Physics Connections G10

STEM Asyut Physics Club

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- **Fluids:**

  Fluids, including liquids and gas, have an essential role to play in power generation and power storing. it is used to transfer power efficiently in fluid systems in the Capstone project, e.g., in turbines run by steam, compressed air systems, or pumped hydro systems. Fluid flow enables fluid power to be used to transmit power in an electric power form. How fluid flow is influenced by certain conditions is something that can be used to design efficient power systems and reliable power systems.

- **Pressure: (F/A)**

  Pressure is a key consideration in systems where steam, compressed gas, or fluid hydraulics is used to transmit or store energy. It is employed to calculate fluid power and to propel pistons or turbines. Energy is stored and transmitted in liquid fuel cells or pumped hydro plants by means of differences in pressure. Pressure is employed to achieve efficiency while precluding system failure through checking and controlling.

- **Pascal's Principle:**

Pascal's Principle is that all change in pressure applied to an enclosed fluid is transmitted in equal directions. This is used in hydraulics to transmit power and to accumulate power. If in Capstone project power is to be accumulated and supplied through a hydraulic press or through a piston, Pascal's Principle is used to guarantee that each section in the system is acted upon by an equal amount of power to render the process efficient and reliable.

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- **Continuity Equation:**

The continuity equation ($A_1V_1 = A_2V_2$) states that the mass flow rate of a fluid is constant across a system, meaning that the rate at which the fluid enters the system, is the same as the rate at which it exits the system. When applied to the capstone, the continuity equation can be utilized in Hydraulic system where narrowing the pipe the velocity of water will be higher through it, ensuring that the kinetic energy of hydropower plant is higher due to the high number of revolves as normal.

- **Laminar vs Turbulent Flow:**

Laminar flow occurs when the particles in fluid move smoothly and quietly in one direction parallel to each other with little or no chaotic movement, while turbulent flow occurs when fluid particles move chaotically in irregular paths. it can be used in hydropower systems where laminar flow of water through the pipes significantly increases turbine efficiency while turbulent flow can cause energy loss, or it can be used in wind turbines where managing airflow to remain laminar, reduces drag and increases flow efficiency therefore increasing power output.

- **Bernoulli’s....equation:**

It plays important role in our project: P+1/2ρv2+ρgh=constant, expresses energy conservation in flowing fluids. In hydropower, water at height h has potential energy (ρgh), which converts to kinetic energy (1/2ρv2) as it flows down, driving turbines to generate electricity. Bernoulli’s principle analyzes pressure and velocity changes, optimizing energy extraction. For wind turbines, air’s kinetic energy (1/2ρv2) creates pressure differences across blades, causing rotation. Faster-moving air lowers pressure, enhancing aerodynamic efficiency. Both systems rely on Bernoulli’s principle to transform fluid energy into mechanical and electrical energy efficiently. Bernoulli’s principle explains how faster-moving air lower pressure has enabled better aerodynamic efficiency.

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