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Extended application of results from fire resistance tests — Non-loadbearing walls

Part 2: Masonry and Gypsum Blocks

ICS 13.220.50

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National foreword

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Foreword

This document (EN 15254-2:2009) 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of an identical text or by endorsement, at the latest by December 2009, and conflicting national standards shall be withdrawn at the latest by December 2009.

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1 Scope

This document provides guidance, and where appropriate defines procedures, for variations of products and element construction parameters related to the design of internal and external non-loadbearing walls made of clay units, calcium silicate units, aggregate concrete units, autoclaved aerated concrete units and gypsum blocks with different types of mortar that have been tested in accordance with EN 1364-1.

Manufactured stone masonry units according to EN 771-5 are not covered.

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 771-1, *Specification for masonry units — Part 1: Clay masonry units*

EN 771-2, *Specification for masonry units — Part 2: Calcium silicate masonry units*

EN 771-3, *Specification for masonry units — Part 3: Aggregate concrete masonry units (Dense and light-weight aggregates)*

EN 771-4, *Specification for masonry units — Part 4: Autoclaved aerated concrete masonry units*

EN 772-16, *Methods of test for masonry units — Part 16: Determination of dimensions*

EN 998-1, *Specification for mortar for masonry — Part 1: Rendering and plastering mortar*

EN 998-2, *Specification for mortar for masonry — Part 2: Masonry mortar*

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

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

EN 1364-1, *Fire resistance tests for non-loadbearing elements — Part 1: Walls*

EN 1996-1-1, *Eurocode 6 — Design of masonry structures — Part 1-1: General rules for reinforced and unreinforced masonry structures*

EN 1996-1-2:2005, *Eurocode 6 — Design of masonry structures — Part 1-2: General rules — Structural fire design*

EN 1996-3, *Eurocode 6 — Design of masonry structures — Part 3: Simplified calculation methods for unreinforced masonry structures*

EN 12859, *Gypsum blocks — Definitions, requirements and test methods*

EN 12860, *Gypsum based adhesive for gypsum blocks — Definitions, requirements and test methods*

EN 13501-2, *Fire classification of construction products and building elements — Part 2: Classification using data from fire resistance tests, excluding ventilation services*

EN 15318, *Design and application of gypsum blocks*

3 Definitions

For the purpose of this standard, the definitions given in EN 1996-1-2:2005 and the following, apply.

3.1
unfilled perpend joints
vertical plain joints or joints with tongue and groove, not filled with mortar or adhesive

3.2
historic test data
test data generated by fire resistance tests that have been undertaken by an accredited and/or Notified Test Laboratory or by a laboratory officially recognised by national fire authorities in accordance with European and/or former and current national standards based on the temperature-time curve identical to the one specified in EN 1363-1 (and defined in ISO 834)

NOTE 1 Previously existing test data is acceptable even though the test may not have been carried out using the plate thermometer.

NOTE 2 This data may only be used as described in this European Standard.

NOTE 3 Previously existing test data is acceptable provided that there has been no change to the product since this data was generated.

3.3
reference test
fire resistance test in accordance with EN 1364-1, and where applicable EN 1363-2, on which the extended application is based and the results of which are used as the main source of data for the extended application

3.4
test result
outcome of a testing process and its associated procedures detailed within a specific test standard (which may include some processing of the results from the testing of a number of specimens)

NOTE A test result is expressed in terms of one or more fire performance parameter(s).

4 General principles

4.1 General

(1) The fire resistance behaviour of masonry mainly depends on:

— masonry unit material - clay, calcium silicate, autoclaved aerated concrete, dense/lightweight aggregate concrete or gypsum;

— type of unit - solid or hollow (type of holes, percentage and direction of holes), shell and web thickness;

— dimensions of units, especially the height;

— gross density of units;

— strength of units;

— type of mortar - general purpose, thin layer or lightweight mortar;

— type of perpend joint – filled or unfilled perpend joint, especially for unplastered walls;

— use of finishes;

— geometrical slenderness of the wall, as defined in EN 1996-1-1;

— length of the wall between vertical stiffeners.

(2) For the determination of values by consideration of test results, the interpretation of any existing fire test result has to be based on the requirements for the relevant test method from EN 1364-1. For the evaluation of historic test data, differences between the test methods, in particular, fixed ends, free ends or one fixed end and one partly free end with respect to both directions (horizontal and vertical) have to be considered. Any historical test data shall be obtained by a comparable or a more onerous test method than in EN 1364-1 on a wall which is of the same or of worse resistance to fire performance.

(3) Extrapolations are only possible within the same type of material – e.g. tests on clay unit masonry with units according to EN 771-1 may only be used for extrapolations for clay unit masonry.

(4) To establish the extended application, the rules given in Clause 5 shall be followed for each of the given parameters.

(5) Whenever a parameter change goes beyond the limits defined in this document, a new reference test is needed.

4.2 Classifications

In some cases there are different extended application rules given for the classifications EI, E and E-W respectively and for the classification EI-M as defined in EN 13501-2.

4.3 Additional information

For the classification according to these extended application rules additional information on material properties and additional measurements during the test procedure according to EN 1363-1, EN 1364-1 and EN 1363-2 or historic standard national fire test methods are necessary:

— measurement of the deflection of the test specimen at least in mid height, to allow for an extrapolation for height, see 5.5 4;

— gross dry density, compressive strength and moisture content of the units (i.e. difference between density of the units at the start of the fire test and the gross dry density of the units, related to the gross dry density of the units, in percent by mass);

— percentage of voids, web and shell thickness and combined thickness according to EN 772-16 for perforated units;

— gross dry density and compressive strength of the mortar;

— thickness of unfilled perpend joints in unplastered or unrendered walls;

— thickness and type of plaster or render in rendered walls.

NOTE The measurement of the temperature within the test specimen at least in mid height across the wall thickness is advised to allow for a future calculation of fire resistances according to EN 1996-1-2. Thermocouples should be placed at least in depths of 10, 30 and 50 mm from the exposed side and then every 50 mm.

5 Rules for extended application

5.1 Units according to EN 771-1, EN 771-2, EN 771-3 and EN 771-4

5.1.1 Rules for units

(1) Extrapolations are only possible within the same type of material – e.g. tests on clay unit masonry with units according to EN 771-1 can only be used for extrapolations for clay unit masonry. Test results for lightweight aggregate concrete masonry cannot be applied for dense concrete unit masonry.

(2) The test results are valid for the tested type of unit. If solid units, i.e. group 1 units according to EN 1996-1-1 are tested, the results are only valid for group 1 units with the same or a smaller percentage of voids.

(3) For vertically perforated units (group 1, 2 and group 3 according to EN 1996-1-1), the test results can be applied for units with the same or a smaller percentage of voids. If the difference between the tested percentage of voids and the upper limit of the group in EN 1996-1-1 is less than 5 % of the overall surface of the unit, test results are valid for all percentages of voids within that group. The tested percentage of voids can be rounded up to the next multiple of 5 %.

(4) For vertically perforated units, the test results can be applied for units with the same or a higher thickness of webs and shells and for the same or higher values of the combined thickness according to EN 772-16. The value of the combined thickness can be rounded down to the next multiple of 10 mm/m.

(5) Test results for vertically perforated units meeting all the requirements of 5.1.1 can be applied for solid units.

(6) For the classification EI, E and E-W the test results are valid for the tested size of the unit and units larger in height, length and width.

(7) For units with a length between 200 and 1 000 mm, test results for a unit length from that range are valid for the whole range of unit lengths between 200 and 1 000 mm.

(8) For the classification EI-M, test results are valid for the tested length and width and units larger in length and width. It is not possible to extrapolate from tests on masonry walls with unit heights equal or smaller than 250 mm to units with greater heights.

(9) For tested wall thicknesses up to 140 mm, the test results are valid for masonry with units with the same or a higher declared value of the gross density of the units within the following ranges:

- unit density between 300 and 999 kg/m³: tested density and up to 800 kg/m³ higher density or 1 600 kg/m³, the lower value applying;
- unit density between 1 000 and 2 200 kg/m³: tested density and up to 600 kg/m³ higher density.

Test results for lightweight aggregate concrete masonry cannot be applied for dense concrete unit masonry.

(10) For wall thicknesses greater than 140 mm, the test results are valid for masonry units with a higher declared value of the gross density of units. Test results for lightweight aggregate concrete masonry cannot be applied for dense concrete unit masonry.

(11) The tested density can be rounded down within the following ranges:

- for unit densities between 300 and 999 kg/m³ to the next multiple of 50 kg/m³;
- for unit densities between 1 000 and 2 200 kg/m³ to the next multiple of 200 kg/m³.

(12) The test results are valid for masonry with the same or a higher declared value of the compressive strength of units tested according to EN 772-1 within the ranges given in Table 1 and with the same or lower utilisation factor. The tested compressive strength can be rounded down to:

— the next multiple of 1 N/mm² for compressive strengths up to 7 N/mm²;

— the next multiple of 2 N/mm² for compressive strengths between 7,1 and 16 N/mm²;

— the next multiple of 5 N/mm² for compressive strengths greater than 16 N/mm².

Table 1 — Ranges of unit compressive strength for extrapolation

Row Number	**Type of unit**	**Unit compressive strength f_b in the test** N/mm²	**Permissible range of unit strengths for extrapolation** N/mm²
1	Calcium silicate units, clay units, aggregate concrete units	2 to 50	Tested strength up to 50
	autoclaved aerated concrete units	1,5 to 10	Tested strength up to 10
2	Calcium silicate units, clay units, aggregate concrete units	50 to 75	Tested strength up to 75
3	Clay units	75 to 150	Tested strength up to 150

5.1.2 Rules for masonry mortars and joints

(1) For all types of mortar – general purpose mortar, lightweight mortar, thin layer mortar – the test results are valid for mortar compressive strengths equal to or greater than tested. Test results with general purpose mortar are valid for general purpose mortar and thin layer mortar.

(2) Test results with lightweight mortar with a gross density up to 800 kg/m³ tested are also valid for walls with lightweight mortars with a density higher than tested, for general purpose mortar with a bond strength classification equal to or greater than M5 according to EN 998-2 and for thin layer mortar.

(3) Test results with lightweight mortar with a gross density > 800 kg/m³ are also valid for general purpose mortar with a bond strength classification equal to or greater than M5 and for thin layer mortar.

(4) Test results with thin layer mortar are valid for all types of thin layer mortar and general purpose mortar with a bond strength classification equal to or greater than M5.

(5) Test results for unplastered or unrendered specimens with unfilled perpend joints are valid for all types of perpend joints (filled, unfilled, tongue and groove) with a maximum perpend joint thickness equal to or smaller than tested.

(6) Test results for unplastered or unrendered specimens with filled perpend joints are valid for all values of perpend joint thickness.

(7) Test results for plastered or rendered specimens are valid for all types of perpend joints.

(8) For the classification EI-M an extrapolation is possible within one type of mortar and from:

— general purpose mortar to thin layer mortar;

— lightweight mortar to thin layer mortar;

— lightweight mortar to general purpose mortar with a strength equal to or greater M5;

— thin layer mortar to general purpose mortar with a bond strength classification equal to or greater than M10.

5.1.3 Influence of plaster, rendering or external covering

(1) If plaster or rendering based on gypsum or lightweight aggregates is used, the result is valid for the tested type of plaster and renders LW and T according to EN 998-1 of the same or greater thickness. If tested without plaster or rendering the test results are also valid for plastered or rendered walls.

(2) Rendering for external walls may be replaced by a second leaf of masonry or a thermal insulation with insulation material of reaction to fire class A1 or A2.

5.1.4 Geometrical parameters

(1) If the wall is tested with 3 m height, the height may be extrapolated up to a slenderness (height ratio h/t) of 40 or a maximum height of 8 m for classifications E, EI or E-W, the lower value applying, if the deflection of the tested specimen in mid height is smaller than half of the thickness of the wall. For greater tested deflections in mid height, the maximum slenderness is restricted to the tested slenderness.

(2) The height can also be extrapolated by an appropriate design method given in EN 1996-1-2.

(3) If the wall is tested with 3 m height, the height may be extrapolated up to a slenderness (height ratio h/t) of 40 and a maximum height of 5 m for classification EI-M, the lower value applying, if the deflection of the tested specimen in mid height is smaller than half of the thickness of the wall. For greater tested deflections in mid height, the maximum slenderness is restricted to the tested slenderness.

(4) Test results are valid for all wall lengths (l).

(5) Test results are valid for wall thicknesses (t) equal to or greater than tested. These limits shall not exceed those given in the design for the ultimate and service limit state according to EN 1996-1-1 or EN 1996-3.

5.1.5 Connection systems

If the wall is tested with a connection system defined in EN 1996-1-2:2005, Annex E, test results are valid for all types of connection systems defined in EN 1996-1-2:2005, Annex E.

5.2 Gypsum blocks according to EN 12859

5.2.1 Rules for blocks

(1) The test results for solid blocks are only valid for solid blocks. If blocks with cavities are tested, the results are valid for blocks with a smaller percentage of cavities, and thicker shells as well as for solid blocks.

(2) For the classification EI the test results are valid for blocks of height, length or thickness equal to or greater than tested up to the maximum dimensions given in EN 12859.

(3) The test results are valid for walls with blocks with the same or higher declared value of the gross density of the blocks.

(4) The test results are valid for walls with the same or a higher declared value of the flexural strength of blocks.

5.2.2 Rules for adhesives

An extrapolation is only possible for gypsum blocks assembled with gypsum based adhesives defined in EN 12860.

5.2.3 Influence of plaster, rendering or external covering

NOTE Walls made from gypsum blocks are usually not plastered.

(1) Results for walls tested with unfilled perpend joints and no plastering or rendering are valid for all types of perpend joints.

(2) An up 3 mm skin of organic plaster or rendering may be applied without adversely affecting the fire performance.

(3) Inorganic plaster or rendering may be applied without adversely affecting the fire performance.

5.2.4 Geometrical parameters

(1) If the wall is tested with 3 m height, the height may be extrapolated up to a slenderness (height ratio h/t) of 60 or a maximum height of 8 m, the lower value applying, if the deflection of the tested specimen in mid height is smaller than half of the thickness of the wall. These limits shall not exceed those given in the design for the maximum dimensions and stress level according to EN 15318. For greater tested deflections in mid height, the maximum slenderness is restricted to the tested slenderness.

(2) Limitations of the length of a wall depend on the rules for the design of partitions in EN 15318.

(3) Test results are valid for the tested thickness of the wall (t) and wall thicknesses equal to or greater than tested.

5.2.5 Connection systems

(1) Test results according to EN 1364-1, using connection system b) below are valid for the following connection systems:

a) Head connection with a resilient strip: cork or mineral based, bonded underneath the top junction with a gypsum adhesive. The gap between the strip and the partition is filled with gypsum adhesive. The head angle is then covered with a joint tape;

b) Head connection with polyurethane foam in situ expanded in the up to 20 mm top gap. After expansion and cutting the excess foam, the head angle is then covered with a joint tape bonded with a gypsum adhesive;

c) Head connection with a mineral wool cord fitted in the gap at mid block thickness, and then finished with polyurethane foam as in b);

d) 4 sides unrestrained: junction with a resilient strip, the same technique as in a).

a), b), and c) configurations are 1 side unrestrained, the 3 other sides are fixed edges where gypsum blocks are bonded to the perimeter with gypsum adhesive.

(2) Test results according to EN 1364-1 achieved with connection systems a), c) or d) are valid for all walls constructed with connections systems a), c) or d).

6 Report of the extended application analysis

The Extended Application report shall be used in conjunction with the classification document as specified in EN 13501-2 (based on tests according to EN 1364-1 or historic data) and shall contain the following:

1) Name of the Applicant.

2) Name of the expert body which has performed the extended application.

3) Type of the tested walls.

This shall include a general description and any trade names of all the products involved.

4) Scope of the extended application.

5) Summary of the report(s) of the reference test(s) and previously granted extended applications, if available.

NOTE This is a specially prepared summary and not necessary the brief summary sometimes given as part of the test report or as a separate document. Alternatively, it is acceptable to append full copies of the relevant reports of the reference test(s).

6) The analysis of the extended application, writing including:

   — source of any calculation model used;

   — justification of the use of the calculation model for this particular extended application;

   — list of any assumptions made, together with a justification for those assumptions;

   — any supporting information and test references from other fire resistance tests (to European standards) or from historic fire resistance tests (to national standards) or from ad hoc or small-scale tests.

7) The conclusion of the analysis, including the new classification of the fire resistance (EI, EI-M as appropriate).

Bibliography

[1] EN 1991-1-2, *Eurocode 1: Actions on structures — Part 1-2: General actions — Actions on structures exposed to fire*

[2] EN 771-5, *Specification for masonry units — Part 5: Manufactured stone masonry units*

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