CRRI-Triangular Notch for Measurement of Small Open Channel Flow

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Introduction

A V-notch or triangular notch is a sharp-crested opening in a channel wall, used for accurate measurement of flow rates in small irrigation channels by obstructing water flow and measuring the water's head (depth) upstream, which is then converted to discharge using specific formulas, making it suitable for small channels.

V-notches are preferred over rectangular notches for flow measurement, particularly under low-flow conditions, as they offer higher accuracy by producing larger head variations for small changes in discharge. They require only a single head measurement (H) for discharge estimation, also do not require ventilation and their sharp geometry with zero crest length allows better passage of debris. These characteristics make V-notches suitable for accurate measurement across a wide range of flow conditions.

Possible modifications in V-notch

In general the outflow from a V-notch directly falls over the downstream channel bed causing channel scouring. Modifications can be made in the downside of the notch to minimize the kinetic energy of outflowing water thus minimizing channel scouring/ erosion. Additionally, appropriate modifications to the notch unit would enable the collection of flowing channel water samples for water quality testing.

CRRI V-notch

A 30 degree V-notch was developed at CRRI and tested for its performance in flow measurement in small irrigation channels and also a unique arrangement was made to reduce the kinetic energy of outflow water from the notch along with arrangement for water sample collection for quality assessment of channel water.

For discharge measurement over the notch section, the developed notch was calibrated under field conditions, and the coefficient of discharge corresponding to varying head (h) values above the crest was determined. Subsequently, the channel discharge can be estimated by recording the head (h) from the water level observation pipe and applying Equation (1).

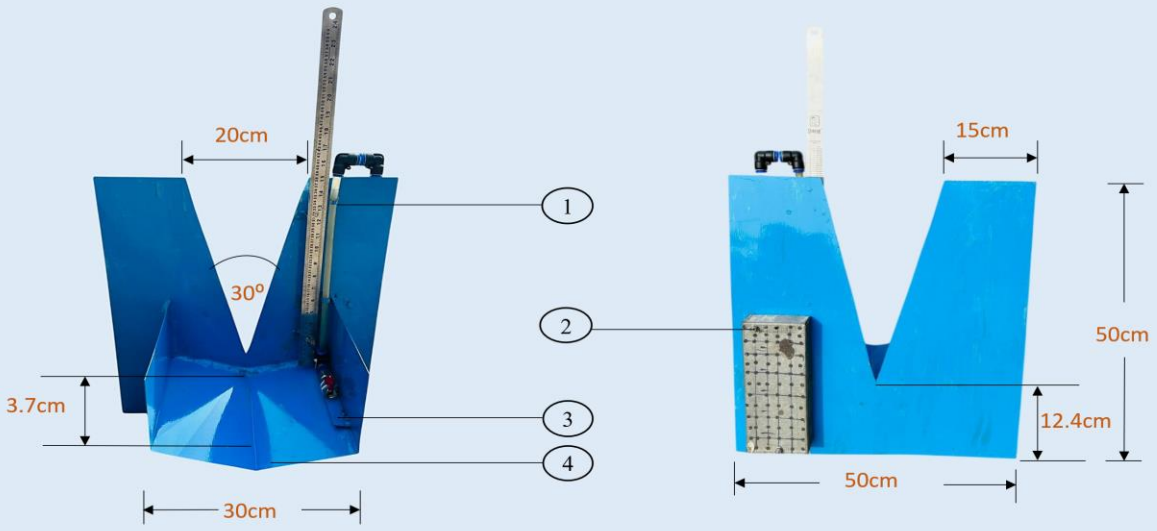
$$Qactual = \frac{8}{15} * Cd * \sqrt{2g} * \tan\left(\frac{\theta}{2}\right) * h^{5/2}$$

Where,

Q_{actual} = discharge over the V-notch, i.e., discharge of the upstream channel (m^3/s)

g = Gravitational acceleration (m/s^2)

h = height of water level above notch (m) and θ = notch angle



Parts Name

1: water level observation pipe
2: Filter mesh
3: Clearance pipe
4: Water sample collection arrangement

Fig1. Parts and dimensions of the developed V-Notch unit

Novelty of CRRI V-Notch

- Reduction of the falling water's kinetic energy at the channel bed by 30%.
- Easy to handle, having user friendly scale and replaceable water depth tube.
- suitable for 30cm channel width
- The extended downward notch section can be used for irrigation water sampling and quality testing.

Field calibration, average Cd estimation and performance evaluation

Table 1: The coefficient of discharge (C_d) values for different flow heads were estimated for the developed V-notch and the average C_d value estimated was 0.60

Head (cm)	Head (m)	Q_{cal} (lit/s)	Q_{theo} (m^3/s)	h^5/2	tan(θ/2) = 0.26794	√(2g) * 8/15	Cd	Cd (avg)
5.2	0.052	0.2307	0.0002	0.0006	0.2679	2.3624	0.59	
8	0.08	0.6818	0.0007	0.0018	0.2679	2.3624	0.60	
7.2	0.072	0.5357	0.0005	0.0014	0.2679	2.3624	0.61	
8.6	0.086	0.8065	0.0008	0.0022	0.2679	2.3624	0.59	
9.5	0.095	1.1538	0.0012	0.0028	0.2679	2.3624	0.66	
6.1	0.061	0.3191	0.0003	0.0009	0.2679	2.3624	0.55	
11	0.11	1.4563	0.0015	0.0040	0.2679	2.3624	0.57	
8	0.08	0.6781	0.0007	0.0018	0.2679	2.3624	0.59	0.60
6.5	0.065	0.3947	0.0004	0.0011	0.2679	2.3624	0.58	
10	0.1	1.1538	0.0012	0.0032	0.2679	2.3624	0.58	
9.5	0.095	1.0638	0.0011	0.0028	0.2679	2.3624	0.60	
6	0.06	0.3333	0.0003	0.0009	0.2679	2.3624	0.60	
7.5	0.075	0.6250	0.0006	0.0015	0.2679	2.3624	0.64	
8.5	0.085	0.8716	0.0009	0.0021	0.2679	2.3624	0.65	
9.8	0.098	1.0714	0.0011	0.0030	0.2679	2.3624	0.56	

The developed V-notch can be used up to a head (h) of 37.6 cm and to measure a maximum channel discharge of **32.80 lit/sec** (Fig.2).

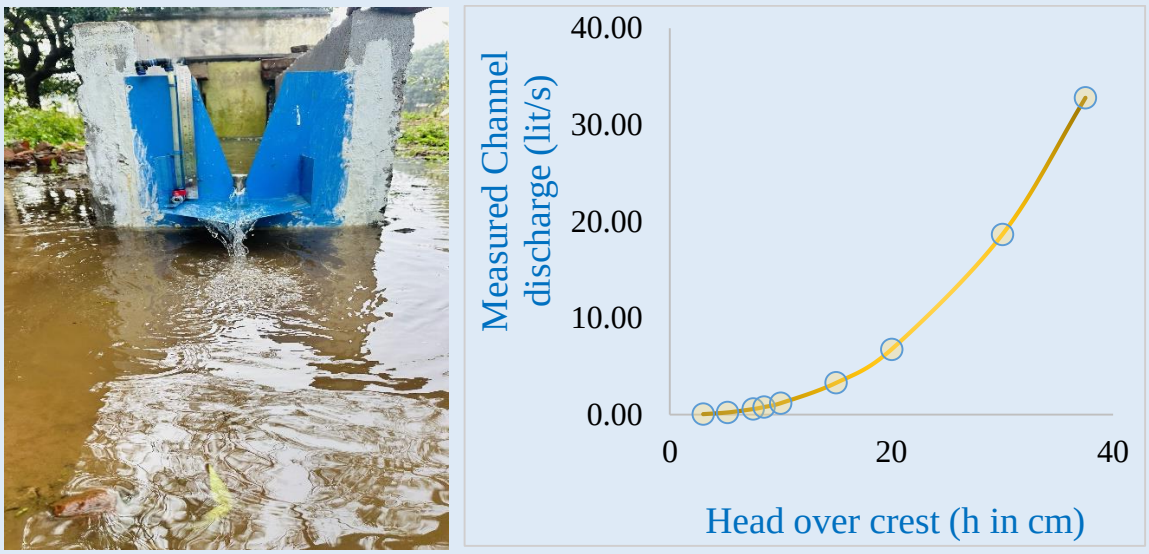


Fig 2. Variation in flow depth Vs discharge of the developed triangular notch unit

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