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Power Generation From Locomotive Rooftops

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Abstract: **This paper describes about the modified locomotive roof top that can generate electricity. The new modification of the locomotive roof top is by adding the blade/fins to the horizontal shaft to help it to spin faster and more efficient. Optimum design and performance of the system also discussed. This system is suitable to use for the high speed wind places. The system is containing the combination of the DC generator, roof top wind turbine, batteries. This system managed to produce 12 Vdc to 14 Vdc to charge the 12 Vdc batteries system. The operational concept of the system is the load will use the energy from the batteries that charged using locomotive roof top. The observed performances of system are the voltage and current of the roof top wind turbine, batteries and the load.**

I. INTRODUCTION

Numerous wind turbines are installed at one site to build a wind produce more energy over the year. Two distinctly configurations are available for turbine design, the horizontal-shaft wind turbine (HSWT) configuration and the vertical-axis wind turbine (VAWT) configuration. The horizontal-axis machine has been the standard in Denmark from the beginning of the wind power industry. Therefore, it is called Danish wind turbine. The vertical-axis machine has the shape of an egg beater and called the Durries rotor after its inventor. It has been used in the past because of its specific structural advantage. However, most modern wind turbines use a horizontal-shaft design. The advantages of the HSWT are the blades are to the side of the turbine's center of gravity, helping stability. It also allows the angle of attack to be remotely adjusted gives greater controls, so the turbine collects the maximum amount of wind energy.

The hilltops, ridgelines and passes can have higher and more powerful winds near the ground than higher up because due to the speed up effect of winds moving up a slope. In these places, horizontal shaft turbines are suitable. The blades spin at higher speeds than the vertical turbines; in our work it decreases the risk of injuring birds. The modified roof top can be recognized as a type of [HSWT]. It is because it spin horizontally when get the kinetic energy from the wind. It also has the same shaft position, blade form and operates in the same basic manner as

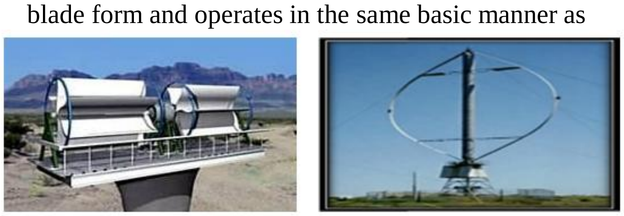


Figure 1 - Horizontal shaft Wind Turbine and Vertical Axis Wind Turbine

II. DESIGN OF ROOF TOP

We made survive that the wind average yearly wind speeds in Remote area, our location for this project. Once, we found that value, converted the units to meters per second because meters is the standard unit for finding dependent values such as, air density, tip speed ratio, rotations per minute, and power generation. While researched computation equations, which is all about the maximum and reasonable amount of energy that can be fully gathered from wind turbine usage. (Wind speed in remote area = 12.4 mph, 5.543m/s) – To compute the amount of power the wind in the area could generate, the calculations shown below prove that our design is well-suited to the criteria established for the design problem at hand.

2. 1 Wind force

The roof top wind turbine absorbs the wind energy with their individual blade will move slower that the wind velocity.The different speed generates a drag force to drive the blades. The drag force Fw acting on one blade is calculated as

$$F_W = [C_D A p(U_W - U_b)^2]/2$$

where A is swept area of the blade; ρ is air density (about 1.225kg/m^3 at sea level and at temperature of 15^{0}C); U_W is wind speed; C_D is the drag coefficient (1.9 for rectangular form); and U_b is the speed on the blade surface. It is seen that the wind velocity U_W dominates the wind force as compared to other parameters A, C_D and ρ. As expected, more driving force F_W is easily and effectively to rotate the turbine and to gain more electricity eventually. The maximum power is obtained while

$$U_b = U_W/3$$

2.2 Roof top wind turbine

The view of the roof top wind turbine is shown in figure 2. This is a roof top wind turbine with shaft diameter size, 1 inch. This size has 3 curves blade to capture the wind kinetic energy. Stainless steel is use to produce this roof top wind turbine because it cannot be effected by rust. The mechanical aspects of this product are just the simple bearing with the proper installation of the components. In this product, research process involved the study how to generate the electricity from the spinning roof top wind turbine. Dc generator is a solution where it manages to meet the objective of the product. The dc generator is connected to the shaft. When the wind blows on the fins and generates enough drag forces, the roof top wind turbine will rotate. Dc generator and the moving roof top wind turbine will spin synchronously to generate electricity.

Figure 2- Roof Top Wind Turbine

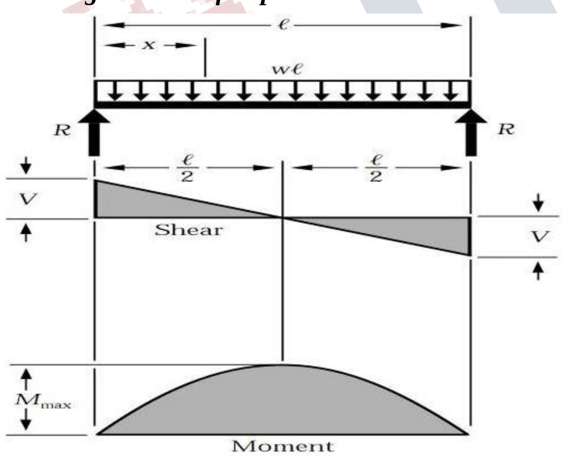


Figure.3 :Simply Supported With Udl

III. FABRICATION OF ROOFTOP WIND TURBINE

The frame structure for the total unit is fabricated using L-Angle frames and ordinary frames. These frames are made of mild steel. They are held to proper dimensions are attached to form a unit with the help of welding. Then the bearings which are of standard make are kept in place with their respective shafts through them and are welded to the frame structure. The rotor are made of stainless steel and blades are also made of stainless steel which avoid the corrosion. Supporting shaft is welded to both end of rotor by fixing it to the frame structure. These supporting shaft are responsible for the rotation of the turbine. A special stand arrangement is made to seat the 12v DC generator using frames.

Wires are connected to the terminals of the DC generator and its other ends are connected to a 6 volt battery. Another wire is taken from these points on the battery and its other ends are connected to the positive and negative terminal of an inverter. An output wire from the inverter is sent to the light. The light is fitted to a stand.

<u>*Materials used*</u>**:**

- **Frame - Mild Steel**
- **Rotor shaft - Stainless Steel**
- **Blades - Stainless Steel**

3.1. Main Parts Invovled

1. ***Frame :*** **the frame is made of mild steel with square section of size 20mm*20mm, being cut for length 1100 mm 4 numbers and height of 1000mm 4 numbers and 40mm length of 2 numbers angular piece is welded in square shape and its weight about 15 kg. Two u shaped mild steel pieces are welded on the frame on both ends for proper seating of bearings on both ends. These u shaped metal pieces are drilled for nut and bolt arrangement on both end of frame and which is shown in above figure.**

2.Wind turbine**:** This is made of stainless steel both blades and rotor .Rotor is 1.5 inch diameter and length of 1 meter. Blades are welded to the rotor ,three blades are with angle of 120^0 . Blades length is of 1 meter same as the length of rotor. Blades width is 100 mm and having thickness of 1 mm. since stainless steel is used because which reduce the rust and weight of the wind turbine. This wind turbine is mounted on the two bearings which allows free rotation.

3. Bearings**:** here two bearings are used for support of wind turbine.this means the bearing unit can support rotating equipment without special design to allow for mounting. A variety of standardized housing shapes is available, including pillow and flange types. The outer diameter of the bearing is spherical just like the inner diameter of the housing, so it capable of aligning itself on the shaft. For lubrication, grease is sealed inside the bearing, and particle generation is prevented by a double seal. For details, see the catalog devoted to the concerned type of bearing

4. DC Generator: this is used to produce electricity which is coupled to shaft of the wind turbine.this is also called stepper motor or dc dynamo.its capacity is about 12 volt and 2.5 amp/phase current.it is 1.8 degree / 200 steps per revolution and 7- wire-bipolar. the rotor which rotates within a static magnetic stator cuts the magnetic flux surrounding it, thus producing the electric motive force (emf).

5. ***Battery*****:** This is used to store the electricity produced by the generator. In order to store energy a **Lead-Acid battery of 6.5V and 4.5AH** is used. A lead-acid battery unit has one/two/six/twelve/ more individual cells connected in series and placed in a rubber container. The electrolyte is water solution of sulphuric acid .Anode, cathode and barrier materials. At the end of charging water electrolysis occurs, oxygen is released near positive electrode and hydrogen near negative electrode. lead acid battery systems arethe first choice for small and medium energy storage applications where energy/mass. energy/weight , energy/cost etc. are not decisive factors. They are not cost effective for energy storage in MWh range.

IV. *WORKING PRINCIPLE*

The project is concerned with generation of electricity from roof top wind turbine set up. The rotation of roof top wind turbine - setup is coupled to the shaft of dc generator arrangements.

Here the rotational motion of the roof top wind turbine is converted into rotary motion of the shaft of dc generator arrangement. The axis of the wind turbine shaft is coupled with the shaft of dc generator arrangement. The wind turbine arrangement is made of three blades. The roof top wind turbine absorbs the wind energy with their individual blade will move. As the turbine rotate the dc generator shaft also rotate. Because of rotation of the shaft electricity produced. The amount of current produced is depending on the wind velocity.

Figure 4: Side and front view of model

Hence, although the speed due to the rotary motion achieved by the wind. as the wind is hit to the blades , finally the speed is multiplied to a higher speed. This speed which is sufficient to rotate the rotor of a generator is fed into to the rotor of a generator. The rotor which rotates within a static magnetic stator cuts the magnetic flux surrounding it, thus producing the electric motive force (emf). This generated emf is then sent to an inverter, where the generated emf is regulated. This regulated emf is now sent to the storage battery . This current is then utilized in the night time for lighting purposes.

A. DC Motor Working

In our work we are used a stepper motor. The thumbnail to the left is a cross-sectional view of the inside of a hybrid bipolar stepper motor. As you can see, it has eight poles with six teeth each. This motor contains two coils- one wrapping the odd-numbered poles, and the other wrapping the even numbered poles. The steel end-cap in the center of the image covers a cylindrical permanent magnet which surrounds the shaft.

If positive current is sent to the odd-numbered coil, poles 1 and 5 are magnetized as south, and poles 3 and 7 are magnetized as north. Assuming the permanent magnet in the center of the motor has its north pole facing toward us, this will result in the rotor turning so that the teeth line up with stator poles 1 and 5, as they are in the image. At the same time, poles 3 and 7 will become aligned on the opposite end of the motor, where the gear on the rotor is permanently offset by the width of one tooth and the permanent magnet has magnetized the rotor as south. The rotation of the motor is continued by sending negative current through the even-numbered phase, then negative current through the odd-numbered phase, then positive current through the even-numbered phase, and so on.

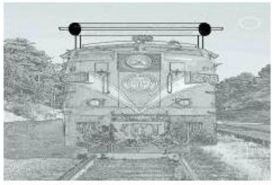
V. *APPLICATIONS*

1. *RESIDENTIAL* *The house pictured is in an elevated, windy location and has a large pitched roof to concentrate wind at the roof apex. This represents an ideal location to mount Wind turbine horizontally along the apex. This modular 'by-the-meter' approach provides a simple and efficient solution to structural mounting along the lines of maximum wind concentration.*

2. *BUILDINGS* Tall buildings provide a structure where both horizontal Wind turbine orientations can be applied. Building top not only provide structurally practical mounting points but also significantly improve turbine performance via wind concentration.

3. *BRIDGES* With clear wind funneling through, bridges provide the opportunity for excellent wind energy recovery. Wind turbines could also be conceivably used along the roadside across the bridge and even along the top structure of the bridge.

4. *TRAINS* This concept is also used to generate electricity in trains by installing a rooftop wind turbines on top of all wagons of the train. The turbine mounted on top will be able to rotate by the force of the wind during the motion of the train and this motion can be easily converted to electricity with the help of generator and by this we can easily supply electricity to the entire wagon of the train



5. ***MARINE SHIPS*** This concept is used to generate electricity in marine ships by installing rooftop turbine on the board of the ship. The roof top wind turbine installed on the ship will be able to rotate by the force of the wind generated during the sail of the ship and the momentum produced is used to run the generator coupled to the turbine. And the electricity generated can be utilized to power up the entire ship.

VI. ADVANTAGES & DISADVANTAGES

6.1ADVANTGES

- It can be used to produce electricity in remote places
- Extremely low noise and vibration.
- Able to operate vertically, horizontally or any angle in-between.
- Able to operate efficiently in gusty and turbulent winds such as typically found in urban environments.
- Able to be modularly mounted onto buildings at low cost in a location where wind is at highest concentration.
- Excellent power production at low cost.
- Able to run and produce power during heavy rain.
- Safe to birds. In addition, Roof top Wind turbines are surrounded by a relatively large, static frame that further deters birds and animals. If specifically required Wind turbine can be fitted with a mesh cover guard however there is a small impact on performance.
- In cyclones and extremely strong winds, the Wind turbine electronic control system slows the turbine to a stop, protecting it from damage.
- Life-span. The only moving parts are bearings and these have a design life of greater than 17 years. Replacement of bearings after this time is simple and low cost.

6.2 DISADVANTAGES

- Loss of power due to friction of moving parts.
- Small wind turbines are less reliable.
- Should be installed in places free from obstruction like trees, buildings etc.,
- Power production is intermittent hence storage of power is necessary.
- Wind turbines may get damaged due to natural calamities like thunder, storm etc.
- Some of the parts may get corroded.

VII. CONCLUSION

Our objective is to establish a wind turbine for remote places around that can have mass usage at low cost. We still feel that decentralized biomass-based solutions are a good option to power for rural and remote areas. However, aggregation of biomass remains a challenge that needs to be effectively addressed.

We incorporated wind energy into a facility to solve power problems in remote areas and to help provide power with cleaner resources. And we are all proud to be involved in helping the environment, especially as our planet’s resources draw closer to expiration. It’s about time that our world focuses on preserving what is left and using what is free, available and clean to us. We are also pleased that we have a positive aspect for the welfare of our gracious society making it eco-friendly. Our two goals that aimed towards were cost and efficiency. We incorporated the HSWTs in a secrete, subtle, and aesthetically-pleasing fashion. Most importantly, our turbines generate enough clean power to support the basic needs of power and the operations of the stadium. Our team learned so much from this project – all the dimensions to accomplishing a task such as this one.

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