Essentials of Soil Mechanics

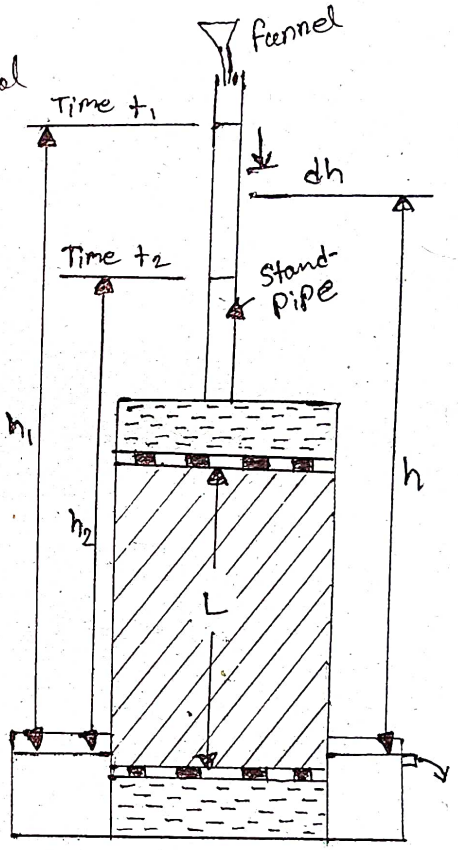
Code: CE706

Assignment : week 6

---

1) Falling head, Coefficient of Permeability (k) :

Let, h_1 and h_2 be the time interval t_1 and t_2 ($t_2 > t_1$) respectively. Let h be the head at any intermediate time interval t and -dh be the change in the head in a smaller time interval "dt". Hence, from Darcy's Law the rate of flow "q" is given by –



Falling Head Test

$$q = \frac{(-dh \cdot a)}{dt} = kiA$$

where i = hydraulic gradient $= \frac{h}{L}$

$$\therefore \frac{kh}{L} \cdot A = -\frac{dh}{dt} \cdot a$$

$$\Rightarrow \frac{Ak}{aL} dt = -\frac{dh}{h} \quad \cdots (1)$$

Integrating between two time limits in equation (1) :

$$\frac{Ak}{aL} \int_{t_1}^{t_2} dt = -\int_{h_1}^{h_2} \frac{dh}{h}$$

$$\Rightarrow \frac{Ak}{aL} \int_{t_1}^{t_2} dt = \int_{h_1}^{h_2} \frac{dh}{h}$$

$$\Rightarrow \frac{Ak}{aL} \int_{t_1}^{t_2} dt = \int_{h_1}^{h_2} \frac{1}{h} dh$$

$$\Rightarrow \frac{Ak}{aL}(t_2 - t_1) = \log_e (h_1 - h_2)$$

$$\Rightarrow \frac{Ak}{aL}(t_2 - t_1) = \log_e \frac{h_1}{h_2} \quad \ldots (2)$$

Denoting $t_2 - t_1 = t$ we get -

$$\frac{Ak}{aL} t = \log_e \frac{h_1}{h_2} \quad [\text{from eq } 2]$$

$$\Rightarrow k = \frac{aL}{At} \log_e \frac{h_1}{h_2}$$

$$k = 2.303 \frac{aL}{At} \log \frac{h_1}{h_2}$$

⊞ Constant head Co-efficient of Permeability (k):

If Q is the total quantity of flow in a time interval t, we have from Darcy's Law:

$$q = \frac{Q}{t} = kiA \quad [\text{Darcy's Law}, q = kiA]$$

$$\Rightarrow \frac{Q}{t} = kiA \quad \left[i = \frac{h}{L}\right]$$

$$\Rightarrow k = \frac{Q}{t} \cdot \frac{1}{A} = \frac{Q}{t} \cdot \frac{L}{h} \cdot \frac{1}{A} = \frac{QL}{Aht}$$

$$\therefore k = \frac{QL}{Aht}$$

Where,

A = total cross sectional Area of the sample
q = discharge per unit time.
i = hydraulic gradient = $\frac{h}{L}$
k = Darcy's coefficient
t = time.
Q = Total quantity of flow

2] Solution:

we know,

$$k = \frac{aL}{At} \ln \frac{h_1}{h_2}$$

$$= \frac{3.8 \times 18}{50.26 \times 6.25 \times 10^{-3}} \ln \frac{50}{25}$$

$$= 150.93 \text{ cm/Day}$$

$$= 1.509 \text{ m/Day}$$

$D = 8$ cm

$A = \frac{\pi}{4} \times 8^2 = 50.26 \text{ cm}^2$

$h_1 = 50$ cm

$h_2 = 25$ cm

$t = 0.15 \text{ hr} = \frac{0.15}{24} = 6.25 \times 10^{-3}$ Day

$L = 18$ cm

$d = 2.2$ cm

$a = \frac{\pi}{4} \times (2.2)^2 = 3.8 \text{ cm}^2$

$k = ?$ m/day