

# AERODYNAMICS LABORATORY

## Introduction:

Aerodynamics is a subject which deals the study of flow behaviour that passes over an object. When the object is placed in a flow field it will be affected by aerodynamic forces, in this lab we will learn to analyse the various forces that are acting on a body and learn how to calculate them in qualitative and quantitative manner.

Aerodynamics is broadly classified into low-speed aerodynamics and high-speed aerodynamics. To make students aware of the concepts of aerodynamics, this laboratory is equipped with the following facilities.

## List of facilities available:

1. Open jet facility
2. Low-speed Wind Tunnel
3. Hele Shaw Apparatus
4. Water Flow Channel

## OPEN JET FACILITY

The high pressure air from the compressor is stored in storage tanks. High pressure air enters the settling chamber through a tunnel section with a gate valve followed by a pressure regulating valve and mixing length. The settling chamber is connected to the mixing length by a wide angle diffuser. The flow is further conditioned inside the settling chamber by closely meshed grids. The settling chamber temperature is the same as the ambient temperature and the back pressure is the ambient pressure of the atmosphere to which the jets are discharged. A pressure regulating valve is used to adjust the flow to the desired Mach Numbers



**Specifications and items available:-**

- Compressor : Triple cylinder single stage air-cooled air compressor with 20 H.P motor.
- Traverse Mechanism : Three-dimensional traverse mechanism.
- Jet speed range : 0 – 1.1 Mach Number.
- Reservoirs : 3 Nos (each 150 psi capacity).
- Reservoirs Volume : 4.7 cubic meters.
- Pressure Calculation : Manometers and Digital Pressure Transducer.



**Scope:**

Flow through nozzles, subsonic and supersonic jet characteristics, Jet control techniques, Co-flow jet studies, Single expansion ramp nozzle characteristics, Mixer ejector characteristics, Flow through intakes, Twin jet characteristics and jet impingement studies

**LOW SPEED WIND TUNNEL**

Wind tunnels are devices which provide air streams flowing under controlled conditions so that models of interest can be tested using them. All the modern wind tunnels have four important components: Effuser, Test- section, Diffuser, Driving unit (consists of fan which runs on motor) and control panel.

**Specifications and items available**

Wind Tunnel Type	: Low speed, open circuit and suction type
Test section size	: 300mm X 300mm
Air speed	: 0 - 35m/sec
Contraction ratio	: 9:1
Driving Unit	: Axial flow fan driven by DC motor.
Wind Tunnel size	: 1 m × 2 m × 5 m
Power requirement	: AC 3PH, 440V, 15 Amp electrical supply
Material of construction	: FRP/MS
Force Measurement	: 3-component strain gauge balance
Pressure measurement	: Manometers
Smoke flow visualization	: Available

**Scope:**

To conduct Quantitative and Qualitative analysis of aerodynamic forces like lift, drag and pitching moment that are acting on a body for given conditions.

**HELE SHAW APPARATUS**

The Hele-Shaw apparatus produces a flow pattern which is similar to that of potential flow. The flow in the apparatus is actually a highly viscous flow between two parallel plates with a very small gap between them. This equipment basically consists of two parallel plates made of thick, transparent (glass or plastic) plates clamped together along the edges with a narrow (about 3 mm) space in between them. The assembly of these two transparent sheets kept parallel with a uniform narrow space between them is provided with two small tanks of rectangular cross-section at the top end. The tanks are connected to the rectangular slit formed by the transparent sheets by a set of small holes (about 1 mm diameter) arranged in a row. The holes from the two tanks are arranged to occupy alternate locations for communication. The other end of the rectangular slit is made to terminate in a circular hole, by gradually narrowing it after a specified distance from the tanks at the top. One of the tanks is filled with water and the other with a dye (say potassium permanganate).



## WATER FLOW CHANNEL

The channel is manufactured of G.I sheet of 5mm thickness. The width of the test section is of about 280mm and the depth of water will be maintained 8mm. The experimental system mainly consists of four parts. Those are water chamber, wedge, wire mesh, test section and injection system.

The water flow channel is said to be one of the best and cheapest techniques to visualize the real flow field around the objects. This facility is used to visualize vortex structure behind the objects, Flow separation point, Reattachment point, zone of influence, vortex size etc.,



## LIST OF EQUIPMENTS

S.No	Name of the Equipment	Quantity	Cost
1.	Air Compressor	1	2,86,417
2.	Openjet Facility (Pressure vessels, Settling Chamber, Heavy Duty Pipe Line)	1	3,84,492
3.	Traverse Mechanism	1	1,42,155
4.	Low speed Wind Tunnel	1	4,86,625
5.	Hele-shaw Apparatus	2	In-house Fabrication
6.	Open Channel	2	In-house Fabrication
7.	U-Tube Manometers	4	In-house Fabrication
8.	Multi tube Manometer	1	In-house Fabrication
			12,99,689 INR