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Subject: Soil Mechanics-I

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MID SEMESTER SOLUTION

Q-1. (i) (b) $Q_r = 650$ kN

$$K_B = \frac{3}{2\pi}\left[\frac{1}{1+(\frac{1}{2})^2}\right]^{5/2} = 0.273$$

$$\sigma_z = K_B \cdot \frac{Q}{z^2} = 0.273 \times \frac{650}{4} = 44.4 \text{ kN/m}^2$$

Q-1-(II) (b) $e_{max} - e_{min} = 0.30$

$I_D = 66.6\%$, $e_{nat} = 0.40$

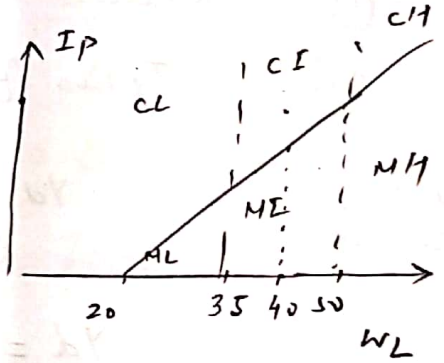
$$I_D = \frac{e_{max} - e_{nat}}{e_{max} - e_{min}} \times 100$$

$$66.6 = \frac{e_{max} - 0.40}{e_{max} - e_{min}} \times 100$$

$$\frac{e_{max} - 0.40}{0.30} \times 100 = 66.6 \Rightarrow \boxed{e_{max} = 0.6}$$

III. (b) $W_L = 40\%$, $I_p = 28\%$

$$I_p = 0.73(W_L - 20)$$
$$= 0.73(20) = 14.6$$



IV. (d) $$\gamma_d = \frac{(1-\eta_a)\, G\gamma_w}{1+wG}$$

Q-2. Mass of empty Core cutter = 1071 gm

Mass of Core cutter + Mass of soil = 2970 gm

Mass of soil = (2970 − 1071) = 1899 gm

Vol of Core cutter = $\frac{\pi}{4} \times (10.2)^2 \times 12.6$

= 1029.58 cc

In-situ density (γ_b) = $\frac{M}{V} = \frac{1899}{1029.58} = 1.84$ g/cc

In-situ dry density (γ_d) = $\frac{\gamma_b}{1+w} = \frac{1.84}{1.08} = 1.73$ g/cc

$$\gamma_d = \frac{G\gamma_w}{1+e}$$

$e = 0.55$

$\eta = \frac{e}{1+e} = \frac{0.55}{1.55} = 35.48\ \%$

$e \cdot S = wG$

$S_r = \frac{0.06 \times 2.65}{0.55} = 28.9\ \%$

$ac = 1 - S = 71.09\ \%$

Q-3.

Is light	Is heavy
(i) Wt = 2.6 kg	(i) Wt = 4.9 kg
(ii) Ht of fall = 310 mm	(ii) Ht of fall = 450 mm
(iii) Vol of mould = 1000 cc	(iii) Vol of mould = 1000 cc
(iv) No of layer = 3	(iv) No of layer = 5
(v) No of blows = 25	(v) No of blows = 25

Factors affecting compaction

(i) Water content

(ii) Compactive effort

(iii) Types of structure — Dry side of optimum / Wet side of optimum

Q-4.

$\gamma_d = 1.8\ g/cc$, $OMC = 16\ \%$.

$G = 2.65$.

$\gamma_d = \frac{G\gamma_w}{1 + \frac{wG}{S}} \Rightarrow 1.8 = \frac{2.65 \times 1}{1 + \frac{0.16 \times 2.65}{S}}$

$1 + \frac{0.424}{S} = 1.472$

$S = \frac{0.424}{0.472} \times 100 = 89.93\ \%$.

$\gamma_{dmax} = \frac{G\gamma_w}{1+wG}$

$= \frac{2.65 \times 1}{1 + 0.16 \times 2.65} = 1.86\ g/cc$

Q-5. $e_{nat} = 0.50$, $e_{max} = 0.75$, $e_{min} = 0.35$

$G_s = 2.67$

(i) Relative Density (I_D) $= \frac{e_{max} - e_{nat}}{e_{max} - e_{min}} \times 100$

$= \frac{0.75 - 0.50}{0.75 - 0.35} \times 100 = 62.5\%$

(ii) Relative Compaction (R_c) $= \frac{(\gamma_d)_{field}}{\gamma_{dmax}}$

$\gamma_d = \frac{G\gamma_w}{1+e} = \frac{2.67 \times 1}{1.50} = 1.78$ g/cc

$R_c = \frac{1.78}{\frac{2.67 \times 1}{1.35}} \times 100 = 90\%$

Q-6. (a) $w_L = 55\%$, $w_p = 25\%$, $w_s = 15\%$.

$w_n = 30\%$

$I_L = \frac{w_n - w_p}{I_p} = \frac{0.30 - 0.25}{0.55 - 0.25} = 0.167$

$I_p = 0.55 - 0.25 = 0.30$

(b) (i) Kaolinite ~~Illite~~ – Montmorillonite – ~~Kaolinite~~ Illite

(ii) ~~Illite~~ Kaolinite – Montmorillonite – * Illite.

Q-7. Only 11% passes through the 75μ sieve. Hence it is (< 50%) a coarse grained soil. As a greater percentage of coarse fraction pass through 4.75 mm sieve (> 50%) the soil is sand.

The amount of soil passing through 75 μm sieve is b/w 5% and 12%, hence the soil will have a dual symbol.

$$C_u = \frac{D_{60}}{D_{10}} = \frac{1.3}{0.07} = 90 > 6$$

$$C_c = \frac{D_{30}^2}{D_{60} \times D_{10}} = \frac{0.5^2}{6.2 \times 0.07} = 0.567$$

For the soil be considered well graded $C_u > 6$ & $1 < C_c < 3$. These criterion are not satisfied, so the soil is poorly graded.

- Nature of fines: I_p corresponding to A-Line $= 0.73(42-20) = 16.06$

$I_{p(actual)} = 42 - 21 = 21\%$.

$\because I_{p(actual)} > I_{p(A-Line)} \Rightarrow$ above A-Line

classify the fines as clayey.

From the above facts, the soil is now classified as SP-SC.

Poorly graded sand with clayey fines.

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