INSTITUTE OF TEXTILE TECHNOLOGY, CHOUDWAR

ME LAB - II MANUAL

4th Semester

Branch: Mechanical

MANORANJAN PANDA
MECHANICAL INSTRUCTOR
4th Semester

AIM:

Study of 2-S, 4-S petrol & diesel engine models.

INTRODUCTION AND THEORY:

A heat engine is a device, which Converts the chemical energy of a fuel into thermal energy and uses this energy to produce mechanical work. Heat engines are classified into two broad types.

Any type of engine or machine, which derives heat energy from the combustion of fuel or any other source and converts this energy into mechanical work, is termed as a **heat engine**.

1. EXTERNAL COMBUSTION ENGINES &
2. INTERNAL COMBUSTION ENGINES.

INTERNAL COMBUSTION ENGINES:

Internal combustion engine in which the combustion of fuel takes place inside the cylinder is known as I.C. Engine. In an internal combustion engine, the products of combustion are directly the motive fluid.

Diesel engine and petrol engine are the examples of this type, where the working substance is the product of combustion.

Reciprocating Internal combustion Engines offers following Advantages over External Combustion Engines:

- Overall Efficiency is High.
- Greater Mechanical Simplicity.
- General Lower Initial cost.
- Easy Starting from Cold conditions.
- These Units are Compact and Thus Require less Space.
- Weight to Power Ratio is Generally Lower.

I.C. ENGINE CLASSIFICATION

The I.C. engine can be classified on the following basis

- **WORKING CYCLE**
  - (a) Spark Ignition Engines
  - (b) Compression Ignition Engines
- **NO. OF STROKES**
  - (a) Two Stroke Engines
  - (b) Four Stroke Engines

PARTS COMMON TO BOTH PETROL AND DIESEL ENGINE

1. CYLINDER
2. CYLINDER HEAD
3. PISTON
4. PISTON RINGS
5. GUDGEON PIN
6. CONNECTING ROD
7. CRANKSHAFT
8. CRANK
9. ENGINE BEARING
10. CRANK CASE
11. FLYWHEEL
12. GOVERNOR
13. VALVE AND VALVE OPERATING MECHANISMS

PARTS FOR PETROL ENGINES ONLY

1. SPARK PLUGS
2. CARBURETTOR
3. FUEL PUMP

PARTS FOR DIESEL ENGINE ONLY

1. FUEL PUMP
2. INJECTOR

CYLINDER: The Cylinder Contains Gas under Pressure and Guides the Piston. It is in direct contact with the Products of Combustion and it must be cooled. It is one of the most important part of the engine in which the piston moves to and fro in order to develop power. Generally, the engine cylinder has to withstand a high-pressure and temperature more than 2000^0C.The Cylinder is made of hard Grade Cast Iron and is Usually cast in One Piece.

Engine bodies are designed of STEEL ALLOYS or ALUMINIUM ALLOYS.

CYLINDER HEAD: Head is an arrangement which covers cylinder bore and consists of suction and exhaust valves. Cylinder and Cylinder head are made from the same material, usually cast as one piece.

The Main function of Cylinder head is to seal the working ends of the Cylinder and not to Permit entry and exit of Gases on cover head valve engines.

PISTON: Piston is the heart of an engine whose main function is to transmit the force exerted by the burning of charge to connecting rod. A Piston is fitted to each Cylinder as a face to receive gas Pressure and transmit the thrust to the Connecting Rod

PISTON RINGS: Piston rings are housed in the circumferential grooves provided on the outer surface of the piston. Two sets of rings are used generally.

The function of upper ring is to provide airtight seal to prevent leakage of burnt gases in to the lower piston. Similarly, the function of lower ring is to provide effective seal to prevent leakage of the oil ring in to the engine cylinder.

CONNECTING ROD: It is a link between the piston and crankshaft.

Function - To Transmit force from the piston to the crack shaft. Reciprocating motion is converted in to circular motion of crack shaft.

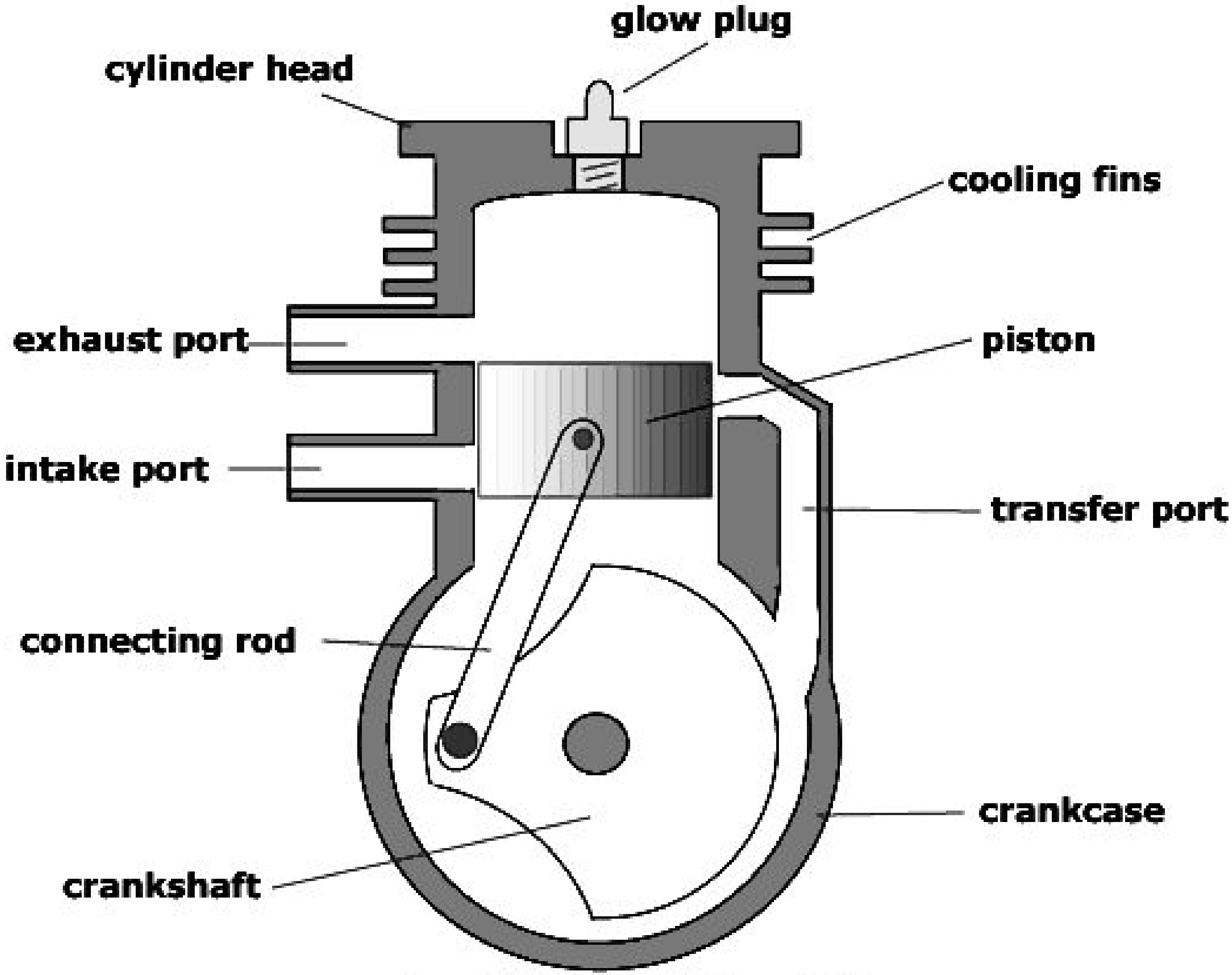
A special care is to be taken while designing the crankshaft, as it is subjected to alternatively compressive and tensile stresses, as well as bending stresses. A connecting rod is made of special steel alloys or aluminum alloys.

CRANK SHAFT: Crankshaft is the back of an engine. It consists of one or more eccentric portions called cranks. That part of the crank, to which bigger end of the connecting rod is fitted, with the help of crank pin.The Crank Shafts of an Internal combustion Engine receive via its cranks the Efforts supplied by the Pistons to the connecting Rods. The Shape of the Crankshafts i.e. the mutual arrangements of cranks depends on the numbers and arrangements of Cylinders and the Turning Order of the engine.

CRANK CASE: It holds the cylinder and crankshaft of an engine. It also serves as a sump for the lubricating oil.

FLYWHEEL: A wheel mounted on the crankshaft, whose function is to maintain its speed constant. It is done by storing excess energy during the power stroke, which is returned during other strokes.

The weight of the Flywheel depends on the Nature of variation of the Pressure.


glow plug
cylinder head
cooling fins
exhaust port
piston
intake port
transfer port
connecting rod
crankcase
crankshaft

Determine the brake thermal efficiency of single cylinder petrol engine.

A) ENGINE

1) MAKE –Engine **BAJAJ MAKE**

2) SPEED – 800-6000 RPM

B) ELECTRICAL DYNAMOMETER -

A Electrical Dynamometer consist of alternator of 2 KW Capacity and Lading Rheostat to Load the engine.

C) AIR INTAKE MEASUREMENT:

Intake tank fitted with orifice and water manometer.

D) FUEL INTAKE MEASUREMENT:

Calibrated Burette arrangement fitted on the control panel to measure the fuel consumption with 2 Nos. Ball valves to control and measure the quantity of fuel consumed.

E) EXHAUST GAS CALORIMETER:

Water-cooled exhaust gas calorimeter, shell and coil type to study the heat lost to exhaust gases. Water flows inside the copper tubes and exhaust Gases flows into the shell.

PROCEDURE

- Ensure that all the Nut bolts are Tight.
- Start the engine: - To start the Engine Kick start the Engine.
- First, measure the speed of the engine with the Help of Tachometer (Not supplied along with this Unit)
- Then measure the time required for consumption of Fuel.
- Then take the reading of manometer and Temp indicator.
- Thus take all these reading by increasing load by Holding down the Knife Switch.
- Note Down all the readings in the Observation Table.

OBSERVATIONS

1) **Specific gravity of fuel (c) -** 0.75

2) **Calorific value of fuel** - 42500 KJ / kg.

3) **Dia of Orifice** - 18 mm.

4) **Coefficient of discharge of orifice meter (C_d) -** 0.62.

5) **Density of air (Pa)** - 1.207 kg/m^3

OBSERVATION TABLE

S.NO.	*Manometer Difference H1-H2 (Meters)*	*Fuel Consumption For 10 ml*	*N (RPM)*	*Load on the Engine (Kw)*
1.				

CALCULATIONS

1. BRAKE POWER: -

$$B.P = \frac{2 B \times N T}{60{,}000} \text{ KW} \qquad = \text{Load on the Engine in KW.}$$

2. TOTAL FUEL CONSUMPTION: - KG/SEC.

$$TFC = \frac{\text{FINAL READING} - \text{INITIAL READING}}{\text{TIME}} \times \frac{\text{SP.GRAVITY}}{1000}$$

WHERE: -

TIME IS IN SECOND

SP GRAVITY OF FUEL = 0.75

$$TFC = \frac{C\,C\ (ml)}{Time} \times \frac{Sp\ Gravity}{1000} \text{ KG/S}$$

3. BRAKE THERMAL EFFICIENCY: -

$$= \frac{BP}{TFC \times CV} \times 100$$

BP IN KW
TFC IN Kg/SEC
CV= 44000 KJ /Kg

4. AIR FUEL RATIO

$$= \frac{\text{MASS OF AIR CONSUMED IN UNIT TIME}}{\text{MASS OF FUEL CONSUMED IN UNIT TIME}} = \frac{Ma}{Mf}$$

MASS OF AIR $Ma = Q \times p_a$

$Q = C_d A \sqrt{2g\, h_a}$

WHERE $C_d = 0.62$

A = AREA OF ORIFICE METER M^2
g = 9.81
DIA. OF ORIFICE = 18 mm

$$h_a = \frac{p_w \times H_w}{p_a} \text{ m}$$

$H_W = H_1 - H_2$

WHERE

p_w = DENSITY OF WATER = 1000

H_w = MANOMETER READING (mtrs)

p_a = DENSITY OF AIR = 1.178

MASS OF AIR $Ma = Q \times p_a$

Conclusion

TESTING OF I.C. ENGINE:

An internal combustion engine is put to the thermodynamic tests, to determine the following quantities.

1) POWER AND MECHANICAL EFFICIENCY:

The main purpose of running an engine is mechanical power. Power is defined as the rate of doing work and linear velocity or the products of torque and angular velocity. Thus, the measurement of power involves the measurement of force (Torque) as well as speed. The first is done with the help of dynamometer, and latter by a tachometer or by some other suitable device.

The power developed by an engine at the out shaft is called the brake power (B.P.) and is given by -

$$\textbf{B.P.} = 2\pi N T$$

Where,

T is torque Nm

N is rotational speed in rev / sec.

T = W x R.

Where, W = 9.81 x Net mass in kg applied.

R = Radius in m.

The total power developed by combustion of fuel in the combustion chamber is however more than the B.P. and is called indicated power. Some is consumed is overcoming friction between moving parts, some in the processes of inducting the air and exhausting the products of combustion from the engine combustion chamber.

Indicated power is the power developed in the cylinder and thus forms the basis of evolution of combustion efficiency or the heat release in the cylinder.

The difference between I.P. and B.P. is the induction of the power lost in the mechanical components of the engine and forms the basis of mechanical efficiency, which is defined as follows and given on the next page.

1) MECHANICAL EFFICIENCY: - B.P. / IP.

The difference between I.P. & B.P. is called friction power (F.P.)

F.P. = I.P. - B.P.

Mechanical Efficiency -B.P. / (B.P. + F.P.)

2) VOLUMETRIC EFFICIENCY:

It is defined as the ratio of the mass of air inducted in to the engine cylinder during the suction stroke to the mass of air corresponding to the swept volume of the engine at atmospheric temperature and pressure.

Alternatively, it can be defined as the ratio of the actual volume inhaled during suction stroke measured at intake conditions to the swept volume of the piston.

3) FUEL - AIR RATIO (F/A):

Fuel air ratio is the ratio of the mass of air in the fuel air mixture. Air fuel ratio is the reciprocal of the fuel air ratio.

4) SPECIFIC FUEL CONSUMPTION - (S F C) :

Specific fuel consumption is defined as the amount of fuel consumed per unit of power developed per hour.

S. F. C. = FUEL CONSUMED IN GRAMS PER HOURHORSE POWER DEVELOPED

5) BRAKE SPECIFIC FUAL CONSUMPTION (BSFC):

BSFC is determined based on brake out put of the engine while indicated specific fuel consumption (ISPC) is determined based on indicated out put of the engine.

6) THERMAL EFFICIENCY:

Thermal efficiency of an engine is defined as the ratio of the out put to that of the chemical energy input in the from of fuel supply. It may be based on brake or indicated out put.

DETAILED SPECIFICATION OF TEST RIG :

A) ENGINE

1) MAKE – Brand New Assemble Engine Double Cylinder
2) SPEED – 1500 RPM with Governor Mechanism.

B) ELECTRICAL DYNAMOMETER -

An A.C. Alternator is coupled to the Engine connected with Load Bank.

C) AIR INTAKE MEASUREMENT:

Air Intake tank fitted with orifice and water manometer.

D) FUEL INTAKE MEASUREMENT:

Calibrated Burette arrangement fitted on the control panel to measure the fuel consumption with 2 Nos. Ball valves to control and measure the quantity of fuel consumed.

E) EXHAUST GAS CALORIMETER:

Water-cooled exhaust gas calorimeter, shell and coil type to study the heat lost to exhaust gases. Water flows inside the copper tubes and exhaust Gases flows into the shell.

PROCEDURE

- Adjust the flow rate of water for calorimeter and Engine jacket.
- Start the engine
- First, measure the speed of the engine with the Help of Tachometer (Not supplied along with this Unit)
- Then measure the time required for consumption of Fuel.
- Measure the flow of cooling water from calorimeter from engine jacket with the Help of a measuring Flask.
- Then take the reading of manometer and Temp indicator.
- Thus take all these reading by increasing load.
- Note Down all the readings in the Observation Table.

OBSERVATIONS

1) **Specific gravity of fuel (c) -** 0.76

2) **Calorific value of fuel -** 44000 KJ / kg

3) **Dia of Orifice -** 25 mm

4) **Coefficient of discharge of orifice meter (C_d) -** 0.62

5) **Density of air (Pa)** - 1.207 kg/m^3

6) **Specific heat of water** - 4.2 kJ/Kg^{0}k

7) **Specific heat of exhaust gas** – 1.05 KJ/kg/ ^{0}C

8) **Water ambient temp. =** __________ ^{0} C

9) **Air ambient temp.** = __________ ^{0}C

OBSERVATION TABLE

S.NO.	*Manometer Difference H1-H2 (Meters)*	*Fuel Consumption For 10 ml*	*Water Flow rate Engine Jacket (Kg/Sec.)*	*Water Flow rate Calorimeter (Kg/Sec.)*
1.				

S.NO.	*T1 ^0C*	*T2 ^0C*	*T3 ^0C*	*T4 ^0C*	*T5 ^0C*	*T6 ^0C*
1.						

CALCULATIONS

1. BRAKE POWER: -

B.P = Load on the engine (KW) = __________ KW

2. TOTAL FUEL CONSUMPTION: - KG/SEC.

$$TFC = \frac{\text{FINAL READING} - \text{INITIAL READING}}{\text{TIME}} \times \frac{\text{SP.GRAVITY}}{1000}$$

Where,

TIME IS IN SECOND

SP GRAVITY OF FUEL = 0.76

$$TFC = \frac{\text{C C (ml)}}{\text{Time}} \times \frac{\text{Sp Gravity}}{1000} \text{ KG/S}$$

3. BREAK SPECIFIC FUEL CONSUMPTION

$$= \frac{TFC}{BP} \times 3600 \text{ Kg/ Kw. Hr.}$$

Where,
TFC IN Kg/Hr
BP IN KW.

4. BRAKE THERMAL EFFICIENCY: -

$$= \frac{BP}{TFC \times CV} \times 100$$

BP IN KW
TFC IN Kg/SEC
CV= 44000 KJ /Kg

5. AIR FUEL RATIO

$$= \frac{\text{MASS OF AIR CONSUMED IN UNIT TIME}}{\text{MASS OF FUEL CONSUMED IN UNIT TIME}} = \frac{Ma}{Mf}$$

MASS OF AIR $Ma = Q \times p_a$

$Q = C_d A \sqrt{2g}\, h_a$

WHERE $C_d = 0.62$

A = AREA OF ORIFICE METER M^2
g = 9.81
DIA. OF ORIFICE = 25 mm

$$h_a = \frac{p_w \times H_w}{p_a} \text{ m}$$

$H_W = H_1 - H_2$

WHERE

p_w = DENSITY OF WATER = 1000

H_w = MANOMETER READING (mtrs)

p_a = DENSITY OF AIR = 1.178

MASS OF AIR $Ma = Q \times p_a$

Conclusion

List of Experiment

1.Study of Bernoulli's Theorem

EXPERIMENT NO.1

Aim: Study of Bernoulli's Theorem.

System Components:

- Sump Tank.
- Mono-Block Centrifugal Pump.
- Constant Head Tank -
- Venturi Tube made of transparent Acrylic.
- Piezometer Panel consisting of transparent tubes mounted on a graduated screen

Procedure:

1. Connect the power plug to electric board.
2. Ensure that control valve is adjusted to fully open
3. Fill the sump tank with water.
4. Ensure that the two ends of the Venturi apparatus is connected properly to the constant tanks with the coupler provided.
5. Switch on the electric power supply of Electric Board.
6. Partially 'Close' the By pass valve so that water flows into the constant head tank.
7. Adjust Flow Control valve and Discharge valve to maintain constant water level in Constant head tank.

8. Allow the water to flow through the apparatus (Venturimeter).
9. Remove the air bubbles from Peziometer tubes using Blood Pressure bulb.
10. Close the Drain valve provided at the bottom of measuring tank.
11. Measure time required for increase in water level.
12. Note down the readings in the observation table.
13. Calculate the result as per the calculation procedure.
14. Repeat the above procedure for different head and flow rates.
15. Switch off the Electric supply at motor & mains.

6. OBSERVATION TABLE

Sr. No	Section diameter D (mm)	Pressure head (mm of water)	Increase in water level of measuring tank	Time required (T)
1	25.3			
2	20.1			
3	17.4			
4	14.5			
5	15.2			
6	16.9			
7	18.6			
8	20.4			
9	22.1			
10	24			
11	25.3			

CALCULATION PROCEDURE

1) **Total Head =** $\frac{P}{\rho g} + \frac{v^2}{2g}$

Where $P / \rho g$ = h meters of water column.

z_1 is constant for all the venture- tapings.

2) Pressure Head

Pressure Head = $\frac{P}{\rho g}$ = h meter.

3) Velocity Head:

Discharge = $\frac{\text{Area of Measuring Tank X height}}{\text{Time difference between above readings x 1000}}$ m3/sec

Where,

Area of Measuring tank = 550X340mm^2

Velocity of flow = $\frac{\text{Discharge}}{\text{Area of cross section at particular point}}$ m / sec

Velocity head = $\frac{V^2}{2g}$ in meters = ---------------- meters

Where g = 9.81

RESULT TABLE

Sr. No.	Section diameter D (m)	Area of c/s (m^2)	Discharge (m^3 /sec)	Velocity of flow v (m/sec)	Velocity head (m)	Pressure head h (m)	Total head H (m)
1	25.3						
2	20.1						
3	17.4						
4	14.5						
5	15.2						
6	16.9						
7	18.6						
8	20.4						
9	22.1						
10	24						
11	25.3						

CONCLUSION:

From the Result Table it can be verified that the Total head is almost equal at all sections of venture.

VENTURIMETER & ORIFICEMETER SET-UP

1. **OBJECTIVE:-** To demonstrate the use of Venturimeter & Orifice meter as flow Meter.
2. **AIM:-** To determine the Co-efficient of Discharge C_d for Venturimeter.
   To determine the Co-efficient of Discharge C_d for Orificemeter.
3. **INTRODUCTION:-** If a constriction is placed in closed carrying a stream of fluid, there will be increase in velocity, and hence increase in Kinetic Energy, at the constriction, from an energy balance, Rate of discharge from the constriction can be calculated by knowing this pressure reduction, the area available for flow at the constriction, the density of fluid, and the Co-efficient of discharge. The last named is defined as the ratio of actual flow to the theoretical flow.
4. **THEORY:-**

VENTURIMETER

A VENTURIMETER consists of:

(a) An Inlet Section followed by a convergent cone.

(b) A Cylindrical Throat.

(c) A gradually divergent cone.

The Inlet Section of the Venturimeter is to the same dameter as that of the pipe, which is followed by a convergent cone. The convergent cone is a short pipe, which tapers from the original size of the pipe to that of the Throat of the Venturimeter. The Throat of the Venturimeter is a short parallel side tube having its cross- sectional area smaller than that of the pipe. The divergent cone of the Venturimeter is gradually diverging pipe with its cross- sectional area increasing from that of the Throat to the original size of the pipe. At Inlet Section & Throat of the Venturimeter, Pressure taps are provided.

5. **DESCRIPTION:-** The apparatus consists of a Venturimeter and an Orifice meter, fitted in pipeline. The pipeline is taken out from a common inlet. At the downstream end of the pipeline, separate control valves are provided to regulate the flow through the Venturimeter and Orifice

6. UTILITIES REQUIRED:

(a) Electric supply: Single Phase. 220 Volts. 50 Hz 5 Amp.

(b) Water Supply (Initial Fill)

(c) Drain Required.

(d) Space required : 1.5 m x 1m

7. EXPERIMENTAL PROCEDURE:

Starting Procedure

(a) Clean the apparatus and make All Tanks free from Dust.

(b) Close the drain valves provided

(c) Fill Sump tank ¾ with clean water and ensure that no foreign particles are there.

(d) Close all Flow Control Valves given on the water line and open By- Pass valve.

(e) Close all Pressure Taps of Pressure Gauges connected to Venturimeter & Orifice meter.

(f) Now switch on the Main Power Supply.

(g) Switch on the Pump.

(h) Operate the Flow Control Valve to regulate the flow of water in the desired Test Section.

(i) Measure the flow of water, discharged through desired test section.

(j) Repeat Steps (j) to (p) for different flow rates of water, operating Control Valve and by-Pass Valve.

(k) When experiment is over for one desired test section, open the By-Pass Valve fully. Then close the flow control valve of running test section and open the Control valve of secondly desired test section.

8. SPECIFACTION:-

Venturimeter	:	Material Clear Acrylic compatible to 1" Pipe.
Orifice meter	:	Material Clear Acrylic compatible to 1" Pipe
Water circulation	:	FHP Pump.
Flow Measurement	:	Using Measuring Tank with Piezometer,
Sump Tank	:	Material SS.

The whole set-up is well designed and arranged in a good quality painted structure.

9. FORMULE:-

FOR BOTH VENTURIMETER & ORIFICEMETER:

(a) Head loss :

$$H = (P1 - P2) \times 10 \times (13600/1000) = \text{------}m$$

(b) Theoretical discharge:

$$Q_t = \frac{a_1 a_2 \sqrt{2gH}}{\sqrt{a_1^2 - a_2^2} \times 100} \; m^3/s \quad = \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \sqrt{2gH}$$

(c) Actual Discharge:

$$Q_a = \frac{A \times R}{t \times 100} \; m^3/s$$

(a) Co-efficient of discharge,

$$C_d = \frac{Q_a}{Q_t}$$

10. OBSERVATION & CALCULATION:

Data:

A	=	$0.1\ m^2$
g	=	$9.81\ m/sec^2$
pm	=	$13600\ kg/m^3$
pw	=	$1000\ kg/m^3$
P1	=	Inlet Pressure at Venturimeter/ Orifice meter.
P2	=	Throat/Outlet Pressure at Venturimeter / Orificemeter.

FOR VENTURIMETER:

d_1	=	0.028 m
d_2	=	0.014 m
a_1	=	6.157×10^{-4} m2
a_2	=	$1.539 \times 10^{-4}\ m^2$

FOR ORIFICEMETER:

d_1	=	0.028 m
d_2	=	0.014 m
a_1	=	6.157×10^{-4} m2

$a_2 = 1.539 \times 10^{-4}\ m^2$

OBSERVATION TABLE:

S.No.	h(cm)	R (cm)	T (sec.)

CALCULATION TABLE:

S.No.	H(m)	$Q_a(m^3/s)$	$Q_t(m^3/s)$	$C_d = Q_a/Q_t$

11. NOMENCLATURE:

A=Area of Measuring Tank, m^2

a_1= Area at inlet of Venturimeter and orifice meter, m^2

a= Cross-section area at test point, m^2

E=Total energy.

g= Acceleration due to gravity, m/s^2

h=Presser Head m of water.

P=Pressure of fluid.

Q= Discharge through test section, m^3/s

R= Rise of water level in measuring Tank. m.

R_1=Final height of water in Measuring Tank after time t. cm.

R_2=Initial height of water in Measuring Tank. Cm.

t= Time taken for R (sec)

V= Velocity of fluid, m/s

Conclusion

MANUAL

OF

Cc, Cv, Cd

EXPERIMENTAL

SET UP

OPERATIONAL MANUAL

PROCEDURE:

⇒ Fill the storage tank with the water.

⇒ Connect the plug to the power supply cable.

⇒ Make sure that bypass valve is fully open and the control valve is fully closed.

⇒ Switch On the pump.

⇒ Keep the delivery valve open and 25% close the bypass valve (If necessary) to have maximum flow rate through the open Tank.

⇒ Wait for the steady state to achieve.

⇒ Keep the drain valve of the collection tank open till its time to start collecting the water.

⇒ Close the drain valve of the collection tank and note down the initial level of the water in the collection tank and also the height of liquid over the Orifice.

⇒ Collect a known quantity of water in the collection tank and note down the time required for the same.

⇒ Change the flow rate of water through the open Tank with the help of delivery valve and repeat the above procedure.

⇒ Take about 2-3 readings for different flow rates.

SHUT DOWN PROCEDURE:

⇒ Switch Off the pump.

⇒ Initially close all the pressure tapings and manometer taping cocks.

⇒ Remove any excess water or air from the system by opening the manometer cocks.

⇒ Now shut all the supply control valves of the respective flow meters.

⇒ Drain the measuring tank with the help of drain valve provided at the bottom of the tank.

⇒ Drain the supply tank with the drain valve provided at the bottom of the tank.

⇒ Close dust cover of the domestic flow meter.

PRECAUTIONS OF CC, CV, CD EXPERIMENTAL SET UP:

⇒ Do not transfer the equipment once it is fixed on a leveled surface of the laboratory.

⇒ Take care of the flow meters fitted on the center of the equipment.

⇒ Take cares of the Mercury filled glass tube Manometer.

⇒ Take care of glass level tube of measuring tank.

⇒ Always drain the tank after the experiment.

⇒ Do not open the supply valve when the pump is not started.

⇒ Open the supply valve only after fully opening the bypass valve.

⇒ Control the Bypass valve so that flow rate of water can be available through supply valve.

⇒ Do not disturb the manometer position during the experiment or after the experiment is over.

⇒ Make sure that the pressure tapings of meters and vent cocks of manometer are simultaneously opened. If only higher-pressure side or lower pressure side taping is opened then Mercury of the Manometer may get overflowed because of high-pressure drop.

⇒ Do not touch the mercury in hand or any body part.

Apply standard joints / M-seal in case of leakages

The equipment is set on the bench. The flexible supply pipe from the bench control valve is connected to the inlet pipe of the apparatus. The overflow line from the bottom of the tank is connected to the liquid level adjuster and is then directed to the bench top. Orifice is fixed at the discharge of the tank.

Water is admitted to the tank to allow it to fill to the height of the overflow pipe. The inflow is regulated so that a small steady discharge is obtained from the overflow, thus ensuring that the level in the tank remains constant while the measurements are made. To measure C_d, timing the collection of a known weight of water in the measuring tank, and noting the head H_0 above the contracted section establish the discharge rate.

It is advisable to read H_0 several times while the discharge is being collected, and to record the mean value over the timed interval. About eight different flow rates should be sufficient to establish the relationship between discharge rate Q and head H_0.

OBSERVATION:

CONCLUSION:

RESULTS AND CALCULATIONS:

- ⇒ Type of Orifice : Sharp Edged
- ⇒ Diameter of orifice :D_0 =12.5 mm
- ⇒ Cross sectional area of orifice :A_0 = cm^2
- ⇒ Head above the contracted section :H_0 = cm
- ⇒ Time required to collect water := s
- ⇒ Discharge rate Q := cm^3/s
- ⇒ Coefficient of Discharge $C_d = \frac{Q}{A_0\sqrt{2gH_0}}$

TABLE .1 MEASUREMENTS OF H_0 AND Q FOR SHARP EDGED ORIFICE

V cm^3	t (s)	H_0 (cm)	10^4Q (cm^3/s)	$H_0^{1/2}$ ($cm^{1/2}$)	C_d

Calculation Table for Orifice:

Sr. No.	C_d	H	C_v	C_c
1				
2				
3				
4				
5				
6				
7				
8				
9				

$$CV = \frac{Q}{\sqrt{H_0}}$$

$C_c = C_d / Cv$

RESULTS AND CALCULATIONS:

- ⇒ **Type of Orifice** — Sharp Edged
- ⇒ Diameter of orifice — D_i =10mm
- ⇒ Cross sectional area of orifice — A_0 $=\pi/4(Di)^2$
  $= 3.14 * (1)^2 /4$
  $=0.785\ cm^2$
- ⇒ Head above the contracted section — H_0 =8 cm
- ⇒ Time required to collect water — = 30 s
- ⇒ Area of Measuring tank — $= 40 * 40\ cm^2$
- ⇒ Volume collected — V $= 40 * 40 * 1.3$
  $= 2080\ cm^3$
- ⇒ Discharge rate — Q = 2080/30
  $= 69.33\ cm^3/s$

$h_1 = 1.5$ cm
$h_2 = 2.8$ cm
$\Delta h = 1.3$ cm

Coefficient of Discharge

$$C_d = \frac{Q}{A_0\sqrt{2gH_0}}$$

C_d =69.33/0.785 (2 *981 * 8)$^{1/2}$
= 0.705

TABLE .1 MEASUREMENTS OF H_0 AND Q FOR SHARP EDGED ORIFICE

V cm^3	t (s)	H_0 (Cm)	10^4Q (Cm^3/s)	$H_0^{1/2}$ ($Cm^{1/2}$)	C_d
2080	30	8	693300	2.82	0.705