DEPARTMENT OF CIVIL ENGINEERING

MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY

CE 362 Open channel flow sessional

Experiment No. 8

DETERMINATION DISCHARGE AND MEAN VELOCITY OF AN OPEN CHANNEL

8.1 General:

Measurement of discharge is a principal work in hydrographic surveying in order to design any river engineering works the discharge mean velocity of the river is required. This experiment mainly deals with the measurement of discharge of a channel by area velocity method. Also the value of Manning's n and Chezy's C will be derived which are required to use the uniform flow equations. Also the relationship of n and C with the depth of flow will be developed. The experiment also deals with the development of depth discharge relationship of the channel which is very useful to predict the discharge of the channel for different depth of flow.

8.2 Theory

8.2.1 Depth of the velocity:

The velocity along a vertical varies from zero at the stream bed to a maximum at or near the water surface (practical maximum velocity occurs below the water surface and at a distance of 0.05 to 0.25 of the total depth). The average velocity in the vertical known as the depth means velocity. Generally, the average of the velocities at 0.2 to 0.8 of the depth below the water surface is approximately equal to the mean velocity in the vertical. The velocity at 0.6 depths below the water surface is also approximately equal to the mean velocity in the vertical. Normally when the depth of flow in a vertical is greater then 0.61 m, then the depth mean velocity determined by average velocity at 0.2 and 0.8 depth otherwise velocity at 0.6 depth taken as average velocity. So

Depth mean velocity, $V = (v_{0.2} + v_{0.8}) / 2 = V_{0.6}$ ……(1)

8.2.2 Discharge of flow:

Measurement of discharge in irregular channel like rivers is a complex one. There are different methods and of them area velocity method is the familiar one. In this method a channel section is subdivided into a number of segment or strips by a number of successive verticals. The mean velocities in the verticals are determined according to article 8.2.1. If V_1 be the mean velocity in a vertical then discharge through a strip is given by,

$$Q = V_1 \Delta A_1 \quad \text{……(2)}$$

Where, ΔA is the area of the strip.

The sum of the discharges through all the strips is the total discharge, i, e.

$$Q = \sum_{f=1}^{n} Q_i \quad \text{.....(3)}$$

8.2.3 Mean velocity of the stream:

The mean velocity of the whole section is equal to the total discharge divided by the whole area and given by,

$$V = \frac{Q}{\sum \Delta A} \quad \text{.....(4)}$$

8.2.4 Manning's and Chezy's roughness of coefficient:

The velocity distribution in open channel is dependent on the roughness height k which is related to is related a Manning's n or Chezy's C. When velocities at 0.2 and 0.8 of the depth are known, Manning's n can be determined by the equation,

$$n = \frac{(x-1)R^{1/6}}{(6.7\sqrt{8}\,(x + 0.95)} \quad \text{.....(5)}$$

Where, $x = v_{0.2} / v_{0.8}$ .....(6)

With the value of n known, Chezy's C can be determined by the relation,

$$c = \frac{1}{n} R^{1/6} \quad \text{.....(7)}$$

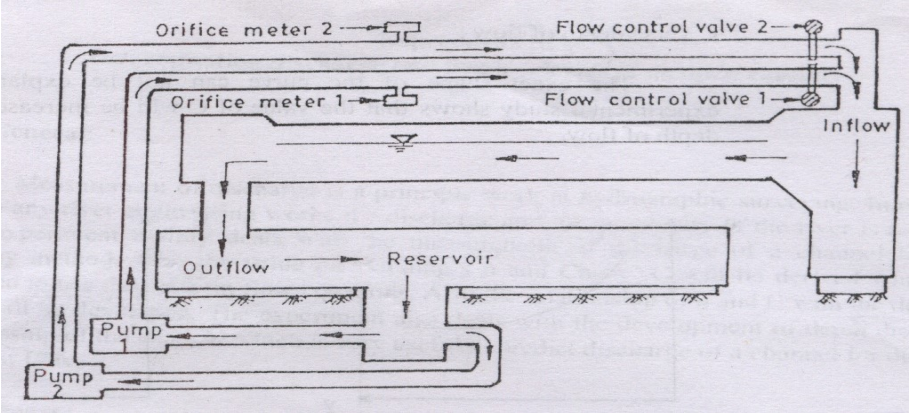
This equation provides an important relationship between Chezy's C and Manning's n.
The variation of n and C with the depth of flow is also significant. it was found that the value of n generally decreases with the increase in depth of flow. So, from Eq.(8.7) we can say that the value of C will be increase in depth of flow.

8.3 Objectives of the experiment:

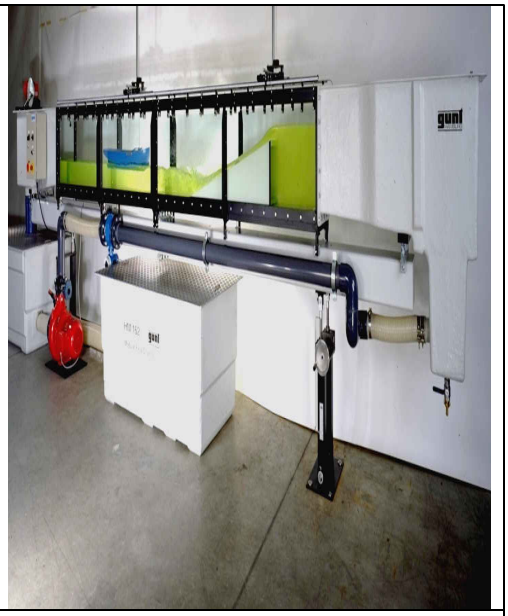
1. To determine the total discharge and mean velocity of the flow.
2. To calculate Manning's n and Chezy's C.
3. To plot n and C against depth of flow and observe the relationship.

8.4 Experimental setup:

The experimental setup for the experimental is given below. The longitudinal slope of the flume is 1 in 840.



8.5 Apparatus

	
Current meter	**Open channel**

8.6 Procedure

8.6.1. To determine the total discharge and mean velocity of the flow.

1. Divide the channel section into 3 vertical segments.
2. Measure the depth of flow at the middle of each vertical strip.
3. Measure mean velocity at every vertical using the Eq.(8.1)

4. calculate discharge through each strip from Eq. (8.2)
5. Calculate total discharge using Eq. (8.3) and compare it with the actual discharge.
6. Calculate the mean velocity using Eq. (8.4)

8.6.2. To calculate Manning's n and Chezy's C

1. Find the value of x at each vertical using Eq.(8.6) and find average value of x.
2. By this average value of x calculate n using Eq. (8.5)
3. With the value of n calculate C using Eq. (8.7)

8.6.3 To plot n and C against depth of flow:

1. For every depth of flow the value of n and C will be derived.
2. Plot n verses depth of flow in a plain graph paper.
3. Plot C verses depth of flow in a plain graph paper.

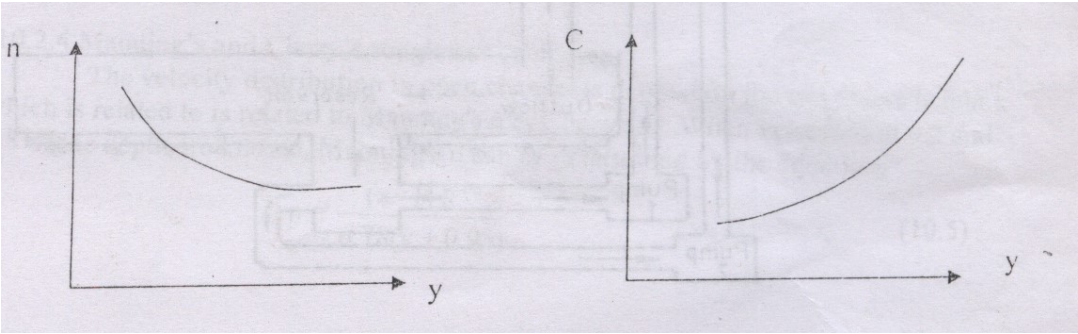
8.7 Typical shape of the graphs:

8.7.1 n verses depth of flow:

The exact shape of the curve cannot be explained analytically. But experimental study shows that the value of n will be decreased with the increase in depth of flow.

8.7.2 C verses depth of flow:

The exact shape of the curve cannot be explained analytically. But experimental study shows that the value of C will be increased with the increase in depth of flow.



8.8 DATE SHEET

DETERMINATION DISCHARGE AND MEAN VELOCITY OF AN OPEN CHANNEL

LOCATION OF CURRENT METER		CURRENT METER READING			Point Velocity V(m/s)	Depth main velocity V(m/s)	Discharge Through Strip Q (m^3/s)
Horizontal	Vertical	No of Revolution (N)	Time (Sec)	Revolution per sec n(rev/sec)			
1st Strip							
2nd Strip							
3rd Strip							
4th Strip							
5th Strip							
6th Strip							

X	Y	R= A/P=By/(B+2y)	Manning's n	Chezy's C

Level / Term : **Dept. :**
Reg No. : **Section :**
Group No. : **Date :**

Signature of the Teacher

8.9 Calculation

8.10Plotting of n and c v_s depth of flow:

Group No	Manning's n	Depth Of Flow	Chezy's C