

Initial Loss

In the precipitation reaching the surface of a catchment the major abstraction is from

the infiltration process. These are

(i) the interception process and

(ii) the depression storage,

and together they are called initial loss.

(i) Interception

The volume of water so caught is called interception. The intercepted precipitation may follow one of the three possible routes:

(a) obstructed by vegetation : interception loss

(b) contribution to surface flow through drip water : through fall

(c) flow through stem : stem flow

Interception loss is about 10 to 20%

The interception loss is estimated as

$$I_i = S_i + k_i E t$$

where I_i = interception loss in mm, S_i = interception storage whose value varies from 0.25 to 1.25 mm depending on the nature of vegetation, k_i = ratio of vegetal surface area to its projected area,

E = evaporation rate in mm/h during the precipitation and

t = duration of rainfall in hours

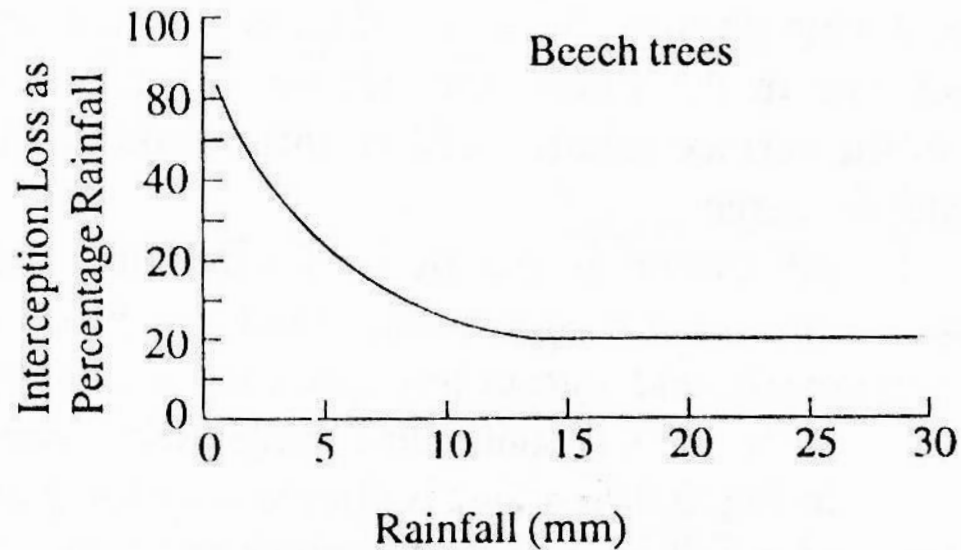


Fig. 3.7 Typical interception loss curve

(ii) Depression storage

the volume of water trapped in these depressions is called depression storage.

Depression storage depends on a vast number of factors the chief of which are :

- (a) the type of soil,
- (b) the condition of the surface reflecting the amount and nature of depression,
- (c) the slope of the catchment and
- (d) the antecedent precipitation

values of 0.50 cm in sand, 0.4 cm in loam and 0.25 cm in clay

Infiltration

this movement of water through the soil surface is known as infiltration

Infiltration process

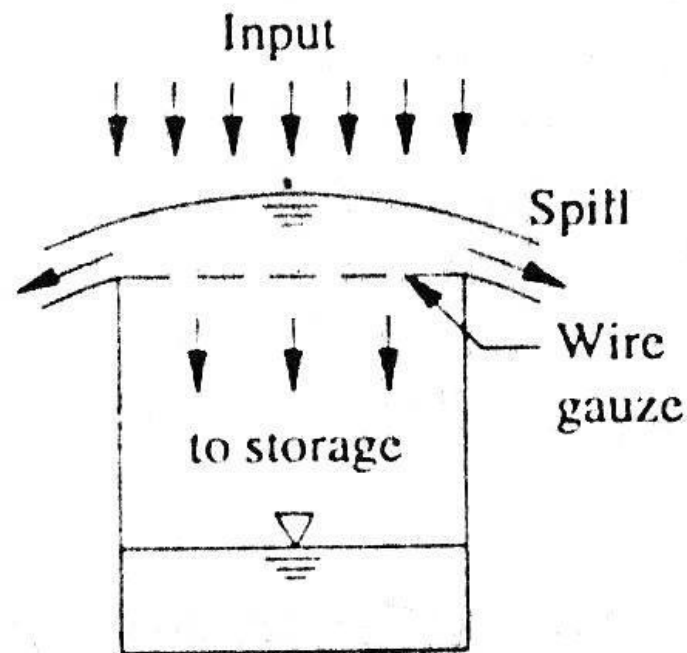


Fig. 3.8 An analogy for infiltration

Infiltration Capacity

The infiltration rate at which a given soil at a given time can absorb water is defined as the infiltration capacity. It is denoted as f_c and is expressed in units of cm/h. The actual rate of infiltration f can be expressed as

$$f = f_c \quad \text{when } i \geq f_c$$

$$f = i \quad \text{when } i < f_c$$

Where i = intensity of rainfall

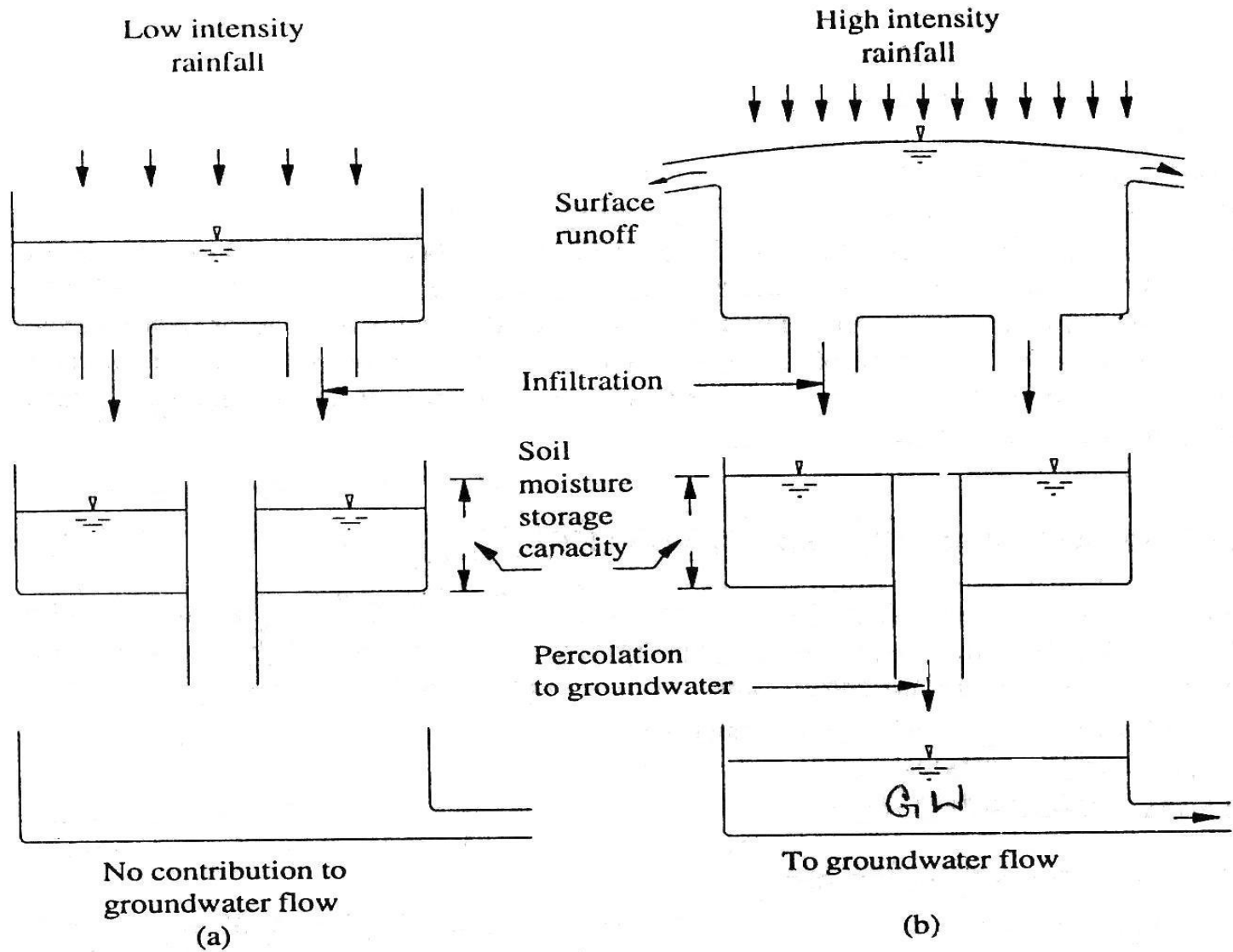


Fig. 3.9 An infiltration model

Measurement of Infiltration

There are two kinds of infiltrometers :

- (i) Flooding - type infiltrometer, and
- (ii) Rainfall simulator

(i) Flooding - type infiltrometer

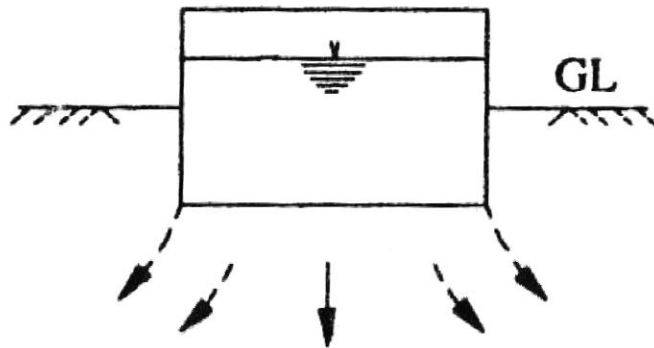


Fig. 3.10 Simple infiltrometer

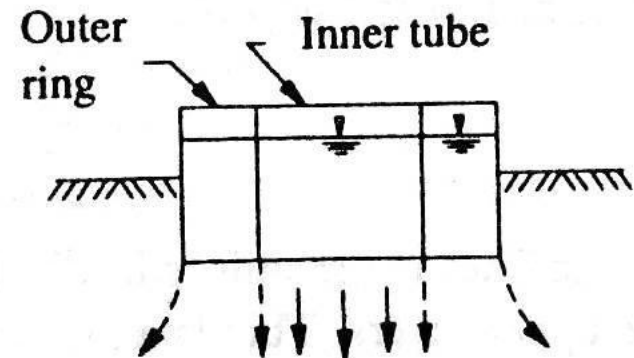


Fig. 3.11 Ring infiltrometer

(ii) Rainfall simulator

Infiltration Capacity values

Horton (1930) expressed the decay of the infiltration capacity with time as

$$f_{ct} = f_{cf} + (f_{co} - f_{cf}) e^{-K_h t} \quad \text{for } 0 \leq t \leq t_d$$

Where f_{ct} = infiltration capacity at any time t from start of the rainfall

f_{co} = initial infiltration capacity at $t = 0$

f_{cf} = final steady state value

t_d = duration of the rainfall and

k_h = constant depending upon the soil characteristics and vegetation cover

Φ – Index

The Φ index is the average rainfall above which the rainfall volume is equal to the runoff volume.

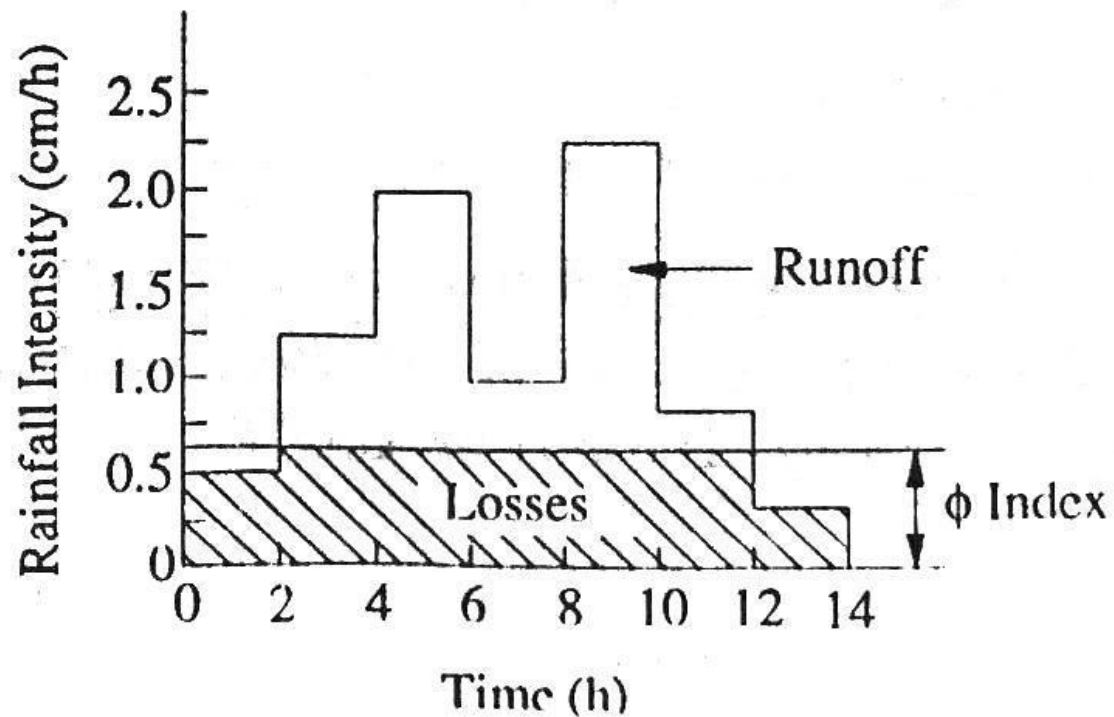


Fig. 3.13 ϕ Index

EXAMPLE 3.5 A storm with 10.0 cm precipitation produced a direct runoff of 5.8 cm. Given the time distribution of the storm as below, estimate the ϕ index of the storm.

Time from start (h)	1	2	3	4	5	6	7	8
Incremental rainfall in each hour (cm)	0.4	0.9	1.5	2.3	1.8	1.6	1.0	0.5

SOLUTION : Total infiltration = $10.0 - 5.8 = 4.2$ cm

Assume t_e = time of rainfall excess = 8 h for the first trial.

Then

$$\phi = \frac{4.2}{8} = 0.525 \text{ cm/h}$$

But this value of ϕ makes the rainfalls of the first hour and eighth hour ineffective as their magnitude is less than 0.525 cm/h. The value of t_e is therefore modified.

Assume t_e = 6 h for the second trial

In this period,

Infiltration = $(10.0 - 0.4 - 0.5 - 5.8)$

= 3.3 cm

$$\phi = \frac{3.3}{6} = 0.55 \text{ cm/h}$$

This value of ϕ is satisfactory as it gives $t_e = 6$ h and by calculating the rainfall excesses.

Time from start (h)	1	2	3	4	5	6	7	8
Rainfall excess (cm)	0	0.35	0.95	1.75	1.25	1.05	0.45	0

Total rainfall excess = 5.8 cm = total runoff.