EXPERIMENT 3

DENSITY (UNIT WEIGHT) DETERMINATIOM

Purpose:

This lab is performed to determine the in-place density of undisturbed soil obtained by pushing or drilling a thin-walled cylinder. The bulk density is the ratio of mass of moist soil to the volume of the soil sample, and the dry density is the ratio of the mass of the dry soil to the volume the soil sample.

Standard Reference:

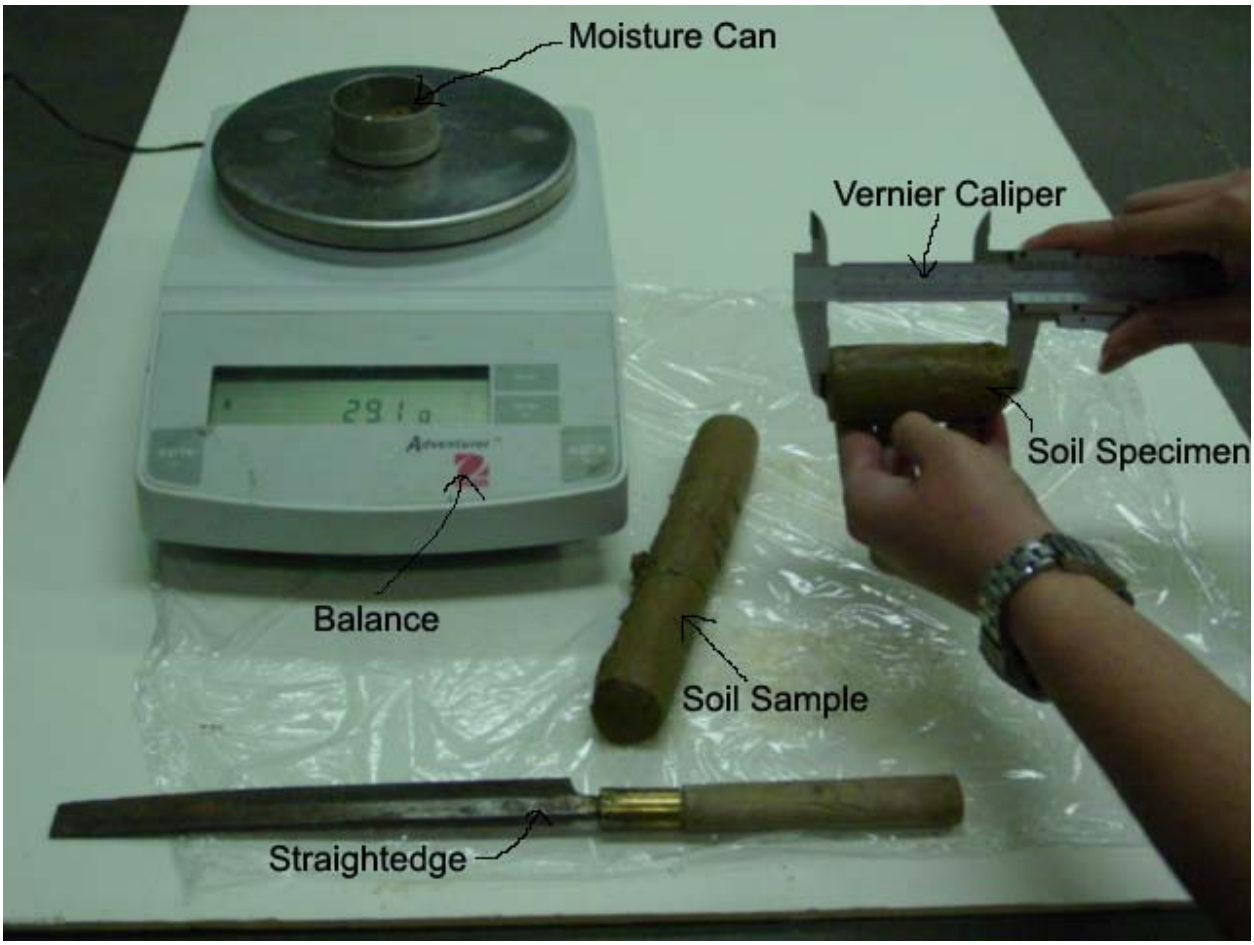
ASTM D 2937-00 – Standard Test for Density of Soil in Place by the Drive-Cylinder Method

Significance:

This test is used to determine the in-place density of soils. This test can also be used to determine density of compacted soils used in the construction of structural fills, highway embankments, or earth dams. This method is not recommended for organic or friable soils.

Equipment:

Straightedge, Balance, Moisture can, Drying oven, Vernier caliper



Test Procedure:

(1) Extrude the soil sample from the cylinder using the extruder.

(2) Cut a representative soil specimen from the extruded sample.

(3) Determine and record the length (L), diameter (D) and mass (M_t) of the soil specimen.

(4) Determine and record the moisture content of the soil (w). (See Experiment 1)

(Note: If the soil is sandy or loose, weigh the cylinder and soil sample together. Measure dimensions of the soil sample within the cylinder. Extrude and weigh the soil sample and determine moisture content)

Data Analysis:

(1) Determine the moisture content as in Experiment 1

(2) Determine the volume of the soil sample

$$V = \frac{\pi D^2 L}{4} \quad cm^3$$

(3) Calculate bulk density (ρ_t) of soil

$$\rho_t = \frac{M_t}{V} \quad \frac{g}{cm^3}$$

or unit weight $\gamma_t = \rho_t g$

(4) Calculate dry density (ρ_d) of soil

$$\rho_d = \frac{\rho_t}{1+w} \quad \frac{g}{cm^3}$$

or dry unit weight $\gamma_d = \rho_d g$

EXAMPLE DATA

DENSITY (UNIT WEIGHT) DETERMINATION
DATA SHEET

Sample number: B-1, ST-1, 10'-12' Date Tested: September 10, 2002

Soil description: Gray silty clay

Mass of the soil sample (M_t): 125.20 grams

Length of the soil sample (L): 7.26 cm

Diameter of the soil sample (D): 3.41 cm

Moisture content determination:

Specimen number	1
Moisture can and lid number	15
M_C = Mass of empty, clean can + lid (grams)	7.83
M_{CMS} = Mass of can, lid, and moist soil (grams)	13.43
M_{CDS} = Mass of can, lid, and dry soil (grams)	12.69
M_S = Mass of soil solids (grams)	4.86
M_W = Mass of pore water (grams)	0.74
w = Water content, w%	15. 2

Example calculations: w=15.2%, M_t=125.2g, L=7.26cm, D=3.41cm

$$V = \frac{\pi(3.41)^2(7.26)}{4} = 66.28 \quad cm^3$$

$$\rho_t = \frac{125.20}{66.28} = 1.89 \quad \frac{g}{cm^3} \quad or \quad \gamma_t = 1.89 \times 62.4 = 118 \quad \frac{lb}{ft^3}$$

$$\rho_d = \frac{1.89}{1+\left(\frac{15.20}{100}\right)} = 1.64 \quad \frac{g}{cm^3} \quad or \quad \gamma_d = 1.64 \times 62.4 = 102.3 \quad \frac{lb}{ft^3}$$

(Note: 62.4 is the conversion factor to convert density in g/cm^3 to unit weight in lb/ft^3)

BLANK DATA SHEETS

DENSITY (UNIT WEIGHT) DETERMINATION
DATA SHEET

Sample number: Date Tested:
Soil description:

Mass of the soil sample (M_t):
Length of the soil sample (L):
Diameter of the soil sample (D):

Moisture content determination:

Specimen number	1
Moisture can and lid number	
M_C = Mass of empty, clean can + lid (grams)	
M_{CMS} = Mass of can, lid, and moist soil (grams)	
M_{CDS} = Mass of can, lid, and dry soil (grams)	
M_S = Mass of soil solids (grams)	
M_W = Mass of pore water (grams)	
w = Water content, w%	

Calculations: