Part B

Objective:- To determine the coefficient of permeability of soil sample using falling head method.

Apparatus:-

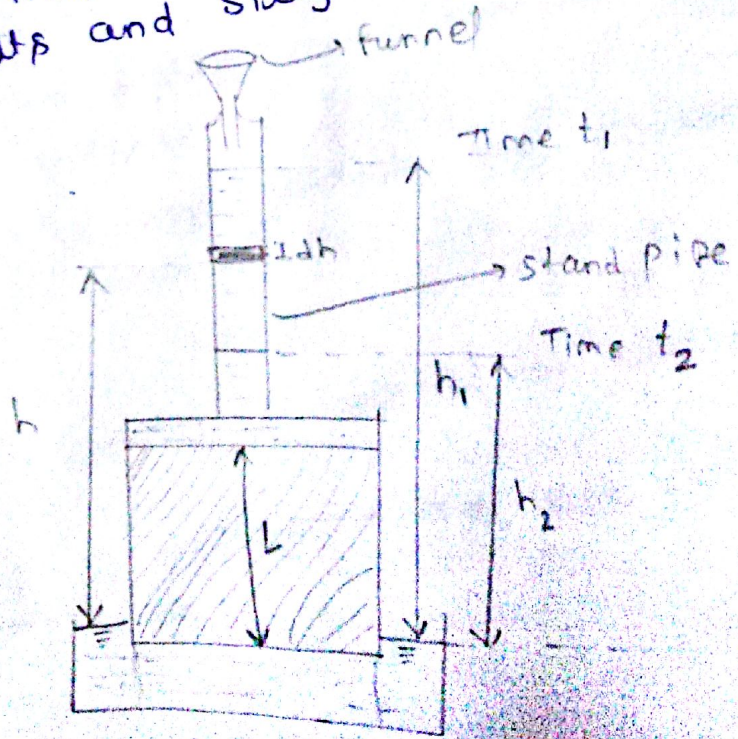
→ permeameter frame consisting of sand pipe, graduated scale, rubber tubing connected to permeameter mould.
→ Permeameter mould including cover, base, detachable collar, porous stone, downing plate.
→ Round filter paper
→ Dynamic compaction device
→ Stop watch, De-aerial water.

Theory:- Permeability is defined as the property of porous material which permits the passage or seepage of water through its inter connected voids. The coefficient of Permeability can be found using these methods:-

→ Variable Head Method
→ Constant Head Method

Varriable Head Method:-

The Varriable Head Method is used for fine grained soils like silts and silty clays.



falling Head Method

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from Darcy's law

$$q = KiA = K\frac{h}{L}A \quad \rightarrow (1)$$

h = the flow head at an intermediate time 't' between t_1 and t_2 corresponding to h_1 and h_2

K = Coefficient of permeability

A = Area of permeameter

L = Distance between manometer tapping points (cm)

q = discharge (cm^3/s) in time t

a = area of stand pipe

If the level of water in the stand pipe falls by 'dh' in time 'dt', the flow in unit time through the sample.

$$q = a \times \text{velocity of fall}$$

$$q = a\left(-\frac{dh}{dt}\right) = -a\frac{dh}{dt} \quad \rightarrow (2)$$

eqn (1) = eqn (2)

$$\frac{Kh}{L}A = -a\frac{dh}{dt}$$

$$\Rightarrow -\frac{a}{KA}\int_{h_1}^{h_2}\frac{dh}{h} = \int_{t_1}^{t_2} dt \qquad t_2 - t_1 = t$$

$$a\ln\left(\frac{h_1}{h_2}\right) = \frac{KA}{L}(t_2 - t_1)$$

$$K = \frac{aL}{tA}\ln(h_1/h_2)$$

$$\boxed{K = 2.303\left(\frac{L}{t}\right)\left(\frac{a}{A}\right)\log(h_1/h_2)}$$

Observation and Calculation:-

Diameter of Stand pipe (cm) d = 1.01 cm

$$a = \frac{\pi}{4}d^2 = 0.801\ cm^2$$

Dia of cylindrical Sample (D) = 9.91 cm

$$A = \frac{\pi}{4}D^2 = \left(\frac{\pi}{4}\right)(9.91)^2 = 77.13246\ cm^2$$

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length of specimen (L) = 12.92 cm

h_1	$\sqrt{h_1 h_2}$	h_2	Time Required (t) sec (i)	(ii)	(iii)	Avg	Permeability $K = 2.303 \frac{aL}{At} \log(h_1/h_2)$
90	60	40	32	31	31.6	31.533	$K = 1.723 \times 10^{-3}$ cm/s
			31.58	31.40	31.8	31.593	$K = 6.206$ cm/hr
					$t =$	63.126	
81	63	49	20.4	20.2	20.1	20.233	$K = 1.666 \times 10^{-3}$ cm/s
			20.24	20.1	20.4	20.246	$K = 5.998$ cm/hr
					$t =$	40.479	

Average $K = 1.694 \times 10^{-3}$ cm/s or 6.1 cm/hr

Result :-

From the experiment we get coefficient of Permeability $= 1.6944 \times 10^{-3}$ cm/s or 6.1 cm/hr

Precautions :-

→ All possible leakage of limits must be eliminated.

→ Porous stone must be saturated before being put to use.

→ De-aired and distilled water should be used to prevent chocking of flowing water.

→ Soil sample must be carefully saturated before taking the observation.

→ use of High heads which result in turbulent flows, should be avoided.

Applications :-

→ water flowing through soils creats considerable seepage force which has direct effect on the hydraulic structures.

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→ The rate of Settlement of compressible clay layer under load depends on its permeability. The quantity of water escaping through and beneath the earthen dam depends on the permeability of the embankments and its foundations respectively.

→ The rate of discharge through wells and excavated foundation pits depends on the coefficient of permeability of soils.

Type of Soil	Permeability Range (cm/s)
Gravel	10^3 to 1.0
Sand	1.0 to 10^{-3}
Silt	10^{-3} to 10^{-6}
Clay	$< 10^{-6}$

Conclusion:-

Our soil sample is

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