Design, Analysis and Development of Epoxy Resin made Omnidirectional Wind Turbine

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Abstract. Wind as a wellspring of energy is being utilized for a significant stretch of time. It has increased more importance in the current time of energy emergency. The Horizontal Axis Wind Turbine and the Vertical Axis Wind Turbine is created and executed monetarily. Inorder to have joined combined advantage the Omnidirectional Wind Turbine is created in this work. In this, plan of the part assumes the crucial job. The plan was advanced to accomplish auxiliary quality in which the E - Glass Fiber is utilized to design the blades and thwarts without trading off the weight and quality. The investigation is finished utilizing the ANSYS Fluent to decide stream boundaries. Omnidirectional breeze exploits to other family unit power age strategies. So, Apartment tenants could reasonably produce power and freely utilize feed-in levies. The Omnidirectional Wind turbine is appropriate to metropolitan situations consequently augmenting the scope of reasonable areas for the outfitting of feasible energy. Further prototyping and test will be made so as to advance its presentation. Past this arrangement, the innovation can be utilized for creating on-framework and off-matrix options for the metropolitan market just as for RVs, vessels and other independent applications at various sizes.

1. Introduction
Over Centuries by and large world has been rely upon non-sustainable power source assets like fuel, wood, gaseous petrol, coal, uranium and so on. All these energy assets are restricted and make contamination. Due to above expressed issue the world has top to zero in on sustainable power source assets like sun-oriented energy, hydropower, wind energy, flowing energy. These energies give advanced utilization of energy eco-accommodating and limiting the contamination. Out of these energies wind energy assumes an imperative function in everyday life. The breeze energy is used by utilizing wind turbine [1]. The most evolved types today are wind energy and biomass since they are brief timeframe put away energy assets. A converter is needed to transform active breeze energy into operational energy ex. Power. This part depicts the historical backdrop of wind turbine innovation improvement and its possible applications. Wind turbine innovation offers savvy answers for kill the reliance on exorbitant unfamiliar oil and gas currently used to produce power. Furthermore, this innovation gives electrical energy without nursery impacts or destructive contamination releases [1]. Besides, wind turbine establishment and power producing costs are lower contrasted with other electrical energy age plans including coal terminated steam turbo-alternators, tsunami turbines, geothermal-, aqueous, biofuel-, and biodiesel-based electrical fuel sources and atomic reactor-based generators [2]. Wind turbine innovation offers a financially savvy substitute restoration fuel source.
Mention that a breeze turbine is equipped for producing more prominent measure of electrical energy with zero nursery impacts contrasted with other energy creating plans including sun based cell, tsunami, biofuel, hydrogen, biodiesel, and biomass advancements. A breeze turbine is the converse of an electrical fan. A breeze turbine utilizes wind energy to create the power; a fan utilizes power to produce wind. In more modern wording, a breeze turbine changes over the motor energy of the breeze into electrical energy.

2. Scope and Objective

2.1. Scope of the Project
The turbines are located in the centre median of the highways where the continuous motion of vehicles in high speed to produce more power. By installing the turbines in tall buildings the power is generated. The turbines can be used in the hill region to achieve more efficiency. The project will become an example for future works.

2.2. Objective of the Project
The primary objective is to develop a wind power generation which is simple and cost effective. The reduction of coal for the power generation.

3. Current Research
Wind power age limit in India has fundamentally expanded lately. Starting at 31 December 2018 the complete introduced wind power limit was 35.288 GW, the fourth biggest introduced wind power limit on the planet [3]. Wind power limit is for the most part spread over the South, West and North districts. R.A. Msuya et al expressed that most little scope level breeze turbine generators are straightforwardly determined framework, variable speed, and halfway associated power electronic converter framework. Decision of such framework is to dodge costs related with gearbox. Notwithstanding, because of low wind speed in a large portion of the tropical nations, coordinated generators with littler or medium speed Permanent Magnet (PM) generator configuration discovered to be significant and given elite proficiency [4]. So as to have the option to gather wind energy in off-matrix populace effectively, there was a need to plan a coordinated generator that can have the option to work under low wind speed, legitimately associated with the end client. Consequently, the investigation planned a six shaft pair wind turbine generator utilizing lasting magnet (PM) model, utilizing Maxwell two measurements (2D) and Rotational Machine Expert (RMxprt) programming. The planned PM AC wind turbine generator worked with productivity of 93% at rotational speed (rpm) extend from 50 to 350 with greatest force yield of 980 watts [5].

4. Design
The design is done in the solid works software. The features used for the design are Boss-Extrude: Extruding the selected sketch or contour in one or two direction based on the dimension. Cut-Extrude: This is used to cut the solid by extruding the profile in one or two direction based on the dimension. Cut-Loft: This is used to cut the solid by selecting the two or more different or similar profiles. Mirror: This is used to recreate/mirrors the edges faces based on the axis of the body. Surface sweep: This is used to create the surface feature based on the profile (open or close) following the open or closed path. Thicken: This is used to create the solid feature by applying the thickness to the surface[6]. It is mostly used for converting the complicated surfaces to the solid. Fillet: It is used to create the rounded edge from the straight edge to reduce the stress factor and provides smooth contact at joints [8]. Figure 1 and Figure 2 shows the wireframe and inner part of the model.
5. Analysis

5.1. Parameters

| Boundary Conditions | Analysis type: |
|---------------------|----------------|
| Velocity inlet = 5 ms$^{-1}$ | Pressure based analysis |
| Pressure inlet = 1.015e5 N/m$^2$ | Relative velocity based analysis |
| Temperature = 310K | Transient type analysis |

The above table 1 shows the Parameters, the velocity inlet of 5 ms$^{-1}$ is applied in all three coordinates $V_x = 5$ ms$^{-1}$, $V_y = 5$ ms$^{-1}$, $V_z = 5$ ms$^{-1}$. The air strikes the blades of turbine in which they provide the necessary thrust for the motion of the turbine. The turbine starts to rotate which in turn rotate the generator which produces the power.

5.2. Analysis Results

After the completion of mesh as in figure 3 and 4, the fluent solver is initiated as in figure 5. In the fluent the analysis solver parameters is selected based on the standards which are performed in the analysis.
Based on these parameters the solution is initiated and the results are obtained.

5.2.1 Velocity contour: ANSYS Fluent empowers you to plot form lines or profiles superimposed on the physical space [7]. Shape lines will be lines of consistent size for a chosen variable (isotherms, isobars, etc). A profile plot draws these forms extended off the surface along a reference vector by a sum corresponding to the estimation of the plotted variable at each point on a superficial level as in figure 6.

5.2.2. Velocity Path lines: Path lines are the lines gone by impartially light particles in balance with the smooth movement. Path lines are a magnificent tool for perception of complex three-dimensional flows. In this model as appeared in figure 7, you will utilize path lines to analyze the stream around and in the wake of the module.

5.2.3. Velocity Vector: Velocity vectors in figure 8 give an incredible representation of the flow around the module, portraying subtleties of the wake structure.

Figure 5. Solver Methods

Figure 6. Velocity Contour

Figure 7. Velocity Path lines
5.2.4. Shear Stress, Strain rate
For no-slip wall conditions, ANSYS FLUENT utilizes the properties of the flow contiguous the wall/fluid limit to anticipate the shear stress on the fluid at the wall[8]. In laminar flows this count essentially relies upon the velocity gradient at the wall, while in turbulent flows will process the distracting speed at the limit.

Figure 8. Velocity Vector

Figure 9. Shear Stress
6. Fabrication

6.1. Die Preparation
Die is the major component in the manufacturing. Die can be prepared from various materials and for our design parameters and from economic analysis we concluded that to make the die from the wood rather than the ferrous materials. In the wood there are many types of wood which having its own significance and performance.

After the study of properties of all commercial wood we chose MDF (Medium Density Fibreboard) for the die production.

The Standard MDF board of size (1200*600) is divided into two pieces. The maximum dimension of the product is nearer to 600mm. So based on size it is divided into two pieces. The MDF pieces are merged to form a solid block. The binding resin is used to join the MDF pieces and then dwell time is given for proper setting as shown in figure 11.

![Figure 11. Application of Binder](image)

6.2. Mould Design
The mould design is obtained main design of the product. There are four moulds to be prepared for the fabrication of the product. In these moulds the inner part is produced from the part1 and part2. We need to fabricate the two pieces in each part. The exterior parts are made from the part3 and part4. In this moulds also we need to fabricate the two pieces. Parts design are shown in figure 12 to 15.

![Figure 10. Strain Rate](image)
6.2.1. Parts Sketching

![Figure 12. Inner Part 1](image1)

![Figure 13. Inner Part 2](image2)

![Figure 14. Outer Part 1](image3)

![Figure 15. Outer Part 2](image4)

6.3. VMC Machining

6.3.1. Procedure
- The part file is to be imported to the software developed specifically for the machine.
- In that machine for the imported part it generates the coding for the tool movement.
- The work piece is to be located. The tool to be fitted and then the (x,y,z) coordinates of the start point to be specified.
- The coolant supply is to be checked before the start of work.

6.4. Mould Preparation
The mould is obtained from the E-Glass fibre shown in figure 16 & 17. The black coloured resin is applied for the preparation of the mould. For the mould after applying resin we need to wait for setting up to 36 hours as shown in figure 18 & 19.

6.4.1. E-Glass Fibre
E Glass or electrical evaluation glass was initially created for stalemate encasings for electrical wiring. It was later found to have amazing fiber framing abilities and is presently utilized solely as the strengthening stage in the material normally known as fiberglass.
6.4.2. Composition

Material Composition is shown in table 2. E-Glass is a low alkali glass with a typical nominal composition of SiO$_2$ 54wt%, Al$_2$O$_3$ 14wt%, CaO+MgO 22wt%, B$_2$O$_3$ 10wt% and Na$_2$O+K$_2$O less than 2wt%. Some other materials may also be present at impurity levels.

| Table 2. Material Composition |
|------------------------------|
| Material:                    | E-Glass Fibre               |
| Composition:                 | 54% SiO$_2$ - 15% Al2O3-12%CaO |

6.4.3. Resin

Epoxy resins are commonly around multiple times more grounded than the following most grounded resin type. Epoxy sticks to Carbon Fiber, Fiberglass, and Aramid (Kevlar), great and structures a for all intents and purposes watertight boundary. Epoxy additionally sticks to more seasoned epoxy and most materials very well.
6.5. Part Preparation

The initial coating of mixture of resin, hardener, colouring agent are applied in to the mould and the glass fibre is placed and the above fibre the mixture is applied again and based on the required thickness fibre and the mixture is applied to the mould as shown in figure 20.

6.6. Releasing the part

The parts are to be provided with sufficient time for setting but it does not take more time like the mould the parts are released from the mould within 3 or 4 hours as shown in figure 21.

6.7. Blades

Blades are prepared based on the dimension from the design. The outer blade in which the centre line is drawn in it based on that the blades distances are marked and the line is drawn on it

6.8. Stand Preparation

The stand is prepared by using the L-section bracket shown in figure 22. The L-section is used for three legs of stand. The circular plate is used at the top for bearing seating which is shown in figure 23.
6.9. Shaft attachment
The shaft is connected with the completed part by means of attachment in which the rectangular block consists of four holes for fasteners and the bush is provided at the centre that is shown in figure 24. The bush is welded to the block. The hole is drilled in the bush and tapped in it. The dead screw is used as fasteners. The outer blade is shown in figure 25.

6.10. Assembly
The two pieces of part1 and part2 are to be prepared and then they are assembled into the complete part. The outer parts are assembled with the bottom plate. The shaft attachment is attached to the bottom of outer blade by fasteners.
6.11. Bearings

Figure 26. Bearing F204

Two pieces of F204 bearing is used for the assembly of shaft that is shown in figure 26. Self-aligning ball bearings have two rows of balls, a common sphered raceway in the outer ring and two deep uninterrupted raceway grooves in the inner ring. They are available open or sealed. The bearings are insensitive to angular misalignment of the shaft relative to the housing which can be caused, for example, by shaft deflection.

7. Electrical System

7.1. DC to DC Converter
A DC-to-DC converter is an electronic circuit or electromechanical device that converts a source of direct current (DC) from one voltage level to another. It is a type of electric power converter. Power levels range from very low (small batteries) to very high (high-voltage power transmission). DC-to-DC converter is used as step up converter in which the low volt power is converted to the high volt.

7.2. Permanent Magnet Generator
A permanent magnet generator is a device that converts mechanical energy to electrical energy. In this device that is shown in figure 27, the rotor windings have been replaced with permanent magnets. These devices do not require a separate DC supply for the excitation circuit or do they have slip rings and contact brushes. These machines are superior alternatives to traditional induction motors that can be coupled with turbines, diesel generators and used for hybrid vehicles. Another major advantage is that these machines does not require any specific work environment and hence can be used in wind and water machines.

8. Conclusion
The omnidirectional wind turbine is fabricated as per the design shown in figure 28 and the turbine is tested to attain the voltage output from the generator in the range of (1.5-5.0V) by using the step up converter it is converted up to the 20 to 30V.

8.1. Application
The turbines are located in the centre median of the highways where the continuous motion of vehicles in high speed to produce more power. By Installing the turbines in tall buildings to achieve the power generation. The turbines can be used in the hill region to achieve more efficiency.
8.2. Future Scope

Further prototyping and test will be made in order to optimize its performance. Specialized facilities have been made available at National Institute of Wind Energy for this purpose. Beyond this solution, the technology can be used for developing on-grid and off-grid alternatives for the urban market as well as for motor homes, boats and other stand-alone applications at different sizes. One particularly interesting possible application is wave energy generation, as under the waves it is also a chaotic situation with water flowing in every direction. In order for this technology to be used in that scenario, a greater R&D effort should be made.

9. References

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