OBJECTIVES

To investigate and analyze the flow pattern of different geometry body submerged in a fluid.

LEARNING OUTCOMES

At the end of this lab session, students should be able to:

1. Draw correctly two dimensional flow patterns over different geometrical bodies; circular, square, aerofoil, 90°elbow, streamlined body and source flow.
2. Determine the stagnation point, separation point and wake associated for each case.
3. Describe the implication of the streamline patterns observed on velocity, flow rate, pressure gradient and drag for each case.
4. Discuss the difference between flows phenomena over different geometrical bodies submerged in fluid.
5. Write a well describe technical report based on the visualized pattern according to the well-established report writing format as well as deriving clear and meaningful conclusions.

THEORY

The concept of a boundary layer and dealt with the effects viscosity has on a fluid adjacent to solid surface and with the calculation of forces acting on the surface due to fluid friction. We are, therefore, now in position to consider the external flows of real fluids, namely taking into account viscous effects. The knowledge of potential flow and of boundary layer theory makes it possible to treat and external flow problem as consisting broadly of two distinct regimes that immediately adjacent to the body's surface, where viscosity is predominant and where frictional force are generated, and that outside the boundary layer, where viscosity is neglected but velocities and pressure are affected by the physical presence of the body together with its associated boundary layer. In this outside zone, the theories of ideal flow may be used. In additional, there is stagnation point at the front of the body (which may stretch in a stagnation region if the body is very blunt) and there is the flow region behind the body (which is known as the wake). These flow regimes are shown in Figure 1.

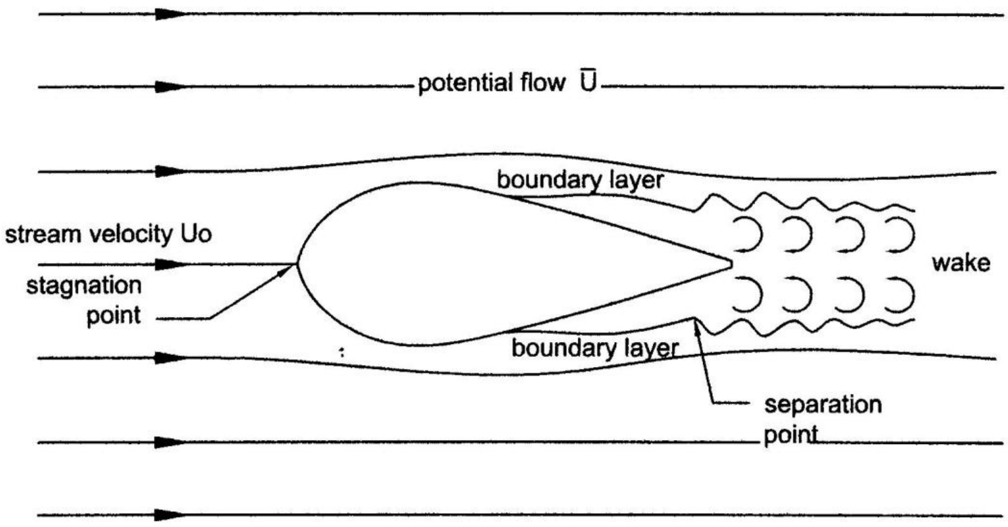

Figure 1 Flow regimes around an immersed body

The wake, which starts from points S at which the boundary layer separation occurs, deserves a fuller description. It will be remembered that separation occurs due to adverse pressure gradient *(dp/dx >0)*. Which combined with the viscous forces on the surface, produces flow reversal, thus causing the stream to detach itself from the surface? The same situation exists at the rear edge of a body as it represents a physical discontinuity of the solid surface. In both cases the flow reversal produces a vortex, as shown in Figure 2.

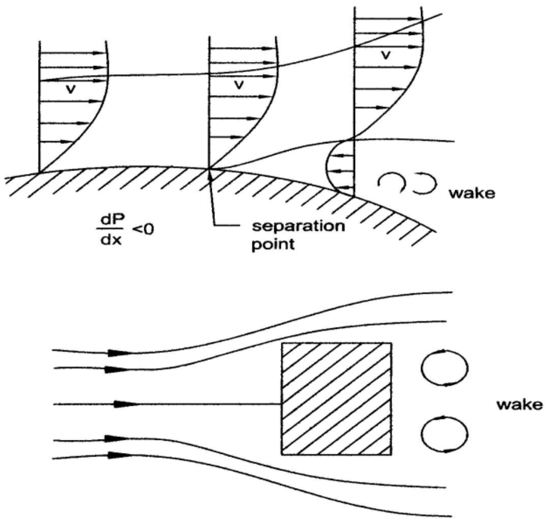

Figure 2 Formation of a vortex in a wake

APPARATUS

1) Laminar Flow Visualization Apparatus.
2) Geometrical experimental models.

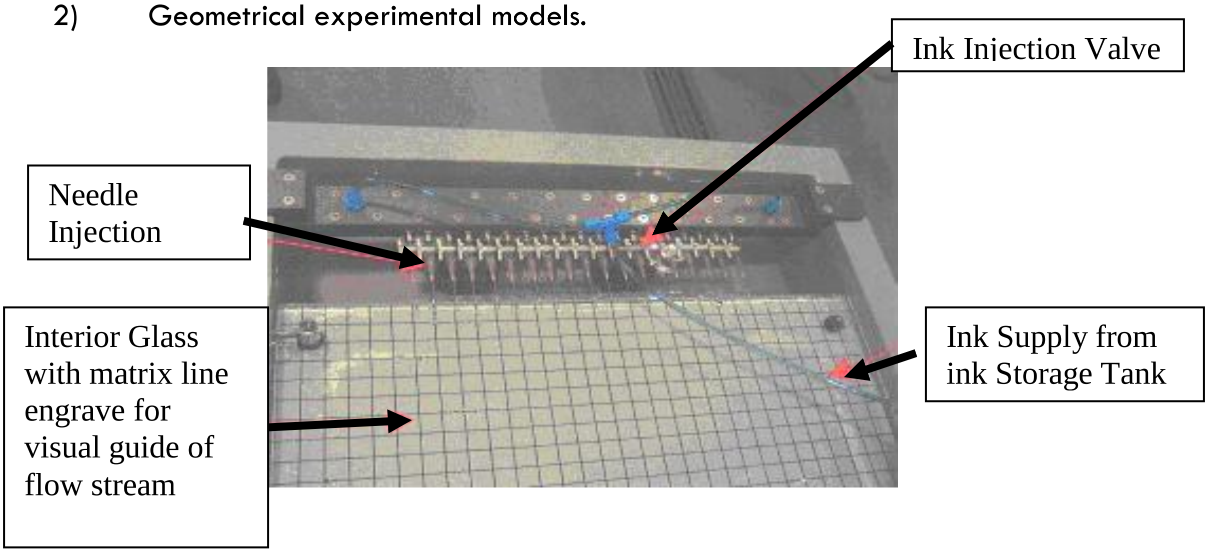

Figure 3 Laminar Flow Visualization Apparatus

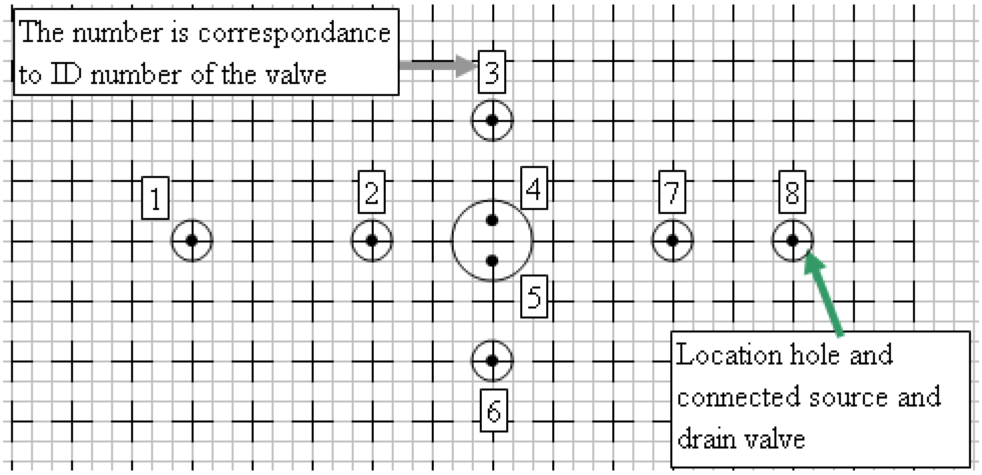

Figure 4 : Top View of Visualization Glass Sheet