COEFFFICIENT OF DISCAHRGE OF A WEIR

(Broad crested weir)

Introduction:

Weirs are concrete or masonry structures used to raise the upstream water level and also as discharge measuring devices. If the width of the crest in the direction of flow is greater than two and half times the head causing flow then the weir is termed as Broad crested weir.

Objective:

To determine the coefficient of discharge (Cod) of a Broad crested weir.

Theory:

A weir is an opening in the side walls of a tank. It is same as an orifice without having an outer boundary. If the head is reduced the liquid flows with its level below the top of the orifice. The wall above the liquid level is superfluous and can be removal.

The difference between a large orifice and weir is that liquid flows through the orifice while it flows over the weir. The flow of liquid coming out of orifice is called jet while that comes through the weir is called 'nape, sheet or vein'.

There is no difference between a notch and a weir, except that notch is a small structure and has a sharp edges. Weir, on the other hand, is generally is an over flow structure. With broad crested, built across an open channel.

It is built across a river in order to raise water on the upstream and to allow excess water to flow over its entire length to the downstream side. Weirs are used for measuring the rate of flow of water in rivers or stream.

The relation between H and h for maximum discharge is, $h = \frac{2}{3} H$

Theoretical discharge, $Qt = 1.705 \, L \, H^{\frac{3}{2}}$ in m3/sec

Where,

L = Length of the weir measured parallel to width of channel in meters

H = Constant head over the crest on the upstream of channel in meters.

H = (h2-h1).

Actual discharge, Qa = Internal plan area of collecting tank x rise in collecting tank/ time of collection (t) in m3/sec.

Internal plan area of the tank, $A = L \times B$ =

Actual discharge, $Qa = AXHt$ =

T = Time taken for rise of 10cms,

H = Rise of water (10cms)

Then, Co-efficient of discharge $Cd = \frac{Qa}{Qt}$ =

Graph:

Draw a graph between Qa and H32 taking H32 on the x-axis.

Equipment:

1) A channel or flume to provide a flow passage.

2) A broad crested weir.

3) Hook-gauge to measure the head over the crest over the crest of weir.

4) A collecting tank to fit with a pyrometer, to the discharge over the weir and to find out actual discharge.

5) Stop watch to note the time of collection of water for a known rise of water level in the collecting tank.

6) Meter scale to measure the internal plan dimensions of the collecting tank.

Manual:

Start the experiment by pressing start button with default values of length of the collecting -tank, width of the collecting, pause the experiment after few cycles and note the observation.

Observation1:

1) Open the control valve and allow the water level to rise up to the skill level of the weir.

2) Adjust the tip of the hook gauge such that it coincides with water surface and note the reading on hook gauge scale as h1on u/s.

Observation2:

1) Operate the control valve such that water flows over the weir to some height.

2) Again adjust the tip of the hook gauge such that it coincides with water surface and note the water level by means of hook gauge as h2.

Observation3:

1) Note the time required for known rise of water level.

2) Keeping the length and width of the collecting tank as default values repeat the experiment by adjusting flow of water and hook gauge.

Result:

Average coefficient of discharge of a broad crested weir.

Quiz:

1) What is weir? How is different from notch?

2) How is actual discharge of weir measured?

3) Where is broad crested weir is used?

4) Does the magnitude of the flow rate affect the discharge coefficient Cod?

5) Does Cod increases or decrease with increasing flow rate?

6) What is the pattern of the water as its passes over the weir?

7) Would you expect the length of the weir crest to affect the discharge coefficient Cod?

8) What is the effect of drowning the weir (increasing the downstream depth)?

Reference:

1) FLUID MECHANICS- RK BANSAL

2) EXPERIMENTS ON FLUID MECHANICS- SARABJIT SINGH

3) WIKIPEDIA

4) The constructor- http://theconstructor.org/