



To Harvest Maximum Amount of Wind Energy by Modification in Its Design

Kalariya Parth Rohitbhai^a, Kalariya Prince^b, Ladani Keyur^c, , Bhalodiya Harsh^d, Goswami Prince^e, Ladani Dhyey^f, Gajera Meetkumar^g, Chahwala Smit^h

^a Kalariya Parth Rohitbhai, LDRP-ITR, Gandhinagar-382015, India

^b Kalariya Prince, LDRP-ITR, Gandhinagar-382015, India

^c Ladani Keyur, LDRP-ITR, Gandhinagar-382015, India

^d Bhalodiya Harsh, LDRP-ITR, Gandhinagar-382015, India

^e Goswami Prince, LDRP-ITR, Gandhinagar-382015, India

^f Ladani Dhyey, LDRP-ITR, Gandhinagar-382015, India

^g Gajera Meetkumar, LDRP-ITR, Gandhinagar-382015, India

^h Chahwala Smit, LDRP-ITR, Gandhinagar-382015, India

ABSTRACT

Wind energy is one of the best non conventional energy sources as in this energy there is no issue of any kind of pollution. As in thermal power plant extreme pollution is created by the combustion of coal and it is very dangerous for the human kind because this pollution leads to the cancer and dangerous disease. The main target of this paper is to introduce the importance of wind energy and spread the energy availability as a natural source. To generate power from the wind number of efforts are done with the help of windmill still there are some problems for the windmill to extract wind

Efforts are done to change in the design of wind mill blade but what kind of design is effective to extract the power of wind is very important. Developer are doing hard work for the new generation design and also they are trying to develop less friction components which are in the rotational motion and the components which are transmitting power to the next sequence

Windmill is developed as per the location of geographical area and speed of the wind in that area. Now horizontal Axis wind mill and vertical Axis wind mill are in the latest trend but both the wind mills can work as per condition of the wind velocity of that area. Low wind speed it is not desirable for the maximum power generation for that wind power plant and the other side high speed wind is effective compared to the low speed wind but extreme high speed of the wind can damage the rotational components of the wind turbine.

So one should take in mind that speed of the wind should be optimised and it must be extracted by the blade as per the design data. This will give better efficiency to the developer and also create less noise to the concerned geographical area. Aerofoil shape of the blade is the best design as per the new trend and till some changes are going to be taken the existing design that will make the blade more effective.

Keywords: Wind mill, HWAT and components, Wind speed, Power generation, Losses due to friction, Maximum wind velocity.

1. Introduction.

Nowadays wind energy is utilised widely. It is a way to generate power by non conventional way. Also in this way there is no issue of pollution. But developer has to develop the proper wind mill design to harvest the power of wind. Wind energy is a continuous source of energy of nature but there may be change in the velocity of wind as per the geographical area. Wind pressure affects the velocity of the wind. To harvest wind power horizontal axis wind turbine and vertical axis wind turbines are used and they are very familiar for the developer.

Horizontal Axis wind turbine and vertical Axis wind turbine have some personal technical problems also weight of the turbine blades is most

* Corresponding author. Tel.: 98258 48387; fax: +0-000-000-0000.

E-mail address: neel_me@ldrp.ac.in

critical technical issue. Developers are trying to make blades of the turbine from the nano carbon material but issue is that price of that material is too much high. Other side different composites material are also available that can make the blades less bulky. In India there large possibility of harvesting wind power but due less awareness of the people Our Government is not fully successes in this way of generating energy.

Nomenclature	
WT	Wind turbine
V _{max}	Maximum speed of wind
V _{min}	Minimum speed of wind (%)
W	Work of the rotor
H _w	Height of tower
Q _w	Flow rate of wind
g	Force due to gravity
W _s	Weight of the whole system .
A blade	= Blade area in [m ²]

2. Components of wind Turbine

Foundation

Foundation of the wind turbine is very important component of the windmill because it must be capable to transmit all the forces and load to the soil without disturbing the whole construction. The windmill concern with offshore turbines and their base is constructed under the sea and it's foundation cannot be easily seen but the upper portion is in the floating condition and this portions is sufficient strong to provide support to the tower and hole construction and also it will make the whole unit exactly 90 degree compared to the earth level.

Tower

The turbine tower is made maximum 5 meter height and it is mostly made from the steel with higher grade. Reason behind the best quality steel is to concern with high temperature during the day and also monsoon rainy effect on the material. Height of the tower is decided by the diameter of the blade while it is in operation. Simply when the rotor of the turbine is in the operation, at that time the imaginary circle is formed by the rotation of the blade, at this moment the diameter is decided and the height of the turbine also concluded by this diameter. This will help the turbine to extract maximum amount of the wind at the time of operation.

Rotor

Rotor is mostly made with three blades reason behind the three blades as its maximum efficiency and also dynamically better balance at the time of various forces. It is not necessary that developer has to make 3 blades every time but in most of the cases developer choose the number of blades is three. There is various numbers of rotors with for 5 or 6 blades are available in the market. Blade can rotate up to 90 degree to the axis of that component and this 90 degree of motion of blade is known as blood pitch.

One should keep in mind that the blade of the turbine is made from the hollow material and reason behind that the rotor can rotate at higher speed when the weight of the overall unit of rotor will be less. As per the concern of this concept developer is making blade from the hollow material and mostly they are using composite material so blades of the turbine are lower in weight and also they have extra ordinary strength so these blades can withstand the number of forces and also that can resist the storm.

Hub

This is component on which whole rotor unit stands and comes into action at the time operation.

Nacelle

Gear box is the important thing that is the reliable for the power generation at the time wind flow. This is the portion of the turbine on which electromechanical components are managed and it is providing enough space to the whole unit for their better performance. Nacelle is providing the space to the generator and shaft for their operation. In recent trend the generator is available with high speed shaft rotation.

Yaw mechanism is provided in the turbine. Direction of the wind is continuously changing as per the change in the time -blade of the turbine cannot face the wind at 90 degree then definitely there will be reduction in the efficiency of the wind turbine Therefore developer has to make such a mechanism that can continuously rotate the blade and whole unit and can put that unit exactly 90 degree to the direction of wind so turbine can get its maximum efficiency and it will do better output. This automatic control mechanism is known as yaw mechanism.

Generator

This is the component that converts the mechanical energy of the rotor to the electrical energy and it is component that exactly giving the same output as one can get in the electric motor. Synchronous generator needs a continuous supply of wind at constant speed therefore in a new trend induction generator is used because this generator can work at different speed of the wind. For the working of gear box, better and constant wind speed is required and this thing is not practically possible. This will create uneven forces to the teeth of the gear box and it will damage the components of the gear box. So one has to keep in mind the smooth operation of the gear box should take place for better performance of the whole unit. As less wear takes place so overall cost of the maintenance of the system will be reduced.

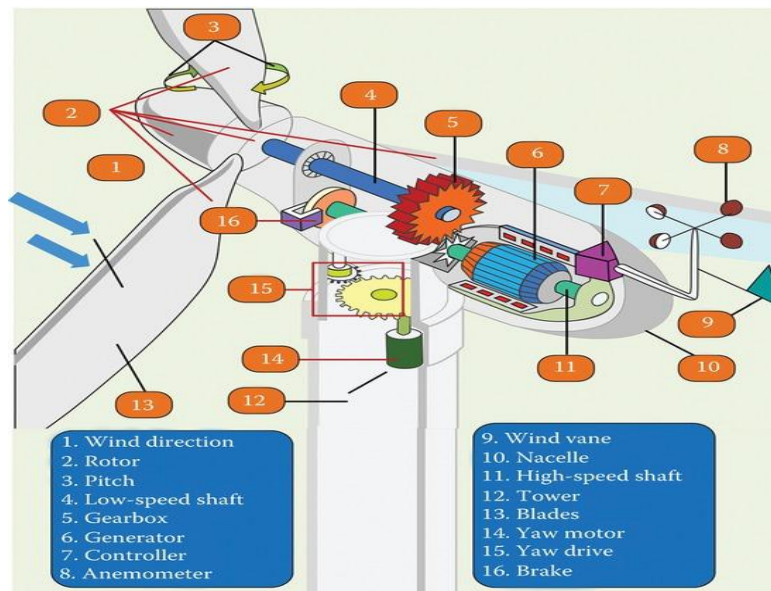


Figure 1 components of the turbine

2. Horizontal axis wind turbine

HWAT is used to convert kinetic energy of wind into electrical energy. This will swap the wind to the upward or downward direction as per design of its aerofoil shape. In the aero plane there is generation of the upward lift force, the same phenomena is used in the HWAT and this lift force will rotate the blades of the turbine. This wind turbine can rotate any of the direction of the wind ad its direction has been changed as per wind direction. Blades of the turbine are made from Fiberglass reinforced polyester. In this turbine weight of the blades are less due to fiber materials. Yet less weight , the strength of the blade is not affected.

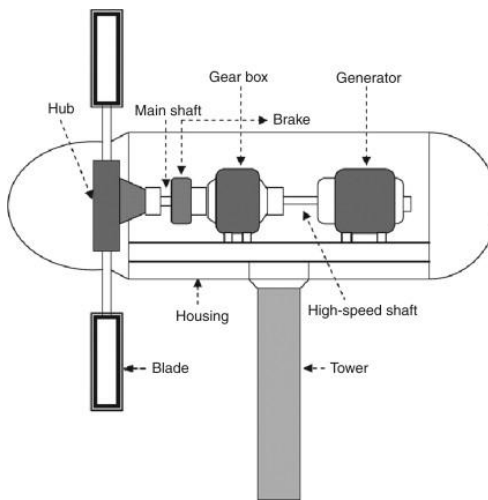


Figure 2 Horizontal axis wind turbine

Developer should keep in mind that whenever conversion of energy takes place there will be always losses of energy. In Wind turbine there is availability of wind energy and this energy is converted into electrical energy so there is always loss and as per the laws of thermodynamics full energy conversion is not possible.

2.1 Modification of Composite material blades for better performance

In a new trend single beam design is very famous due to its fast working of operation. In an open space it can come into operation very fast and also close its blades when the speed is too high. It gives the better power generation due to the air lifting effect. In a new system active vibration isolators are used to reduce the vibration in the rotor. If the rotor can work with less vibration then there will be a decrease in the friction between the rotating parts and overall maintenance of the rotor and whole system will be reduced due to less vibration. New techniques applied with isolators are installed near the rotor and hub for the reduction in the vibration. Advanced material for the blade is also used to reduce the overall weight of the rotor.

2.2 Selection of blade material

Rotor blades are very important and are concerned with the aspect of the turbine cost. Costing of the plant is directly concerned with the rotor blades material because if blades are not sufficient capable to swap the wind then overall power generation will be reduced and on the other side if blades are bulky then the rotor cannot rotate with the required speed so the developer has to take in mind that the blade must be made from the lower weight material. In a new trend Carbon fibre is available, but the issue is that this material is not fully recyclable. So after utilisation it will create an adverse effect on the nature. This will also lead to human-kind to global warming. So the selection of the material is also important as well as the design of other parts.

3. Vertical axis wind turbine

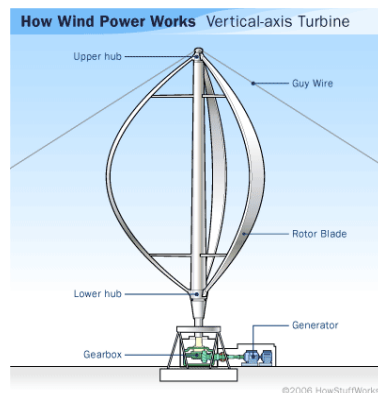


Figure 3 Vertical axis wind turbine

Vertical Axis wind turbine is almost similar to the horizontal Axis wind turbine. Mainly direction of the Blade is different compared to the horizontal Axis wind turbine. In vertical Axis wind turbine blades are arranged to the vertical direction when in the horizontal Axis wind turbine blades are arranged in horizontal direction. Vertical Axis wind turbines blades are cheaper to manufacture compared to the horizontal Axis wind turbine and also these blades are easy to transport so this turbine can be installed at higher speed and waiting period of installation can be reduced. Also there is another advantage is that this turbine can work with the low wind speed so it creates less damage to the people and nature.

4. Conclusion

Aerofoil shape of the blade is really a great design for the better harvestmen of wind power. Till number of factors are related to the design of blade of turbine like drag force lift force and other parameters. Wind is striking to the blade and then lift force is generated in proper way then and then the rotor can rotate with its maximum rotational speed. As per new design criteria the maximum rotation of the rotor is 30 rpm and till developer is trying to enhance the rotation of rotor by reducing the weight of the rotor. Composite material is one of the best option to make the blades of the turbine. Carbone fibre and nano fiber materials are well known for the blade manufacturing materials. But cannot be recycled fully and create bad effect to the earth. Aerofoil shape is still better option and CFD analysis is going on for flow analysis of win. Fluent software is also useful to carry out path flow direction and making blade better as per the requirement.

Acknowledgements

We are thankful to of Team members and staff of our Institute for helping us in this article. The team member of other team also helped us for the preparation of the paper and guided us about the same.

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