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# Soil

By Rajat Singh

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## Unit weight and it's Measurement

$$\rho = \left( \frac{m}{Vol^m} \right)$$

$$\gamma = \frac{\text{weight}}{Vol^m}$$

$$\gamma = \rho g$$

 $Lm^3$ 

$$\text{ⓧ } kN/m^3$$

$$kg/m^3$$

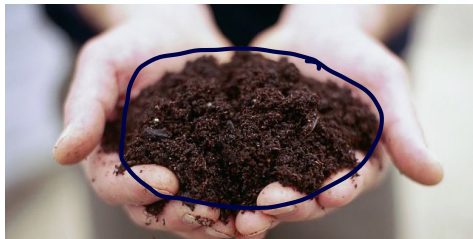
$$g/cm^3$$

## Unit weight and it's Measurement

### Bulk Unit weight

$$\gamma_t = \left[ \frac{\text{Total weight}}{\text{Total vol}^m} \right]$$

$$\gamma_t = \frac{W_s + W_w}{V_v + V_s}$$



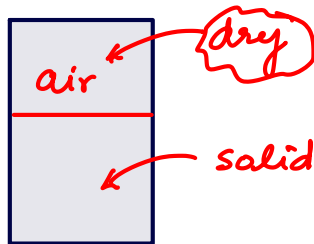
air
water
Solid

## Unit weight and it's Measurement

### Dry Unit weight

$$\gamma_{dry} = \left[ \frac{w_s}{v_v + v_s} \right]$$

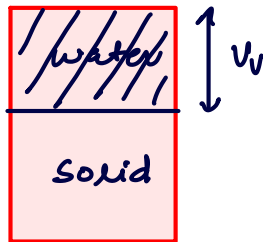
\*



## Unit weight and it's Measurement

Saturated unit weight

$$\gamma_{sat.} = \frac{[w_w + w_s]}{V_v + V_s}$$

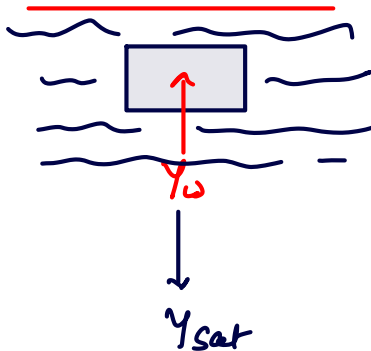


## Unit weight and it's Measurement

 $\gamma_w$ 

## Submerged unit weight

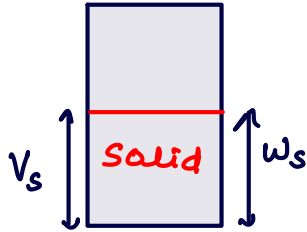
$$\gamma_{sub} = \gamma_{sat} - \gamma_w$$



## Unit weight and it's Measurement

## Unit weight of soil solid

$$\gamma_s = \frac{w_s}{V_s}$$



$$\gamma_s > \gamma_{sat} > \gamma_{bulk} > \gamma_{dry} > \gamma_{sub}$$

$\rho_{mp}$



## Specific Gravity

True specific Gravity or Absolute specific Gravity

$$G_s = \frac{\text{weight of soil solid of given vol}^m}{\text{weight of std. fluid of same vol}^m}$$

Std. fluid

water

$$G_s = \frac{w_s}{w_w} \times \frac{V}{V} = \frac{\gamma_s}{\gamma_w}$$

## Specific Gravity

Apparent specific Gravity Or Mass specific Gravity Or Bulk sp. Gr.

$$G_m = \frac{\text{weight of soil of given vol}^m}{\text{weight of std. fluid of same vol}^m.}$$

$$G_m = \frac{\gamma_{\text{bulk}}}{\gamma_w}$$

Imp. Relation  $\rightarrow$ 

$$se = wQ$$

$$V_w = \frac{w_w}{Y_w}$$

$$V_s = \frac{w_s}{Y_s}$$

$$\begin{aligned} e &= \frac{V_v}{V_s} \times \frac{V_w}{V_w} \\ &= \frac{1}{\left(\frac{V_w}{V_v}\right)} \times \frac{V_w}{V_s} \\ &= \frac{1}{s} \times \frac{w_w/Y_w}{w_s/Y_s} \\ e &= \frac{1}{s} \times w \times Q_s \end{aligned}$$

$$\checkmark \quad se = wQ_s$$

$$Q_m = \frac{Q_s}{1+e}$$

\*

$$n = \frac{e}{1+e}$$

$$Q_m = Q_s (1-n)$$

\*

$$1-n = 1 - \frac{e}{1+e}$$

$$(1-n) = \frac{1+\cancel{e}-\cancel{e}}{1+e} = \frac{1}{1+e}$$

$$\frac{1}{1+e} = (1-n)$$

