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IRRIGATION ENGINEERING

[BTAI 2201]

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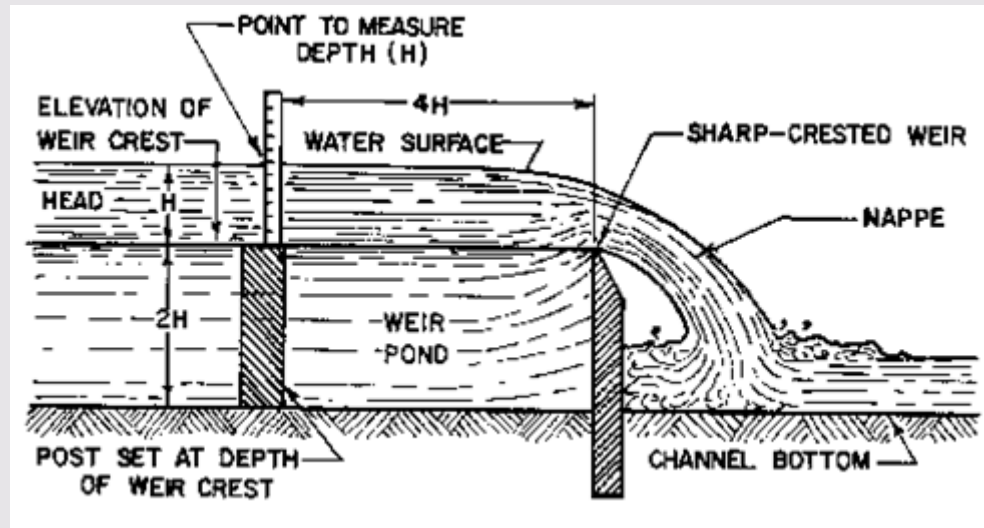
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Weirs:

Effective use of water for irrigation requires that flow rates and volumes be measured and expressed quantitatively.

Measurement of flow rates in open channels is difficult because of non-uniform channel dimensions and variations in velocities across the channel.

A weir is a calibrated instrument used to measure the flow in an open channel, or the discharge of a well or a canal outlet at the source.





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Weirs:

Terms Used

Weir Pond: Portion of the channel immediately upstream from the weir.

Weir Crest: The edge over which the water flows is the weir crest.

Broad-crested weir: A weir having a horizontal or nearly horizontal crest sufficiently long in the direction of flow. When the crest is "broad", the streamlines become parallel to the crest invert and the pressure distribution above the crest is hydrostatic.

Sharp Crested Weir: A weir having thin- edged crest such that the overflowing sheet of water has the minimum surface contact with the crest. A sharp-crested weir allows the water to fall cleanly away from the weir, e.g., V notch, Cipolletti weir etc.

Head: The depth water flowing over the weir crest measured at some point in the weir pond.

End Contraction: The horizontal distance from the ends of the weir crest to the sides of the weir pond.

Weir Scale or Gauge: The scale fastened on the sides of the weir or on a stake in the weir pond to measure the head on the weir crest.

Nappe: The sheet of water which overflows a weir is called a nappe.



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Weirs:

Advantages

- a) Capable of accurately measuring a wide range of flows
- b) Can be both portable and adjustable
- c) Easy to construct
- d) Tends to provide more accurate discharge rating than flumes and orifices

Disadvantages

- a) Relatively large head required, particularly in free flow condition.
- b) The upstream pool must be maintained clean of sediment and kept free of weeds and trash. Otherwise, measurement accuracy will be compromised.



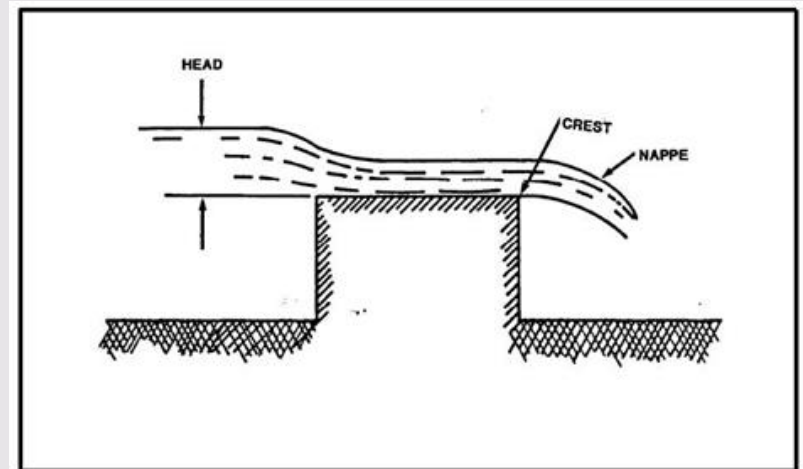
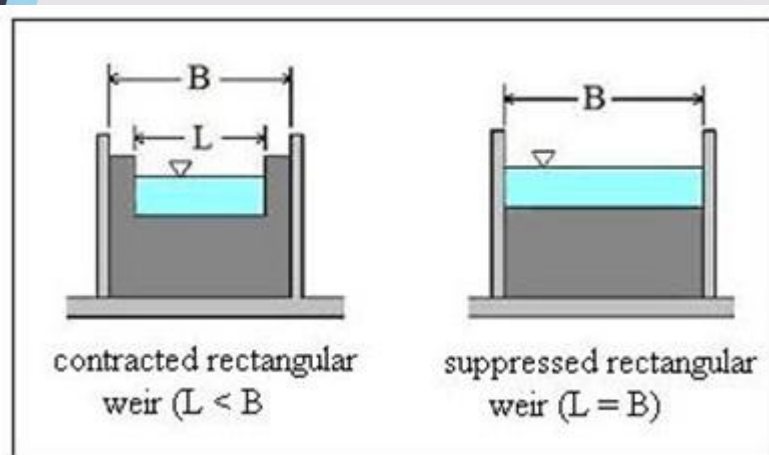
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Weirs:

Classification

- Sharp-Crested Weir:** These are generally used for water measurement on the farm.
- Broad-crested Weirs:** has a horizontal or nearly horizontal crest sufficiently long in the direction of the flow so that the nappe will be supported and hydrostatic pressures will be fully developed for at least a short distance.
- Suppressed Weir:** A rectangular weir whose notch or opening sides are coincident with the sides of the approach channel





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Weirs:

Classification

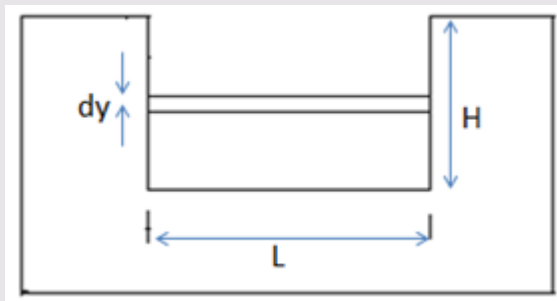
d) Contracted Weir: The sides and crest of a weir are far away from the sides and bottom of the approach channel

Rectangular Weirs

Rectangular weir takes its name from the shape of its notch. The discharge through a weir or notch is directly related to the water depth (H), and H is known as the head.

This head is affected by the condition of the crest, the contraction, the velocity of approaching stream and the elevation of the water surface downstream from the weir.

Rectangular weirs can be suppressed, partially contracted, or fully contracted



$$Q = CLH^{\frac{3}{2}} \quad \text{Or} \quad Q = 0.0184LH^{\frac{3}{2}} \quad Q \text{ in lps \& H in cm}$$

$$Q = 0.0184(L - 0.1H)H^{\frac{3}{2}} \quad \text{One side contraction}$$

$$Q = 0.0184(L - 0.2H)H^{\frac{3}{2}} \quad \text{Both side contraction}$$



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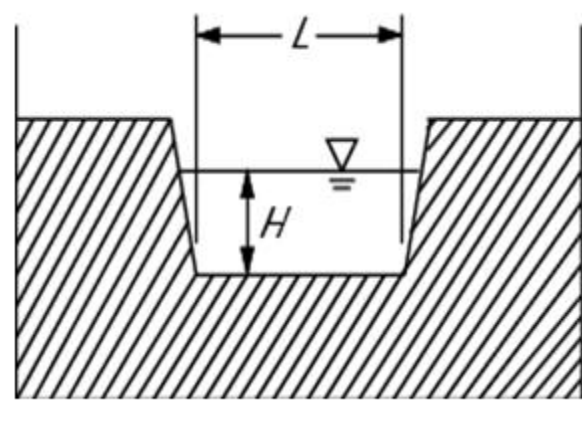
Weirs:

Cipoletti Weirs

Trapezoidal in shape

The slope of the sides, inclined outwardly from the crest, should be **one horizontal to four vertical**.

The selected **length of notch** (L) should be **at least 3H** and preferably 4H or longer. Cipoletti weirs are considered fully contracted.



$$Q = 0.0186LH^{\frac{3}{2}}$$

Q in lps & H in cm



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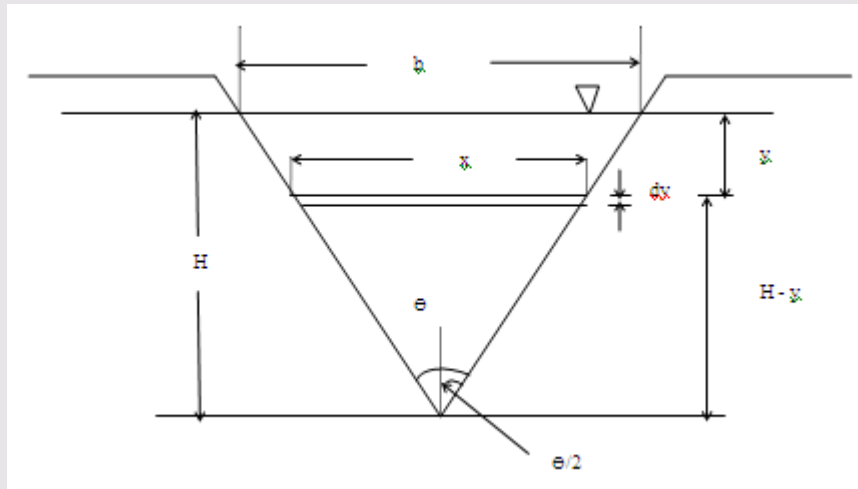
Weirs:

V- notch Weir

Notch is “V” in shape.

The V-notch design causes small changes in discharge hence causing a large change in depth and thus allowing more accurate measurement than with a rectangular weir.

Head (H) should be measured at a distance of at least **4H upstream of the weir.**



$$C = \frac{8}{15} \sqrt{2g} \tan\left(\frac{\theta}{2}\right)$$

$$\text{If } \theta = 90^\circ$$

$$C = \frac{8}{15} \sqrt{2g}$$

$$Q = 0.0138H^{5/2} \quad Q \text{ in lps \& H in cm}$$



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Weirs:

Limitations of Weirs:

- ✓ Weirs are not always suitable for measuring flow. Sufficient head is required for operating any type of weir.
- ✓ They are not accurate unless proper conditions are maintained.
- ✓ They require a considerable loss of head which is mostly not available in channels on flat gradients.
- ✓ Weirs are not suitable for water carrying silt.
- ✓ Weirs are not easily combined with turnout structures.



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