MID-TERM REPORT ON

VIRTUAL LABS

UNDER THE GUIDANCE OF

Dr. Ramancherla Pradeep Kumar

Head, EERC, IIIT-HYD.

SUBMITTED BY

K.P.RAJESH

Roll no: 201011006

M.Tech (CASE-1)



INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY

HYDERABAD

(Deemed University)

FLUID-MECHANICS

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EXPERIMENT: 1) VERIFICATION OF BERNOULIS THEOREM

INRTRODUCTION: Most of the hydraulics studies are based on the principle of Bernoulli’s theorem. Verification of above principle experimentally helps in better understanding of the principles of hydraulics flow. The theorem is based on the law of conservation of energy. According to the Bernoulli’s theorem in an ideal incompressible steady and continues flow, the sum of the pressure energy ,potential energy, and the kinematic energy per unit weight of the fluid is constant.

OBJECTIVE**:**

To verify Bernoulli’s theorem

EQUIPMENT**:**

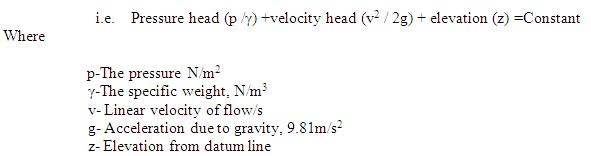
a) Apparatus for the verification of Bernoulli’s theorem.

b) measuring tank and

c) A stop watch

THEORY:

Bernoulli’s theorem states that for a stream lined, steady, frictionless and incompressible fluid flow, the sum of pressure head, velocity head and potential head is a constant



Water at constant head from a tank is allowed to flow through a horizontal pipe line of varying cross section. The pressure heads Hp1,Hp2, etc are noted from piezometers fitted at cross sections A1,A2Etc .By measuring the actual discharge ,the actual velocities of flow at A1,A2 etc are calculated.

The actual discharge Qa= ax h/t m3/s

Where

a-area of measuring tank in cm 2.

h-Level difference of water in the measuring tank in cm.

t-The mean time to collect water

The velocity of flow at the cross section A1 is given by

V1=Qa/A1

The velocity head is given by Hv1=V12/2g

Assuming that the pipe line has negligible frictional loss in flow, Bernoulli’s equation for the horizontal pipe at cross section A1 can be verified as:

Pressure head Hp1+ velocity head Hv1=constant

OBSERVATIONS**:**

Constants

* Measuring tank size, a m2
* The height (hm )for which the time t1 and t2 are noted to collect water in the measuring tank.
* The areas of cross section A1,A2, etc

Variables

* The piezometer readings HP1,HP2 etc in m of water
* Time tm seconds required to collect water for a height of hm in the measuring tank as mean value of readings t1 and t2

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sir no | h(m) | t1(s) | t2(s) | Qa(m3/s) | A(m2) | V(m/s) | He(m) | Hp(m) | Total |
| 1 |  |  |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |  |  |  |

MANUAL:

Start the experiment by pressing the start button with default values of discharge, length and depth of convergent and divergent passages and keep the values of collecting tank as fixed.

Observation 1:

1) The water should start flowing from the flow channels through inlet(conduit) and it should fill the balancing tank up to certain level .

2) Then water shall start flowing trough the convergent and divergent passage of rectangular cross sections, while flowing trough that sections, the level in the piezoometers start rising

Observation 2:

1) The level in the piezometer should be maintain constant to keep constant head.

2) After rising the flow in the piezometers, pressure head should be maintained at various cross sections of the conduit by scale provided on the piezometer.

Observation 3:

1) After measuring the pressure head water should start flowing from the outlet the to the collecting tank, then the collecting tank should be filled with water up to some height.

2) Then water shall start rising in the collecting tank with In 10cms rise of interval.

3) Note the time for collection of water to the rise of every 10cms in the collecting tank.

4) Change the discharge and size of the conduit (convergent and divergent) and repeat the experiment for different trials.

Graph: The graph of pressure head, on various cross sections. Take cross section area on x-axis.

Result: To verify the Bernoulli’s theorem by calculating total head

QUIZ:

* Bernoulli’s equation holds good for non ideal fluids
* True
* False
* The pressure head is given by
* P/γ
* V2/2g
* Incompressible ideal fluids are fluids which have constant density.
* True
* False
* If the flowing fluid medium is a real one then the difference in Bernoulli’s theorem is to add the head loss.
* True
* False
* Is the Bernoulli’s theorem is applicable to gases and vapors too.
* True
* False
* Are the datum pressure, velocity energies inter compatible
* True
* False
* A flow in which fluid particles do not rotate about there mass centers and retains their original orientation is called irrigational flow.
* True
* False
* There is a difference in the energy level between the supply reservoir and that at the fluid pressure top location.
* True
* False
* Calculation of velocity head at various sections along the conduit using the average velocity at that section is
* True
* False
* Bernoulli’s theorem deals with law conservation of momentum
* True
* false

REFERENCES:

* Fluid mechanics - Dr.R.K.Bansal
* Experiments in fluid mechanics - Sarabjit Singh
* Wikipedia

EXPERIMENT: 2)CO-EFFICIENT OF DISCHARGE OF AN ORIFICE -METER

INTRODUCTION: An orifice is an opening in the side or bottom of a vessel or a tank, through which the liquid will flow under the condition that the liquid surface is always above the top edge of the opening. The orifices are used for the measurement of flow of liquids. The measurement of flow depends on the velocity of flow liquid and the form in which liquid d flows.

In an orifice the liquid flows in the form of a jet caused by the opening of the orifice, and the velocity of flow is caused due to conversion of pressure energy of liquid in to kinetic energy.

OBJECTIVE:

To determine the coefficients of discharge (Cd) for the given orifice meter

GRAPHS:

A Vs

A Vs h

Taking h and on x-axis A on y- axis.

EQUIPMENT:

a) Measuring tank of Size 0.6 x 0.6 x 0.8 meter with overflow arrangement, gauge glass, scale arrangement and a drain valve.

b) Stop Watch.

c) Orifice meters fitted onto horizontal pipes of diameters 20mm, 25mm and 40mm with pressure tapping’s and gate valves to regulate flow rate.

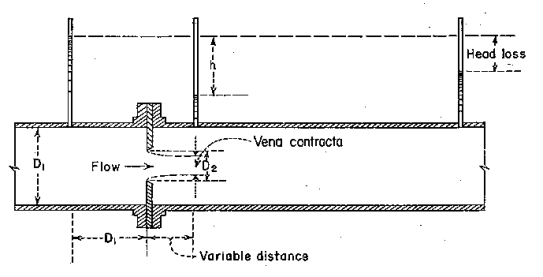
d) Differential mercury manometer with wooden scale of 1m length and scale graduations of 1mm to measure the loss of head.

e) The orifice diameter corresponding to the pipe diameters are as follows:

|  |  |  |
| --- | --- | --- |
| Sir no | Pipe diameter(mm) | Orifice diameter(mm) |
| 1 | 20 | 13.41 |
| 2 | 25 | 16.77 |
| 3 | 40 | 26.83 |

THEORY:

Orifice meter or orifice plate is a device used for measuring the rate of flow of a fluid through a pipe. It works on the same principle as a venturimeter. It consists of a flat circular plate which has a circular sharp edged hole called orifice. It is an opening in the side or bottom of a vessel or a tank through which liquid will flow under the condition that the liquid surface is always above the top edge of the opening. The orifice diameter is 0.5 times the diameter of the pipe. A differential manometer is connected at section 1 which is at a distance of about 1.5 to 2 times the pipe diameter upstream from the orifice plate, and at section 2, which is at a distance of about half the diameter of the orifice on the downstream side from the orifice plate.



**CO-FFICIENT OF DISCHARGE:**

**the actual discharge,**

image9.png

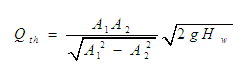
Where

a – Area of measuring tank in cm2

h – Height differences in pyrometer in cm.

t – Time to collect water for a height difference of h cm, measured in seconds.

Theoretical discharge,



Where

A1 – The area at inlet side in cm2

A2 – The area at throat in cm2

Hw - Head difference in the manometer, converted to cm of water.

g – Acceleration due to gravity (9.81).

Coefficient of discharge,

image11.png

OBSERVATIONS:

CO-FFICIENT OF DISCHARGE :

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Sl**  **No** | **Manometer readings in (cm)**  **Hug** | | **Head loss in cm of water h=(H1-H2)** | **Time taken for 10 cm rise of water in sec (t)** | **Actual discharge (A) in m3/sec** | **Theoretical discharge (Qt) in m3/sec** | **Co-efficient of discharge (Cod)** |
| **H1** | **H2** |
| 1 |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |  |

MANUAL:

Start the experiment by pressing start button with default values of dia of orifice and size of collecting tank, and discharge then pass the experiment after few cycles and note the observation.

Observation 1:

1) After pressing the start button, water should allow to flow in to the balancing tank through the inlet and it should fill up to level of orifice. Maintain a steady head in the balancing tank.

2) After filling of water in the balancing, the water level of pyrometer is slightly increasing then measure the pressure head

Observation 2:

1) After the balancing tank is filled up to certain height the water shall start flowing in to the collecting tank through the orifice.

2)Measure the head causing flow in the collecting tank.

Observation 3:

1)Note the time taken for rise of water in collecting tank for certain interval.

2)Repeat the procedure by changing the die of orifice and discharge and head causing flow.

### MAINTENANCE:

1. After completing the experiment close the inlet valve and open all the gate valves & needle valves then close them.
2. Drain the water from measuring tank after completing the experiment

#### RESULT:

The coefficient of discharge Cod=

QUIZ:

1. Venacontracta is at a distance of half the diameter of the orifice
2. True
3. False
4. The orifice diameter is 0.5 times the diameter of the pipe
5. True
6. False
7. The principle of orifice meter is different from that of the venturimeter
8. True
9. False

4) The approximate distance of venacontracta from the centre of orifice is d

1. True
2. False

5) The standard values of Cod ranges from (0.85-0.99)

1. True
2. False

REFERENCES:

1. FLUID MECHANICS- RK BANSAL
2. EXPERIMENTS ON FLUID MECHANICS- SARABJIT SINGH
3. WIKIPEDIA
4. The constructor- http://theconstructor.org/

EXPERIMENT: 3)CO-EFFICIENT OF DISCHARGE OF AN MOUTH – PIECE

INTRODUCTION: A mouth piece is a short length of the pipe about three times its diameter connected to the face of an orifice, which is provided in the side or bottom of the vessel. It is used for the measurement of discharge of large quantities of liquid since, the rate of discharge through a mouth piece will be more than that of an orifice, for the same diameter and head.

OBJECTIVE:

To determine the coefficients of discharge (Cod) of the given mouth piece .

GRAPHS:

Qa Vs

Qa Vs h

Taking h and on x-axis A on y- axis.

EQUIPMENT:

* Mouth piece fitted to a balancing tank.
* Piezometer, to measure the head of water.
* Meter scale, to measure the internal dimensions of the collecting tank.
* Calipers to measure the internal diameter of the mouth piece.
* Stop watch to measure the time of collection of discharge for known rise of water level in the collecting tank.
* collecting tank with control valve to collect the water.

THEORY:

It is used for the measurement of discharge of large quantities of liquid since, the rate of discharge through a mouth piece will be more than that of an orifice, for the same diameter and head.

The test rig consists of a mouthpiece fitted to a tank along with piezometer . The liquid is allowed to flow through the mouth piece and the liquid from the mouth piece is colllected in the collecting tank fitted with piezometer to measure the rise of the liquid level.

**Observations and tabulations:**

Diameter of mouthpiece , d = mm

Internal plan dimension of collecting tank

Length of collecting tank , L= mm

Width of collecting tank , B= mm

Area of collecting tank , A=LXB = mm

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Slyly** | **HEAD**  **(h)**  **mm** | **Time ‘t’ for’s’ mm of rise in collecting tank** | | |  | **Actual discharge (A) in m3/sec** | **Theoretical discharge (Qt) in m3/sec** | **Co-efficient of discharge (Cod)** |
| **T1** | **T2** | **avgas** |
| 1 |  |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |  |  |

**Mean value of Cod=**

**Specimen calculations**

Area of mouth piece , a = =

Actual discharge , Q= =

Theoretical discharge , = A =

Coefficient of discharge =

g – Acceleration due to gravity (9.81).

MANUAL:

Start the experiment by pressing start button with default values of die of mouthpiece and size of collecting tank, and discharge then pass the experiment after few cycles and note the observation.

Observation 1:

1) After pressing the start button, water should allow to flow in to the balancing tank through the inlet and it should fill up to level of mouth piece. Maintain a steady head in the balancing tank.

2) After filling of water in the balancing, the water level of piezometer is slightly increasing then measure the pressure head

Observation 2:

1) After the balancing tank is filled up to certain height the water shall start flowing in to the collecting tank through the mouth-piece.

2)Measure the head causing flow in the collecting tank.

Observation 3:

1)Note the time taken for rise of water in collecting tank for certain interval.

2)Repeat the procedure by changing the die of orifice and discharge and head causing flow.

**RESULT:**

* The Value of coefficient of discharge =

QUIZ:

* Coefficient of mouth piece is better than orifice
* true
* false
* Location of vena contracta is d/2
* true
* false
* A mouth piece is a short length of the pipe where 3times its diameter is connected to the face of an orifice.
* true
* false
* The rate of discharge of an mouth piece is more than that of orifice
* true
* false
* The approximate distance of venacontracta from the centre of mouthpiece is d
* true
* false

REFERENCES:

* FLUID MECHANICS- RK BANSAL
* EXPERIMENTS ON FLUID MECHANICS- SARABJIT SINGH
* WIKIPEDIA
* The constructor- <http://theconstructor.org/>