ICS 91.100.10
CCS Q 11

NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 45002-2024

Method for determining water retention of cement mortar

水泥胶砂保水率测定方法

Issued on: November 28, 2024 **Implemented on: June 1, 2025**

Issued by: State Administration for Market Regulation;
Standardization Administration of the PRC

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1 Scope

This document sets out the requirements for the laboratory and the materials used in determining the water retention of cement mortar, describes the methods for determining the water content and the water retention of cement mortar, and sets out the treatment of the test results.

This document applies to the determination of the water retention of mortars made with common Portland cement and with masonry cement; other cements and materials may be tested by reference to it.

2 Normative references

The contents of the following documents constitute indispensable provisions of this document through the normative references made to them in the text. For dated references, only the edition corresponding to that date applies to this document; for undated references,

the latest edition, including all amendments, applies.

GB/T 6682, Water for analytical laboratory use - Specification and test methods; GB/T 17671, Method of testing cements - Determination of strength (ISO method); JC/T 681, Planetary cement mortar mixer; GSB 08-1337, Chinese ISO standard sand.

3 Terms and definitions

No terms and definitions need to be established for this document.

4 Laboratory environment and materials

4.1 Laboratory environment. The temperature of the laboratory shall be maintained at 20 °C +/- 2 °C, and the relative humidity shall not be lower than 50 %.

4.2 Water for the test. Drinking water shall be used. In case of dispute, grade 3 water complying with GB/T 6682 shall be used.

4.3 Standard sand. The sand shall meet the requirements of GSB 08-1337.

5 Determination of the water content of the cement mortar

5.1.1 Balance. The weighing range shall not be less than 2 kg and the scale interval shall not be greater than 0.1 g.

5.1.2 Planetary cement mortar mixer. It shall comply with JC/T 681.

5.1.3 Plunger-type cement mortar consistency apparatus. It shall comply with Annex A.

5.1.4 Tamping rod. A cylinder made of aluminium alloy, of mass 250 g +/- 15 g, with dimensions complying with Figure 1.

5.1.5 Metal straightedge. It shall comply with GB/T 17671.

5.1.6 Measuring cylinder. The scale interval shall not be greater than 0.5 mL.

5.2.1 Preparation of the test body. After the mortar has been prepared by the method laid down in GB/T 17671, the mortar container of the plunger-type cement mortar consistency apparatus is immediately filled in two layers, each layer being tamped 10 times with the tamping rod and compacted. The excess mortar at the top is removed with the metal straightedge held at an angle of 45°, moved radially across the mortar container with a sawing action; the sawing action is to be slow, so as not to drag the compacted mortar. The surface of the mortar is then smoothed off with the same metal straightedge held at an almost horizontal angle and moved in the opposite direction, the total number of smoothing passes not exceeding 3. Finally the mortar around the rim of the mortar container is wiped clean with a wrung-out damp cloth. The above operations are to be completed within 60 s of mixing.

5.2.2 Determination of the water content of the cement mortar at the defined consistency. The mortar container filled with cement mortar is placed on the base plate, the plunger is released from its initial position, and the scale value of the depth to which it sinks into the mortar is read; the above operations are to be completed within 150 s of mixing. When the scale value is 35 mm +/- 3 mm, the mortar has reached the defined consistency requirement. Otherwise the water content is adjusted, the mortar is mixed again, and the above test is repeated until the scale values of two consecutive tests both reach 35 mm +/- 3 mm. Before the start of each test the plunger is wiped with a damp cloth. The water content of the cement mortar at the defined consistency, my, and the scale value in millimetres are recorded.

6 Determination of the water retention of the cement mortar

6.1 Principle. Water is drawn from freshly mixed cement mortar at the defined consistency by filter paper; the mass fraction that the water retained in the mortar after suction represents of the initial water is the water retention of the cement mortar.

6.2.1 Rigid mould. A cylinder of internal diameter 100 mm +/- 1 mm and effective internal depth 25 mm +/- 1 mm.

6.2.2 Rigid base plate. Circular, without holes, of diameter 110 mm +/- 5 mm and thickness 5 mm +/- 1 mm.

6.2.3 Filter paper. Slow quantitative filter paper, circular, of diameter 110 mm +/- 1 mm.

6.2.4 Metal mesh. Circular and provided with a retaining ring, of diameter 110 mm +/- 1 mm, with a mesh size of 45 μm.

6.2.5 Metal weight. Of mass 2 kg +/- 1 g.

6.3.1 Preparation before the test. The mass mu of the empty dry mould is weighed to the nearest 0.1 g. The mass mv of 15 unused filter papers is weighed to the nearest 0.1 g.

6.3.2 Procedure for determining the water retention. When the cement mortar has reached the defined consistency, the mortar remaining in the mixing bowl is mixed again at low speed for 15 s; the rigid mould is then filled with the mortar using a metal spatula and the surface is smoothed off, and the mass mw of the mould filled with mortar is weighed to the nearest 0.1 g. The surface of the mortar is covered with the metal mesh, and the 15 weighed filter papers are placed on top of the metal mesh; the rigid base plate is placed on the filter papers, the mould is turned through 180° and set on a horizontal surface, and the metal weight is placed on the mould. After 300 s +/- 5 s the metal weight is removed, the mould is turned through 180° again, and the rigid base plate, the filter papers and the metal mesh are removed. The mass mx of the filter papers after suction is weighed to the nearest 0.1 g.

7 Treatment of the test results

7.1 Calculation of the results. Formula (1) gives the mass of the initial water in the cement mortar before suction. In this formula mz is the mass of the initial water in the cement mortar before suction, in grams (g); my is the water content of the cement mortar at the defined consistency, in grams (g); mw is the mass of the mould filled with cement mortar, in grams (g); mu is the mass of the empty dry mould, in grams (g); 1 350 is the mass of the standard sand, in grams (g); and 450 is the mass of the cement, in grams (g).

Formula (2) gives the water retention of the cement mortar. In this formula R is the water retention of the cement mortar; mx is the mass of the 15 filter papers after suction, in grams (g); and mv is the mass of the 15 filter papers before suction, in grams (g).

7.2 Treatment of the results. The mean of the results of two tests is calculated, to the nearest 1 %. If the deviation of either of the two test values from the mean is greater than 2 %, the test shall be repeated.

A Annex A (normative) Plunger-type cement mortar consistency apparatus

A.1 General. A schematic diagram of the plunger-type cement mortar consistency apparatus is shown in Figure A.1, in which the numbered items are: 1 base; 2 support; 3 holder; 4 guide bush; 5 release device; 6 aluminium measuring rod; 7 plunger; 8 mortar container.

A.2 Structure and components. A.2.1 Base: of metal, with a circular recess in the upper face that holds the mortar container in place. A.2.2 Support: of metal, used to connect the base to the holder. A.2.3 Holder: of metal or hard plastic, used to hold the aluminium measuring rod. A.2.4 Guide bush: fixed on the holder, used to guide the aluminium measuring rod and to reduce friction as it descends. A.2.5 Release device: a manual or automatic device used to grip and release the aluminium measuring rod. A.2.6 Aluminium measuring rod: of aluminium alloy, carrying a measuring scale with a smallest division of 1 mm. A.2.7 Plunger: corrosion-resistant and non-reactive with cement mortar, with a hemispherical lower end of radius 12.5 mm +/- 0.25 mm. A.2.8 Mortar container: of metal, cylindrical and provided with overflow protection, of internal diameter 80 mm +/- 1 mm and effective internal depth 70 mm +/- 1 mm.

A.3 Requirements. A.3.1 Coaxiality: once the apparatus has been assembled, the mortar container shall sit directly below the plunger, and the coaxiality of the aluminium measuring rod and the plunger with the mortar container shall not be greater than 0.5 mm. A.3.2 Mass: the combined mass of the aluminium measuring rod and the plunger shall be 90 g +/- 2 g. A.3.3 Coefficient of friction: the contact surfaces of the guide bush and the aluminium measuring rod shall be smooth and the coefficient of friction shall not be greater than 0.8,