I INFILTRATION

Water entering the soil at the ground surface is called infiltration. It replenishes the soil moisture deficiency and the excess moves downward by the force of gravity called deep seepage or percolation and builds up the ground water table. The maximum rate at which the soil in any given condition is capable of absorbing water is called its infiltration capacity (fp). Infiltration (f) often begins at a high rate (20 to 25 cm/hr) and decreases to a fairly steady state rate (fc) as the rain continues, called the ultimate fp (= 1.25 to 2.0 cm/hr) (Fig. The infiltrationrate (f) at any time t is given by Horton's equation.

$$f = f_c + (f_o - f_c)\, e^{-kt}$$

$$k = f_0 - f_c / F_e$$

where f0 = initial rate of infiltration capacity fc = final constant rate of infiltration at saturation k = a constant depending primarily upon soil and vegetation e = base of the Napierian logarithm Fc = shaded area in Fig. 3.6 t = time from beginning of the experiment.

1.1 INFILTRATION INDICES

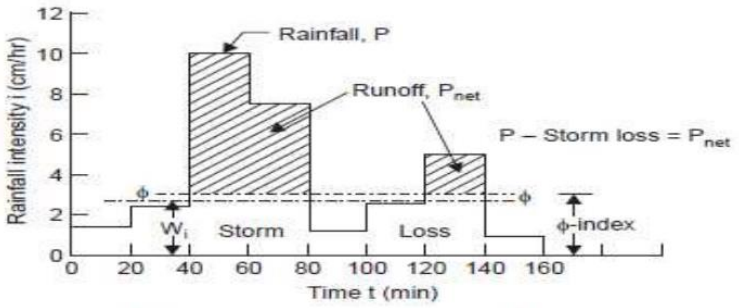
The infiltration curve expresses the rate of infiltration (cm/hr) as a function of time. The area between the rainfall graph and the infiltration curve represents the rainfall excess, while the area under the infiltration curve gives the loss of rainfall due to infiltration. The rate of loss is greatest in the early part of the storm, but it may be rather uniform particularly with wet soil conditions from antecedent rainfall. Estimates of runoff volume from large areas are sometimes made by the use of infiltra- tion indices, which assume a constant average infiltration rate during a storm, although in actual practice the infiltration will be varying with time. This is also due to different states of wetness of the soil after the commencement of the rainfall. There are three types of infiltration indices:

i) φ-index
ii) W-index
iii) fave–index

(i) φ-index—The φ-index is defined as that rate of rainfall above which the rainfall volume equals the runoff volume. The φ-index is relatively simple and all losses due to infiltra- tion, interception and depression storage (i.e., storage in pits and ponds) are accounted for; hence,

φ-index = basin recharge/duration of rainfall

provided i > φ throughout the storm. The bar graph showing the time distribution of rainfall, storm loss and rainfall excess (net rain or storm runoff) is called a hyetograph. Thus, the φindex divides the rainfall into net rain and storm loss



(ii) W-index—The W-index is the average infiltration rate during the time rainfall intensity exceedsthe infiltration capacity rate, i.e.,

$$W\text{-index} = \frac{F_p}{t_R} = \frac{P - Q - S}{t_R}$$

where P = total rainfall Q = surface runoff S = effective surface retention tR = duration of storm during which i >fpFp = total infiltration The W-index attempts to allow for depression storage, short rainless periods during a storm and eliminates all rain periods during which i <fp . Thus, the W-index is essentially equal to the φ-index minusthe average rate ofretention by interception and depression storage, i.e., W < φ

Information on infiltration can be used to estimate the runoff coefficient C in computing the surface runoff as a percentage of rainfall i.e., Q = CP

$$C=(i-W)/i$$

(iii) fave -index—In this method, an average infiltration loss is assumed throughoutthe storm, for the period i>f

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