1. **SCOPE**

1.1. **Description of Test**

This method describes the procedure for determining the density of fine-grained soils in place and coarse-grained soils in place.

1.2. **Application of Test**

For purposes of this test method, fine-grained soils include all soil materials having more than 90% of its particles passing a 5.00 mm Canadian Metric sieve.

For purposes of this test method, coarse-grained soils include all material having more than 10% of its particles retained on a 5.00 mm Canadian Metric sieve.

2. **APPARATUS AND MATERIALS**

2.1. **Equipment Required**

Sampling tools - hammer, chisel, trowel, large spoon, 100 mm auger, banister brush and spikes.

Containers - two 2.3 L size mason jars for which the tare weights are known.

Balance - 0.1 g accuracy.

Sand Cone Density Apparatus - consisting of a double cone assembly having a cylindrical valve between the cones with an orifice 12.7 mm in diameter. The upper cone will be large enough to serve as a hopper to hold the density sand.

Density Sand - prepare a supply of air dried clean flowing sand which passes the 2.00 mm sieve and is retained on the 900 mm sieve. Thoroughly mix and pre-weigh 5000 g samples and store in a clean dry place.

Calibration Mold - a cylindrical mold 127 mm in diameter with 28.6 mm wide flange around the upper rim. The volume of the mold will be stamped into the metal.
Sieves - a 5.00 mm, 2.00 mm, 900 mm, and a 400 mm Canadian Metric Standard sieve.

Drying equipment - oven - capable of maintaining a temperature of 110°C and a hot plate or stove.

Thermometers - ranging between 35°C to 150°C.

3. **PROCEDURE**

3.1. **Test Procedure**

3.1.1. **Determination of Unit Weight of Sand**

Place the calibration mold in a pan.

Set the sand cone device in place on the flange of the calibration mold and close the valve.

Place the pre-weighed 5000 g sample of density sand in the hopper.

Open the valve and keep it open until the sand has stopped flowing and then close.

Re-weigh the sand remaining in the hopper.

The difference between the original (5000 g) and final weight will be the "weight of sand to fill calibration mold and cone."

The weight of sand to fill the lower cone will be determined in similar manner. Place the sand cone device on a flat surface and allow the sand (5000 g) to run into the cone. The difference between the original and final weight shall be recorded as the "weight of sand to fill cone."

Calculate the unit weight of sand from the above determinations.

If a base plate is to be used in the taking of density tests, the plate shall be placed between the flat surface and the cone. Test as above to determine the weight of sand to fill the cone and base plate.
3.1.2. Testing Procedure for Fine Grained Soils

Select the site to be tested at random or where sampling for proctor has been taken.

Scrape smooth and remove all loose material at the location to be tested.

Securely pin the base plate in position with spikes provided.

Start a small hole in the centre with a hammer and chisel.

Carefully enlarge the hole outwards with small hand tools until sufficient soil has been removed to fill two 2.3 L mason jars.

Exercise extreme care in removing the soil so as not to cause disturbance to surrounding material. Do not project the hole below the level of the material to be tested.

Place all the material removed from the hole in the mason jars except stone particles larger than 12.5 mm. These stones will be replaced in the hole during the volume measurement with density sand. The sealed jars will be taken to the lab and weighed to the nearest gram and the tare weight subtracted. The result will be recorded as "weight of material removed."

Boring the density hole with a hand auger may be permissible where soil is cohesive, slightly damp and not too sandy or granular.

Carefully place and centre the sand cone device over the test hole with the valve closed.

Place 5000 g of density sand into the storage hopper of the sand cone device.

Turn on the valve.

If stone particles are to be replaced in the hole, allow a small quantity of sand to run into the hole, close the valve, lift the apparatus, and partially imbed these particles into the sand. Replace the device, turn on the valve, allow the sand to run until the test hole and funnel are completely filled, and turn off the valve.

Remove the apparatus and remove the sand from the test hole and place in a large cloth bag along with other used sand for later reclaiming.
Weigh the unused sand in the hopper to determine the amount of sand used in the test. This weight of sand will be used to obtain the volume of hole and funnel.

Remove the soil from the two mason jars, mix thoroughly and obtain a representative sample for moisture determination as per STP 205-3.

3.1.3. Testing Procedures for Coarse-Grained Aggregates

The procedure is similar to that used for fine-grained soils with the following exceptions:

A base plate will not be used.

Coarse particles will not be replaced into the density hole.

All material removed from the density test hole will be dried and recorded as the "dry weight of material removed."

4. RESULTS AND CALCULATIONS

4.1. Calculations

Volume of Calibration Mold - as stamped on mold.

Unit Weight of Sand =

\[
\text{weight of sand to fill calibration mold} \div \text{volume of calibration mold}
\]

Volume of Cone = \[
\text{weight of sand to fill cone} \div \text{unit weight of sand}
\]

Volume of Density Hole and Cone =

\[
\text{weight of sand to fill hole and cone} \div \text{unit weight of sand}
\]

Volume of Density Hole =

volume of hole and cone less volume of cone
Moisture Content = \( \frac{\text{weight of moisture}}{\text{weight of dry sample}} \times 100 \)

Density of Fine-Grained Soil = 
\[
\frac{\text{weight material removed} \times 1000 \times 100}{\text{volume of density hole} \times (100 + \% \text{ moisture})}
\]

Density of Coarse-Grained Aggregates = 
\[
\frac{\text{dry weight of material removed} \times 1000}{\text{volume of density hole}}
\]

4.2. **Reporting Results**

Report dry density and moisture content on form MR 13-79.

5. **ADDED INFORMATION**

5.1. **General**

During the calibration for determining the unit weight of sand the counter and field lab should be free of any sudden jars or vibrations.

The sand should be re-sieved after each use to remove any foreign matter gained from the surface tested and stored in a relatively dry place when not being used.

The site chosen must always be flat and smooth as possible for the test.

A soil tray will be used for fine grained soils, however, it will not be used for most base courses due to the rough surface causing seating problems of the tray.

An auger may be used for digging the hole in most cohesive fine grained soils and a chisel and hammer must be used for base course as the material is too coarse to dig by hand auger.

Great care must be taken to get the walls of the hole as smooth as possible as this affects the volume measurement.

The test should be done in such a way that the sand cone is free from any vibrations or disturbances during the flowing of the sand as this affects the volume of the hole.
Material excavated from the hole should be placed in sealed containers and weighed as quickly as possible to prevent moisture loss.

When the percentages of compaction change abruptly either the construction procedure has changed or the material; thus a new proctor will be required where the density test was taken and will be used for future calculations.
APPROVAL SHEET

New ___ Revision X ___ Date of Previous Document 85-04-01
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Description of Revision (Reason for Revision):
Format of test procedure updated.

Review/Implementation Process:
Reviewed by the Materials Section of the Technical Standards and Policies Branch.

Other Manuals/Policies Affected:
Nil

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Nil

Comments/Concerns/Implications (Budget/Environment/Stakeholders):

Prepared and Recommended by D. MacLeod 93-11-25
Materials Standards Engineer Date

Approval Recommended by R.A. Widger ___-___
Senior Materials Engineer Date

Approval Recommended by A.R. Gerbrandt ___-___
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Approved by D.G. Metz ___-___
Assistant Deputy Minister, Infrastructure Date

Electronic File Updated ___-___
Update Mailed ___-___