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METHODS OF TEST FOR SOILS

PART XXIX DETERMINATION OF DRY DENSITY OF SOILS IN-PLACE BY THE CORE-CUTTER METHOD

(First Revision)

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PART XXIX DETERMINATION OF DRY DENSITY OF SOILS IN-PLACE BY THE CORE-CUTTER METHOD

(First Revision)

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(*Continued on page* 9)

Indian Standard

METHODS OF TEST FOR SOILS

PART XXIX DETERMINATION OF DRY DENSITY OF SOILS IN-PLACE BY THE CORE-CUTTER METHOD

(First Revision)

0. FOREWORD

0.1 This Indian Standard (Part XXIX) (First Revision) was adopted by the Indian Standards Institution on 22 September 1975, after the draft finalized by the Soil Engineering Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 With a view to establishing uniform procedure for the determination of different characteristics of soils and also for facilitating comparative studies of the results, the Indian Standards Institution has brought out this Indian Standard methods of test for soils (IS:2720) which is published in parts. This part [IS:2720 (Part XXIX)-1975] deals with the determination of dry density of soil in-place by using a core-cutter. The in-place density of soil is needed for stability analysis, for the determination of the degree of compaction of compacted soil, etc. The core-cutter method covered by this part is suitable for fine-grained soils free from aggregations. It is less accurate than the sand-replacement method and is not recommended, unless speed is essential or unless the soil is well compacted. Other parts relating to in-place determination of density of soils are:

Part XXVIII Determination of dry density of soils in-place by the sand replacement method

Part XXXIII Determination of the density in-place by the ring and water replacement method

Part XXXIV Determination of density of soil in-place by the rubber-baloon method

0.2.1 This standard was first published in 1966. In this revision, the test has been made applicable to soil 90 percent of which passes the 4·75-mm IS Sieve. The dimensions and requirements of the core-cutter have been modified. Detailed requirements for the steel rammer required for the test have been spelt out.

0.3 In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country. This has been met by basing the standard on the following publications:

BS 1377:1974 Methods of testing soils for civil engineering purposes. British Standards Institution.

INDIA. MINISTRY OF IRRIGATION AND POWER. CBIP Publication No. 42. Standards for testing soils, 1963. Central Board of Irrigation and Power, Delhi.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard (Part XXIX) covers the method for the determination of the in-place density of fine-grained natural or compacted soils free from aggregates using a core-cutter.

1.1.1 For the purpose of the tests described in this standard, a soil shall be termed as fine-grained soil if not less than 90 percent of it passes a 4·75-mm IS Sieve.

2. APPARATUS

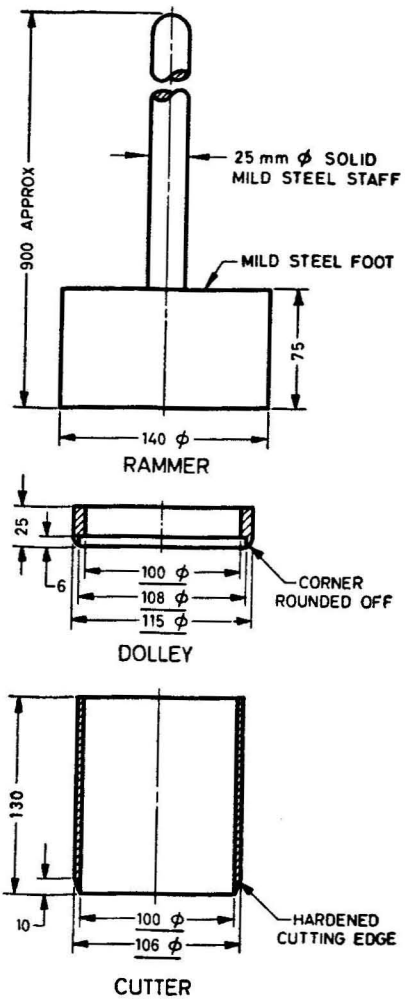
2.1 Cylindrical Core-Cutter — of seamless steel tube, 130 mm long (*see* Note 1) and 10 cm internal diameter, with a wall thickness of 3 mm, bevelled at one end, of the type illustrated in Fig. 1. The cutter shall be kept properly greased or oiled.

NOTE 1 — *Length of Cutter* — If the average density over a smaller depth is required then the appropriate length of cutter should be used.

NOTE 2 — Where situations permit, for quality control purposes smaller size cutters have also been used.

2.2 Steel Dolley — 2·5 cm high and 10 cm internal diameter with a wall thickness of 7·5 mm with a lip to enable it to be fitted on top of the core-cutter (*see* Fig. 1).

*Rules for rounding off numerical values (*revised*).



NOTE 1 — These designs have been found satisfactory, but alternative designs may be employed provided that the essential requirements are fulfilled.

NOTE 2 — Essential dimensions are underlined. (Tolerance on all essential dimensions shall be $\pm 0{\cdot}25$ mm).

All dimensions in millimetres.

FIG. 1 CORE-CUTTER APPARATUS FOR SOIL DENSITY DETERMINATION

2.3 Steel Rammer — With solid mild steel foot 140 mm diameter and 75 mm height with a concentrically screwed 25 mm diameter solid mild steel staff. The overall length of the rammer including the foot as well as the staff should be approximately 900 mm. The rammer (foot and staff together) should weigh approximately 9 kg (*see* Fig. 1).

2.4 Balance — Accurate to 1 g.

2.5 Palette Knife — A convenient size is one having a blade approximately 20 cm long and 3 cm wide.

2.6 Steel Rule

2.7 Grafting Tool or Spade or Pick Axe

2.8 Straight Edge — A steel strip about 30 cm long, 2·5 cm wide and 3 to 5 mm thick, with one bevelled edge will be suitable.

2.9 Apparatus for Extracting Samples from the Cutter — Optional.

2.10 Apparatus for Determination of Water Content — In accordance with IS : 2720 (Part II)-1973*.

3. PROCEDURE

3.1 The internal volume (V_c) of the core-cutter in cubic centimetres shall be calculated from its dimensions which shall be measured to the nearest 0·25 mm.

3.2 The cutter shall be weighed to the nearest gram (W_c).

3.3 A small area, approximately 30 cm square of the soil layer to be tested shall be exposed and levelled. The steel dolly shall be placed on top of the cutter and the latter shall be rammed down vertically into the soil layer until only about 15 mm of the dolly protrudes above the surface, care being taken not to rock the cutter (*see* Note). The cutter shall then be dug out of the surrounding soil, care being taken to allow some soil to project from the lower end of the cutter. The ends of the soil core shall then be trimmed flat to the ends of the cutter by means of the straight edge.

NOTE — The cutting edge should be kept sharp. The cutter should not be used in stony soils.

3.4 The cutter containing the soil core shall be weighed to the nearest gram (W_s).

3.5 The soil core shall be removed from the cutter and a representative sample shall be placed in an air-tight container and its water content (w) determined as in IS : 2720 (Part II)-1973*.

*Methods of test for soils: Part II Determination of water content (*second revision*).

NOTE — It is necessary to make a number of repeat determinations (at least three) and to average results, since the dry density of the soil varies appreciably from point to point. The number of determinations should be such that an additional one would not alter the average significantly.

4. CALCULATIONS

4.1 The bulk density γ_b; that is, the weight of the wet soil per cubic centimetre shall be calculated from the following formula:

$$\gamma_b = \frac{W_s - W_c}{V_c}, \text{ g/cm}^3$$

where

W_s = weight of soil and core-cutter in g,

W_c = weight of core-cutter in g, and

V_c = volume of core-cutter in cm^3.

4.2 The dry density γ_d, that is, the weight of the dry soil per cubic centimetre shall be calculated from the following formula:

$$\gamma_d = \frac{100\ \gamma_b}{100 + w}, \text{ g/cm}^3$$

where

γ_b = bulk density (*see* **4.1**), and

w = water content of the soil (percent) to two significant figures.

5. REPORTING OF RESULTS

5.1 The results of the test shall be recorded in a suitable form. A recommended *proforma* for the record of the results of this test is given in Appendix A.

5.2 The following values shall also be reported:

a) Dry density of the soil to second place of decimal in g/cm^3, and

b) Water content of the soil (percent) to two significant figures.

APPENDIX A

(*Clause* 5.1)

DETERMINATION OF DRY DENSITY OF SOIL IN-PLACE (CORE-CUTTER METHOD)

A-1. The test results shall be tabulated as follows:

PROJECT: TESTED BY:

LOCATION: DATE:

1. Determination No.	1	2	3
2. Weight of core-cutter + wet soil (W_s), in g			
3. Weight of core-cutter (W_c), in g			
4. Weight of wet soil ($W_s - W_c$), in g			
5. Volume of core-cutter (V_c), in cm^3			
6. Bulk density $\left(\gamma_b = \frac{W_s - W_c}{V_c}\right)$, in g/cm^3			
7. Water content container No.			
8. Weight of container with lid (W_1), in g			
9. Weight of container with lid and wet soil (W_2), in g			
10. Weight of container with lid and dry soil (W_3), in g			
11. Water content (w), in percent $w = \frac{W_2 - W_3}{W_3 - W_1} \times 100$			
12. Dry density $\left(\gamma_d = \frac{100 \quad \gamma_b}{100 + w}\right)$, in g/cm^3			

(*Continued from page* 2)

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