DEPARTMENT OF CIVIL ENGINEERING
FLUID MECHANICS & HHM LAB

Fluid mechanics and Hydraulics & Hydraulic Machine Laboratory is established in the Department of Civil Engineering in 2004.These labs are run in conjunction with the theory course CE201 (Fluid Mechanics) and CE209 (Hydraulics & Hydraulic Machine). It is an introductory course where flow behavior, fluid forces, analysis tools, Hydraulic Pump, Hydraulic Turbines and Open channel flume are introduced. The goals of the experiments include determination of forces generated when fluid flow takes place over a solid object, applications of the control volume approach, demonstration of the momentum and energy equations. Intricate flow phenomena such as separations and transition to turbulence are demonstrated. Experimental setups such as flow through a tube, flow over a flat plate are made available to the students. The lab experiments utilize U-tube manometer and digital manometer, a hot-wire anemometer system and data acquisition. The lab runs closely with the lectures in such a way that experiments support the text covered in the class room.

Description of apparatus

1. **Meta-centric height of a ship mode**

   The ship model is made up of stainless steel and size of the water tab is 60 cm x 60 cm. Archimedes' principle is used to find the weight of the ship model in this apparatus. Archimedes' principle states that a body immersed in a fluid is subjected to an upwards force equal to the weight of the displaced fluid. Metacentric height (GM) is measured through this apparatus. Metacentric height is used to demonstrate the stability condition of the floating body.

Metacentric Height Apparatus

2. **Hele Shaw Apparatus**

Hele-Shaw apparatus produces streamlines in a laminar and steady flow. It allows students to study various source and sink arrangements, and look at flow around an unlimited variety of different shaped models. The apparatus can represent water seepage through solids, and can simulate any process satisfying the Laplace equation in two dimensions. The apparatus works with a steady, air-free water supply and suitable drain. The equipment consists of a channel formed between two plates. Water flows along the channel at a low Reynolds number, so the inertia forces are not important. A dye flowing through several small holes at the upstream end produces streamlines. The removable top glass plate has grid-lines to help analysis of the flow patterns.

Hele- Shaw Apparatus

3. **Orifice-Meter Apparatus**

The orifice Meter is a device in Fluid Mechanics which is used for measuring the flowing fluid rate. The orifice meter or Plate works on the principle of Bernoulli's theorem and that is the sum of all the energy at a point is equal to the sum of all the energy at the other point.

Orifice-Meter Apparatus

4. **Venturimeter Apparatus**

Venturimeter is a device in Fluid Mechanics which is used for measuring the flowing fluid rate. It is having 3 parts – a short converging part, a throat, and a diverging part. Venturimeter works on Bernaulli's principle and has several applications.

Venturimeter Apparatus

5. **Reynolds Number Apparatus**

The Reynolds number (Re) is a dimensionless number that gives a measure of the ratio of inertial forces to viscous forces for given flow conditions. The Reynolds number is an important parameter that describes whether flow conditions lead to laminar or turbulent flow.

Reynolds Number Apparatus

6. Notch Apparatus

Notch Apparatus is designed for the study of flow measurement in open channels. The set-up consists of an Open Flow Channel, rectangular in cross-section. Water enters from one end of the channel & at the other end, a notch is fitted. A hook gauge with vernierscale is fitted to measure the height of fluid in flow channel.

Notch Apparatus

7. Impact of Jet Apparatus

This apparatus is used for the comparison of experimentally measured force with the theoretical calculated force. A jet of water is produced when water is fed to a vertical pipe terminating in a tapered nozzle. The jet will impinge on a vane, of different shapes. Vanes usually used are flat plate, inclined plate, curved plate and hemispherical cup.

Impact of Jet Apparatus

8. Pipe Friction Apparatus

The pipe friction apparatus consists of a test pipe (mounted vertically on the rig), a constant head tank, a flow control valve, an air-bleed valve, and two sets of manometers to measure the head losses in the pipe. The Friction Loss in a Pipe apparatus allows students to study the change in the laws of resistance for laminar to turbulent flow and find the critical Reynolds number. Friction head losses in straight pipes of different sizes can be investigated over a range of Reynolds' numbers from 10^3tonearly 10^5, therebycovering the laminar, transitional and turbulent flow regimes in smooth pipes.

Pipe Friction Apparatus

9. Centrifugal Pump

Centrifugal pumps are a sub-class of dynamic axis symmetric work absorbing turbo machinery. Centrifugal pumps are used to transport fluids by the conversion of rotational kinetic energy to the hydrodynamic energy of the fluid flow. The rotational energy typically comes from an engine or electric motor.

Centrifugal Pump

10. Reciprocating Pump

A reciprocating pump is a class of positive displacement pumps which includes the piston pump, plunger pump and diaphragm pump. It is often used where a relatively small quantity of liquid is to be handled and where delivery pressure is quite large.

Reciprocating Pump

11. Pelton Wheel Turbine

The Pelton wheel extracts energy from the impulse of moving water, as opposed to water's dead weight like the traditional shot water wheel. Many variations of impulse turbines existed prior to Pelton's design, but they were less efficient than Pelton's design. Water leaving those wheels typically till had high speed, carrying a way much of the dynamic energy brought to the wheels.

Pelton Wheel Turbine

12. Francis Turbine

The speed range of the turbine is from75 to1000rpm.Wicket gates around the outside of the turbine's rotating runner control the rate of water flow through the turbine for different power production rates. Francis turbines are almost always mounted with the shaft vertical to keep water away from the attached generator and to facilitate installation and maintenance access to it and the turbine.

Francis Turbine

13. Open Channel Flume

An open channel is simply a natural or manmade course through which water flows with a free surface. A flume is a specially shaped, fixed structure used to measure the flow of water. Flumes can be used in line with or inserted into open channels to measure the flow of water through the channels. In this Laboratory, students perform several experiments on open channel flume.

Open Channel Flume

14. Double Ring Infiltrometer

The double ring infiltrometer is a simple instrument which is used to determine the infiltration rate of water into the soil. The infiltration rate is determinated as the amount of water per surface area and time unit, which penetrates the soils.

Double Ring Infiltrometer

15. Symon's Gauge

Symon's gauge is the non-recording type rain gauge commonly used in India by meteorological department. Symon's gauge mainly consists of a funnel and a receiver. Receiver: The receiver is made up of Zinc metal in shape of cylindrical bottle. It is used for the measurement of total rainfall.

Symon's Gauge

16. Class A Pan Evaporimeter

The Class A Evaporation Pan is **a standard device for manual measurement of evaporation** (Australian Bureau of Meteorology Class A type). The pan represents an open body of water: It is filled with water and exposed on a flat plateau.

Class A Pan Evaporimeter