

1. Introduction to Infiltration

The term infiltration was first introduced by Robert E. Horton (1935). He defined it as the entry of water into the soil through the surface layer, moving vertically downward.

Specifically, it is the downward movement of water from the soil surface into the soil through the pores. When rainwater falls on the ground, a small portion is initially absorbed by the top layer of the soil to fill the soil moisture deficiency. Any excess water then infiltrates further downward to join the groundwater.

Percolation vs. Infiltration

Once water enters the soil, the process of the transmission of water through the soil profile is known as percolation. Infiltration and percolation are directly interrelated; when percolation stops, infiltration also stops.

2. Infiltration Capacity

The capacity of soil to absorb water from continuous rain falling at an excessive rate decreases over time until a minimum constant rate is reached.

Definition: The infiltration capacity (f_p) of soil is the maximum rate at which water can enter the soil under a given set of conditions.

Infiltration Curve

The relationship between the rate of infiltration and time is typically represented by an infiltration curve. As time progresses, the rate of infiltration starts high and gradually decays toward a constant minimum rate.

3. Effects of Infiltration

Reduces Flooding: By absorbing water into the ground, it reduces surface runoff.

Delays Arrival: It delays the time it takes for water to reach river channels or reservoirs.

Groundwater Recharge: It replenishes underground water supplies.

Reduces Soil Erosion: By limiting surface runoff, it prevents the washing away of topsoil.

Fills Soil Pores: It maintains field capacity, making water available to plants.

Sustains Vegetation: It supports green vegetation on the ground surface, which in turn helps reduce the impact of storms.

4. Factors Affecting Infiltration

A. Condition of the Entry Surface (Vegetation vs. Bare Land)

Vegetation: Areas with grass, plants, and bushes have a high infiltration capacity. Vegetation provides decaying organic matter, which attracts burrowing insects. This creates a spongy, permeable soil structure, increasing infiltration.

Bare Land: On empty land, raindrops hit the soil directly, washing fine particles into the soil pores. This "clogging" effect reduces water flow and prevents soaking.

B. Permeability and Percolation Characteristics

Infiltration depends heavily on percolation. Water is pulled downward by the force of gravity and capillary action. Percolation depends on soil factors such as porosity, the presence of organic matter, and the presence of salts.

C. Antecedent Moisture Conditions

"Antecedent" refers to the moisture already present in the soil before it starts raining.

Wet Soil: If the ground is already wet, it cannot absorb much more water, resulting in a low infiltration rate.

Dry Soil: Dry soil allows for fast infiltration. The significant difference in "pull" between the wet top and dry bottom, combined with gravity, causes water to soak in very quickly.

D. Temperature

Warm Water: In summer, warm water is less viscous, allowing it to flow into soil pores more easily.

Freezing Temperatures: In winter, water may turn into ice inside the soil. This blocks the pores and can stop water from soaking in entirely.

E. Intensity and Duration of Rainfall

Heavy Rain: Very heavy rain hits the ground hard, packing the soil down and filling small holes with fine dirt. This compaction decreases infiltration.

Light Rain: Light rain does not pack the soil down, allowing for a higher infiltration rate.

Duration: If it rains for a long duration, the soil becomes saturated, and the rate of soaking decreases.

F. Movement of Humans and Animals

Frequent movement of people or animals over the land compacts the soil. This leaves less space for water, causing the infiltration rate to drop.

G. Human Activities

Human actions, such as construction or farming, change the surface of the land, which often results in a reduction of infiltration capacity.

H. Quality of Water

Turbidity: If water is "dirty" (containing silt or mud), it clogs the tiny holes in the soil, slowing down infiltration.

Chemical Reactions: Salts in the water can react with the soil, making it harder for water to pass through.