, in terms of loadbearing capacity criteria of the protected horizontal structural member.

In special circumstances, where specified in national building regulations, there can be a need to subject the protection material to a smouldering curve. The test for this and the special circumstances for its use are detailed in Annex C.

The limits of applicability of the results of the assessment arising from the fire test are defined, together with permitted direct application of the results to different structures, membranes and fittings.

This document applies only where there is a gap and a cavity between the horizontal protective membrane and the structural building member. Otherwise, the test methods in EN 13381-3, EN 13381-4 or EN 13381-5, as appropriate, apply.

Tests are intended to be carried out without additional combustible materials in the cavity.

Annex A gives details of assessing the performance of the ceiling when exposed to a semi-natural fire.

## 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.

EN 1363-1:2012, *Fire resistance tests — Part 1: General Requirements*

EN 1363-2, *Fire resistance tests — Part 2: Alternative and additional procedures*

EN 1992-1-1, *Eurocode 2: Design of concrete structures — Part 1-1: General rules and rules for buildings*

EN 1992-1-2:2004, *Eurocode 2: Design of concrete structures — Part 1-2: General rules — Structural fire design*

EN 1993-1-1, *Eurocode 3: Design of steel structures — Part 1-1: General rules and rules for buildings*

EN 1993-1-2, *Eurocode 3: Design of steel structures — Part 1-2: General rules — Structural fire design*

**prEN 13381-1:2019 (E)**

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

EN 1994-1-2, *Eurocode 4 — Design of composite steel and concrete structures — Part 1-2: General rules — Structural fire design*

EN 1995-1-1, *Eurocode 5: Design of timber structures — Part 1-1: General — Common rules and rules for buildings*

EN 1995-1-2:2004, *Eurocode 5: Design of timber structures — Part 1-2: General — Structural fire design*

EN 312, *Particleboards — Specifications*

EN 823, *Thermal insulating products for building applications — Determination of thickness*

EN 12467, *Fibre-cement flat sheets — Product specification and test methods*

EN 13381-4, *Test methods for determining the contribution to the fire resistance of structural members — Part 4: Applied passive protection to steel members*

EN 13381-5, *Test methods for determining the contribution to the fire resistance of structural members — Part 5: Applied protection to concrete/profiled sheet steel composite member*

prEN 13381-7, *Test methods for determining the contribution to the fire resistance of structural members — Part 7: Applied protection to timber members*

EN ISO 13943, *Fire safety — Vocabulary (ISO 13943)*

ISO 8421-2, *Fire protection — Vocabulary — Part 2: Structural fire protection*

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### **3 Terms and definitions, symbols and units**

#### **3.1 Terms and definitions**

For the purposes of this document, the terms and definitions given in EN 1363-1, EN ISO 13943 and ISO 8421-2 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

##### **3.1.1**

##### **horizontal structural building member**

horizontal structural element of building construction which is loadbearing, separating and which is fabricated from concrete, steel, steel/concrete composite or timber

##### **3.1.2**

##### **horizontal protective membrane**

horizontal membrane or ceiling lining that does not form any part of any loadbearing part of the structure and can comprise multiple layers of materials, together with any supporting framework, hangers, fixings and any insulation materials which is either suspended from or attached directly to a structural building member, or is self-supporting and fixed beneath a structural building member, and

which is intended to give additional fire resistance to that structural building member, as for example ceiling tiles resting on a light supporting frame, ceiling boards, metal trays, plastered and similar ceilings not directly applied to the underside of the structural member

### 3.1.3

#### **separating gap**

distance between the non-exposed surface of the horizontal protective membrane and the lowest surface of the exposed side of the structural building member

### 3.1.4

#### **cavity**

whole void or voids between the non-exposed surface of the horizontal protective membrane and the highest surface of the exposed side of the structural building member

### 3.1.5

#### **horizontal protective membrane test specimen**

full horizontal protective membrane assembly submitted for test, including typical fixing equipment and methods and typical features such as insulating materials, light fittings, ventilation ducts and access panels

### 3.1.6

#### **fire protection**

protection afforded to the structural building member by the horizontal protective membrane system such that the temperature on the surface of the structural building member and within the cavity is limited throughout the period of exposure to fire

### 3.1.7

#### **characteristic temperature**

average of the mean temperature and the maximum individual temperature  $[(\text{mean} + \text{maximum})/2]$  for a group of thermocouples

## 3.2 Symbols and units

Symbol	Unit	Designation
$L_{exp}$	mm	Exposed length of the structural building member.
$L_{sup}$	mm	Centre to centre distance between the supports of the structural building member tested.
$L_{spec}$	mm	Total length of the main beams or members of the structural building member.
$A_{m/V}$	$m^{-1}$	Section factor of unprotected steel beam (see EN 13381-4).

## 4 Test equipment

### 4.1 General

The furnace and test equipment shall be as specified in EN 1363-1.

### 4.2 Furnace

The furnace shall be designed to permit the dimensions of the test specimen to be exposed to heating to be as specified in 6.4.1 and its installation to be as described in Clause 7.

### 4.3 Loading equipment

Loading shall be applied according to EN 1363-1. The loading system shall permit loading, of the magnitude defined in 5.3, to be uniformly applied along the length and width of the test specimen at loading points positioned as defined in 5.3.

The loading equipment shall not inhibit the free movement of air above the test specimen and no part of the loading equipment, other than at the loading points, shall be closer than 60 mm to the unexposed surface of the test specimen.

## 5 Test conditions

### 5.1 General

A horizontal structural building member, including any supporting construction, which carries a horizontal protective membrane, to be used as a fire resistant barrier against fire from below, is subjected to predefined loading and to the fire test defined herein.

The temperature within the cavity and the surface temperature of the structural building member are measured throughout the test.

Any leakage through the structural floor slab and at the sides of the structure shall be minimized. The gap between the floor slab and the furnace shall be made tight by e.g. mineral wool pads or similar in such a way that the slab can deflect vertically.

It is recommended that the test is continued until the characteristic temperature recorded by all thermocouples within the cavity reaches the appropriate limiting temperature of the structural building members used or until any individual temperature recorded within the cavity rises to 750 °C for concrete, steel, or concrete/profiled steel composite members and 500 °C for timber structural members.

The procedures given in EN 1363-1 and, if applicable, in EN 1363-2, shall be followed in the performance of this test method unless specific contrary instruction is given. Where required, the semi-natural fire test shall be performed in accordance with Annex A.

### 5.2 Support and restraint conditions

#### 5.2.1 Standard conditions

The test specimen shall be tested as a simply supported one way structure with two free edges and an exposed surface and span as specified in 6.4.1.

It shall be installed to allow freedom for longitudinal movement and deflection using at one side rolling support(s) and at the other hinge support(s) as shown in Figure 1.

The surface of the bearings shall be smooth concrete or steel plates. The width of the bearings shall be at least as wide as the beam.

#### 5.2.2 Other support and restraint conditions

Support and restraint conditions differing from the standard conditions specified in 5.2.1 shall be described in the test report and the validity of the results restricted to that tested.

### 5.3 Loading conditions

The test specimen shall be subjected to loads determined in accordance with EN 1363-1. The means of determination of the load shall be clearly indicated in the test report.

The applied load shall be calculated such that the maximum bending moment equals 60 % of the ultimate cold condition limit state value of the design moment resistance specified in the appropriate structural Eurocodes (EN 1992-1-1, EN 1993-1-1, EN 1994-1-1 and EN 1995-1-1).

The design moment resistance shall be calculated using either the actual or nominal material properties, derived according to 6.5, of the loadbearing member with a material safety factor ( $\gamma_m$ ) equal to 1,0.

The load shall be symmetrically applied to the test specimen either along two transverse loading lines, applied at  $1/4 L_{sup}$  and  $3/4 L_{sup}$  and separated from each other by a distance of  $L_{sup}/2$ , see Figure 2, or by the use of dead weights. In both cases the loading shall produce stresses approximating to a uniformly distributed load.

The method of loading shall be by a system which will produce a bending moment, which is uniform over at least 20 % of the span of the beam around mid-span.

Point loads shall be transferred to the test specimen, along the two transverse loading lines, through load distribution beams or plates, see Figure 1 and Figure 3, the total contact area between these and the test specimen shall be as specified in EN 1363-1.

Load distribution beams, for safety reasons, shall have a height to width ratio  $< 1$ .

If the load distribution plates are of steel or any other high conductivity material, they shall be insulated from the surface of the test specimen by a suitable thermal insulation material.

Unexposed surface thermocouples shall not be closer than 100 mm to any part of the load distribution system.

## 6 Test specimens

### 6.1 General

One test specimen shall normally be required.

The structural building member to be used in the test shall be as given in 6.4.1 and be chosen from the standard elements described in 6.4.2 and be representative of that to be used in practice.

Where a horizontal protective membrane is manufactured with elements or components of variable size or may be installed by different procedures, then separate tests shall be carried out on elements or components at maximum and minimum sizes (the components which are cut to finish the ceiling extremities shall not be considered as smaller size components). The installation procedures for which the sponsor requires approval shall be deemed as being represented by the fire test.

The horizontal protective membrane to be used in the test shall be constructed as described in 6.3 and shall be installed according to practice, by the procedures given in the installation manual or other written instruction provided by the sponsor. It shall include all thermal insulating layers or materials to be used in practice within the cavity.

### 6.2 Fixtures and fittings

All fixtures and fittings, such as light fittings, ventilation openings and access panels expected to be installed, shall be tested in a separate full size test. The installation and frequency of use of these shall then if possible be representative of practice. Such fixtures and fittings shall not be installed within the test specimen at a distance of less than 250 mm from any of its edges.

### 6.3 Horizontal protective membranes

The test specimen shall reproduce the conditions of use, including junctions between membrane and walls and edge panels, joints and jointing materials and be installed from below by the same method and procedures as given in the installation manual, or in written instructions, which shall be provided by the sponsor.

It shall be fitted with all the components for hanging, expansion and abutting, plus any other fixtures which are to be defined by the sponsor, with a frequency representative of practice.

For horizontal protective membranes which are suspended from the structural building member by hangers, the suspension system and the length of the hangers shall be representative of practice.

The profiles bearing the various panels shall be installed against each other without any gap, unless a gap (or gaps) is required for design purposes. In this case the gap (or gaps) at the junctions of main runners shall be representative of that to be used in practice and shall be installed within the main runners and not at their ends.

The profiles within the test specimen shall include a joint representative of joints to be used in practice in both longitudinal and transverse directions.

The horizontal protective membrane shall be fixed according to normal practice on all four edges, either directly to the furnace walls or to a test frame. A test frame, where used, shall be fixed directly to the horizontal structural building member being protected, or to the furnace walls.

If the construction or properties of the horizontal protective membrane are different in the longitudinal and transverse directions, the performance of the specimen may vary depending upon which components are aligned with the longitudinal axis. If known from experience, the specimen shall be installed so as to represent the most onerous condition by arranging the more critical components parallel to the longitudinal axis. If the more onerous condition cannot be identified, two separate tests shall be carried out with the components arranged both parallel and perpendicular to the longitudinal axis.

### 6.4 Structural building members supporting horizontal protective membranes

#### 6.4.1 General principles

The dimensions of the structural building member supporting the horizontal protective membrane and which is exposed to the furnace shall be:

- a) exposed length ( $L_{exp}$ ) : at least 4 000 mm
- b) span ( $L_{sup}$ ) :  $L_{exp}$  plus up to 400 mm maximum at each end
- c) length ( $L_{spec}$ ) :  $L_{exp}$  plus up to 500 mm at each end
- d) exposed width : at least 3 000 mm

The additional length, required for installation purposes, shall be kept as small as practically possible.

Test specimens of exposed width less than 3 000 mm may be tested according to this method. However, application of the result shall be restricted to constructions of equal or less width than that tested.

The gap between the structural building member and the longitudinal furnace walls or simulated furnace walls shall not exceed 30 mm and shall be sealed with compressed mineral fibres or ceramic fibres of adequate fire performance (or comparable materials of equivalent performance) to allow both deflection of the member under heating conditions and prevention of leakage of hot gases during the test.



#### 6.4.2 Standard horizontal structural building members

The following structural building members are considered to be standard for this test method:

a) Reinforced aerated concrete slabs on steel beams:

The structural member shall comprise hot rolled steel 'I' section beams of profiles with section factor  $A_m/V$  equal to  $(275 \pm 25) \text{ m}^{-1}$  (for three sided exposure) and with a section depth of typically  $(160 \pm 20) \text{ mm}$ . The grade of steel used shall be any structural grade (S designation) according to the specification given in EN 13381-4. Engineering grades (E designation) shall not be used.

These beams shall be spaced at  $(700 \pm 100) \text{ mm}$  centres resting on the bearing surface of the furnace test frame. The beams may be assembled incorporating cross members welded at the ends.

The centre of either of the outer steel beams shall not be placed less than 275 mm from the furnace wall in order that the edge of the horizontal protective membrane rests only on the peripheral support. The centre of either of the outer steel beams shall not be placed more than 450 mm from the furnace wall.

The reinforced aerated concrete slabs shall be of density not more than  $650 \text{ kg/m}^3$  and minimum thickness 100 mm and maximum width 650 mm. They shall be placed transversely on the profiles of the steel beams and separated from each other by gaps of 5 mm to 10 mm which shall be sealed with ceramic fibre or equivalent material and silicone flexible sealant. New, unused, reinforced aerated concrete slabs shall be used for each test.

The aerated concrete slabs shall rest on the steel beam framework without mechanical connection so that there is no gain in mechanical strength of the structure with increasing deformation.

b) Reinforced dense aggregate concrete slabs on steel beams:

All the principles given in a) for reinforced aerated concrete slabs on steel beams apply except that the concrete slabs shall comprise dense aggregate concrete of density  $(2\,350 \pm 150) \text{ kg/m}^3$  and shall have a thickness of between 60 mm to 120 mm. See EN 13381-3 for the aggregates of the concrete.

c) Timber floors (or roofs):

The standard structural building member from which a horizontal membrane is suspended for the protection of a timber structural building member shall comprise equally spaced softwood joists, of nominal density  $(450 \pm 75) \text{ kg/m}^3$  and cross-section  $(220 \pm 10) \text{ mm} \times (75 \pm 5) \text{ mm}$  at 530 mm to 600 mm centres, see Figure 4. The number of joists (preferably six) and their spacing shall be appropriate to the exposed width, which shall be from 3 000 mm to 3 300 mm.

The joists shall be connected by cross members of the same material and cross-section, located in the area of the furnace support. They shall also be connected by cross members of the same material but with cross-section  $(175 \pm 10) \text{ mm} \times (40 \pm 5) \text{ mm}$ , located around mid-span, see Figure 4. The wooden floor shall be made from particle board sheets of thickness  $(21 \pm 3) \text{ mm}$  and density  $(600 \pm 50) \text{ kg/m}^3$  according to EN 312, laid perpendicular to the joists, with tongue and groove joints and nailed down.

d) Concrete/profiled steel sheet composite slabs: