Review Paper on Design and Analysis of Maglev Vertical Axis Wind Turbine

Pavan S. Adate[1] Vaibhav R. Kadam[2] Abhishek A. Kadam[3] Omkar M. Dongare[4] Rohit. B. Patil[5]
[1,2,3,4]B.Tech Student [5]Assistant Professor
[1,2,3,4,5]Department of Mechanical Engineering
[1,2,3,4,5]Adarsh Institute of Technology & Research Centre, Vita, Sangli, Maharashtra, India

Abstract— The vertical axis concept for the wind turbine that is implemented as the power generation portion of this project. The characteristic of that, it is fully supported and rotates about a vertical axis. This axis is vertically oriented through the center of the wind sails which allows for a different type of rotational support rather than the conventional ball bearing system. This support is called maglev which is based on magnetic levitation. Magnetic levitation is the phenomenon operates on the repulsion characteristics of permanent magnets. Maglev is a method by which an object is suspended with no support other than magnetic fields. Magnetic pressure is used to counteract the effects of the gravitational and any other accelerations. The principal advantage of a maglev wind turbine is use of magnets for levitation of bleads instead of ball bearing. Maglev offers a near frictionless substitute for ball bearings with little to no maintenance. So, to use Magnetic levitation to reduces the friction & to increase the efficiency.

Keywords: Maglev, Vertical Axis Wind Turbine

I. INTRODUCTION

Renewable energy is generally electricity supplied from sources, such as wind power, solar power, geothermal energy, hydropower and various forms of biomass. These sources have been coined renewable due to their continuous replenishment and availability for use over and over again. The popularity of renewable energy has experienced a significant upsurge in recent times due to the exhaustion of conventional power generation methods. India has a potential of 20,000 MW of wind power. Wind power accounts nearly 9.87% of India's total installed power generation capacity. Generation of wind power mainly account from southern state of India. Now a day, we will ultimately need to search for renewable or virtually inexhaustible energy for the human development to continue. Renewable energy is generally electricity supplied from sources, such as wind power, solar power, geothermal energy, hydropower and various forms of biomass. The popularity of renewable energy has experienced a significant upsurge in recent times due to the exhaustion of conventional power generation methods. The exploration of renewable energy is the only approach to reduce our dependence on fossil fuels. Among the renewable energy sources Wind Energy is one of the fastest growing energy sources which is growing at the rate of 30% annual graph. A wind turbine is device that converts the winds kinetic energy into electrical energy. The blades of wind turbine turn between 13 and 20 revolutions per minute, depending on their technology, at a constant velocity, where the velocity of the rotor varies in relation to the velocity of the wind in order to reach a greater efficiency. Rapid evolution of wind technology has led to an increase in the durability of wind turbines. Wind turbines are manufactured in a wide range of vertical and horizontal axis types. The smallest turbines used for applications such as battery charging, for auxiliary power for boats or to power traffic warning signs. Slightly larger turbines can be used for making contributions to a domestic power supply while selling unused power back to the utility supplier via the electric grid. The wind speeds in most of Asian zone is much lower than 7 m/s, especially in the cities, but the mechanical frictional resistance of existing wind turbines is too big, usually it can't start up when the wind speed is not big enough. This project introduces structure and principle of the proposed magnetic levitation wind turbine for better utilization of wind energy. Maglev Wind turbine has the features of no mechanical contact, no friction etc. minimizing the damping in the magnetic levitation wind turbine, which enables the wind turbine start up with low speed wind and work with breeze. The Maglev vertical axis wind turbine (VAWT), which was first unveiled at the Wind Power Asia exhibition in Beijing, is expected take wind power technology to the next level with magnetic levitation. Magnetic Levitation (Maglev) into turbine system in order to increases the efficiency. If the efficiency of a wind turbine is increased, then more power can be generated thus decreasing the need for expensive power generators that cause pollution. Since one of the main complaints about wind turbines is the sound, they produce, this is a huge advantage over another turbine design.

II. LITERATURE REVIEW

1) Dinesh N Nagarkar, et al. [1] presented a paper titled, 'Wind Power Plant Using Magnetic Levitation Wind Turbine'. Wind is a non-conventional source of energy, by which the electricity can be obtained by converting kinetic energy of wind into electrical energy by using wind turbine. generation of electricity using maglev technology is now becoming more competitive. It works on the principle of electromagnetism. It has colossal structure. It has several advantages over conventional wind turbine and has certain applications. Magnetic levitation is an important development to reduce stress from the mechanical load on the wind turbine.
2) B. Bittumony, et al. [2] presented a paper titled, 'Design and Analysis of Maglev Vertical Axis Wind Turbine'. The research demonstrated a simple way to enable a darrieus VAWT to be self-starting and achieve higher efficiencies. Historically VAWTs cost more to operate and maintain than Horizontal Axis Wind Turbine. A counter rotating wind turbine with a freely rotating generator can produce higher amounts of power than common wind generators. The wind turbine rotors and Stator levitated properly using permanent magnets which allowed for a smooth rotation with negligible friction. At moderate wind speeds the power output of the generator

satisfied the specifications needed to supply the LED load. The project as an overall system we found that it functioned properly but there feel limited the amount of power it could output.

3) Shozab Hasnain Rizvi, et al. [3] presented a paper titled, 'Vertical Axis Maglev Wind Turbine Design & Analysis for Power Generation'. This paper focuses on Vertical Axis Wind Turbine utilizing magnetic Levitation as an axial flux generator as well as an alternative to the conventional ball bearings. Maglev Levitation is a method by which an object is suspended without any support using the magnetic fields. The fluid analysis as well the modelling of the prototype has been performed using ANSYS & SolidWorks software's respectively.
4) Geng, F, et al. [4] presented a paper titled, 'Improvement of efficiency and fatigue life of vertical-axis wind turbines. This paper focuses on the transverse failure behavior of a single fiber epoxy system under a quasi-static axial loading has been analyzed. The crack development is simulated by the cohesive zone model. In parallel, the optimal computational settings for accurately estimating drag and lift coefficients of an airfoil have been explored at a wide range of angles of attack.

III. MAGLEV VAWT

Magnetic levitation is supposedly an extremely efficient system for wind energy. The vertically oriented blades of the wind turbine are suspended in the air replacing ball bearings.

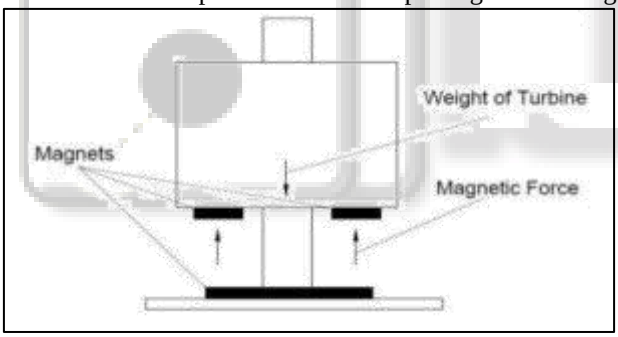

Fig. 1**:** FBD OF MAGLEV VAWT

Fig-1 shows free body diagram of Maglev VAWT, where weight of rotor is acting downward and magnetic force acting upward. Using the effects of magnetic repulsion, wind turbine blades will be fitted on a rod for stability during rotation and suspended on magnets as a replacement for ball bearings which are normally used on conventional wind turbines.

IV. PROBLEM STATEMENT

The fast-growing demand for wind energy has led to a wide variety of wind turbine designs. A specific contemporary type is the vertical-axis wind turbine (VAWT), where the rotor shaft is oriented vertically and the generator and gearbox are placed at the base of the turbine. Compared with horizontal-axis wind turbines, VAWTs are generally considered more capable of handling highly turbulent, gusty wind conditions and rapidly changing wind directions. Since these conditions are commonly encountered in urban environments, this type of wind turbine can play a vital role in urban wind energy. On the downside, however, VAWTs are up to now generally less efficient and can be more prone to fatigue.

V. PROPOSED WORK

Voltage generated from Maglev wind turbine can be increased by increasing the number of turns of the coil in proportion with magnetic lines of force obtained from the permanent magnet. Therefore, greater thickness of the permanent magnets should be used while fabricating the axial flux generator. The Maglev windmill can be designed for using in a moderate scale power generation ranging from 400 Watts to 1 kW. Also, it is suitable for integrating with the hybrid power generation units consisting of solar and other natural resources.

VI. CONCLUSION

Vertical axis wind turbine offers economically viable energy solution for rural as well as urban areas. The Blade design like height & diameter plays critical role for performance and energy extraction from turbine. Magnetic levitation represents a very promising future for wind power generation. Maglev wind turbines will require lower wind velocity for start-up and also, they show better performance at lower wind velocities. Also, from various literature review, journal papers & articles it is clear that maglev VAWT is frictionless, less noisy, more efficient.

ACKNOWLEDGEMENT

We are extremely grateful to our institute, Adarsh Institute of Technology and Research Centre, Vita for the Confidence bestowed on us and entrusting our project "Design and Analysis of Maglev Vertical Axis Wind Turbine." At this juncture, we feel deeply honoured in expressing our sincere thanks to our internal guide Prof. R. B. Patil Sir, Mechanical Engineering Department, Adarsh Institute of Technology and Research Centre, Vita for Providing Valuable Insights leading to our project and helping us whenever we needed support.

REFERENCES

[1] Dinesh N Nagarkar and Dr. Z. J. Khan, "Wind Power Plant Using Magnetic Levitation Wind Turbine", International Journal of Engineering and Innovative Technology (IJEIT) Volume 3, Issue1, July 2013.
[2] B. Bittumony, 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 Volume 4, Issue 4, April 2014.
[3] Shozab Hasnain Rizvi, Namita Sawant and Nabil Mahadik, "Vertical Axis Maglev Wind Turbine Design & Analysis for Power Generation", International Research Journal of Engineering and Technology (IRJET) Volume 7, Issue 6, June 2020.
[4] Geng, F., Suiker, A. S. J., Blocken, B. J. E., and Kalkman, I. M. "Improvement of efficiency and fatigue life of vertical-axis wind turbines", 18th Engineering Mechanics Symposium, Arnhem, Netherlands.

[5] Mr. Sharangdhar Dehadrai, Mr. Anurag Wasnik, and Mr. Yogesh Gaidhane, "Study on Magnetic Levitation for Vertical Axis Wind Turbine and Low Wind Speed", IJSTE - International Journal of Science Technology & Engineering, Volume 2, Issue 10, April 2016.
[6] T. G. Sriganesh, G. J. Naveen, Vishnu P., "Development of vertical axis wind turbine by Maglev suspension – An innovative approach" International Conference on Thermo-fluids and Energy Systems (ICTES2019), Jan 2020.

