Design and Fabrication Of Vertical Axis Wind Turbine

Bankar Pranav P.[1], Mitkar Sudarshan S.[2], Bagal Sagar K.[3], Divate Shubham V.[4], Prof. Gadpyale Uday [5], Prof. Jagtap H.P.[6]

[1, 2, 3, 4, 5, 6]Zeal Education Society, Zcoer, Narhe, Pune, Maharashtra, India

Abstract-*In recent era, research and development activities in the field of renewable energy, especially wind and solar, have been considerably increased, due to the worldwide energy crisis and high global emission. The horizontal axis wind turbine cannot be used for household purpose. So, Savonius vertical axis wind turbine can be better option as it operate in low wind condition also. The efficiency of model is varying wind conditions as compared to the traditional horizontal axis wind turbine and contribute to its steady growing popularity for the purpose of mass utilization in the near future as a reliable source of power generation. The Savonius rotor is widely considered to be a drag-driven device. This indicates that the wind drag, acting on its blades, is the only driving force. However, it has been observed that at low angles of attack the lift force also contributes to the overall torque generation. Due that the Savonius rotor is not use solely drag-driven machine but a combination of a drag-driven and lift-driven device.*

Keywords*-*Renewable energy, VAWT, Savonius, Multi stage generator, Household, Handmade PM generator

I. INTRODUCTION

With the traditional energy sources exhausting quickly, renewable and clean energies such as wind energy and solar energy have been taken more and more attentions by countries all over the world at present. There are two categories of wind energy conversion systems including horizontal axis wind turbines (HAWTs) and vertical axis wind turbines (VAWTs). Compared with HAWTs, VAWTs have many advantages. For instance, they can accept wind flow by any directions thus a yaw system of wind turbine is not needed, they usually have simple structures to manufacture and maintain, and costs are largely lower than the former. However, VAWTs have an obvious disadvantage of low wind energy utilization coefficient, which limit their applications. A wind energy conversion system which has characteristics of high wind energy utilization coefficient, simple structure, fast start-up feature, etc. is one of the key scientific problems that the scholars consider to solve at present. Savonius wind rotor is a typical VAWT and has excellent performance such as simple structure, fast start-up and running at low wind speed, yet the coefficient of power is lower than that of other type of wind rotors. Scholars have put their efforts on performance improvement of Savonius wind rotor. Research objectives for Savonius wind rotor mainly focus on the operating characteristics and the structural characteristics.

With technology development of low-speed permanent magnet generator, advantages of Savonius type wind rotorshave been taken more attentions again. By research achievements of the scholars, one reason of low wind energyutilization of the Savonius wind rotor is that airflow changes sharply in inner flow field. Scholars attempted to optimize shape or structure, furthermore, add certain systems on the wind rotor to improve structural characteristics and increase wind energy conversion coefficient. Considering improving wind energy utilization of Savonius rotor by developing flow field around the rotor, a novel wind rotor is proposed which is so-called the Fish-ridged wind rotor.

II.PROBLEM DEFINATION

As world population and standards of living increase there is an ever growing demand for energy. This increase in energy creates significant demand for energy created by fossil fuels, which the world has a limited amount of and carbon emissions can lead to global warming. The fears of diminishing natural resources and concern of significant climate change as a result of the burning of fossil fuels has created great worldwide interest in clean renewable energy that can meet the electrical demands of the world. One common strategy is to use wind turbines that generate electricity from wind.

III. OBJECTIVE

The objective of this project is to design VAWT that is capable of producing power which is useful for the region where electricity is not available or less available. The design of the turbine will include exploration of various self-starting options, as well as construction of model and full-scale turbines. The full-scale turbine will be designed such that it can be connected to a generator and a torque transducer to measure the output power, torque and rotational speed of the turbine.

1. To develop a vertical axis wind turbine set that will generate electricity for rural areas economically.

2. To carry out a performance test for vertical axis wind turbine.
3. To apply engineering knowledge and skill to develop the conceptual ideas into a reliable, functional and efficient design, with appropriate consideration for manufacture, installation, maintenance, and operation.
4. To calculate specifications and outputs of turbine setup.

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IV. RESEARCH METHODOLOGY

i. The VAWT system components and functions are investigated, identified the latest technologies and their limitations. Conceptual designs are developed from this point, and this will form the basis of the technical analysis and complete design.
ii. Depending upon material availability and cost of blade material is selected according to design specification.
iii. Working of actual model for VAWT
iv. By studying power transmission systems the bevel gears mechanism is used for power transmission to output shaft.
v. Performance analysis of VAWT system is carried out by varying the input parameters.
vi. By using generator mechanical energy from output shaft is converted into electricity and utilized to glow LED bulb.

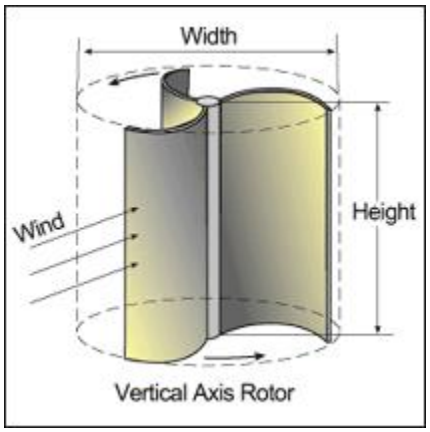
V. COMPONENTS USED

Rotor Shaft

The rotor is a moving component of an electromagnetic system in the electric motor, electric generator, or alternator. Its rotation between the windings and magnetic fields which produces a torque around the rotor's axis.

Turbine Blade

A turbine blade is the component of a wind turbine system. The blades are responsible to produce energy from the wind. Most commonly used wind mills are propeller type with two or three blades for economical reasons. Three blades designs use for naturally balanced. Blades of propeller type wind turbine are made of aerofoil section. The materials used for blade alloys and glass fiber reinforced plastic. The bending moment is caused by the stress induced by vibration and resonance within the operating range of machinery and wind velocity. To protect blades in upwind designs, turbine blades must be made stiff .



Stepper Motor

A stepper motor revolves into number of steps. The number of steps can be two, four, six or eight. The rotor angle can be change using computer programming. The stepper motor used to rotate shaft in require angle. A microcontroller is used to choose rotation of steeper motor either clockwise or anticlockwise. It also gives sequence on off devices.

Stand

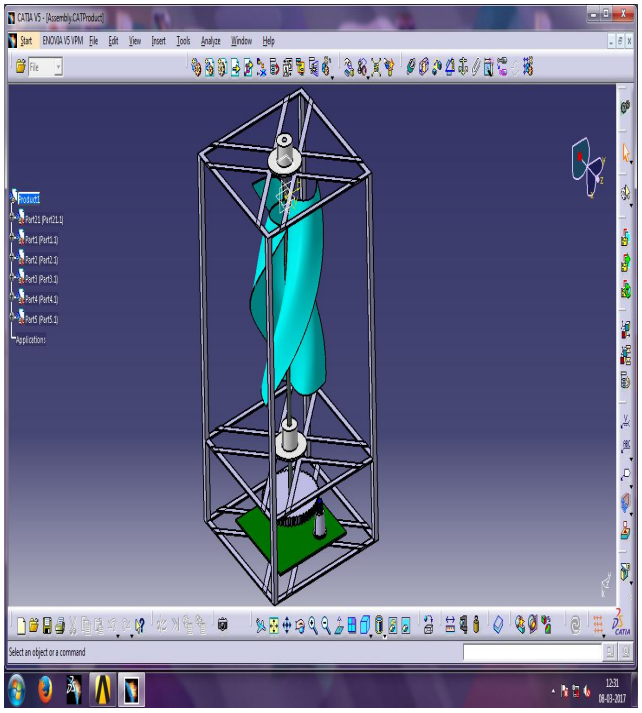
It is a rigid structure used to support a wind turbine and a whole system.

Bearings

The bearing is machine element which reduces friction during the relative motion.it reduces friction between

the moving part.The bearing design for free linear movement of moving part or free rotation around fixed axis. Bearing also design to transfer the axial load or radial load from source of load to the supporting structure it. Lubrication used to reduce friction.

VI. MODELLING



The importance of modeling and simulation in the manufacturing technology is increasing due to the need for continuous reduction of development times. This necessitates the optimization of the production processes, the enhancement of product quality and reduction of costs. The application of numerical modelling is especially resorted to in the development of new production methods and the use of new materials. Specialized software solutions are available to optimize the design of castings, welding process, heat treatment and metal forming (sheet metal processing, tube bending, extrusion, rolling, drawing, forging etc).

VII. RESULT

The Experiment have been conducted in the laboratory with the help of blower with different velocity of wind speed, the wind speed is measured using Anemometer, the motor is connected with the Digital Multimeter, current and voltage is noted with the corresponding wind speed, and the power is calculated.

Wind speed in m/s	Voltage (V)	Current(I) amps	Power P=VI (W)
7	2.07	120Ma	0.25
10.7	2.7	185mA	0.49
24	3.1	195mA	0.60

VIII. FUTURE SCOPE

1. Selection of proper generator will give more energy.
2. Weight reduction can be possible.
3. More than two bearings can be used for supporting & smooth running of shaft
4. Frame can be selected as per application
5. Due to fixed support losses are come in picture. To avoid this proper alignment should be mate.

IX. CONCLUSION

The VAWT is designed and fabricated in such a way that the it can able to capture wind from all the direction, power developed from the project is 1W for a speed of 25m/s, the efficiency of VAWT can be increase by changing the size and shape of the blade, the theoretical and experimental result is varying because in theoretical calculation we consider the wind is hitting all the three turbine blades, practically it is hitting only one turbine at a time.

REFERENCES

[1] Niranjana S. J., "Power Generation by Vertical Axis Wind Turbine", International Journal of Emerging Research in Management &Technology, ISSN: 2278-9359, Volume-4, Issue-7, July 2015, PP. 1-7.

[2] P. D Abd. Aziz A. K. R Mohamad, F.Z Hamidon, N. Mohamad, N. Salleh and N. Mohd Yunus, "A Simulation Study on Airfoils Using VAWT Design for Low Wind Speed Application", 4th International Conference on Engineering Technology and Technopreneuship (ICE2T), 2014, PP 105-109.

[3] Jan Kumbernuss, Chen Jian, Junhua Wang, H.X. Yang and W.N. Fu, "A novel magnetic levitated bearing

system for Vertical Axis Wind Turbines (VAWT)", Applied Energy, Vol. 90, 2012, PP 148–153.

[4] B. Bittumon, Amith Raju, Harish Abraham Mammen, Abhy Thamby and Aby K Abraham, "Design and Analysis of Maglev Vertical Axis Wind Turbine", International Journal of Emerging Technology and Advanced Engineering, ISSN 2250-2459, Volume 4, Issue 4, April 2014, PP 374-379.

[5] Minu John, Rohit John, Syamily P.S and Vyshak P.A, "Maglev Windmill", JRET: International Journal of Research in Engineering and Technology, eISSN: 2319-1163 | pISSN: 2321-7308, Volume 03, Issue 05, May-2014, PP 50-56.

[6] Liu Shuqin, "Magnetic Suspension and Self-pitch for Vertical-axis Wind Turbines", "Fundamental and Advanced Topics in Wind Power", book edited by Rupp Carriveau, ISBN 978-953-307-508-2, Published: July 5, 2011 under CC BY-NC-SA 3.0 license.

[7] A Text Book of Mechanical System Design, Farazdak Haideri, Third Edition, Chapter 2, Page No. 149 – 241.

[8] Mechanics of Materials I, Third Edition, E. J. Hearn, University of Warwick, United Kingdom, Chapter 1, Page No. 1-8.

[9] Mechanical Vibrations, Thammaiah Gowda, Jagadeesha T, D. V. Girish, Tata Mcgraw Hill Education Private Limited, Page No. 44, Topic – Spring Element.

[10] Strength of Materials, S. Ramamrutham, R. Narayanan, Dhanpat Rai Publication Company, Page No. 116-118.