POWER GENERATION BY USING HIGHWAY VERTICAL AXIS WIND MILL

N. VENKATA SUBBAIAH[1], M.L.S DEVA KUMAR M.Tech, M.B.A, Ph.d [2],

[1]*PG Student, Dept. of mechanical (Energy Systems), Jawaharlal Nehru technological university, anantapuramu, Andhra Pradesh, India.*

[2] *professors, Dept. of mechanical engineering, Jawaharlal Nehru technological university, anantapuramu, Andhra Pradesh.*

ABSTRACT:

Energy is an important aspect in our every day's life. The resources we use are limited where as the population consuming the same is increasing day by day. Therefore there is a need of finding a way to establish a relationship between a natural resources and growing population. In this context wind energy play the vital role in maintaining the relationship between human being and a energy requirement. Wind energy is free of cost and available with ease. Tapping of wind energy is essential for the conservation of other non-renewable resources. Wind energy has been harnessed for centuries but it has only emerged as a major part of our energy solution quite recently and this project focus on utilizing wind energy by using vertical axis wind turbine.

This energy is available in highways, this highways can provide a considerable amount of wind energy to recapture this wind from vehicles while in moving. In the objective of the project, in the present work, vertical axis wind turbine (VAWT) is designed and fabricated as per the specification, the VAWT blades are designed with aerofoil shape, with less weight and more stiffness, the assembled VAWT is mounted on the highways of a divider, so that the air velocity obtained from the moving vehicle is sufficient enough to cut the turbine blades, VAWT is a special purpose wind mill, this are designed in such a way that the vehicle moving on both the sides of highway are capable to cut the blades of VAWT, the blades are connected to the shaft intern connected to the generator, it generates the power maximum speed of the generator is 500 rpm, if the generator rotates with full speed it gives an output of 14.5 volts. To generated power, this power developed by the VAWT is stored in battery, the power is used for road lamps and many different application some useful application.

I. INTRODUCTION

The main aim of this project is fabrication of a highway windmill. This project converts wind energy into electrical energy. The electrical energy produced here is used to drive the home appliances.

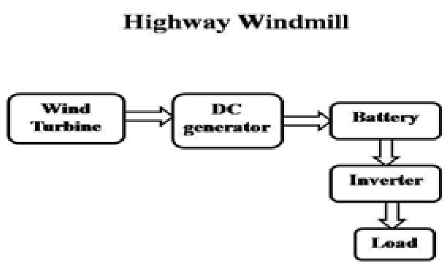
A windmill is a type of engine. It uses the wind to make energy. To do this it uses vanes called sails or blades. The energy made by windmills can be used in many ways. These include grinding grain or spices, pumping water and sawing wood. Modern wind power machines are used to create electricity. These are called wind turbines. Before modern times, windmills were most commonly used to grind grain into flour. The windmill has been in history for many years.

A wind turbine is a device that converts the wind's kinetic energy into electrical energy. Wind turbines are manufactured in a wide range of vertical and horizontal axis types. The smallest turbines are used for applications such as battery charging for auxiliary power for boats or caravans or to power traffic warning signs. Slightly larger turbines can be used for making contributions to a domestic power supply while selling unused power back to the utility supplier via the electrical grid. Arrays of large turbines, known as wind farms, are becoming an increasingly important source of intermittent renewable energy and are used by many countries as part of a strategy to reduce their reliance on fossil fuels. An electrical generator is a machine which converts mechanical energy into electrical energy. Induced EMF is produced in it according to Faraday's law of electromagnetic induction. This EMF causes a current to flow if the conductor circuit is closed. An inverter is an electronic device or circuitry that changes Direct Current (DC) to Alternating Current (AC).The input voltage, output voltage and frequency, and overall power handling depend on the design of the specific device or circuitry. The inverter does not produce any power; the power is provided by the DC source. It just converts direct current into alternating current.

In this project wind turbine uses wind's kinetic energy and converts into mechanical energy. This highway windmill uses wind energy generated by the moving vehicles and converts into mechanical energy. The DC generator converts the mechanical energy into electrical energy. Inverter converts direct current into Alternating current and this is used to drive the home appliances.

Hardware Description

The following shown in figure 1.1 of the project and design aspect of independent modules are considered. Block diagram is shown in fig



The Main Blocks of this Project are

- Wind turbine.
- DC Generator.
- Battery.
- Inverter.
- Load.

The difference between DC and AC electricity

When science teachers explain the basic idea of electricity to us as a flow of electrons, they're usually talking about Direct Current (DC).

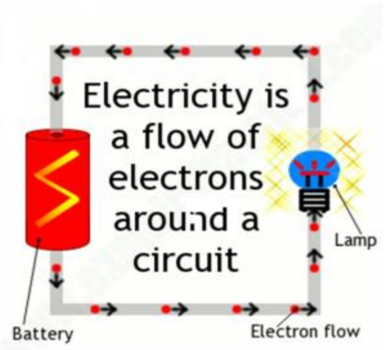


Fig: 1.6 Electrons flow around circuit

II CHAPTER
WIND TURBINE

Wind results from air in motion. Air in motion arises from a pressure gradient. On a global basis one primary forcing function causing surface winds from the poles toward the equator is convective circulation. Solar radiation heats the air near the equator, and this low density heated air is buoyed up. At the surface it is displaced by cooler more dense higher pressure air flowing from the poles. In the upper atmosphere near the equator the air thus tend to flow back toward the poles and away from the equator. The net result is a global convective circulation with surface winds from north to south in the northern hemisphere. Wind energy is rapidly emerging as one of the most cost-effective forms of renewable energy with very significant increases in annual installed capacity being reported around the world.

Local winds are caused by two mechanisms. The first is because of land and water. Solar isolation during the day is readily converted to sensible energy of the land surface but is partly absorbed in layers below the water surface and partly consume in evaporating some of that water. The land mass becomes hotter than the water, which causes the air above the land to heat up and become warmer than the air above water. The warmer lighter air above the land rises and the cooler heavier air above the water moves into replace it. This is the mechanism of shore breezes. At night, the direction of the breezes is reversed because the land mass cools to the sky more rapidly than the water, assuming a sky. The second mechanism of local winds is caused by hills and mountain sides. The air above the slopes heats up during the day and cools down at night, more rapidly than the air above the low lands. This causes heated air the day to rise along the slopes and relatively cool heavy air to flow down at night.

Wind turbines convert the wind's kinetic energy into electricity power through a mechanical means. Wind technology is adaptable and versatile and can be one of the most cost-competitive renewable energy technologies when produced on a large scale (wind farm). Smaller systems work very well when combined with a solar array, as cloudy days are often windy and a hot sunny day may not contain a steady breeze.

Vertical Axis Windmill

Vertical axis wind turbines (VAWTs) are a type of wind turbine where the main rotor shaft is set traverse, not necessarily vertical, to the wind and the main components are located at the base of the turbine. This arrangement allows the generator and gearbox to be located close to the ground, facilitating service and repair. VAWTs do not need to be pointed into the wind, which removes the need for wind sensing and orientation mechanisms. Major drawbacks for the early designs (Savonius, Darrieus and giromill) included the significant torque variation during each revolution, and the huge bending moments on the blades. Later designs solved the torque issue by providing helical twist in the blades.

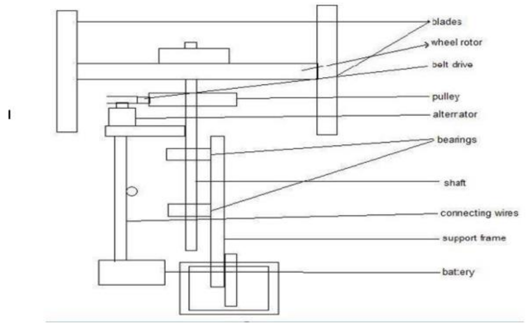


Fig:2.1 Line diagram of Vertical axis wind mill

Types of Vertical Axis Wind Mills

- **Savories type wind mill:**
- **Darrieus type windmill:**

Fig:2.2 Savonieus type VWAT

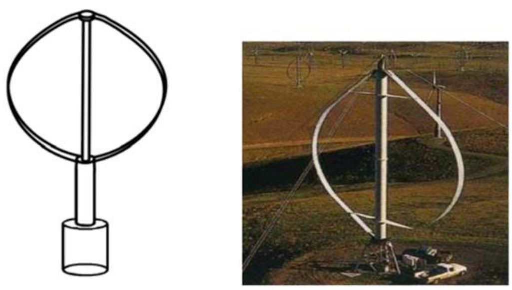


Fig:2.3 Durrieus type VAWT

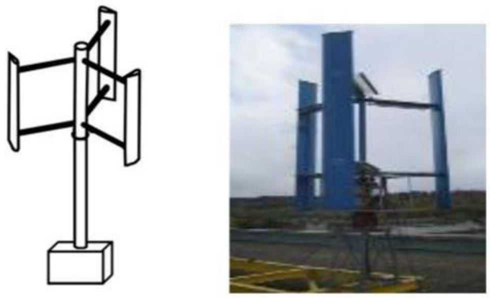


Fig: 2.4 Giromill type VAWT

Various Vertical axis wind turbines

Fig: 2.5 various types of VAWT

Fig: 2.6 Giromill type VAWT

Maximum Power

The total power cannot be converted to mechanical power. Consider a horizontal-axis, propeller-type windmill, henceforth to be called a wind turbine, which is the most common type used today. Assume that the wheel of such a turbine has thickness b. Let pi and VI are the wind pressure and velocity at the upstream of the turbine. Ve is less than VI because the turbine extracts kinetic energy.

Considering the incoming air between I and A as a thermodynamic system, and assuming that the air density remains constant (since changes in pressure and temperature are very small compared to ambient), that the potential energy is zero, and no heat or work are added or removed between I and A, the general energy equation reduces to the kinetic and flow energy-terms only.

The Principles of Conversion

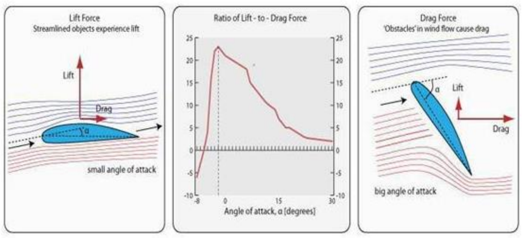


Fig: 2.7 Principles of conversion

III CHAPTER
LITERATURE REVIEW

The use of wind energy for energy generation is one of the oldest methods for harnessing renewable energy. Use of renewable energy is an essential ingredient of socio-economic development and economic growth. Renewable energy sources such as wind energy, tidal energy etc. is abundant and can help in reducing the dependency on fossil fuels. With increased concern for environment now days led to the research for more environment friendly sources of energy and with this considerations wind energy can be considered as a viable option in this regard. Different configurations of wind turbines such as horizontal axis wind turbine and vertical axis wind turbines are mainly used for energy extraction. Horizontal axis mainly used in large scale applications and thus its implementation is generally a concern due to huge installment setup and initial cost; whereas vertical axis wind turbines offer promising solution for smaller ruler areas or medium sized residential spaces. Energy generation from wind turbines will surely be affected by geometry of blade it is using and its orientation in turbine. For effective use of turbine both parameters should be optimally set and determined. This review work focuses on various stages for design and development of highway vertical axis wind turbine which will studies various parameters such as general wind energy scenario, different available energy extraction methods, design and aerodynamic performance analysis of highway vertical axis wind turbines. Project work will include design parameters of highway vertical axis turbine blades considering different parameters such as geometry orientation in assembly.

Literature Survey of Vertical Axis Wind Turbines

The literature review pertaining to the pure experimental aspects of wind turbine and the literature related to experimental methods.

D.A. Nikam et al. analyzed the on design and development of vertical axis wind turbine blade. This paper explains that the wind mill such as vertical and horizontal wind mill is widely used for energy production. The horizontal wind mill is highly used for large scale applications which require more space and huge investment. Whereas the vertical wind mill is suitable for domestic application at low cost. The generation of electricity is affected by the geometry and orientation of the blade in the wind turbine. To optimize this by setting the proper parameter for the blade design. The experimental result indicates that the blade plays critical role in the performance and energy production of the turbine. The optimized blade parameter and its specification can improve the generation of electricity.

Altab Hossain et al. investigated the design and development of A 1/3 scale vertical axis wind turbine for electrical power generation. In this paper the electricity is produce from the wind mill by wind power and belt power transmission system. The blade and drag devices are designed in the ratio of 1:3 to the wind turbine. The experiment is conducted by different wind speed and the power produced by the windmill is calculated. The experimental result indicates that 567 W power produced at the speed of 20 m/s while 709 W power produced at the speed of 25 m/s. From this, the power production wills increases when the velocity is high.

M. Abid et al. analyzed the design, development and testing of a savonius and darrieus vertical axis wind turbine. This paper shows that vertical axis wind mill is more efficient when compare to horizontal axis wind mill. The darrieus turbine consists of 3 blades which can start alone at low wind speed. When savonius turbine is attached on the top of existing wind mill which provide the self-start at low wind speed. The result indicates that the darrieus vertical axis wind turbine acts as a self-starter during the testing. The function required the starting mechanism which can be provided by the combination of NACA 0030 aerofoil and savonius turbine. The high blade thickness of the NACA 0030 aerofoil will improves the self starting capability of the turbine.

IV CHAPTER
COMPONENT DESCRIPTION

The Important components of vertical axis wind turbine are:

1. Turbine Blades

2. Shaft – the shaft is the part that gets turned by the turbine blades. It in turn is connected to the generator within the main housing.

Bearing-The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. It achieves this by using at least two races to contain the balls and transmit the loads through the balls. In most applications, one race is stationary and the other is attached to the rotating assembly (e.g., a hub or shaft).

Turbine Blade

Various iterations were made for the design of the blade of turbine and concluded on particular design of the blade. As shown in the figure the blade is designed with the help of galvanized iron sheet. Holes are made on the base section and vertical end portion to make the necessary arrangement for fixing with the other part of the turbine. The design of the blade plays a vital role in proper functioning of the turbine. Thus proper care must be taken while designing the blade. It design should be focused on getting the maximum efficiency from the turbine.

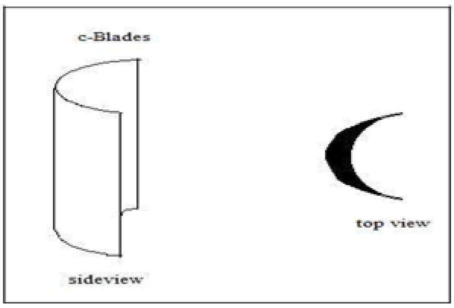


Fig: 4.1 Views of Blade

Shaft Designing

While designing the shaft of blades it should be properly fitted to the blade. The shaft should be as possible as less in thickness & light in weight for the six blade, the shaft used is very thin in size are all properly fitted. So no problem of slip ping & fraction is created, it is made up of hollow Aluminum which is having very light weight. Length of shaft & diameter are 91.44cm& 2.54cm respectively. And at the top and bottom ends mild steel of length 8cm and 15cm respectively are fixed to give str ength to the hollow shaft.

Design of Bearing

For the smooth operation of Shaft, bearing mechanism is used. To have very less friction loss the two ends of shaft are pivoted into the same dimension bearing. The Bearing has diameter of 2.54cm. Bearing are generally provided for supporting the shaft and smooth operation of shaft. Greece is used for bearing maintenance.

Blade Selection

Blade selection is one of the major step in the design of a wind turbine. Blades convert kinetic energy from the wind into rotational energy in the turbine shaft. Vertical axis wind turbines are of generally two types- drag machines and lift machines. Drag machines move slower than the wind, have low efficiency and are self-starting, while in case of lift machines blade speeds are greater than the wind speed and are more favorable from an energy production view point but they are not self starting . Wind energy generated by moving vehicles may not be continuous as there may be idle time with no vehicle traffic and the turbine may need to stop and start frequently. Therefore, self-starting property is one of the very crucial parameter in case of highway wind turbines. Two or three blades are the standard but four blades were chosen because it resolves a few issues with vibrations, noise and starting. Also, when four blades are used, at least one blade will be always in direct contact with the wind. To maximize power extraction, the use of cambered or angled blades is beneficial because such profiles will significantly increase the performance in the upwind where most of the power is produced. Thicker aerofoil's are desirable in gusty conditions because turbines operating at lower tip speed ratios will experience smaller fluctuations in λ during the gusts and the drop in CP is also reduced Helically twisting the blades have been shown to produce smoother torque output that can increase the life of the mechanical components of the VAWT Also, helically twisted turbine yields a steady power output and a higher mean CP.

An Alternator

An alternator is an electromechanical device that converts mechanical energy to electrical energy in the form of alternating current. Most alternators use a rotating magnetic field but linear alternators are occasionally used. In principle, any AC electrical generator can be called an alternator, but usually the word refers to small rotating machines driven by automotive and other internal combustion engines. Alternators in power stations driven by steam turbines are called turbo-alternators.

Transmission and Distribution:

In addition to generation, storage can act as an alternative or supplement to new transmission and distribution (T&D). Distribution systems must be sized for peak demand; as demand grows, new systems (both lines and substations) must be installed, often only to meet the peak demand for a few hours per year. New distribution lines may be difficult or expensive to build, and can be avoided or deferred by deploying distributed storage located near the load (Nourai 2007). (Energy can be stored during off-peak periods when the distribution system is lightly loaded, and discharged during peak periods when the system may otherwise be overloaded.) Energy storage can also reduce the high line-loss rates that occur during peak demand (Nourai et al. 2008).

V CHAPTER
FABRICATION

Cutting

Metal Cutting

Cutting processes work by causing fracture of the material that is processed. Usually, the portion that is fractured away is in small sized pieces, called chips. Common cutting processes include sawing, shaping (or planing), broaching, drilling, grinding, turning and milling. Although the actual machines, tools and processes for cutting look very different from each other, the basic mechanism for causing the fracture can be understood by just a simple model called for orthogonal cutting.

In all machining processes, the work piece is a shape that can entirely cover the final part shape. The objective is to cut away the excess material and obtain the final part. This cutting usually requires to be completed in several steps – in each step, the part is held in a fixture, and the exposed portion can be accessed by the tool to machine in that portion. Common fixtures include vise, clamps, 3-jaw or 4-jaw chucks, etc. Each position of holding the part is called a setup. One or more cutting operations may be performed, using one or more cutting tools, in each setup. To switch from one setup to the next, we must release the part from the previous fixture, change the fixture on the machine, clamp the part in the new position on the new fixture, set the coordinates of the machine tool with respect to the new location of the part, and finally start the machining operations for this setup. Therefore, setup changes are time-consuming and expensive, and so we should try to do the entire cutting process in a minimum number of setups; the task of determining the sequence of the individual.

Welding

Welding is a process in which two or more parts are joined permanently at their touching surfaces by a suitable application of heat and/or pressure. Often a filler material is added to facilitate coalescence. The assembled parts that are joined by welding are called a weldment. Welding is primarily used in metal parts and their alloys.

Welding processes are classified into two major groups:

Fusion welding: In this process, base metal is melted by means of heat. Often, in fusion welding operations, a filler metal is added to the molten pool to facilitate the process and provide bulk and strength to the joint. Commonly used fusion welding processes are: arc welding, resistance welding, oxyfuel welding, electron beam welding and laser beam welding.

Solid-state welding: In this process, joining of parts takes place by application of pressure alone or a combination of heat and pressure. No filler metal is used. Commonly used solid-state welding processes are: diffusion welding, friction welding, ultrasonic welding.

Arc welding and similar processes

Arc welding is a method of permanently joining two or more metal parts. It consists of combination of different welding processes wherein coalescence is produced by heating with an electric arc, (mostly without the application of pressure) and with or without the use of filler metals depending upon the base plate thickness. A homogeneous joint is achieved by melting and fusing the adjacent portions of the separate parts. The final welded joint has unit strength approximately equal to that of the base material. The arc temperature is maintained approximately 4400°C. A flux material is used to prevent oxidation, which decomposes under the heat of welding and releases a gas that shields the arc and the hot metal. The second basic method employs an inert or nearly inert gas to form a protective envelope around the arc and the weld. Helium, argon, and carbon dioxide are the most commonly used gases.

Shielded-Metal Arc (SMAW) or Stick Welding

This is an arc welding process wherein coalescence is produced by heating the work piece with an electric arc setup between a flux-coated electrode and the work piece. The electrode is in a rod form coated with flux. Figure M6.1.1 illustrates the process.

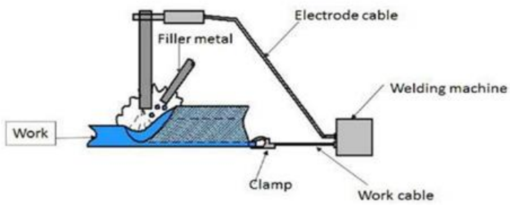


Fig : 5.1 Shielded-Metal Arc (SMAW)

Drilling: The geometry of the common twist drill tool (called drill bit) is complex; it has straight cutting teeth at the bottom – these teeth do most of the metal cutting, and it has curved cutting teeth along its cylindrical surface (Figure 6). The grooves created.

by the helical teeth are called flutes, and are useful in pushing the chips out from the hole as it is being machined. Clearly, the velocity of the tip of the drill is zero, and so this region of the tool cannot do much cutting. Therefore it is common to machine a small hole in the material, called a center-hole, before utilizing the drill. Center-holes are made by special drills called center-drills; they also provide a good way for the drill bit to get aligned with the location of the center of the hole. There are hundreds of different types of drill shapes and sizes; here, we will only restrict ourselves to some general facts about drills.

Proposed System

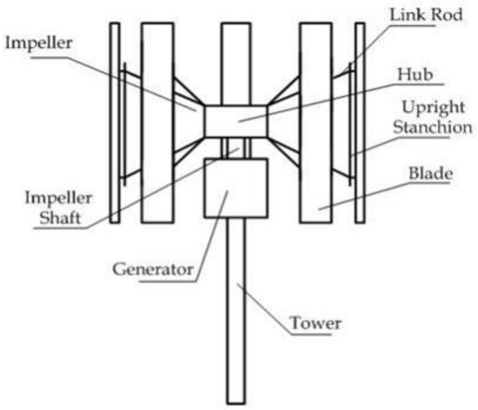


Fig: 5.2 Highway Vertical Axis Wind Turbine

Wind energy is considered the fastest growing source of clean energy. However, it is limited by its variable nature. Highways can provide a considerable amount of wind to drive a turbine due to high vehicle traffic. Due to the pressure difference in the air adjoining the vehicle wind will be generated. This project aims to extract this energy in the most efficient manner. The wind turbines will be placed on the road dividers so that wind flow from both sides of the highway will be acting tangentially in opposite directions on both sides of the turbine. These types of turbines can be installed on express highways and other high speed traffic areas to generate electricity. This system can be connected to the Inverter to power the electrical devices. The wind power harnessed through this technique can be used for street lighting, traffic signal lighting, toll gates etc. This project eliminates the power demand.

VI CHAPTER
DESIGNING METHODOLOGY

This design methodology is to increase the efficiency of the windmill at first the designing steps starts with the design of windmill blades. Because this blades will mainly affects the overall efficiency of the windmill. For a particular application the wind mill blade should be in required size. Before this getting knowledge about the aerodynamic style of windmill blade in order to get the full efficiency is very much important.

The various considerations are. A. Wind speed:

The speed of the wind is very much important for the production of electricity in the windmill. Because in windmill are using the wind as a raw material for the power production this bakes the axis rotate and this axis is coupled with a dc generator and makes its also rotate and produce electricity.

B. Tower height and design

The height of the tower is very much important for a windmill. In VAHW the tower is kept little sort to obtain whole air density passing from the vehicle. We also should concentrate in the design of the tower because it should able to withstand for its own weight and also in the speed of the wind.

C. Shape of the blade:

As discussed earlier the shape of the wind mill blades is the important one if one could place an efficient design of a blade then the efficiency of the windmill will be increased.

The various windmill shapes are as follows;

a) Flat, unmodified blade surface

b) wing shape with one leading edge

c) Both edges tapered to a thin lin

d) Both edges leading blade.

Fig.6.1.wind mill blade shape

VII CHAPTER
IMPLEMENTATION AND RESULT

Calculations

The power in the Wind

The power in the wind can be computed by using the concepts of kinetics. The wind mill works on the principle of converting kinetic energy of the wind to mechanical energy. The kinetic energy of any particle is equal to one half its mass times the square of its velocity, or ½ mv^2. The amount of air passing in unit time through an area A, with velocity V, is A. V, & its mass M is equal to its Volume multiplied by its density □ of air, or

m = □ AV……………….(1)

(m is the mass of air transferring the area A swept by the rotating blades of a wind mill type generator

Substituting this value of the mass in expression of K.E.

Substituting this value of the mass in expression of K.E.= ½ □AV.V^2 watts= ½ □ AV^3 watt………….. (2)

Second equation tells us that the power available is proportional to air density (1.225 kg/m^3) & is proportional to the intercept area. Since the area is normally circular of diameter D in horizontal axis aero turbines, then

$$A = \frac{\pi D^2}{4} \quad (\text{Sq. m})$$

Wind velocity vs. power output

Power output= (1/2) Av^3

- Air density at that particular height and location, (normally 1.225 kg/m3) A- Swept area by blades=3.33 each

V- Wind velocity in m/s.

Table: 7.1 Wind velocity vs. power output

S.No	Wind Velocity(m/s)	Output(Watts)
1	3	55.09
2	4	130.53
3	5	254.95
4	6	440.55
5	7	699.59

Graphs:

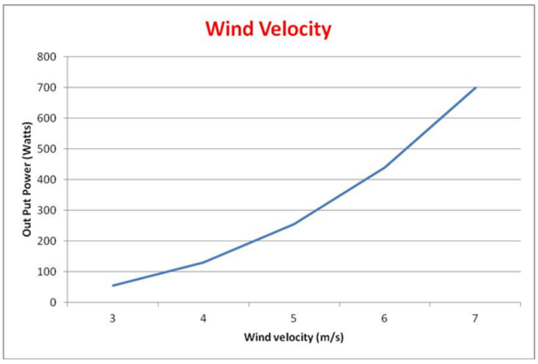


Fig: 7.1 Wind velocity vs. power output

Motor speed vs. output voltage

Maximum speed of the generator is 500rpm. If the generator rotates with full speed it gives an output of 14.5 volts.

Table: Motor speed vs. output voltage

S.No	Speed(rpm)	Voltage(V)
1	125	3.625
2	250	7.25
3	500	14.5

Graphs:

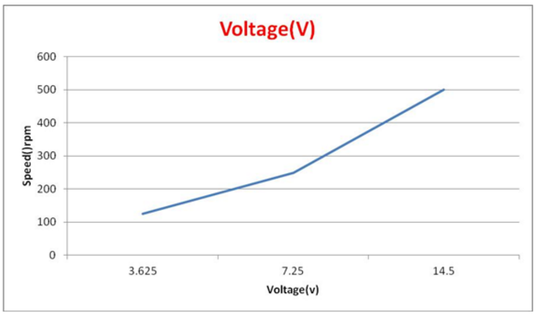


Fig: 7.2 Motor speed vs. output voltage

For 6 Blades

The vertical axis wind mill is designed with various number of blades and also different angle of twist of the blade. Following figures shows the various results with different number of blades and different angle of twist of the blade. The experiment was carried out for six blades, three blades and two blades. These three patterns of turbine were again tested with various angle of twist of the blade.

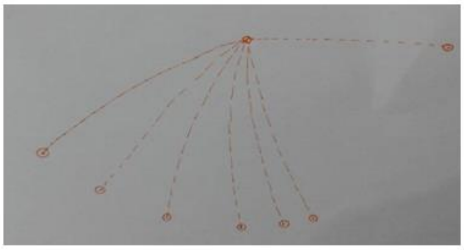


Fig: 7.3 Blades profile for various angle of twist

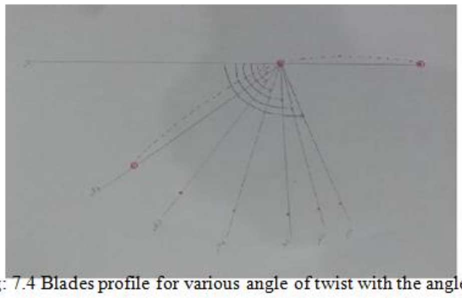


Fig: 7.4 Blades profile for various angle of twist with the angle

Angle and maximum speed for 6 blades

The below figure shows the turbine with six number of blades and with some angle of twist. This design was tested with various angle of twist. The outcome of the experiment is shown in below table with graph.

Fig: 7.5 Turbine with six number of blades

Graphs:

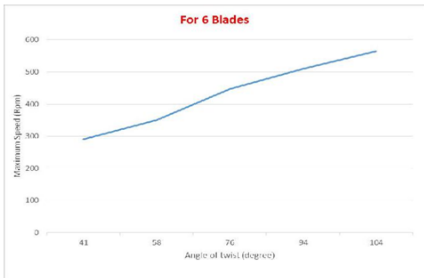


Fig: 7.6 Maximum Speed vs. Angle of twist for six blades

The above chart shows the variation of maximum speed of vertical axis wind mill with various angle of twist. As shown in the chart the maximum speed goes on increasing from the initial value of angle of twist. It goes on increasing till it reaches some particular value. In this case we find the maximum speed goes on increasing till 104 degree.

7.5 For 3 Blades

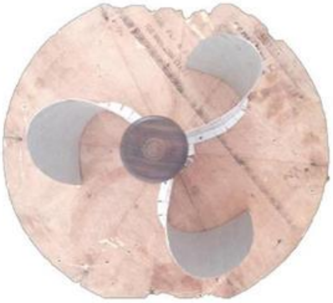


Fig: 7.7 Turbine with three number of blades

Table:7.4 Angle and maximum speed for 3 blades

S.No	Angle(degree)	Maximun Speed(RPM)
1	41	250
2	58	289.9
3	76	342
4	94	400
5	104	473.5
6	110	438

Graph:

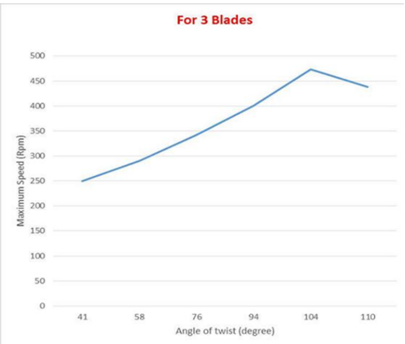


Fig: 7.8 Maximum Speed vs. Angle of twist for three blades

The above chart shows the variation of the maximum speed with the angle of twist for three blades. The chart clearly pictures the change in maximum speed with angle of twist. Initially the maximum speed increases with the angle of twist. It increases upto some particular value as shown in the figure. In this case the maximum speed increases upto 104 degree and then it decreases.

7.6 For 2 Blades

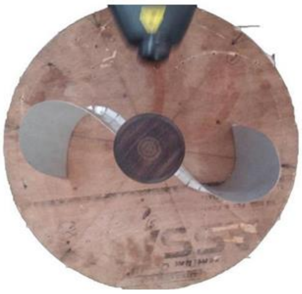


Fig: 7.9 Turbine with two number of blades

Table:7.5 Angle and maximum speed for 2 blades

S.No	Angle(degree)	Maximum Speed(RPM)
1	41	211
2	58	228
3	76	239
4	94	248
5	104	279
6	110	276

Graph:

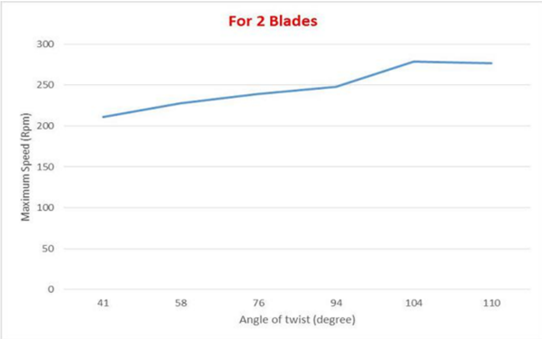


Fig : 7.10 Maximum Speed vs. Angle of twist for two blades

The above chart shows the variation of the maximum speed with the angle of twist for two blades. The chart clearly pictures the change in maximum speed with angle of twist. Initially the maximum speed increases with the angle of twist. It increases upto some particular value as shown in the figure. In this case the maximum speed increases upto 104 degree and then it decreases.

Discussion

1. Rotational Speed of the Turbine is proportional to the number of blades.

2. The rotational speed of the turbine increases with the increase in the angle of bend of the blade, but from a certain angle of bend its speed decreases.

3. From our experiment we found the optimum angle of bend lies between 104^0 and 110^0.

4. With the increase in the number of blades the complexity also increases.

More number of blade results in more cost of the turbine.

VIII CHAPTER
ADVANTAGES AND DISADVANTAGES

Advantages

1. The major advantage of this design is that the rotor blades can accept the wind from any compass.

2. Another added advantage is that the machine can be mounted on the ground eliminating tower structures and lifting of huge weight of machine assembly, i.e. it can be operated close to the ground level.

3. Since this machine has vertical axis symmetry, it eliminates yaw control requirement for its rotor to

capture wind energy. A dual purpose and relatively simple shaft axis support is anticipated as well as ground level power output delivery due to presence of vertical shaft. This may in turn, allow easier access and serviceability.

4. Airfoil rotor fabrication costs are expected to be reduced over conventional rotor blade costs.

5. The absence of pitch control requirements for synchronous operation may yield additional cost savings.

6. The tip speed ratio and power coefficient are considerably better than those of the S-rotor but are still below the values for a modern horizontal-axis, two-bladed propeller rotor.

7. It is easy to fabrication and does not need higher winds easy operation for small winds also.

8. Compare to the horizontal type for same power production this model takes low wind energy and low cost.

9. Vertical axis wind turbines offer many advantages over horizontal axis wind turbines. Not only will the vertical axis wind turbine achieve higher average power output in areas where turbulent winds are present, but it is also significantly quieter than horizontal axis models. As a result, vertical axis wind turbines work well on rooftops, making them particularly useful in residential and urban environments.

10. The device is designed/constructed to operate at low tip speed ratios and features blades that are symmetric about the mid-chord plane. The blades are actively pitched. by means of a mechanical system so that the chord of each blade fixed to the edge of the main rotor. One of the attractions of the device is that it is self-starting and produces relatively high torque.

11. Other VAWT configurations include the Savonius VAWT, which is popular because of the simplicity of manufacture, and the straight bladed VAWTs.

12. However, VAWTs do have several inherent advantages over HAWTs including:

13. VAWTs do not have to have a means of "yawing" (rotating about a vertical axis) to follow the changing wind direction; the generator (or other power takeoff device) can be located at ground level, reducing the structural requirements of the support tower.

Advantage of Vertical Axis Wind Turbine over Horizontal Axis Wind Turbine

There are several reasons why we would choose a vertical axis wind turbine over a horizontal axis windmill.

1. They are mounted lower to the ground making it easy for maintenance if needed.

2. They start creating electricity at speeds of only 6 mph. And

3. Third, they may be able to be built at locations where taller structures, such as the horizontal type, can't be.

4. Higher power utilization-- 20% higher than HAWT.

5. Lower noise level--only 27-37 DB, suitable for your living condition.

6. Safer operation--Spin at slower speeds than horizontal turbines, decreasing the risk of injuring birds and also decreasing noise level.

7 Simpler installation and maintenance-- besides the traditional installation site, it can be mounted directly on a rooftop, doing away with the tower and associated guy lines.

Disadvantages

1. Rotor power output efficiency of a Darrieus wind energy conversion system is also somewhat lower than that of a conventional horizontal rotor.

2. Because a Darrieus rotor is generally situated near ground proximity, it may also experience lower velocity wind compared to a tower mounted conventional wind energy conversion system of comparable projected rotor disc area. This may yield less energy output.

3. Properly the biggest disadvantage with vertical axis machines is that far less is known about them than horizontal axis ones. This handicap is rapidly being removed.

4. Although a Darrieus machine has much directional symmetry for wind energy capture, it requires external mechanical aid for startup. Tests indicate that, with small machines, the problem can be solved by attaching S-rotors at the top and bo of the vertical (rotational) axis. This approach does not appear to be feasible with larger machines, but if the wind power system connected to a utility grid, the generator can serve as a motor to start the turbine. The (alternating-current) load can also provide a means for controlling the speed of the rotor regardless of the wind speed, so that variable-pitch blades are not required. At very high speeds, stalling occurs and the rotation stops automatically.

5. The disadvantages are that producing efficient energy from winds takes twice as much time. The turbines have to be installed on flat land and some models require guide wires, which add more stress to the bottom of the tower; and they have a low starting torque. A consumer has to look at a design that is suitable for them by deciding on the best one for their needs.

IX CHAPTER
CONCLUSION AND FUTURE SCOPE

Conclusion

By using this technology all the highways can be lightened without use of non- renewable energy resources. Also, if this method is implemented in all national highways it can able to produce large amount of power. And it can also provide job for many educated fellowship. By increasing numbers it can develop more energy & light up the highways so that the percentage of accidents gets minimized.

The project "Highway Wind Mill" was designed such that to deliver power to switch on the emergency head lamp. The dynamo uses electromagnetic principles to convert mechanical rotation into direct current (DC) using wind energy. The system generates electrical power as non-conventional method by wind energy power using wind turbine set up.

A careful selection has to be made for the blade profile so that the losses will be minimum and the power generation can be enhanced. Since the wind energy is not constant at all the time so the operation of the wind machine will be intermittent and the power production rate will also vary; the component should be design in such a manner so that the losses should be at minimum.

Future Scopes

1. By fixing solar panel in this vertical axis wind turbine will increase the efficiency.

2. Fixing more in series or in parallel manner will give more efficiency.

The wind energy can be tapped to a full extend when the force acting on the blade of the turbine which is coming in the opposite direction of the wind is minimized. This can be achieved when there are some holes on the blade which are closed when the wind is pushing the turbine and the holes are opened when the blade of the turbine is coming in the opposite direction of wind.

The experiment set up is placed at the base level and the same setup may be tested at a different height.
It has tested with one profile of blade and the profile of the blade may be changed for better efficiency.

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