Free essay on the uses of fluid mechanics

Engineering, Aviation

Fluid Mechanics is a branch of engineering study and it deals with various properties of fluids. In our daily life we use various types of fluids. Most of the fluids are readily available and have some excellent properties. Significance of Fluid mechanics is to know how the fluids and its various properties can be used in our daily life. This part of engineering is integral part of main stream engineering like Civil Engineering, Mechanical Engineering as well as Chemical Engineering as these brunches of engineering often deals with fluid. In this essay various aspects of fluid mechanics and its application have been discussed.

Theories of fluid mechanics based on remarkable contribution of famous scientist like Archimedes, Daniel Bernoulli, Osborn Reynolds and many other scientists.

The earliest and most fundamental principle in fluid mechanics is Buoyancy principal by Greek mathematician Archimedes. This principle is also known as Archimedes Principal. As per this principle, after placing an object in a fluid the buoyant force, acting on an object, is same as weight of the fluid displaced by that object. Archimedes Principal has many applications in our daily life such as transportation sectors, jewelry shop, engineering sector, defense sector, marine research and many areas. One of the most important as well as common application of buoyancy principle can be found when large ship floats on surface of water. Ship is constructed in such a way that it is given a hollow shape which makes overall density of the ship lesser than water on which it floats. As a result, volume of water displaced by the ship is sufficient to have a weight greater than weight of the ship. In other word, buoyant force acting at the bottom of the ship is large enough to support

weight of the ship. A submarine also uses buoyancy principle. It has a ballast tank which is large in shape and this controls the vertical position of submarine in the sea. When the ballast tank of the submarine is filled with water, weight of the submarine become greater than weight of the water displaced by the submarine and it submerges in the sea. On the other hand, submarine can float on the surface of water when it release the water in the ballast tank to make its weight lesser than the weight of the water displaced by it. The concept of buoyancy principle, used in submarine, is also utilized in FLIP i. e. Floating Instrument Platform. It is a research ship which carries out research on waves in deep water. This ship is capable of turning horizontally or vertically. The ship can be flipped vertically by pumping water into tank. By using this principle, presence of other material can be detected in a valuable object like golden jewelry or other expensive thing without breaking it. Balloon is operated by using the Archimedes principle. Balloon is filled up with a gas that is less dense than air and it makes the total weight of balloon and gas itself lighter than air displaced by the balloon. As a result, air pushes the balloon up. Sometime hot air is used in the balloon as hot air is lighter than normal or cold air. The balloon descends at the time when its weight is heavier than the weight of air displaced by the balloon and it becomes stationary when two weights balance each other. So, the movement of balloon can be controlled by varying the quantity of light gas or hot air in the balloon. So, there is plethora of applications of Archimedes principle except which we can not imagine our modern life.

Remarkable contribution of Swiss scientist Daniel Bernoulli in fluid mechanics is the Bernoulli's principle or Bernoulli's equation which is very important to

analyze steady flow of incompressible, inviscid fluid along a streamline. This principle or equation is one of important aspects in fluid mechanics. As per this equation summation of potential energy, mechanical energy, and kinetic energy in a streamline flow is constant. As most of the fluid satisfies the criteria of the Bernoulli equation, this equation is widely used. Some applications of Bernoulli's principle are flying of Aeroplane in the sky, sailing of boat, using of pitot tube to measure flow rate and velocity of fluid etc. Reason behind aircraft flies in the sky is the Bernoulli's Principle which tells that increase of flow of fluid causes pressure drop. The wings of aircraft is so designed that speed of airflow above the wing is greater than speed of the airflow beneath the wing. Actually upper portion of the wing is curved and bottom part of the wing is flat. When aircraft travels through the air, air above upper part of the wing has to travel greater distance in same time than the air adjacent to bottom part of the wing and this causes higher speed of airflow above the wing. As a result of this, air pressure below the wings of aircraft is higher than the air pressure above the wing and this pushes the aircraft up through the air under lower pressure. Same concept, based on Bernoulli's Principle, is used in sailing boats. The Bernoulli equation is applied to measure flow from tanks, within pipes as well as in open channels; to predict the velocity at orifice. When a fluid flows under differential pressure, to measure the velocity as well as rate of flow of the fluid a pitot tube is utilized. Application of pitot tube can be found where we need to measure flow rate of a fluid through a duct or pipe. Venturi flowmeter, used to analyse flow of fluid, is based on Bernoulli equation. Application of Bernoulli equation can also be found in modeling sluice gate

which is used to control open channel flows.

Another important aspect of Fluid Mechanics is Reynolds number. Reynolds number is used to determine whether a flow is laminar or turbulent in a pipe flow application. When the Reynolds number of a particular flow is less than the value of 2100, the flow is called laminar which can be characterized by low flow velocity as well as high viscosity. Flow of high viscous fluid such as lubricating oil is laminar flow and concept about laminar flow is necessary when dealing with lubricating oil and other highly viscous fluid. If the Reynolds number of a particular flow is greater than 4000, the flow is termed as turbulent flow which has high flow velocity and low viscosity. Water or air flow, having high velocity, is typically turbulent flow. When water or air or fluid having almost same property of water is transported in a pipe or other closed conduit, knowledge of turbulent flow condition is needed. Application of Reynolds number can be found in modeling of organisms like microorganisms, blue whale in sea; modeling airflow around a body like wing of an aircraft. Reynolds number is also used to derive some equations used in fluid mechanics like Darcy–Weisbach equation etc.

We daily use centrifugal pump to transport water or lift water to a certain height. This is one of the common applications of fluid mechanics. Concept of this part of fluid mechanics i. e. centrifugal pump is based on energy conversion. Transportation of fluid by the pump is possible by conversing rotational kinetic energy to hydrodynamic energy of flow of the fluid. Moreover, this concept is also used in sewage, petroleum, petrochemical pumping. Use of turbine is also popular in our daily life. Principle of turbine operation is based on fluid mechanics. Basically, concept of turbine uses the

opposite principle of that of centrifugal pump because turbine converts potential energy of water into kinetic energy.

There are also various applications which are based on various aspects of fluid mechanics like Kinematics of Fluid Motion, Aerodynamic Forces, Dynamics of Fluid Motion, Control Volume Analysis, Flow in Open Channels, Turbomachines etc. Mass Flow Meters uses the concept of Torque-Flow Rate Relationship. For aerodynamic forces we are able to fly Kites. Knowledge of Kinematics of Fluid Motion is required to make Conditioning system, Bathroom Ventilation etc. Dynamics of Fluid Motion is needed to know to make Floating Table Tennis Ball, Vacuum Cleaner etc. Control Volume Analysis is used for Forced Air Heater, Hand-Dryer etc. Concept of Viscous Flow in Pipes is needed to know the function of Vacuum Cleaner, Bicycle Pump. Concept of Flow in Open Channels is utilized in Curb Drain, Drainage Ditch. Knowledge of Compressible Flow is used in Supersonic Flight. Turbo-machines are used in Car Water Pump, Airplane Propeller Design.

In the conclusion it can be said that most of the part of our daily life as well as very important industries depends on fluid rather application of fluid mechanics. There are still various opportunities of researches in the field of fluid mechanics. Attempts are being made to use readily available fluid in more efficient manner as well as scope of innovation in this area of engineering are being financially supported. With the invention and development of technology study of fluid mechanics has been more realistic and many researches are being carrying out in this field of engineering to spread its application to mankind.

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