Effect of Types of Weir on Discharge

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Date Received: 17th July 2014
Date Published: 1st October 2014

Abstract - The measurement of discharge is one of the main concerns in hydraulic engineering. The study of types of weir on discharge is important as the knowledge of the accurate measurement of discharges helps in understanding of the flow mechanism as well as designing the hydraulic structures for future. Structures such as rectangular weir, vee notch weir and crump weir are placed in a channel to measure the flow rate. By using Bernoulli's equation, weir equation are derived and used to determine the flow rate. The main objective is to determine the optimum discharge for different types of weirs. This discharge is important in designing the hydraulic structure. Overestimated discharge may cause failure to the structure and if the discharge is underestimated, it may not fulfill the design requirements. The studies are experimented from maximum flow to minimum flow by measuring head over the weir for different working sections; flat and slope of 1:2400 and different height of partially opened sluice gate of 4cm and 6cm for crump drowned condition. The result shows that the coefficient of discharge, C_d decreases when the head of water above the crest increases; except for crump weir in which C_d is independent of the head. Meanwhile, the velocities when slope is 1:2400 are higher as compared to flat.

***Keywords*:** Discharge, Head, Open channel, Velocity, Weirs.

I. INTRODUCTION

THE purpose of this study is to present an analysis on effect of types of weir on discharge. A weir is an obstruction in open channel in which water must flow over and is used indirectly to obtain flow rate based on the weir geometry and the head on the weir crest [1]. Once the upstream water level exceeds the crest height of the weir, the water will start flow over the weir. As the depth of water above the weir, h_1 increases, the discharge over the weir, Q will also increases correspondingly. The ideal relationship between h_1 and Q may readily derive for each weir shape based on the basis of the Bernoulli equation [2]. This discharge depends on many parameters such as viscosity, surface tension and geometry, thus, it is difficult to calculate the exact value of discharge. Surface tension results from intermolecular forces which attracts molecules to one another. At the surface, forces are less than those within the fluid and as a result there is net tension over the surface. In water, due to intermolecular hydrogen bonding, this force is very strong and is the basis of capillary and the reason for the formation of familiar drops, bubbles and meniscuses [3]. In most natural fluid flows, surface tension is very small compared to other forces and can be ignored in majority cases [4]. The reasons of using coefficient of discharge, C_d is that the flow heads at both upstream and over the crest are not equal due vertical curvature of the streamlines; another reason is due to the assumption that the pressure distribution upstream weir is hydrostatic [5]. Using Bernoulli's equation, weir equation can be derived and used to determine the flow rate as shown in Table 1:

Table 1 Flow equations for different weirs

Weir	Equation	Remarks
Rectangular	• $Q = C_d \frac{2}{3} b\sqrt{2g}h_1{}^{3/2}$	Bernoulli
Vee notch	• $Q = \frac{8}{15} C_d\sqrt{2g}\tan(\alpha/2)h_1{}^{5/2}$	Bernoulli
Crump (undrowned condition)	• $Q = \left(\frac{2}{3}\right)^{3/2} C_d C_v b\sqrt{g}\mathrm{h}_1{}^{3/2}$	Tecquipment Manual
Crump (drowned condition)	• $Q = \left(\frac{2}{3}\right)^{3/2} C_d C_{vf} b\sqrt{g}\mathrm{h}_1{}^{3/2}$	Tecquipment Manual

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