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BRITISH STANDARD

BS 1881-116: 1983

Reprinted, incorporating Amendments No. 1 and No. 2

Testing concrete —

Part 116: Method for determination of compressive strength of concrete cubes

UDC 666.972.017:691.32:620.1

Cooperating organizations

The Cement, Gypsum, Aggregates and Quarry Products Standards Committee, under whose direction this British Standard was prepared, consists of representatives from the following:

Association of Consulting Engineers
Association of County Councils
Association of District Councils
Association of Metropolitan Authorities
Autoclaved Aerated Concrete Products Association
*British Precast Concrete Federation Ltd.
*British Quarrying and Slag Federation
British Railways Board
*British Ready Mixed Concrete Association
British Steel Industry
Cement Admixtures Association
*Cement and Concrete Association
*Cement Makers' Federation
Chemical Industries Association
*Concrete Society Limited
*County Surveyors' Society
*Department of the Environment (Building Research Establishment)
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*Institution of Water Engineers and Scientists
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Sand and Ballast Hauliers and Allied Trades Alliance
*Sand and Gravel Association Limited
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Stone Federation

The organizations marked with an asterisk in the above list, together with the following, were directly represented on the Technical Committee entrusted with the preparation of this British Standard:

British Civil Engineering Test Equipment Manufacturers' Association
Electricity Supply Industry in England and Wales
Greater London Council
Institute of Concrete Technology
Coopted member

This British Standard, having been prepared under the direction of the Cement, Gypsum, Aggregates and Quarry Products Standards Committee, was published under the authority of the Board of BSI and comes into effect on 31 January 1983.

The following BSI references relate to the work on this standard:
Committee reference CAB/4
Draft for comment 80/12101 DC

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Amendments issued since publication

Amd. No.	Date	Comments
6097	July 1989	
6720	July 1991	Indicated by a sideline in the margin

Contents

Foreword

This Part of this British Standard, prepared under the direction of the Cement, Gypsum, Aggregates and Quarry Products Standards Committee, is a revision of clause **2** of BS 1881-4:1970. Together with Parts 115, 117, 118, 119 and 120, this Part of BS 1881 supersedes

BS 1881-4:1970, which is withdrawn. Diagrams are now included to show the types of irregular, unsatisfactory failures which can occur mainly due to misshapen specimens, but also due to poor alignment of the specimen in the testing machine, or to a machine fault.

An estimate of repeatability for this test is included. No estimate is given for reproducibility due to lack of information on which to base values for this test. Reference should be made to BS 5497-1 for further information on the determination of repeatability and reproducibility.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 4, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Part of this British Standard describes the method for determining the compressive strength of concrete cubes.

NOTE The titles of the publications referred to in this Part of this standard are listed on the inside back cover.

2 Definitions

For the purposes of this Part of this standard the definitions given in BS 5328 and BS 5497-1 apply.

3 Apparatus

3.1 *Testing machine.* The testing machine shall comply with BS 1881-115.

3.2 *Auxiliary platens.* When auxiliary platens are used, the top auxiliary platen shall rest on and be aligned with the cube. It shall not be fixed to the upper machine platen.

NOTE It is recommended that auxiliary platens should be used in order to save wear on the machine platens and to minimize the effect of overfilled cubes on strength measurement.

4 Test specimens

4.1 Sampling. Sampling of the concrete shall be carried out in accordance with BS 1881-101 or 1881-125.

4.2 Preparation. Test specimens shall be concrete cubes made, cured and stored in accordance with the relevant Part of this standard. Do not test cubes which have been made in badly assembled moulds or which are clearly misshapen. State the reasons in the test report. Remove any projecting fins unless auxiliary platens of the required dimensions are to be used; report any treatment to remove fins.

4.3 Mass. Weigh each specimen, as-received or saturated, in accordance with BS 1881-114.

4.4 Dimensions. Check those dimensions of each specimen that will be horizontal when it is tested.

NOTE Go/no go gauges of appropriate size are recommended as a convenient means for making these checks.

If any dimension is not within 1 % of the nominal value, determine its average value in accordance with 6.2.2 of BS 1881-114:1983.

4.5 Density. Determine the density of each specimen in accordance with BS 1881-114.

5 Procedure

5.1 Preparation. Immerse in water, for a minimum of 5 min, those cubes which have not been cured in water or where the surfaces have been allowed to dry. Remove the cubes from the curing or density water tank and test while they are still wet.

5.2 Placing the cube in the testing machine. Ensure that all testing-machine bearing surfaces are wiped clean and that any loose grit or other extraneous material is removed from the surfaces of the cube which will be in contact with the platens. Use no packing between the cube and platens, and the spacing blocks if used.

Carefully centre the cube on the lower platen and ensure that the load will be applied to two opposite cast faces of the cube. If auxiliary platens are being used, align the top auxiliary platen with the cube.

5.3 Loading. Without shock, apply and increase the load continuously at a nominal rate within the range 0.2 N/(mm^2 s) to 0.4 N/(mm^2 s) until no greater load can be sustained. On manually controlled machines as failure is approached the loading rate will decrease: at this stage operate the controls to maintain as far as possible the specified loading rate. Record the maximum load applied to the cube.

6 Type of failure

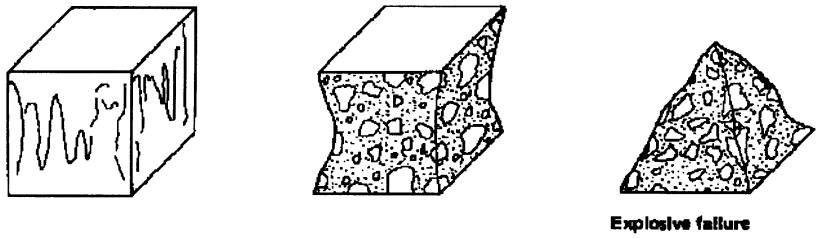
Record any unusual features in the type of failure. Refer to Figure 1 for examples of satisfactory failure, and to Figure 2 for examples of some unsatisfactory failures.

NOTE Unsatisfactory failures are usually caused by insufficient attention to the detail of the various procedures that have to be followed to make and test the specimens. For example, unsatisfactory failure may be due to the cubes being badly made, the use of moulds that do not comply with the specification, or mis-placement of the cubes in the testing machine. It is also possible for a machine fault to be the cause of unsatisfactory failure.

7 Calculation and expression of results

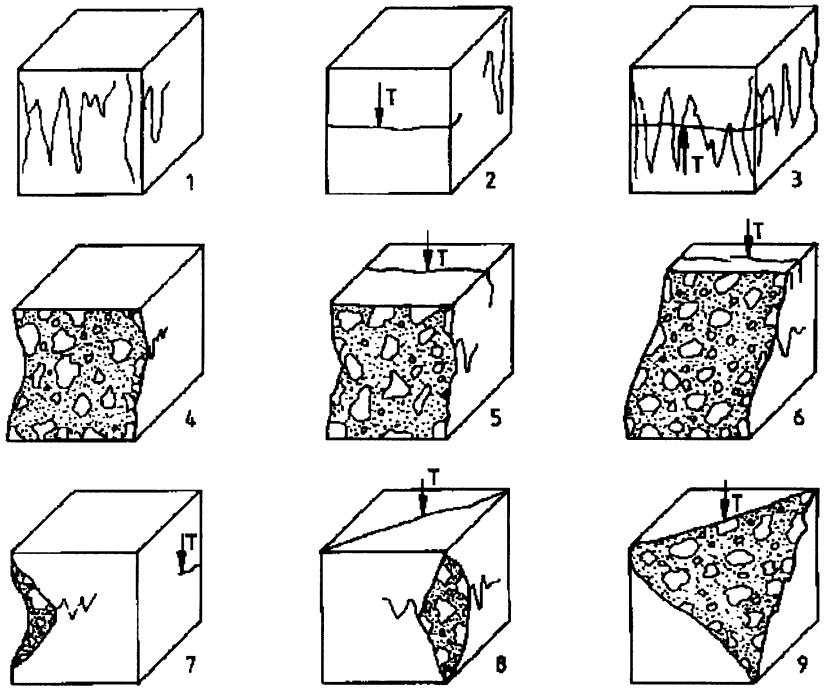
7.1 Calculation of cross-sectional area

7.1.1 Calculate the cross-sectional area of the cube from the nominal dimensions if both lie not more than 1 % above or below the nominal cube size, whether the cube is to be tested between the machine platens or auxiliary platens.



NOTE All four exposed faces are cracked approximately equally, generally with little damage to faces in contact with the platens.

Figure 1 — Satisfactory failures



NOTE T = tensile crack

Figure 2 — Some unsatisfactory failures

7.1.2 If the cube is to be tested between the machine platens and one or both dimensions is or are oversize or undersize by more than 1 % of the nominal cube size, calculate the cross-sectional area from the average values obtained as in **4.4**.

7.1.3 If the cube is to be tested between auxiliary platens and one or both dimensions is or are oversize by more than 1 % of the nominal cube size, calculate the cross-sectional area from the nominal dimensions. If one or both dimensions is or are undersize by more than 1 % of the nominal size, calculate the cross-sectional area from the average dimensions obtained as in **4.4**.

7.2 Calculation of strength. Calculate the compressive strength of each cube by dividing the maximum load applied to it by the cross-sectional area. Express the results to the nearest 0.5 N/mm^2.

7.3 Precision. Precision data are given in Table 1. These apply to compressive strength measurements made on cubes from concrete taken from the same sample, and when each test result is obtained as the strength of a single cube. They indicate the variability that occurs when making and curing the

cubes (in accordance with BS 1881-108 and BS 1881-111), as well as in the measurement of their compressive strengths.

Table 1 — Precision data for measurements of the compressive strength of hardened concrete, expressed as percentages of the mean of the two cube strengths whose differences is to be compared with *r* or *R*

Test method	Repeatability conditions		Reproducibility conditions	
	s_r	r	s_R	R
	%	%	%	%
100 mm cubes	3.2	9.0	5.4	15.1
150 mm cubes	3.2	9.0	4.7	13.2

NOTE 1 The precision data were determined as part of an experiment carried out in 1987 in which precision data were obtained for several of the tests described in BS 1881. The concretes were made using an ordinary Portland cement, Thames Valley sand, and Thames Valley 10 mm and 20 mm coarse aggregates.

NOTE 2 The difference between two test results from the same sample by one operator using the same apparatus within the shortest feasible time interval will exceed the repeatability value *r* on average not more than once in 20 cases in the normal and correct operation of the method.

NOTE 3 Test results on the same sample obtained within the shortest feasible time interval by two operators each using their own apparatus will differ by the reproducibility value *R* on average not more than once in 20 cases in the normal and correct operation of the method.

NOTE 4 For further information on precision, and for definitions of the statistical terms used in connection with precision, see BS 5497-1;

8 Test report

8.1 General. The report shall affirm that the tests were made in accordance with this Part of this standard. The report shall also state whether or not certificates of sampling, specimen preparation and curing are available. If available, a copy of each certificate shall be provided.

8.2 Information to be provided by the producer of the cubes

8.2.1 *Mandatory information.*The following information shall be provided by the producer of the cubes for inclusion in the test report:

a) date, time and place of sampling and sample identity number;

b) time and place of making cubes;

c) number and nominal size of specimens;

d) method of compaction (hand or vibration) including type of equipment used;

e) identification number or codes of cubes;

f) name of person making cubes;

g) required age of the specimens at the time of testing;

h) conditions of curing and storage.

8.2.2 *Optional information.* If requested, the following information shall be provided by the producer of the cubes for inclusion in the test report:

a) name of project and place where concrete used;

b) name of supplier and source of concrete;

c) date and time of production of concrete or delivery to site;

d) specification of concrete mix (e.g. strength grade);

e) consistence of concrete;

f) air content of concrete (if air-entrained).

8.3 Information to be provided by the test laboratory. The following information shall be provided by the test laboratory for inclusion in the test report:

a) identification of the specimen;

b) checked nominal or measured dimensions of specimen;

c) date of receipt of the specimen at the laboratory;

d) condition of the specimen when received (include poor compaction, honeycombing or bad dimensions);

e) describe treatment to remove fins;

f) conditions of curing or storage at the laboratory;

g) moisture condition at testing (saturated or moist);

h) date of test;

i) age of the specimen at test;

j) mass of the specimen (as-received or saturated);

k) density of the specimen (as-received or saturated, and the method of determining the volume);

l) maximum load at failure;

m) compressive strength;

n) appearance of the concrete and type of fracture if these are unusual;

o) certificate that the test has been carried out in accordance with this Part of this standard;

p) other remarks.

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Publications referred to

BS 1881, *Testing concrete.*
BS 1881-101, *Methods for sampling fresh concrete.*
BS 1881-108 *Method for making test cubes from fresh concrete.*
BS 1881-111, *Method for normal curing of test specimens (20 °C method).*
BS 1881-114, *Methods for determination of density of hardened concrete.*
BS 1881-115, *Specification for compression testing machines for concrete.*
BS 1881-125, *Methods for mixing and sampling fresh concrete in the laboratory.*
BS 5328, *Methods for specifying concrete, including ready-mixed concrete.*
BS 5497, *Precision of test methods.*
BS 5497-1, *Guide for the determination of repeatability and reproducibility for a standard test method.*

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London
W4 4AL