SLOVENSKI STANDARD
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Preskusne metode za ugotavljanje prispevka konstrukcijskih elementov k požarni odpornosti - 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

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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.

If this draft becomes a European Standard, 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.

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Foreword

This document (prEN 13381-1:2008) has been prepared by Technical Committee CEN/TC 127 “Fire safety in buildings”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

This document will supersede CEN/TS 13381-1:2005.

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. Other Parts of this standard are:

Part 2: Vertical protective membranes,

Part 3: Applied protection to concrete members,

Part 4: Applied passive protection products 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.

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 shall be given in national regulations.

Annexes A and B are normative.

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.

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.

1 Scope

This Part of this European Standard 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 horizontal structural building members.

This European Standard 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 to the side which would be exposed in practice and 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.

A related test method for determining the contribution to the fire protection of vertical structural members by vertical protective membranes is given in Part 2 of this standard.

This European Standard 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.

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 European Standard 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 prEN 13381-3, prEN 13381-4 or prEN 13381-5, as appropriate, apply.

Tests shall 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 referenced documents are indispensable for the application 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, *Fire resistance tests — Part 1: General requirements*

EN 1365-2, *Fire resistance tests for loadbearing elements — Part 2: Floors and roofs*

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

EN 1992-1-2, *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*

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 (including Technical Corrigendum 1:1995)*

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

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

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

prEN 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 members*

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 13943:2000)*

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

3 Terms and definitions, symbols and units

3.1 Terms and definitions

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

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
any horizontal membrane or ceiling lining plus 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

The horizontal protective membrane does not form any part of any loadbearing part of the structure and can comprise multiple layers of materials

3.1.3
separating gap
distance between the uppermost surface of the horizontal protective membrane and the lowest surface of the underside of the structural building member

3.1.4
cavity
whole void or voids between the uppermost surface of the horizontal protective membrane and the highest surface of the underside 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

3.2 Symbols and units

Symbol	Unit	Designation
L_{exp}	mm	Length of the structural building member, plus the horizontal protective membrane, which is exposed to the furnace.
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 prEN 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 mean 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 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 (γ_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} approximately and separated from each other by a distance of approximately $L_{sup}/2$, see Figure 2, or by the use of dead weights. In both cases the loading shall produce stresses approximating to a uniformly distributed load.

Point loads shall be transferred to the test specimen, along the two transverse loading lines, through load distribution beams or plates, see Figures 1 and 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.

Horizontal protective membranes suspended from the structural building member by hangers or similar fixings or attached to the structural building member by a framework structure, would typically be:

— 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.

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.

Alternatively the actual structural building member to be used in practice may be used, however the application of the result shall be restricted to that member only.

Where a horizontal protective membrane is manufactured with elements or components of variable size or may be installed by different procedures, then a unique test shall be carried out on elements or components at maximum and minimum sizes. 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 ducts and access panels expected to be installed, shall be included in the test specimen. 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 specimen and not at its perimeter.

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 200 mm maximum at each end

c) length (L_{spec}) : L_{exp} plus up to 350 mm at each end

d) exposed width : at least 3 000 mm

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 ± 25) m^{-1} (for three sided exposure) and with a section depth of typically (160 ± 5) mm. The grade of steel used shall be any structural grade (S designation) according to the specification given in prEN 13381-4. Engineering grades (E designation) shall not be used.

These beams shall be spaced at (700 ± 100) 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 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 ± 150) kg/m^3 and shall have a thickness of between 60 mm to 120 mm.

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 ± 75) kg/m^3 and cross-section (220 ± 10) mm x (75 ± 5) 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 ± 10) mm × (40 ± 5) mm, located around mid span, see Figure 4. The wooden floor shall be made from particle board sheets of thickness (21 ± 3) mm and density (600 ± 50) kg/m^3, laid perpendicular to the joists, with tongue and groove joints and nailed down.

d) Concrete/profiled steel sheet composite slabs

The standard concrete/profiled steel sheet composite test slab shall be prepared according to the specification given in prEN 13381-5. The grade of steel and the concrete type, composition and strength shall be as specified in prEN 13381-5.

The standard concrete/profiled steel sheet composite slab shall be fixed to and supported on two equally spaced steel beams with a representative span as specified in 6.4.1.