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Methods of test for masonry - Part 2: Determination of flexural strength

Prüfverfahren für Mauerwerk - Teil 2: Bestimmung der Biegezugfestigkeit

Méthodes d'essai de la maçonnerie - Partie 2: Détermination de la résistance à la flexion

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 1052-2:2016) has been prepared by Technical Committee CEN/TC 125 “Masonry”, 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of an identical text or by endorsement, at the latest by September 2016, and conflicting national standards shall be withdrawn at the latest by September 2016.

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1 Scope

This European standard specifies a method for determining the flexural strength of small masonry specimens for the two principal axes of loading. Guidance is given on the preparation of the specimens, the conditioning required before testing, the testing machine, the method of test, the method of calculation and the contents of the test report.

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 772-1, *Methods of test for masonry units — Part 1: Determination of compressive strength*

EN 772-10, *Methods of test for masonry units — Part 10: Determination of moisture content of calcium silicate and autoclaved aerated concrete units*

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

EN 1015-3, *Methods of test for mortar for masonry — Part 3: Determination of consistence of fresh mortar (by flow table)*

EN 1015-7, *Methods of test for mortar for masonry — Part 7: Determination of air content of fresh mortar*

EN 1015-11, *Methods of test for mortar for masonry — Part 11: Determination of flexural and compressive strength of hardened mortar*

3 Principle

The flexural strength of masonry is derived from the strength of small specimens tested to destruction under four point loading. The maximum load achieved is recorded. The characteristic value, calculated from the maximum stresses achieved by the samples is considered to be the flexural strength of the masonry.

4 Terms, definitions and symbols

4.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

4.1.1
masonry
assemblage of masonry units laid in a specified pattern and jointed together with mortar

4.1.2
flexural strength of masonry
strength of masonry in pure bending assuming a linear stress distribution of internal stresses

4.2 Symbols

For the purposes of this document, the following symbols apply.

b	is the height or width of a masonry specimen perpendicular to the direction of span, (mm)
$F_{i,\,max}$	is the maximum load applied to an individual masonry specimen, (N)
f_{mean}	is the mean flexural strength of the masonry specimens, (N/mm²)
f_{xi}	is the flexural strength of an individual masonry specimen, (N/mm²)
f_{xk}	is the characteristic flexural strength of masonry, (N/mm²)
h_u	is the height of masonry unit, (mm)
k	is the numerical factor
l_s	is the length of a masonry specimen in the direction of span, (mm)
l_u	is the length of masonry unit, (mm)
l_1	is the spacing of the outer bearings, (mm)
l_2	is the spacing of the inner bearings, (mm)
l_3	is the length of specimen outside the outer support ($1/2(l_s - l_1)$), (mm)
m	is the mass of the sample, (kg)
n	is the number of specimens
s	is the standard deviation of the log values
t_u	is the width of masonry unit, (mm)
x	is the distance between the flexural crack in the specimen after testing and the nearer of the outer supports, (mm)

5 Materials

5.1 Masonry units

5.1.1 Conditioning of the units

The conditioning of masonry units shall be as specified:

Record the method of conditioning the units prior to laying. Measure the moisture content by mass of autoclaved aerated concrete and calcium silicate masonry units in accordance with EN 772-10. Record the age of non-autoclaved concrete units at the time of testing the masonry specimens.

5.1.2 Testing

Determine the compressive strength of a sample of masonry units, using the method given in EN 772-1. For non-autoclaved concrete units determine the compressive strength at the time of testing the masonry specimens.

5.2 Mortar

The mortar, its mixing procedure and its flow value shall conform to the requirements of EN 998-2, unless otherwise specified, and these shall be reported in the test report.

Take representative samples of fresh mortar from the mason's board to make mortar prisms, to determine the flow value in accordance with EN 1015-3, and to determine the air content in accordance

with EN 1015-7. Use the prism specimens to determine the mean compressive strength at the time of testing of the masonry specimens in accordance with EN 1015-11.

6 Apparatus

A testing machine complying with the requirements given in Table 1, and accommodating variations of plane. The testing machine shall have adequate capacity but the scale used shall be such that the ultimate load on the specimen exceeds one fifth of the full scale reading. The machine shall be provided with a load pacer or equivalent means to enable the load to be applied at the rate specified.

The bearings shall be designed to ensure that contact is provided over the full width of the masonry, for example by using a hollow rubber bolster of at least 7 mm wall thickness and a 10 mm bore containing an 8 mm diameter steel rod.

Table 1 — Requirements for testing machines

Maximum permissible repeatability of forces as percentage of indicated force	Maximum permissible mean error of forces as percentage of indicated force	Maximum permissible error of zero force as percentage of maximum force of range
2,0	± 2,0	± 0,4

7 Preparation of specimens

7.1 Masonry specimens

For each of the two principal axes of loading use at least five specimens according to Figure 1 having the sizes given in Table 2. The size of the masonry specimens shall be chosen so that the distance between the inner and outer bearings shall be not less than the thickness of the masonry specimen. The thickness of the specimen shall be equal to t_u unless otherwise specified.

Table 2 — Specimen sizes for testing the flexural strength of masonry

Direction	h_u mm	b mm	Additional conditions
Flexural strength for a plane of failure parallel to the bed joints	any	≥ 400 and ≥ 1,5 l_u	minimum 2 bed joints within l_2
Flexural strength for a plane of failure perpendicular to the bed joints	≤ 250	≥ 240 and ≥ $3h_u$	minimum 1 head joint every course within l_2
	> 250	≥ 1000	minimum 1 bed joint and minimum 1 head joint every course within l_2

7.2 Construction and curing of the specimens

Build the specimens within 30 min after completion of the conditioning of the units, using mortar mixed not more than one hour beforehand unless the mortar is designed to be used over a more prolonged period. Construct the specimens to the bond specified. Do not allow the work to be interrupted before completion.

Immediately after building, pre-compress each specimen using a uniformly distributed mass to give a vertical stress between $2,5 \times 10^{-3}$ N/mm² and $5,0 \times 10^{-3}$ N/mm²; then cure the specimens, and maintain them undisturbed until testing. For other than lime-based mortar prevent the test specimens from drying out during the curing period by close covering with polyethylene sheet, and maintain the specimens undisturbed until testing unless otherwise specified. Test each specimen at an age of

28 days ± 1 day, unless otherwise specified, and determine the compressive strength of the mortar at the same age, following EN 1015-11. For lime-based mortars an alternative curing regime and period may be necessary and this should be specified.

8 Procedure

8.1 Placing the specimens in the testing equipment

Test the masonry specimen in the vertical attitude under four-point loading (see Figure 1). As an alternative, the specimen can be tested in a horizontal position. If the specimens are to be tested horizontally, weigh the mass m of each specimen to 0,1 kg. The distance between the outer bearings and the end of the specimen shall be greater than or equal to 15 mm. The distance between the inner bearings may be varied to suit the format of the masonry but shall be 0,4 times to 0,6 times the spacing of the outer bearings. The inner bearings shall be located so that they are, as far as practicable, midway between the nearest mortar joints which are parallel to the bearings.

When testing in the vertical attitude ensure that the base of each masonry specimen is free from frictional restraint, for example by setting it on two layers of polytetrafluoroethylene with grease between them or on ball, needle or roller bearings.

When testing in the horizontal attitude care is needed, especially with masonry of low flexural strength, to avoid failures in handling and placing in the test machine. It may be necessary to build extra test specimens to ensure that five valid results can be achieved.

8.2 Loading

Increase the flexural stress at a rate between 0,03 N/mm²/min and 0,3 N/mm²/min.