

## Experiment No

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### Title: VERIFICATION OF BERNOULLI'S THEOREM APPARATUS

#### Introduction:

When an incompressible fluid is flowing through a closed conduit, it may be subjected to various forces, which cause change of velocity, acceleration or energies involved. The major forces involved are pressure and body forces. Due to elevation of conduits, pressure may change or due to change of cross section, velocity of fluid may change. But, though there is change of velocity, pressure also changes accordingly. In other words, if velocity energy of fluid is raised, its pressure will drop, i.e. total energy of fluid is constant at any two points in the path of flow. The theorem is known as Bernoulli's theorem. Hence, when applied to steady irrotational flow of incompressible fluids,

$$\frac{P}{w} + \frac{V^2}{2g} + Z = C$$

where,

P = pressure in N/m<sup>2</sup>

V = velocity at the point in m/s

Z = potential head from datum in m

#### APPARATUS:

The apparatus consists of a rectangular flow channel, which is tapered along the length. Flow area at inlet is maximum and it goes on reducing towards outlet. Water is fed to flow channel through a supply tank. Outlet is directly collected in measuring tank.

**EXPERIMENTAL PROCEDURE:**

1. Connect the water pipe to the inlet valve.
2. Reduce flow by inlet gate valve, so that there is only a small rise of water in the last pressure tapping.
3. Allow the levels to stabilize and note down the heads.
4. Close outlet valve of the measuring tank, and measure the time to rise water level by 10 cms.
5. Now, repeat the procedure by changing the discharge, and note the drop of head towards outlet for each observation.

**OBSERVATION TABLE**

Sr. No	<u>Head in cms</u> (Tapping no.)														Discharge time for 10 litres of water flow)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
1																
2																
3																

**CALCULATIONS:-**

(For observation No. )

Area of flow channel, A = m<sup>2</sup> ----- ( refer table )

1) Discharge,  $Q = \frac{A}{t}$  ----- m<sup>3</sup>/sec

2) Velocity of water,

$$V = \frac{Q}{A} = \text{----- m/sec}$$

Hence,

3) Velocity energy or head =  $\frac{V^2}{2g}$

4) Pressure head,

$$H = \frac{P}{w} \quad \text{----} \quad \text{Where, } w = \rho g \text{ in N}$$

$$\text{or } H = h + h_1$$

Where,  $h$  = Water rise from top channel,  $m$

$h_1$  = Distance from top of channel to its center (See chart)

5) Now, datum line is same at inlet and outlet.

$$\text{Hence, } Z_1 = Z_2 = Z_3 = 0$$

According to Bernoulli's equation,

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

or,

$$H_1 + \frac{V_1^2}{2g} + Z_1 = H_2 + \frac{V_2^2}{2g} + Z_2$$

as,  $Z_1 = Z_2$  for the channel,

$$H_1 + \frac{V_1^2}{2g} = H_2 + \frac{V_2^2}{2g} = C$$

Find out the value of  $C$  for each section (at same flow rate). It is same for all section

**Note-** Practically, value of 'C' goes on reducing slightly towards outlet, due to various factors which are not considered, e.g. friction, turbulence etc.,

### **CONCLUSION:-**

1. As value of 'C' is fairly constant, total energy of flow is same over the entire length.
2. As velocity of flow increases, pressure head drops.
3. Bernoulli's equation, i.e.

$$\frac{P}{w} + \frac{V^2}{2g} + Z = C \text{ is thus verified}$$

### **PRECAUTIONS:-**

1. Note down the head readings after the level has been stabilised.
2. After noting the discharge, drain the measuring tank.
3. After completion of experiment, drain all the water from the equipment.

**TABLE:**

Tapping Sr. No.	$h_1$ m	Area $m^2$
Inlet		$7.5 \times 10^{-4}$
1	0.03000	$7.2 \times 10^{-4}$
2	0.02925	$6.90 \times 10^{-4}$
3	0.02825	$6.60 \times 10^{-4}$
4	0.02700	$6.30 \times 10^{-4}$
5	0.02600	$6.00 \times 10^{-4}$
6	0.02525	$5.70 \times 10^{-4}$
7	0.02450	$5.40 \times 10^{-4}$
8	0.02325	$5.10 \times 10^{-4}$
9	0.02220	$4.80 \times 10^{-4}$
10	0.02150	$4.50 \times 10^{-4}$
11	0.02050	$4.20 \times 10^{-4}$
12	0.01950	$3.90 \times 10^{-4}$
13	0.01800	$3.60 \times 10^{-4}$
14	0.01750	$3.30 \times 10^{-4}$
outlet		$3.00 \times 10^{-4}$