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British Standard

Testing concrete

Part 110. Method for making test cylinders from fresh concrete

Essais du béton
Partie 110. Méthode de confection de cylindres d'essai en béton frais

Prüfverfahren für Beton
Teit 110. Verfahren zur Herstellung von Probezylindern aus Frischbetor

British Standards Institution

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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 5.1,5.2, 5.3,5.4,5.5,5.7,5.8 and 5.9 of BS 1881 : Part 3 : 1970. together with Parts 108, 109, 111, 112 and 113, this Part of BS 1881 supersedes BS 1881 : Part 3 : 1970, which is withdrawn.

The dimensions and tolerances specified in this Part of this standard comply with ISO 1920.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

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Part 110. Method for making test cylinders from fresh concrete

1. Scope

This Part of this British Standard describes a method for making test cylinders of nominal diameter 100 mm and 150 mm out of fresh concrete. The method applies to plain and air-entrained concrete made with lightweight, normal weight and heavy aggregates having a nominal maximum size not exceeding 20 mm for 100 mm cylinders and 40 mm for 150 mm cylinders.

NOTE 1. A cylinder produced for determining tensile splitting strength should preferably be of 150 mm diameter with a length of 150 mm. A cylinder produced for determining the static modulus of elasticity should preferably be of 150 mm diameter with a length of 300 mm . See BS 1881 : Part 117 and Part 121.

This method does not apply to aerated concrete, very stiff concrete, which cannot be compacted by vibration alone, and no-fines concrete.

NOTE 2. The titles of the publications referred to In this standard are llsted on the inside back cover.

2. Definitions

For the purposes of this Part of this British Standard the definitions given in BS 5328 and BS 1881 : Part 101 apply.

3. Apparatus

3.1 *Mould*

3.1.1 *Construction and assembly.* The mould shall comprise a cylindrical former and a base plate both of ferrous metal (preferably cast iron or steel). The cylindrical former shall be capable of being split longitidinally to facilitate removal of the cylinder. The surface hardness of the top surface of the base plate shall be at least 95 Rockwell (scale B) Hardness Value* when determined in accordance with BS 891 : Part 1. All parts of the mould shall be robust enough to prevent distortion.

Before assembly for use, the joints between the two sections of the cylindrical former and between them and the base plate shall be thinly coated with oil or grease to prevent escape of water. When the mould is assembled, the sections of the cylindrical former shall be positively located and the whole assembly including the base plate rigidly held together in such a manner as to prevent leakage from the mould. The internal faces of the assembled mould shall be thinly coated with release agent to prevent adhesion of the concrete.

The sections of the cylindrical former shall be clearly marked with a reference number or code to enable each cylinder to be identified when it is demoulded and the mould to be correctly re-assembled.

A mould shall be refurbished or discarded when any dimensional deviations exceed twice the tolerances specified in 3.1.2.

3.1.2 *To/erances* When assembled, the dimensions and internal faces of a new mould shall be accurate within the following limits.

(a) *Dimensions.* The internal diameter of the mould, based on the average of three pairs of measurements at right angles to each other symmetrically placed along the axis of the mould, shall be the nominal size of 150 ± 0.15 mmt, or 100 ± 0.15 mmt. The length, based on the average of four symmetrically placed measurements, shall be the nominal size ± 0.5 mmt.

(b) *Flatness* The flatness tolerance (see BS 308 : Part 3) for the top surface of the base plate shall be 0.03 mm wide. That for the top and bottom surfaces of the cylindrical former shall be 0.06 mm wide and that for the joint faces shall be 0.06 mm per 150 mm length and 0.15 mm for the entire surface.

(c) Squareness The squareness tolerance (squareness 3 of BS 308 : Part 3) for the axis of the mould with respect to the bottom surface of the mould as datum face shall be a cylinder of diameter 1.0 mm perpendicular to the datum face.

(d) *Parallelism.* The parallelism tolerance (parallelism of BS 308 : Part 3) for the top surface of the mould with respect to the bottom surface of the mould as datum face shall be 1.0 mm wide.

(e) *Cylindricity.* The cylindricity tolerance (see BS 308 : Part 3) for the inner cylindrical surface shall be 0.5 mm.

(f) *Surface texture.* The surface texture of the top surface of the base plate shall not exceed 3.2 μm R_a, when determined in accordance with BS 1134.

3.2 Scoop, approximately 100 mm wide.

3.3 Compacting bar or vibrating hammer or table. A compacting bar made out of steel bar weighing 1.8 kg, 380 mm long and having a ramming face 25 mm square, or a vibratlng hammer or vibrating table suitable for compacting the concrete in accordance with 6.2 or 6.3.

3.4 Plasterer's steel float.

3.5 Sampling tray, 1.2 m x 1.2 m x 50 mm deep made from minimum 1.6 mm thick non-corrodible metal.

3.6 *Square mouthed* shovel. size 2 in accordance with BS 3388.

3.7 Glass capping plate (required if capping in accordance with 7.1.3.2 or 7.1.3.5), at least 8 mm thick with surfaces complying with the tolerances specified in 3.1.2(b) and (f).

*Indentations on the faces of moulds resulting from the hardness test are acceptable.

This tolerance should be considered in conjunction with those for flatness, squareness and parallelism.

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3.8 Top *plate* (required if capping in accordance with 7.1.3.3). at least 8 mm thick, which can be clamped to one end of the mould. The surface clamped to the mould shall comply with the tolerances specified in 3.1.2(b) and (f) and shall have a Rockwell (scale B) Hardness Value' of at least 95 when tested in accordance with BS 891 : Part 1.

3.9 Grinding *equipment* (required if grinding in accordance with 7.1.3.4). capable of producing a surface in accordance with the tolerance specified in 7.2.

3.10 Steel *collar* (required if capping in accordance with 7.1.3.5). with a machined edge suitable for use when capping in accordance with 7.1.2.4.

3.11 *Steel plate* (required if capping in accordance with 7.1.3.6), with the working surface complying with the tolerances specified in 3.1.2(b) and (f) and with a Rockwell (scale B0 Hardness Value' of at least 95 when tested in accordance with BS 891 : Part 1.

4. Sampling

Obtain the sample of fresh concrete by the procedure given in Part 101 of this British Standard. Commence making the cylinder as soon as possible after sampling.

5. Preparing the sample

Empty the sample from the container(s) on to the sampling tray. Ensure that no more than a light covering of slurry is left adhering to the container(s).

Thoroughly mix the sample by shovelling it to form a cone on the sampling tray and turning this over with the shovel to form a new cone, the operation being carried out three trmes. When forming the cones deposit each shovelful of the material on the apex of the cone so that the portions which slide down the sides are distributed as evenly as possible and so that the centre of the cone is not displaced. Flatten the third cone by repeated vertical insertion of the shovel across the apex of the cone, lifting the shovel clear of the concrete after each insertion.

NOTE. The following modifications to the mixing procedures may be necessary when preparing samples of very high workability concrete (e.g. superplasticized concrete) for test.

(a) *Sampling tray.* The vertical lips on the edges of the tray may have to be larger to contain the sample without spillage during mixing.

Mixing the sample. The coning procedure is not suitable for high workability concrete and the following alternative method of mixing is recommended. Having poured the cncrete on to the sampling tray, use the shovel to turn the concrete from the outside toward the centre, working progressively once round all sides of the sampling tray.

6. Procedure

6.1 Filling the mould. Place the mould on a rigid horizontal surface or on the vibrating table and fill with concrete in such a way as to remove as much entrapped air as possible (without significantly reducing the amount of entrainlned air, if present) and to produce full compaction of the concrete with neither excessive segregation nor laitance. For this purpose, by means of the scoop place the concrete in the mould in layers approximately 50 mm deep and compact each layer by using either the compacting bar or the vibrator in the manner described in 6.2 or 6.3. After the top layer has been compacted, smooth it level with the top of the mould, using the plasterer's float, and wipe clean the outside of the mould.

6.2 Compacting with compacting bar. When compacting each layer with the compacting bar distribute the strokes of the compacting bar in a uniform manner over the cross-section of the mould, and ensure that the compacting bar does not penetrate significantly any previous layer nor forcibly strike the bottom of the mould when compacting the first layer. The number of strokes per layer required to produce full compaction will depend upon the workability of the concrete but in no case shall the concrete be subjected to less than 30 strokes per layer for 150 mm cylinders or 20 strokes per layer for 100 mm cylinders, except in the case of very high workability concrete. Record the number of strokes.

6.3 Compacting with vibrator. When compacting each layer by means of the hammer or vibrating table use applied vibration of the minimum duration necessary to achieve full compaction of the concrete. Over-vibration may cause excessive segregation and laitance or loss of entrained air, if present, The required duration of vibration will depend upon the workability of the concrete and the effectiveness of the vibrator and vibration shall cease as soon as the surface of the concrete becomes relatively smooth and has a glazed appearance. Record the duration of vibration.

7. Preparation of upper surface of cylinder

7.1 Method of preparation

7.1.1 *General.* Prepare the upper surface of the cylinder in accordance with either 7.1.2 or 7.1.3 depenoing upon the method by which the cylinder will be tested.

7.1.2 Preparation for tensile splitting strength test. Using the float, finish the upper surface of the cylinder level with the top of the mould.

7.1.3 Preparation for static modulus of elasticity test

7.1.3.1 *General.* If practicable, prepare the upper surface of the cylinder whilst it is still workable by one of the two methods given in 7.1.3.2 or 7.1.3.3. If this is not possible, allow the concrete to harden and grind the upper surface by the method given in 7.1.3.4; if this is impracticable, use one of the two methods given in 7.1.3.5 and 7.1.3.6.

7.1.3.2 *Mortar capping of newly-cast cylinder.* Fill the mould to within 3 mm to 6 mm of the top, leaving the surface rough to provide a key for the capping material. As soon as possible after the mould is filled, prepare a mortar using a cement similar to that used in the concrete and fine sand not less than 90 % of which passes a 300 pm BS 410 woven wire sieve and is retained on a 150 μm BS 410 woven wire sieve. Ensure that the water/cement ratio of the mortar does not exceed that of the concrete and that the mortar is of a stiff workability. Remove any free water which has collected on the upper surface of the concrete with a sponge, blotting paper or other suitable material before applying the mortar. Using the float, apply the mortar firmly and compact it in such a manner as to leave a slightly convex surface above the edge of the mould. Coat the glass capping plate with a thin film of release agent and press it on to the cap with a rotary motion until it makes complete contact with the rim of the mould. Leave the plate in position until the cylinder is removed from the mould.

7.1.3.3 Finishing of newly-cast cylinder by use of the steel top plate. Using the float, finish the upper surface of the cylinder level with the top of the mould. Coat the steel top plate with a thin film of release agent and press it on to the concrete with a rotary motion until it makes complete contact with the rim of the mould. Clamp the top plate

*Indentations on the face resulting from the hardness test are acceptable.

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firmly to the top of the mould and place the mould, complete with top and base plates, with its axis horizontal on supports which will prevent any movement. Lightly tap the capping plate to ensure good contact with the surface of the concrete. Allow the cylinder to harden in a horizontal position until it is removed from the mould.

7.1.3.4 *Grinding of hardenedcylinder.* Using the float, finish the upper surface of the cylinder level with the top of the mould. When the concrete has hardened, grind the surface until it complies with 7.2. Water only shall be used as a coolant during grinding.

7.1.3.5 Mortar capping of soaked hardened cylinder. Roughen the upper surface of the cylinder by wire brushing or hacking. Place the cylinder, with its roughened surface uppermost, on a horizontal surface. Clamp the steel collar to the cylinder in such a way that the upper edge is horizontal and just extends above the highest part of the concrete surface. Fill the collar with a mortar of stiff workability composed of three parts by mass of high alumina cement complying with BS 915 to one part by mass of fine sand, not less than 90 % of which passes a 300 μm BS 410 woven wire sieve and is retained on a 150 μm BS 410 woven wire sieve. Using the float, apply the mortar firmly and compact it in such a manner as to leave a slightly convex surface above the edge of the collar.
Coat the glass capping plate with a thin film of release agent and press it on to the cap with a rotary motion until it makes complete contact with the edge of the collar. Immediately place the cylinder, with the collar and plate, in moist air of at least 90 % humidity and at a temperature of 20 ± 5 °C. Remove the plate and collar when the mortar is sufficiently hard to permit this to be done without damaging the cap.

7.1.3.6 Sulphur capping of dty hardened cylinder. Prepare the capping material by mixing equal parts of sulphur and fine siliceous sand, not less than 90 % of which passes a 300 pm BS 4 10 woven wire sieve and is retained on a 150 μm BS 410 woven wire sieve, with a small proportion (1 % to 2 %) of carbon black or a small proportion (2 % to 4 %) polysulphide rubber*. Heat the capping material to a temperature of approximately 130 °C to 150 °C and allow to cool slightly whilst stirring continuously. Pour the mixture on to the horizontal steel plate which has been slightly warmed and thinly coated with paraffin. Place the cylinder into the layer of capping material, in such a manner that the cap is as thin as practicable using a guide to ensure that the axis is vertical.

After a few seconds, cut the surplus capping material from the cylinder and remove the cylinder from the supporting surface.

When testing the cylinder, check that the cap does not flow or fracture before the concrete fails. After the test, check to ensure that no air was entrapped between the cylinder and the cap.

7.2 Tolerances. If the upper end is ground or capped when hardened, check to ensure the end complies with the following limits.

(a) *Flatness* The flatness tolerance (see BS 308 : Part 3) for the prepared surface is 0.06 mm wide.

(b) *Parallelism.* The parallelism tolerance (parallelism 4 of BS 308 : Part 3) for the prepared surface with respect to the lower surface of the cylinder as datum face is *2.0* mm wide.

Any slight protrusion on a capped surface may be removed by scraping.

8. Conditioning of prepared cylinder

Cylinders prepared by capping as in 7.1.3.5 shall, after the caps have hardened, be further cured in accordance with BS 1681 : Part 111 for a minimum of 48 h before testing.

Similarly, cylinders whose ends have been prepared by grinding as in 7.1.3.4 shall also be further cured for a minimum of 48 h.

All cylinders may be removed from the water for not more than 1 h for measuring dimensions but shall be re-immersed for at least 1 h before testing.

9. Report

9.1 General. The report shall affirm that the cylinders were made in accordance with this Part of this British Standard. The report shall state whether or not a certificate of sampling is available. If available a copy of the certificate shall be provided.

9.2 Information to be induded in the test report

9.2.1 *Mandatory information.* The following information shall be included in the test report:

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

(b) time and place of making cylinders;

(c) number and nominal size of cylinders;

(d) method of compaction (hand or vibration) including type of equipment used and the number of strokes of the compacting bar or duration of the vibration;

(e) method of end preparation;

(f) identification numbers or codes of cylinders;

(g) name of person making cylinders;

(h) certificate that the cylinders were made in accordance with this Part of this standard.

9.2.2 *Optional information.* If requested the following information shall be included 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) workability of concrete;

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

(g) lengths and weights of cylinder after end preparation;

(h) age(s) at which cylinders are to be tested.

*For information on the availability of a suitable material. apply to Central Enquiry Section, British Standards Institution. 2 Park Street, London W1A 2BS.

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Publications referred to

BS 308 Engineering drawing practice
Part 3 Geometrical tolerenclng
BS 410 Specification for test sieves
BS 891 Method for Rockwell hardness test
Part 1 Testing of metals
BS 915 High alumina cement
BS 1134 Method for the assessment of surface texture
BS 1881 Testing concrete
Part 101 Method of sampling fresh concrete on site
Part 108* Method for making tast cubes from fresh concrete
Part 109' Method for making test beams from fresh concrete
Part 111 Method of normd curing of test specimens (20 ºC method)
Part 112' Methods of accelerated curing of test cubes
Part 113* Method for making end airing no-fines test cubes
Part 117 Method for determination of tensile splitting strength
Part 121 Method for determiantion of static modulus of elasticity in compression
BS 3388 Forks, shovels and spades
BS 5328 Methods for specifying concrete, Including ready-mixed concrete
ISO 1920- Concrete tests - Dimensions, tolerances end applicability of test specimens

* Referred to in the foreword only.

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Cqmmittees responsible for this British Standard

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British Ready Mixed Concrete Association
Cement Admixtures Association
Cment and Concrete Association
Cement Makers' Federation
Concrete Society Limited
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Institution of Structural Engineers
Institution of Water Engineers and Scientists
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Royal Institution of Chartered Surveyors
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