DEPARTMENT OF ENVIRONMENTAL, WATER RESOURCES, AND COASTAL ENGINEERING

MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY

FLUID MECHANICS SESSIONAL

EWCE 262

Experiment No. 6

FLOW OVER A VNOTCH

6.1General

The most common types of sharp-crested weir are the rectangular weir and the triangular weirs. The triangular or V-notch weir is preferable to the rectangular weir for the measurement of widely variable flows. In the case of a rectangular weir, the total weighted perimeter does not vary directly with the head, as the length of the base is the same for all heads. Therefore, the coefficient of contraction, which depends on the wetted perimeter, is not constant for all heads. But in case of a V-notch, there is no base to cause contraction, which is will be due to the sides only. The coefficient of contraction wii, therefore, be a constant for all heads. For this reason, the V-Notch is the most satisfactory type for flow measurement in canals.

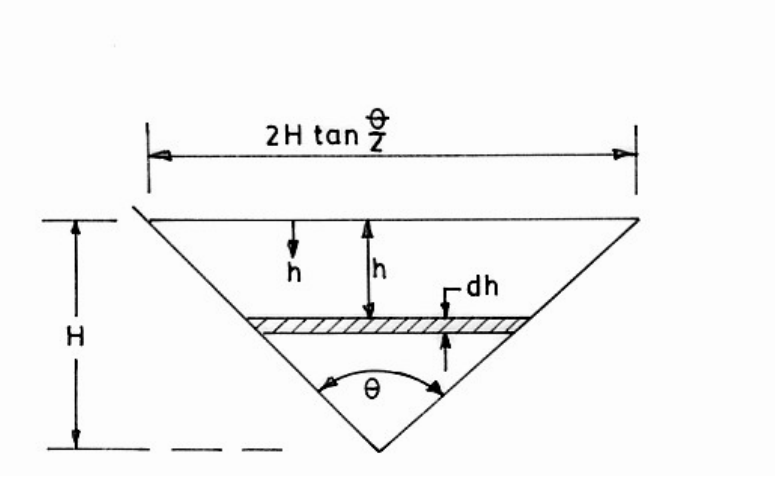


Fig. 1 Flow Over a V-Notch

6.2 Practical Application

The V-notch weir is preferred when small discharges are involved, because the triangular cross-section of the flow `nappe' leads to a relatively greater variation in head.V-notch weir has the advantage that it can function for a very small flows and also measure reasonably larger flows as well.

	
V-notch	V-notch
	
V-notch	V-notch

6.3Theory

Consider the Vnotch shown in the figure. Let H be the height of water surface and be the angle of notch. Then, width of the notch at the water surface

$$L = 2H \tan\frac{\theta}{2} \quad (1)$$

Consider a horizontal strip of the notch of thickness dh under a head h. Then,

width of the strip, $W = 2(H - h)\tan\frac{\theta}{2}$ (2)

Hence, the theoretical discharge through the strip

dQ_t = area of the strip x velocity = $2(H - h)\tan\frac{\theta}{2} dh\sqrt{2gh}$ (3)

Integrating between the limits 0 and H and simplifying, the total theoretical discharge over the notch is given by

$$Q_t = \frac{8}{15}\sqrt{2g}\tan\frac{\theta}{2}H^{5/2} \quad (4)$$

$= KH^{5/2}$ (5)

where,

$$K = \frac{8}{15}\sqrt{2g}\tan\frac{\theta}{2} \quad (6)$$

Let Q_a be the actual discharge. Then the coefficient of discharge, C_d, is given by

$$C_d = \frac{actual\ discharge}{theoreticaldischarge} = \frac{Q_a}{Q_t} \quad (7)$$

$$Q_a = K\, C_d\, H^{5/2} \quad (8)$$

The co-efficient of discharge depends on relative head (H/P), relative height (P/B) and angle of the notch (θ).

From hydraulic point of view a weir may be fully contracted at low heads while at increasing head it becomes partially contracted. The flow regime in a weir is said to be partially contracted when the contractions along the sides of the V-notch are not fully developed due to proximity of the walls and /or bed of approach channel. Whereas a weir which has an approach channel and whose bed and sides of the notch are sufficiently remote from the edges of the V-notch to allow for a sufficiently great approach velocity component parallel to the weir face so that the contraction is fully developed is a fully contracted weir. In case of a fully contracted weir C_d is fairly constant for a particular angle of notch.

At lower heads, frictional effects reduce coefficients. For the most common angle of notch 90 degree, the discharge coefficient, C_d is about 0.6.

6.4 Objectives

1. To find C_d for the Vnotch.
2. To plot Q_t vs. Q_a in a plain graph paper.
3. To plot Q_a vs. H in a loglog paper and to find (a) the exponent of H and (b) C_d.

6.5 Procedure

1. Position the weir plate at the end of the approach channel, in a vertical plane, with the sharp edge on the upstream side.
2. Admit water to channel until the water discharges over the weir plate.
3. Close the flow control valve and allow water to stop flowing over weir.
4. Set the point gauge to a datum reading.
5. Position the gauge abut half way between the notch plate and stilling baffle.
6. Admit water to the channel and adjust flow control valve to obtain heads, H, increasing in steps of 1 cm.
7. For each flow rate, stabilize conditions, measure and record H.
8. Take readings of volume and time using the volumetric tank to determine the flow rate.

6.6. Apparatus

V-Notch, **Flow Channel** etc.



V-Notch



Flow Channel

FLOW OVER A VNOTCH

Experimental Data Sheet

Angle of the notch, $\theta = 90^0$

No of Obs.	Actual discharge Q_a	Head over the weir H	Theoretical Discharge, Q_t	C_d
1.				
2.				
3.				
4.				
5.				
6.				

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6.8 Calculation from graph

6.9 Discussion

Why should the tail water level remain below the vertex of the notch? What minimum ventilation below the flow over the notch at downstream side should be maintained?

Why the water head measurement is made at some distance upstream from the notch? What is this minimum distance in case of a Vnotch?

What are the possible experimental errors?

6.10 Practice Questions

1. Why does the Vnotch give more accurate flow measurement than any other weirs and orifices when the flow is slightly fluctuating?

2. What is the average value of C_d for a 90^o Vnotch? Does it depend on flow condition (partially or fully contracted)?

3. Determine the discharge of water over a 60^{o} triangular weir if the measured head is 0.623 ft.