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Example 1:

$$\text{Moisture Content (\%)} = \frac{\text{Moist Weight} - \text{Dry Weight}}{\text{Dry Weight}} \times 100$$

Example: Find the moisture content of a soil sample when the moist (wet) weight of the sample is 54kg and the weight after oven drying is 45kg.

Answer:

$$\text{Moisture Content (\%)} = \frac{54\text{kg} - 45\text{kg}}{45\text{kg}} \times 100 = \frac{9\text{kg}}{45\text{kg}} \times 100 = 20\%$$

Example 2:

$$\text{Swell (\%)} = \left(\frac{\text{Natural Weight (Per Volume)}}{\text{Loose Weight (Per Volume)}} - 1 \right) \times 100$$

Example: Find the swelling of a soil when it is 1500kg/m³ in density in its natural state and the density when it is excavated is 1200kg/m³.

Answer:

$$\text{Swell (\%)} = \left(\frac{1500 \text{ kg/m}^3}{1200 \text{ kg/m}^3} - 1 \right) \times 100 = (1.25 - 1) \times 100 = 25\%$$

Example 3:

$$\text{Shrinkage (\%)} = \left(1 - \frac{\text{Natural Weight (Per Volume)}}{\text{Compacted Weight (Per Volume)}} \right) \times 100$$

Example: Find the shrinkage of a soil that is 1500kg/m³ in its natural state and 2000kg/m³ when compacted.

Answer:

$$\text{Shrinkage (\%)} = \left(1 - \frac{1500 \text{ kg/m}^3}{2000 \text{ kg/m}^3} \right) \times 100 = (1 - 0.75) \times 100 = 25\%$$

Example 4:

If the length (L) of the soil heap is longer than the base width (B) of the heap, then it is called a bank. And the volumes (V) are calculated with simple trigonometry as follows.

$$\text{Volume (V)} = \text{Triangular Area} \times \text{Length(L)}$$

$$\text{Triangular Area} = \frac{1}{2} \times \text{Base Width (B)} \times \frac{1}{2} \times \text{Base Width(B)} \times \tan R$$

$$\text{Triangular Area} = \frac{1}{4} \times (B^2) \times \tan R$$

$$V = \frac{1}{4} \times (B^2) \times \tan R \times L$$

Usually, the volume of the soil required to be dumped is known. Then the above can be reorganised as follows;

$$B = \sqrt{\frac{4 \times V}{L \times \tan R}}$$

$$\text{Height (H)} = \frac{1}{2} \times B \times \tan R$$

Example: Find the base width and the height of a triangular soil bank containing 75m³ of excavated soil which has undergone 25% swelling. The angle of repose for the soil is 37 degrees and the length of the soil bank is 10m.

Answers:

$$B = \sqrt{\frac{4 \times V}{L \times \tan R}} = \sqrt{\frac{4 \times 75 \times 1.25}{10 \times \tan(37)}} = \sqrt{\frac{375}{7.54}} = \sqrt{49.74} = 7.05m$$

$$H = \frac{1}{2} \times 7.05 \times \tan(37) = 2.66m$$

Example 5:

If the soil is dumped from a fixed point a conical pile will result. And the volumes (V) are calculated with simple trigonometry using the base diameter (D) as follows.

$$\text{Volume (V)} = \frac{1}{3} \times \text{Base Area} \times \text{Height(H)}$$

$$\text{Base Area} = \pi \frac{D^2}{4}$$

$$V = \frac{1}{3} \times \pi \frac{D^2}{4} \times H$$

$$H = \frac{D}{2} \times \tan R$$

$$V = \frac{1}{3} \times \pi \frac{D^2}{4} \times \frac{D}{2} \times \tan R$$

$$V = \frac{3.142}{24} \times D^3 \times \tan R$$

Usually, the volume of the soil required to be dumped is known. Then the above can be reorganised as follows;

$$\text{Base Diameter (D)} = \left(\frac{7.638 \times V}{\tan R} \right)^{1/3}$$

$$\text{Height (H)} = \frac{1}{2} \times D \times \tan R$$

Example: Find the base diameter and the height of a conical soil pile containing 75m³ of excavated soil which has undergone 12% swelling. The angle of repose for the soil is 32 degrees.

Answers:

$$D = \left(\frac{7.638 \times 75 \times 1.12}{\tan(32)} \right)^{1/3} = \left(\frac{641.592}{0.625} \right)^{1/3} = (1026.55)^{1/3} = 10.08m$$

$$H = \frac{1}{2} \times 10.08 \times \tan(32) = 3.149m$$