DISCHARGE OVER A BROAD-CRESTED WEIR

- A weir having a wide crest is known as broad crested weir

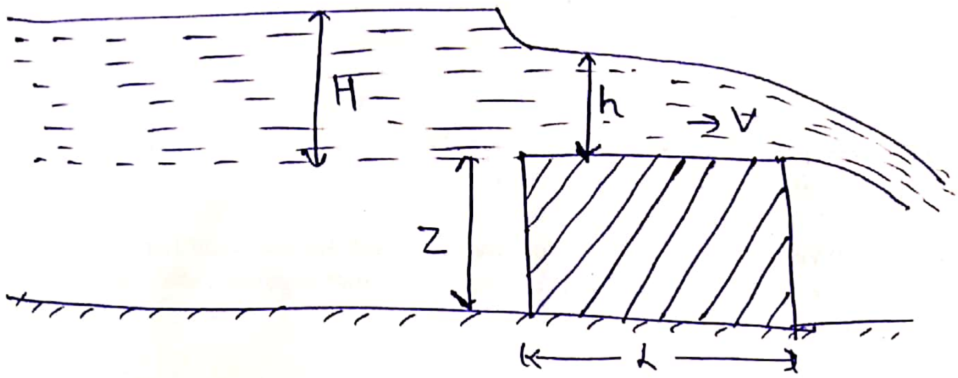


fig: Broad-crested weir

if $2L > H$, the weir is called broad-crested weir

if $2L < H$, the weir is called a narrow-crested weir

Let H = Ht of water above the crest

L = length of the crest.

h = head of water at the middle of weir which is Constant

V = Velocity of flow over the weir

Applying Bernoulli's equation to still water surface on the upstream side and running water at the end of weir

$$0 + 0 + H = 0 + \frac{V^2}{2g} + h$$

$$\frac{V^2}{2g} = H - h$$

∴ the discharge over weir

$$Q = C_d \times \text{Area of flow} \times \text{Velocity}$$

$$= C_d \times L \times h \times \sqrt{2g(H-h)}$$

discharge will be maximum, if $(Hh^2 - h^3)$ is maximum

or

$$\frac{d}{dh}(Hh^2 - h^3) = 0$$

$$2h \times H - 3h^2 = 0$$

$$\boxed{h = \frac{2}{3}H}$$

$$Q_{max} = C_d \times L \times \sqrt{2g\left[H \times \left(\frac{2}{3}H\right)^2 - \left(\frac{2}{3}H\right)^3\right]}$$

$$= C_d \times L \times \sqrt{2g}\sqrt{H \times \frac{4}{9} \times H^2 - \frac{8}{27}H^3}$$

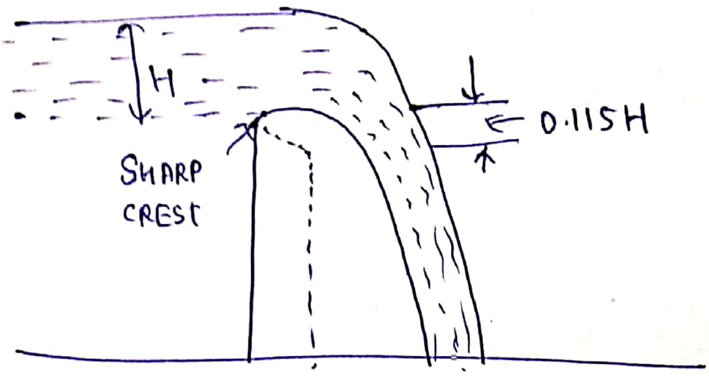
$$\boxed{Q_{max} = 1.705 \times C_d \times L \times H^{3/2}}$$

DISCHARGE OVER NARROW CRESTED WEIR →

if $2L < H$, it is similar to a rectangular weir hence

$$\boxed{Q = \frac{2}{3} \times C_d \times L \times \sqrt{2g} \times H^{3/2}}$$

DISCHARGE OVER AN OGEE WEIR →

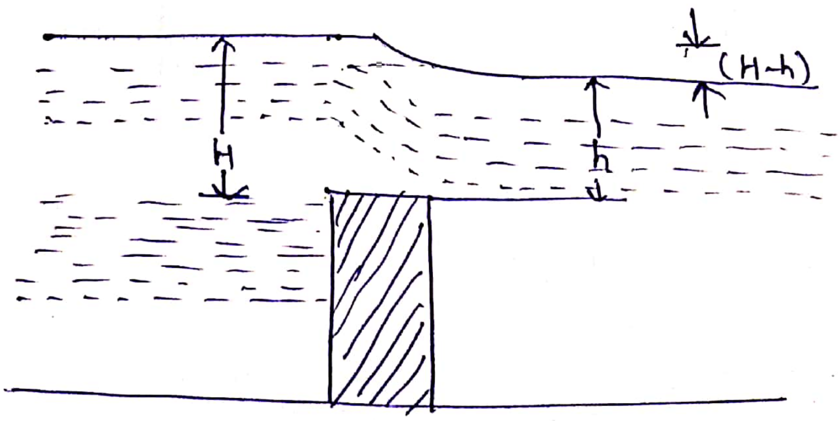


- the crest of the weir rises upto maximum height of 0.115H (H = Ht of water above inlet of the weir)
- Discharge is similar to rectangular weir

$$\boxed{Q = \frac{2}{3} \times C_d \times L \times \sqrt{2g} \times H^{3/2}}$$

DISCHARGE OVER SUB-MERGED OR DROWNED WEIR →

→ when the water level on the downstream side of a weir is above the crest of the weir, then the weir is called submerged or drowned weir



• the total discharge over the weir is obtained by dividing the weir into two parts.

the portion b/w u/s and D/s water surface may be treated as free weir and portion b/w down stream water surface and crest of weir as a drowned weir.

Let

H = Ht of water on the upstream of the weir

h = Ht of water on the downstream side of weir

$$Q_1 = \frac{2}{3} \times C_{d_1} \times L \times \sqrt{2g} \times (H-h)^{3/2}$$

$$Q_2 = C_{d_2} \times L \times h \times \sqrt{2g(H-h)}$$

$$Q = Q_1 + Q_2$$

$$\boxed{Q = \frac{2}{3} \times C_{d_1} \times L \times \sqrt{2g} \times (H-h)^{3/2} + C_{d_2} \times L \times h \times \sqrt{2g(H-h)}}$$