

We will cover numerical problems and solutions for

Soil BD and PD

Soil Porosity

Soil Water Content

BD

1. Calculate the bulk density of a 400 cm³ soil sample that weighs 575 g (oven dry weight).

Solution: $\rho_b = M_s/V_s$
 $= 575\text{g}/400\text{cm}^3$
 $= 1.44\text{g}/\text{cm}^3$

2. Calculate the bulk density of a 400 cm³ soil sample that weighs 600 g and that is 10% moisture.

Solution: Oven dry wt. = $600\text{g}/1.1 = 545.5\text{g}$
 $\rho_b = 545.5\text{g}/400\text{cm}^3 = 1.36\text{ g}/\text{cm}^3$

BD

3. Calculate the volume of a soil sample that is 12% moisture, weighs 650 g and has a bulk density of 1.3 g/cm³.

Solution: Oven dry wt. = 650g/1.12 = 580.4g
1.3 g/cm³ = 580.4g/vol.
vol. = 446.4cm³

4. Calculate the bulk density of a rectangular soil sample with dimensions 12 cm by 6 cm by 4 cm, that is 15% moisture content and weighs 320 g.

Solution: Vol. of soil = 12cm x 6cm x 4cm = 288cm³
Oven dry wt. = 320/1.15 = 272g
 $\rho_b = 272/288 = 0.97\text{g/cm}^3$

BD and Porosity

5. Calculate the oven dry weight of a 350 cm³ soil sample with a bulk density of 1.42 g/cm³.

Solution: $1.42\text{g/cm}^3 = M_s/350\text{cm}^3$ $M_s = \text{oven dry wt.} = 497\text{g}$

6. Calculate the porosity of a soil sample that has a bulk density of 1.35 g/cm³. Assume the particle density is 2.65 g/cm³.

Solution: $\text{Porosity} = (1 - (\rho_b/\rho_d)) \times 100 = (1 - (1.35/2.65)) \times 100 = 49\%$

Porosity

7. Calculate the porosity (n) of a 250 cm³ clod that contains 140 cm³ water when saturated.

Solution: Porosity = $V_{\text{air}} + V_{\text{water}} / V_{\text{total}} = 140\text{cm}^3 / 250\text{cm}^3 = 56\%$

8. Calculate the bulk density of a soil sample that has a porosity of 45%.

Solution: for 1cm³ soil, assume ρ_d of 2.65 g/cm³

$$1\text{cm}^3 - .45\text{cm}^3 = .55 \times 2.65\text{g/cm}^3 = 1.46\text{g/cm}^3$$

Porosity and PD

9. Calculate the porosity of a 250 g sample that contains 65 g of water when 55% of the pores are full of water.

Solution:

Oven dry wt. = 250g-65g = 185g soil

Vol. of soil solids = 185g/2.65g/cm³ = 69.8cm³ soil

Saturated water content = 65g/0.55 = 118.2cm³ water

Total vol. of soil = 118.2cm³ + 69.8cm³ = 188cm³

Porosity = $V_{\text{air}} + V_{\text{water}}/V_{\text{total}} = 118.2\text{cm}^3/188\text{cm}^3 \times 100 = 63\%$

10. What is the particle density of a soil sample that has a bulk density of 1.55 g/cm³ and a porosity of 40%?

Solution: Porosity = $(1-(\rho_b/\rho_d)) \times 100$

$$40 = ((1-1.55/\rho_d) \times 100)$$

$$1.55/\rho_d = 0.6$$

$$\rho_d = 2.58\text{g/cm}^3$$