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Design and Implementation of Modified Wind Turbine Blades for Increased Output

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ABSTRACT

The most popular renewable energy source is wind since it is commercially accepted, inexpensive, easy to operate and maintain, takes comparatively less time to develop from concept to operation, creates jobs, and has the least negative environmental impact. The availability of multi-megawatt horizontal axis wind turbines and the wind industry's rapid technological advancements have further fuelled the global push for wind power use. It is well knowledge that wind speed and, thus, energy production rise with altitude. However, structural and other problems prevent one from going higher than a certain point. As a result, additional efforts must be undertaken to boost wind turbine efficiency while preserving hub heights. By altering and rebuilding the blades, the cut-in speed and/or the rated speed can be decreased, increasing the wind turbines' efficiency or energy output. Finding the optimization parameters—such as the power coefficient, energy cost, annual energy yield, blade mass, and physical, geometric, and aerodynamic limitations on the blade design—solves the issue. An overview of the widely used models, methods, instruments, and experimental strategies used to boost wind turbine efficiency is given in this study. The current review work places special emphasis on methods for designing wind turbine blades, both numerically and experimentally; methods for studying wind turbine performance, both analytically and experimentally; active and passive strategies for increasing wind turbine power output; lowering cut-in speed for better wind turbine performance; and, finally, research and development efforts pertaining to new and effective wind turbine materials.

Key words: Wind Turbine, Blade design, Renewable energy, Wind energy conversion, Performance optimization

1. INTRODUCTION

Wind power has emerged as a critical component in reducing dependence on fossil fuels. A key factor in maximizing the efficiency of wind turbines lies in the design of their blades, which are responsible for capturing wind energy and converting it into mechanical power. Traditional wind turbine blades have certain limitations, such as inefficiencies in energy capture at low wind speeds, structural fatigue, and material degradation over time. This mini-project focuses on the design and implementation of modified wind turbine blades to overcome these challenges. By exploring different blade geometries, and aerodynamically optimized shapes, this project aims to improve power output, durability, and operational efficiency.

Factors such as blade length, twist angle are the major parameters of the design. The ultimate goal of the project is to design and test blade modifications that not only boost performance but also contribute to the sustainability and cost-effectiveness of wind energy.

2. HARDWARE DESIGN

2.1 Design of Modified wind turbine blades

Making a thin steel sheet 50*50cm square. Find the centre of the square use a ruler to measure mark 50cm from center point to a corner and repeat the process. Cut from the corner to the 13cm mark repeat the process until you cut 4 lines. Connect the wheel to the shaft by using the bolt.

The blade is the most critical aspect of a wind turbine because it absorbs energy from air. It accounts for 20% to 25% of the total cost of the wind turbine. The aim of this project is to create a special type of pinwheel blade for a small shaped wind turbine that can operate in weak-wind.

New and more powerful blade designs are needed to satisfy the demand for electricity. For the construction of blades for both traditional airplane and wind turbine technologies, many forms of air foil structures are accessible with technological innovation. The design of a new air foil or the selection of a current one from the list typically depends on the type of operation for which the blade should be used. In this segment, various pinwheel type horizontal axis wind turbine blades are constructed through Solid Work.

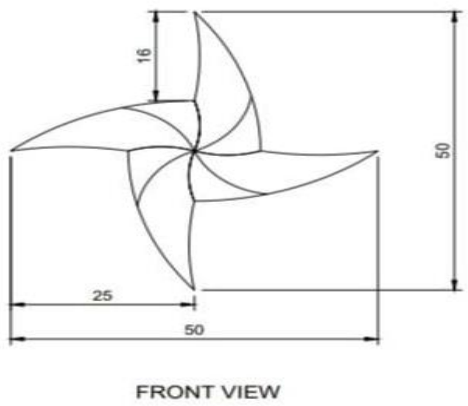

Fig 1. Front view

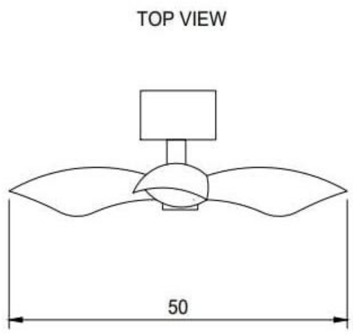

Fig 2. Top view

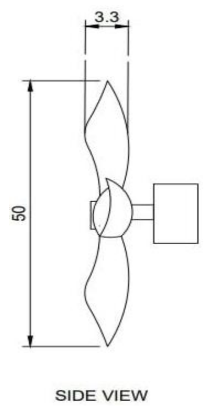

Fig 3. Side view

Design Calculation

Given:

ρ=0.97;

Velocity=4 m/s;

S=50cm;

Diameter=S($\sqrt{2}$)=50($\sqrt{2}$)=70.01cm/100=0.7001m;

Diameter=0.7001m;

Available wind power $P\alpha$ $= (1/8)\rho\pi D^2V^3$ Watts

$= (1/8)(0.97)(3.14)(0.7001)^2(4)^3$

= 11.94 Watts

2.2 Central shaft

The shaft of the turbine consists of a single 25cm length of steel measuring 0.7mm in diameter. the use of steel over a lighter metal such as cast iron was based on the availability of materials. the top and bottom ends mild steel of length 1inch each are respectively are fixed to give strength to the hollow shaft.

The primary purpose of a shaft is to engender Torque from the driving components like an Electric Motor or an engine.

Table no.1: Dimensions of central shaft

Length	25cm
Diameter	0.7mm

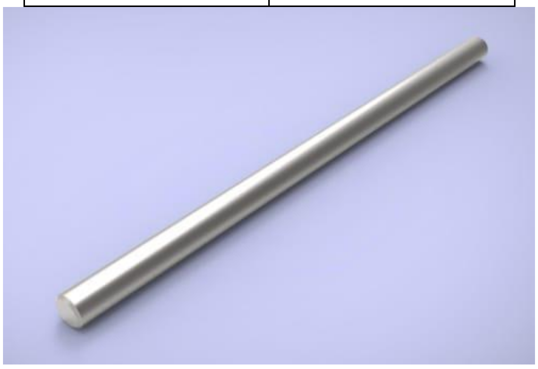

Fig 4. Central shaft

2.3 Bearing

For the smooth operation of shaft, bearing mechanism is used. to have very less friction loss, the two ends of shaft are provided into the same dimension bearing. the bearing has diameter of (outside) 2.54cm. bearings are generally provided for supporting the shaft and smooth operation of shaft.

Table no.2: Dimensions of

Bore	0.8mm
Outer Diameter	25mm
Width	6mm

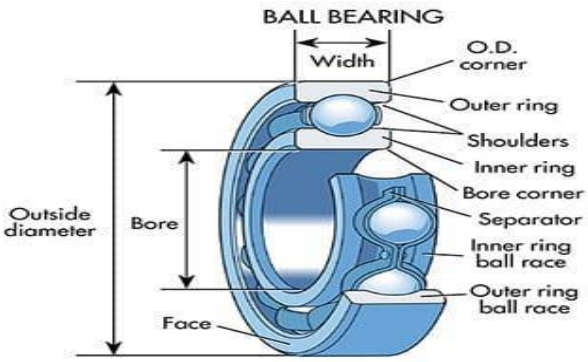

Fig 5. Bearing

2.4 Permanent Magnet DC Motor

A permanent magnet DC motor (PMDC) is a type of DC motor that uses a permanent magnet to create the magnetic field required for its operation.

Table 3: Details of PMDC

Power	50Watts
Voltage	16VDC
Current	3.9Amps
Speed	600RPM
Duty Cycle	S1
Insulation Class	B

Fig 6. DC Motor

2.5 Rechargeable Battery

A rechargeable battery, storage battery, or secondary cell, is a type of electrical battery which can be charged, discharged into a load, and recharged many times. By using Wind we charge the rechargeable battery, through the battery the electric energy is supplied to various components in the circuit.

Fig 7. Rechargeable

Table 4: Details of Rechargeable battery

Capacity	7Ah
Nominal Voltage	12V
Terminal Type	T1
Cells Per Unit	6V
Voltage Per Unit	12V
Max. Discharge Current	105A
Max. Charging Current limit	2.1A

2.6 Load

A LED strip light is a flexible circuit board populated by surface mounted light emitting diodes and other components that usually comes with an adhesive backing. traditionally, strip lights had been used solely in accent lighting, back lighting, task lighting and decorative lighting applications.

Fig 8. Load

CONCLUSION

The proposed modified wind turbine blades are expected to play a crucial role in the next generation of wind energy systems. The proposed model is giving approximately 6.85V at the speed of 4.8m/s. It will improve efficiency, durability and environmental compatibility. These innovations will contribute to the broader goals of reducing carbon emissions and achieving sustainable energy system.

REFERENCES

1. **FarhaKhanam, NeeleshSoni,** "Performance Improvement of Horizontal Axis Wind Turbine by Using Modified Blade of NACA 5510", International Journal of Advanced Research in Science, Engineering and Technology, Vol. 3, Issue 2, February 2016.
2. **P Sakthivel, GP Rajamani** "Design and Analysis of Modified Wind Turbine Blades" Asian Journal of Research in Social Sciences and Humanities, 2017.
3. **Tenghiri,Y Khalil,F Abdiand A Bentamy** "Optimum design of a small wind turbine blade for maximum power production"2017 This paper presents a typical design methodology of the rotor blades of a small wind turbine with a power generation of 11 kW (rotor radius of 3.5 m).