MODIFIED PROCTOR TEST

1. Objective

To obtain the graphical relationship of the "dry density' to "moisture content" in the form of "compaction curve", for determining the values of Optimum Moisture Content (OMC) and Maximum Dry Density (MDD).

2. Apparatus Required

Fig. 1: Proctor Mould & Metal Rammer

Metal mould (volume = 1000 cm^3 for 100 mm diameter mould and volume= 2250 cm^3 for 150 mm diameter mould (as per IS:10074-1982) & Metal rammer conforming to IS: 9189-1979. (weight = 4.9 kg)

Fig. 2: Balance

Balance: one of capacity 10 kg and least count 1g and other of 200 g capacity and sensitivity 0.01 g

Fig. 3: Sieve

4.75mm, 19 mm and 37.5 mm I.S. Sieves conforming to IS: 460 (Part 1) – 1985

Fig. 4: Oven

Thermostatically controlled to maintain temperature between 105^0 to 110^0C

Fig. 5: Steel Straight Edge

For trimming the protruded excessive soil of the mould

Fig. 6: Airtight Container

Taking sample for determination of Moisture Content

3. Reference

IS-2720 (Part-8):1983 (Reaffirmed- May 2015) "Methods of test for soils: Determination of water content - dry density relation using heavy compaction".

4. Procedure

1. Take a representative portion of air-dried soil large enough to provide about 5 kg of material passing 19mm IS sieve (for soils not susceptible to crushing during compaction) or about 15 kg of material passing 19mm IS sieve (for soils susceptible to crushing during compaction. Sieve this on a 19mm IS sieve and the reject the coarse fraction after its proportion of the total sample has been recorded.
2. Add suitable amount of water with the soil and mix it thoroughly. For sandy and gravelly soil add 3% to 5% of water. For cohesive soil the amount of water to be added should be 12% to 16% below the plastic limit.
3. Weigh the mould with base plate attached, to the nearest 1g and record the weight as W_1. Attach the extension collar with the mould. Compact the moist soil into the mould in five layers of approximately equal mass, each layer being given 25 blows, with the help of 4.9 kg rammer, dropped from a height of 450mm above the soil. The blows must be distributed uniformly over the surface of each layer. The operator shall ensure that the tube of the rammer is kept clear of soil so that the rammer always falls freely.
4. After completion of the compaction operation, remove the extension collar and level carefully the top of the mould by means of straightedge. Weigh the mould with the compacted soil to the nearest 1 g and record this weight as W_2.
5. Remove the compacted soil from the mould and place it on the mixing tray. Determine the water content of a representative sample of the specimen. Record the moisture content as 'M'.
6. The remainder of the soil shall be broken up and repeat Steps (iii) to (v) above, by adding suitable increment of water to the soil. For sandy and gravelly soils the increment is generally 1% to 2% and for cohesive soils the increment is generally 2% to 4%. The total number of determinations made shall be at least five, and the moisture contents should be such that the optimum moisture content, at which the maximum dry density occurs, is within that range.
7. For compacting soil containing coarse material up to 37.5 mm size, the 2250 cm^3 mould should be used. A sample weighing about 30 kg and passing the 37.5 mm IS sieve is used for the test. Soil is compacted in five layers, each layer being given 55 blows of the 4.9 kg rammer.

NOTE 1 - It is important that the water is mixed thoroughly and adequately with the soil, since inadequate mixing gives rise to variable test results. This is particularly important with cohesive souls when adding a substantial quantity of water to the air-dried soil. With clays of high plasticity, or where hand mixing is employed, it may be difficult to distribute the water uniformly through the air-dried soil by mixing alone, and it may be necessary to store the mixed sample in a sealed container for a minimum period of about 16 hours before continuing with the test.

NOTE 2.- It is necessary to control the total volume of soil compacted, since it has been found that if the amount of soil struck off after removing the extension is too great, the test results will be inaccurate.

NOTE 3 - The water added for each stage of the test should be such that a range of moisture contents is obtained which includes the optimum moisture. In general, increments of 1 to 2 percent are suitable for sandy and gravelly soils and of 2 to 4 percent for cohesive soils. To increase the accuracy of the test it is often advisable to reduce the increments of water in the region of the optimum moisture content.

5. Calculation

1. Bulk density, γ_m in g/cm^3 of each compacted specimen is calculated from the following equation.

$$\gamma_m = (W_2 - W_1)/V_m$$

Where,
W_1 = Weight in g of mould + base plate
W_2 = Weight in g of mould + base plate + soil
V_m = Volume of mould i.e. 1000 cm^3.

2. Dry density, γ_d in g/cm^3 of each compacted specimen is calculated from the following equation.

$$\gamma_d = 100\ \gamma_m / (100+M)$$

Where,
γ_m = Bulk density of soil in g/cm^3.
M = Moisture content of soil

6. Graph

The dry densities, γ_d, obtained in a series of determinations is plotted against the corresponding moisture content 'M'. A smooth curve is then drawn through the resulting points and the position of

the maximum on this curve is determined, which is called maximum dry density (M.D.D). And the corresponding moisture content is called optimum moisture content (O.M.C.).

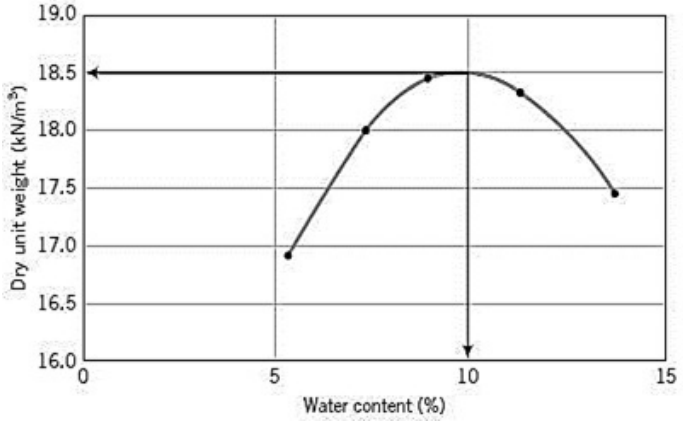

Fig. 7 : Plot of dry Unit Weight v/s Moisture Content (Compaction Curve)

7. Video

- Modified Proctor Test