DOMESTIC HYDROELECTRIC PLANT

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ABSTRACT

India is the fourth largest energy consumer in the world after the United States, China, and Russia. In recent years, India's energy consumption has been increasing at a relatively fast rate due to population growth and economic development. Rapid urbanization and improving standards of living for millions of Indian households, the demand is likely to grow significantly. Hydroelectric power generation is one of many ways in which electricity can be generated. In 2009, the three most heavily used sources for generating electricity were coal, natural gas and oil. These sources not only release emissions that are harmful to the environment, they are resources that are quickly running out. Therefore, different ways of generating power will need to be explored.

Hydroelectric power works to harvest the inherent energy of moving water by directing the water through turbine converting the energy of the moving water into mechanical energy. The mechanical energy is then converted into electricity in the generator. In order to choose the appropriate generator for a specific application, the flow rate and pressure head of water source must be known. Hydropower on a small-scale is one of the most cost-effective energy technologies to be considered for rural electrification in less developed countries.

An Attempt Was Made to Extract Potential Energy From Rain Water At Terrace To Produce High Grade Electric Energy With Help Of Pelton Wheel Turbine. In India Some Eastern States Like Assam, Meghalaya, Mizoram and Tripura Have Recorded Rainfall 2600mm to 3000mm Every Year, As the Device Proposed Can Be Helpful to Harness the Maximum Power Through Out the Regions.

INTRODUCTION

Hydroelectric power is a form of energy a renewable resource. Hydroelectric power plants do not use up resources to create electricity nor do they pollute the air, land or water, as other power plants may. Hydroelectric power comes from flowing water winter and spring runoff from mountain streams and clear lakes.

When water is falling by the force of gravity, can be used to turn turbines and generators that produce electricity. Hydropower is the largest renewable resource used for electricity. It plays an essential role in many regions of the world with more than 150 countries generating hydroelectric power.

Domestic hydroelectric plant is the plant which is used for domestic purpose. Many countries get a lot of rainfall and rain water stored on the terrace. Using that water, we generate electric power for domestic purpose.

Hydro power plants convert potential energy of water into electricity. They are classified as micro hydro power plants for the generating capacity less than 100 KW. Hydroelectric power plants are much more reliable and efficient as a renewable and clean source than the fossil fuel power plants. The Potential energy of water stored in the terrace gets converted into the Kinetic energy of the moving water in the penstock and this Kinetic energy gets converted into electric energy with the help of Pelton turbines.

The Pelton turbine is an impulse hydro turbine developed in 1889 by an American engineer Lester Allan Pelton. Pelton turbine is a tangential flow impulse turbine, which operates under high head of water and requires comparatively less quantity of water. Martin and Sharma (2014) opined that, for domestic power generation

through roof top rain water harvesting, Pelton wheel is the most economical. and generator combination. Small, mini and micro hydro plants (usually defined as plants less than 10 MW, 2 MW and 100kW, respectively) also play a key role in many countries for rural electrification. An estimated 300 million people in China, for example, depend on small hydro.

LITERATURE REVIEW

Kotousov [2005] experimented for 5 shape of nozzles and found out the most efficient shape of the nozzle. He observed that negative pressure zone is created near the outlet section of nozzle causing cavitations in this zone. The velocity of the jet increased due to change in density of the jet and with variation in temperature. The reduction in absolute static pressure below atmospheric in the region of dynamic regime caused gas evolution. The mean density of water decreased by 10-20% of homogeneous water as dissolved gases mainly carbon dioxide and chlorine evolved in it. As the discharge was kept constant, the effect of decrease in density will lead to increase in the jet velocity. Swelling of flow due to gas evolution and cavitations was observed.

Zhang and Casey [2007] worked on precise shape of the jet discharged from nozzle of Pelton turbine. After experimental studies, it is found that bifurcations of the distributor affect flow development in nozzle and the interaction of the jet with surrounding air causes a turbulent free surface.

Staubli and Abgottspon [2008] have discussed the effect of location of injectors on efficiency of turbine. The authors discussed the difference between the upper and lower injector efficiencies for one and two nozzle operations with the help of results obtained at three different sites. They found that for both the cases (one and two nozzle operation), upper injector showed lower efficiencies as it had more curved bend. For one nozzle operation difference in efficiency was from 0.5% to 1.5%. Kubota T [2010] studied jet nozzle interference for its effect o efficiency of turbine. To increase the specific speed of Pelton turbine, number of nozzles and bucket width per unit runner diameter needs to be increased. It was concluded that efficiency has decreased for high specific speed of presented 6-nozzle Pelton turbine.

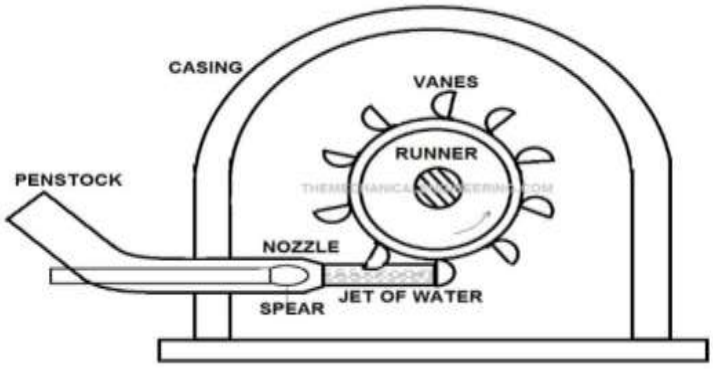
WORKING

Actual Working: -

- In this model, we are generating the electric power with the help of Pelton turbine. Pelton turbine is an efficient machine particularly suited to high heads. When the water enters into the penstock and goes to the Pelton turbine. The rotor consists of a large circular disc or wheel on which number of spoon shape buckets are spaced uniformly round its periphery.
- The wheel is driven by jet of water being discharged at atmosphere pressure from pressure nozzle. The wheel is driven by jets of water being discharged at atmospheric pressure from pressure nozzles.
- The nozzles are mounted so that each directs a jet along a tangent to the circle through the centers of the buckets. Down the center of each bucket, there is a splitter ridge which divides the jet into two equal streams which flow round the smooth inner surface of the bucket and leaves the bucket with a relative velocity almost opposite in direction to the original jet.

- Due to the high-speed rotation of the turbines the shaft is connected between the turbine and the generator rotates. Due to rotation of generator the electricity is produced.

Pelton Turbine



COMPONENTS: -

1. **Nozzle :-** A nozzle is a device designed to control the direction or characteristics of a fluid flow (specially to increase velocity) as it exits (or enters) an enclosed chamber or pipe. A nozzle is often a pipe or tube of varying cross-sectional area, and it can be used to direct or modify the flow of a fluid (liquid or gas). Nozzles are frequently used to control the rate of flow, speed, direction and the pressure of the stream that emerges from them. In a nozzle, the velocity of fluid increases at the expense of its pressure energy.

Nozzle

2. **Bucket :-** Each bucket consists of two halves separated by a high ridge, known as a splitter. The splitter divides the water jet so that the flow to both sides of the bucket is even. A notch on each bucket allows the water jet to flow into each bucket at an optimum angle. The spoon shape of the bucket causes the kinetic energy of the water jet to be converted to mechanical energy gradually, as the water completes a 180 degree turn in the bucket. The mechanical energy manifests itself as torque on the runner shaft, which causes the runner to rotate. After leaving the bucket, the water is discharged through a discharge pit.

Bucket

3. **Runner :-** The runner consists of a circular disc on the periphery of which several buckets evenly spaced are fixed. It is mounted on shaft and its transmit rotary motion to the shaft .

Runner

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4. **Generator (PMDC Motor):-** We are using PMDC motor as a generator. Permanent magnet direct current (DC) machines can be used as either conventional motors or as DC turbine generators as constructionally there is no basic difference between the two. It may be driven mechanically as a simple generator to generate an output voltage. This then makes the permanent magnet DC generator (PMDC generator) ideal for use as a simple turbine generator.

6.3.4 Generator

5. **Piping :-** Piping is used for to direct flowing water from the roof to the buckets of the turbine.

Pipe

6. **Casing :-** The function of the casing is to prevent the splashing of the water and to discharge water to the tailrace. It also acts as a safe ground against accidents. It is made of cast iron or fabricated steel plates. The casing of the Pelton wheel does not perform any hydraulic function.

6.3.6 Casing

SPECIFICATION CHART:

Area of Roof (m^2) / Height Floor (m)	1000 Sq. ft 92.90 m^2	1500 Sq. ft 139.35 m^2	2000 Sq. ft 185.80 m^2	2500 Sq. ft 232.25 m^2	3000 Sq. ft 278.70 m^2
08	21.30 watts	36.45	48.60	60.75	72.90
15	45.56	68.35	91.35	113.91	136.76
22	66.83	100.24	133.66	167.08	200.49
29	88.0	132.05	176.79	220.19	264.29 watts

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RESULT TABLE:-

Name Of Part	Specifications	Materials
Nozzle	Jet Diameter: 6mm	Acrylonitrile Butadiene Styrene
Bucket	Depth: 5.83mm Width: 21.6mm Height: 19.9mm No. Of Buckets: 18	Acrylonitrile Butadiene Styrene
Runner	Diameter: 56 mm Thickness: 8 mm No. Of Holes: 18 (Φ20)	Acrylonitrile Butadiene Styrene
Generator	12 Volts PMDC Motor	-
Pipe	Diameter: 12mm	Polyvinyl chloride
Casing	Diameter: 130mm	Acrylic And Polyvinyl chloride

CONCLUSION :-

The use of Domestic hydroelectric powerplant provides an environmentally friendly solution to powering houses as an alternative solution. Zero greenhouse emissions are achieved with domestic powerplant opposed to greenhouse gases from conventional power plants. However, the friction offered by bucket surfaces is more due to 3D printing. To overcome this problem, better manufacturing processes can be put into use to make smoother and shinier surfaces which will offer negligible resistances.

This model being demonstrated on a house of 2 floor height and 1000 sq.ft area. Theoretical calculations of the considered arrangements target to produce power of 24 watts. The calculations were based on an average rainfall of 12 mm/hr. The standard pressure and temperature values are used as base of calculations.

The next step of the analysis was to use ANSYS software to simulate stresses experienced by different elements of our system. And utilise fail safe approach by designing spring at the end of the power transmitting shaft. We are trying to harness the rain water energy with the help of Pelton wheel turbine.

- Here with this model we extracted power of watts. And further this power can be used for domestic purpose.
- An attempt was made to extract potential energy from rain water at terrace to produce high grade electric energy with help of Pelton wheel turbine.
- A complete design of Pelton turbine has been presented in this report based on theoretical analysis and some empirical relations. In next phase the system may be model and optimize using different configurations and may get the optimum results.

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