

Soil Mechanics

HW6

Name : Mohammad Al-Swaity

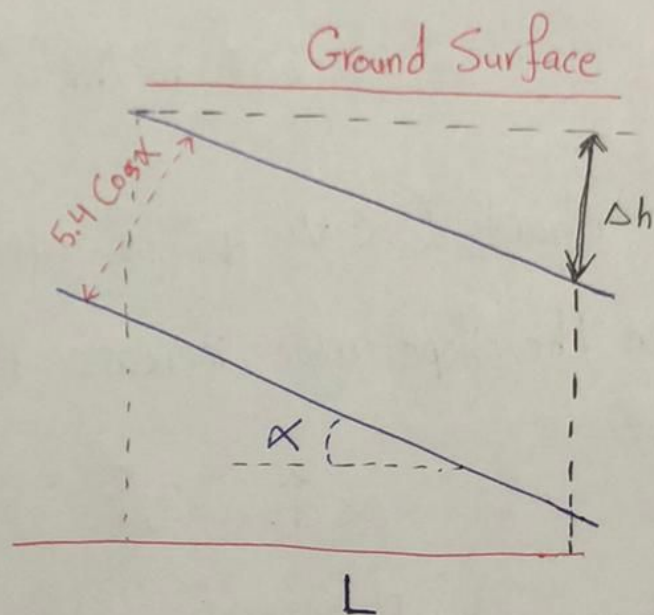
ID : 1181136

Problem ①:-

$$H = 5.4 \text{ m}$$

$$K = 6 \times 10^{-3} \text{ cm/sec}$$

$$= 0.216 \text{ m/hr}$$



$$i = \frac{\Delta h}{\text{length}} = \frac{\frac{L \tan \alpha}{\cos \alpha}}{L} = \tan \alpha \cos \alpha = \sin \alpha$$

$$A = 5.4 \cos \alpha (L) = 5.4 \cos \alpha \quad \text{" Assume } L = 1 \text{ "}$$

one unit length

find q when : ① $\alpha = 5^\circ$:

$$q = iAK = \sin(5^\circ) (5.4 \cos(5^\circ)) (0.216)$$
$$= 0.101 \text{ m}^3/\text{hr}$$

$$\textcircled{\text{II}} \alpha = 7^\circ: q = KiA = (0.216) \sin 7^\circ (5.4 \cos 7^\circ) \\ = 0.141 \text{ m}^3/\text{hr}$$

$$\textcircled{\text{III}} \alpha = 9^\circ: q = (0.216) \sin 9^\circ (5.4 \cos 9^\circ) \\ = 0.180 \text{ m}^3/\text{hr}$$

$$\textcircled{\text{IV}} \alpha = 12^\circ: q = (0.216) \sin 12^\circ (5.4 \cos 12^\circ) \\ = 0.237 \text{ m}^3/\text{hr}$$

The chart (α vs q) is attached in Excel file

* When the slope angle increase then the flow rate increase.

$$\alpha \uparrow \quad q \uparrow \quad / \quad \alpha \downarrow \quad q \downarrow$$

the reasons: when α increase then each of i and A increase

then q increase because

$$q = KiA$$

Problem (2) :-

length of levee = 650 m / ($q = 13.5 \text{ m}^3/\text{hr}$) / thickness
= 2.5 m

K ?

$$i = \frac{\Delta h}{l} = \frac{175 - 158}{210} = 0.081$$

$$A = (650)(2.5) = 1625 \text{ m}^2$$

$$q = KiA$$

$$K = \frac{13.5}{(0.081)(1625)} = 0.103 \text{ m/hr}$$

Problem (3): $H_1 = 1.5 \text{ m}$, $K_1 = 9 \times 10^{-4} \text{ cm/sec}$

$H_2 = 2.5 \text{ m}$, $K_2 = 7.8 \times 10^{-3} \text{ cm/sec}$

$H_3 = 3.5 \text{ m}$, $K_3 = 4.5 \times 10^{-5} \text{ cm/sec}$

$$\frac{K_{H(eq)}}{K_{V(eq)}} ?$$

continue →

$$\begin{aligned}
 K_H(e_q) &= \frac{K_1 H_1 + K_2 H_2 + K_3 H_3}{H_1 + H_2 + H_3} \\
 &= \frac{(9 \times 10^{-4} \times 1.5) + (7.8 \times 10^{-3} \times 2.5) + (4.5 \times 10^{-5} \times 3.5)}{1.5 + 2.5 + 3.5} \\
 &= 2.801 \times 10^{-3} \text{ cm/sec}
 \end{aligned}$$

$$\begin{aligned}
 K_V(e_q) &= \frac{H_1 + H_2 + H_3}{\frac{H_1}{K_1} + \frac{H_2}{K_2} + \frac{H_3}{K_3}} \\
 &= \frac{7.5}{\frac{1.5}{9 \times 10^{-4}} + \frac{2.5}{7.8 \times 10^{-3}} + \frac{3.5}{4.5 \times 10^{-5}}} \\
 &= 9.403 \times 10^{-5} \text{ cm/sec}
 \end{aligned}$$

$$\therefore \frac{K_H(e_q)}{K_V(e_q)} = \frac{2.801 \times 10^{-3} \text{ cm/sec}}{9.403 \times 10^{-5} \text{ cm/sec}} = 29.79$$

$$\longrightarrow \boxed{\frac{K_H(e_q)}{K_V(e_q)} = 29.79}$$

Problem (4): (A)

for A: elevation head at A = 0

Pressure head at A = 35 cm

total head at A = 35 cm

for D: elevation head at D = 11 cm

Pressure head at D = 9 cm

total head at D = 20 cm

$$\begin{aligned} * \text{head loss A to D} &= (\text{Elevation Pressure})_A - (\text{Elevation Pressure})_D \\ &= 35 - 9 = 26 \text{ cm} \end{aligned}$$

$$* i = \frac{15 + 11}{4 + 7 + 15} = 1$$

* head loss in AB + head loss in BC + head loss in CD = 26

$$\Delta h_{AB} + \Delta h_{BC} + \Delta h_{CD} = 26 \text{ cm} \quad \text{--- (1)}$$

$$* q_{AB} = q_{BC} = q_{CD} \quad \underline{\text{continue}} \rightarrow$$

$$* \quad q_{AB} = q_{BC} = q_{CD}$$

$$K_{AB} i_{AB} A = K_{BC} i_{BC} A = K_{CD} i_{CD} A$$

$$* \quad K_{AB} = \frac{K_1 H_1 + K_2 H_2}{H_1 + H_2} = \frac{(K_1 + \frac{1.5}{2} K_1) 2}{4}$$

$$\rightarrow K_{AB} = 0.875 K_1$$

$$\therefore 0.875 K_1 \frac{\Delta h_{AB}}{4} = \frac{K_3 \Delta h_{BC}}{7} = \frac{K_4 \Delta h_{CD}}{15}$$

$$\frac{0.875 K_4 (\Delta h_{AB})}{4 \times 1.5} = \frac{K_4 (\Delta h_{BC})}{3 \times 7} = \frac{K_4 (\Delta h_{CD})}{15}$$

$$\frac{\Delta h_{AB}}{6.857} = \frac{\Delta h_{BC}}{21} = \frac{\Delta h_{CD}}{15}$$

$$\textcircled{2} \quad \Delta h_{AB} = 0.327 \Delta h_{BC} = 0.457 \Delta h_{CD}$$

$$\textcircled{1} \text{ and } \textcircled{2} : \Delta h_{AB} + \frac{\Delta h_{AB}}{0.327} + \frac{\Delta h_{AB}}{0.457} = 26$$

$$\therefore \Delta h_{AB} = 4.16 \text{ cm}$$

$$\therefore \Delta h_{BC} = 12.72 \text{ cm}$$

$$\Delta h_{CD} = 9.10 \text{ cm}$$

$$\textcircled{B} \text{ Elevation head at B} = \frac{11}{7+4+15} \times 4 = 1.692 \text{ cm}$$

$$\text{Pressure head at B} = (\text{Elevation Pressure})_A - \Delta h_{AB}$$

$$= 35 - 4.16$$

$$= 30.84 \text{ cm}$$

$$\text{total head at B} = 30.84 + 1.692 = 32.532 \text{ cm}$$

$$\text{Elevation head at C} = \frac{11}{26} \times 11 = 4.654 \text{ cm}$$

$$\text{Pressure head at C} = (\text{Elevation Pressure})_B - \Delta h_{BC}$$

$$= 30.84 - 12.72$$

$$= 18.12 \text{ cm}$$

$$\text{total head at C} = 18.12 + 4.654 = 22.774 \text{ cm}$$

—————→ Continue

In general :

	Elevation head	Elevation Pressure	total head
A	0	35	35 cm
B	1.692	30.84	32.532 cm
C	4.654	18.12	22.774 cm
D	11	9	20 cm