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The Study of Fluid and Mechanics

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Abstract:-Fluid-mechanics is an "ancient science" that is incredibly alive today. The modern technologies require a deeper understanding of the behavior of real fluids, on the other hand new discoveries often pose new challenging mathematical problems. The aim of this thesis is to furnish some results in very different areas that are linked by the common scope of giving new insight in the field of fluid mechanics. Since the arguments treated are various, a n extensive bibliography has been added. For the sake of completeness, there is an introductory chapter and each subsequent new topic is illustrated with the will of a self-contained exposition.

I. INTRODUCTION

This short script gives an introduction to fluid mechanics, the physics of moving fluids. Hydraulic and pneumatic power is widely used in the operation of engineering systems. The brakes on motor vehicles, railcar doors and hydraulic actuators and presses are typical examples. Fluid power is also widely used on aircraft, particularly for lowering and raising the undercarriage and for operating the flight control surfaces. The study of this unit will introduce learners to a range of concepts and applications of fluid mechanics that will enable them to solve engineering problems associated with fluid systems. The unit will provide learners with an understanding of surface tension and the viscous behavior of Newtonian fluids that will then be used to determine a range of parameters in bearing systems. Learners will be introduced to the characteristics and behavior of fluids at rest and will apply this knowledge to the inputs and outputs of hydraulic devices and systems, as well as to the determination of thrust forces and pressures that act on immersed rectangular and circular surfaces. However the field of fluids in motion applies to many things in current research. We refer the interested reader to that excellent book.

II. FLUIDS

A fluid is a substance that may flow. That is, the particles making up the fluid continuously change their positions relative to one another. Fluids do not offer any lasting resistance to the displacement of one layer over another when a shear force is applied. This means that if a fluid is at rest, then no shear forces can exist in it, which is different from solids; solidscan resist shear forces while at rest. To summarize, if a shear force is applied to a fluid it will cause flow. Recall the example in class when a book was placed between my hands that were previously moving parallel to one another, even in the presence of the fluid, air. The book was somewhat distorted by the shear forces exerted on it by my hands, but eventually adopted a deformed position that resisted the force. A further difference between solids and fluids is that a solid has a fixed shape whereas a fluid owes its shape at any particular time to that of the vessel containing it.

III. DEFINITION OF FLUID MECHANICS

Fluid mechanics is that branch of applied mechanics that is concerned with the statics and dynamics of liquids and gases. The analysis of the behavior of fluids is based upon the fundamental laws of applied mechanics that relate to the conservation of mass, energy and momentum. The subject branches out into sub-disciplines such as aerodynamics, hydraulics, geophysical fluid dynamics and bio-fluid mechanics.

IV. FLUID MECHANICS

The study of forces that develop when an object moves through a fluid medium
• Two fluids of interest
– Water
– Air
• In some cases, fluid forces have little effect on an object's motion (e.g., shot-put)

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• In other cases, fluid forces are significant
– Badminton, baseball, swimming, cycling, etc.
• Three major fluid forces of interest:
– Buoyancy
– Drag
– Lift

V. FLUID PROPERTIES

A. Density

Density is the ratio of the mass of a given amount of the substance to the volume it occupies. Mean density is defined as the ratio of a given amount of a substance to the volume that this amount occupies. The density is said to be uniform if the mean density in all parts of the substance is the same.

B. Buoyancy

Associated with how well a body floats or how height it sits in the fluid. Archimedes' principle: anybody in a fluid medium will experience a buoyant force equal to the weight of the volume of fluid which is displaced.
Example:
A boat on a lake. A portion of the boat is submerged and displaces a given volume of water. The weight of this displaced water equals the magnitude of the buoyant force acting on the boat.
The boat will float if its weight in air is less than or equal to the weight of an equal volume of water.
Buoyancy is closely related to the concept of density.
Density = mass/volume

C. Drag

Resistive force acting on a body moving through a fluid (air or water)
Two types:
a) Surface drag: depends mainly on smoothness of surface of the object moving through the fluid.
Shaving the body in swimming; wearing racing suits in skiing and speed skating.
b) Form drag: depends mainly on the crosssectional area of the body presented to the fluid
Bicyclist in upright v. crouched position
Swimmer: related to buoyancy and how high the body sits in the water.

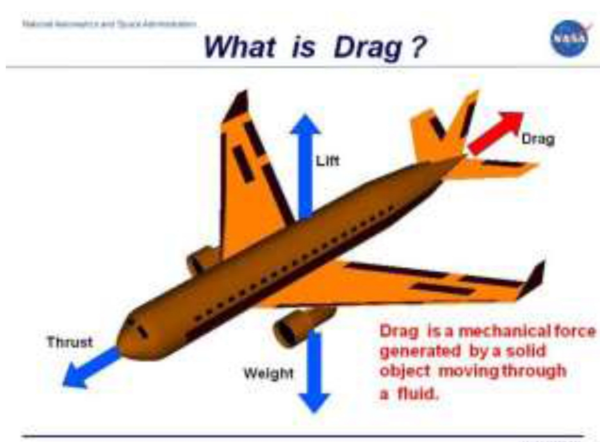

Fig. drag force in aeroplane

D. Lift

Represents a net force that acts perpendicular to the direction of the relative motion of the fluid;
Created by different pressures on opposite sides of an object due to fluid flow past the object
Example: Airplane wing (hydrofoil)

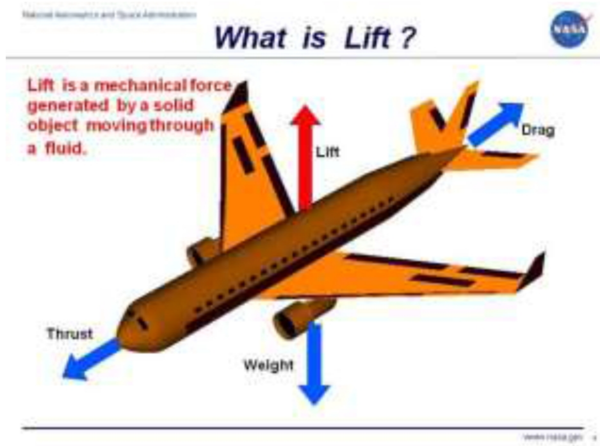

Fig. lift force in aeroplane

VI. BERNOULLI'S PRINCIPLE

Bernoulli's principal stated as the velocity of a flowing fluid is inversely proportional to its pressure.
– Fast relative velocity lower pressure–
Slow relative velocity higher pressure

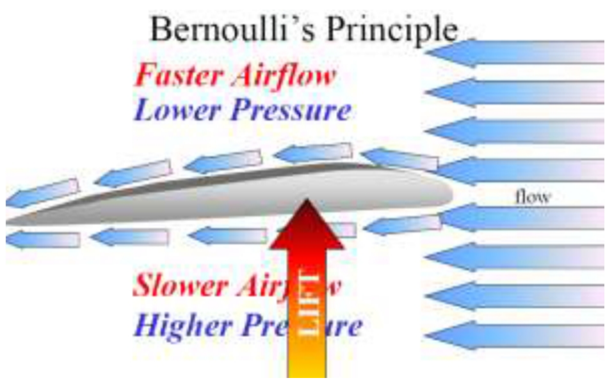

Fig. Bernoulli's principal

A. Compressibility

The degree of compressibility of a substance is characterized by the bulk modulus of elasticity, K, defined as:
K= -
Whereδp represents the small increased in pressure applied to thesubstance that causes a decrease of the volume by δV from its original volume of V. Note the negative sign in the definition to ensure that the value of K is always positive. K has the same dimensional formula as pressure, which is: [ML-1T-2]. K can also be expressed as a function of the accompanying change in density caused by the pressure increase. Using the definition of density as ass/volume. Note that the value of K depends on the relation between pressure and density under which the compression occurs. The reciprocal of the bulk modulus is Compressibility.

B. Surface Tension

Surface tension is the surface force that develops at the interface between two immiscible liquids or between liquid and gas or at the interface between a liquid and a solid surface. Because of surface tension, small water droplets, gas bubbles and drops of mercury tend to maintain spherical shapes. The presence of surface tension and its dynamics are due to complex interactions at the molecular level along interfaces. Away from interfaces, molecules are surrounded by like molecules on all sides and so intermolecular force

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interactions result in a zero net force. At interfaces, molecules interact with molecules of the same fluid on only one side. The molecules at the interfaces experience a net force that puts the inter

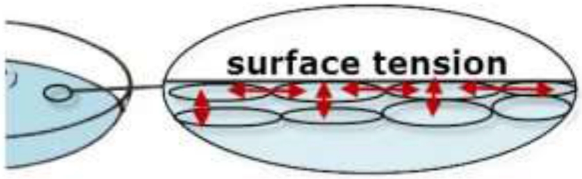

Fig. surface tension in bubble

The ultimate magnitude and direction of this tension force is determined not only by what happens on either side of the interface, but by the way molecules of the two fluids interact with each other. Surface tension, therefore, is specific to the participating fluids. Surface tension forces are also sensitive to the physical and chemical condition of the solid surface in contact, such as its roughness, cleanliness, or temperature.
Dimensional Formula:
[MLT-2]/[L] = [MT-2]
A common symbol for surface tension is σ.

C. Vapour Pressure

At the surface of a liquid, molecules are leaving and re-entering the liquid mass. The activity of the molecules at the surface creates a vapour pressure, which is a measure of the rate at which the molecules leave the surface. When the vapour pressure of the liquid is equal to the partial pressure of the molecules from the liquid which are in the gas above the surface, the number of molecules leaving is equal to the number entering. At this equilibrium condition, the vapour pressure is known as the saturation pressure.
The vapour pressure depends on the temperature, because molecular activity depends upon heat content. As the temperature increases, the vapour pressure increases until boiling is reached for the particular ambient atmospheric pressure.

Dimensional Formula:
[ML-1T-2]

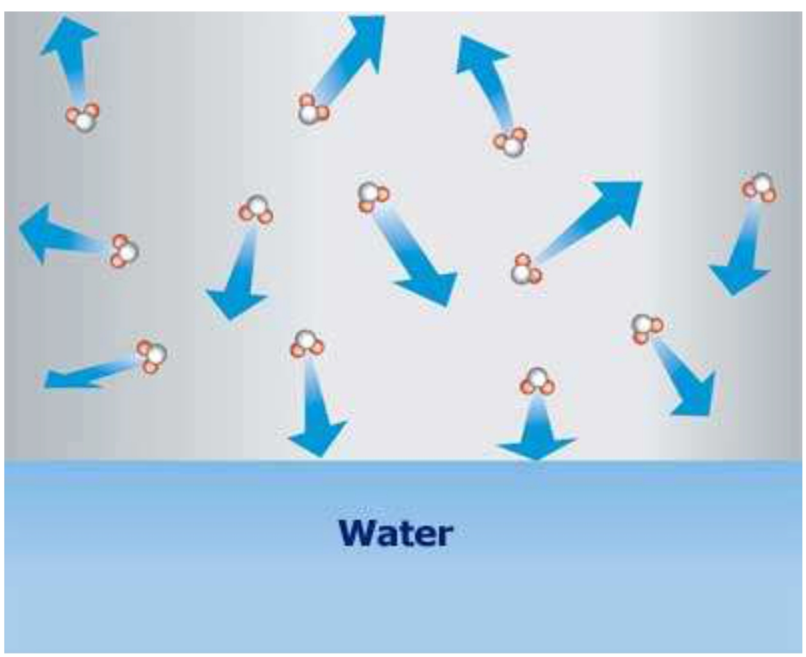

Fig. vapour pressure

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D. Viscosity

Viscosity can be thought of as the internal “stickiness” of a fluid. It is one of the properties that control the amount of fluid that can be transported in a pipeline during a specific period of time. It accounts for the energy losses associated with the transport of fluids in ducts, channels and pipes. Further, viscosity plays an important role in the generation of turbulence. Needless to say,
Viscosity is an extremely important fluid property in our study of fluid flows.

All real fluids resist any force tending to cause one layer to move over another, but the resistance occurs only when the movement is taking place.From experiments with various fluids, Sir Isaac Newton postulated that for the straight and parallel motion of a given fluid, the tangential stress between two adjoining fluid layers is proportional to the velocity gradient in a direction perpendicular to the layers.

That is:

$$\tau = \mu \frac{\partial u}{\partial y}$$

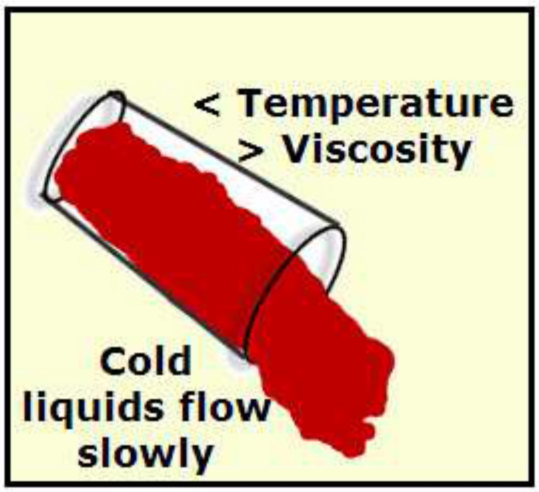

Fig. viscosity in liquid

Where μ is a constant for a particular fluid at a particular temperature. Thecoefficient of proportionality is the absolute viscosity (sometimes referredto as the coefficient of viscosity). Note that μ is a scalar quantity, whilethe other terms are vector quantities. Note also that the surface overwhich the stress acts is perpendicular to the velocity gradient.

E. Pressure

To define pressure, consider some imaginary surface of area A at an arbitrary part of a fluid. This surface must experience forces, say of magnitude F, and due to a very large number of molecular collisions from the fluid adjoining it. Pressure, which is a scalar quantity, is defined as the ratio of the force and the area, that is F/A.

Dimensional Formula is:

[ML-1T-2

VII. CONCLUSION

In this content we studying the basic concept of related to the fluid power and also try to search and finding application of the concept of fluid mechanics.

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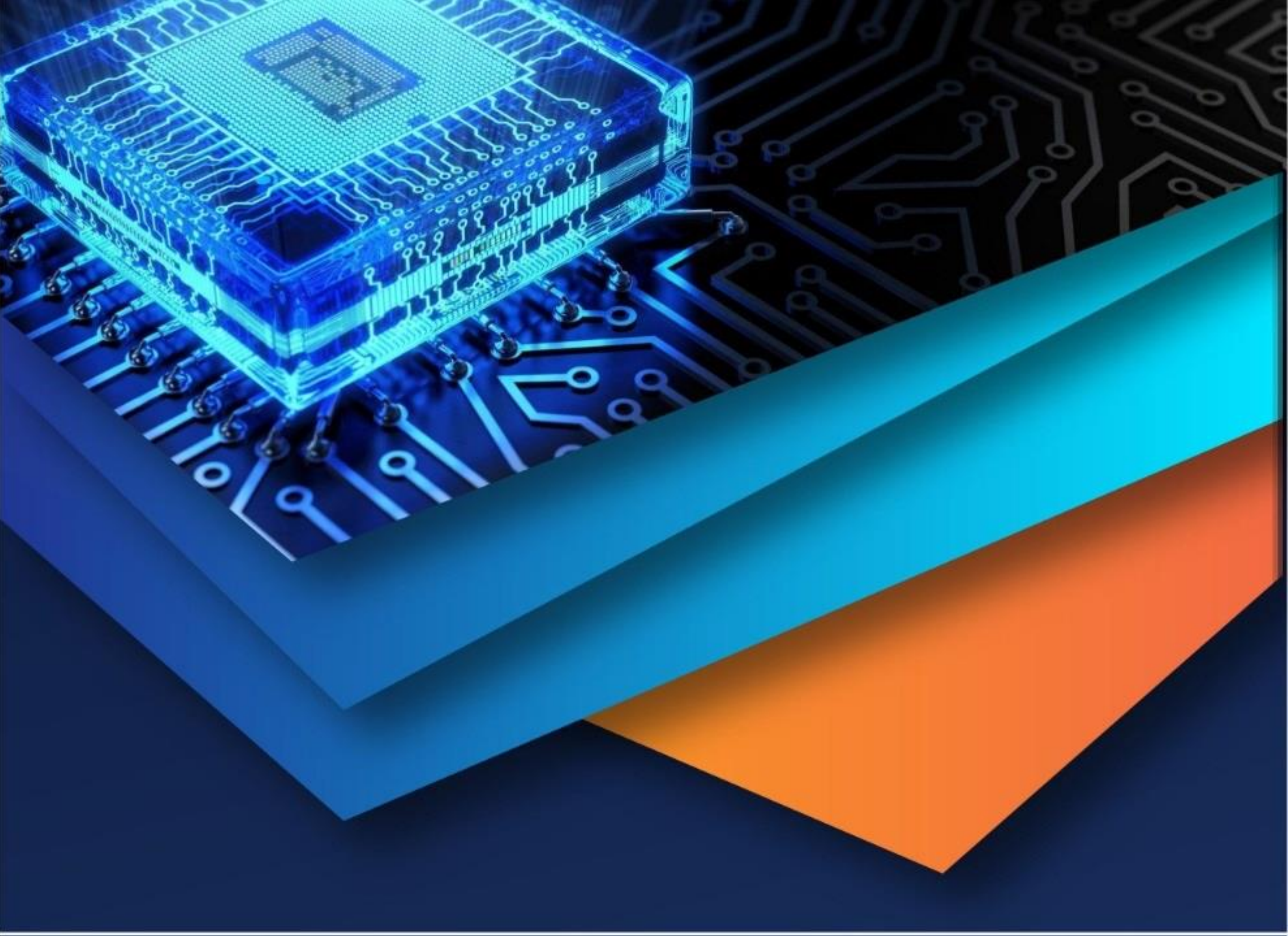
Vijayanathan.R. received his Master of philosophy Library and Information Science from Annamalai University in 1999 Also he obtained his post-graduate degree in Master of Economics in Bharathidasan University in 1996.He is working as a Sr. Librarian, Department of library and Information Science in Cauvery College of Engineering and technology, Trichy from 2009. He has guided many M.Phil scholars and Committee member in various Universities in Tamil Nadu. He served more than 14 years as Senior Librarian in reputed Engineering College and also he had attended many workshops, seminars and conferences on Research issues in Bibliometric ananalysis.He has published 21 research papers in National and International journals. His areas of interested are networking; Cloud computing, IC Technologies, Environmental study, Library Automation, Webometric study, Scientometric study, Bibliometric analysis, and citation study.



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