ONLINE LEARNING

FIELD DENSITY TEST

Sand Replacement Method

(aka Sand Cone)

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MATEST

FDT – On site Procedure

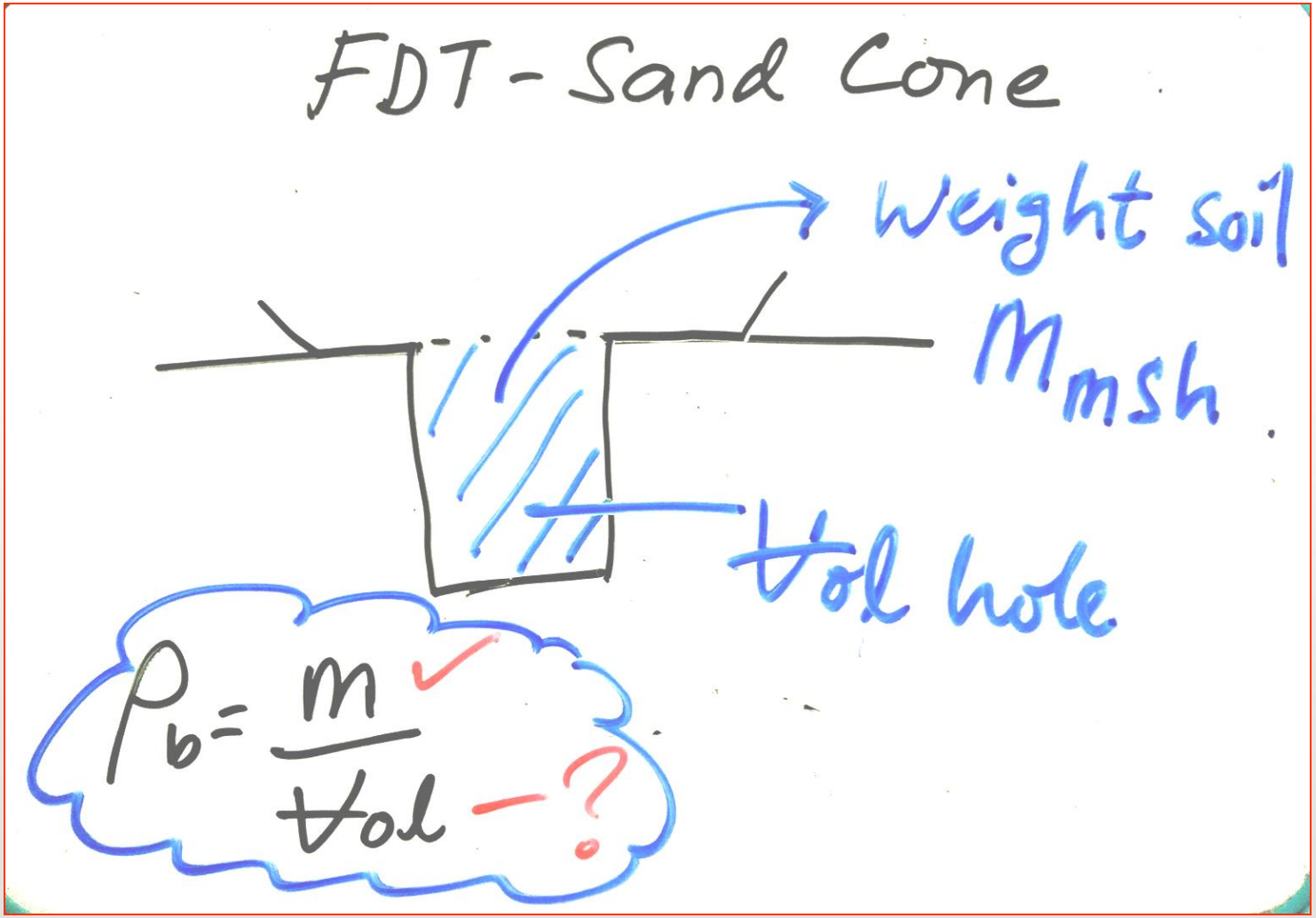
1. Leveled the pre-compacted road layer
2. Place and secure the plate on the leveled surface
3. Dig the soil according to plate opening and put it in the tray
4. Weight the moist soil from hole
5. Take a small sample of soil for moisture content determination
6. Weight the sand cone apparatus before test
7. Invert and place the apparatus over the hole, open the valve and let the sand flow out until it stop flowing
8. Weight the sand cone apparatus after test
9. Determine the mass of sand required to fill the hole
10. Determine the Degree of compaction (DOC)

Derivation and Calculation

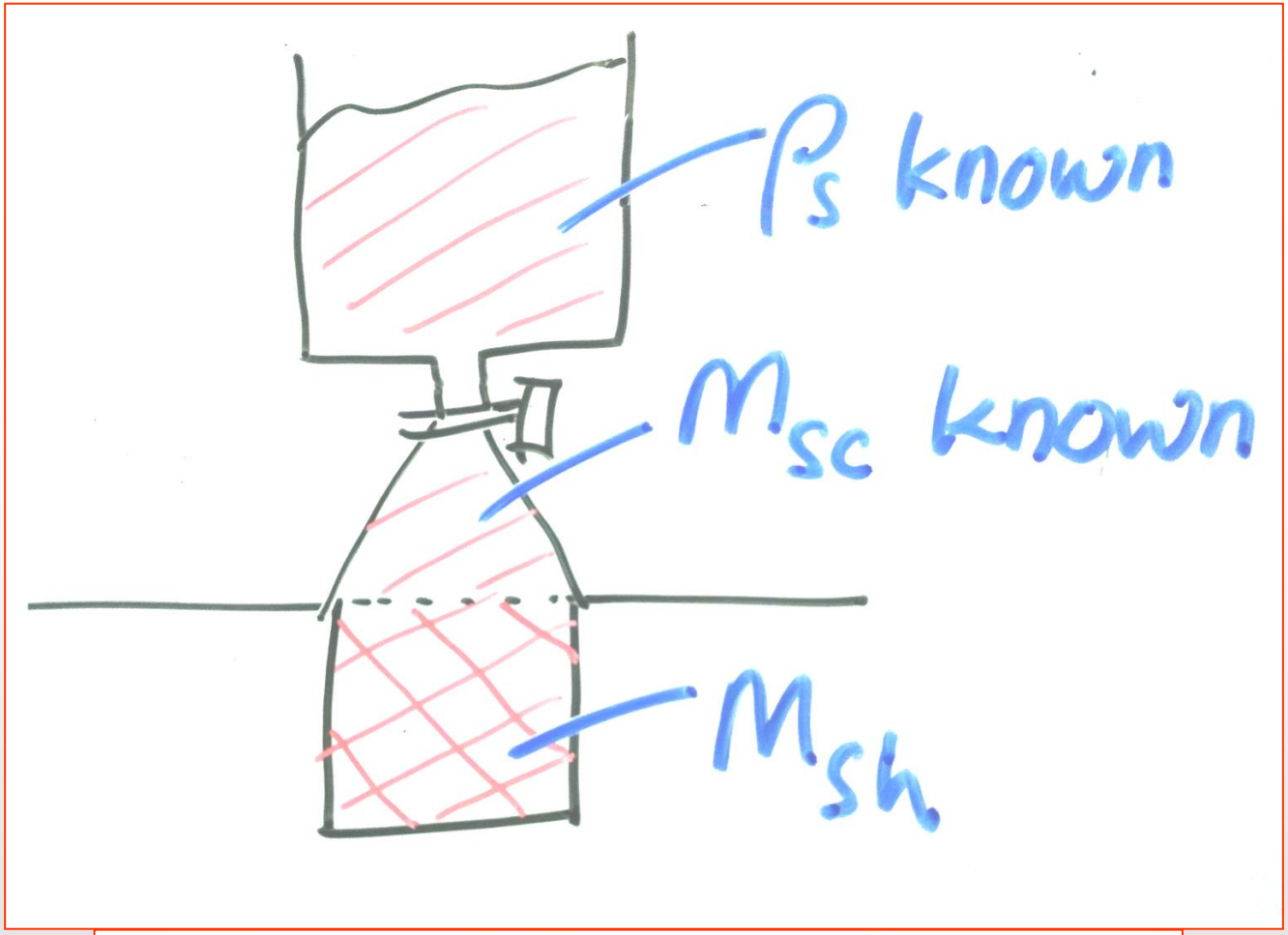
Note:

1. Density (ρ_s) and mass of sand to fill the cone (m_{sc})should have been pre-determined and calibrated in the laboratory
2. MDD and OMC for the road layer material has been determined through laboratory compaction

Derivation



Derivation



$$m_{sb} - m_{sa} = m_{sc} + m_{sh}$$

Derivation

$$\text{Density} = \frac{m}{\forall_h}$$

$$\rho_s = \frac{m_s}{\forall_s} \; ; \quad \forall_s = \forall_h$$

$$\forall_s = \frac{m_s}{\rho_s} = \forall_h$$

Derivation

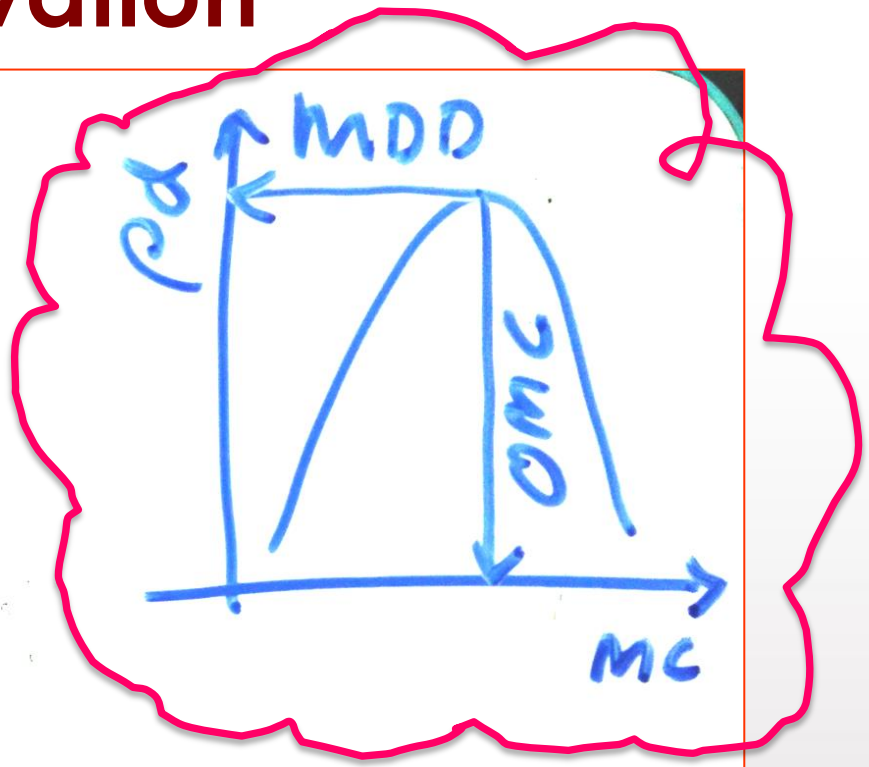
$$\rho_b = \frac{m_{msh}}{V_h}$$

$$= \frac{m_{msh}}{\left(\frac{m_{sh}}{\rho_s}\right)} = \frac{m_{msh}}{m_{sh}} \times \rho_s$$

Derivation

$$\rho_d = \frac{\rho_b}{1 + mc}$$

from sample



$$DOC = \frac{\rho_d}{MDD} \times 100 \geq 95\%$$

Worked Example

A field density test (using sand replacement method) was carried out on a compacted road base layer. The following results were recorded:

Mass of sand in the bottle (before test)	6655 g
Mass of sand in the bottle (after test)	2965 g
Mass of moist material from test hole	4315 g

Moisture content sample of this material:

(original mass)	312.3 g
(final mass)	286.8 g

Knowing the density of sand is 1252 kg/m^3, mass of sand in cone 1275 g, and MDD of 2.220 Mg/m^3, determine the relative compaction (DOC) of the road base.

Given Data:

M_{sb} = 6655 g

M_{sa} = 2965 g

M_{msh} = 4315 g

M_{sc} = 1275 g

ρ_s = 1252 kg/m^3

MDD = 2220 kg/m^3

Moisture content determination:

moist mass = 312.3 g

dry mass = 286.8 g

Solution

ρ_b = [4315 / (6655 – 2965 - 1275)] x 1252 kg/m^3
= 2237 kg/m^3

mc = (312.3 - 286.8) / 286.8
= 0.088

ρ_d = 2237 / (1+0.088)
= 2056 kg/m^3

DOC = [2056 / 2220] x 100%
= 92.6% (less than 95%, not properly compacted)

Thank you for your attention

e-mail your questions to:

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