OPEN CHANNEL FLOW EXPERIMENT

1. INTRODUCTION

A multi-purpose experimental channel utilized to show the general characteristics of the open channel flow and gravimetric tank used to find the discharge are shown in Figure 1.1. Water is supplied from the gravimetric tank and delivered to the channel inlet by using a control valve. The valve can be adjusted by a control arm placed along with the channel. Water falling from the channel outlet into the gravimetric tank returns to the feeding tank.

The discharge is measured by weighing the water in the gravimetric tank. The weight of water collected over the timed interval clearly corresponds to the weight added at the weight hanger. The balance arm ratio is 3:1, each kilogram weight added at the weight hanger represents 3-kilogram weight of water collected in the gravimetric tank over the timed interval. The duration of time is measured until the tank is balanced with the added weight. Then, the flow rate is determined with formula: Q = V / t. This procedure is shown in Figure 1.1.

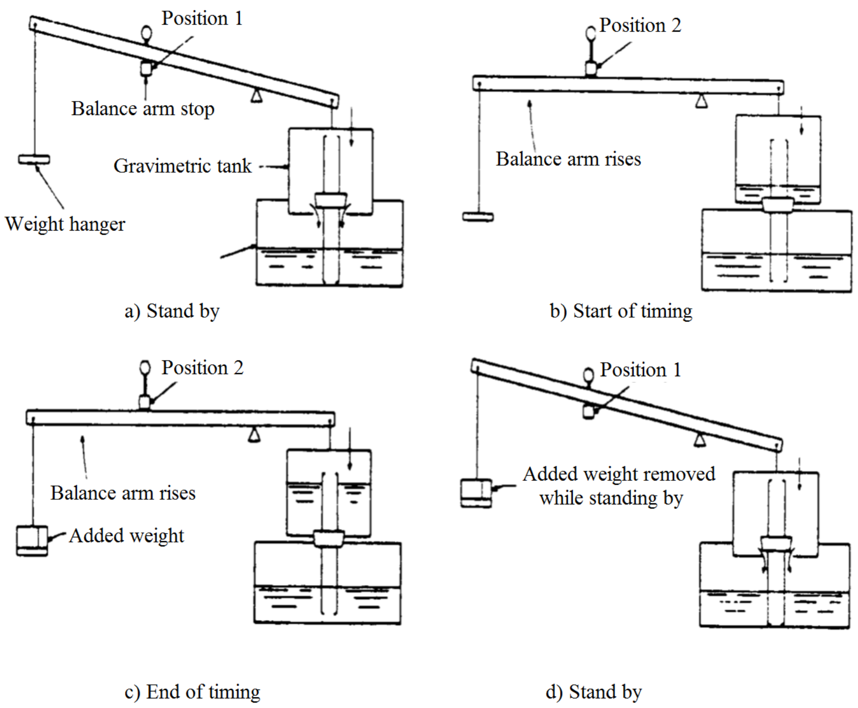


Figure 1.1 Steps in determining discharge

It is recommended to measure the discharge rate within 30-90 seconds. The balancing of the added weight when measuring discharge should give an interval in this range. If the maximum available weight produces a smaller time than 30 seconds, successive readings should be taken to obtain an average result over a total time of 30 seconds, preferably around 90 seconds.

2. FLOW OVER a SHARP- CRESTED WEIR

Sharp-crested weir is frequently used for the determination of flow characteristics in open channels (Figure 2.1). In this experiment, the relation between the weir head and the discharge is examined. The weir coefficient may be determined as follows;

$$C = 142.8\ Q\ /\ h^{3/2} \qquad (1)$$

where;

Q = Discharge (l / sec)

h = Measured water depth over weir (mm)

Assume the height of water above the crest of weir is equal to the water depth at the upstream section (0.3 m away from the crest) and write your experimental data in Table 2.1.

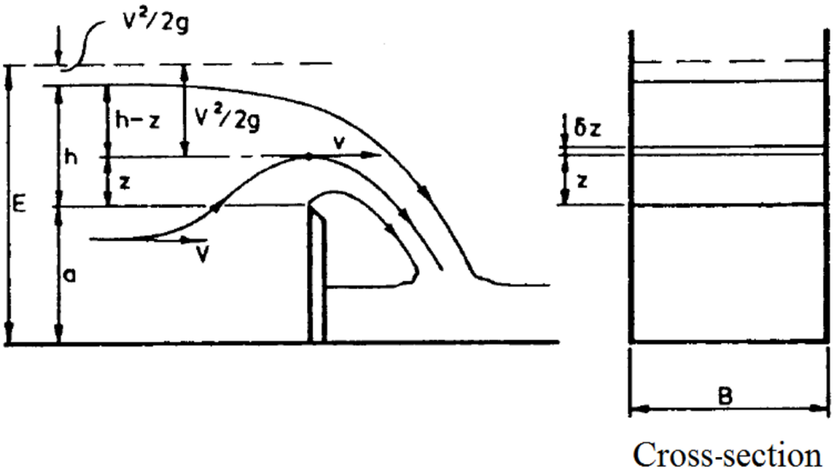


Figure 2.1. Flow over a sharp-crested weir

Draw the h-Q and C-h / a curves after the tables are filled with obtained data set. A sharp-crested weir discharge coefficient may be obtained from the C-h / a curve as follows;

$$C = a + b(h/b) \qquad (2)$$

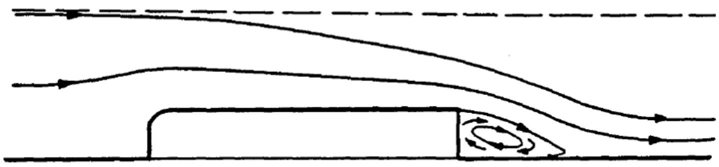
3. FLOW OVER a BROAD-CRESTED WEIR

Broad-crested weir is also used to determine the amount of flow in open channel. In this experiment, the relationship between the weir head and the discharge is examined and the weir coefficient (C) is determined (Figure 3.1). Both the specific energy (E) and the static head (h) are used to calculate the discharge coefficient, while experimental procedure is the same as that for the sharp-crested weir. The specific energy (E) may be calculated related to (E) and (h) in the determination of the weir coefficient as follows;

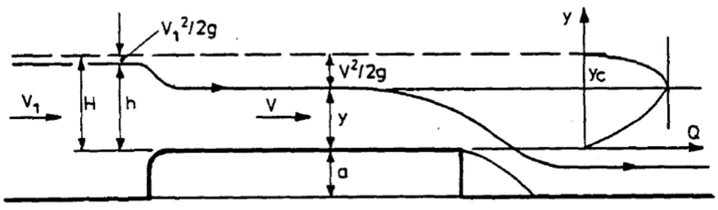
$$E = h + \frac{V^2}{2g} \tag{3}$$

$$Q = C\left(\frac{2}{3}\right) B\, g^{0.5}\, E^{3/2} \tag{4}$$

$$Q = C\left(\frac{2}{3}\right) B\, g^{0.5}\, h^{3/2} \tag{5}$$



a) General characteristics of flow



b) Idealised conditions assumed in analysis

Figure 3.1. Flow over a broad-crested weir

Unit uniformity should be provided in the formulas.

In addition, take L=120 mm, b = 75 mm and a = 15 mm. Write your experimental data in Table 3.1.

Then, draw h - Q, C - h /a and C- E /a curves and find the coefficient for the weir.

4. FLOW UNDER a SLUICE GATE

In this experiment, the amount of flow under a gate is investigated and the sluice coefficient is determined experimentally (Figure 4.1). Thus, the channel is adjusted to a bed slope of about 1/500. Then the sluice gate should be located at the upstream section that is 3 m away from the channel outlet. The flow conditions at the downstream section of the gate are adjusted via the gap under the sluice gate. The weir coefficient can be calculated as follows;

$$Q = C\,a\,B\,[2g\left(E - \frac{a}{2}\right)]^{0.5} \tag{6}$$

Write your experimental data in Table 4.1. Once the experimental data are tabulated, E (mm) -Q (l / sec) and [(E-a / 2)]$^{0.5}$-Q (l / sec) curves should be drawn. Where; "a" represents the gap under the gate.

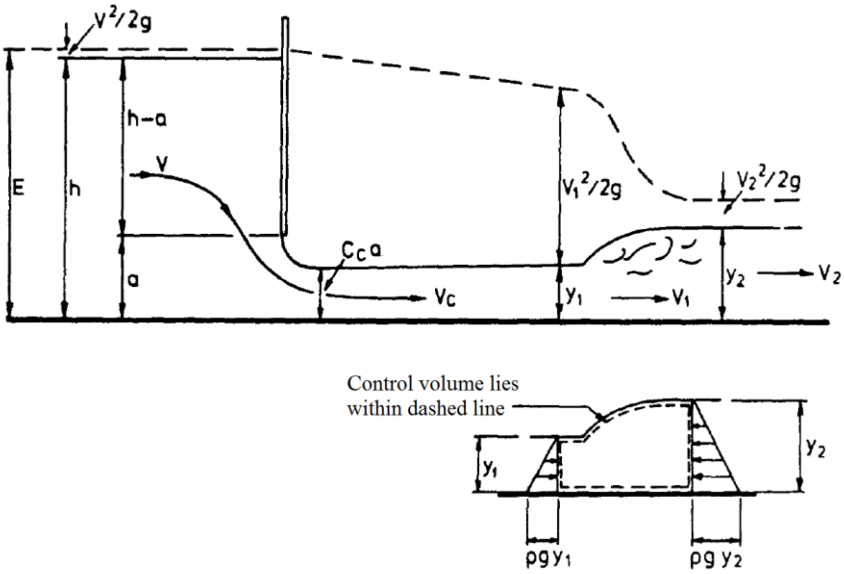


Figure 4.1. Water surface profile under a sluice gate

5. THE VENTURI- FLUME

The venturi-flume is formed by a smooth contraction in the cross-section of a channel and also used to determine the amount of flow in an open channel (Figure 5.1). The flume coefficient can be calculated as follows;

$$Q = C\, B_c\, (g)^{0.5}\, (2E/3)^{3/2} \tag{6}$$

where, B_c is the channel width at the throat section (B_c = 50 mm).

Write your experimental data in Table 5.1. The curves of E (mm) -Q (l / sec) and y_1 (mm) -Q (l / sec) should be plotted in the same graph.

After determining the characteristics of the weir discharge, the water surface profiles and energy grade line are determined. Water surface profile and the specific energy may be determined with using limnimeter and pitot tube, respectively.

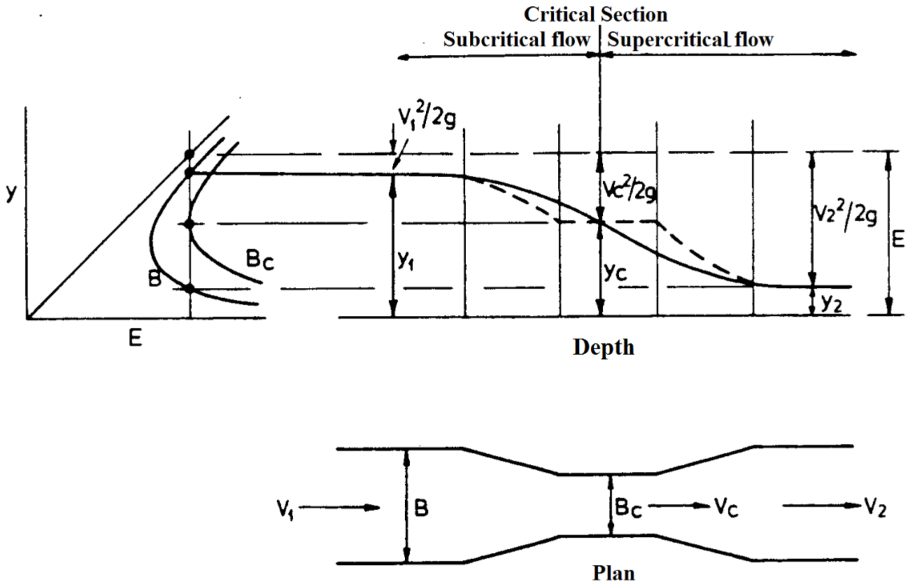


Figure 5.1. Flow through the venturi-flume

Name: **Group**:

Surname: **Student ID**:

Date:

Table 2.1

Depth h (mm)	Weight W (kg)	Time t (s)	Discharge Q (l/s)	Weir coefficient C	h/a

Table 3.1

Total Depth E (mm)	Static head h (mm)	Weight W (kg)	Time t (s)	Discharge Q (l/s)	C depending on E	C depending on h	H/a	h/a

Table 4.1

Depth h (mm)	Weight W (kg)	Time t (s)	Discharge Q (l/s)	Velocity V (m/s)	Specific Energy E (mm)	Weir coefficient C

Table 5.1

Water depth h (mm)	Weight W (kg)	Time t (s)	Discharge Q (l/s)	At the upstream section V_1 (m/s)	Specific Energy E (mm)	Weir coefficient C