INDIAN INSTITUTE OF TECHNOLOGY GANDHINAGAR
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SAND REPLACEMENT (INSITU-DENSITY) METHOD
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THEORY:

The in-situ density is defined as the bulk density of soil measured at its actual depth. By conducting this test, it is possible to determine the field density of the soil. The moisture content is likely to vary from time and hence the field density also. So it is required to report the test result in terms of dry density.

NEED & SCOPE:

This method of test is intended for determining the **in-situ density** of soils. The apparatus described herein is restricted to the tests in soils containing particles not larger than 2" in diameter. The in situ density of natural soil is needed for the determination of bearing capacity of soils, for the purpose of stability analysis of slopes, for the determination of pressures on underlying strata for the calculation of settlement and the design of underground structures. It is very quality control test, where compaction is required, in the cases like embankment and pavement construction.

APPARATUS REQUIRED:

1. Sand pouring Apparatus
2. Standard sand-graded between the No.25 (600 micron) and No.52 (300 micron) B.S. Sieves
3. Soil tray with a central hole
4. Balance of 15kg capacity
5. Sensitive balance accurate to 0.1gm
6. Oven

Miscellaneous equipments such as small pick chisels or spoon for digging test hole, moisture tins.

PROCEDURE:

1. Weight of Sand Occupying the Cone of the Sand Pouring Apparatus

Pour sand into the apparatus with valve closed and determine weight of apparatus and sand (W_1). Place the apparatus on a smooth glass plate and open the valve to fill the conical portion. After the sand stops running, close the valve sharply, and weight the remaining sand into the apparatus (W_2). The weight ($W_1 – W_2$) represents the weight of sand required to fill the cone of the apparatus. Replace the sand removed in the apparatus.

2. Density of Sand

Fill the Sand Pouring Apparatus with known weight of sand (W_3) and place it concentrically on top of the calibrating cylinder. Open the shutter and allow the sand to drain out. When no further movement of sand takes place in the apparatus, close the shutter and weight the sand remaining in the apparatus (W_4).The weight (W_3-W_4) represents the quantity of sand used in filling calibrating cylinder as well as cone of the apparatus.

Now [(W_3-W_4) – ($W_1 – W_2$)] gives the weight of sand required to fill the calibrating cylinder. Volume (V_c) of the cylinder may be determined either by measuring its internal dimensions or by filling it with water.

Density of sand can be computed using mass of sand filled in cylinder and volume (V_c) of the cylinder.

3. Density of Soil

Prepare the surface of the location to be tested so that it is a level plane. Keep the soil tray firmly on the place surface. Excavate with hand tools a hole with diameter equal to that of the hole of the plate and about 10cm in depth with smooth walls and rounded bottom edges. Place all loosened soil in a container being careful to avoid losing any material. Seat the already weighed apparatus with sand on the hole of the tray. Open the valve and after the sand has stopped flowing close the valve. Weigh the apparatus with remaining sand and determine the weight of sand occupying the cavity. Weigh the material that was removed from the test hole. Mix the material thoroughly and weigh a representative sample for moisture determination. Dry and weigh the sample to determine moisture content.

OBSERVATIONS & RECORDINGS:

From the known density of sand and the weight of sand occupying the hole, calculate the volume of hole.

From the weight of the soil scooped out of hole whose volume is now known and the value of moisture content, calculate the wet and dry density of soil.

i) SAND REPLACEMENT METHOD:

No.	Particulars	1	2	3
1.	Bulk density of standard Sand gm/cc			
2.	Weight of Sand pouring apparatus +sand before Experiment gm			
3.	Weight of sand pouring apparatus + sand after Experiment gm			
4.	Weight of sand drained out gm			
5.	Weight of sand occupying cone gm			
6.	Weight of sand occupying cavity gm			
7.	Volume of cavity			
8.	Weight of soil scooped out from the cavity gm			
9.	Wet density gm/cc			
10.	Moisture content			
11.	Dry density gm/cc			

Moisture Content Percent:

CONTAINER No.:			
Wt. of container + Wet Soil gm			
Wt. of container + Dry soil gm			
Wt. of container gm			
Wt. of water gm			
Wt. of dry soil gm			
Moisture Content in percent			

- Average Moisture Content of the Soil Layer = percent
- Average Dry Density of the Soil Layer = gm/cc