

Soil Mechanics

Final Exam

Name: Mohammad Al-Swaity

ID: 1181136

Problem ①: $i = \frac{\text{head loss}}{\text{length of seepage}} = \frac{L \tan \alpha}{\frac{L}{\cos \alpha}} = \sin \alpha$

* The Area = $H \cos \alpha (1) = 6 \cos \alpha \text{ m}^2$
~~substituting~~

* $q = k i A$

$= (6 * 10^{-2} \text{ cm/sec}) (\sin 6^\circ) (6 \cos \alpha \text{ m}^2)$

$= (6 * 10^{-4} \text{ m/sec}) (0.105) (5.97 \text{ m}^2)$

$= 3.7611 * 10^{-4} \text{ m}^3/\text{sec}$

$= 32.5 \text{ m}^3/\text{day}$

→ $q = 32.5 \text{ m}^3/\text{day}$

Problem (2):

$$Q = \frac{\pi K (H_2^2 - H_1^2)}{\ln\left(\frac{r_2}{r_1}\right)}$$

$$\frac{200 \text{ cm}^3 * 86400}{\text{day}} = \frac{\pi K ((4.5 * 100)^2 - (6 * 100)^2) \cdot \text{cm}^2}{\ln\left(\frac{1800}{3600}\right)}$$

$$(200)(86400) \frac{\text{cm}}{\text{day}} = \frac{\pi K (-157500)}{-0.693}$$

$$\rightarrow K = 24.214 \text{ cm/day}$$

Problem ③: (A) $\Delta \sigma' = \frac{P}{A} = \frac{4000 \text{ kN}}{4 \text{ m}^2} = 1000 \text{ kN/m}^2$

$$\begin{aligned} * \sigma'_0 &= (\gamma_{d(\text{sand})} D_f) + (\gamma_{\text{sat}(\text{sand})} - \gamma_w)(H_1 - D_f) + (\gamma_{\text{sat}(\text{clay})} - \gamma_w)\left(\frac{H_2}{2}\right) \\ &= (18 * 2) + (19 - 9.81)(4) + (20 - 9.81)(2.5) \end{aligned}$$

$$\rightarrow \sigma'_0 = 98.24 \text{ kN/m}^2$$

$$\Delta \sigma' + \sigma'_0 = 1098.24 > \sigma'_{c0} = 70 \text{ kN/m}^2$$

$$\therefore S_c = \frac{C_s H_2}{1 + e_0} \log \frac{\sigma'_{c0}}{\sigma'_0} + \frac{C_e H_2}{1 + e_0} \log \left(\frac{\sigma'_0 + \Delta \sigma'}{\sigma'_{c0}} \right)$$

$$= \frac{0.03(5)}{2} \log \frac{70}{98.24} + \frac{0.4(5)}{2} \log \left(\frac{98.24 + 1000}{70} \right)$$

$$= -0.01104 + 1.12$$

$$= 1.109 \text{ m}$$

$$\rightarrow S_c = 1.109 \text{ m}$$

(B) (1) ~~$C_c = H_2 \log\left(\frac{t_2}{t_1}\right)$~~

$$C_c = \frac{\Delta e}{\log\left[\frac{60' + 106'}{60}\right]}$$

$$\rightarrow \Delta e = 0.42$$

$$e_f = 1 + 0.42 = 1.42$$

$$C_x = \frac{C_\alpha}{1 + e_f} = \frac{0.02}{2.42} = 8.264 \times 10^{-3}$$

$$* S_s = C_x H_2 \log\left(\frac{t_2}{t_1}\right)$$

$$5 \text{ cm} = 8.264 \times 10^{-3} (5) \log\left(\frac{t_2}{t_1}\right)$$

~~$S_s = C_x H_2 \log\left(\frac{t_2}{t_1}\right)$~~

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Problem (4): (A) $\phi = \tan^{-1} \left(\frac{\tau_2 - \tau_1}{\sigma_2 - \sigma_1} \right)$

$$\phi = \tan^{-1} \left(\frac{30 - 26}{30 - 20} \right)$$

$$\rightarrow \phi = 21.8^\circ$$

$$* \tan \phi = \frac{\tau_1 - c}{\sigma_1}$$

$$\tan(21.8^\circ) = \frac{26 - c}{20}$$

$$\rightarrow c = 18$$

(B) Clay soil [loose]

(C)

