LINEAR HEAD DISCHARGE WEIRS FOR SMALL AND LARGE DISCHARGE

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Introduction

A weir is a notch of regular form through which water flows and is a flow rate measuring structure. The discharge through sharp crested weir varies with head above the weir crest according to the weir geometry. The geometry of the weir section and datum for head measurement may be chosen to yield a linear head discharge relation. Recently a large number of practical linear weirs have been proposed. Among practical linear weirs, the chimney weir is geometrically the simplest linear plate weir. It is formed by the addition of a rectangular section on top of an inverted V-notch to give the appearance of a chimney. This modification results in a considerably enhanced measuring range over that of an inverted V-notch. Sharp crested - chimney weirs can be used to measure a wide range of flows in open channels. The objective of the present study is to propose a linear head discharge weir for practical purposes with better performance.

Methodology

The weirs were fabricated using 3.2 mm thick mild steel plates having a sharp edge of 1 mm with a 45° chamfer. Experiments were conducted using fourteen chimney weirs of different dimensions in a horizontal rectangular flume, 300mm wide, and 12 m long in the Fluid Mechanics Laboratory of the Civil Engineering Department, University of Peradeniya. A constant head tank was used to supply the water continuously through a recirculation path.

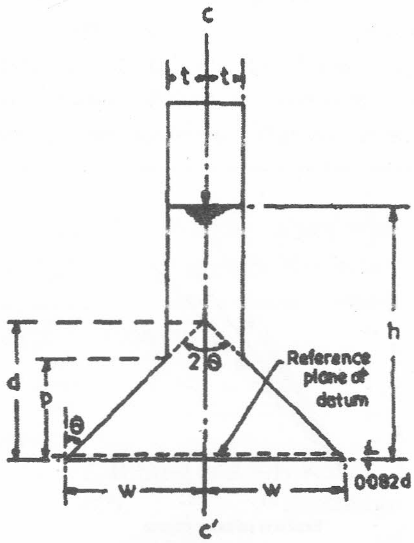

Fig. 1.Chimney Weir Model

d-altitude of v-notch
p-height of weir crest
w-half crest width

The maximum depth of flow in the channel was 340 mm. First the V-notch was calibrated and the discharge in the flume was measured using the calibrated V-notch. Then the weirs were fitted at the end of the rectangular flume. Water sealant was

used to prevent the leakages and G-clamps were used to fix the weirs properly.
For each chimney weir experiments were conducted for different discharges up to a maximum of 32 *l*/s. The head (H) over the chimney weir was measured with a hook gauge. The weir geometry was then modified and experiments were repeated.

Result
Figure 2 shows the discharge versus H variation for different types of chimney weirs tested. Figure 3 shows the variation of coefficient of discharge (C_{dl}) with the ratio upstream head (h)/altitude (d) above the inverted V-notch. Graph was drawn for half crest width w=120mm.

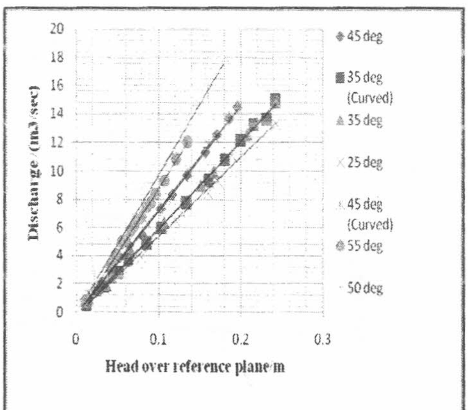

Fig. 2. Discharge versus H for Different Chimney Weirs

Figure 4 shows the variation of discharge deviation with the head over reference plane. Figure 5 shows the deviation of predicted discharge from observed discharge.

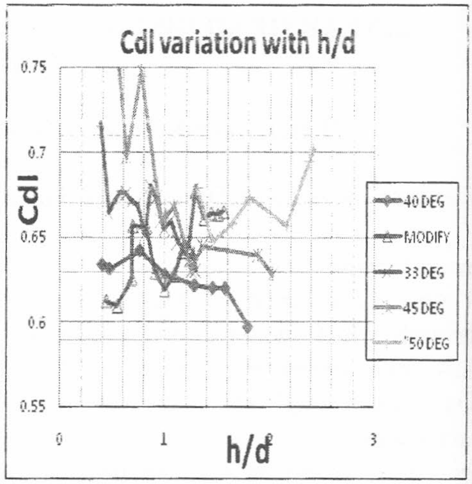

Fig. 3. Variations of C_{dl} with h/d

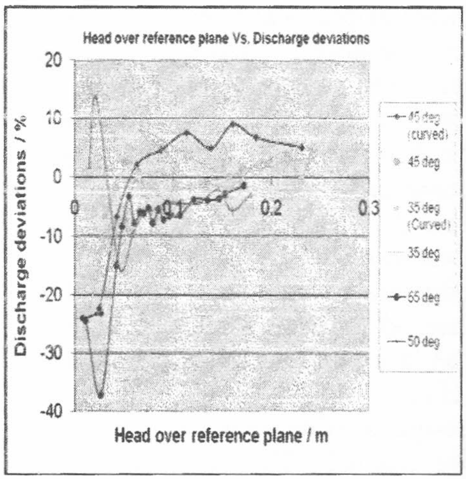

Fig. 4. Variation of Discharge Deviation with Head over Reference Plane

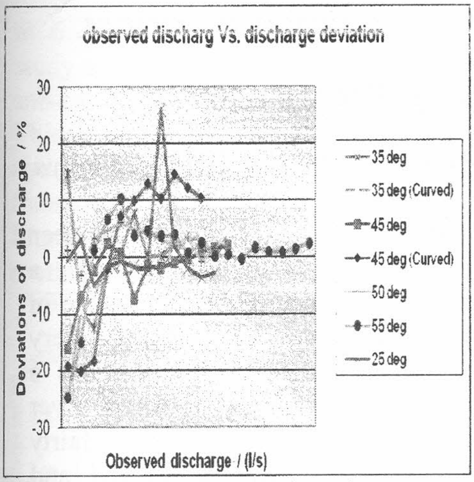

Fig. 5. Deviation of Discharge Predicted with Observed Discharge

Discussion

For large discharges the average coefficient of discharge value of the chimney weirs tested (45, 40, 33,25,30,50 degree) was found to be 0.64 and the deviation of discharge was 5%. The 40 degree chimney weir has a small range of deviation of discharge (below 5%). For all of the chimney weirs tested for large discharge, R^2 -where R=Correlation Coefficient- was found to be above 0.99 without a reference plane. Coefficient of discharge does not show any uniform trend with the ratio upstream head/altitude above the inverted V-notch.

For small discharges 54.5% of the cases had a deviation of discharge of ±5%.While 24.2% of the cases had values between 5% and 10%. - The remaining cases had discharge deviation in excess of 10%. It was observed that the discharge deviation was high for very small discharges. Average coefficient of discharge was 0.62. Modified geometries with curved edges recorded the worst performance.

Conclusion

(1) 40 degree chimney weir has a high regression factor than other angles of chimney weirs for large discharge (R^2=0.998).

(2) For large discharges the average coefficient of discharge value of the chimney weirs is 0.64 and for small discharge it was found to be 0.62.

(3) All chimney weirs gave a linear head discharge relationship but the accuracy of this relationship varied with the geometry of the chimney weir.

(4) The assumption of constant discharge coefficient is limited to the cases which recorded deviation within 5%.

(5) The modified chimney weirs with rounded edges do not show any better performance in the linear head-discharge relationship.

Reference

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