TEST 2: SPECIFIC GRAVITY OF SOIL SOLIDS (G_S)

Definition:

the ratio of the mass of a unit volume of a soil solids to the mass of the same volume of gas-free distilled water at a stated temperature (at 20°C).

Purpose and significance:

- To determine the specific gravity of soil solids (G_s).
- It is used in calculating the phase relationships of soils, such as void ratio (e) and degree of saturation (S).
- It is used to calculate the density of the soil solids.

Standard Reference:

- ✓ BS 1377-2:1990 Methods of test for soils for civil engineering purposes: Part 2: Classification tests. 8 Determination of particle density, 8.3 Small pycnometer method.

  ASTM D 854-00 – Standard Test for Specific Gravity of Soil Solids by Water Pycnometer.

Apparatus:

1. Pycnometer with capacity 50 or 100 mL and stopper.
2. Balance accurate to 0.001 g.
3. Sieve No. 10 (2.00 mm).
4. Drying oven maintaining a uniform temperature of 110 ∓ 5 °C.
5. Vacuum pump/ Desiccator.
6. Wash bottle containing air-free distilled water, Spoon, Funnel.
7. Thermometer.

Specimen preparation:

Select a soil sample to be representative of the total soil and pass it through sieve No. 10 (2.00 mm) then leave it in the oven overnight at 110± 5 °C. Take about 10 g of the oven dried soil for the test.

Test Procedure:

1. Measure and record the mass of an empty clean and dry pycnometer with its stopper ($\boldsymbol{W_P}$).
2. Place the specimen (10 g oven dried, passed through sieve No. 10) and transfer it into the pycnometer, taking care not to lose any of the soil specimen. Measure and record the mass of the pycnometer containing the dry soil with its stopper ($\boldsymbol{W_{P+S}}$).
3. Add sufficient air-free distilled water to cover the soil (about half to three-fourth of the pycnometer). Soak the sample for 10 minutes.
4. Apply a partial vacuum to the contents for at least 10 minutes, to remove the entrapped air.
5. Stop the vacuum and carefully remove the vacuum line from the pycnometer.
6. Add more air-free distilled water to fill the pycnometer (to the mark), wipe it dry with the minimum of handling. Measure and record the mass of the pycnometer and its stopper + soil+ water ($\boldsymbol{W_{P+S+W}}$).
7. Clean out the pycnometer and fill it with air-free distilled water only then insert the stopper and wipe it dry. Measure and record the mass of the pycnometer and its stopper + water ($\boldsymbol{W_{P+W}}$).

Note:

the test should be carried out at any temperature provided it is constant throughout the test, such as at a constant-temperature room or using a constant-temperature bath. Otherwise, a thermometer must be used to measure the temperature during the test. **Discuss.**

Calculation:

The specific gravity is calculated as follows;

$$G_s = \frac{w_{soil}/V}{w_{water}/V} = \frac{w_{p+s} - w_p}{(w_{p+w} - w_p) - (w_{p+s+w} - w_{p+s})}$$

Where:

G_s = Specific gravity

w_p = mass of pycnometer (g)

w_{p+s} = mass of pycnometer and soil (dry specimen) (g)

w_{p+s+w} = mass of pycnometer, soil and water (g)

w_{p+w} = mass of pycnometer when full of water only (g).

Note:

- The specific gravity of solids for most natural soils falls in the general range of 2.65 – 2.85, the smaller values are for the coarse – grained soils. **Discuss**
- The test should be conducted on at least two specimens of the same soil, so that two values of specific gravity can be obtained. Calculate the average of the two results if they differ by no more than 0.03.
- Express the average value of the particle density to the nearest 0.01.

SPECIFIC GRAVITY DETERMINATION
DATA SHEET

Date tested:

Tested by:

Class:

Specimen description:

Specimen number			
Pycnometer bottle number			
Mass of Pycnometer, w_p (g)			
Mass of Pycnometer and dry specimen, w_{p+s} (g)			
Mass of Pycnometer, specimen and water, w_{p+s+w} (g)			
Mass of Pycnometer and water, w_{p+w} (g)			
Specific gravity, $\mathbf{G_s}$			
Average Specific gravity, $\mathbf{G_s}$			

Group names:

1-

2-

3-

4-

5-

Supervisor signature