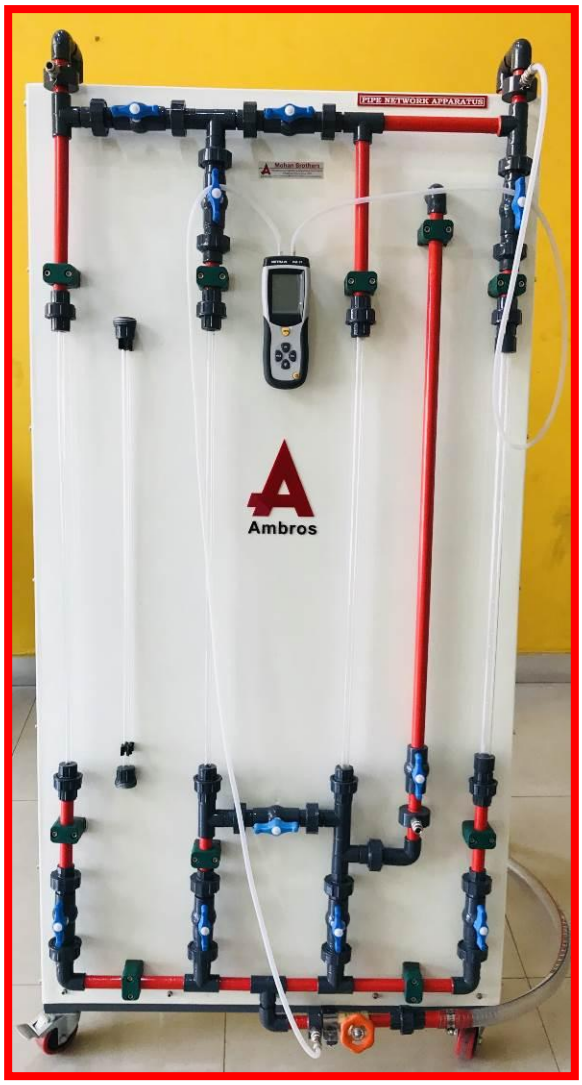
PIPE NETWORK APPARATUS



INSTRUCTION MANUAL

Mohan Brothers
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FLOW IN PIPE NETWORKS

OBJECTIVE

- Measurement of head loss versus discharge for different sizes of pipes.
- Characteristics of flow through interconnected pipes of different sizes.
- Characteristics of flow through parallel pipe networks.
- Characteristics of flow through series pipe networks.

INTRODUCTION:

It is found that the total friction resistance to fluid flow depends on the following:

- The area of the wetted surface
- The density of the fluid
- The surface toughness
- It is independent of the fluid pressure
- It increase with the square of the velocity

The loss of head in pipe due to friction is calculated from Darcy- weisbach equation

This has been given by:

$$h_f = 4fLV^2/2gd$$

h_f	=	loss of head due to friction
f	=	Friction factor
L	=	Distance between pressure point
V	=	Mean velocity of fluid
d	=	diameter of pipe
g	=	Acceleration due to gravity

EXPERIMENT A
FLOW THROUGH PIPES WITH DIFFERENT DIAMETERS

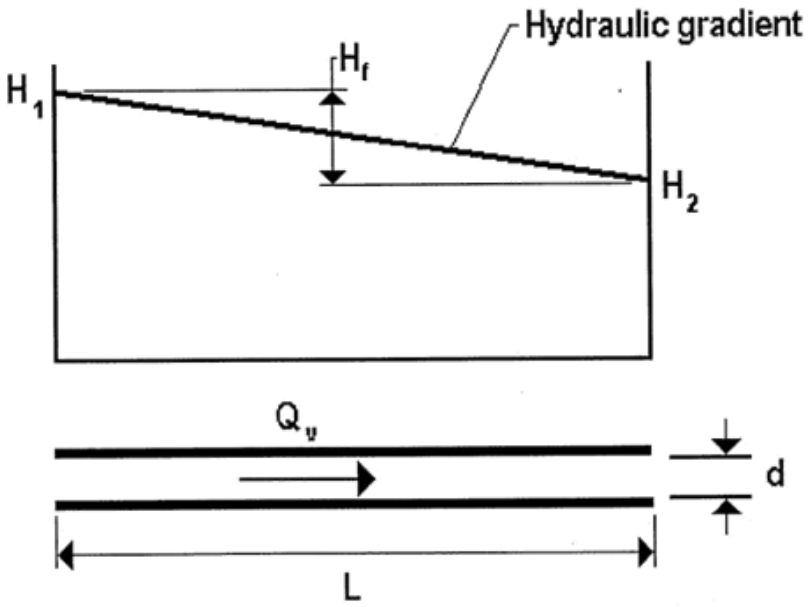
OBJECTIVE:

- To measue head loss versus discharge for water flowing through individual pipes with different internal diameters.

METHOD:

- By measuring the flow rate and crossponding head loss (pressure drop) across pipes with different inside diameters.

THEORY:



Any pipeline of diameter (D) and length (L) carrying a flow rate (Q) within a network will have a head loss along its length. This head loss is largely the result of pipe friction and:

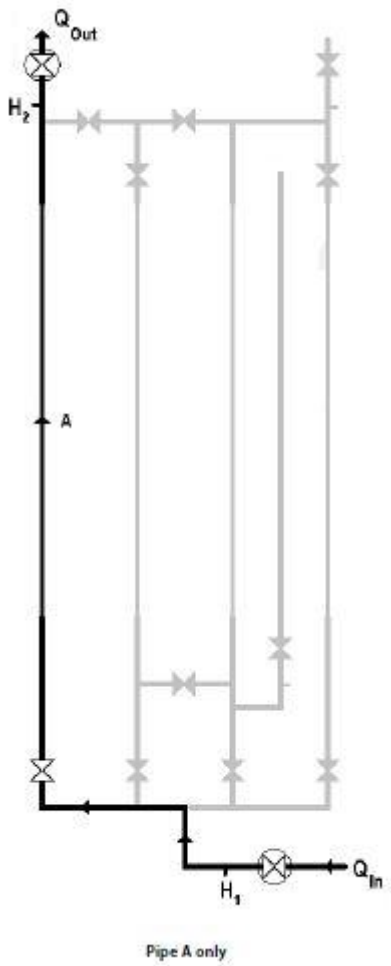
$$\text{Friction head loss } H_f = K\frac{LQ^2}{D^5}$$

Other losses arise from junctions, bends, valves or sudden change of pipe section.

INITIAL VALUES OF VARIABLES TO BE USED:

d_1	=	Dia. of first Pipe	=	6 mm
d_2	=	Dia. of second Pipe	=	11 mm
d_3	=	Dia. of Third Pipe	=	12 mm
d_4	=	Dia. of Forth Pipe	=	15 mm
L	=	0.7 m, (for all pipes)		

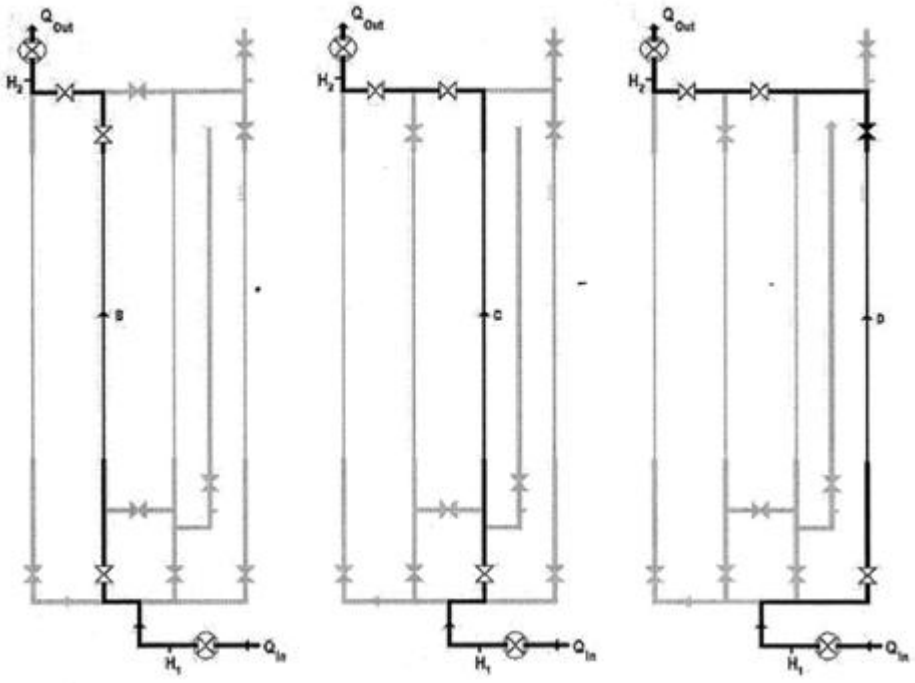
PROCEDURE:



Diagram

- Connect up the equipment as shown in the schematic diagram using the test pipe-1.
- Switch on the hydraulic bench pump and open the flow control valve to allow a nominal flow through the pipe.
- Note the head loss across the pipe on the appropriate manometer scale and determine the volumetric flow rate using the hydraulic bench measuring tank and stopwatch.
- Repeat this procedure for a range of increasing flow rates.
- Once completed, the test pipe should be replaced with each of the remaining pipes in turn and the whole procedure repeated as above.

Repeat these measurements as shown in diagram below:



OBSERVATION TABLE:

Test	Pipe Bore m	Pipe Length L, m	Head Loss mm H_2O	Volume Collected V, m^3	Time T Sec	Flow Rate Q m^3/sec	K
1.							
2.							
3.							
4.							
5.							
6.							

NOTE: All measurement converted to meters for purpose of calculation.

RESULT:

- Compare the values obtained for k for the same diameter pipe at different flow rates and different diameter pipes at the same flow rates.

EXERCISE B
FLOW THROUGH PIPES CONNECTED IN PARALLEL

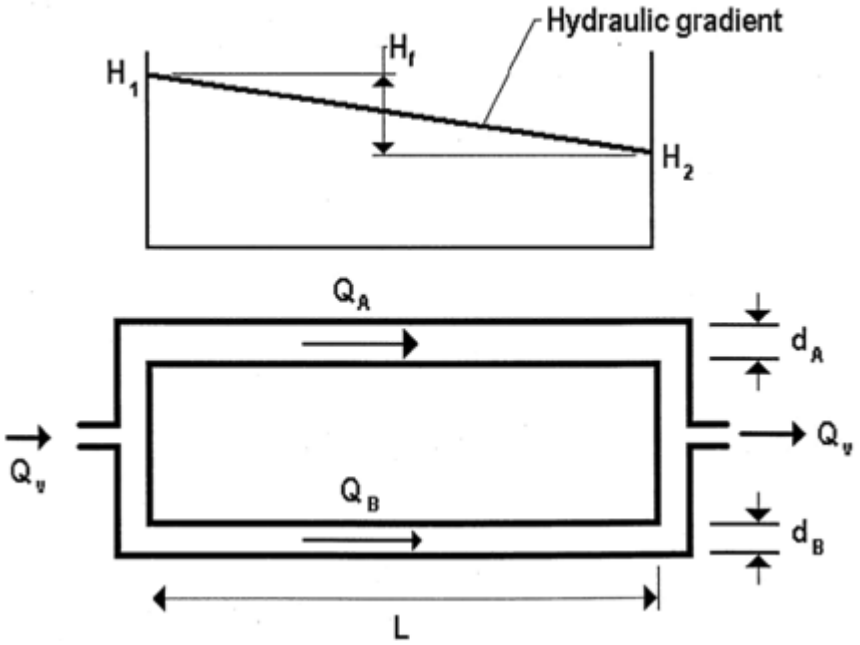
OBJECTIVE:

- To measure head loss versus discharge for water flowing through pipes with different internal diameters that are connected in parallel.

METHOD:

- By measuring the flow rate and crossponding head loss (pressure drop) across different combination of pipes in parallel then comparing the loss with the predicted loss from the individual pipe at the same flow rate.

THEORY:



In the pipe network consisting of pipes of various diameters in parallel with each other, the pressure in the common mainflods, at the junction of the pipes, must be the same for all the pipes. The total flow Q_V therefore disturbs itself between the individual pipes in accordance with the controlling end pressure and:

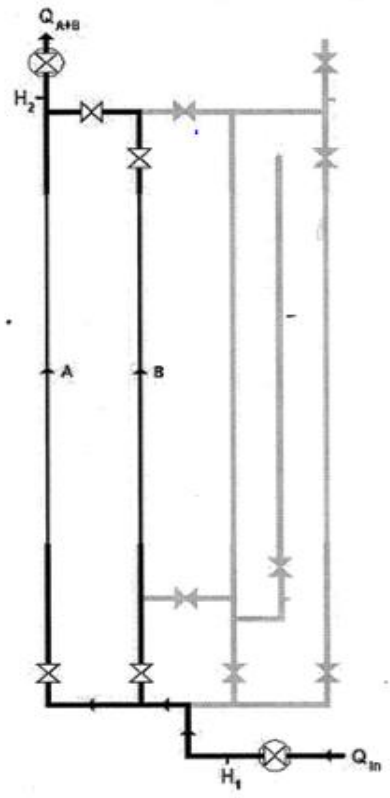
- $Q_T = Q_A + Q_B$ for two pipes in parallel
- $Q_T = Q_A + Q_B + Q_C$ for three pipes in parallel
- $Q_T = Q_A + Q_B + Q_C + Q_D$ for four pipes in parallel

INITIAL VALUES OF VARIABLES TO BE USED:

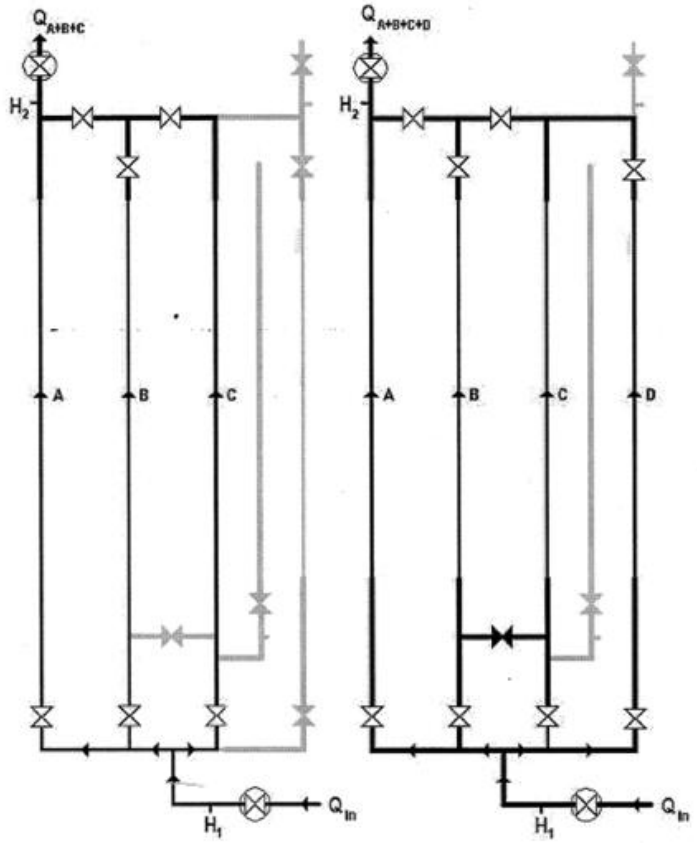
- d_1 = Dia. of first Pipe = 6 mm
- d_2 = Dia. of second Pipe = 11 mm
- d_3 = Dia. of Third Pipe = 12 mm
- d_4 = Dia. of Forth Pipe = 15 mm
- L = 0.7 m, (for all pipes)

READINGS TO BE TAKEN:

- Connect up the equipment as shown in the schematic diagram.
- Switch 0n the hydraulic bench pump and open the flow control valve to allow a nominal flow through the pipe network.
- Note the head loss across the network on the appropriate manometer scale and determine the volumetric flow rate using the hydraulic bench measuring tank and a stopwatch.
- Repeat this procedure for a range of increasing flow rates.



Repeat these measurements with the network of pipe configured for three pipes in parallel then four pipes in parallel as shown in the diagram below:



RESULT:

- For each set of readings construct a table as follows:

OBSERVATION & CALCULATION TABLE:

Test	Pipe Bore m	Head Loss mm H_2O	Volume Collected V, m^3	Time T Sec	Measured Flow Rate Q m^3/sec	Calculated Flow Q m^3/sec
1.						
2.						
3.						
4.						
5.						
6.						

NOTE: All measurement converted to meters for purpose of calculation.

EXERCISE C
FLOW THROUGH PIPES CONNECTED IN SERIES

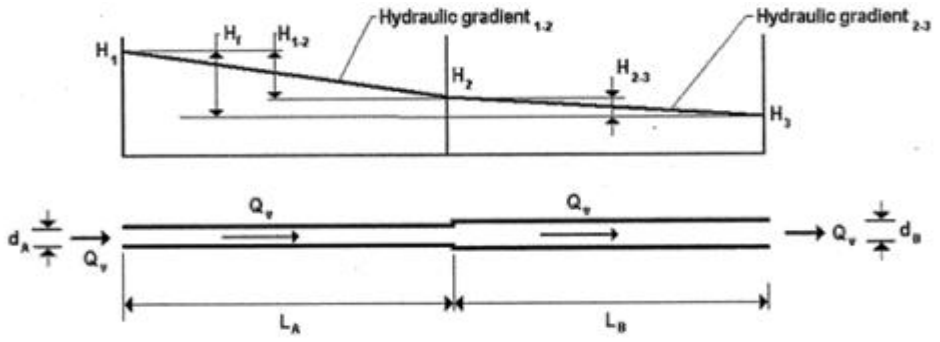
OBJECTIVE:

- To measure head loss versus discharge for water flowing through pipes with different internal diameters that are connected in series.

METHOD:

- By measuring the flow rate and corresponding head loss (pressure drop) across pipes with different inside diameters.

THEORY:



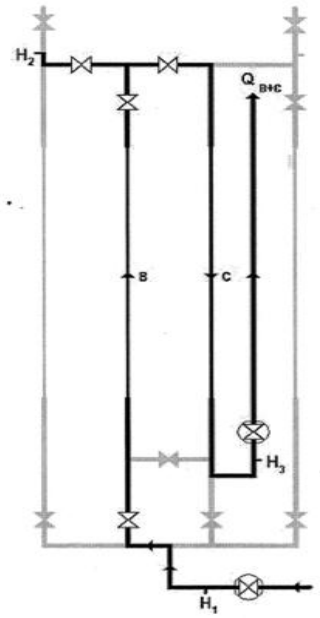
In the pipe network consisting of pipes of various diameters in series with each other, the same total flow Q must pass through each of the pipes in turn. The velocity in each section of the pipe will very depending on the diameter, so the head loss will very. Where pipe lengths differ, the head loss also be affected. A flow Q through the series network will have a total head loss H_f along the whole length which is the sum of the losses in each of the individual pipes.

For Example

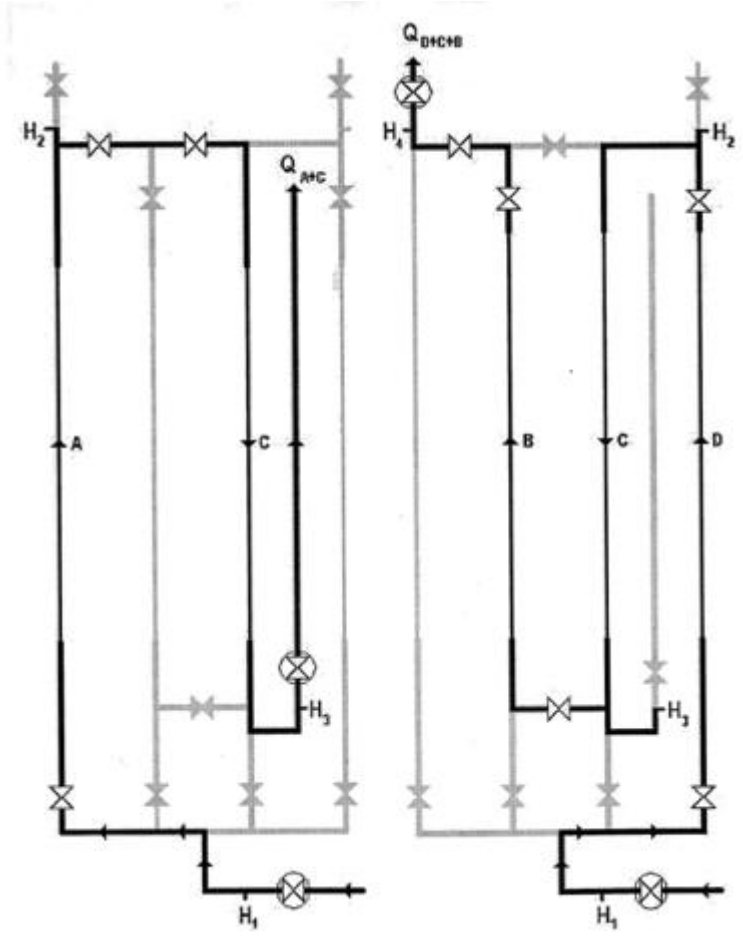
- $H_f = H_{1\text{-}2} + H_{2\text{-}3}$ for two pipes in series
- $H_f = H_{1\text{-}2} + H_{2\text{-}3} + H_{3\text{-}4}$ for three pipes in series

PROCEDURE:

- Connect up the equipment as shown in the schematic diagram.
- Switch on the hydraulic bench pump and open the flow control valve to allow a nominal flow through the pipe network.
- Note the head loss across the network on the appropriate manometer scale and determine the Volumetric flow rate using the hydraulic bench measuring tank and a stopwatch.
- Repeat this procedure for a range of increasing flow rates.



Repeat these measurements with the network of pipe configured for two alternative pipes in series then three pipes in series as shown in the diagram below:



RESULT:

- For each set of readings construct a table as follows:

OBSERVATION & CALCULATION TABLE:

Test	Pipe Bore m	Pipe Length L m	Head Loss mm H_2O H_{1-2}	Head Loss mm H_2O H_{2-3}	Head Loss mm H_2O H_{3-4}	Volume Collected V, m^3	Time T Sec	Flow Rate Q m^3/sec	Total Head Loss mm H_2O H_f
1.									
2.									
3.									
4.									
5.									
6.									

NOTE: All measurement converted to meters for purpose of calculation.