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# Flapper Wind Turbine

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**Abstract-** Through the next several decades, renewable energy technologies, thanks to their continually improving performance and cost, and growing recognition of their Environmental, economic and social values, will grow increasingly competitive with Traditional energy technologies, so that by the middle of the 21st century, renewable Energy, in its various forms, should be supplying half of the world's energy needs."

We has selected this as our final year project so as to begin thinking towards power generation through clean sources such as wind. Power generation in our country is very low at present. Industrially developed states like, Maharashtra is suffering through major power shortages, and this is a signal of major crises. Even in cities like Mumbai peoples are suffering from power cuts.

We knew that this project does not reflect any new discovery; but our intention is that residential societies should install such wind mills on the terrace to tackle with the power cuts and become independent unto certain amount. So we should use these turbines in place where wind flow is more and continuous like near river, seashore or at higher altitudes.

In this project wind turbine charges a 12 volt battery and runs various 12 volt appliances. We have fabricated the small scale wind turbine on the basis of design calculations and made changes in design to track it with manufacturing constraints.

**Index Terms-** Wind Turbine, VAWT, Alternative Energy Source, Power Generation.

## 1. INTRODUCTION

### *1.1. Introduction*

The Environment is full of Unlimited supply of Renewable energy Resources like wind, sun and tidal.

By the middle of 21st century, the renewable energy resources would have gained more recognition and would supply half of the world with energy because of their continually improving performance and cost.

Wind energy conversion systems convert the power in the wind to rotational shaft power and to electricity by coupling a generator to the unit.

Places with annual average wind speeds of about 5 meters per second, residential and village-scale wind turbines can provide electricity at costs competitive with or below those of diesel generators, and can be used in stand-alone applications not requiring a local power distribution system.

Vertical-axis wind turbines (VAWTs) are a type of wind turbine where the main rotor shaft is set transverse to the wind (but not necessarily vertically) while 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.

Advantages of Vertical Axis windmill

- Very quiet operation
- Lower capital costs due to simpler design
- Less dangerous to birds
- More acceptable because of lower profile - less visual pollution
- Superior handling of high gusts of winds

## 2. LITERATURE REVIEW

The case study, 'T*he low-cost vertical axis wind turbine project*' by AkshayPendharkar& Narayanan Komerath published in The Proceedings of the 2013 Annual Conference of the American Society for Engineering Education, Atlanta Georgia June 2013, documents the multi-year process by which a small device is developed using a team of mostly undergraduates. The detailed process exhibits several positive and negative features of the constantly changing team, where a great deal of the effort goes into the students learning, as is appropriate for our environment. The particular constraints on the system are driven by the needs of the anticipated customer environment. These do introduce challenges, as well as exciting possibilities for innovation.

According to the study of 'D*esign of an alternative hybrid vertical axis wind turbine*', Different types of turbines were evaluated to determine which would complement the wind conditions from the gathered information. It was concluded that creating a turbine that combined lift and drag would be the best option. A turbine of this nature was then designed, along with an airfoil that would be efficient and manufacturable, and a shroud that would increase the air velocity where it contacts the blades.

The turbine was built, and the testing completed on it led to the conclusion that both the scale of the model and certain design aspects needed to be adjusted in order for it to be successful.

According to the research done by a group of students in GRIET on a '*Vertical Axis Wind Turbine'* they were able to generate 300Watt of power at a wind speed of 7m/s.

We are trying to make a better flapper wind turbine that can produce more power than their Savonius Wind Turbine.

## 3. THEORY AND CONCEPTS

### 3.1. *Aim*

This flapper turbine has a flapper mechanism which close wind blade and allow air to flow without resistance so net power generation in this system is more than normal wind turbine.

This renewable sources of energy can be used to reduce problem of power in our country which is suffering from power shortages. (Almost 87% of rural area in India is still suffering from power shortage)

### 3.2. *Problem statement*

Average wind velocity available in India is in the range of 0.5 to 7m/s which is insufficient for the working of a horizontal Wind turbine, therefore only option is vertical wind turbine.

But some efficiency was drop because of drag generated by opposite blade.

To solve this problem we develop flapper type wind turbine which remove opposite blade drag and allow wind mill to rotate at very low air velocity.

### 3.3. *Objectives*

Our main objective is to build a wind mill in such a way that cost of wind mill is easily affordable by common people.

Design of the project. Experimental and theoretical analysis of the project.

Our objective is to build small scale wind turbine which run on low air velocity and can be install on roof top of building and charges a minimum12 volt battery and runs various 12 volt appliances without invertors.

Fig.1. CAD model of the final turbine.

### 3.4. *History*

Darrieus Wind Turbine: French aeronautical engineer Georges Jean Marie Darrieus patented in 1931 a "Turbine having its shaft transverse to the flow of the current".Darrieus Wind Turbine is not self-starting, i.e it needs to be initially started before it starts to rotate with the help of wind.

Savonius Wind Turbine: The Savonius is a drag-type VAWT, so it cannot rotate faster than the wind speed.
Savonius has low rotor speed which is not suitable for generating electricity but has high torque which is used for grinding purpose and for pumping water.

Giromill Wind Turbine: The straight-bladed wind turbine, also named Giromill or H-rotor, is a type of vertical axis wind turbine developed by Georges Darrieus in 1927. Giromill model can't completely make use the available air flow. The gap between the central shaft and the blades allows the air to escape.
Hence the design of Flapper Wind Turbine (shown in figure 1) came into play. This model uses many flaps which are closed to make use of the available air flow. While on the other arms the flaps will be partially or completely open to reduce the opposite force acting on it.

### 3.5. *Scope Of the Project*

To utilize the available wind resources and to reduce the usage of non-renewable energy resources. Wind energy is by far the fastest-growing renewable energy resource.

Large-scale wind facilities approaching the output rating of conventional power plants, control of the power quality is required to reduce the adverse effects on their integration into the network.

These wind turbines can be used to provide constant lighting. In most cities, bridges are a faster route for everyday commute and in need of constant lighting makes this an efficient way to produce natural energy.

### 3.6. *Factors Affecting The Performance*

Wind Speed: The wind turbine only generates power with the wind. The wind rotates the axis and causes the shaft on the generator to sweep past the magnetic coils creating an electric current.

Blade Length: Length of the blade is directly proportional to the swept area. Larger blades have a greater swept area and thus catch more wind with each revolution.

Base Height: The higher a windmill is, the more productive it will be due to the fact that as the altitude increases so does the winds speed.

Base Design: Base is important in the construction of the windmill because not only do they have to support the windmill, but they must also be subject to their own weight and the drag of the wind.

## 4. PROJECT DETAILS

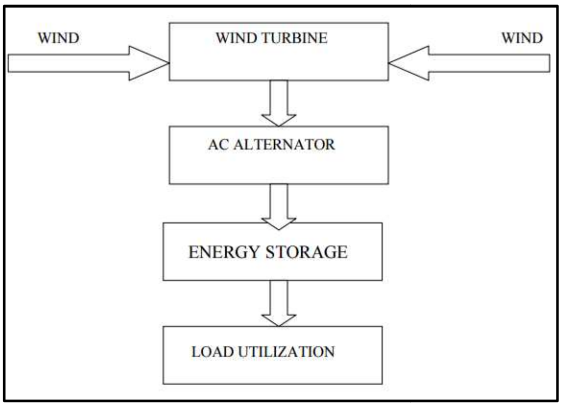


Fig.2. Block Diagram Of the Working of Turbine

**4.1. *Working*(figure 2)**

The working of wind mill is very simple as the air comes in the structure the working blades rotates which is connected to main rotor shaft by the supporting arms the main rotor is coupled to a generator from where we can get the output.

The power in the wind can be extracted by allowing it to blow past moving wings that exert torque on a rotor. The amount of power transferred is directly proportional to the density of the air, the area swept out by the rotor, and the cube of the wind speed.

The mass flow of air that travels through the swept area of a wind turbine varies with the wind speed and air density. As an example, on a cool 15°C (59°F) day at sea level, air density is about 1.22 kilograms per cubic meter (it gets less dense with higher humidity). An 8 m/s breeze blowing through a 100 meter diameter rotor would move about 76,000 kilograms of air per second through the swept area.

The kinetic energy of a given mass varies with the square of its velocity. Because the mass flow increases linearly with the wind speed, the wind energy available to a wind turbine increases as the cube of the wind speed. The power of the example breeze above through the example rotor would be about 2.5 megawatts.

As the wind turbine extracts energy from the air flow, the air is slowed down, which causes it to spread out and diverts it around the wind turbine to some extent.

**4.2. *Design Of The Turbine***

4.2.2. *Frame: (figure 3)*

- Material used is M.S. Angle
- Cutting the angle as per the size required
- Weld the angle to make the frame
- Drill the angle at required places for different joints.

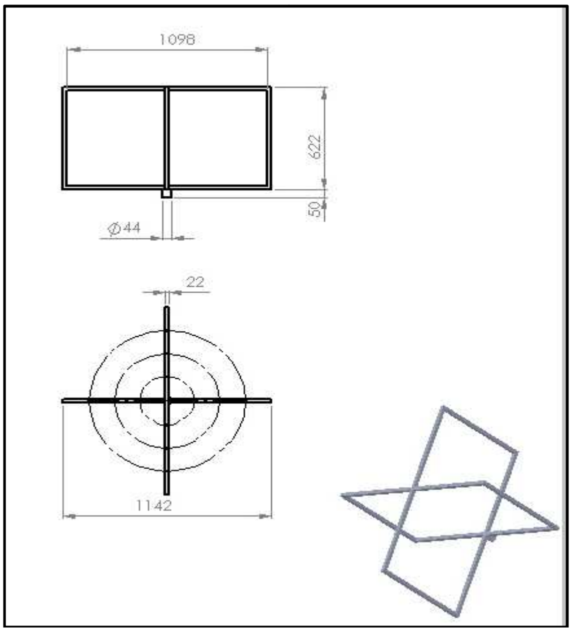


Fig.3. Frame To Hold The Flaps with Dimensions

4.2.2. *Shaft: (figure 4)*

- Material used in Bright steel
- Mark the shaft as per required
- Cut the shaft

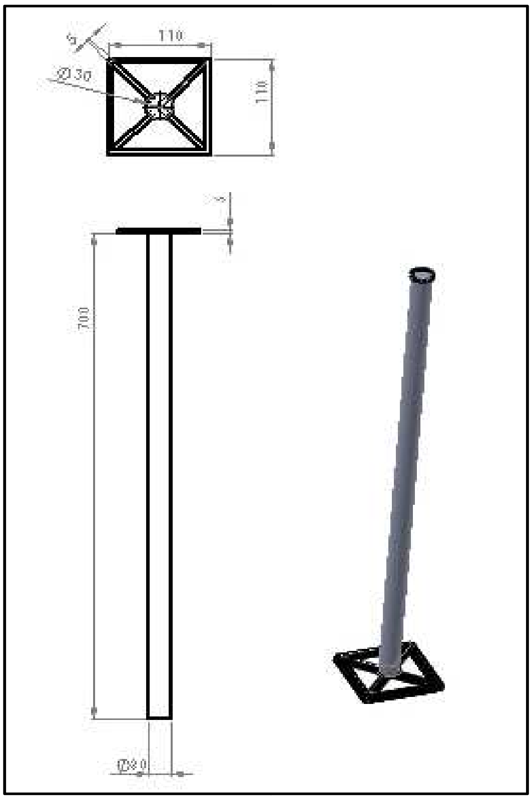


Fig.4. Central Shaft On which the Turbine Rotates with Dimensions

4.2.3. *Flaps: (figure 5)*

- Material used is Fibre sheets
- Cut the flaps as per the size required
- Weld it to the links used for the opening and closing of flaps.

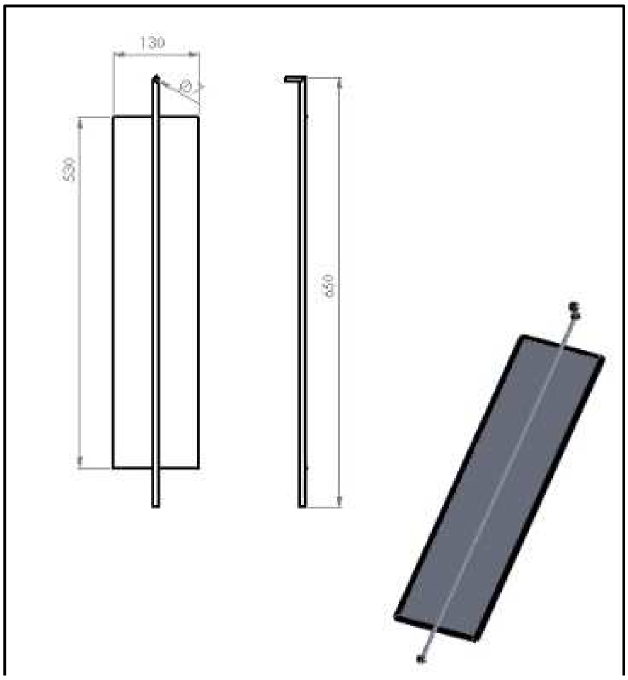


Fig.5. Flaps of the Turbine with Dimensions

### 4.3. *Research Techniques*

Experimental calculations after successfully making the project model.

- Calculation of Wind Energy and Power
  Kinetic Energy = Work = ½ $mV^2$
  Where:
  m= mass of moving object
  V = velocity of moving object
- Mass of moving air
  Mass (m) = density (ρ) x volume (Area x distance)
  = ρ x A x d
  = $(kg/m^3)$ $(m^2)$ (m)
  = kg
- Power in the Wind
  Power = Work / t
  = Kinetic Energy / t
  = ½ $mV^2$ / t
  = ½(ρ x A x d) $V^2$/t
  = ½ρA$V^2$ (d/t)

### 4.4. *Design Specification*

- Turbine Blades = PVC Fiber Sheets
- Frame = 1 inch square M.S. Steel
- Shaft = 20mm Brittle Steel rod
- 10mm shafts for flap connections
- Cast Iron Big Pulley
- PVC Small Pulley
- Link = 4mm M.S. Steel strips
- 300rpm Dynamo

## 5. DISCUSSIONS

This windmill is new of its kind and has many benefits which are not found in the traditional windmill some of these benefits are:

- Being rotating over a vertical axis which decreases the required space for its rotation and consequently can be used a large number of them within a smaller area and consequently generate greater energy and more effective utilization of the wind.
- Being vertical the area of the blades which the wind moves are much more than the traditional mills because the blades are subjected to the same angle from all heights and consequently better utilization and much more effectiveness from the blades of the traditional mills.
- The operation of the rotating of the mill over a vertical axis and being cylindrical in shape and as the blades are installed at an angle, all this renders smooth movement of the mill with almost no friction with the air. This is because the air enters the opposite side of the direction of the entry of the air into the cylinder and this is the reason for the movement of the cylinder without much resistance which increases its speed with almost no friction of the blades with the air.
- Because it is vertical also, more number of blades can be used and this increases the amount of air affecting the movement and consequently increases the utilization of the air currents giving greater efficiency from traditional mills.
- As it rotates over a vertical axis, then any direction from which wind comes will rotate the mill and consequently no need to change the direction of the mill in order to be facing the wind, so wind from any direction will operate it.
- Being cylindrical in shape also helps to utilize the wind in any vertical or non vertical angle as it converts this wind to a moving energy because the angles hit by the wind on the cylinder leads to its moving.

## 6. CONCLUSION

As we all know that environment is full of renewable energy sources so the manufacturing of flapper wind turbine will be effective in charging 12V battery and running the 12V appliances. Since it is the type of vertical axis wind turbine can start at the wind speed of 2m/s which is undoubtedly preferable than the horizontal axis wind turbine. Though there are various factor like wind speed, turbine geometry, drag force etc. which affect the performance of wind turbine, flaps of the flapper wind turbine adjust automatically as per the direction of wind hence reducing the drag force and increases the efficiency by utilizing more kinetic energy of wind.

The tip speed ratio of the vertical axis wind turbine is usually 1.5-2. Such low rotating speed basically can't produce aerodynamic noise hence this advantage is apparent and wind turbine can be easily erected at residential areas and urban public facilities. Hence our project flapper wind turbine is economically feasible environmentally stable. It can be easily affordable to common men and it will be the best substitutes in future.

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