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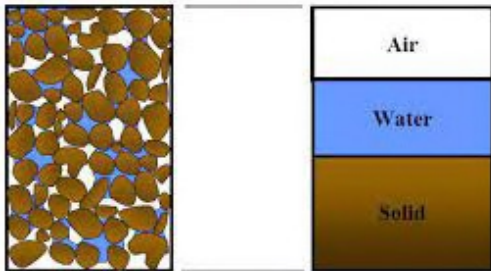
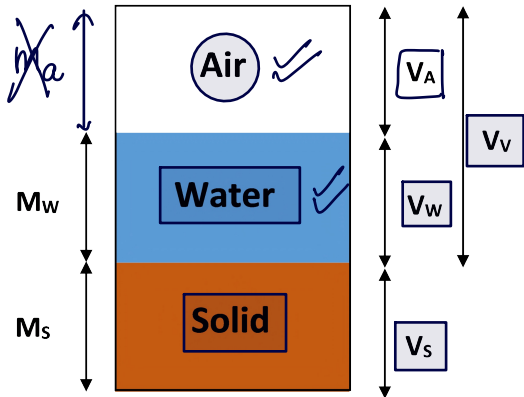
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Three Phase Diagram



$$V_v = \text{void vol}^m = V_w + V_{air}$$

\downarrow \downarrow
water air

$$\Rightarrow V = \text{vol}^m \text{ of soil} = V_v + V_s$$

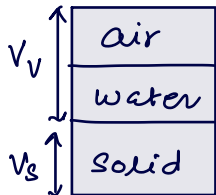
$$\text{weight of air} = 0$$

Terms and Definitions in Soil

 e

Void Ratio

Void ratio is the volume of voids to the volume of solids.
 It is denoted by 'e'.



$$e = \frac{V_v}{V_s}$$

$$V_v \neq 0$$

$$e \neq 0$$

$$e > 0$$

$$e \in (0 - \infty)$$

Porosity

It is defined as the ratio of volume of voids to the total volume. It is denoted by 'n'.

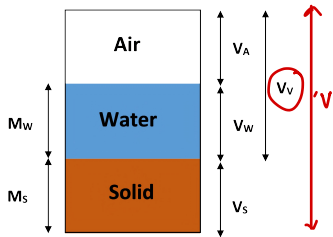
$$n = V_v / V$$

$$\checkmark \quad n = \frac{V_v}{V} \times 100$$

$V =$ Total vol^m of soil b/w
 n (0-100%)

$$n \neq 0\%$$

$$n \neq 100\%$$



$$\eta = \frac{v_v}{v} = \frac{v_v}{v_v + v_s}$$
$$= \frac{v_v/v_s}{v_v/v_s + 1}$$

$$e = \frac{\eta}{1-\eta} \quad (*)$$

$$\eta = \frac{e}{1+e} \quad (*)$$

Water cont \rightarrow W

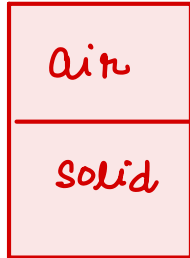
$$\rho_w = 1 \text{ g/cc} = 1000 \text{ kg/m}^3$$

$w = 0$ (0 - ∞)

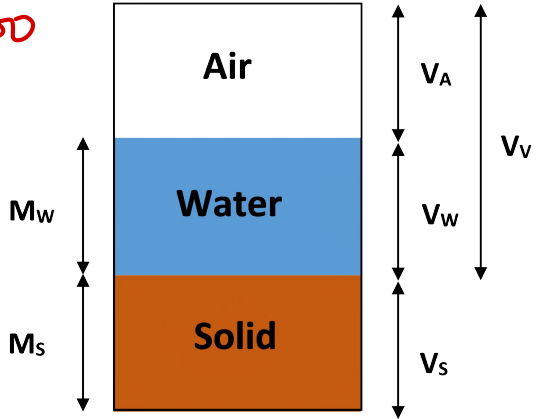
$$w = \frac{w_w}{w_s} \times 100$$



Saturated



dry



Degree of saturation

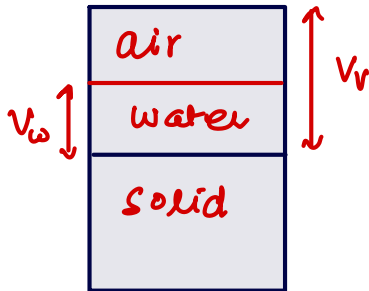
The degree of saturation is the ratio of the volume of water to the volume of voids. It is denoted by 'S'.

$$S = \frac{V_w}{V_v} \times 100$$

✓✓ $S\% = 0\%$ dry soil

✓✓ $S\% = 100\%$ ✓✓

Saturated soil



Percentage air voids

It is the ratio of volume of air to the total volume.

$$n_a = \frac{V_a}{V} \times 100$$

$$n_a = 0\%$$

$$n_a < 100\%$$

$$0 \leq n_a < 100\%$$

Air content a_c

Air content is defined as the ratio of the volume of air to the volume of voids

$$a_c = \frac{V_a}{V_v} \times 100$$

$$S = \frac{V_w}{V_v} \times 100$$

$$a_c + S = \frac{V_a}{V_v} + \frac{V_w}{V_v} = \frac{V_v}{V_v} = 1$$

$$a_c + S = 1$$