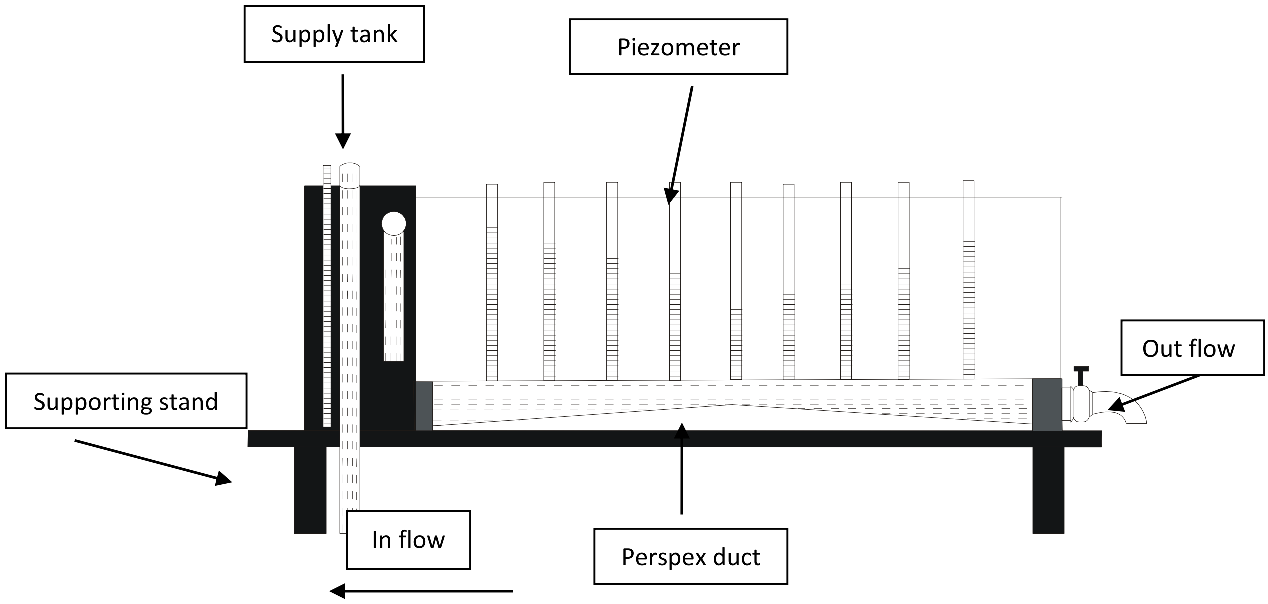
Highlighted topic only will be conducted in experiment for this academic section

VERIFICATION OF BERNOULI THEOREM

OBJECTIVE :

To verify the Bernoulli's theorem experimentally.

EXPERIMETNAL SET-UP :



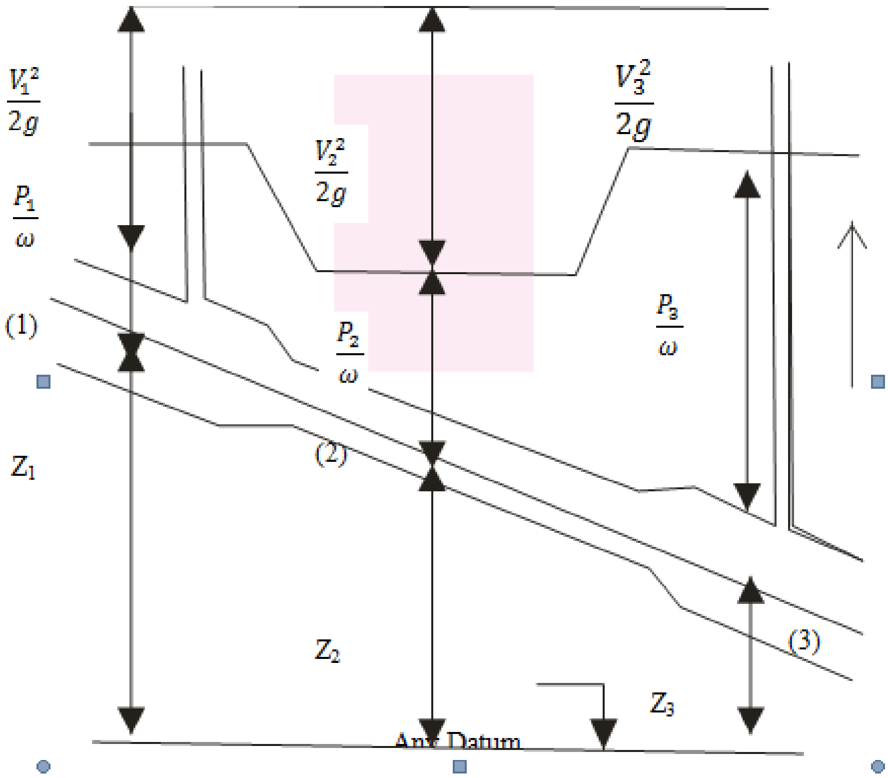
Apparatus for verification of Bernouli's Theorem

The experimental set up consists of a horizontal Perspex duct of smooth variable cross-section of convergent and divergent type. **The section is 18mm 16mm 14mm 12mm 10mm 12mm 14mm 16mm 18mm.**. The piezometric pressure P at the locations of pressure tappings is measured by means of 9 piezometer tubes installed at an equal distance of 3 cm. along the length of conduit. The duct is connected with supply tanks at its entrance and exit end with means of varying the flow rate. **A measuring tanks is 30x30x30cm**. Height is used to find the actual discharge.

THEORY :

Considering friction less flow along a variable area duct, the law of conservation of energy states "In a steady, ideal flow of an incompressible fluid, total energy at any point of the fluid remains constant". This is called Bernoulli's equation.

$$\frac{P_1}{\omega} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\omega} + \frac{V_2^2}{2g} + Z_2$$



Graphical Presentation of Bernoulli's Theorem

The total head of flowing fluid consists of pressure head, velocity head and elevation head. Hence $\frac{P_1}{\omega} + \frac{V_1^2}{2g} + Z_1 = \frac{P_1}{\omega} + \frac{V_2^2}{2g} + Z_2$

Where, P,V, and Z refer to the pressure, velocity and position of the liquid relative to some datum at any section. **But due to frictional losses in pipe as well as losses due to sudden expansion and contraction the total head at each cross section may not be constant**.

a) Note down the piezometers distance from inlet section of the Perspex duct
b) Note down the cross sectional area of Perspex duct at each of the piezometer tapping points.
c) The datum head is treated as constant throughout the duct.
d) By maintaining suitable amount of steady head or nearby study head conditions in the supply tanks there establish a steady non-uniform flow in the conduit.
e) The discharge flowing in the conduit is recorded together with water levels in each piezometer tubes.
f) This procedure is repeated for other value of discharge.

RESULT AND DISCUSSION :

a) If V is the velocity of flow at a particular section of the duct and Q is the discharge, then by continuity equation: $V = \frac{Q}{area\ of\ section}$
b) Calculate velocity head and total head.
c) Plot piezometric head (P/ω+Z), velocity head ($V^2$2g), total head ($P/\omega+Z+V^2/2g$) against distance of piezometer tubes from same reference point.

OBSERVATION SHEET :

Area of measuring tank(cm) = 30x30cm^2.

Increase in depth of water, m.=

Time, sec =

Discharge,

m^3/sec =

Tube no.	**Distance of piezometric tube from inlet point**	**Diameter (m)**	**Area of c/s of conduit A (m^2)**	**Velocity of flow m./sec**	**$V^2/2g$ (m)**	**Pressure head(m)**	**Total head (m)**
1							
2							
3							
4							
5							
1							
2							
3							
4							
5							
1							
2							
3							

4							
5							

COMMENTS :

Since the conduit is horizontal, the total energy at any section with reference to the datum line of the conduit is the sum of P/ω and $V^2/2g$ where ω is the weight density of the fluid and g is the acceleration due to gravity). **One can compare the values of the total energy at different sections and comment about the constancy of energy in converging and diverging conduit.**

PRECAUTIONS :

- Apparatus should be in leveled condition.
- Reading must be taken in steady or nearby steady conditions and it should be noted that water level in the inlet supply tank should reach the overflow condition.
- There should not be any air bubble in the piezometer and in the Perspex duct.
- By closing the regulating valve, open the control valve slightly such that the water level in the inlet supply tank reaches the overflow conditions. At this stage check that pressure head in each piezometer tube is equal. If not adjust the piezometers to bring it equal

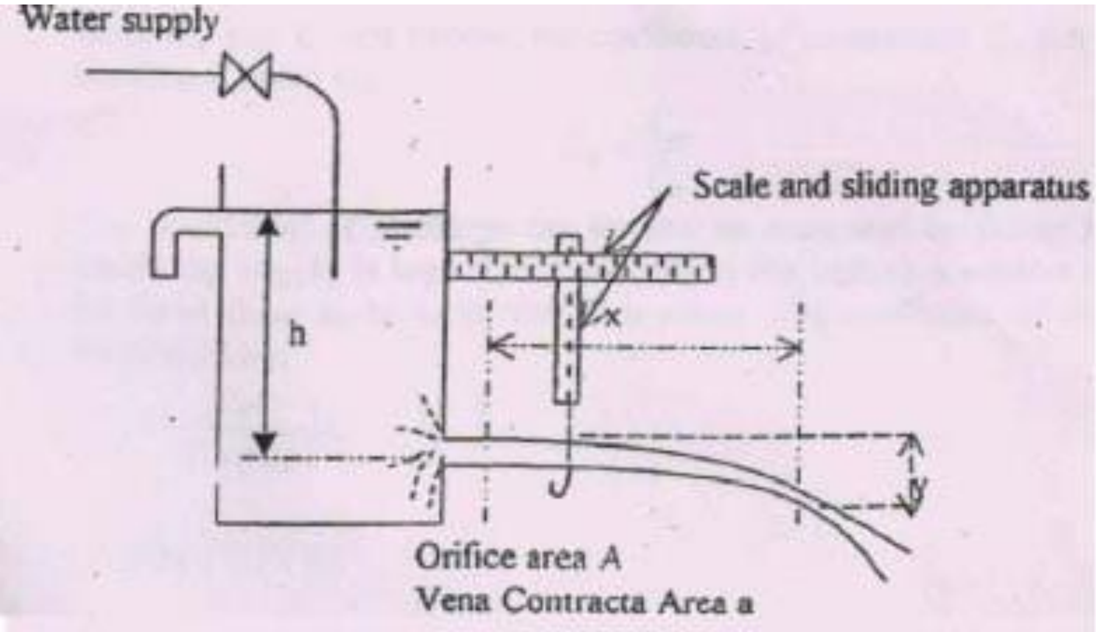
APPARATUS FOR CONDUCTING ORIFICE EXPERIMENTS

OBJECTIVE :

To determine the coefficient of discharge C_d coefficient of velocity C_V and coefficient of contraction C_c of various types of orifices and mouth pieces.

THEORY :

An orifice is an opening in the wall of a tank, while a mouthpiece is a short pipe fitted in the same opening. **A mouthpiece will be running full if its length does not exceed two to three times the diameter**. Both orifice and mouthpiece are **used for discharge measurement**. The jet approaching the orifice continues to converge beyond the orifice till the streamlines become parallel. This section of the jet is then **a section of minimum area and is known as vena contracta.**



If V_c is the true horizontal velocity at the vena contracta, then the properties of jet trajectory give the following relationship :

$$y = \frac{g}{2V_c^2} x^2$$

$$V_c = \left\{ \frac{gx^2}{2y} \right\}^{1/2}$$

$$\frac{V_o^{\ 2}}{2g} = h$$

The theoretical velocity in the plane of the vena contracta V_o is given by

i.e. $Vo = (2gh)^{1/2}$

Now coefficient of velocity

$$Cv = \frac{Actual}{theoritical}$$

$$C_v = \frac{x}{2\sqrt{yh}}$$

Where

h is the constant head in the supply tank and

x & y are coordinates of jet with respect to centre of opening.

The actual discharge Q when divided by $a\sqrt{2gh}$ yield the coefficient of discharge C_d.i.e.

$$C_d = \frac{Q}{a\sqrt{2gh}}$$

where

a is the area of cross section of the orifice (or the mouthpiece) and

g is the acceleration due to gravity.

Once C_d and C_v are known, the coefficient of contraction C_c can be obtained by dividing C_d with C_v.

$$C_c = \frac{C_d}{C_v}$$

The coefficient of discharge can be also be computed by falling head method in which the supply is kept closed after filling the tank to a suitable level and fall in the head from h_1 to h_2 in time T is noted. The coefficient of discharge is then obtained from

$$C_d = \frac{2A}{T.a\sqrt{2g}}\left[h_1^{1/2} - h_2^{1/2}\right]$$

APPARATUS :

The experimental set up consists of an supply tank with **overflow arrangement and piezometer tube** for water level measurement in the tank. There is also provision for fixing the various orifices and mouthpieces (interchangeable) installed in the vertical plane of the tank side. **A set of orifice consisting of 10mm dia and 15mm. dia orifice is provided with the apparatus.** Further a set of mouth piece is also provided. Arrangement is made such that the water passes only through this attached opening. Water comes out of the opening in the form of jet.

A horizontal scale on which is mounted a vertical scale with a hook gauge is attached to the supply tank. Thus hook gauge can be moved horizontally as well as vertically in x and y direction and its corresponding movement can be read on horizontal and vertical scales respectively. **A collecting tank is used to find the actual discharge of water through the jet**.

PROCEDURE:

i. Note down the relevant dimensions as area of collecting tank and supply tank.
ii. Attach a orifice/mouthpiece and note down its diameter.
iii. The water supply was admitted to the supply tank and conditions were allowed to steady to give a constant head. The lowest point of the orifice/mouthpiece is used as the datum for the measurement of h and y.
iv. The discharge flowing through the jet is recorded together with the water level in the supply tank.
v. A series of readings of dimensions x and y was taken along the trajectory of the jet.
vi. The above procedure is repeated by means of flow control valve.

vii. the above procedure is repeated for other types of orifice/mouthpiece.

SAMPLE DATA SHEET :

Size & shape of the mouth piece/orifice =

Area of cross section of mouth piece/orifice, a, m^2 =

Area of cross section of collecting tank, m^2 =

Area of cross section of supply tank, A, m^2 = 0.3 x 0.3

Reading on the piezometer at the level on the centre of mouth piece/orifice h_o =

A. CONSTATN HEAD METHOD :

(i) Determination of C_d

Run no.	Reading on the piezometer a_1 (m)	Value of h h= a1-h_o (m).	Discharge measurement				$C_d = \frac{Q}{a\sqrt{2gh}}$
			Initial (m)	Final (m)	time (sec)	Discharge Q (m^3/sec)	
1							
2							
3							
4							
5							
6							

Average C_d =

(ii) Determination of Cv

Reading of horizontal scale at exit of orifice/mouthpiece X_o =

Reading of vertical scale at exit of orifice / mouthpiece y_o =

Run no.	h (m)	X (m)	Y(m)	X = X-X_o (m)	Y = Y-Y_o (m)	$C_v = \frac{x}{2\sqrt{yh}}$
1						
2						
3						
4						
5						

Average Cv =

Therefore $C_c = \frac{C_d}{C_v}$

(B) FALLING HEAD METHOD :

Reading on the piezometer at the level on the centre of mouth piece/orifice h_o =

$$k = \frac{2A}{a\sqrt{2g}}$$

Run no.	**Piezometer reading**		**h_1=a_1-h_o (cm)**	**h_2=a_2-h_o (cm)**	**Time in lowering the water T (sec)**	$C_c = \frac{k}{T}(\sqrt{h_1} - \sqrt{h_2})$
	Initial a_1 (cm.)	Final a_2 (cm)				
1						
2						
3						
4						

Average value of C_c =

PRECAUTIONS :

1. Apparatus should be in leveled condition.
2. Reading must be taken in steady or near by steady conditions. And it should be noted that water level in the inlet supply tank must be constant.
3. There should not be any air bubble in the piezometer.
4. Orifice must be free from dirt and kept clean.

VENTURI METER APPARATUS.

OBJECTIVE :

To calibrate a venturimeter and to study the variation of coefficient of discharge with the Reynolds number.

THEORY :

Venturimeter is a device **used for measurement of rate of flow** of fluid though a pipe. The basic principle on which a venturimeter work is that by reducing the cross-sectional area of floe passage, a pressure difference is created and the measurement of the pressure difference enable the determination of the discharge through the pipe.

A venture meter consists of an inlet section followed by a convergent cone, a cylindrical throat and a gradually divergent cone. Since the cross sectional area of the throat is smaller than the cross sectional area of the inlet section, the velocity of flow at the throat will become greater than that at the inlet section, according to continuity equation. The increase in the velocity of flow at the throat results in the decrease in the pressure at this section. A pressure difference is created between the inlet section and throat section which can be determined by connecting a differential U-tube manometer between the pressure taps provided at these section. The measurement of pressure difference between these sections enables the rate of flow of fluid (Q) to be calculated as

$$Q = C_d \frac{a\sqrt{2g\Delta h}}{\sqrt{1-(a/A)^2}}$$

Where a is the area of cross section of throat, A is the area of cross section of inlet section, g is the acceleration due to the gravity, Δh is the difference of head in terms of water and C_d is the coefficient of discharge of venture meter.

The coefficient C_d accounts for viscous effects of the flow and depends upon the Reynolds number, R_e (which is equal to V. d/v where, V=Q/a; d is the diameter of throat) and the ratio d/D. for the given experimental set-up, d/D is fixed. Usually C varies between 0.96 and 0.99 for Reynolds number greater than 10^5.

EXPERIMETAL SET UP :

The experimental setup consists of a pipe-line circuit thorough which the fluid is circulated continuously. **The circuit consists of a pipeline having venturimeter of 25mm diameter (having a d/D=0.6).** A regulating valve is provide on the downstream side of pipeline to regulate the flow. The venturimeter is provided with two pressure tapings, one at upstream and other at the throat section. A U tube differential manometer is provided to measure the pressure difference between two side. A measuring tank is used to find the actual discharge through the circuit.

PROCEDURE :

i. Note down the relevant dimensions as diameter of pipeline, throat dia. of venture meter and area of collecting tank, room temperature etc.

ii. Pressure tappings of a venturimeter are kept open.

iii. Open the inlet flow control valve and regulate the valve to allow a steady flow though the pipe. Check if there is any air bubble in the manometer tube. If yes, remove the same.

iv. The flow rate was adjusted to its maximum value. By maintaining suitable amount of steady flow in the circuit. Time is allowed to stabilize the levels in the manometer tube.

v. The discharge flowing in the circuit is recorded together with the water levels in left and right limbs of manometer tube.

vi. The flow rate is reduced in stages by means of flow control valve and the discharge & reading of manometer are recorded.

0BSERVATION SHEET :

Name of experiment : **Calibration of Venturimeter**

Diameter pipe line, D = 25mm.

Cross sectional area of the pipe line, (A), m^2 =

Diameter of throat section, d =12.5mm.

Cross sectional area of the throat section, (a) m^2 =

Area of measuring tank, a', cm^2 =30x30cm.

Temperature of water, ^0C =

Kinematic viscosity of water, v, m^2/sec =

Note:

Dynamic (Absolute) and Kinematic Viscosity of Water - SI Units

Temperature(*t*) (*°C*)	**Dynamic Viscosity *(μ)* *(Pa s, N s/m²) x 10⁻³***	**Kinematic Viscosity*(ν)* *(m²/s) x 10⁻⁶***
0	**1.787**	**1.787**
5	**1.519**	**1.519**
10	**1.307**	**1.307**
20	**1.002**	**1.004**
30	**0.798**	**0.801**
40	**0.653**	**0.658**
50	**0.547**	**0.553**
60	**0.467**	**0.475**
70	**0.404**	**0.413**
80	**0.355**	**0.365**
90	**0.315**	**0.326**
100	**0.282**	**0.294**

Sn	Discharge measurement				Manometer reading			C_d	
	Initial (cm.)	Final (cm.)	Time (sec.)	Discharge Q (cm^3/sec)	Left limb h_1(cm.)	Right limb h_2 (cm.)	Diff. of head h=12.6(h_1 -h_2) (cm.)	$C_d = \frac{Q}{a\sqrt{2gh}}$	$R_e = \frac{Qd}{av}$
1									
2									
3									
4									
5									
6									
							Average		

RESULTS & DISCUSSINS :

1. Fill up the data sheet.
2. Calculate the discharge, difference of manometer reading and C_d for different sets of readings.
3. Plot Q v/s Δh on a log graph paper and fit in a straight line for the plotted points. This is the calibration curve for the given Venturimeter.
4. Plot C_d v/s R_e for the observed data.

PRECAUTIONS :

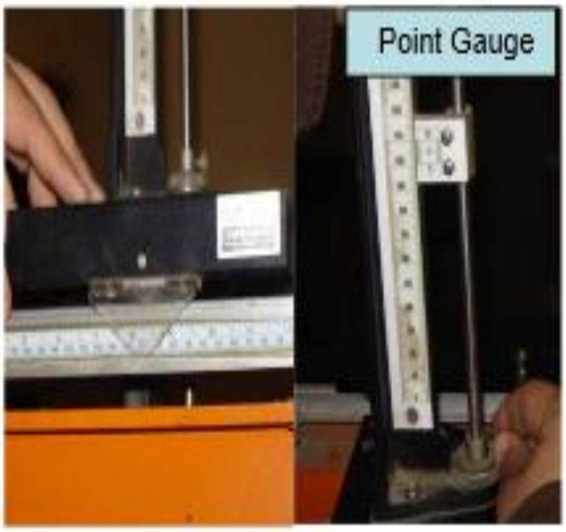
- Remove all entrapped air form two limbs two of manometer.
- Maintain constant discharge for one set.
- Take a number of reading to obtain accurate result.

HYDRAULIC FLUME APP.

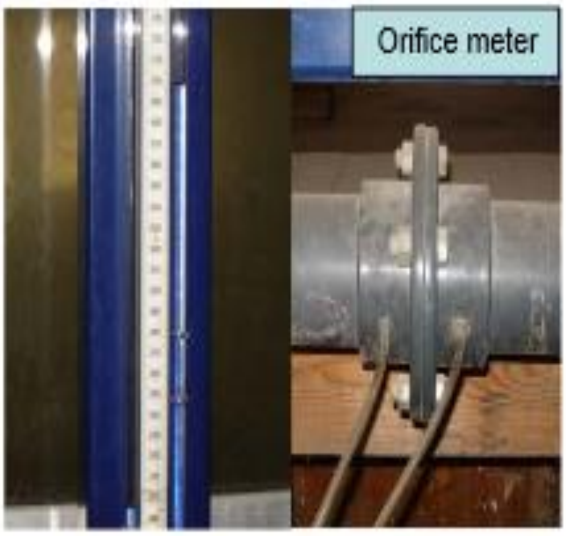
EXPERIMENTAL SET UP :

The experimental set up consists of a tilting flume **12.5cm. wide and 30cm. deep** . **The total length of flume is nearly 245cm**. for visual observation of flow pattern along the flume section both sides of flume are provided with transparent Perspex sheet. The upstream and downstream sections are provided with adjustable gates. In apportion of flume one can fix a model of weir or roughened plate etc. the flume is provided with pipe railing in full length (between the gates for the movement of pointer gauge. **A pointer gauge is used to measure the head of water over the model**. **The flume has the screw mechanical jack to give a tilt to the channel**.


Tail Water Gate


Point Gauge


Bed Slope
Wheel


Orifice meter


Pumping System

EXPERIMENT NO. 1

OBJECTIVE :

To determine the discharge coefficients of broad crested weir and to measure the water surface profile for flow over broad crested weir.

APPARATUS :

Model of broad crested weir, collecting tank and pointer gauge.

INTERODUCTION AND THEORY :

A channel is a structure in which water flows under atmospheric pressure while in a pipe water flows at pressure greater than atmospheric pressure. Therefore techniques of measurements of discharge in pipes cannot be applied here.

Different types of models are available to fine discharge in an open channel as venturiflume, spillway weir, broad crested weir, V notch and rectangular notch etc. for calibration of either venturiflume or weir some flow is allowed in the flume. Once the flow becomes steady and uniform discharge coefficients can be determined for any model.

The weir is a device used for the measurement of flow in a channel. It is an obstruction in the channel that causes the liquid to rise behind the weir and then flows over it. By measuring the height of upstream liquid surface, the rate of flow is determined. The sheet of water flowing through a weir is known as the nappe. The top of a weir over which the water flows is known as crest. The weir may be broad crested, spillway etc.

The relationship between discharge and head over the weir can be developed by making the following assumptions as to the flow behavior :

(a) Upstream of the weir, the flow is uniform and the pressure varies with depth according to the hydrostatic equation $p=\rho gh$

(b) The free surface remains horizontal as far as the plane of the weir, and all particles passing over the weir move horizontally.

(c) The pressure throughout the sheet of liquid or nappe, which passes over the crest of the weir, is atmospheric.

(d) The effect of viscosity and surface tension are negligible.

(e) The velocity in the approach channel is negligible.

Weir in which the sheet of flowing fluid is supported by the surface of the crest is called broad crested weir may be determined by applying formula.

$$C_d = \frac{Q}{\left(\frac{2}{3}H\right)b\sqrt{2g}\left(\frac{H}{3}\right)^{1/2}}$$

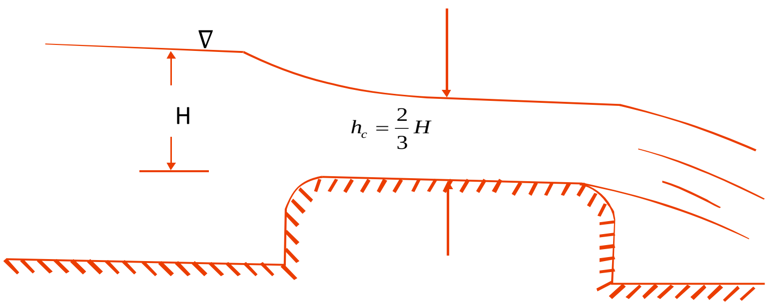
Where

Q is the discharge over a broad crested weir,

b is the width of weir,

g is acceleration due to gravity and

H is the head above the crest of broad crest of broad crested weir.



The pattern of flow over a broad crested weir has been shown in fig. it should be noted that the curvilinear flow at the entrance and the outfall of the weir prevents the critical depth form occurring at any one section for all flow rates. It should be noted that on account of curved streamlines the pressure at the upstream of the weir is non-hydrostatic.

EXPERIMENTAL PROCEDURE :

Step1 : The channel is adjusted so that the bed is horizontal. The broad crested weir model is placed in the channel and carefully sealed to prevent leakage between the walls and floor of the channel, and the model.

tep2 : The channel is filled with water up to the crest level and reading on the scale on the point gauge is noted down.

Step3 : The flow regulating valve is adjusted to give the maximum possible discharge without flooding the model. Optionally a gate can be used for controlling the discharge in the channel.

Step4 : conditions are allowed to steady before the rate of discharge and head over the model is recorded .

Step5 : The discharge is reduced in stages and a series of readings of Q and head over the model are recorded.

Step6 : the water surface profile can be plotted by the help of point gauge for a constant run.

RESULTS AND DISCUSSIONS :

1. Note down (a) width of broad crested weir and (b) area of collecting tank.
2. Calculate the discharge and head over the weir.
3. Find out the coefficient of discharge C_d of weir.

SAMPLE DATA SHEET :

Broad Crested Weir

Width of broad crested weir, b, cm =

Crest level of broad crested weir H_1 cm. =

S. no.	Discharge measurement			Reading of water level above the crest H_2 (cm)	Head over weir H= H_1-H_2 (cm.)	$C_d = \frac{Q}{(2/3)H\,b\sqrt{(2g(H)}/3}$
	volume	time	Discharge Q (cm^3/sec)			
1						
2						
3						
4						
5						
6						

Average C_d=

EXPERIMENT No. 2 :

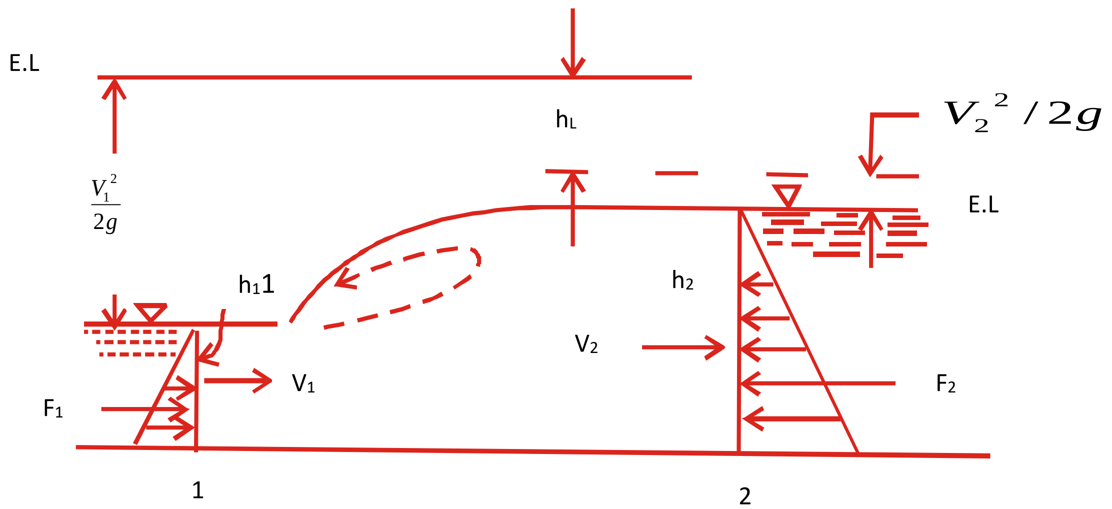
OBJECTIVE :

Measurement of water surface profile for a hydraulic jump.

APPARATUS :

It consist of a channel having a sluice gate at the inlet end, a tail gate at the downstream end, and top rails for the movement of pointer gauge. A sluice valve is provided in the supply pipe. Scale is also required.

INTRODUCTION AND THEORY :



When supercritical flow meets sub-critical flow there forms what is known as **hydraulic jump which is accompanied by violent turbulence, eddy formation, air entrainment and surface undulations**. Hydraulic jump is a very useful means to dissipate the excess energy of flowing water which otherwise would cause damage downstream. Consider the flow situation, shown in fig. in which section 1 is in supercritical zone and section 2 is in sub-critical zone. Assuming the channel bed to be horizontal, friction forces to be negligible and flow to be two dimensional, one can write, using the momentum equation.

$$P_1 - P_2 = \rho q (V_2 - V_1) \qquad (1)$$

Where, q=Q/B

in which B is the width of channel and P represents the hydrostatic force. Writing down the values of P_1 and P_2 for rectangular channel, in equation (1), one gets,

$$\frac{\rho g h_1^2}{2} - \frac{\rho g h_2^2}{2} = \rho q (V_2 - V_2) \qquad (2)$$

Where,

ρ is the mass density of water.

From the continuity equation, $q=V_2h_2 = V_1h_1$ (3)

Combining equation (2) & (3) and then, solving, for h_2/h_1 one obtains,

$$\frac{h_2}{h_1} = \frac{1}{2}(-1+\sqrt{1+8Fr_1^2}) \quad (4)$$

In which, $Fr_1 = V_1/\sqrt{gh_1}$ and is termed as Froude number of the incoming, flow at section 1. h_2 and h_1 as related by Equation (4), are known as conjugate or sequent depths. A jump forms when Equation (4) is satisfied.

Because of eddies (or rollers), and flow decelerations that accompany the jump, considerable head loss occurs. This head loss, h_L may be calculated by using the energy equation, thus,

$$h_L = (h_1 + \frac{V_1^2}{2g}) - (h_2 + \frac{V_2^2}{2g}) \quad (5)$$

From Equations (3) and (5), it can be shown that,

$$h_l = \frac{(h_2 - h_2)^3}{4h_1h_2} \quad (6)$$

Height of jump h_1 is defined as the difference between the depths after and before the jump, i.e.

$h_j = h_2 - h_1$

This variation of h_j/E_1 and h_L/E_1 with Fr_1 has been shown in Fig 2. Here, E_1 is the specific energy at section 1.

EXPERIMENTAL PROCEDURE :

Step1 : Adjust the supply valve, sluice gate and the tail gate so that there forms a stable hydraulic jump in the flume.

Step2 : Take the pointer gauge readings for the bed levels and water surface elevations at pre-jump section (1) and post-jump section (2).

Step3 : Measure the discharge.

Step4 : Repeat step 1 & step 2 for other positions of valve, sluice gate and tail gate.

FIGURES TO BE PREPARED :

(1) Plot h_2-h_1 v/s Fr1

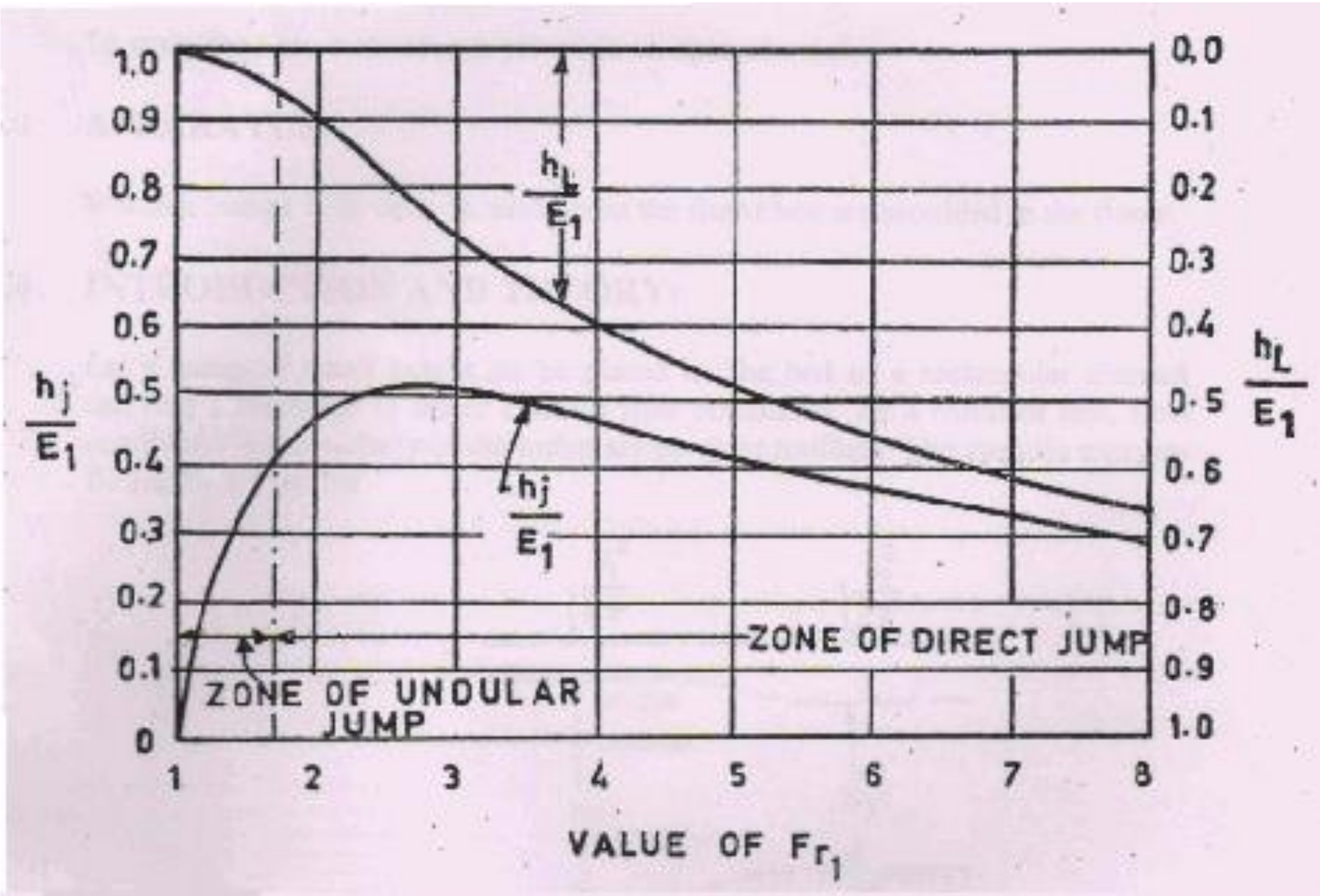
On an ordinary graph paper. On the same plot also draw the line represented by Equation . Note the scatter of observed data points.

(2) On Fig 2 mark the data points of h_1-E_1 and h_j-E_1 for various values of Fr1. Note the scatter of the experimental data points from the standard curves.

OBSERVATION AND COMPUTATIONS SHEET.

Run No.	Discharge measurement			Pre-jump depth, h_1	Pots-jump depth, h_2	$V_1 = \frac{Q}{Bh_1}$	$\frac{h_2}{h_1}$	$V_2 = \frac{Q}{Bh_2}$	$Fr_1 = \frac{V_1}{\sqrt{gh_1}}$	$E_1 = h_1 \frac{V_1^2}{2g}$	$E_2 = h_2 \frac{V_2^2}{2g}$	$\frac{h_j}{E_1} = \frac{h_2 - h_1}{E_1}$	$\frac{h_L}{E_1} = 1 - \frac{E_2}{E_1}$
	Volume of water	Time	Discharge Q										
Unit →													
1													
2													
3													
4													
5													
6													

7.0 COMMENTS


1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
hj / E1
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
hL / E1
1
2
3
4
5
6
7
8
VALUE OF Fr1
ZONE OF DIRECT JUMP
ZONE OF UNDULAR JUMP

EXPERIMENT NO. 3:

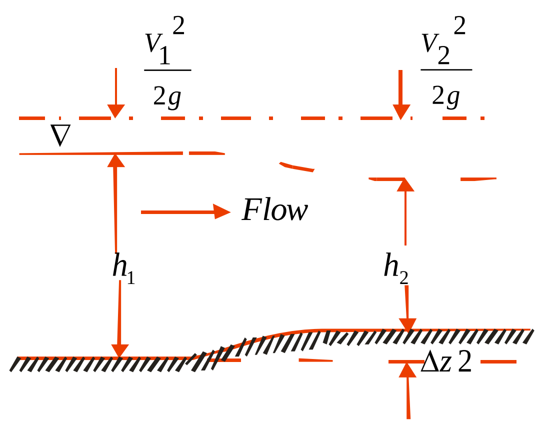
OBJECTIVE :

To study the flow over a hump placed an open channel.

APPARATUS :

Wooden humps with their flat surface on the flume bed are provided in the flume.

3.0 INTRODUCTION AND THEORY : Let a jump of small height Δz be placed on the bed of a rectangular channel carrying a discharge Q under uniform flow conditions. As a result of this, flow conditions in the vicinity of the hump are no more uniform. The specific energies E_1 and E_2 are related.



$$E_2=E_1-\Delta_Z \qquad (1)$$

Where,

$$E_1=y_1+\frac{V_1^2}{2g}$$

$$= h_1 + \frac{Q^2}{2gBh_1^2} \quad (2)$$

and $$E_2 = y_2 + \frac{V_2^2}{2g}$$

$$= h_2 + \frac{Q^2}{2gBh_2^2} \quad (3)$$

In which, B is the width of channel.

By increasing the value of Δz suitable, the flow conditions, for a given discharge, Q, over the hump can be made critical. Let this height be $(\Delta z)_{c}$. if Δz exceeds $(\Delta z)_{c}$, the flow conditions upstream will be modified and the flow conditions over the hump will be that of critical state. New conditions of flow on the upstream of hump will be given as,

$$E'_1 = E_C + \Delta z$$

Where, E'_1 is the new value of E_1 (4)

If Δz<(Δz)c the upstream conditions remain unaffected and Eq (3) holds good. If Δz = (Δz)c, the upstream condition remain unchanged but the flow over the hump is in critical state. Then,

$$E_2 = E_c = E_1 - (\Delta z)_c \quad (5)$$

EXPERIMENTAL PORCEDURE :

a. Establish uniform flow at a depth of about 10cm. in the flume by adjusting discharge and the tail gate position.
b. Measure the depth of flow at few stations from slightly upstream of the hump to the downstream of the hump along the centre line of the flume.
c. Place hump on the bed transverse to the flow leaving no gap between the flume boundary and the hump.
d. Take pointer gauge readings for surface and bed elevations at different stations upstream of the hump along the centre line of the flume.
e. Measure the discharge.

FIGURES TO PREPARE :

1. Plot the longitudinal water surface profile showing the hump on the bed.
2. Plot the specific energy curve E v/s h for discharge, Q using $E=h+(Q^2/2gA^2)$
3. Plot the experimental observations on E v/s h curve.

SAMPLE DATA SHEET :

Sn	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Depth h							
Velocity $V = \frac{Q}{Bh}$							
Specific Energy $E = h + \frac{V^2}{2g}$							

Conclusion: