## (iii) Discharge Measurement by permanent structures:-

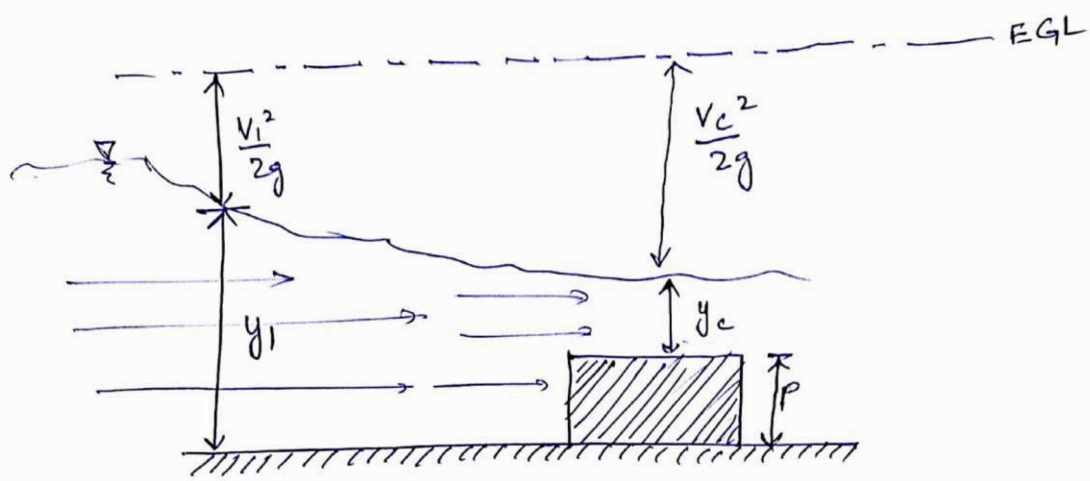
* Permanent structures for the measurment of discharge are built at the sites where regular discharge measurements are required.
* Structures built for other purposes such as Spillways of dams may also be used.
* This may be a masonry structure built in the bed of the channel across the flow. The height is so designed that for all possible discharges in the channel, the depth over the sill remains the critical depth.
* Broad crested weirs are generally constructed to find discharge of open channel.

## * Broad Crested Weirs:-

Broad Crested weirs are structures that are generally constructed from reinforced Concrete and which usually span the full width of the channel.

→ They are used to measure the discharge of rivers

→ Used in medium to large size rive's and Cannals.




The discharge calculation can be summarised as

$$Q = C_d \, 1.7 \, B H^{1.5}$$

$C_d$ = Coefficient of discharge (Depends on type of weir structure)

B = width of weir.

H = Height of head of water above weir crest

Q = Volumetric flow (discharge)

Example 5.4:- Depth of water just upstream of a broad crested weir was measured to be 0.5m in a 10m wide channel. Find discharge - The height of weir was 0.2m.

Given data:-

Head above weir crest = H = 0.5 − 0.2 = 0.3m

$C_d$ = coefficient of discharge = 0.60

B = width of wier = 10m

$$Q = C_d \, 1.7 \, B H^{1.5}$$

$$Q = 0.6 \times 1.7 \times 10 \times (0.3)^{1.5}$$

$$\boxed{Q = 1.676 \text{ m}^3/\text{sec}}$$

## Example 5.5:-

Water flows along a rectangular channel at a depth of 1.3m when the discharge is 8.74 $m^3/sec$ - The channel width B is 5.5m. Ignoring energy loss, what is the minimum height "P" of a broad crested weir if it is to function with critical depth on the crest.

**Given data:-**

$$y = 1.3m$$
$$b = 5.5m$$
$$Q = 8.74\, m^3/sec.$$

**Required data:-** P = weir Height = ?

**Solution:-**

$$V_1 = \frac{Q}{A} = \frac{Q}{b.y}$$

$$V_1 = \frac{Q}{by} = \frac{8.74}{5.5 \times 1.3}$$

$$\boxed{V_1 = 1.222\, m/sec}$$

$$y_c = \left(\frac{q^2}{g}\right)^{\frac{1}{3}} = \left(\frac{Q^2}{b^2 g}\right)^{\frac{1}{3}}$$

$Q = qb$
$q = \frac{Q}{b}$

$$y_c = \left(\frac{(8.74)^2}{(5.5)^2 \times 9.81}\right)^{\frac{1}{3}}$$

$$\boxed{y_c = 0.636\, m}$$

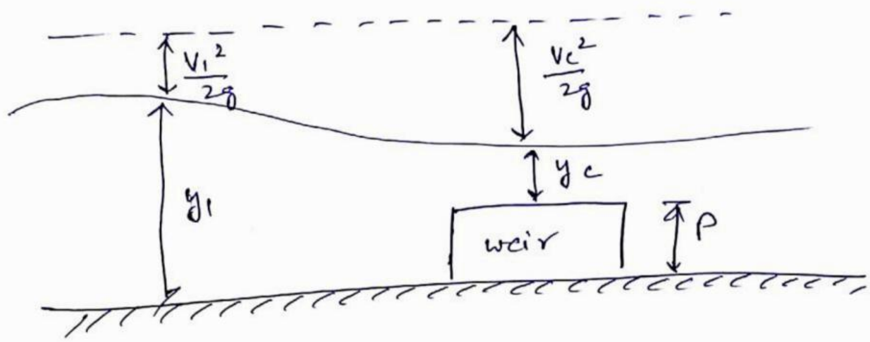
Also

$$V = \sqrt{gy}$$

$$V_c = \sqrt{g y_c}$$

$$V_c = \sqrt{9.81 \times 0.636}$$

$$\boxed{V_c = 2.498 \text{ m/sec}}$$




$$\frac{V_1^2}{2g} + y_1 = \frac{V_c^2}{2g} + y_c + P$$

$$\frac{(1.222)^2}{2 \times 9.81} + 1.3 = \frac{(2.498)^2}{2 \times 9.81} + 0.636 + P$$

$$0.0761 + 1.3 = 0.318 + 0.636 + P$$

$$\boxed{P = 0.422 \text{ m}}$$

Thus the weir should Have a height of 0.422m measured from the bed level.

## Rating Curve:-

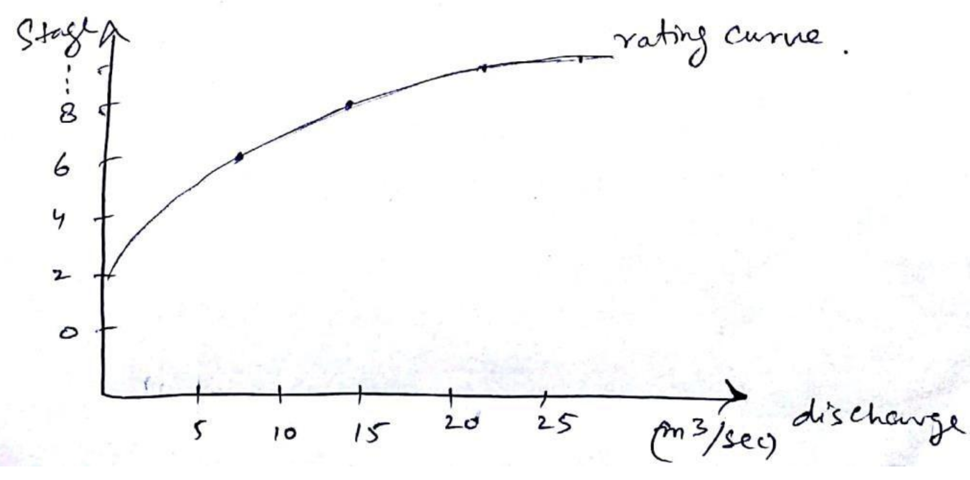
In hydrology a rating curve is a graph of discharge versus stage for a given point on a stream usually at a guaging station, where the stream discharge is measured across the stream channel with a flow meter.

"The graphical curve between stage and discharge is called the stage-discharge curve or rating curve".

The rating curve is nothing but the graph giving the relation b/w stage and discharge.

Stage is plotted along y-axis and discharge is plotted along x-axis. The shape of rating curve looks like parabola.

The stage discharge rating depends upon the channel control. For a permanent control this relation may be applicable for years. It may be necessary to take at least three discharge measurements in a week to check the rating curve.



There may be three types of rating curve for an type of river.

→ <u>Low Flow Rating curve:-</u>

It is the most frequently occurring.

→ <u>Intermediate Flow Rating Curve:-</u>

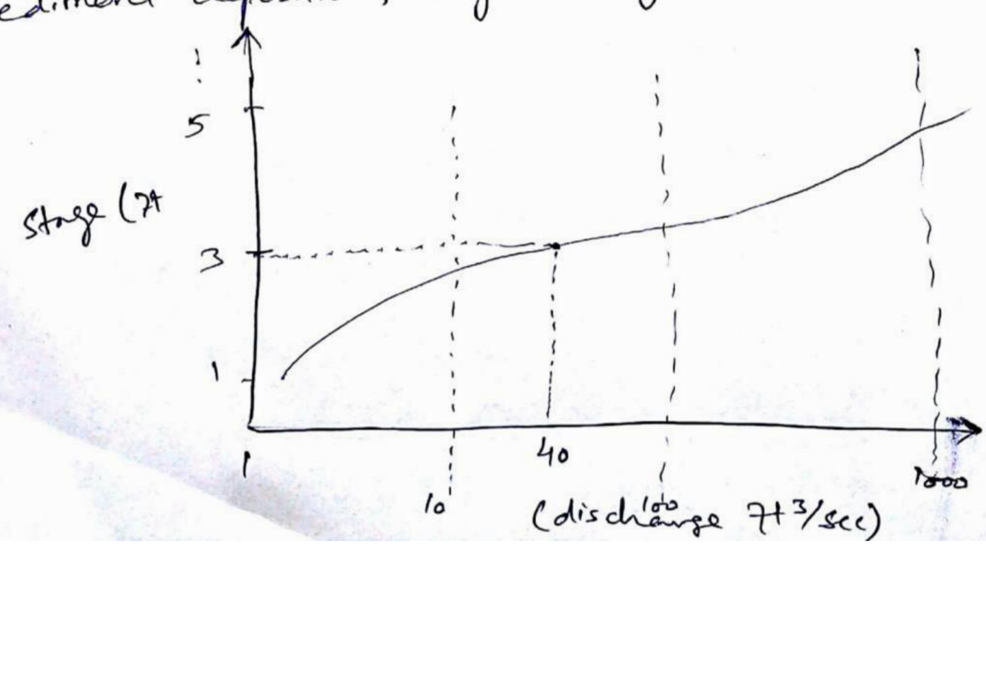
It is the stage b/w a flood and low flows.

→ <u>High Flow Rating Curve:-</u>

This occurs in high flood days, so is for rarely occuring situation. Because of this it is often represented by dotted lines and is obtained by extension of low flow rating curve.

→ Not all rating curves are divided into three segments. This division is purely artificial.

Accurate stage - discharge relations can only be developed by measuring discharge across many ranges of stage. Furthermore, channels should be continually surveyed for changes caused by erosion, sediment deposition, vegetation growth and ice formation.



## Stream Flow Units:-

(i) — Rate of Run off:-

It may be measured in cubic foot persecond or Cubic meter persecond.

one Cubic foot per second is volume of one $ft^3$ when Collected in one second.

The $\frac{ft^3}{second}$ are also called "Cusec" or "cfs". In the metric system the Cubic meter persecond are also called cumec.

(ii) Volume Run off:-

volume of flow is expressed in cubic feet, cubic meters, cubic inches and also in Arce foot and second foot days.

→ Second foot Day (SFD)

It is the volume of water Collected in 24 hours (one day) at the rate of 1 cubic foot persecond

$$1\ Sfd = 1 \times 24 \times 60 \times 60 = 86400\ ft^3$$

→ Second foot hour (SFH)

$$1 sfh = 1 \times 60 \times 60 = 3600\ ft^3$$

volume Collected in one hour at the rate of 1 cfs

Acre foot:- It defined by the volume of water necessary to cover one acre of surface are to a depth of one foot.

$$\text{one Acre} = 43560\ ft^3$$

$$1\ sfd = \frac{86400}{43560}$$

$$\boxed{1\ sfd = 1.9835\ \text{Acre Foot}}$$