A Literature Review- Design and Analysis of Wind Turbine for Street Light

Darshana Ishwardas Patil1 Prof. M. Shakebuddin2
1 M.Tech Student 2 Assistant Professor
1,2 Department of Mechanical Engineering
1,2 Anjuman College of Engineering & Technology, Nagpur, Maharashtra, India

Abstract— An energy crisis is the major problem in all over world. Almost all the energy requirement is fulfilled by thermal power plants based on coal and diesel leading to pollution in the environment. Preventing these polluting power sources it is necessary to adopt alternate energy resources like solar power, wind power, etc. But out of all these wind energy is preferred as domestic safe-economical energy resource. The proposed work focuses on design and CFD analysis of wind turbine for domestic purpose. In present work, we will be accumulating all the data relevant to wind turbines, domestic wind turbines, its components, basic working principle of wind turbine, types of blades used, etc. According to collected data CAD model of domestic wind turbine will be generated and CFD analysis will be performed. After that results will be discussed and design will be finalized.

Key words: Analysis, CFD

I. INTRODUCTION

The development of wind power in India began in the 1990s, and is significantly increasing from the last few years. India has the fifth highest installed wind power capacity in the world. As on October 31, 2009 the installed capacity of wind power in India was around 10,925 MW.

A wind turbine is a device that transforms kinetic energy from the wind energy into mechanical energy in a process known as wind power. Wind energy is one the most widely used renewable energy resources. Small and domestic wind turbines need to be affordable, reliable, and versatile and almost maintenance free for the average person to consider installing one.

Growing awareness of increasing levels of greenhouse gases, global warming and increasing prices of fossil fuels have led to a shift towards investing into low-cost domestic wind turbines.

The domestic wind turbines are vital wind power extracting devices in the rural, suburban and even in the populated city areas where installation of large scale wind turbines would not be accepted due to space constraints and generation of noise. The domestic wind turbines are Simple structured, compact in design, portable.

Domestic wind turbines have been integrated and deployed on domestic house roof tops, farms, remote communities. In poor wind sites and in applications that require a high level of reliability Domestic wind turbines produce more costly electricity than large and medium-scale wind turbines. However, when optimised properly and used at optimal working conditions, domestic wind turbines could be a reliable energy source and produce socio-economically valuable energy not only in developing countries but also in autonomous applications in locations that are far away from the grid power in developed countries. Power coefficients of domestic wind turbines is 0.25 or greater in comparison to large turbines which have values around 0.45. Domestic wind turbines are in fact becoming an increasingly promising way to supply electricity in developing countries. The domestic wind turbines have quite different aerodynamic behaviour when compared to large-scale counterparts.

A. Basic Constructional Components and the Working of Wind Turbine

– Wind energy is harnessed and transformed into electrical energy using turbines called wind turbines. The amount of electricity produced by the turbine depends on its size and the speed of the wind.

– Basic parts of wind turbines: blades, a tower, and a gearbox. They work together to transform the wind’s kinetic energy into mechanical energy that generates electricity.

– The moving air spins the turbine blades. The blades are connected to a low-speed shaft. When the blades spin, the shaft turns. The low-speed shaft is connected to a gearbox. Inside, a large slow-moving gear turns a small gear quickly.

– The first small gear turns another shaft at high speed. The high-speed shaft is connected to a generator. As the shaft turns the generator, it produces electricity.

– The electric current is sent through cables down the turbine tower to a transformer that changes the voltage of the current before it is sent out on transmission lines.

II. LITERATURE REVIEW

Dharampal Yadav, Haripal Dhariwa and Barun Kumar Roy [1] The paper is based on modification of domestic wind turbine In this work traditional wind turbines are replaced by adopting the venturimeter shaped ducted turbine by which we can increase the wind velocity about three times (09-15 m/s) which is suitable for running the generator to its rated speed (200-600 RPM) without using the gear-box. Small sized compact turbine may be constructed of throat diameter ranging between 0.5 m-01 m which can produce power from 100 W to 500 W with approximate cost ranging between Rs. 25,000 to Rs. 50,000. Which can be afforded by a rural people easily.

Odia O. Osadolor1, Ososomi A. Sunday, Okokpujie I. Princes[2] This work focuses on the design and construction of a small wind turbine suitable for generating electricity in low wind speed regime at very low cost. The wind turbine was designed to generate 250 Watts of power at the rated speed of 6,5m/s. In the design process, the various components of the wind turbine were considered and all the loads liable to occur during all temporary and operating conditions were calculated theoretically and the designs were optimized to ensure that the turbine operates at full capacity.
Vaibhav.R.Pannase1, Prof.H.R.Bhagat2, Prof.R.S.Sakarkar[3]: This paper explores the design space that exists between multi blade, high-solidity water-pumping turbines with trapezoidal blade design and modern rectangular horizontal axis wind turbines. In particular, it compares the features and performance of a small 18-bladed, high-solidity HAWT with trapezoidal blade to that of a rectangular bladed 18-bladed HAWT. This is achieved through a Modal analysis on exist trapezoidal blade and optimize rectangular blade along with dynamic response analysis of blade in ANSYS software. The model of blade was developed in CATIA. Dynamic analysis was performed for the blade by using the finite element method.

Rakesh Roshan, Pawan Mirshra, Mahendra Agrawal [4] In this research a small wind turbine has been developed for experimenting the performance of a Horizontal axis wind turbine with varying wind speed. To improve the performance, the flow straighteners are provided at leading edge of the turbine blades. These flow straighteners give a stream line flow to the airflow circulating over the aero foil and reduces the drag. We notice an improved value of Betz limit. The blades are twisted from root to tip about 12 to 13 degree and rpm was noticed. In the present research we obtained an average mechanical efficiency of 39%.

K. Sunil Kumar and R. Palanisamy [6] the optimum twist of a windmill blade is examined on the basis of elementary blade element theory. For a given wind speed and blade angular velocity, it is shown that the maximum power efficiency is achieved when the blade is twisted according to a program that depends upon the variation of the sectional lift and drag coefficients with angle of attack. Results for a typical airfoil cross-section show that the optimum angle of attack decreases from the maximum-lift-coefficient angle of attack at the blade root to greater than eighty percent of this value at the blade tip. The materials used were stainless steel, e-glass epoxy and gray cast iron and results were tabulated.

III. IDENTIFIED GAPS IN THE LITERATURE

Most of the researchers till now have presented a work on modifications of small scale wind turbine, its design improvement, design of turbine blades, weight reduction in its components, and its geometries, etc. There is still a need to modify, optimize and customize the domestic wind turbine to improve its performance, improve its power output. So we are performing design and CFD analysis of Wind turbine for domestic purpose.

IV. PROBLEM FORMULATION

The energy crises is becoming a major problem in the world. Most of energy requirement is accomplished by power plants based on coal and diesel, etc. To avoid these polluting sources we must adopt alternate power sources like wind turbine. The wind turbines which are used for energy generations have heavy framework and is limited because of their heavy designs. The domestic wind turbines can be used for domestic purpose by making a suitable design for considerable load and will serve benefit to the resources that are limited to earth surface. This will also minimize the dependency on power stations and thus will serve a great advantage to our nation.

V. RESEARCH METHODOLOGY

In present study, we will be accumulating all the data relevant to wind turbines, domestic wind turbines, its components, basic working principle of wind turbine, types of blades used, etc. According to collected data CAD model of domestic wind turbine will be generated and CFD analysis will be performed. After that results will be discussed and design will be finalized.

VI. CONCLUSIONS

Wind power utilisation for electricity generation is a huge resource and has been proven to be capable of producing a substantial amount of the electricity meant for consumption. The detail study of the wind turbines, its components, working mechanism from the literatures and available sources helped us to apprise with the deep knowledge of wind turbine with the successful completion of this project, most of the energy requirements will be fulfilled by domestic wind turbine preventing the environmental pollution. With modification in design and performing CFD analysis on it will be capable to withstand the maximum wind load and also the performance of domestic wind turbine will get improve.

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