
Preskusne metode za ugotavljanje prispevka k požarni odpornosti konstrukcijskih elementov - 6. del: Zaščita votlih jeklenih stebrov s polnilom iz betona

Test methods for determining the contribution to the fire resistance of structural members
- Part 6: Applied protection to concrete filled hollow steel columns

Prüfverfahren zur Bestimmung des Beitrages zum Feuerwiderstand von tragenden Bauteilen - Teil 6: Brandschutzmaßnahmen für betonverfüllte Stahlverbund-Hohlstützen

Méthodes d'essai pour déterminer la contribution à la résistance au feu des éléments de construction — Partie 6 : Protection appliquée aux poteaux métalliques creux remplis de béton

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**Test methods for determining the contribution to the fire
resistance of structural members - Part 6: Applied protection to
concrete filled hollow steel columns**

Méthodes d'essai pour déterminer la contribution à la
résistance au feu des éléments de construction - Partie 6:
Protection appliquée aux poteaux métalliques creux remplis
de béton

Prüfverfahren zur Bestimmung des Beitrages zum
Feuerwiderstand von tragenden Bauteilen - Teil 6:
Brandschutzmaßnahmen für betonverfüllte Stahlverbund-
Hohlstützen

This European Standard was approved by CEN on 14 April 2012.

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EN 13381-6:2012 (E)**Foreword**

This document (EN 13381-6:2012) has been prepared by Technical Committee CEN/TC 127 "Fire safety in buildings", 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of an identical text or by endorsement, at the latest by December 2012, and conflicting national standards shall be withdrawn at the latest by December 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes ENV 13381-6:2002.

ENV 13381-6:2002 has been revised and a completely new document, EN 13381-6, has been prepared. The main differences are as follows:

- a) Loaded column omitted, since this European Standard provides thermal data only;
- b) Unfilled sections are required to be tested under EN 13381-8 or ENV 13381-4;
- c) The use of a specified dry sand infill to the sections may be used as an alternative to concrete;
- d) Thermocouple positions redefined to follow the requirements of EN 13381-8 or ENV 13381-4;
- e) New matrix of test sections included based on scope required rather than prescriptive testing;
- f) Method to correct data for stickability added;
- g) Method of analysing the thermal data simplified to a method using linear interpolation;
- h) Extension of the results of testing added.

This European Standard is compatible with prEN 13381-4 (revision of ENV 13381-4:2002) and prEN 13381-8 (revision of EN 13381-8:2010).

This European 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 1: Horizontal protective membranes.

Part 2: Vertical protective membranes.

Part 3: Applied protection to concrete members.

Part 4: Applied protection to steel members.

Part 5: Applied protection to concrete/profiled sheet steel and composite members.

Part 7: Applied protection to timber members.

Part 8: Applied reactive protection to steel members.

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 will be produced 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 should be made and safety precautions should be identified and provided. Written safety instructions should be issued.

Appropriate training should be given to relevant personnel. Laboratory personnel should ensure that they follow written safety instructions at all times.

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

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

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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EN 13381-6:2012 (E)**1 Scope**

This European Standard specifies a test method for determining the contribution of fire protection systems to the fire resistance of structural concrete filled hollow steel columns. The concrete can be lightweight, normal-weight or heavyweight concrete, and of all the strength classes provided for in EN 1994-1-2. The use of a dry sand is considered to be an alternative, conservative approach to the use of wet concrete. A specification for dry sand is given in 5.6.3.

The method is applicable to all fire protection systems used for the protection of concrete filled hollow columns and includes sprayed fire protection, reactive coatings, cladding protection systems and multi-layer or composite fire protection materials.

If there is no hollow section data from prEN 13381-4 (revision of ENV 13381-4:2002) or prEN 13381-8 (revision of EN 13381-8:2010), this European Standard cannot be used. For passive systems, this data can be derived using the Formula in Annex A of prEN 13381-4 (revision of ENV 13381-4:2002).

Testing to this European Standard is not required if the fire protection thicknesses for hollow sections derived from prEN 13381-4 (revision of ENV 13381-4:2002) or prEN 13381-8 (revision of EN 13381-8:2010) are to be used for concrete filled hollow sections.

The evaluation is designed to cover a range of thicknesses of the applied fire protection material, a range of steel sections, characterized by their diameters and wall thicknesses, a range of design temperatures and a range of valid fire protection classification periods.

The test method is applicable to fire protection systems which are intimately in contact with the structural column, or which include an airspace between the structural column and the protection system.

This European Standard specifies the fire tests which are carried out to determine the ability of the fire protection system to provide fire protection to composite columns. The tests produce data on the average steel temperatures of the composite column, when exposed to the time/temperature curve according to the procedures defined herein. This European Standard also provides the assessment procedure, which prescribes how the analysis of the test data should be made and gives guidance on the procedures by which interpolation is undertaken.

In special circumstances, where specified in national building regulations, there can be a need to subject reactive protection material to a smouldering curve. The test for this and the special circumstances for its use are detailed in prEN 13381-8 (revision of EN 13381-8:2010). This exposure, applicable to reactive fire protection materials, is used only in special circumstances (which are specified in the national building regulations of a member state of the European Union) and is therefore not intended to be mandatory for all fire protection materials applied to concrete filled hollow steel columns.

This European Standard ignores any contribution from the concrete to the structural capability of the hollow column and therefore only deals with thermal performance. The justification for using this approach is given in Annex B.

The fire test methodology makes provision for the collection and presentation of data which can be used as direct input to the calculation of fire resistance of concrete/steel composite members in accordance with the procedures given in EN 1994-1-2.

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 steel/concrete composite columns, steel types and thicknesses, concrete densities, strengths, thicknesses and production techniques over the range of thicknesses of the applied fire protection system tested.

This European Standard details the fire test procedures, which should be carried out to provide data on the thermal characteristics of the fire protection system, when exposed to the European Standard temperature/time curve specified in EN 1363-1.

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The assessment procedure is used to establish:

- a) on the basis of temperature data derived from testing concrete filled unloaded tall columns and reference columns, a correction factor and any practical constraints on the use of the fire protection system under fire test conditions, (the physical performance);
- b) on the basis of the temperature data derived from testing short hollow steel sections filled with concrete, the thermal properties of the fire protection system, (the thermal performance).

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 steel sections and grades and to the fire protection system.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 206-1, *Concrete — Part 1: Specification, performance, production and conformity*

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

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

EN 10025-1, *Hot rolled products of structural steels — Part 1: General technical delivery conditions*

EN 10210-1 *Hot finished structural hollow sections of non-alloy and fine grain steels — Part 1: Technical delivery conditions*

[SIST EN 13381-6:2012](https://standards.iteh.ai/catalog/standards/sist/9818c90a-bb14-45be-9060-c91a20443164/en-13381-6:2012)

EN 10210-2: *Hot finished structural hollow sections of non-alloy and fine grain steels — Part 2: Tolerances, dimensions and sectional properties*

EN 10219-2 *Cold formed welded structural hollow sections of non-alloy and fine grain steels — Part 2: Tolerances, dimensions and sectional properties*

ENV 13381-4:2002, *Test methods for determining the contribution to the fire resistance of structural members — Part 4: Applied passive protection products to steel members*

EN 13381-8:2010, *Test methods for determining the contribution to the fire resistance of structural members — Part 8: Applied reactive protection to steel members*

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

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 document, the terms and definitions given in EN 1363-1, EN ISO 13943 and ISO 8421-2, and the following apply:

3.1.1

steel member

element of building construction which is load-bearing and fabricated from steel

Note 1 to entry: For the purpose of this document, the steel used in the testing should be of the same type.

3.1.2

reactive fire protection material

reactive materials which are specifically formulated to provide a chemical reaction upon heating such that their physical form changes and, in so doing, provides fire protection by thermal insulative and cooling effects

3.1.3

passive fire protection material

materials which do not change their physical form during heating and therefore provide protection by virtue of their physical or thermal properties

Note 1 to entry: These may include materials containing water which, during heating, evaporates to produce cooling effects.

3.1.4

fire protection system

fire protection material together with any supporting system including mesh reinforcement as tested and a specified primer and top coat if applicable

3.1.5

fire protection

protection afforded to the steel member by the fire protection system such that the temperature of the steel member is limited throughout the period of exposure to fire

3.1.6

test specimen

steel test section plus the fire protection system under test

Note 1 to entry: The steel test section, representative of a steel member, for the purposes of this test, comprises short steel columns, or beams.

3.1.7

fire protection thickness

thickness of a single layer fire protection system or the combined thickness of all layers of a multi-layer fire protection system or the mean dry film thickness of the fire protection coating, excluding primer and top coat

Note 1 to entry: The thickness of the elements of the supporting system or joint cover strips are not included in the fire protection thickness.

3.1.8

stickability

ability of a fire protection material to remain sufficiently coherent and in position throughout a well defined range of deformations, furnace and steel temperatures, such that its ability to provide fire protection is not significantly impaired

3.1.9

characteristic steel temperature

temperature of the concrete filled hollow columns which is used for the determination of the correction factor for stickability calculated as $(\text{mean temperature} + \text{maximum temperature})/2$