

Unit - II

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Precipitation

The action or process of precipitating the substance from the solution is known as precipitation.

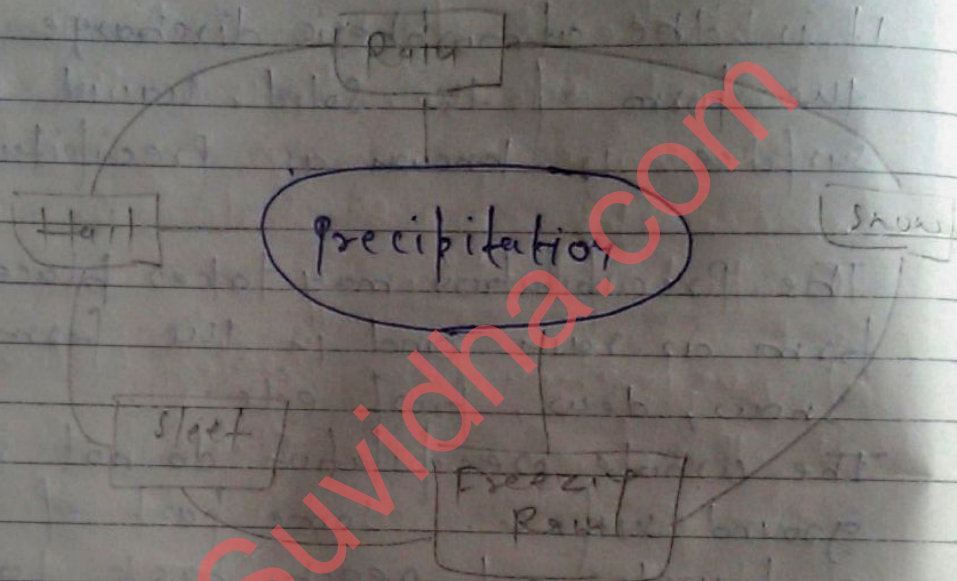
It is the atmospheric discharge of water in the form of the solid, liquid on the earth surface. is known as precipitation.

The Precipitation may takes place in the liquid form as rain and in the form as hail, snow, dew, frost etc.

The whole precipitation do not reach the ground surface. Some part of it may evaporate and reach back to the atmosphere. Some of the precipitation is intercepted by trees and vegetation and thus the remain precipitation would able to reach the ground surface.

The precipitation reaching the ground surface is known as through fall.

Forms of Precipitation :-



Rain :-

Rain is the most common type of precipitation. Rain is when drops of water fall on the earth.

Rain usually takes one or two forms i.e. showers or drizzle etc.

Snow :- Snow is the 2nd most common precipitation in the North-East India. Snow is formed when water vapors turn directly into ice without ever passing through the liquid state.

snow can be formed as ice pellets or ice flakes.

Sleet :- Sleet is a mixture of rain and snow. The rain drops are liquid before freezing that is why sleet are different from snow.

Hail :- Hail is the ice-crystal that begins to fall towards earth's surface.

Freezing Rain :- Freezing rain is when water droplets becomes super chilled. The droplets do not freeze in the air.

Measurement of Precipitation :-

Precipitation can be measured in various forms such as —

- * Amount of precipitation
- * Intensity of precipitation
- * Duration of precipitation
- * Areal extent of precipitation

Measurement methods :-

Measurement of precipitation (Rain and snow) can be done by various devices. These measuring devices and techniques are —

- 1) Rain Gauges
- 2) Snow Gauges
- 3) Radar
- 4) Satellites

Rain Gauges :-

Rain Gauges are mostly commonly used for the measurement of precipitation, both in terms of rain fall and snow.

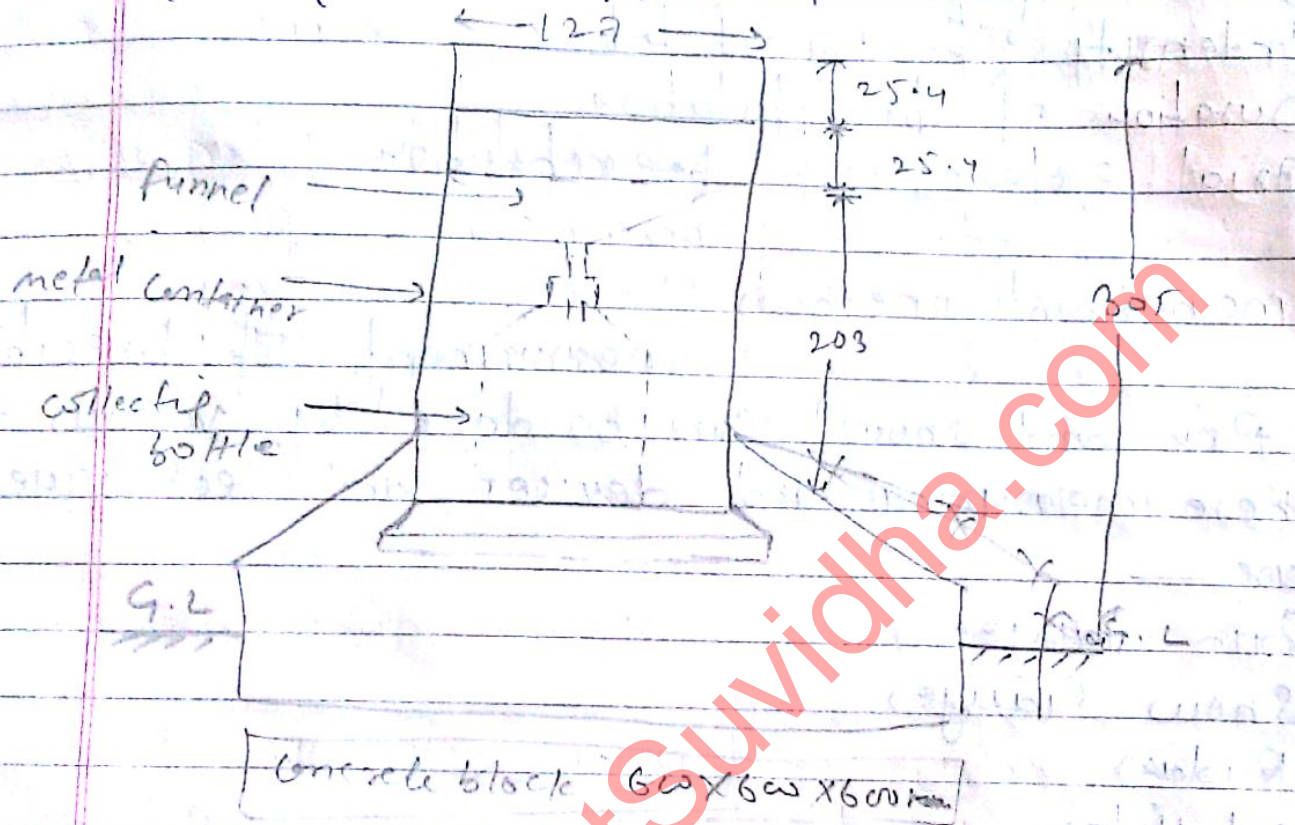
Types of Rain Gauges :-

There are main two types of rain gauges which are used to measure the precipitation. These are.

- 1) Non-Recording rain Gauges
- 2) Recording rain Gauges.

Non-Recording Rain Gauges :-

It is a rain gauge which does not provide the distribution of amount of precipitation in a day. It simply gives the amount of precipitation after 24 hours.



Recording Rain Gauges

These rain gauges are also called integrating rain gauges since they record cumulative rainfall.

In addition to the total amount of rainfall at a station, it gives the duration of rainfall events.

Types of Recording Rain gauges -
There are three main type of recording rain gauges

- i) Float type rain gauge
- ii) Tipping bucket type rain gauge
- iii) Weighing type rain gauge.

Tipping bucket type rain gauge -

A tipping bucket type rain gauge is used for the measurement of rainfall. It measures the rainfall with a least count of 1mm and gives out one electrical pulse for every millimeter of rainfall.

Weighing type Rain Gauge -

Weighing type rain gauge weighs rain or snow which falls into a bucket. The increased weight of the bucket and its contents are recorded on a chart. The record shows accumulation of precipitation.

Float Recording Gauge -

The rise of float with increasing catch of rainfall is recorded.

Measurement of snow -

In case of snow fall, following two properties are measured

- 1) Depth of snow at a particular place in mm
- 2) Equivalent amount of water in mm.

Depth of snow -

A snow gauge is a type of instrument used to measure the depth of snow fall at a particular place or used to measure the solid form of precipitation.

Equivalent Amount of water in a snow -

The equivalent amount of water in a snow pack can be measured by

- * Heating
- * Weighing
- * Adding measured amount of hot water.

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Preparation of Data

Estimation of missing Data -

The record at many rain gauge stations may consist of short breaks due to several reasons. Such as the absence of observer, instrumental failure etc.

It is better to estimate these records and fill the gaps rather than to leave them. This applies especially when the depth is processed with an automatic equipment like an electronic computer.

① Arithmetic Average method :-

If the annual normal annual precipitation at the adjacent stations are within 10% of the normal rainfall of the station under the consideration.

If the missing precipitation at station X is P_n and $P_1, P_2, P_3, \dots, P_m$ are the

rainfalls at the m surrounding rain gauge stations

$$P_n = \frac{1}{m} (P_1 + P_2 + \dots + P_m)$$

② Normal Ratio method —
If different

$$P_n = \frac{1}{m} \left[\frac{N_1}{N_1} P_1 + \frac{N_2}{N_2} P_2 + \dots + \frac{N_m}{N_m} P_m \right]$$

$$= \frac{N_1}{m} \left[\frac{P_1}{N_1} + \frac{P_2}{N_2} + \dots + \frac{P_m}{N_m} \right]$$

Where.

N_1 = Normal annual rainfall at the station X

and N_1, N_2, \dots, N_m are the normal annual rainfall at the m surrounding rain gauge stations.

Numerical :-

Rain gauge station X did not function for a part of a month during which a storm occurred.

The storm rainfall produced rainfalls of 84, 70 and 96 mm. at the three surrounding stations A, B and C. respectively. The normal annual rainfall at the stations X, A, B, C and D are respectively

770, 882, 736, and 994 mm. Estimate the missing storm rainfall at station X.

Soln :-

As the normal rainfall values vary more than 10%, the normal ratio method is adopted.

$$P_x = \frac{P_n}{m} \left[\frac{P_1}{N_1} + \frac{P_2}{N_2} + \dots + \frac{P_m}{N_m} \right]$$

$$P_x = \frac{770}{3} \left[\frac{84}{882} + \frac{70}{736} + \frac{96}{994} \right]$$

$$P_x = ?$$

Average depth of Rainfall OR mean Precipitation ↓

The average rainfall over a catchment area is obtained ^{by} from the following four methods —

- 1) Arithmetic mean method
- 2) The Thiessen polygon method
- 3) Isohyal Isohyetal map method
- 4) Weighted length method

1) Arithmetic mean method :-

It is the simplest method. If there are n numbers of rain gauge stations in a catchment area and $P_1, P_2, P_3, \dots, P_n$ are the values of annual precipitation. Then, acc. to Arithmetic mean method, the average rainfall is given by :-

$$P_m = \frac{P_1 + P_2 + P_3 + \dots + P_n}{n}$$

OR

$$\frac{1}{n} \sum_{i=1}^n P_i$$

ii) The Thiessen
method :- And De-merit :-

- i) It is one of the simplest methods.
- ii) It is used to determine approximate rainfall.
- iii) The method is rapid and got excellent process.

ii) The Thiessen Polygon method :-

A.M. Thiessen in 1911 developed this method in order to determine the average rainfall or mean precipitation in a catchment area with a given period of time.

Consider a catchment with six measuring stations as shown in fig- If P_1, P_2, P_3, P_4, P_5 and P_6 are the rainfalls at stations 1, 2, 3, 4, 5 and 6 with the polygon areas A_1, A_2, A_3, A_4, A_5 and A_6 , then the Thiessen polygon method gives average rainfall as -

$$P_m = \frac{P_1 A_1 + P_2 A_2 + P_3 A_3 + P_4 A_4 + P_5 A_5 + P_6 A_6}{(A_1 + A_2 + A_3 + A_4 + A_5 + A_6)}$$

Merits And De-merits :-

- i) It gives better result as compared to arithmetic mean method.
- ii) If catchment area is large the rain gauge stations are also quite large in number.
- iii) This method does not consider the orographic influences.
- iv) station weights remain constant, when the same no. of stations are used.