BRITISH STANDARD

BS EN
14617-8:2007

Agglomerated stone — Test methods —

Part 8: Determination of resistance to fixing (dowel hole)

The European Standard EN 14617-8:2007 has the status of a British Standard

ICS 91.100.15

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National foreword

This British Standard is the UK implementation of EN 14617-8:2007.

The UK participation in its preparation was entrusted to Technical Committee B/545, Natural stone.

A list of organizations represented on this committee can be obtained on request to its secretary.

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 October 2007

ISBN 978 0 580 55244 1

Amendments issued since publication

Amd. No.	Date	Comments

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 14617-8

October 2007

ICS 91.100.15

English Version

Agglomerated stone - Test methods - Part 8: Determination of resistance to fixing (dowel hole)

Pierre agglomérée - Méthodes d'essai - Partie 8 : Détermination de la résistance aux attaches (trous pour broches)

Künstlich hergestellter Stein - Prüfverfahren - Teil 8: Bestimmung der Beständigkeit gegen Befestigungen (Ankerdornloch)

This European Standard was approved by CEN on 26 August 2007.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 14617-8:2007: E

Contents

Foreword

This document (EN 14617-8:2007) has been prepared by Technical Committee CEN/TC 246 “Natural stones”, the secretariat of which is held by UNI.

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of an identical text or by endorsement, at the latest by April 2008, and conflicting national standards shall be withdrawn at the latest by April 2008.

Test methods for agglomerated stones consist of the following:

EN 14617-1, *Agglomerated stone — Test methods — Part 1: Determination of apparent density and water absorption*

EN 14617-2, *Agglomerated stone — Test methods — Part 2: Determination of flexural strength (bending)*

EN 14617-4, *Agglomerated stone — Test methods — Part 4: Determination of the abrasion resistance*

EN 14617-5, *Agglomerated stone — Test methods — Part 5: Determination of freeze and thaw resistance*

EN 14617-6, *Agglomerated stone — Test methods — Part 6: Determination of thermal shock resistance*

EN 14617-8, *Agglomerated stone — Test methods — Part 8: Determination of resistance to fixing (dowel hole)*

EN 14617-9, *Agglomerated stone — Test methods — Part 9: Determination of impact resistance*

EN 14617-10, *Agglomerated stone — Test methods — Part 10: Determination of chemical resistance*

EN 14617-11, *Agglomerated stone — Test methods — Part 11: Determination of linear thermal expansion coefficient*

EN 14617-12, *Agglomerated stone — Test methods — Part 12: Determination of dimensional stability*

EN 14617-13, *Agglomerated stone — Test methods — Part 13: Determination of electrical resistivity*

EN 14617-15, *Agglomerated stone — Test methods — Part 15: Determination of compressive strength*

EN 14617-16, *Agglomerated stone — Test methods — Part 16: Determination of dimensions, geometric characteristics and surface quality of modular tiles*

No existing standard is superseded.

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, 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 and United Kingdom.

1 Scope

This European Standard specifies a test method to determine the breaking load at the dowel hole of agglomerated stones slabs used for cladding or lining in buildings.

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 197-1, *Cement — Part 1: Composition, specifications and conformity criteria for common cements*

EN 10088-1, *Stainless steels — Part 1: List of stainless steels*

EN 12390-4, *Testing hardened concrete — Part 4: Compressive strength — Specification for testing machines*

3 Principle

This test consists of applying a force in a direction perpendicular to the face of a specimen through a dowel previously placed in a hole drilled in one of its sides and measuring the breaking load of the specimen.

4 Symbols

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

d is the thickness of the test specimen, in millimetres

d_1 is the distance from the hole wall to the face where fracture occurs, in millimetres

b_A is the maximum distance of the centre of the hole to the fracture edge on the face, in millimetres

F is the individual breaking load, in newtons

$\overline{d}_1$ is the mean value of d, in millimetres

$\overline{F}$ is the mean value of F, in newtons

$\overline{b}_A$ is the mean value of b_A, in millimetres

5 Apparatus

5.1 A balance capable of weighing the specimens with an accuracy of 0,1 % of their mass.

5.2 A ventilated oven capable of maintaining a temperature of (70 ± 5) °C.

5.3 A linear measuring device with an accuracy of 0,05 mm.

5.4 A rotary drilling machine equipped with a diamond or tungsten carbide tipped bit.

5.5 A testing machine of appropriate force in accordance with EN 12390-4 and calibrated according to this European Standard.

5.6 A clamping device consisting of two metal plates having the shape and sizes shown in Figure 1.

5.7 A device for applying loads perpendicular to the axis of the dowel (see Figure 2).

5.8 A room or chamber in which the temperature of the air can be maintained at (20 ± 5) °C.

6 Preparation of the specimens

6.1 Sampling

The sampling is not the responsibility of the test laboratory except where specially requested.

6.2 Test specimens

6.2.1 General

The test can be carried out as an identification test or as a technological or performance test.

6.2.2 Tests

6.2.2.1 Identification test

This test is performed only for comparison sake on samples of standard thickness (30 ± 3) mm, which might not be the thickness of the actual agglomerated stone slabs or cut to size products selected for the application.

6.2.2.2 Technological or performance test

This test is performed on samples of the actual thickness of the agglomerated stone slabs or cut to size products selected for the application.

6.2.3 Number of specimens

12 tests shall be made on 3 specimens.

6.2.4 Surface finish of the specimens

a) identification test

The surface finish on the faces and sides of the specimens shall be sawn, honed or polished.

b) technological test

The surface finish on the faces and sides of the specimens shall be carried out according to the application (for example sawn, honed, polished, sanded, rubbed, flamed, bush hammered, riven).

6.2.5 Dimensions of the specimens

a) identification test

— The specimens are square slabs with faces (200 ± 1) mm and a thickness of (30 ± 3) mm. The permissible deviation on the squareness is a maximum of 2 mm.

b) technology test

— The specimens are square slabs with faces (200 ± 1) mm and a thickness (d ± 0,1 d) mm.

6.2.6 Location of the holes

A hole is wet drilled perpendicularly in each of the four sides in the following manner:

a) identification test

— The centre of the hole shall be situated between 98 mm and 102 mm from the other sides, measured to the nearest 0,5 mm.

— The thickness of stone between the edge of the hole and two faces shall be (10 ± 2,0) mm, measured to the nearest 0,5 mm.

b) technological test

— The centre of the hole shall be situated in the middle of the specimen's length.

— The thickness of stone between the edge of the hole and the face to be tested shall be according to the application, measured to the nearest 0,5 mm.

6.2.7 Dimensions and tolerances of the holes

a) identification test

— The diameter of the holes shall be (10 ± 0,5) mm. The depth of the holes shall be (30 ± 2) mm.

b) technological test

— The diameter of the holes shall be in accordance with the requirement of the application. The depth of the hole shall be (30 ± 2) mm.

6.2.8 Drilling the holes

The holes shall be wet drilled with a diamond or tungsten carbide tipped drill bit without hammering.

6.2.9 Conditioning

The specimens shall be dried to constant mass at (70 ± 5) °C in a ventilated oven after the drilling of the holes but before the dowels are fixed in place.

Constant mass is reached when the difference between two weightings carried out (24 ± 2) h apart is less then 0,1 % of the first of the two masses.

After drying and prior to placing the dowels the specimen shall be stored at (20 ± 5) °C until the thermal equilibrium is reached.

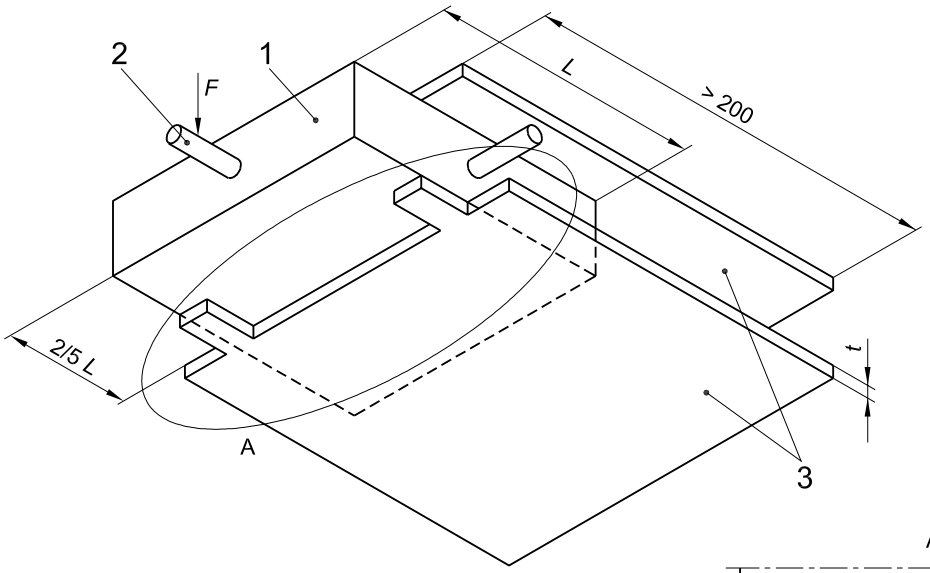
6.2.10 Measuring d and d_1

After conditioning the thickness (d) and the distance from the edge of each hole to the lower face of the specimen in the direction of the force (d_1) shall be measured.

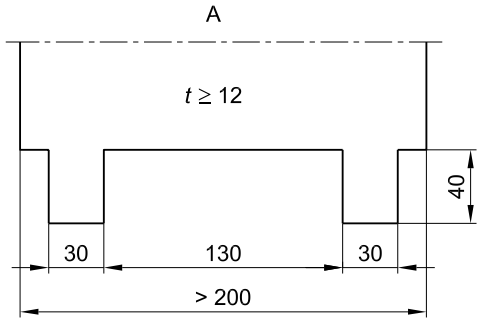
6.3 Clamping device

a) General view

Dimensions in millimetres



a)



b)

b) Detail of a plate suitable for tests on specimens having dimensions of 200 mm × 200 mm

Key

1 specimen

2 dowel

3 metal plate

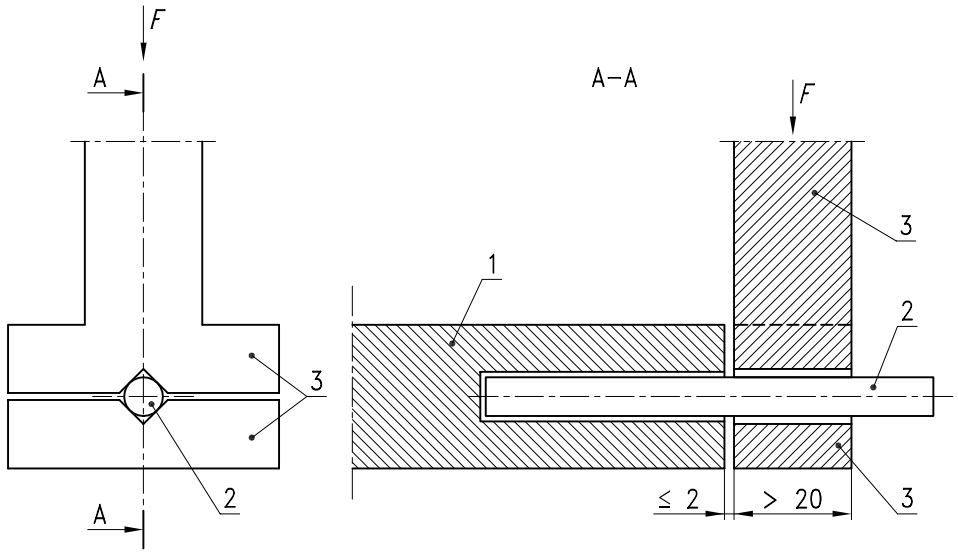
F force applied on the specimen

L length of the specimen

t thickness of the metal plate

Figure 1 — Clamping device to hold the specimen in place

Dimensions in millimetres



Key

1 specimen

2 dowel

3 device for applying load

F force applied on the specimen

Figure 2 — Device for applying loads perpendicular to the axis of the dowel

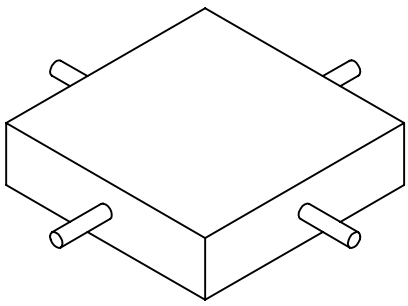


Figure 3 — Test arrangement for a specimen

7 Dowels

7.1 Dimensions and tolerances

a) identification test

— The diameter of the dowels shall be (6,0 ± 0,1) mm. The length of the dowel shall be ≥ 50 mm.

b) technological test

— The diameter of the dowels shall be in accordance with the required use. The length of the dowel shall be ≥ 50 mm.

7.2 Material

The dowels shall be made of stainless steel type 1.4571 according to EN 10088-1.

7.3 Placing the dowels

After the specimens have reached room temperature (20 ± 5) °C the dowels are fixed in the holes. Place one of the sides of each specimen in an upper horizontal position. Place the dowel vertically and centrally in the hole. Fix the dowel in the hole for a length of (25 ± 1) mm using mortar prepared with cement CEM I 52,5 R in accordance with EN 197-1 and a water/cement ratio of (0,6 ± 0,1) by mass.

Wait at least one hour and then repeat the same procedure for the other sides of the specimen that are to be tested.

The specimens shall then be stored at (20 ± 5) °C for a minimum of 48 h prior to testing.

8 Test procedure

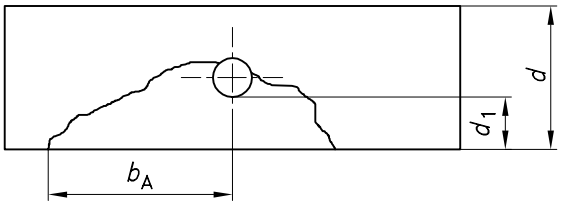
The specimen is clamped between the two metal plates of the clamping device on 60 % of specimen length (see Figure 1).

The load is exerted in a direction perpendicular to the axis of the dowel at a maximum distance of 2 mm from the edge of the specimen by means of the system shown in Figure 2.

The load is increased uniformly at a rate of (50 ± 5) N/s until the specimen breaks. The breaking load is recorded to the nearest 50 N.

If the dowel bends then the test shall be repeated with a larger diameter dowel and a new specimen.

After the specimen has failed the maximum distance from the centre of the hole to the fracture edge (b_A) shall be measured (Figure 4).



Key

d thickness of the test specimen

d_1 distance from the hole to the face in the direction of the force

b_A maximum distance of the centre of the hole to the fractures edge

Figure 4 — Dowel hole failure

9 Expression of the results

For each tested series the following mean values shall be calculated from the individual results recorded for each test:

a) mean value of the distance from the hole to the face where the fracture occurs (d_1) expressed in millimetres to the nearest 1,0 mm;

b) maximum distance from the centre of the hole to the edge of the fracture (b_A) expressed in millimetres to the nearest 1,0 mm;

c) mean value of the breaking load (F) expressed in newtons to the nearest 50 N.

10 Test report

The test report shall contain the following information:

a) unique identification number for the report;

b) number, title and date of issue of this European standard;

c) name and address of the test laboratory and the address of where the test was carried out if different from the test laboratory;

d) name and address of the client;

e) surface finish of the specimens (if relevant to the test);

f) date of delivery of the samples or of the specimens;

g) date when the specimens were prepared (if relevant) and the date of testing;

h) number of specimens in the sample;

j) results of measurements

— for each specimen:

— diameter of the hole;

- diameter of the dowel;
- dimensions of the specimen;
- thickness of the specimen;

- for each test:
  - distance from the hole to the face in the direction of the force (d_1) in millimetres to the nearest 1,0 mm;
  - maximum distance from the centre of the hole to the edge of the fracture (b_A) in millimetres to the nearest 1,0 mm;
  - breaking load (F) in newtons to the nearest 50 N;
- for each relevant direction of loading:
  - the mean value $\overline{d_1}$ and the mean value $\overline{b_A}$ (in millimetres to the nearest 1,0 mm);
  - the mean value of breaking load ($\overline{F}$) in newtons to the nearest 50 N;

k) all deviations from the standard and their justification;

l) remarks.

The test report shall contain the signature(s) and role(s) of those responsible(s) for the testing and the date of issue of the report. It shall also state that the report shall not be partially reproduced without written consent of the test laboratory.

Annex A
(normative)

Statistical evaluation of the test results

A.1 Scope

This annex establishes a method for the statistical treatment of test results obtained following the natural stone test method described in this European Standard.

A.2 Symbols and definitions

Measured values	$x_1, x_2, .. x_i .., x_n$	
Number of measured values	n	
Mean value	$\bar{x} = \frac{1}{n}\sum_i x_i$	
Standard deviation	$s = \pm\sqrt{\frac{\sum (xi - \bar{x})^2}{n-1}}$	
Coefficient of variation	v = $\frac{s}{\bar{x}}$ (for individual values)	
Logarithmic mean	$\bar{x}_{\ln} = \frac{1}{n}\sum_i \ln x_i$	
Logarithmic standard deviation	$s_{\ln} = \pm\sqrt{\frac{\sum (\ln xi - \bar{x}_{\ln})^2}{n-1}}$	
Maximum value	Max.	
Minimum value	Min.	
Lower expected value	$E = e^{\bar{x}_{\ln} - k_s \cdot s_{\ln}}$	where k_s (quantile factor) is given in Table A.1
Quantile factor	k_s see Table A.1	

A.3 Statistical evaluation of test results

For the calculation of the mean value $(\bar{x})$, the standard deviation (s) and the coefficient of variation (v) a normal distribution is assumed.

For the calculation of the lower expected value (E) a logarithmic normal distribution is assumed. The lower expected value (E) corresponds to the 5 % quantile of a logarithmic normal distribution for a confidence level of 75 %.

Table A.1 — Quantile factor (k_S) in dependence on the number of measured values (n) in correspondence to the 5 % quantile for a confidence level of 75 %

n	k_S
3	3,15
4	2,68
5	2,46
6	2,34
7	2,25
8	2,19
9	2,14
10	2,10
15	1,99
20	1,93
30	1,87
40	1,83
50	1,81
∞	1,64

The following examples should help to clarify the method:

EXAMPLE 1

Calculation of mean value, standard deviation, maximum value and minimum value of 6 measured values

Measurement no	Measured value x
1	2 000
2	2 150
3	2 200
4	2 300
5	2 350
6	2 400

Mean value	2 333
Standard deviation	147
Maximum value	2 400
Minimum value	2 000

EXAMPLE 2

Calculation of mean value, standard deviation, coefficient of variation and lower expected value of 10 measured values

Measurement no	Measured value x	(ln x)
1	2 000	(7,60)
2	2 150	(7,67)
3	2 200	(7,70)
4	2 300	(7,74)
5	2 350	(7,76)
6	2 400	(7,78)
7	2 600	(7,86)
8	2 750	(7,92)
9	2 900	(7,97)
10	3 150	(8,06)
	---	---
Mean value	2 480	(7,807)
Standard deviation	363	(0,143)
Variation coefficient	0,15	

From Table A.1 for: $n = 10$ $k_S = 2,1$

lower expected value 1 819

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