Application of Pelton Wheel Turbine for Power Generation in Multistoried Building

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Abstract - *Almost all of our modern conveniences are electrically powered. Electricity is the most versatile and easily controlled form of energy. At the point of use it is practically loss-free and essentially non-polluting. At the point of generation, it can be produced clean with entirely renewable methods, such as wind, water and sunlight. So, taking into consideration the importance of electricity generation by renewable methods we will design and manufacture a system that will generate electricity with the help of Pelton wheel turbine. For a multi storage building when we supply water for different floors from top of the building. So, taking into consideration the importance of electricity generation by renewable methods we will design and manufacture a system that will generate electricity with the help of Pelton wheel turbine. For a multi storage building when we supply water for different floors from top of the building. the force of water downwards we attach a setup containing Pelton wheel turbine and alternator and with the help of this we generate electricity.*

***Key Words*: Small Hydro Power plant, Pelton turbine, renewable sources, Small scale power generation.**

1. INTRODUCTION

In hydro power plant we use the gravitational force of water to run the Pelton turbine which is coupled with electric generator to produce electricity. There an iore various types of turbines used for hydro power generation. Among them Pelton turbine is use on medium to high head sites. Energy from flowing water has been exploited from time immemorial to meet some of the energy requirements. The oil embargo of 1972 triggered the search for alternative energy 22 sources. Small scale hydro energy which had hitherto given way to the development of medium and large hydro projects, engaged the attention more than any other renewable source of energy. [1]

Essentially, on the account of the versatility and convenience of the electrical energy on one hand, and the cheapness and renewability of hydro energy on the other, small hydroelectric power plants have a definite role to play in today's energy scene. The concept of generating electricity from water has been around for a long time and there are many large hydro-electric facilities around the world. What is new to most people is the idea that this same concept will work on a smaller – and even individual – scale. [2]

Worldwide there are literally hundreds of thousands of micro-hydropower sites (up to 100 kW) that could be developed to supply environmentally friendly renewable energy. With the right location, hydro systems can produce many times the power a similarly priced wind or solar system could generate. With special precautions, they can be used virtually year-round, summer or winter. Even a modest output from a hydro system, producing steadily 24 hours a day, will add up to a large cumulative total. Often, peak power use is in the evening when the sun isn't shining and the wind is not necessarily blowing. Batteries can be completely drained by morning with a solar or wind system. With a hydro system located on a year-round creek or river, power is produced steadily around the clock. These are just some of the benefits of hydropower.

2. PROBLEM STATEMENT

Due to increasing needs of luxurious life there emerges a need of electricity generation at a higher rate. Due to low supply of electricity there arises problems of power cut at various places and thus day to day life is affected. Thus, generation of electricity from any source is equally useful due to increasing demands for its use. Electricity can be generated by renewable methods such as water, sunlight, wind.

3. Methodology

First, we will design the Pelton wheel turbine system suitable to our application. We can use the following methods for generation of electricity.

Analytical: Firstly, we need to analyze Pelton wheel turbine system taking into consideration the applications and operational conditions. Then we will analyze the design in ANSYS for static and dynamic conditions.

Theoretical: Theoretically we will calculate all parameters of Pelton wheel turbine as it is the main component of the system.

Experimentally: In our project we will make an experimental setup for effective generation of electricity.

3.1 Block Diagram of Project

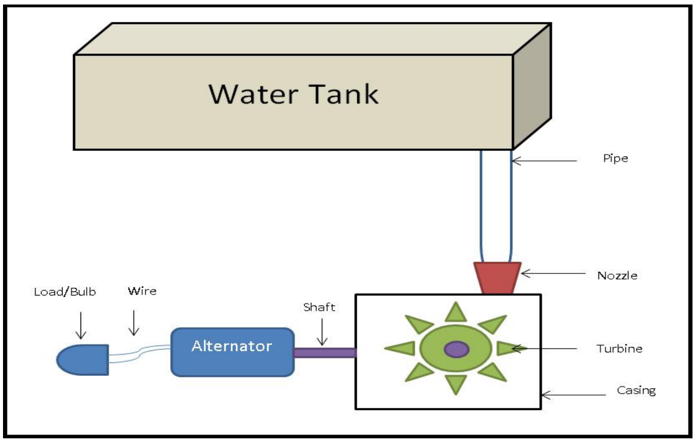

Figure 1 General Block Diagram of Project

3.2 Principle of operation

It works on the principle of converting the kinetic energy of water into mechanical energy which is obtained by rotational movement of impeller and is further converted into electrical energy.

4. Major Equipments

4.1 Pelton Wheel Turbine

Pelton turbine (or Pelton wheel) is among the most efficient impulse turbines and has retained its existence in hydropower for well over a century since it was invented by Lester A. Pelton in 1880.The turbine produces power by utilizing water momentum impinging on buckets mounted on the periphery. Despite its age, the design of Pelton turbine keeps improving and this development is driven by a tough commercial competition between turbine manufacturers and availability of new tools for analysis and optimization. The guidance for designing of Pelton turbine available in the public domain is based on existing know-how. This means that any design improvements were mainly conducted after extensive experimental testing by the trial-and- error approach. However, experimental testing is a very complex task itself. Not to mention the high costs and very longtime scales of manufacturing that would be inevitable part of prototype A. Zidonis, G. A. Aggidis Renewable and Sustainable Energy Reviews 45 (2015)135–144 136 testing. In the recent year's significant effort has been directed towards a better understating of the details of the complex unsteady flow in the runner with the aid of modern numerical modelling known as Computational Fluid Dynamics (CFD).

Figure 2 Pelton Wheel Turbine

4.2 Alternator

An alternator is an electrical generator that converts mechanical energy to electrical energy in the form of alternating current. For reasons of cost and simplicity, most alternators use a rotating magnetic field with a stationary armature. Occasionally, a linear alternator or a rotating armature with a stationary magnetic field is used. [3]

5. Experimental Setup with Working

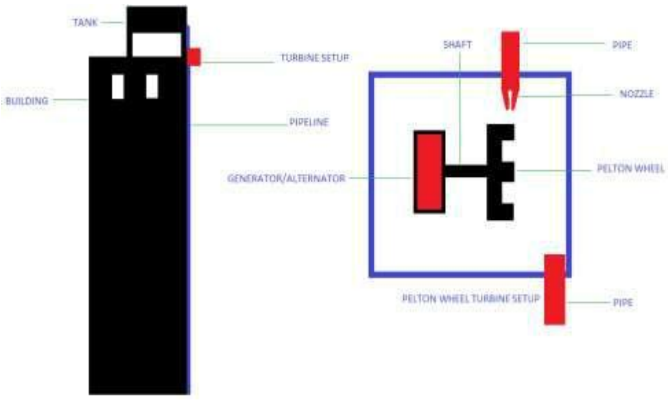

Figure 4 Experimental Setup

Working

Our setup contains a storage tank, suction pipe, motor 1hp, delivery pipe, nozzle, Pelton wheel turbine, and alternator. First off all we switch on the motor and through motor water is transferred from sump to the storage tank through suction pipe. Then slowly water travels downwards as per our use. That water is traveled through a delivery pipe. The nozzle is attached at the other end of the delivery pipe. The water which passes through the nozzle transforms in to a high velocity and low-pressure water jet. This water jet is then injected on the Pelton wheel buckets. Due to the force of the water jet injected on the Pelton wheel buckets, the wheel starts rotating. The wheel is connected to the runner and the runner to the output shaft. And this output shaft is connected to the alternator. The alternator then generates the pulses and the mechanical power converted to the electrical power. This electrical energy is stored in the battery for further use.

One cycle of alternating current is produced each time a pair of field poles passes over a point on the stationary winding. The relation between speed and frequency is N=120f/P, where 'f' is the frequency in Hz (cycles per second). 'P' is the number of poles (2, 4, 6...) and 'N' is the rotational speed in revolutions per minute (RPM). Very old descriptions of alternating current systems sometimes give the frequency in terms of alternations per minute, counting each half-cycle as one alternation; so, 12,000 alternations per minute correspond to 100 Hz.

The output frequency of an alternator depends on the number of poles and the rotational speed. The speed corresponding to a particular frequency is called the synchronous speed for that frequency.

6. Calculation

As we install the project set-up on terrace bellow the tank outlet. So, the head is considered from the Pelton wheel set-up to the outlet of the tank.

So, the head (h) = 2.5 m

Velocity of the jet = $C_V\ (2*g*h)^{1/2}$

$=0.98*(2*9.81*2.5)^{1/2}$

$=6.86$ m/s

Area of jet = $\pi/4(d^2)$

$=\pi/4(0.024^2)$

$=4.52*10^{-4}$

Now, The Discharge (Q) = A*V

$=4.52*6.86$

$=3.1007*10^{-3}\ m^3/s$

Also,

Height of the building = 100m

Length of the pipe =2.5m

Frictional Factor =0.01

Now,

The Frictional head (H_f) $=4flv^2/2gd$

$=4*0.01*2.5*0.86^2/(2*9.81*0.024)$
$=0.15$ m
Total head (H) = $h-h_f$
$=2.5 - 0.16$
$=2.34$
Gravity(g) = 9.81 m/s^2
Power(P) = $\rho*g*Q*h$
$=1000*9.81*3.1007*10^{-3}*2.34$
=75.28 W
Ø Number of buckets
Diameter of pipe(D) = 0.4572
Diameter of jet(d) = 0.024
Jet ratio = 18
No. of Buckets = 15+0.5*18
= 24
By assuming the efficiency, we get
Overall Efficiency = 0.86
Power Output = 0.86*75.28
= 64.74 W

7. CONCLUSION

In our setup we conclude that we are getting free electricity by using Inline Pelton wheel turbine. Here we will not provide any extra resource to generate electricity. So, our project is economic and cost effective. Hence, we will design the micro hydro power plant setup for electricity generation.

8. REFERENCES

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