

Soil Phases

Solids, water, air, and their ratios.

Civil Engineering

Soil is three phases — solids, water and air — and every index property is a ratio between them.

$$e = V_v/V_s \cdot w = M_w/M_s \cdot \gamma_d = \gamma/(1 + w)$$

γ 20 kN/m³, w 25%

$20 \div 1.25$.

$\gamma_d = 16 \text{ kN/m}^3$

Void ratio $e = 0.6$

$n = e/(1 + e)$.

Porosity $n = 0.375$

Fully saturated

No air voids left.

$S_r = 100\%$

THE COMMON MISTAKE

✗ Using one unit weight everywhere

✓ Pick the one the case needs

Bulk, dry, saturated and submerged unit weights all differ. Below the water table, effective stress uses the submerged weight, $\gamma - \gamma_w$.

Educational reference. Index properties describe a soil; on their own they never justify a design.