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# DESIGN AND CONSTRUCTION OF VERTICAL AXIS WIND TURBINE

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*Abstract :* The principal objective of this project is Rural Electrification via hybrid system which includes wind and solar energy. Our intention is to design a wind turbine compact enough to be installed on roof tops. So, we decided to design a vertical axis wind turbine (VAWT). Advantages of VAWT over HAWT are compact for same electricity generation, less noise, easy for installation and maintenance and reacts to wind from all directions. The wind turbine designed to generate electricity sufficient enough for a domestic use. The electricity generated will be stored in the battery and then given to the load. This project emphasizes on electrification of remote areas with minimum cost where load shading still has to be done to meet with demand of urban areas.

## I. INTRODUCTION

Energy plays an important role in everyday life to carry out any task. The non-renewable energy resources such as oil, coal and gas are majorly used as energy nowadays. The main problem behind the non-renewable energy resources are not sustainable and create global warming which is hazardous to the environment. The renewable energy resources are best way to solve this issue. The renewable energy resources such as solar, wind, tidal and bio gas are available in abundant and sustainable which can be utilized for the requirement. Wind energy is the purest form of renewable energy which is available highly for the production of electricity. Wind is the natural resources which cannot affect the environment. Most of the countries including India understand the importance of wind energy and used as a primary source of renewable energy because of low cost compared to other renewable energy resources. The wind energy is produced by converting the kinetic energy of atmospheric air into mechanical energy. The vertical axis wind turbine (VAWT) and horizontal axis wind turbine (HAWT) are the turbines used to convert the mechanical energy from the kinetic energy.

## II. VETRICAL AXIS WINF TURBINE

The vertical axis wind turbine (VAWT) is used for domestic purpose and low volume of production. VAWT requires low-cost investment and less space for the installation compared to HAWT. The rotational axis of vertical axis wind turbine is perpendicular to the direction of wind. It can produce electricity at low wind speed. The maintenance of vertical axis wind turbine is quite easy compared to horizontal axis wind turbine. The efficiency of VAWT is optimal so it cannot be utilized for larger volume of production. The main advantages of VAWT compared with HAWT are generation of electricity at ground level and the way of installation is simple.

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## III. METHODOLOGY

In small-scale residential or rural applications, the use of small wind turbines for the production of electricity is a common practice. A small vertical axis wind turbine is placed on the rooftop of the residential house. VAWT is placed at a position where wind speed is maximum. The wind turbine is designed in such a way that it will rotate even when there is a minimum amount of wind speed available. The turbine is will rotate irrespective of the direction of the wind. The turbine is attached to the rotor of the alternator by using gears. Whenever the turbine rotates with the help of the wind kinetic energy is delivered. This kinetic energy is converted into electric energy with the help of the alternator. The output of the alternator is in AC, this AC voltage is converted into DC with the help of an AC to DC converter. The energy converted is stored in a battery, which can be used whenever there is a shortage of electrical energy or can be used as backup power. The different parts of the project are explained below:

- Turbine Blades
- Setup Arm
- Shaft
- Gears

**3.1 Turbine Blades**

Turbine blades are selected such that most of the air wetting blade surface should create drag so enough torque should be produced to drive the alternator. The design is a rectangular sheet rolled in semicircle. Three blades are made in such way. The reason for making the blades rectangular and rolling them is to make the air wet on one blade in order to give the force to the blade behind it. In this way at low velocities some rpms are gained and efficiency of the turbine can be improved.

**3.2 Setup Arm**

The setup arms are constructed at the columns which serve our alignment requirements of the rotor. Specific systems are needed to be installed for easy assembling and dismantling of blades and shaft. The material used for fabrication of setup arms is strong plastic because of its light weight and high strength. To fasten the shaft with the arms, 15 cm screws are used. There are two setup arms that are designed, one for the top and another for the bottom which goes through 900 apart from each other. In our design we have used length of each arm as 186 cm approximately to the ratio length and size of the rotor and blades weight. After this, we adjusted the assembly to get better wind effect over the blade area and less deformation of the arms. This deformation arises due to arms bending in case of force over the structure of rotor.

**3.3 Shaft**

Shaft is a rotating element of machine which is used to transmit power from one point to another. Due to the tangential force of the wind, the power is delivered to the shaft and transmitted to the various members that are linked to the shaft. To transfer the power from one shaft to another (Generator Shaft), various members such as pulleys, gears etc. are mounted on it. This member causes the shaft to rotate. In other words, the shaft is used for the transmission of torque and bending moment.

**3.4 Gears**

We have used two gears for torque transformation. The driver gear [70 teeth] is attached to the rotor shaft while the driven gear [19teeth] is connected to the generator shaft . In order to achieve 150 rpm, we adopt the gear ratio of 1:3. Gears 4.

**3.4 Assembly Procedure**

Firstly, we considered the base should be the starting point of our assembly. Then we installed the shaft of the turbine rotor into the base and made sure that the shaft is stable. To prevent friction between the shaft and the base we installed two steel bearings for the upper and lower structure of the shaft. Also, these bearing aids to improve the efficiency of the rotor rotation. The first step is to construct base using welding machine in a rectangular shape in order to resist the structural load to provide more stability. Finally, we assembled the ac generator with the wind turbine that is connected to a gear of bigger diameter as shown in figure. The aim of this generator is to convert the rotational power of the wind turbine and transfers it to dc source where voltmeter measures the current and the power is generated.


**Figure 2: Practical Model of Project**

**IV. RESULTS**

The VAWT is designed and fabricated in such a way that it can able to capture wind from all the directions, power developed from the project is stored in a battery. The efficiency of VAWT can be increased by changing the size and shape of the blade, the theoretical and experimental result is varying because, we will be considering wind is hitting all the three turbine blades, but practically it is hitting only one turbine at a time.

**V. CONCLUSION**

Our work and the results obtained so far are very encouraging and reinforce the conviction that vertical axis wind energy conversion systems are practical and potentially very contributed to the production of clean renewable electricity from the wind even under less-than-ideal siting conditions this project will be helpful in rural areas where the electricity supply is scarce. Also in most cities, bridges are a faster route for everyday commute and in need of constant lighting makes this an efficient way to produce energy.

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