FLUID MECHANICS

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Syllabus :-

1.) Introduction + Properties of Fluids.

2.) Fluid Statics
- (A) Pressure Measurements.
- (B) Hydrostatic Forces
- (C) Buoyancy & Floatation.

3.) Fluid Kinematics.

4.) Fluid Dynamics (Bernoulli's Eq^n & Its Applications

5.) Laminar Flow

6.) Vortex Motion

7.) Flow Through Pipes.

8.) Turbulant Flow

9.) Boundary Layer Theory.

10.) Dimensional Analysis.

Fluid MECHANICS → is the study of application of loads and its effect on structure, m/c, fluid etc.

- Engineering Mechanics (Rigid Body)
- SOM (Deformable Body)
- Fluid Mechanics (Fluids)

- KINEMATICS — Load ✗, Effect ✓
- KINETICS — Load ✓, Effect ✓

- Statics [Rest]
- Dynamics [Motion]

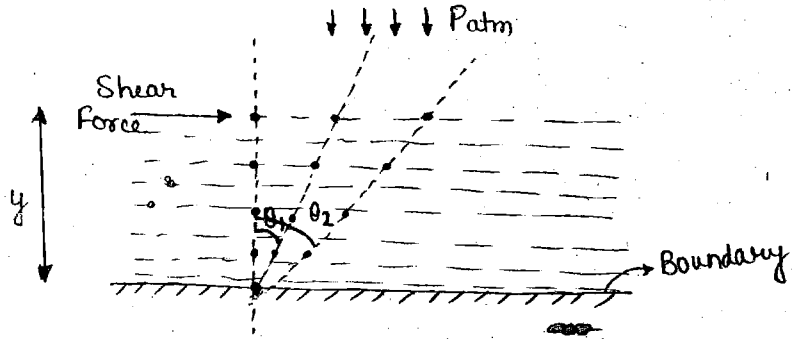
INTRODUCTION AND FLUID PROPERTIES :-

- A fluid is a substance that is having the ability to flow or deform continuously under the action of shear force (no matter how much small the force is).

- For a static fluid, shear force is zero, but viscosity is not 0.

- All types of liquids and gases fall in the category of fluids.

  Example :- Air, Water, Meravry (Hg), Steam, Petrol etc.



$\frac{d\theta}{dt}$ = Rate of deformation

$\theta \frac{du}{dy}$ = Velocity gradient

Differences Between SOLIDS & FLUIDS :-

- In case of solids, on application of load, the deformation is constant whereas in case of fluids, the deformation is continuous w.r.t. time and hence, in case of fluid, rate of deformation $\frac{d\theta}{dt}$ is more important than deformation.

- In case of solids, on removal of load, the solids will try to regain their original position while fluids, on removal of loads never tries to regain their original position.

➤ In case of solids, all types of load are possible. i.e. tension, compression, shear, twisting, bending etc. But in case of liquids, only shear force can be applied.

➤ In case of solids, all types of effects are possible i.e. bending, twisting, longitudnal deformation, angular deformation etc. whereas in case of fluids, only angular deformation is possible.

NOTE: Intermolecular forces of attraction between molecules of same nature is known as COHESION. whereas, intermolecular forces of attraction between molecules of different nature is known as ADHESION.

Water in contact of glass → more adhesion
Mercury in contact of glass → more cohesion.

and, water in contact with plastic → more cohesion

and hence, from the above, we can say that,
COHESION & ADHESION are dependent on nature of the surfaces in contact.

1. FLUID PROPERTIES

→ Properties are certain measurable characteristics that can be quantified.

With the help of properties, we can identified the fluid.

1.) Density or Mass density :-

Density is defined as the ratio of mass per unit volume and its SI unit is kg/m^3.

Density basically represents heaviness of a fluid. More the density, more is the number of molecules and more is the mass and so heavier is the fluid.

$$\rho_{solids} > \rho_{liquids} > \rho_{gases}.$$

$\rho_{H_2O} \rightarrow 10^3\ kg/m^3$

$\rho_{Hg} \rightarrow 13.6 \times 10^3\ kg/m^3$

$\rho_{air} \rightarrow 1.2\ kg/m^3$

$\rho_{petrol} \rightarrow 750\ kg/m^3$

$\rho_{diesel} \rightarrow 850\ kg/m^3$

ρ → When pressure ↑, density ↑ (closed, constant mass)

ρ → When temp ↑, density ↓

2.) Specific Weight or Weight Density (ω):-

Specific Weight is defined as the ratio of weight per unit volume and the SI unit is N/m^3. Basically, specific weight represents the force exerted by the fluid due to gravity in a given volume

$$W = \frac{\text{Weight}}{\text{volume}} = \frac{m \times g}{V} = \rho \times g$$