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Subject # Soil Mechanics

I.D # 7666

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Ques # 1.

Define the following terms?

1- Hydraulic Gradient:-

$i = h/L$ ⇒ h = head loss, L = length

Head loss divided the length in which head loss take place is called hydraulic gradient $v \propto i$

$A \times v = K i \times A$

$Q = K i A \Rightarrow \boxed{K = Q/iA}$

2- Coefficient of Permeability

The coefficient of permeability of a soil describe how easily a liquid will move through a soil. It is also commonly referred to as the hydraulic conductivity of a soil. This factor can be affected by the viscosity or thickness (fluidity) of a liquid and its density.

3. Liquid Index:

The liquid index of soil shows that how much the soil sample is near to its liquid limit.

If the liquidity index is 100%. its mean that the soil has in liquid state

If the soil is in plastic state, then its liquidity index will be zero. And if it is in minus/negative then the soil in hard dry form

4- Porosity:-

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

n = porosity
V_v = volume of voids
V = volume of soil sample

5. Degree of saturation:-

For the the fully saturated soil sample the degree of saturation will be 1 or 100% and for dry soil sample it will be zero

$$S_r = \frac{\text{volume of water} \times 100}{\text{volume of voids}} = \frac{V_w}{V} \times 100$$

S_r = degree of saturation.

Que 1 b:-

A ~~Soil~~ Sample of wet soil has a volume of $0.0192\ m^3$ . . . . . Void Ratio.

Given :-

$W = 32\ kg$

$V = 0.0192\ m^3$

$W_s = 28.5\ kg$

$G_s = 2.65$

Req :-

* $\gamma_B = ?$
* $w = ?$
* $\gamma_d = ?$
* $\gamma_{sat} = ?$
* $e = ?$
* ~~[illegible]~~
* ~~[illegible]~~

Sol :-

$$W_w = W - W_s$$

$$W_w = 32 - 28.5$$

$$\boxed{W_w = 3.5 \text{ kg}}$$

$$w = W_w / W_s \times 100$$

$$w = \frac{3.5}{28.5} \times 100$$

$$\boxed{w = 12.3\%}$$

$$\gamma_B = W/V = \frac{32}{0.0192}$$

$$\gamma_B = 1666.67 \text{ kg/m}^3$$

$$\gamma_d = \frac{W_s}{V} =$$

$$\gamma_d \Rightarrow \frac{28.5}{0.0192}$$

$$\boxed{\gamma_d = 1484.37 \text{ kg/m}^3}$$

$$\gamma_d = \frac{(G_s + e)\gamma_w}{1+e}$$

$$\Rightarrow e = \frac{G_s \times \gamma_w}{\gamma_d} - 1$$

$$e = \frac{2.65 \times 1000}{1484.37}$$

$$\boxed{e = 0.785}$$

$$\gamma_{sat} = \frac{(G_s + e)\gamma_w}{1+e}$$

$$\gamma_{sat} = \frac{(2.65 + 0.785) \times 1000}{1 + 0.785}$$

$$\boxed{\gamma_{sat} = 1924.37 \ kg/m^3}$$

Ques 29 :-

Prove the given relation:

$$e = \frac{G_s \times \gamma_w (1 + w_c) - 1}{\gamma_B}$$

Answer :-

So

As

$$\gamma_B = \frac{W}{V} \Rightarrow \frac{W_s + W_v}{V_s + V_v}$$

$$\gamma_B = \frac{\frac{W_s}{W_s}(W_s + W_v)}{\frac{V_s}{V_s}(V_s + V_v)}$$

$$\gamma_B = \frac{W_s\left(\frac{W_s}{W_s} + \frac{W_v}{W_s}\right)}{V_s\left(\frac{V_s}{V_s} + \frac{V_v}{V_s}\right)}$$

$$= \frac{W_s\left(1 + \frac{W_w}{W_s}\right)}{V_s\left(1 + \frac{V_v}{V_s}\right)}$$

$$\boxed{\gamma_s = \frac{W_s}{V_s}} \Rightarrow \boxed{w_c = \frac{W_w}{W_s}}$$

As we know that

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

$$\gamma_B = \frac{\gamma_s (1 + w_c)}{1 + e} \qquad \because G_s = \frac{\gamma_s}{\gamma_w}$$

$$\gamma_s = G_s \cdot \gamma_w$$

$$\gamma_B = \frac{G_s \cdot \gamma_w (1 + w_c)}{1 + e}$$

$$1 + e = \frac{G_s \cdot \gamma_w (1 + w_c)}{\gamma_B}$$

$$e = \frac{G_s \cdot \gamma_w (1 + w_c)}{\gamma_B} - 1$$

Hence Proved.

Question 2(b)

Explain grain size classifiction .... detail

Grain Size classification of soil :-

i US - Burcau of Soil Classification:-

Clay	silt	Sand				Gravel.	
		Very Fine Sand	Fine Sand	medium Sand	Corse Sand	Fine Gravel	Coarse Gravel
Particle Size	0.002 mm	0.05 mm	0.1 mm	0.25 mm	0.5 mm	1.00 mm	2.00 mm

ii ASTM Soil Classification System:

Clay	colloid OR Colloidal clay	silt	Sand		Gravel
			Fine sand	Coarse Sand	
Paticles Size	0.001 mm	0.005 mm	0.074 mm	0.25 mm	2.00 mm

M.I.T Soil classification system:

Clay			Silt			Sand			Gravel
Fine clay	medium clay	Coarse clay	Fine Silt	Medium Silt	Corse Silt	Fine Sand	Medium sand	Core sand	
0.002 mm	0.0006 mm		0.002 mm	0.006 mm	0.02 mm	0.06 mm	0.2 mm	0.6 mm	2.00 mm

Ques 3(A)

Describle the ..... Condition?

Quick Sand:-

When the seepage pressure due to upward flow of water in Sand/sandy soil balances the downward force of gravity (weight of material) a condition of instability arises in sand, sand in this state is called Quick sand.

Seepage: Flow of water under gravitational Forces in a Permeable medium:-

When water Pressure with in the soil get high enough to diminate it shear strength all together is called Quik Condition.

Critical hydraulic Gradiant :-

At the bottom surface
i.e at x-x

Upward Force $= (h+L)\gamma_w \cdot A$ — (1)

Downward force $= \frac{\gamma_w \times (G_s+e)}{1+e} \times V$

Since $\gamma_B = W/V = W = \frac{\gamma_w \times (G_s+e)}{1+e} \times V$

$W = \frac{\gamma_w \times (G_s+e)}{1+e} \times A \times L$ → (2)

At balance

Upward force = Downward force

$(h+L)\gamma_w \times A = \gamma_w \times \frac{(G_s+e)}{1+e} \times A \times L$

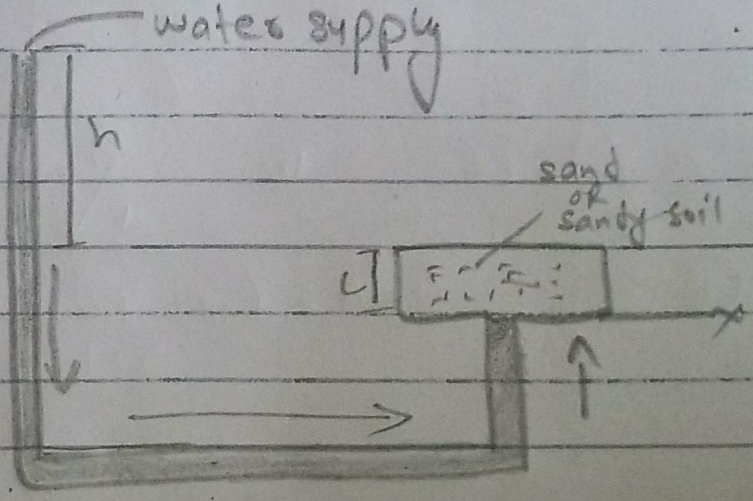
$\frac{h+L}{L} = \frac{G_s+e}{1+e} \times \frac{L}{L}$

$\frac{h}{L} + 1 = \frac{G_s+e}{1+e}$

$$\therefore \frac{h}{L} = \frac{G_s + e}{1+e} - 1$$

$$i_c = \frac{G_s + e - 1 - e}{1+e}$$

$$i_c = \frac{G_s - 1}{1+e}$$



Quest 3 b :-

A soil sample ..... degree of Solution ?

Given data :-

Volume of soil = V = 65ml

As we know 1ml = $10^{-6}m^3$

$65ml = 65 \times 10^{-3} m^3$.

So $V \Rightarrow 0.000065 m^3$

Total weight of soil sample = w = 0.96N

dry weight of soil sample = 0.785N

Sp. gravity of soil solid = G_S = 2.65

Required :-

S_r = Degree of solution = ?

Solution :-

As we know that

$\gamma_B = \gamma_w (G_S + e.S_r)$ —(i)

$e = V_v / V_s = 0.000035 / 0.000030 \Rightarrow \boxed{1.167}$

For bulk unit weight

$$\gamma_B = \frac{W}{V}$$

$$\gamma_B = \frac{0.96}{0.000065}$$

$$\boxed{\gamma_B = 14769 \ KN/m^3}$$

now for

$$V = V_S + V_v \quad \text{or} \quad V_v = V_s - V$$

$$\text{or} \quad \boxed{V_v = 0.00003 5 \ ft^2}$$

$$\gamma_s = \frac{W_s}{V_s} \Rightarrow V_s = \frac{W_s}{\gamma_s}$$

$$\gamma_s = G_s \times \gamma_w$$

$$\Rightarrow V_s = \frac{W_s}{G_s \times \gamma_w}$$

$$\Rightarrow V_s = \frac{0.785}{2.65 \times 9.8}$$

$$\boxed{V_s = 0.00003 ft^3}$$

OR As we know that

$$\boxed{e = 1.167}$$

Pg (15)

$$w = \frac{S \times e}{G_s}$$

$$S = \frac{w \times G_s}{e}$$

$$= \frac{0.123 \times 2.65}{0.785}$$

$$\boxed{S = 0.415 \text{ or } 41.5\%}$$