Experiment 8

Flow Over a Weir

- **Purpose:** The purpose of this experiment is to verify the discharge equation and to determine the discharge coefficient for a sharp crested weir. The flow of water over a weir depends on the shape of the weir and the height of the water level above the sill or notch of the weir. The data from the tests described below are used to verify the theoretical relationships between these factors. These results can then be used to find the coefficient of discharge.

- **Procedure:**

1. Attach the rectangular weir to the channel.
2. Close the pump flow control valve and start the pump.
3. Regulate the flow to maintain a water level in the flow channel so that the weir is filled to the top of the machined section. Be careful to avoid flooding above this level.
4. Allow a steady flow to develop throughout the entire circuit. Measure the height of the water level above the top of the weir as an H to start the analysis.
5. Measure the flow rate with a stopwatch and graduated measuring cylinder, and measure the water level in the approach channel using the gage at a location about halfway along the approach channel; the first reading of the gage should be used as a calibration. For each set of measurements, measure the flow rate at least three times and take the average.
6. Reduce the approach channel water level in about 2 or 3 even steps, each time recording the water level differential in the channel with the gage. Also record the flow rate.
7. Attach the triangular (90°) weir (V-notch), where $\theta = 0.5\,(90°) = 45°$
8. Repeat Steps 2 through 6; however, this time regulate the flow to maintain a level in the approach channel so that the weir is filled only to the top of the triangular section.

- **Questions: (interpretation of results)**

1. By plotting a graph of the logarithm of the flow rate vs. the logarithm of the depth, compare the theoretical power law and coefficient with those obtained from the graph. Comment on your results. See Notes 1 and 2, and Appendix A-1.
2. Calculate the coefficient of discharge. See Eq. (8-6), (8-13) and Appendix 3.

Notes:

1. Consider the flow through a rectangular notch or sharp-crested weir as shown in Figure 8-1. A horizontal differential element is taken at a depth y below the free surface. The area of the element is given by,

$$dA = B\,dy \tag{8-1}$$

The velocity through the element is given by,

$$v = \sqrt{2gy} \tag{8-2}$$

Therefore, the theoretical discharge through the element is,

$$dQ = B\sqrt{2gy}dy \tag{8-3}$$

Integrating Eq. 8-3 yields the theoretical discharge,

$$Q_t = B\sqrt{2g}\int_0^H y^{1/2}dy \tag{8-4}$$

or,

$$Q_t = \frac{2}{3}B\sqrt{2g}H^{3/2} \tag{8-5}$$

The actual discharge is given by,

$$Q_a = C_d\frac{2}{3}B\sqrt{2g}H^{3/2} \tag{8-6}$$

where C_d = the coefficient of discharge, $K = \frac{2}{3}B\sqrt{2g}$, $N = \frac{3}{2}$ and B = 3 cm.

2. Consider the flow through the triangular notched weir shown in Figure 8-2. Consider an element at depth y. The breadth of the element is given by,

$$B = 2\,(H - y)\tan\,\theta \tag{8-7}$$

and the area of the differential element is then given by,

$$dA = 2\,(H - y)\tan\,\theta\,dy \tag{8-8}$$

while the velocity through the element is given by,

$$v = \sqrt{2gy} \tag{8-9}$$

The discharge through the element is,

$$dQ = 2(H - y)\sqrt{2gy}\tan\theta dy \tag{8-10}$$

and the total theoretical discharge is obtained by integrating Eq. 8-10,

$$Q_t = 2\tan\theta\sqrt{2g}\int_0^H (Hy^{1/2} - y^{3/2})dy \tag{8-11}$$

which yields,

$$Q_t = \frac{8}{15}\tan\theta\sqrt{2g}H^{5/2} \tag{8-12}$$

The actual discharge is given by,

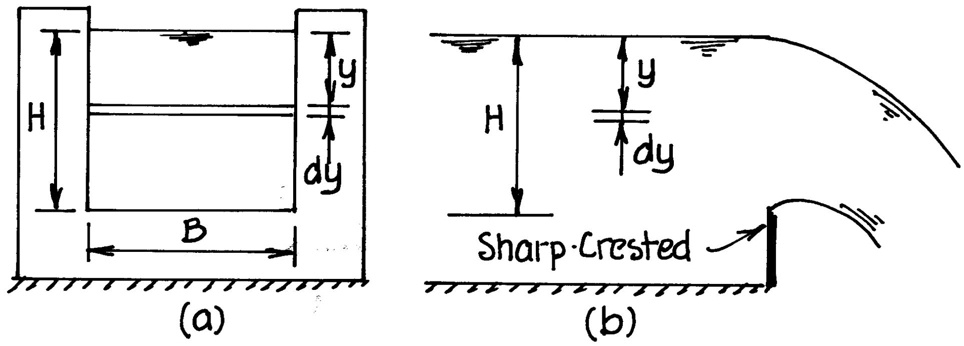
$$Q_a = C_d\frac{8}{15}\tan\theta\sqrt{2g}H^{5/2} \tag{8-13}$$

in which C_d = the *coefficient of discharge*.

θ = 1/2 of the machined angle = 45°

N = 5/2 (triangle), and

$$K = \frac{8}{15}\sqrt{2g}\tan\theta$$



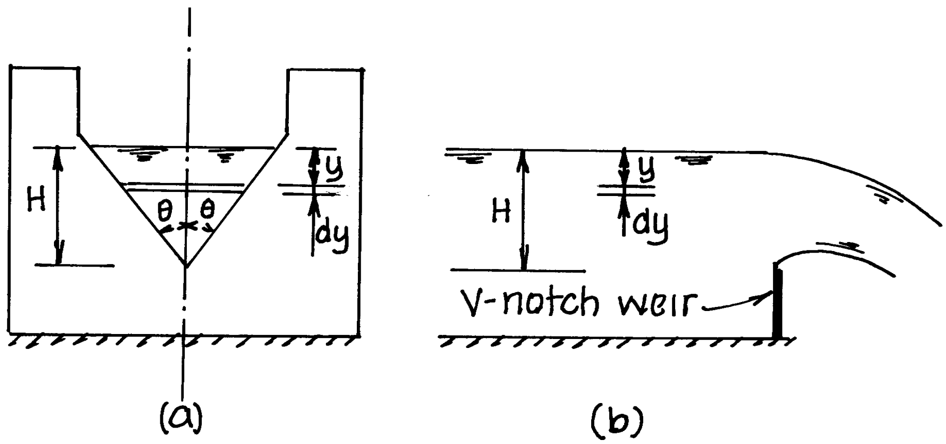


Figure 8-1 Flow Over a Rectangular-Notched, Sharp-Crested Weir
Figure 8-2 Flow Over a Triangular V-Notched Weir

- **Data:**

Water temperature=

Rectangular Weir:

Set	Q (mL/sec)	H (cm)
1		
2		
3		
4		
5		

Triangular Weir (V-notch):

Set	Q (mL/sec)	H (cm)
1		
2		
3		
4		
5		