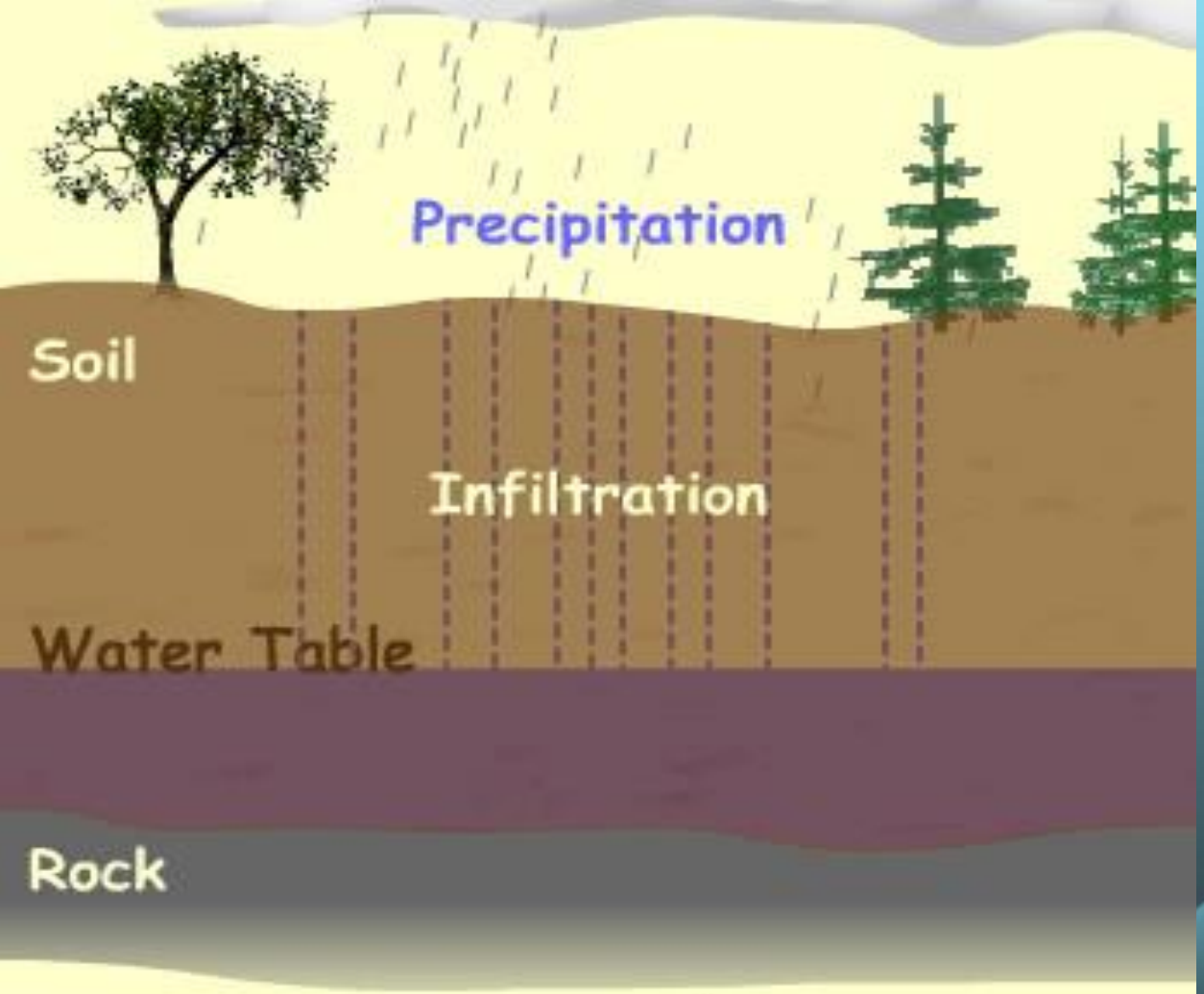


INFILTRATION

Prepaid by :- sliders

INFILTRATION

- The process of entering rain water in to soil strata of earth is called INFILTRATION.
- The infiltrated water first meets the soil moisture deficiency if any & excess water moves vertically downwards to reach the groundwater table. This vertical movement is called **PERCOLATION**.

INFILTRATION CAPACITY

- The infiltration capacity of soil is defined as the maximum rate at which it is capable of absorbing water and is denoted by **f**.
- If $i >= f$ then $f_a = f$ (depend upon soil capacity)
- If $i < f$ then $f_a = i$ (depend upon rainfall intensity)
- where f_a = actual infiltration capacity

i = rate of rainfall

f = infiltration capacity

- For
  Dry Soil – (infiltration rate) f is more
  Moist Soil – (infiltration rate) f is less

- Maximum rate of water absorption by soil – **Infiltration Capacity**

- Maximum capacity of water absorption by soil – **Field Capacity**

INFILTRATION RATE

- The rate at which soil is able to absorb rainfall or irrigation .
- It is measured in (mm/hr) or (inches/hr)
- Infiltrometer is used for measurement of infiltration.
- If (i > f) runoff occurs.
- Infiltration rate is connected to hydraulic conductivity.

- Hydraulic conductivity is ability of a fluid to flow through a porous medium.

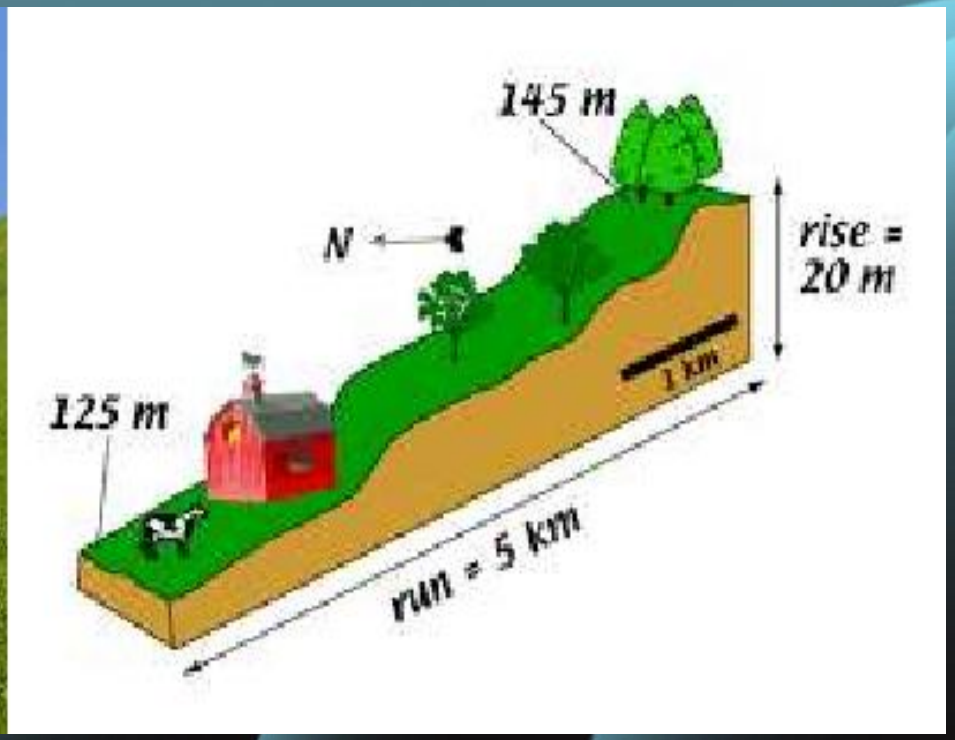
  It is determined by the size and shape of the pore spaces in the medium & viscosity of fluid.

OR

It is expressed as the volume of fluid that will move in unit time under a unit hydraulic gradient through a unit area measured perpendicular to the direction of flow.

FACTOR AFFECTING INFILTERATION CAPACITY

- **SLOPE OF THE LAND:-** The steeper the slope (gradient), the less the infiltration or seepage.



- **DEGREE OF SATURATION:-** The more saturated the loose Earth materials are, the less the infiltration.

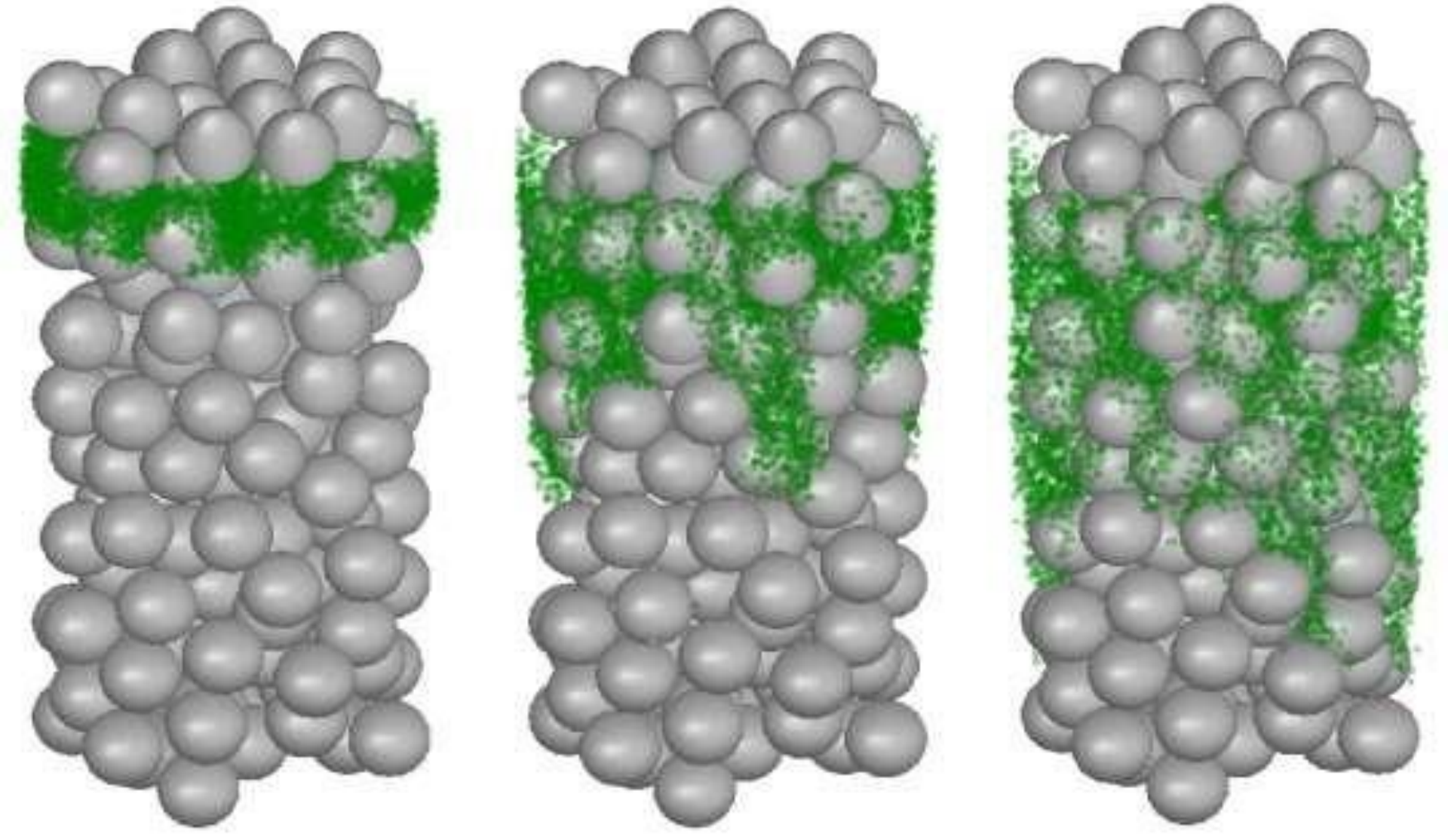
POROSITY:- Porosity is the percentage of open space (pores and cracks) in a earth surface.

- The greater the porosity, the greater the amount of infiltration.

SPONGE

CLAY BRICK

PACKING OF SOIL GRAINS



- **COMPACTION:-** The clay surfaced soils are compacted even by the impact of rain drops which reduce infiltration. This effect is negligible in sandy soils

SURFACE COVER CONDITION:-

Vegetation:- Graysses, trees and other plant types capture falling precipitation on leaves and branches, keeping that water from being absorbed into the Earth & take more time to reach in to the ground.

MORE the vegetation

Slower the Infiltration.

- **Land Use:-** Roads, parking lots, and buildings create surfaces that are not longer permeable. Thus infiltration is less.

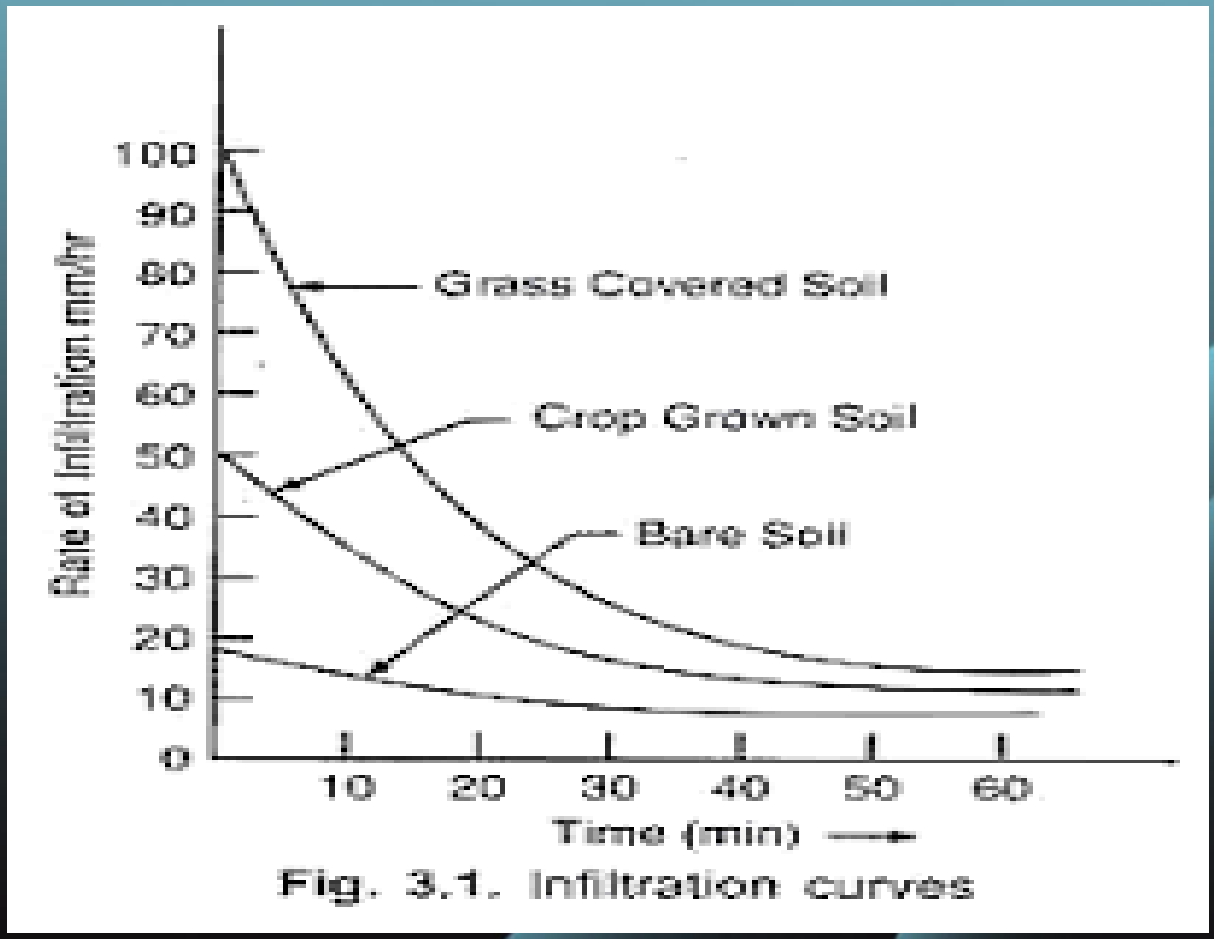
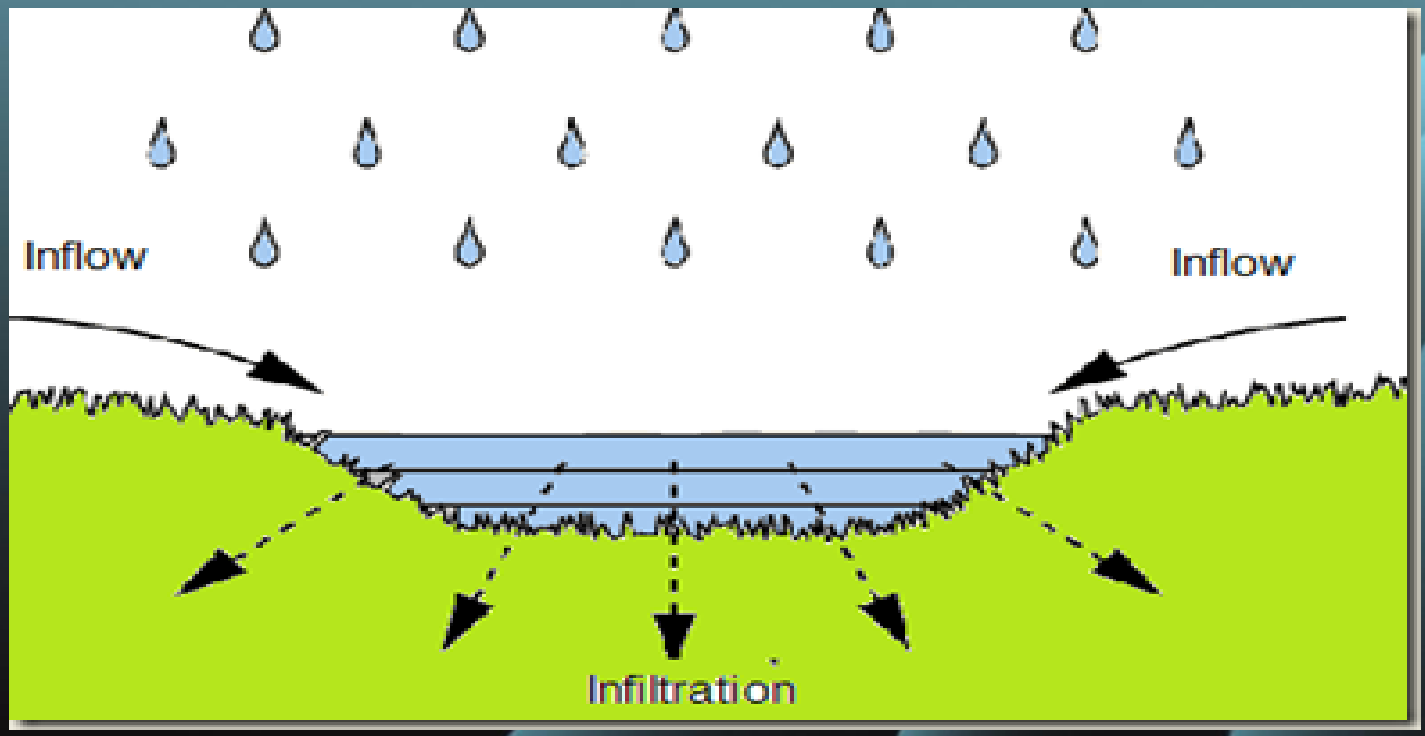


Fig. 3.1. Infiltration curves

- TEMPERATURE – At high temperature viscosity decreases and infiltration increases

- Summer – Infiltration ⇧ increases
- Winter – Infiltration ⇩ decreases



OTHER FACTORS –

a) Entrapped air in pores- Entrapped air can greatly affect the hydraulic conductivity at or near saturation

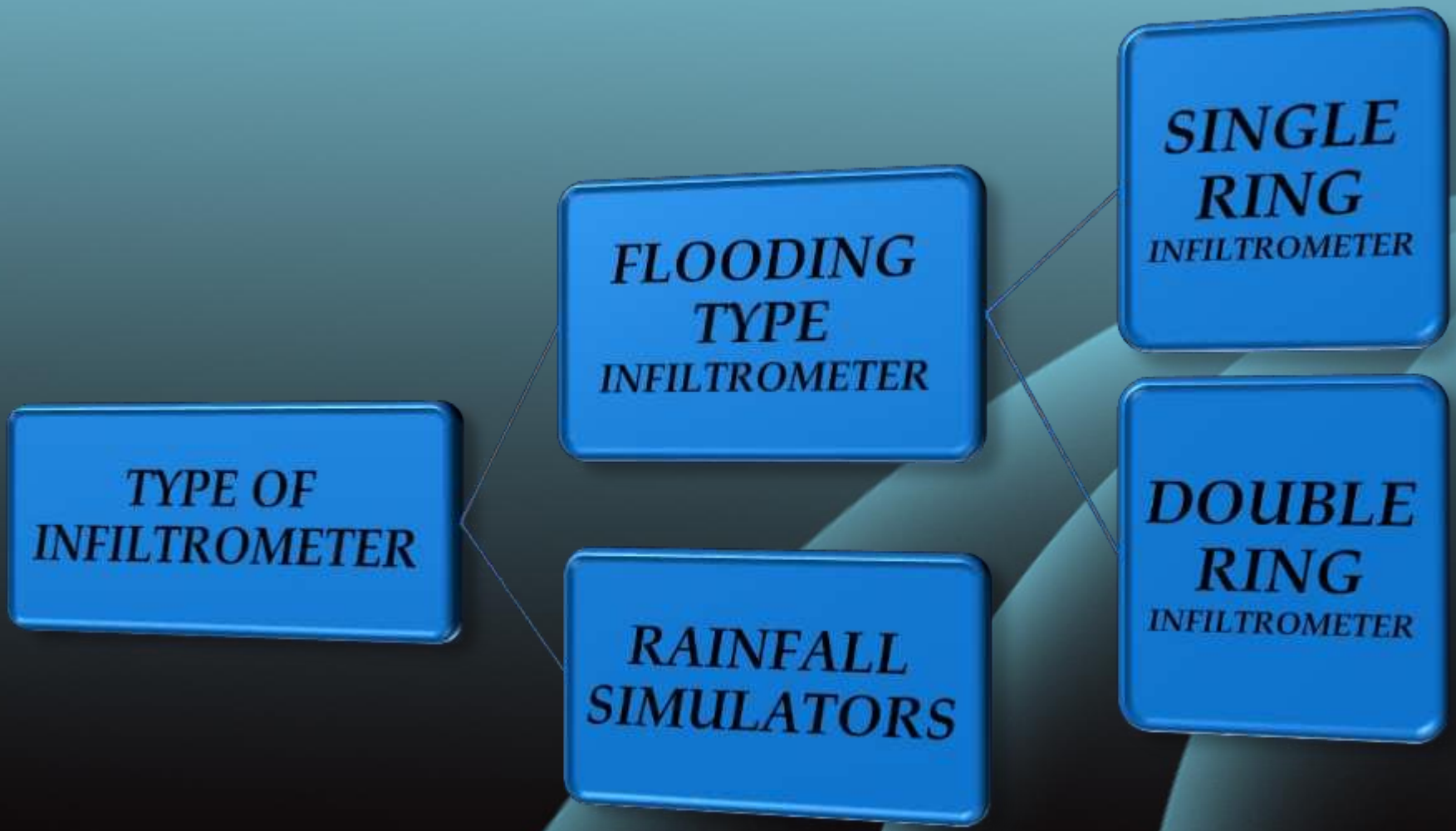
b) Quality of water-Turbidity by colloidal water

c) Freezing- Freezing in winter may lock pores.

d) Annual & seasonal changes –According to change in land use pattern. Except for Massive deforestation & agriculture.

MEASUREMENT OF INFILTRATION

- **Infiltrometer** is a device used to measure the rate of water infiltration into soil.



SINGLE RING INFILTROMETER

- This consist of metal cylinder of diameter 25 cm to 30 cm and length of 50 cm to 60 cm, with both ends open. **length of cylinder** = (2 x diameter)

- It is driven into a level ground such that about 10 cm of cylinder is above the ground.

- Water is poured into the top part to a depth of **5 cm** & pointer is set inside the ring to indicate the water level to be maintained.

- The single ring involves driving a ring into the soil and supplying water in the ring either at constant head or falling head condition.

Constant head refers to condition where the amount of water in the ring is always held constant means the rate of water supplied corresponds to the infiltration capacity.

Falling head refers to condition where water is supplied in the ring, and the water is allowed to drop with time. The operator records how much water goes into the soil for a given time period.

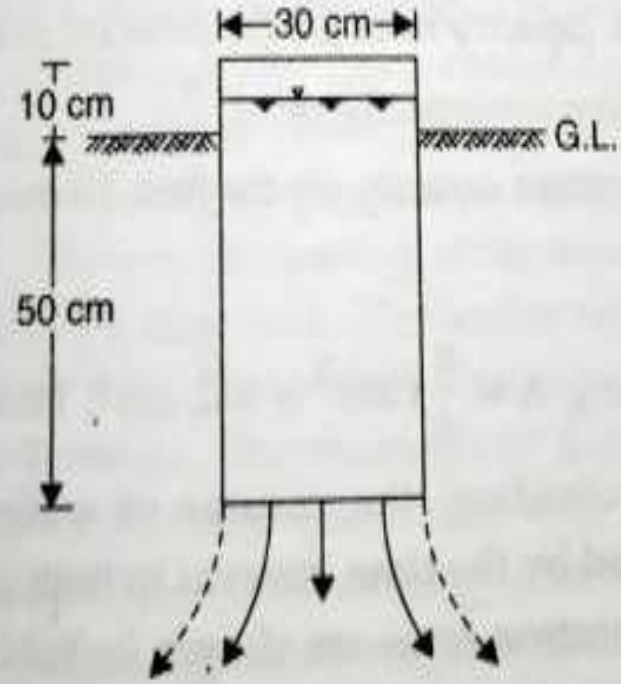
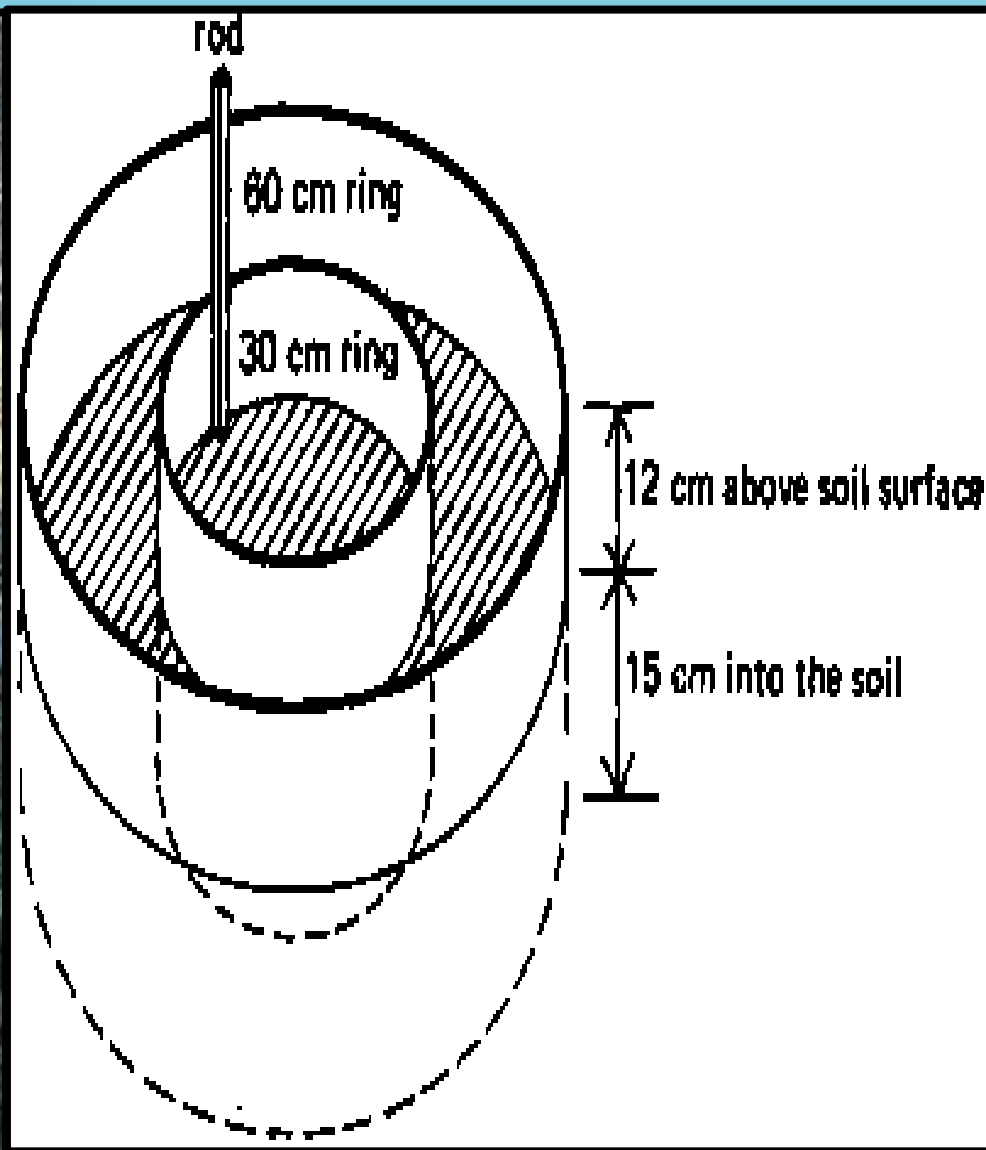


FIGURE 8.3 Tube infiltrometer.

- The major drawback of the **single ring** infiltrometer or **tube infiltrometer** is that the infiltrated water percolates laterally at the bottom of the ring.
- Thus the tube is not truly representing the area through which infiltration is taking place.

DOUBLE RING INFILTROMETER

- This is most commonly used flooding type infiltrometer.
- it consists of two concentric rings driven into soil uniformly without disturbing the soil to the least to a depth of 15 cm. The diameter of rings may vary between 25 cm to 60 cm.
- An inner ring is driven into the ground, and a second bigger ring around that to help control the flow of water through the first ring. Water is supplied either with a constant or falling head condition, and the operator records how much water infiltrates from the inner ring into the soil over a given time period.


rod
60 cm ring
30 cm ring
12 cm above soil surface
15 cm into the soil

INFILTROMETERS

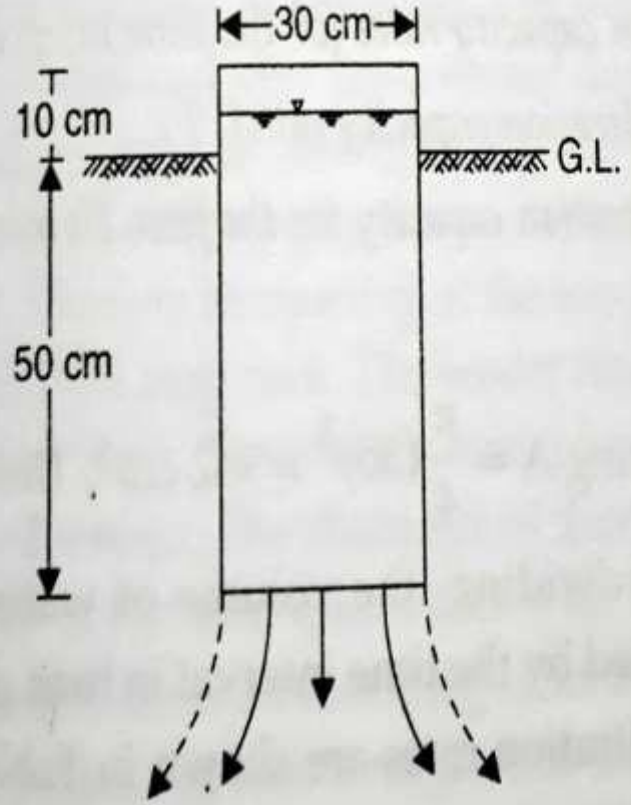


FIGURE 8.3 Tube infiltrometer.

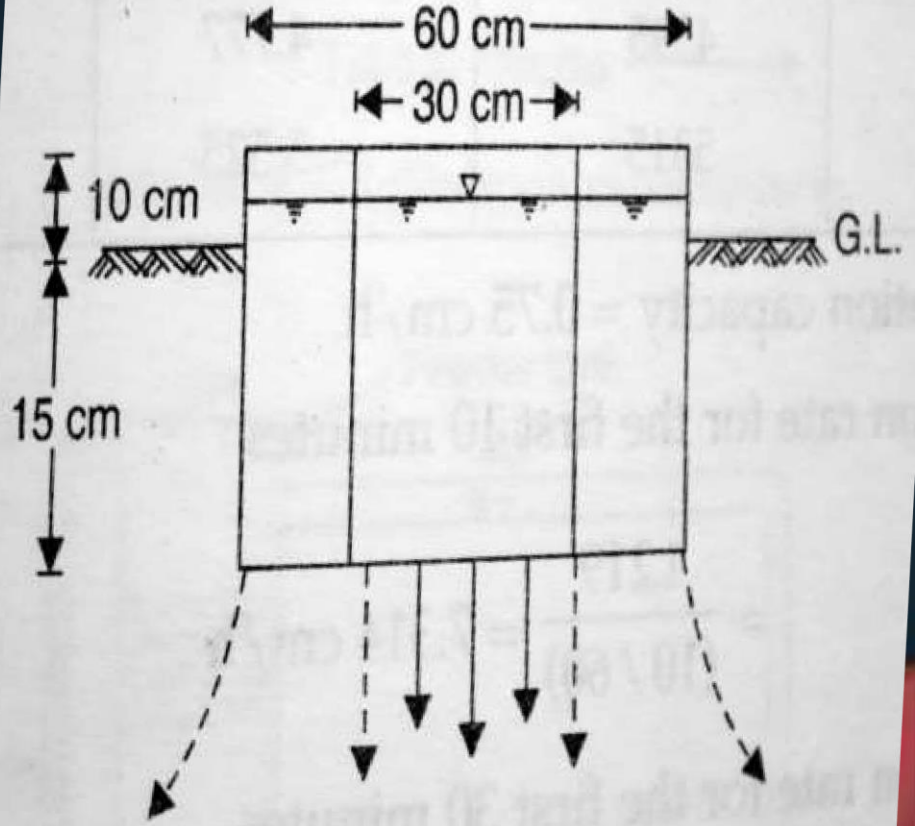


FIGURE 8.4 Double ring infiltrometers.

RAINFALL SIMULATORS

- In this a small plot of land (2m X 4m) size, is provided with a series of nozzles on the longer side with arrangements to collect and measure the surface runoff rate. The specially designed nozzles produce raindrops falling from height of 2m and capable of producing various intensities of rainfall. Experiments are conducted under controlled conditions with various combinations of intensities and durations and the surface runoff rates and volumes are measured in each case. Using the water budget equation infiltration rate and its variation with time are estimate.

$$P-R-G-E-T=\Delta S$$

P = Precipitation, R = Surface runoff, G = net ground water flow, E = Evaporation, T = Transpiration,

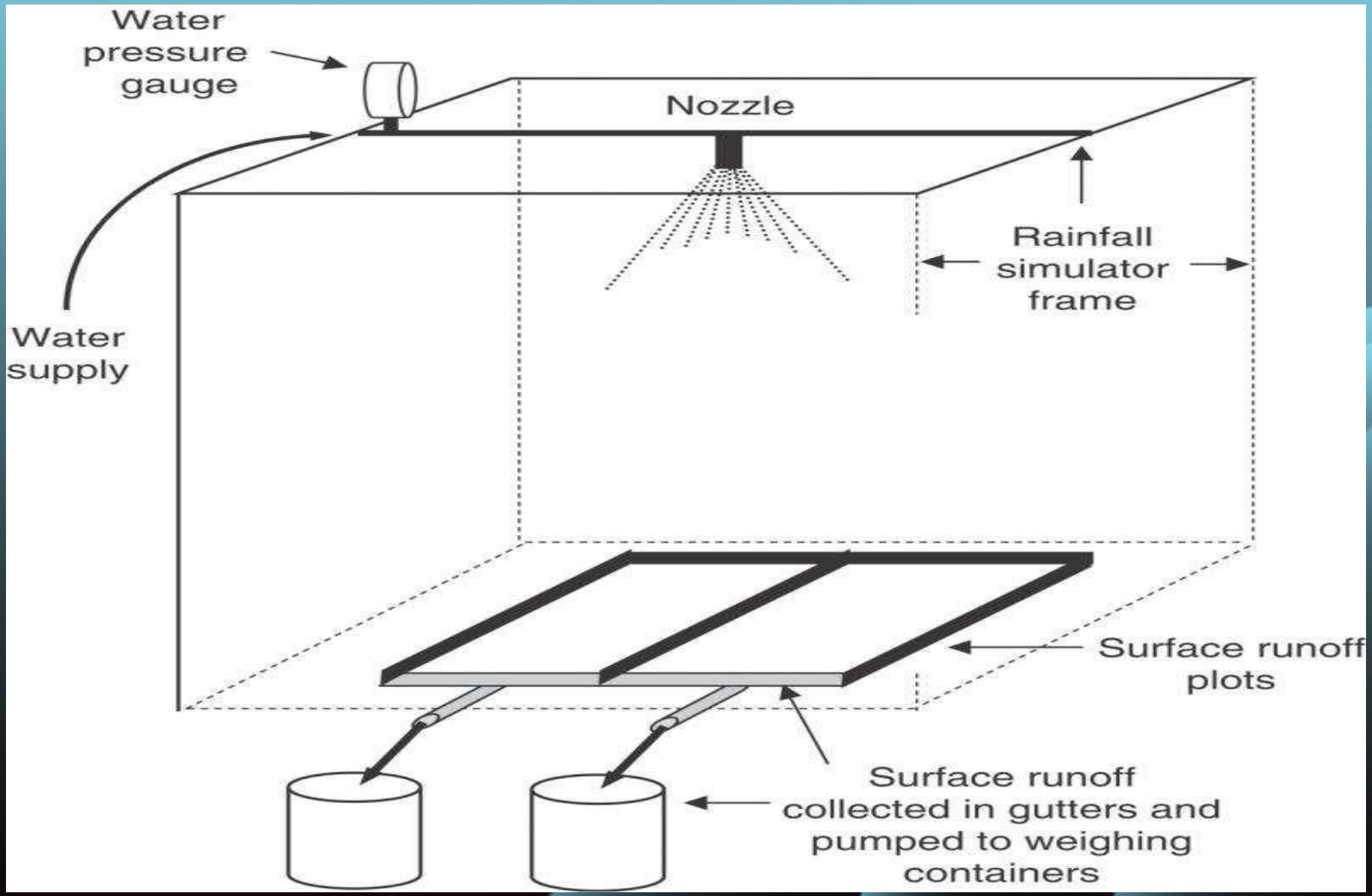
ΔS = change in storage

RAINFALL SIMULATORS

- plot of land (2m X4m)
- The specially designed nozzles produce raindrops falling from height of 2m
- under controlled conditions with various combinations of intensities & durations and the
- surface runoff rates and volumes are measured in each case.

$$\mathbf{P - R - G - E - T = \Delta S}$$

RAINFALL SIMULATOR



INFILTRATION INDICES

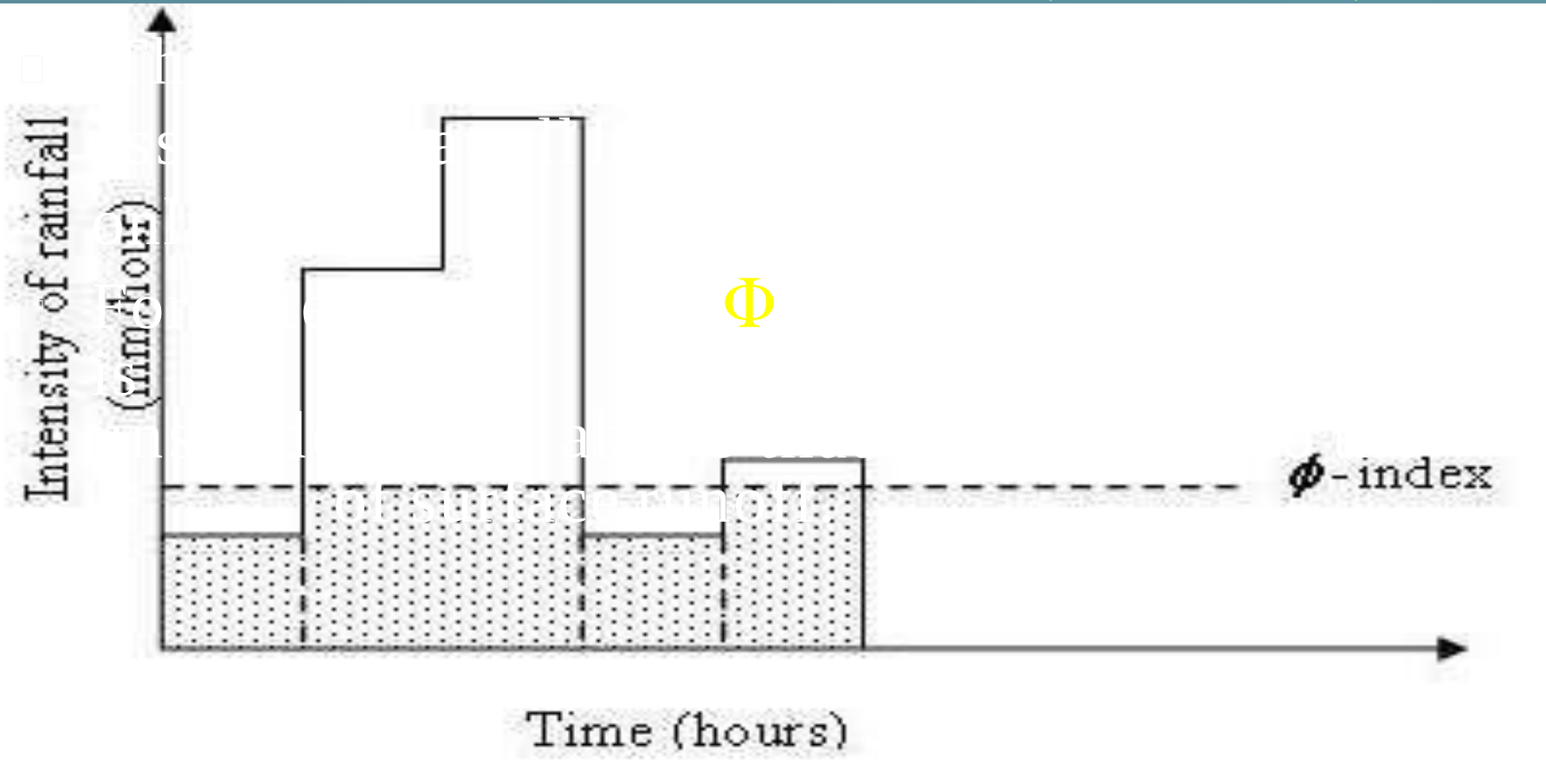
- For consistency in hydrological calculations, a constant value of infiltration rate for the entire storm duration is adopted. The average infiltration rate is called the **INFILTRATION INDEX**.
- The two commonly used infiltration indices are the following:
  - φ – *index*
  - *W - index*

There are extremely used for the analysis of major floods when the soil is wet and the infiltration rate becomes constant.

Φ – INDEX

- This is defined as the rate of infiltration above which

rainfall volume = runoff volume(saturation).



- Φ – *INDEX* *for a catchment, during a storm depends on*

- Soil type
- vegetation cover
- Initial moisture condition

- *Application -* *Estimation of flood magnitudes due to critical storms.*

W – INDEX

- This is the average infiltration rate during the time when the rainfall intensity > infiltration rate.

$$\textbf{W-index} = (P - R - I_a)/t_f = (F/t_f)$$

where P = Total storm precipitation (cm)

R = Total surface runoff (cm)

I_a = Depression and interception losses (cm)

t_f = Time period of runoff (in hours)

- The w- index is more accurate than Φ – index because it excludes the *Depression* & *interception*.

- W-index is the refined version of Φ – INDEX.
- Initial losses I_a are separated from total abstractions.
- W-index = Φ–index $-$ I_a
- The accurate estimation of W-index is rather difficult to obtain hence Φ – index is most commonly used.
- Since retention rate is very low both index W & Φ are almost same.


THANK
YOU