WEIRS

A weir is basically an obstruction in the flow path in an open channel. The weir will cause an increase in the water depth as the water flows over the weir. In general, the greater the flow rate, the greater will be the increase in depth of flow, The height of water above the top of the weir is the measurement usually used to correlate with flow rate.

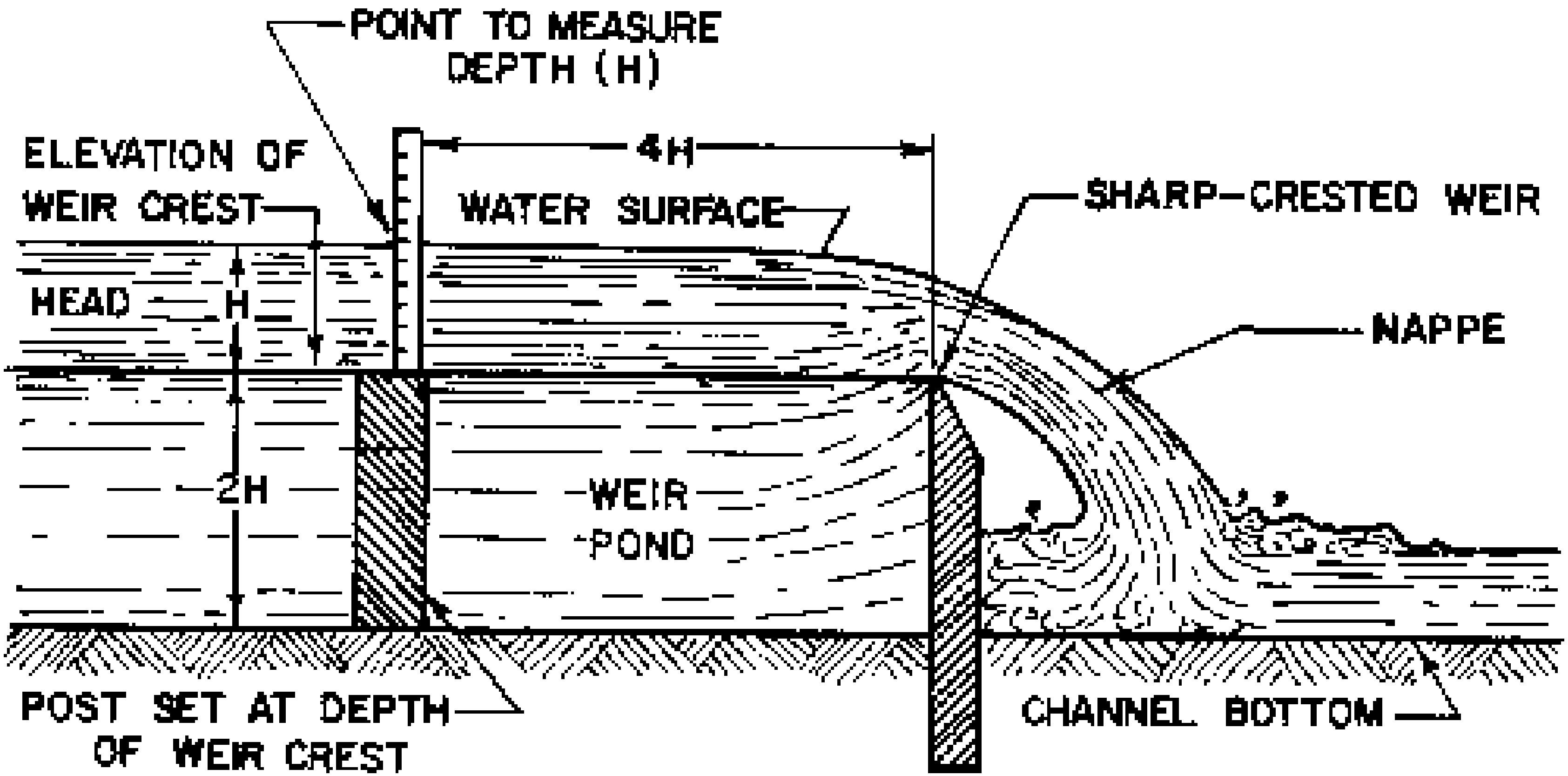


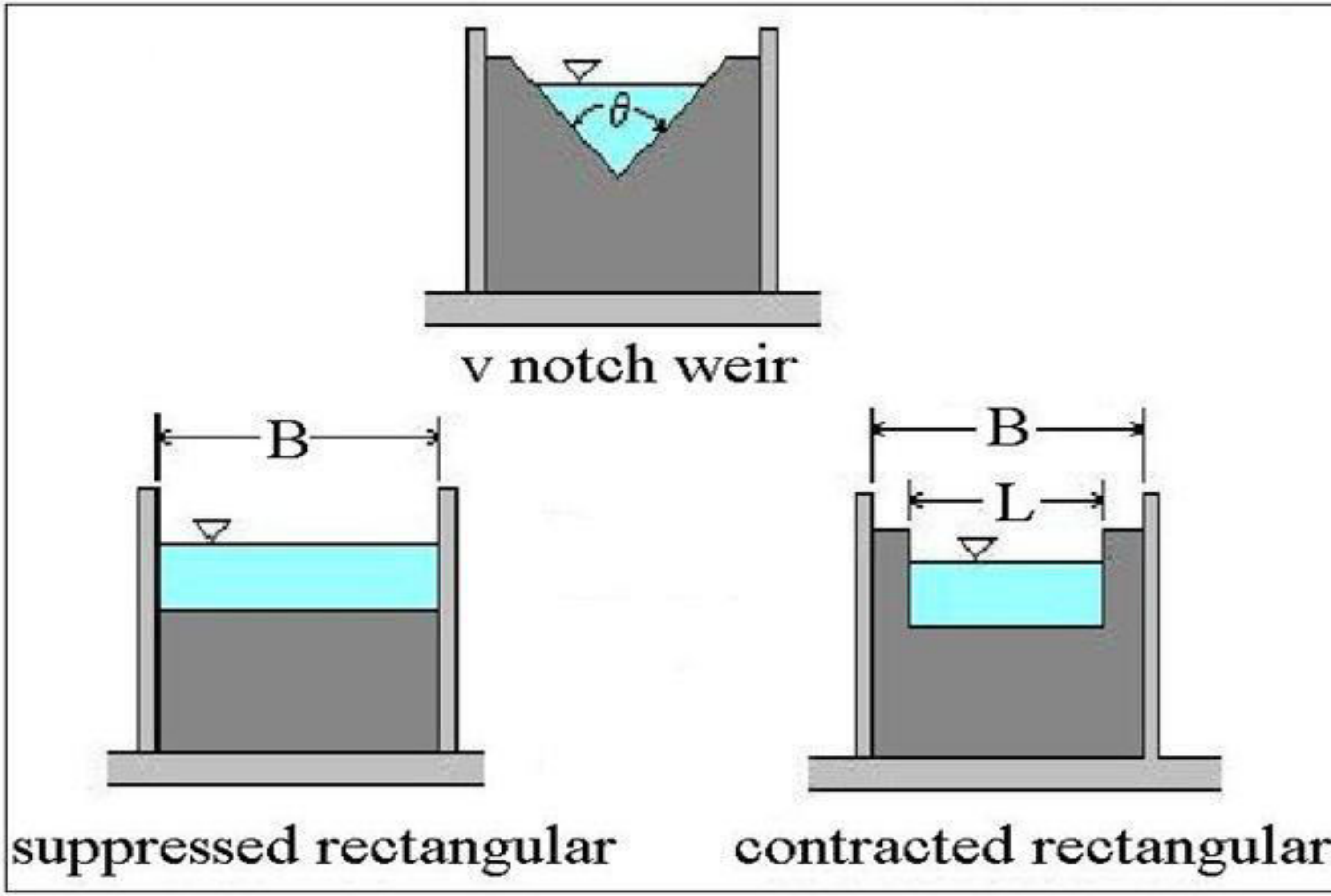
FIGURE 1.- PROFILE OF A SHARP-CRESTED WEIR

TYPES OF WEIRS

SHARP CRESTED WEIR:

- **A weir with a sharp upstream corner or edge such that the water springs clear of the crest is a sharp-crested weir.**

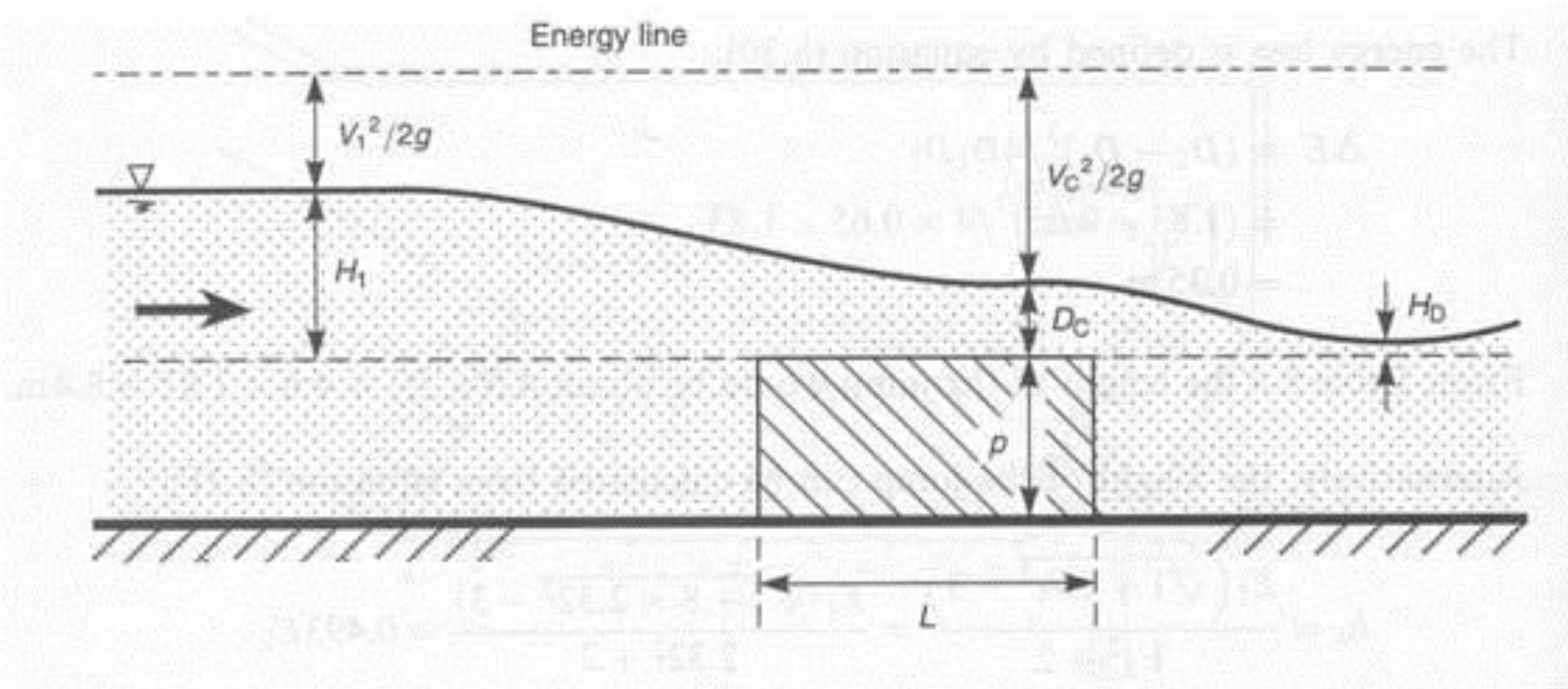
  Sharp-crested weirs are classified according to the shape of the weir opening, such as rectangular weirs, triangular or V-notch weirs, trapezoidal weirs, and parabolic weirs. Weirs not sharp crested are classified according to the shape of their cross section, such as broad-crested weirs, triangular weirs, and trapezoidal weirs.



Common Types of Sharp Crested Weirs

BROAD CRESTED WEIR

- **Broad crested weirs are robust 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, and are much more suited for this purpose than the relatively flimsy sharp crested weirs. Additionally, by virtue of being a critical depth meter, the broad crested weir has the advantage that it operates effectively with higher downstream water levels than a sharp crested weir.**



Energy line
$V_1^2/2g$
$V_C^2/2g$
H_1
D_C
H_D
p
L

Broad Crested Weir & Gauging Station

TYPES OF SHARP CRESTED WEIR RECTANULAR WEIR NOTCH

- **A rectangular notch, symmetrically located in a vertical thin (metal) plate which is placed perpendicular to the sides and bottom of a straight channel, is defined as a rectangular sharp-crested weir.**

SUB DIVISIONS OF RECTANGULAR WEIR NOTCH

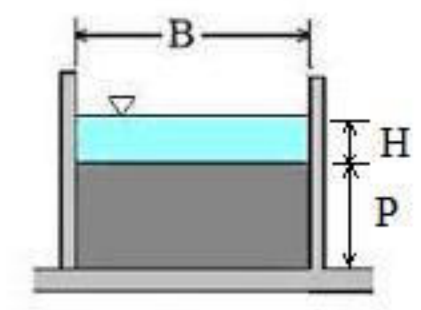
- SUPPRESSED RECTANGULAR WEIR

A suppressed rectangular weir is one for which the weir extends across the entire channel, so that the length of the weir, L, is the same as the width of the channel. The discharge over suppressed rectangular notch can be calculated as:

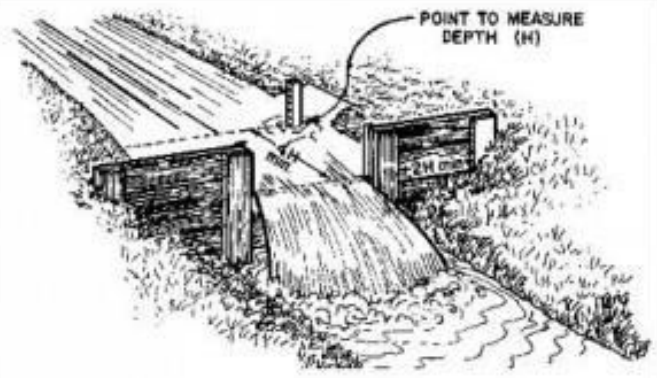
$$Q = 1.84\ B\ H^{3/2}$$

where

- Q is the water flow rate in m^3/sec,
- B is the length of the weir (and the channel width) in m, and
- H is the head over the weir in m.



suppressed rectangular weir (L = B)



Rectangular, Sharp-Crested Weir

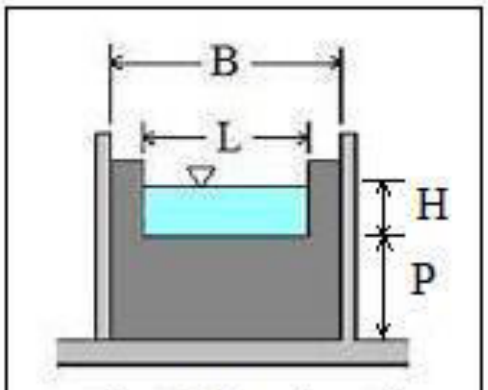
- <u>CONTRACTED RECTANGULAR WEIR</u>

A contracted rectangular weir is one for which the weir extends across only part of the channel, so that the length of the weir, L, is different from as the width of the channel. The discharge over contracted rectangular notch can be calculated as:

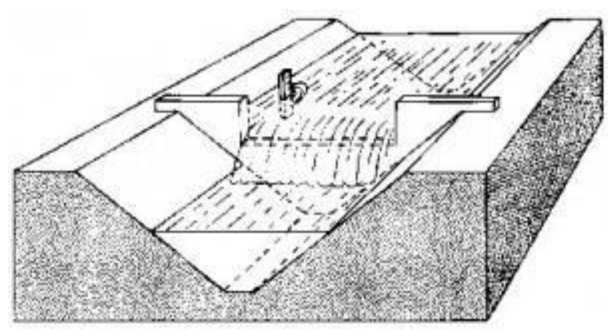
$$Q = 1.84(L - 0.2H)H^{3/2}$$

where

- **Q** is the water flow rate in m^3/sec,
- **L** is the length of the weir in m, and
- **H** is the head over the weir in m.
- **B** is the width of the channel in m, and
- H_{max} is the maximum expected head over the weir in m.

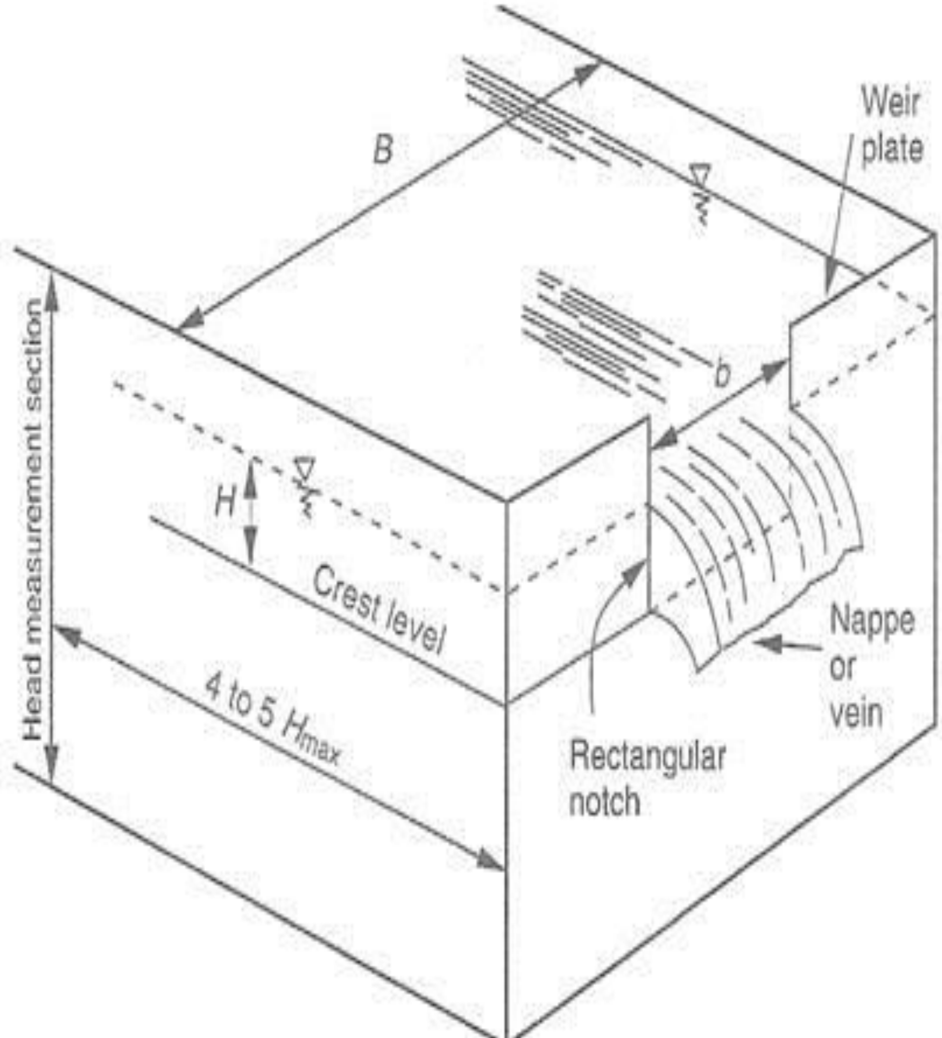


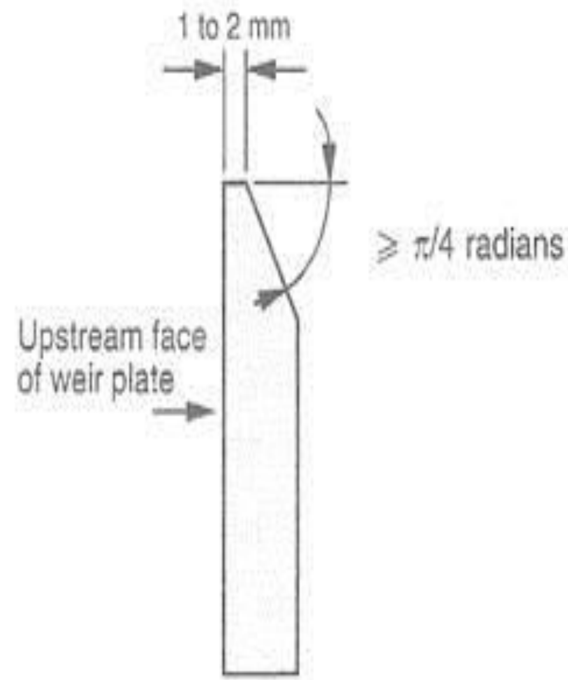
contracted rectangular weir (L < B)


Contracted Rectangular Weir

APPLICATION

- The data gained from flow rate calculations over a rectangular weir can be used in a number of ways. Flood control and general water management policies and practices are often designed around such data. The flow data can be used to determine if a hydroelectric project would be possible or profitable. Water flow data can also be useful for environmental impact studies, specifically in determining how the weir or other structures would affect the ecosystem of a stream or river. Irrigation and other water use needs programs also benefit from this kind of data





Detail of crest and sides of notch


TRIANGLE OR V-NOTCH WEIR

A V-shaped notch is a vertical thin plate which is placed perpendicular to the sides and bottom of a straight channel is defined as a V-notch sharp-crested weir. The line which bisects the angle of the notch should be vertical and at the same distance from both sides of the channel . The V-notch sharp-crested weir is one of the most precise discharge measuring devices suitable for a wide range of flow. In international literature, the V-notch sharp-crested-weir is frequently referred to as the ‘Thomson weir’.

Triangular or V-Notch Weir

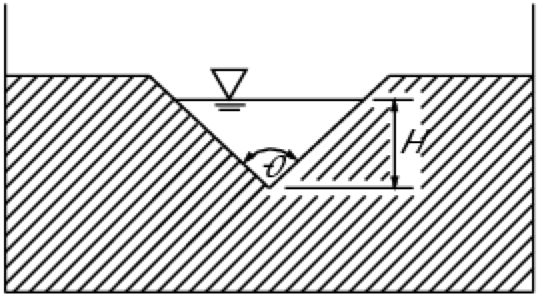
Triangular or V-notched weirs measure low discharges more accurately than horizontal weirs. The V-notch is most commonly a 90° opening with the sides of the notch inclined 45° with the vertical. Since the V-notch weir has no crest length, much smaller flows are represented by a given head than for a rectangular weir

For a triangular or v-notch weir the flow rate can be expressed as:

$$q = 8/15\, c_d\, (2\, g)^{1/2} \tan(\vartheta/2)\, h^{5/2}$$

where

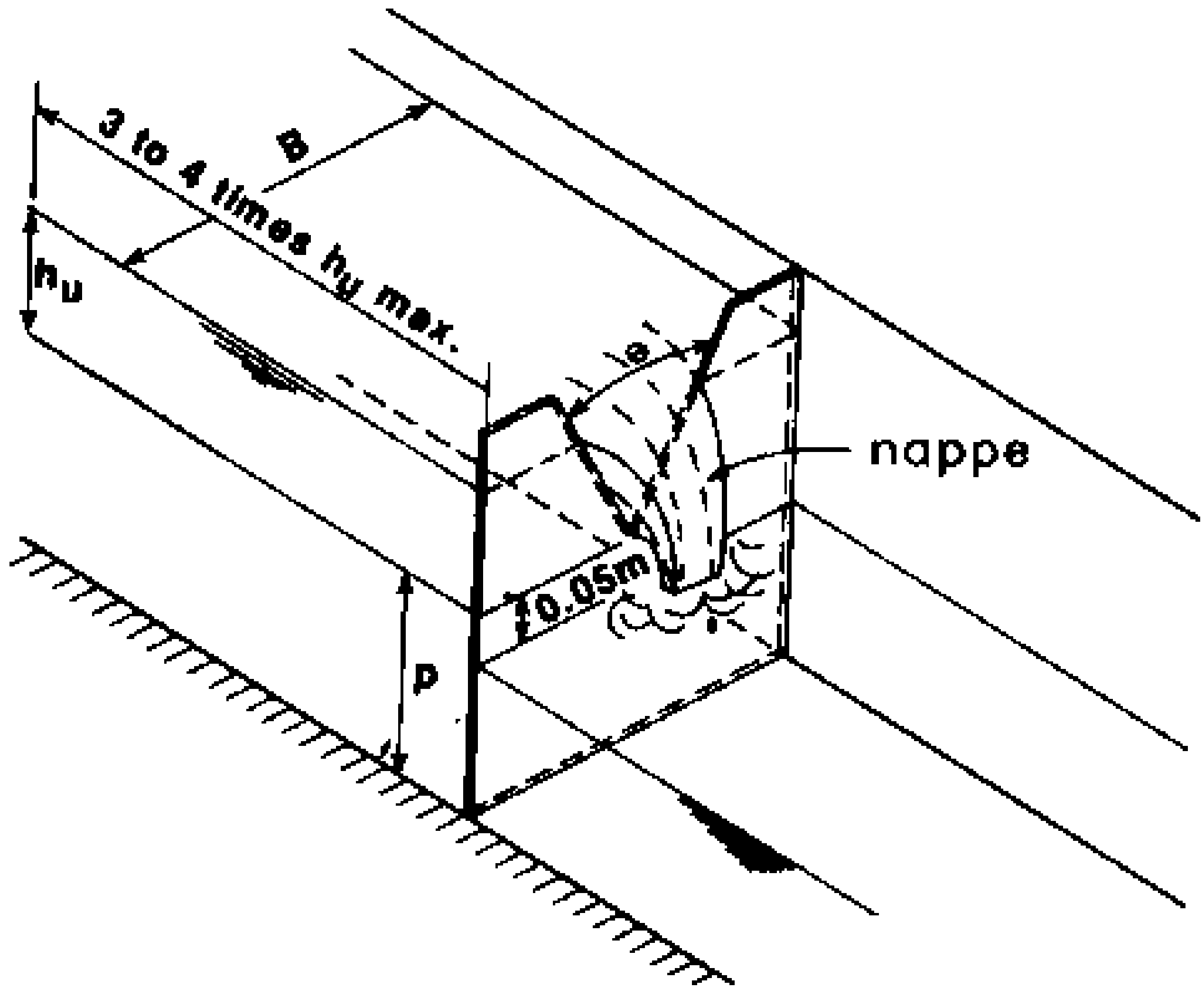
- *ϑ = v-notch angle*
- *h= head of weir*
- *c_d= discharge constant for the weir*
- *- must be determined*
- *g = 9.81 (m/s²) - gravity*



Application

The V-Notch Weir system uses the principle of gravitational discharge of water over a triangular or rectangular notched weir plate.

- Typical applications include:
- Long-term monitoring of dams
- Drainage systems in dams and tunnels
- Springs and artesian wells



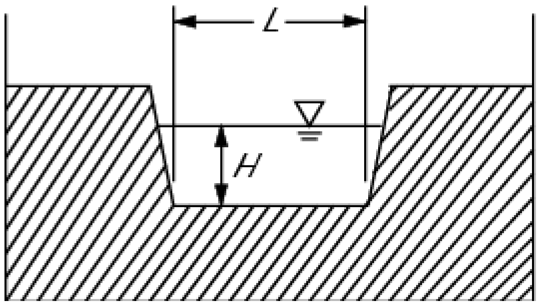
3 to 4 times hu max.
B
hu
θ
nappe
0.05m
P

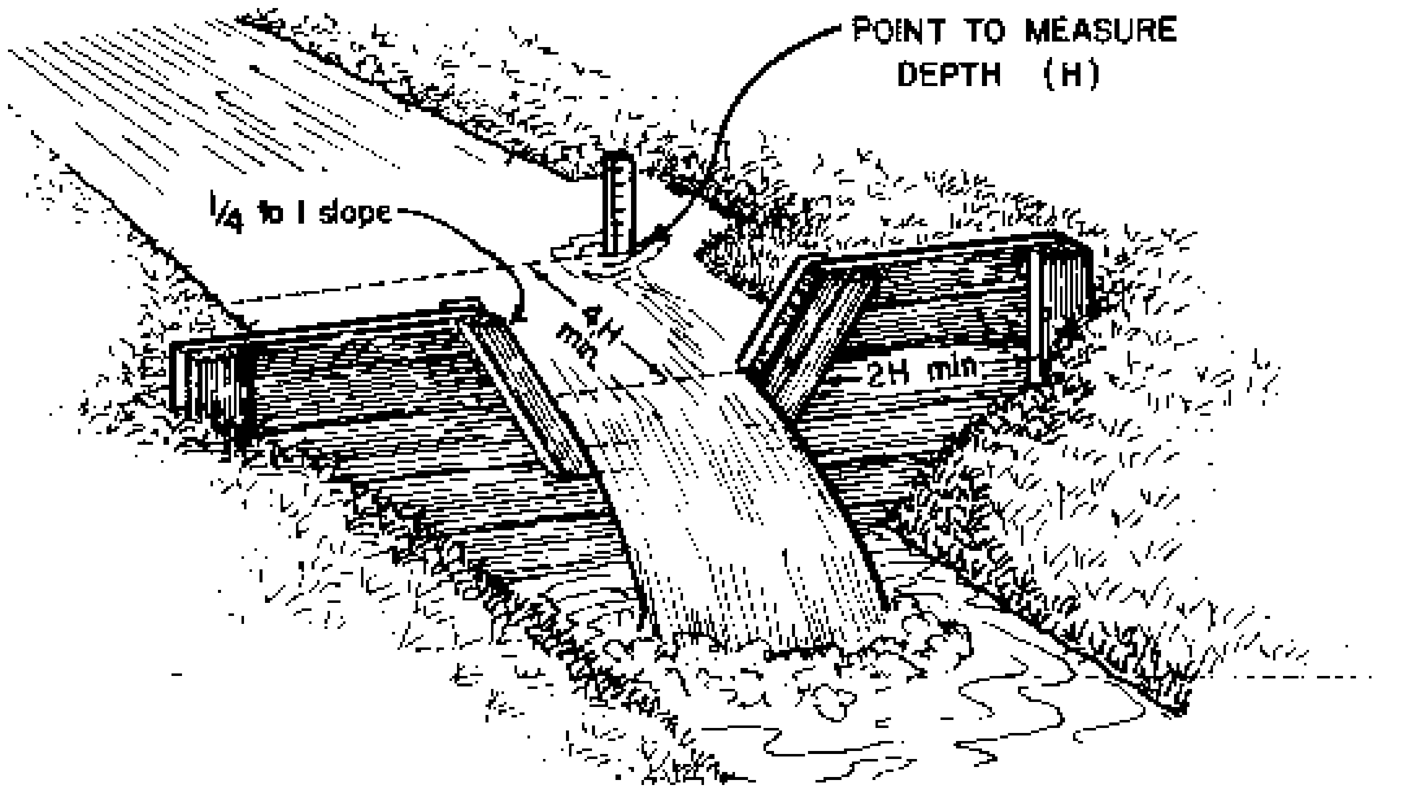
TRAPOZOIDAL SHARP-EDGE WEIR

- The Cipolletti or Trapezoidal Sharp-edge Weir is similar to a rectangular weir with end contractions except that the sides incline outwardly at a slope of 1 horizontal to 4 vertical. This slope causes the discharge to occur essentially as though it were without end contraction. The advantage of this weir is that no correction for end contraction is required. A disadvantage is that measurement accuracy is inherently less than that obtainable with a rectangular suppressed or V-notch weir. The Cipolletti Weir is commonly used in irrigation systems. The formula generally accepted for computing the discharge through Cipolletti weirs is :

$$Q = 3.367\ L\ h_1^{3/2}$$

- where:
- L = length of weir crest in ft
  h_1 = head on weir crest in ft




POINT TO MEASURE
DEPTH (H)
1/4 to 1 slope
4H
min.
2H min

(a)

(b)