Soil Mechanics

Midterm Exam

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Q1: ① from the graph: $D_{10} = 0.13$ mm

② $D_{30} = 0.32$

$D_{60} = 0.9$

$$C_u = \frac{D_{60}}{D_{10}} = \frac{0.9}{0.13} = 6.923$$

$$C_c = \frac{(D_{30})^2}{D_{10} D_{60}} = \frac{(0.32)^2}{(0.9)(0.13)} = 0.875$$

③ according to USCS: Gravel = 4 %

Sand = 91.4 %

fines = 4.6 %

④ AASHTO: Percent finer on No.200 = 4.6 % ≤ 35%

LL = 10 , PL = 5 , PI = 5

A-1-b(0)

GI

USCS: Gravel = 4 % < 15 %

Sand = 91.4 % > 50 %

fines = 4.6 %

LL = 10 / PI = 5

$4 \leq PI \leq 7$

SC- SM

(silty clayey sand)

Q2:-) ① $V_{compacted\ fill} = 1750\ m^3$

γ_B (compacted fill) $= 18\ KN/m^3$

$w = 8\%$

$$\gamma_d\ (\text{compacted fill}) = \frac{\gamma_B}{1+w} = \frac{18}{1.08} = 16.667\ KN/m^3$$

* Option ①: $\gamma_d = 15\ KN/m^3$,, $G_s = 2.7$,, $w = 5\%$

$$\gamma_d V = \gamma_{d(fill)} V_{fill}$$

$V = 1944.483\ m^3$

$$\text{no. of trucks} = \frac{1944.483}{15} = 129.6\ \text{trucks}$$

$$\text{Cost} = (129.6)(375) + 10(1944.483)$$

$$= 48600 + 19444.83$$

$$= 68044.83\ \text{NIS}$$

* option ②: $\gamma_d = 13\ KN/m^3$,, $G_s = 2.7$,, $w = 7\%$

$\gamma_d V = \gamma_{d(fill)} V_{fill} \longrightarrow V = 2243.635\ m^3$

no. of trucks $= 149.576$ trucks

$$\text{cost} = (149.576)(300) + (22436.35)$$

$$= 67309.15\ \text{NIS}$$

* option (2) is more economical

(2) for compacted fill:

$$\gamma_d = 16.67\ kN/m^3$$

* $\gamma_d = \dfrac{G_s \gamma_w}{1+e} \longrightarrow e = \dfrac{G_s \gamma_w}{\gamma_d} - 1$

$$= 0.59$$

* $S e = G_s w$

$$S = 36.6\ \%$$

* $n = \dfrac{e}{1+e} = 0.371$

Q3:-) ① optimum moisture content = 15.6 %

② Maximum dry density = 1.642 g/cm³

③ $\gamma_{max} = \gamma_{d_{max}} (1 + w)$

$= 1.642 (1 + 0.156)$

$= 1.898 \text{ g/cm}^3$

④ $Doc = \frac{\gamma_{d(field)}}{\gamma_{d(max)}}$

$\gamma_{d(field)} = 0.97 * (1.642)$

$= 1.593 \text{ g/cm}^3$

Q4:-) At point A: $K_E = 2 * 10^{-3}$ cm/sec

At point B: $K_E = \dfrac{K_2 H_2 + K_3 H_3}{H_2 + H_3}$

$= \dfrac{1 * 10^{-3} * 5 + \frac{2}{3} * 10^{-3} * 5}{10}$

$= 0.833 * 10^{-3}$ cm/sec

At point C: $K_E = \dfrac{H_4 + H_1}{\frac{H_4}{K_4} + \frac{K_1}{H_1}}$

$= \dfrac{25}{\frac{2 * 12.5}{2 * 10^{-3}}}$

$= 2 * 10^{-3}$ cm/sec

for all soils: $K_E = \dfrac{K_1 H_1 + K_2 H_2 + K_3 H_3}{H_1 + H_2 + H_3}$

$= 1.75 * 10^{-3}$ cm/sec

At point A: total head = 55 + 20 + 10

= 85 cm

elevation head = 30 cm

pore water pressure = $\gamma_w h_w$

= $9.81 * \frac{55}{100}$

= 5.4 KN/m^2

At point B: total head = 30 + 10 = 40 cm

elevation head = 10 cm

pore water pressure = $\gamma_w h_w$

= $9.81 \left(\frac{30}{100}\right)$

= 2.943 KN/m^2

At point C: total head = (85 - 55 - 10) + 30 + 10

= 60 cm

elevation head = 40 cm

pore water pressure = $9.81 \left(\frac{20}{100}\right)$

= 1.962 KN/m^2