Microturbine :Fabrication Forefficient Power Generation

Rohit Shriyan, Saurabh Sande, Aniket Dolas, Siddhant Shinde, Madan Jagtap

Abstract : We all know that in India many of the village's still do not have electricity. But many a times it becomes difficult to transfer energy from its source/ plant up to its destination and as the distance increases cost of electricity also goes on increasing. Now to tackle this problem there are many ideas. One of those is to generate own energy from the resources available. But electricity generation can be very costly. No construction of hydro dams is necessary for such an application. As well as in hydro power plants, compact helical turbines can be used in Wind Farms instead of conventional propeller-type machines of huge diameter. So to solve these problems we are making a Microhydro turbine with less initial cost and maintainace cost. So that electricity is available to everyone also in areas where it is not able to reach. Also it` does not required much large land for its setup. The utilization of energy is an indication of the growth of a nation. For example, the per capita energy consumption in USA is 9000 KWh (Kilo Watt hour) per year, whereas the consumption in India is 1200 KWh (Kilo Watt hour). One might conclude that to be materially rich and prosperous, a human being needs to consume more and more energy. A recent survey on the energy consumption in India had published a pathetic report that 85,000 villages in India do not still have electricity. Supply of power in most part of the country is poor. Hence more research and development and commercialization of technologies are needed in this field.

1. Introduction

The energy produced by the world mainly is dependent on non-renewable energy resources. There is very less amount of energy which is acquired from the **hydroelectric plants**. It is because of many resons. Some of the reasons are as follows :-

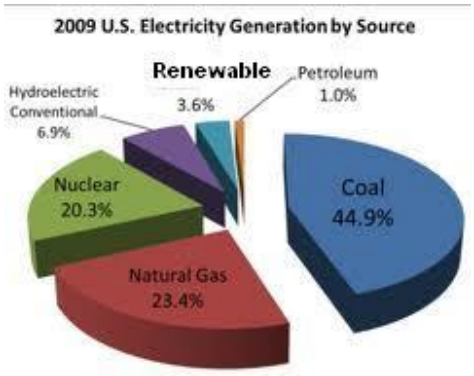

Fig : World energy scenario

- High initial cost
- Requires very large lands
- Many times it is unsafe for nature and humans
- High maintainanace cost

- *RohitShriyan, SaurabhSande, AniketDolas, SiddhantShinde*
- *Department of Mechanical Engineering, Saraswati College of Engineering, Kharghar. siddhantshinde04@gmail.com, snsaurabh25@gmail.com*
- *Prof. MadanJagtap, Department of Mechanical Engineering, Saraswati College of Engineering, Kharghar. jagtap.aero@gmail.com*

2. Literature survey

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Capsone project report on Design and manufacture of cross flow helical turbine ByJosh Anderson, Bronwyn Hughes, Celestine Johnson. A recent survey on the energy consumption in India had published a pathetic report that 85,000 villages in India do not still have electricity. Supply of power in most part of the country is poor. Hence more research and development and commercialization of technologies are needed in this field.

3. Objective

- ❑ Manufacturing of microturbine for efficient energy generation from water flow.
  - Head is not required.
  - Simple design.
  - Installation is easy.
- ❑ Analysis of microturbine (Comparision between the turbines)
  - Variation of efficiency and power generation with various design considerations.
- ❑ Clean source of energy As this turbine has very much requiementsofhead and flow rate and it is aslo efficient thus it is a clean source of energy

4. Purpose

The main purpose for selecting this project is to develop the energy with less requiremenys of heads and flow rate so that it becomes cheap and easily available.

5. Methodology

- ❑ Literature Survey
- ❑ Design of Components to be used such as Blades , struts , shaft , bearings and gantry to mount the turbine by solidworks and other software.
- ❑ Material selection and analysis of the above components and correct its failure using ansys software.
- ❑ Making of the final prototype of the project .

6. Details

There are many microhydro turbines are available. But according to our requirement we have selected a gorlov turbine from a numbers of turbine which has airfoil blades shape and it is helical which gives many advantages as compared to other Microhydro turbine. Because of the following reasons :-

- Self starting ability.
- Gratual rotation of rotor for smooth power generation .
- Simple and efficient design .
- Installation is very easy .
- It does not have parts like casing and nozzle which makes it more cheaper and light weight.

Fig :*Turbine*

- **Blades** :When the water pass over the blade it simply converts the kinetic energy and potential energy of water into the torque which is used for driving the generator shaft. Blades are the Important components of any turbine. It deciedes the overall performance of the turbine .

- **Struts** :- Strut is a structure which supports the blades and which connects blades with the shaft of turbine.It can be of disc plate shape or a longitudinal member which directly connects the blades with the shaft.

- **Shaft :-**It is mechanical element used for transferring torque from turbine to the generator with the help of coupling.

- **Gantry :-** It is frame like structure which supports the turbine in such a way that water should always pass over the blades . It also helps to support the generator.

- ***Generator***:-This final output shaft is coupled with generator which converts mechanical energy in electrical energy. This is finally connected with battery to store up the energy.

7. Mechanism

- Working and installation of turbine is very simple which makes it easy to handle.
- When the water passes over the blades beacauseof airfoil shape and helical shape it tangential drag force is generated which rotates the blades of turbine.
- These blades are connected to shaft via struts .
- Now this rotating turbine shaft having high torque is directly coupled to the shaft of generator through a coupler so that electricity can be generated.

- **Design**
- **F =K_o A V_w^2**
  Where , F = Reaction force in N
  K_o= Constant. In this case K_o is set to about 1.2*ρ=1.2*1000 = 1200 Kg/m^3
  A = Projected area in m^2
  V_w= Water velocity in m/s
- **P =$\frac{2\,\pi\,N\,T}{60}$**
  Where, P = Power in Watts
  N = Speed of turbine in rpm
  T = Torque in Nm
- **$l^2 = (R\,\psi_o)^2 + L^2$**
  Where ,l = Length of blade in m
  R = Radius of turbine in m
  ψ_o= Angle of twist of blade in Degrees
  L = Height of turbine.

T = F R cos α
Where, T = Torque in Nm
F = Force in N
R = Radius of cylinder in m
α = Angle of attack in Degrees

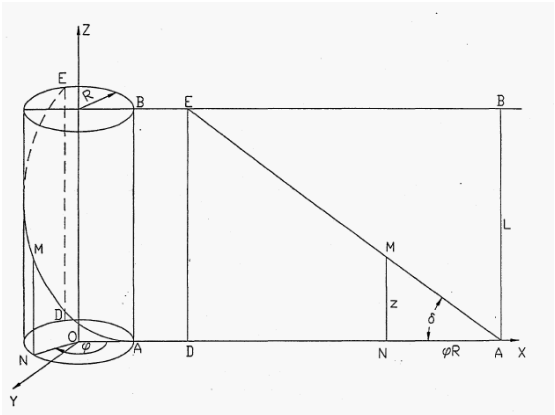


Fig :*Constructional diagram*

Sr. No.	Design parameters	Dimension
1	LENGTH	286 mm
2	DIAMETER	200 mm
3	SOLIDITY (σ)	0.1174
4	L/R	2.86
5	BLADE TYPE	NACA 0018
6	No. OF BLADES	3
7	ANGLE OF TWIST OF BLADE (Ψ)	120˚
8	HELIX ANGLE (Φ)	43.7˚

Design parameters

❑ **CAD MODEL**

CAD model development is one of the important part of our project. We had developed our CAD model in SOLIDWORKS which is a 3-D modeling software.

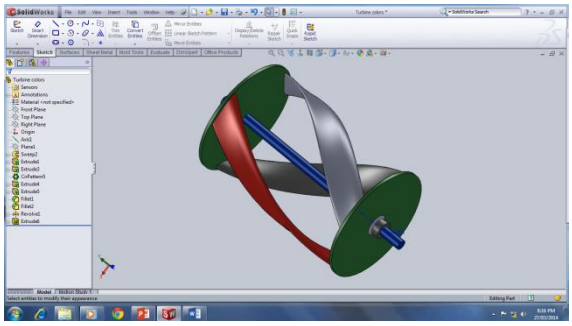


Fig : *CAD Model*

CAD model is useful for product development because before the actual fabrication it gives an idea about our parts concepts, it is also useful for varying the dimensions and properties before fabrication.

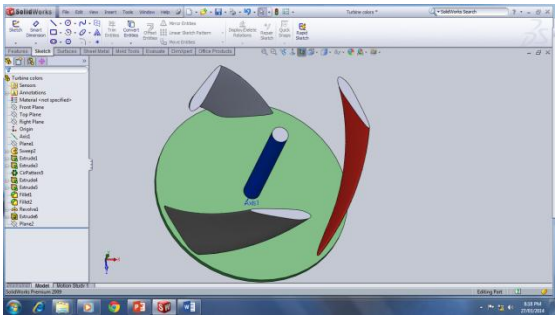


Fig :*Sectional CAD Model*

Sectional CAD model is useful because in our case it gives better views of airofoil.

❑ **Simulation report**

There are many softwares which are used for simulation in Industry. Ansys is one of the most important software which gives most correct analysis report in product development. We had done with our simulation in Ansys which includes development of FEA model , stress analysis, VON MISES stresses, deflection etc.

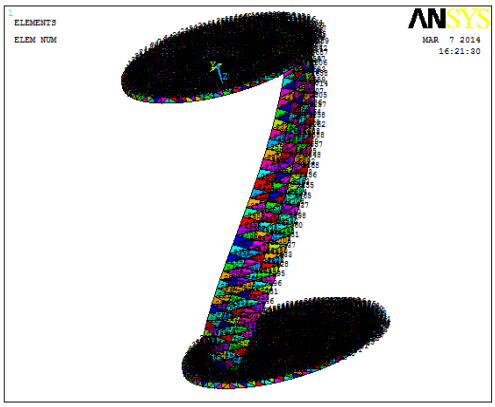


Fig : *FEA Model*

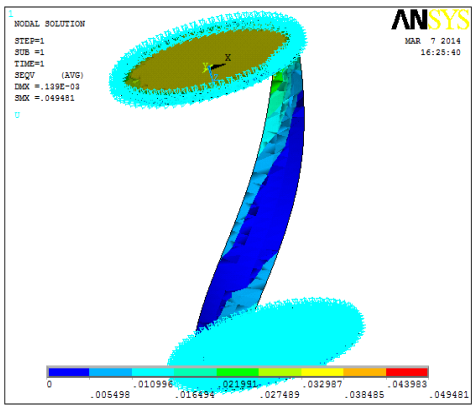


Fig :Vonmises stress analysis

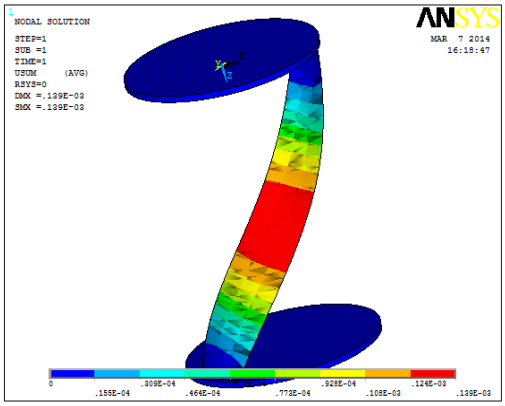
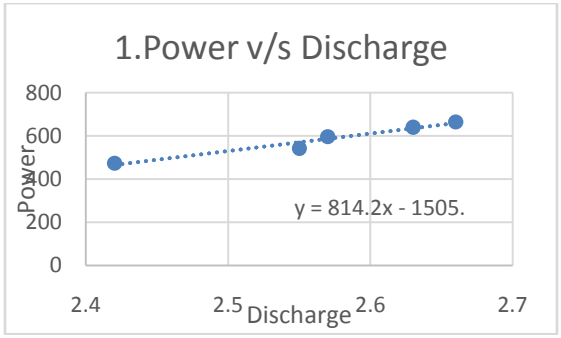


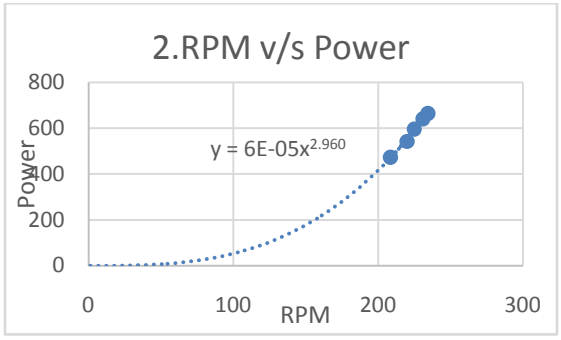
Fig :Deflection analysis

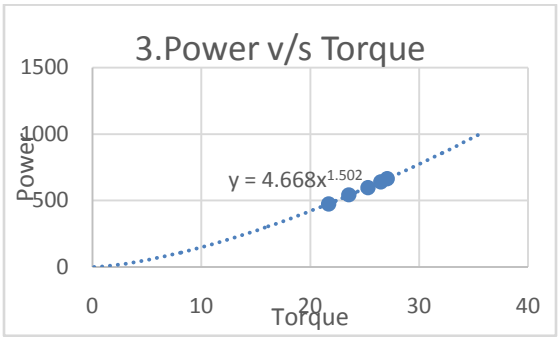
10. Results

No.	RPM	Torque (N.m)	Discharge (m^3/s)	Power (W)
1	220	23.544	$2.55 * 10^{-6}$	542.42
2	225	25.309	$2.57 * 10^{-6}$	596.33
3	208.5	21.678	$2.42 * 10^{-6}$	473.32
4	234.5	27.076	$2.66 * 10^{-6}$	664.9
5	231	26.487	$2.63 * 10^{-6}$	640.73

11. Characteristic curves







11.References

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