भारतीय मानक
Indian Standard

IS 1199 (Part 7) : 2018

ताजा कंक्रीट — नमूने लेना, परीक्षण एवं विश्लेषण पद्धतियाँ

भाग 7 प्रवेश प्रतिरोधन द्वारा कंक्रीट के जमने के समय का निर्धारण

(पहला पुनरीक्षण)

Fresh Concrete — Methods of Sampling, Testing and Analysis

Part 7 Determination of Setting Time of Concrete by Penetration Resistance

(First Revision)

ICS 91.100.30

भारतीय मानक ब्यूरो
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Cement and Concrete Sectional Committee, CED 02

FOREWORD

This Indian Standard (Part 7) (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Cement and Concrete Sectional Committee had been approved by the Civil Engineering Division Council.

Testing plays an important role in controlling the quality of cement concrete work. Systematic testing of the raw materials, the fresh concrete and the hardened concrete, is an inseparable part of any quality control programme for concrete. This helps achieve a higher efficiency of the materials used and greater assurance of the performance of the concrete, in regard to workability, strength and durability. The test methods used should be simple, direct and convenient to apply. This standard was formulated with this objective in view.

This standard was first published in 1959. In this revision, it was decided to review and update the various existing test methods of fresh concrete taking into consideration the latest international practices and developments in this field in the country, and also introduced certain new test methods, wherever required. In the process, the various existing test methods covered in IS 1199:1959 'Methods of sampling and analysis of concrete' have been revised. The revision of standard is being brought out taking into consideration primarily the corresponding ISO Standards while also examining the other best practices world over and in the country. In addition, test methods for determination of properties of new types of concrete like self compacting concrete have been included, covering tests such as consistency, viscosity, passing ability and segregation resistance. Also, for better understanding and implementation, some of the other test methods which were spread over in other Indian Standards have been brought together under the fold of IS 1199 as its various parts, such as the setting time of concrete by penetration method and, water soluble and acid soluble chlorides in mortar and concrete. This is with a view to making the standard complete in all respects, and rendering it a comprehensive source of provisions for testing of concrete and reference in other Indian Standards.

In this revision, IS 1199 has been split into nine parts. The other parts in the series are:

Part 1 Sampling of fresh concrete

Part 2 Determination of consistency of fresh concrete

Part 3 Determination of density of fresh concrete

Part 4 Determination of air content of fresh concrete

Part 5 Making and curing of test specimens

Part 6 Tests on fresh self compacting concrete

Part 8 Determination of water soluble and acid soluble chlorides in mortar and concrete

Part 9 Analysis of freshly mixed concrete

This standard (Part 7) covers the determination of the setting time of concrete with slump greater than zero, by testing mortar sieved from the concrete mixture.

This test method shall be applicable as and when published in place of the corresponding IS 8142 : 1976 'Method of test for determining setting time of concrete by penetration resistance', which shall be superseded after the publication of this standard.

This revision of the standard has been taken up to incorporate the modifications found necessary in the light of experience gained in its use and also to bring it in line with the latest development on the subject. A significant provision in this revision is that the graph of time taken *versus* penetration resistance has been introduced for interpolation of initial setting time and final setting time of concrete, corresponding to a penetration resistance of 3.5 and 27.6 MPa, respectively.

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical-values (*revised*)'.

Indian Standard

FRESH CONCRETE — METHODS OF SAMPLING, TESTING AND ANALYSIS

PART 7 DETERMINATION OF SETTING TIME OF CONCRETE BY PENETRATION RESISTANCE

(First Revision)

1 SCOPE

1.1 This standard (Part 7) covers the method for determining the setting time of concrete with slump greater than zero, by testing mortar sieved from the concrete mixture. The initial setting time and the final setting time are the time intervals required for the mortar sieved from the concrete mixture to reach the specified values of penetration resistance measured from the initial contact of cement and water.

1.2 The method may be used for determining the effect of variables such as temperature, type and content of cement, concrete mix proportions and admixtures, upon the time of setting and hardening characteristics of concrete.

1.3 This test method is applicable under controlled laboratory conditions, as well as under field conditions.

2 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

2.1 Initial Setting Time — The time elapsed after initial contact of cement and water, till the mortar (sieved from the concrete) acquires a penetration resistance of 3.5MPa.

2.2 Final Setting Time — The time elapsed after the initial contact of cement and water, till the mortar (sieved from the concrete) acquires a penetration resistance of 27.6 MPa.

3 PRINCIPLE

The mortar sample is obtained by sieving a representative sample of fresh concrete. The mortar sample is placed in a container and stored at a specified ambient temperature. At regular time intervals, the resistance of the mortar to penetration by standard needles is measured. From a plot of penetration resistance *versus* elapsed time, the time of initial and final setting are determined.

4 APPARATUS

4.1 Containers for Mortar Specimens, shall be rigid, watertight, non-absorptive, free of oil/grease, either cylindrical or rectangular in cross-section, with minimum lateral dimension 150 mm and height at least 150 mm. The container for the mortar from the concrete mixture shall provide enough mortar surfaces for ten undisturbed readings of penetration resistance in accordance with clear distance requirements specified in **8.2**.

4.2 Penetration Resistance Apparatus, spring reaction-type apparatus, graduated from 50 N to 600 N in increments of 10 N or less; or hydraulic reaction-type apparatus with pressure gauge of 700 to 900 N capacity, graduated in increments of 10 N or less.

Indications of actual needle loads by these apparatus shall be accurate to 10 N. Removable needles of 645, 323, 161, 65, 32, and 16 mm^2 bearing areas shall be provided. Each needle shank shall be scribed peripherally at a distance of 25 mm above the bearing face. The length of the 16 mm^2 needle shall be not more than 90 mm to minimize bending. The apparatus shall be recalibrated periodically.

4.3 Pipette, or other suitable instrument for drawing off free water from the surface of the test specimens shall be used.

4.4 Tamping Rod, of circular cross-section, straight, made of steel, having a diameter of 16 ±1 mm, a length of 600 ± 5 mm and having rounded ends.

4.5 Thermometer, capable of measuring the temperature of the fresh mortar to an accuracy of 0.5°C. Glass thermometers having a temperature range from 0°C to100°C or other thermometers of the required accuracy, including the metal immersion type, are acceptable.

5 PREPARATION OF MORTAR SPECIMENS

5.1 From the concrete mixture under test, select a representative sample of concrete of sufficient volume to provide enough mortar to fill the test container, or containers, to a depth of at least 140 mm.

Remove all the mortar from the sample of concrete by sieving it through a 4.75mm IS sieve onto a non-absorptive surface.

5.2 Thoroughly mix the mortar manually on the non-absorptive surface. Measure and record the temperature of the mortar. Place the mortar in the container, or containers, in a single layer. Compact the mortar to eliminate air pockets in the specimen and level the top surface. This may be accomplished by rocking the container back and forth on a solid surface, or by tapping the sides of the container. Sieved mortar is generally of fluid consistency and air pockets are readily removed by this method of compaction.

For stiffer mortars, alternative method as given below, by tamping with the tamping rod, shall be followed.

Place the mortar in the container(s) in layers of 50 mm each, and compact by tamping each layer. Tamp the mortar once for each 6.5 cm^2 of top surface area of the specimen and distribute the strokes uniformly over the cross-section of the specimen. After completion of the tamping, tap the sides of the containers lightly with the tamping rod to remove voids left by the tamping rod and to further level the surface of the specimen.

Upon completion of specimen preparation, the mortar surface shall be at least 13 mm below the top edge of the container to provide space for the collection and removal of bleeding water and to avoid contact between the mortar surface and the protective covering specified in **8**.

6 STORAGE OF MORTAR SPECIMENS

6.1 For test under laboratory conditions, store the specimens, at a temperature of 27 ± 2°C.

6.2 For tests under field conditions, store the specimens under ambient conditions, or as specified by the user. Shield the specimens from direct sunlight.

6.3 Measure and record the ambient air temperature at the start and finish of the test. To prevent excessive evaporation of moisture keep the specimens covered with a suitable material such as a damp burlap or a tight fitting, water impermeable cover, for the duration of the test, except when the bleed water is being removed or penetration tests are being made.

7 NUMBER OF SPECIMENS

7.1 For tests under field conditions, prepare three specimens from each sample of concrete**.**

7.2 For tests under laboratory conditions, the requirements depend upon the purpose of the tests.

7.2.1 For testing to prove compliance of a material with performance requirements, at least three separate batches shall be made for each test condition. One test shall be made on each batch. An equal number of batches for each condition shall be made on any given day. When it is impossible to make at least one test for each variable on a given day, the mixing of the entire series of batches shall be completed in as few days as possible and one of the mixtures shall be repeated each day as a standard of comparison.

7.2.2 For other tests, prepare three test specimens from one batch of concrete for each test variable.

8 PROCEDURE

8.1 Remove bleed water from the surface of the mortar specimens just prior to making a penetration test by means of a pipette or a suitable instrument. To facilitate the collection of bleeding water, tilt the specimen carefully to an angle of about 10° from the horizontal by placing a block under one side 2 min prior to removal of the water.

8.2 Insert a needle of appropriate size, depending upon the state of hardening of the mortar, in the penetration resistance apparatus and bring the bearing surface of the needle into contact with the mortar surface. Gradually and uniformly apply a vertical force downward on the apparatus until the needle penetrates the mortar to a depth of 25 mm as indicated by the scribe mark. The time required to penetrate to the 25 mm depth shall be approximately 10 s. Record the force required and the time of application, measured as elapsed time after initial contact of cement and water. In subsequent penetration tests take care to avoid areas where the mortar has been disturbed by previous tests. The clear distance between two needle impressions shall be at least two diameters of the needle being used, but not less than 13 mm. The clear distance between any needle impression and the side of the container shall be not less than 25 mm.

8.3 Make penetration tests at hourly intervals for normal mixtures and normal temperatures, the initial test being made after an elapsed time of 2 to 3 h. For accelerated mixtures or high temperatures, it may be advisable to make the initial test after an elapsed time of 1 or 2 h and subsequent tests at 30 min intervals. For low temperature conditions or retarded concrete mixtures, the initial penetration test may be deferred for an elapsed time of 4 to 6 h and perhaps longer. Subsequent tests may be made at intervals of 1 h, unless the rate of increase in penetration resistance indicates that shorter intervals are desirable.

8.4 Not less than six penetrations shall be made in each rate of hardening test and the time intervals between penetration resistance determinations shall be such as to give a satisfactory rate of hardening curve, as indicated by equally spaced points. Continue the tests until a penetration resistance of at least 27.5 MPa is reached.

Calculate the penetration resistance in MPa**,** as the force

required to cause a 25 mm depth of penetration of the needle divided by the area of the bearing face of the needle.

NOTE — When carrying out this test, prevent skin contact with fresh concrete by wearing suitable protective clothing, gloves and footwear. If wet cement or concrete enters the eye, immediately wash it out thoroughly with clean water and seek medical treatment without delay. Wash fresh concrete off the skin immediately.

9 PLOTTING TEST RESULTS AND CALCULATION

9.1 Curves

For each variable and condition of concrete as specified in **7** the results from each of three or more rate of hardening tests shall be plotted separately, showing penetration resistance in MPa as the ordinate or y-axis and elapsed time in hours and minutes as the abscissa or x-axis, where 3.5 MPa and 1h are represented by not less than 15 mm.

A typical curve plotting penetration resistance (MPa) *versus* elapsed time (min) based on test observations is shown in Fig. 1.

9.2 Time of Setting

Times of initial and final setting as defined in **2.1** and **2.2** shall be calculated by averaging the elapsed

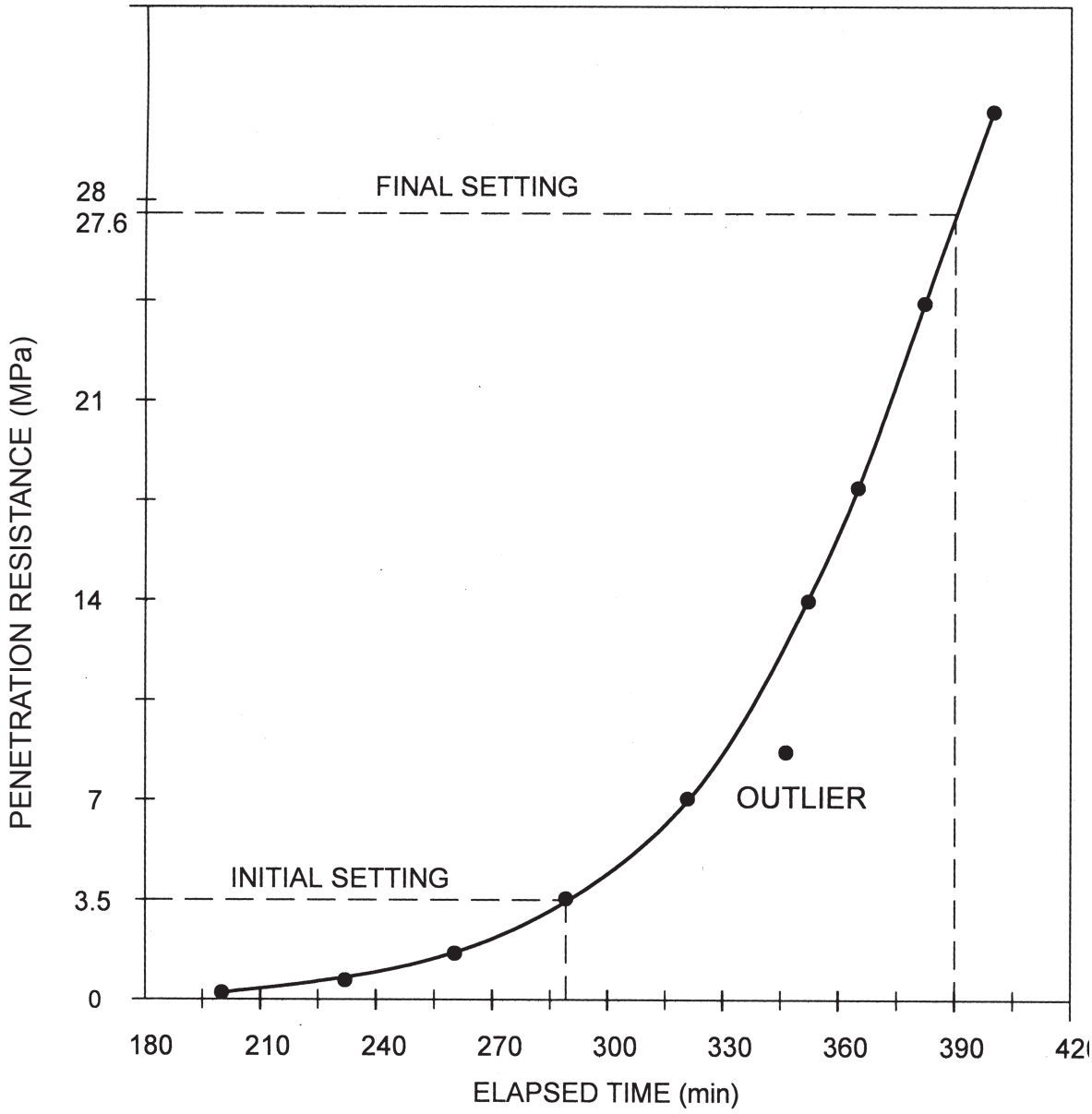

FIG. 1 PLOT OF PENETRATION VALUES *versus* ELAPSED TIME AND HAND FIT CURVE USED TO DETERMINE TIME OF SETTING

times, determined from the curves plotted in accordance with **9.1**. Times of setting shall be reported in hours and minutes to the nearest minutes.

10 REPORT

The report shall include the following:

a) Identification of the test sample;
b) Location, where the test was performed;
c) Date and time of test;
d) Temperature at which test was conducted laboratory/ambient/as specified (mention the value of the temperature in case of ambient/ as specified condition of testing);
e) Data on concrete mix (Grade, mix proportions, and maximum nominal size of aggregates);
f) Consistency of concrete as determined by the slump or other test for consistency;
g) The initial and final setting time as observed, in hours and minutes, to the nearest minute;
h) Any deviation from the standard test method;
j) Declaration by the person technically responsible for the test that it was carried out in accordance with this standard, except as noted in (h); and
k) The report may also include temperature of the mortar after sieving.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

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