

Design and Fabrication prototype of Maglev vertical axis wind turbine

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Abstract: *The main aim of the project is to design and fabricated a prototype vertical axis wind turbine and test the maximum power generated. The positions of the blades of wind turbine is mechanically assembled closer to the rotating shaft, which will have a rotor with required number of blades which is connected to a shaft and coupled to DC Generator through gear mechanism.*

The maglev wind mill uses drag force of wind then it passes through aero foil shaped blades. Aero foil shaped blades used to convert kinetic energy of the wind into the mechanical work. The magnetic levitation used is between the rotating shaft and the fixed base of the machine. This magnetic levitation is reducing the friction loss between the shaft and the bearing then the total wind energy is converted to maximum mechanical work.

Words in focus: *Drag force, maglev wind mill, magnetic levitation, gear mechanism, aero foil.*

1. INTRODUCTION

Power is the main resource in India since last 15 years. The power is generated by using renewable and non-renewable resources. The usage of non-renewable resources is high now days. But it is effects our next generation. Wind and solar energy is the most important renewable energy resources. Around 20% of the world energy requirement is fulfilled by the usage of renewable energy resources. The wind as a free and always available anywhere in this world. And the usage of this resources is very is and it will not affect the world environment. The main aim of this project is effective utilization of the renewable resources.

Main theme of this project is to design and fabricate the magnetic levitation vertical axis wind turbine that has the ability to operate in both high wind speed and low wind speeds conditions and also to check the efficiency of the wind turbine at different angle conditions. Our object in this project is to show the efficiency in varying wind and angle of the blade conditions as compared to the traditional horizontal axis wind turbine. The existing model is levitated in ball bearings. These ball bearings are replaced by the permanent magnetic ball bearings. This levitation will be useful to run the rotating shaft and the wind rotor turbine system. The turbine blades are designed in cylindrical gradually increasing cross section from top to bottom; very light weight material is used for the design of blades and shaft. Shaft also design like a blades increasing cross section from top to bottom.

2. EXISTING MODEL

Fig.1 shows the existing model of the vertical axis wind turbine. Working principal is change the kinetic energy to electrical energy. Basically it is an industrial project. The main drawback of this turbine is the less output as compared with what we are expecting and investing on this project, friction losses due to the contact between rotor and shaft, in high speed winds shaft is going to swing, due to balancing of the shaft.



Fig-1: VAWT

3. DESIGN AND PRO-E MODEL

Vertical axis wind turbine model is developed by PRO-E software. PRO/ ENGINEER are 3D CAD/CAE feature based solid model software. It is one of the applications to providing the assembly modelling, any orthographic 2D views, finite element method analysis, parametric and the direct modelling. This wind turbine designed in PRO-E by using creo 3.0 versions. Assembly of vertical axis wind turbine as shown in the Fig.2

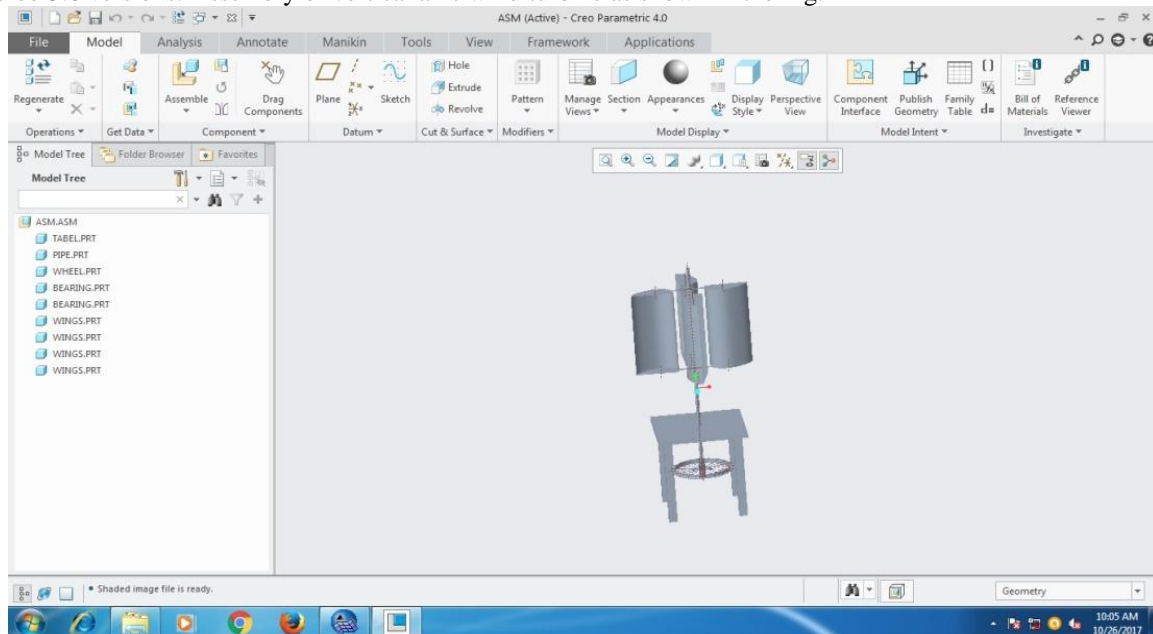


Fig-2: Design of VAWT in PRO-E

Main parts of vertical axis wind turbine are shaft, rotor blade, rotors, bearings, pulley, stand are designed in the PRO-E software. And assembled this all parts are assembled by using PRO-E software. The designed model as shown above Fig.2.this software takes less time and very easy to create parts and assembly.

4. MODIFIED MODEL



Fig-3: Modified model of VAWT

The modified model of vertical axis wind turbine as shown in Fig.3 it consist of blades, pulley, permanent magnetic dynamo, shaft, stand, rotors, pulley. Here the pulley and dynamo connected with driven belt. Shaft is attached to the pulley by contact of bearing to avoid the friction between the pulley and shaft, and at top of the shaft rotors are attached at suitable distance. Rotor blades are rigidly fixed to the rotors at the blade angle is 15° and in this setup Omni metre is not used to measure the velocity flow of air and direction of flow.

The modified model of vertical axis wind turbine as shown in the Fig.3 the main basic components of vertical axis wind turbine as follows:

- 1) Permanent magnet Dynamo
- 2) Shaft
- 3) Rotor Blade
- 4) Bearing

4.1. PERMANENT MAGNET DYNAMO

The dynamo uses to convert the mechanical rotation of the shaft due to wind into a direct electrical current through Faraday's law of induction. The principal of conversion of energy in the form of rotating coils of wire and magnetic fields. A basic dynamo machine consists of a stationary structured stator and set of rotating windings. The stator provides a constant magnetic field. The dynamo used in this experiment as shown in the Fig.4 below. The specification of this dynamo is Voltage-12 Volts, power of dynamo is-300Watts, Max RPM is-1500RPM and Max O/P voltage-36 Volts.



Fig.4 Dynamo

4.2 SHAFT

The vertical axis wind turbine shaft as shown in the Fig.5 below in actual case of vertical axis wind turbine the height of the shaft is Min 5m and Max is 20m. But in this case the tower height is 2.3m. Diameter of the shaft is 30mm. material of the shaft is Alloy steel.



Fig.5 Shaft

4.3 ROTOR BLADES

Design of the blades in any turbine is very important in our vertical axis wind turbine we used tin material for blades. Because it is a malleable, ductile and highly crystalline structure (Tetragonal).it is easily pulled or stretched into a thin wire; good transmission of heat or electricity, very soft and it resists corrosion from water. The dimension of the rotor blades in this case is as follows:

1. Length - 900mm
2. Thickness - 3mm
3. Slope angle - 180°
4. Bend angle - 15°
5. Diameter - 330mm

The rotor blade as shown in the Fig.6



Fig.6 Rotor Blade

4.4 BEARINGS

The bearings are used for smooth operation of shaft. To avoid friction between shaft, rotor and pulley. In this model used bearings has inner diameter of 3.5cm and outer diameter of 7.2cm. Bearings are generally provided for supporting the shaft and smooth operation between the connecting parts. The used bearings in VAWT as shown in the Fig.7 below



Fig. 7 Bearings

5. CALCULATIONS

Mainly in wind turbines power calculation is the amount of kinetic energy per hour.

$$\text{Kinetic energy } K.E = \frac{1}{2} * m * V^2$$

$$\text{We know that the mass of air } m = \rho * A * V$$

$$\text{Therefore the kinetic energy } K.E = \frac{1}{2} \rho * A * V * V^2$$

m = mass of air transverse (kg/s)

A=Area swept by the rotating blades of wind mill type generator (m^2)

ρ = Density of air (kg/m^3)

V= Velocity of air (m/s)

Therefore the power generation in the turbine is calculated by the following equation in Watts

$$K.E = \frac{1}{2} \rho * A * V^3$$

$$\text{Thus area } A = \frac{\pi}{4} * D^2$$

D=Diameter of the blade

Estimated power generation in turbine is

$$P_e = \frac{\rho * \pi * D^2 * V^3}{8}$$

6. RESULT

Results are taken on the basis of giving external wind flow by fan. The values are taken at different wind flow velocities from minimum wind flow energy(5m/s) to maximum wind flow(25m/s) for the duration 1 hour the approximate power generation at low velocity(5m/s) wind flow is 4.592watts and at high velocity(25m/s) wind flow 965.74watts

7. CONCLUSION

Over all, the magnetically levitated vertical axis wind turbine was a success. The rotor blades that were designed harnessed enough air to rotate the stator at low and high wind speeds while keeping the blades closer to the rotating shaft and the base yielding stability. The wind turbine rotors and stator levitated properly using magnets which allowed for a smooth rotation with negligible friction at moderate wind speeds power outputs is low as compare, to the theoretical values. But at high speeds it gives the better power output at the blade angle 15° . After testing the project as an overall system we found that it functioned properly but there feel limited the amount of power output at low wind velocity.

8. REFERENCES

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