PERMEABILITY TEST

Rafia Islam
Lecturer
Department of Environmental, Water Resources and Coastal Engineering (EWCE)
Military Institute of Science and Technology

Permeability of Soils

- Permeability is the measure of the soil's ability to permit water to flow through its pores or voids

Objective

- Determination of the coefficient of permeability of soil

Significance

- Permeability influences the **rate of settlement** of a saturated soil under load
- The **stability of slopes and retaining structures** can be affected by the permeability of the soils
- The design of **earth dams** is based upon the permeability of soil
- Filters to **prevent piping and erosion** are designed based upon their permeability

Hydraulic Conductivity

- Hydraulic conductivity is a measure of soil permeability
- Also known as **Coefficient of permeability**
- k is determined in the lab using two methods:

1. **Constant Head Test**
2. **Falling Head Test**

- k is usually expressed in **cm/sec**
- The coefficient of permeability, k, is a product of Darcy's Law

$$Q = kiA$$

Where:
Q = flow rate (volume/time)
i = hydraulic gradient (unit less)
A = cross-sectional area of flow (area)
k = coefficient of permeability (length/time)

Factors Affecting Permeability

1. **The viscosity of the pore fluid (usually water):**

- The viscosity of water decreases with the increasing temperature which increases the coefficient of permeability
- The coefficient of permeability is standardized at 20°C

Where,
η_T = Viscosity at temperature T^0C
η_{20} = Viscosity at temperature 20°C

2. The void ratio (e)of the soil

3. The size and shape of the soil particles

4. The degree of Saturation (S)

Types of Permeability Test

1. **Constant head permeability test:**

- For soils of high permeability (sands and gravels) a constant head test is used
- A constant total head difference is applied to the soil specimen

2. Falling head permeability test:

- For soils of intermediate to low permeability (fine grained soil), a falling head test is used
- Does not fix the total head difference across the specimen.

Constant Head Permeability Test

Equipment

- ➢ Permeameter
- ➢ Manometer
- ➢ Balance
- ➢ Scoop
- ➢ Cylinders
- ➢ Watch (or Stopwatch)
- ➢ Thermometer
- ➢ Filter paper

Constant Head **Falling Head**

Procedure

- A representative sample should be obtained from original soil. Sieving should be done by the 6.25 mm sieve
- The sample should be taken and with a scoop the material should be poured into the funnel.
- After pouring , the upper filter, the top plate should be fitted
- The lower valve of the cell should be opened to flow water within the sample
- Flow of water should be continued upwards to reach the upper filter
- When the water level in the monometer tubes becomes stable, test measurements should be started

- A measuring cylinder of suitable capacity should be placed under the outlet valve and at the same time the stop watch should be started
- For each time interval record the following data:

(1) Elapsed time from the beginning of measurement.

(2) Amount and temperature of water within the graduated cylinder.

(3) Level of water in the manometer tubes.

Data Sheet

Falling Head Permeability Test

Procedure

- Before starting the flow measurements, the soil sample is saturated and the standpipes are filled with water to a given level
- The test then starts by allowing water to flow through the sample until the water in the standpipe reaches a given lower limit
- The time required for the water in the standpipe to to drop from the upper to the lower level is recorded