UNIVERSITY OF MUSTANSIRIYAH-COLLEGE OF ENGINEERING –CIVIL ENGINEERING DEPARTMENT

Highway Pavement Lab3

Soil compaction tests in place

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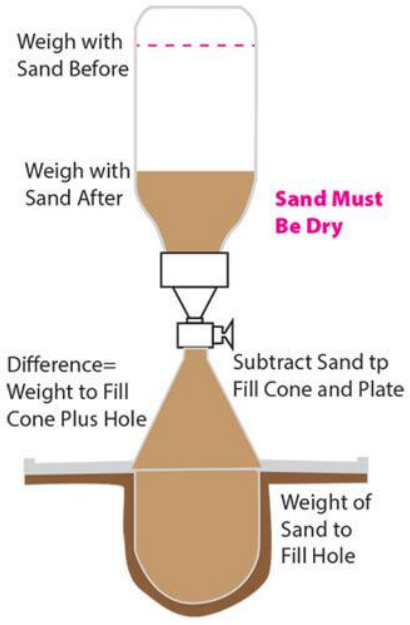


Lab of Highway Pavement

Density in Place: ASTM D1556

The soil compaction test in the place of field work uses to measure the dry density and moisture content of the soil. Results from these field tests are compared to the Proctor test results (established in the lab) of the same soil from the same source used for the field project and the ratio is expressed as the percent compaction.

Several methods of compaction test in the place can be used. The four most common are:

1. Sand Cone Method (Sand –displacement)
2. Rubber balloon Method
3. Nuclear method (γ-radiation)
4. Core cuter method

https://www.youtube.com/watch?v=1qgH2aBphIE

Sand Cone Test (ASTM D1556 / AASHTO T 191)

Sand Cone Density is an accurate and reliable test method that has long been used to measure the in-place density and water content of compacted soils placed during the construction of earth embankments, road fill, and structural backfill using a sand cone apparatus. The procedure is described in ASTM D1556 / AASHTO T 191.

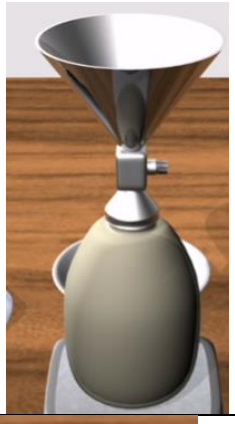
Significance and Use

1. It is preferable for earth embankments construction, road fill and structure back fill construction
2. The use of this test method is generally limited to soil in an unsaturated condition. This test method is not recommended for soils that are soft or friable (crumble easily) or in moisture conditions
3. It is limited to soils without appreciable amounts of rock or coarse materials in excess of 1½ in. [38 mm] in diameter.
4. The soil should have sufficient cohesion to maintain stable sides on a small hole or excavation,

5. This test method is not suitable for organic, saturated, or highly plastic soils that would deform or compress during the excavation of the test hole.

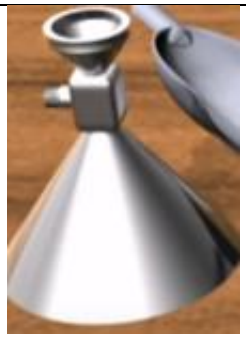
Apparatus

1. Sand-Cone Density Apparatus, consisting of
   a. Sand container,
   b. Sand cone, and
   c. Base plate.

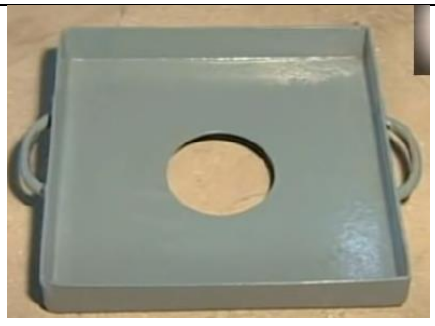


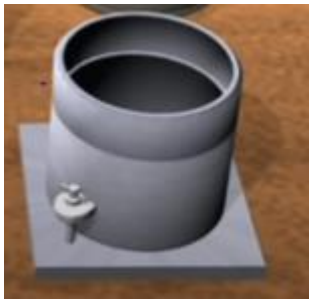
a. Sand container, an attachable jar or other sand container having a volume capacity in excess of that required to fill the test hole and sand cone during the test (1 gallon gar (4 litters=4000cm^3)

b. Sand Cone, a detachable appliance consisting of a cylindrical valve with an orifice approximately 1⁄2 in. [13 mm] in diameter, attached to a metal funnel and sand container



c. Base Plate, a metal base plate or template with a flanged center hole cast or machined to receive the large funnel (cone)



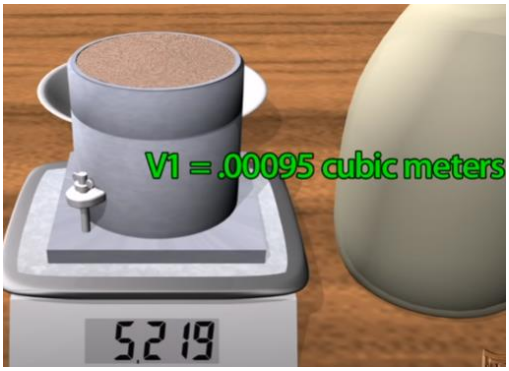
2. Sand—must be clean, dry, uniform in density and grading, un-cemented, durable, and free-flowing 	Balances or Scales 
4 Drying Equipment 	Miscellaneous Equipment: spatula, , digging tools, Pan, containers and mould 

Procedure:

https://www.youtube.com/watch?v=A1OEx0W_yAk

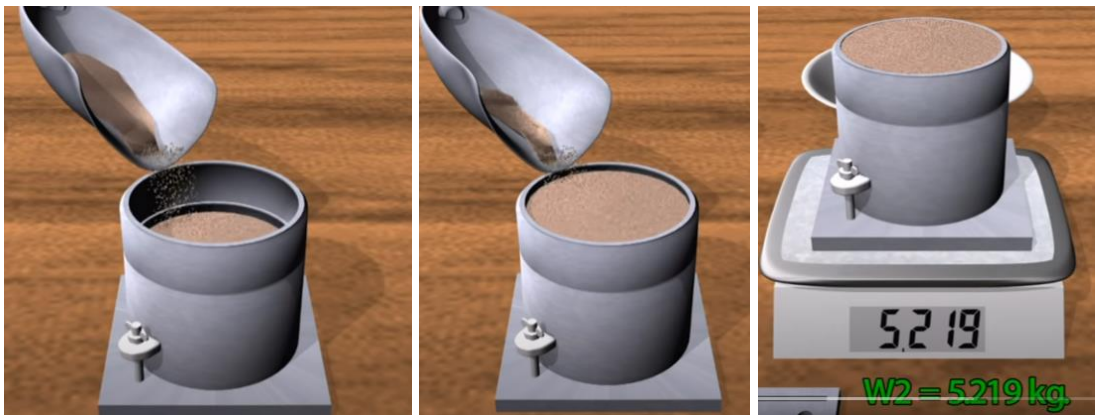
https://www.youtube.com/watch?v=XvRvnSjN2Mg

1. Determine the Bulk density of the standard sand
   a. Find the volume of the mould



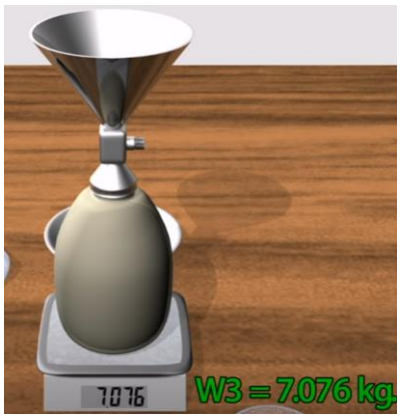
b. Record the weight of the empty mould (W1)

c. Fill the mould with the standard soil and record W2 (W2= the weight of the mould +sand)

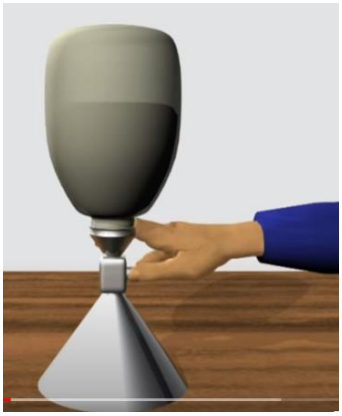


2. Determine the weight of the sand filling the sand cone

a. Fill the sand container with sufficient amount of the standard sand sample
b. Weigh the sand cone + sand container + sand and record W3



c. Invert the sand cone and seat it on a pan, then open the valve of the cone fully until the sand flow stops



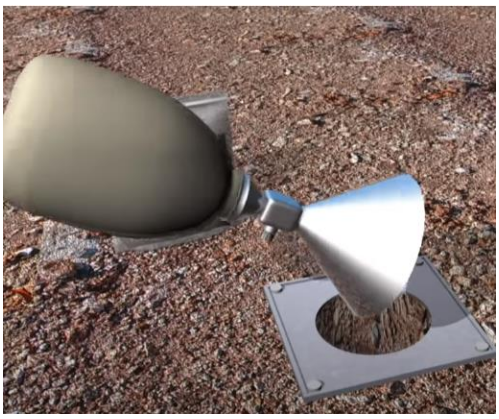
d. Close the valve and return the sand cone +sand container to the balance to weigh the sand cone +sand container + remaining sand to record W4

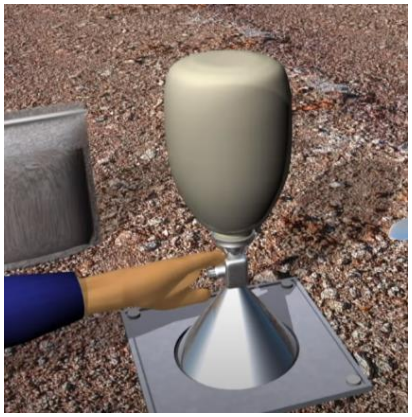
3. Determine the volume of the hole in the site of the project
   a. Select the place of conducting the test which should be clean and level

b. Seat the base plate on the plane surface, making sure there is contact with the ground surface around the edge of the flanged centre hole. Secure the plate against movement using nails

c. Drill depth vertically to depth of 10-15 cm and keep the extracted soil in a plastic bag in order to keep the soil in its moisture level


d. Invert the sand cone and seat it into the flanged hole of metal pale vertically and open the valve to fill the hole with sand

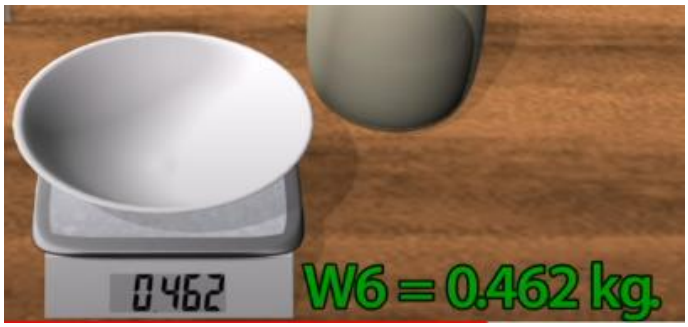




e. When the sand stop to flow, it means that the hole is full, so close the valve

f. Weigh the sand cone +container + remaining sand to record W5

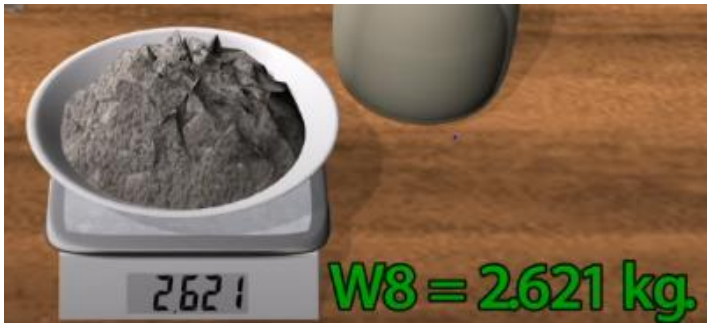
4. Find the wet density of the soil in the place
   a. Weigh the empty evaporating dish (or empty container) and record W6



   b. Put all the extracted soil from the hole in the dish and record the weight of the dish +wet soil (W7)

   c. Dry the soil using the oven for 24 hours

   d. Weigh the dish + dry soil and record (W8)



Calculation:

1. Determine the bulk density of the standard sand

$$\textit{Buk density of the standard sand } (\gamma d) = \frac{W2-W1}{V1}$$

2. Determine the weight of the sand filling the sand cone (Wc)

$$Wc = W3\text{-}W4$$

3. Find the volume of the hole (V2)

$$V2 = \frac{(W3-W5)-Wc}{Bulk\ density}$$

4. Find the moisture unit weight of the soil in the place (γw)

$$\gamma w = \frac{W7-W6}{V2}$$

5. Find the water content of the soil extracted from the site (%Ww)

$$\%Ww = \frac{W7-W8}{W8-W6}$$

6. Find the dry unit weight of the soil in the place (γd)

$$\gamma d = \frac{\gamma w}{\frac{\%Ww}{100}+1}$$

To compare the Dry density in the lab (found from compaction test in the lab) with the dry density in the place , find rate of compaction R.C

$$R.C = \frac{\gamma d\ in\ place}{\gamma d\ max\ (from\ lab\ test)} \times 100 > 75\% \quad \text{……..> (95-100\%)}$$