

Precipitation, is
precipitation. rainfall
remains at the

[Design](#)



Precipitation, which may be in a solid or liquid state is derived from the atmosphere. It results from the condensation of moisture in the atmosphere due to the cooling of a parcel of air. The most common cause of cooling is dynamic or adiabatic lifting of the air. This occurs when a given portion of air is made to rise with the consequent cooling and possible condensation into very small cloud droplets. When they are of sufficient size to overcome the air resistance, the resultant is precipitation.

Rainfall remains at the land surface as depression storage and either evaporates, infiltrates or is discharged as overland flow (USDOT, 2002). However, of these, the principal concern in highway design, is the surface runoff. The most important step commencing the hydraulic design of a highway drainage structure regardless of its size or cost is the determination of the maximum runoff that the highway drainage structure is anticipated to carry or control (AASHTO, 1999).

1. 1. 1 Catchment Runoff Generation

Precipitation is the most essential process for the generation of runoff at a catchment scale. The distribution of precipitation varies spatially and temporally in nature. Precipitation can be in the form of snow, hail, dew, rain and rime.

In this study precipitation is considered in the form of rain only (USDOT, 2002). When a storm occurs, a portion of rainfall infiltrates into the ground and some portion may evaporate. The rest flows as a thin sheet of water over the land surface which is termed as overland flow. If there is a relatively impermeable stratum in the subsoil, the infiltrating water moves laterally in the surface soil and joins the streamflow, which is termed as underflow (subsurface flow) or interflow. If there is no impeding layer in the subsoil the

infiltrating water percolates into the ground as deep seepage and builds up the ground water table (GWT or phreatic surface). The ground water may also contribute to the stream flow, if the GWT is higher than the water surface level of the stream, creating a hydraulic gradient towards the stream.

Low soil permeability favours overland flow. While all the three types of flow contribute to the stream flow, it is the overland flow, which reaches first the stream channel, the interflow being slower reaches after a few hours and the ground water flow being the slowest reaches the stream channel after some days. The term direct runoff is used to include the overland flow and the interflow (Raghunath, 2006). Rainfall travels in a catchment in different directions. Due to vegetation, part of rainfall is intercepted by vegetation canopy.

Interception is known as a loss function to catchment runoff depending on vegetation type and density. The rest of rainfall moves down the vegetation as stem flow, drip off the leaves, or directly falls to the ground as throughfall (USDOT, 2002). Rainfall remains on the land surface as depression storage and either evaporates, infiltrates or is discharged as overland flow. Based on the time delay between the precipitation and the runoff, the runoff is categorized into two categories; as (1) Direct runoff, and (2) Base flow. Direct runoff: it is that part of runoff which enters the stream immediately after the rain fall. It includes surface runoff, prompt interflow and rainfall on the surface of the stream. In case of snow melt the resulting flow entering the stream is also a direct runoff.