Abstract: Wind is a form of solar energy and is a result of the uneven heating of the atmosphere by the sun, the irregularities of the earth’s surface, and the rotation of the earth. Wind is the movement of air from an area of high pressure to an area of low pressure. In this thesis, the wind turbine blade modeling in CREO parametric software and analyzed for its strength using Finite Element analysis software ANSYS. Structural analysis will be done in ANSYS on the different materials (aluminum alloy, galvanized iron) wind turbine blade material galvanized iron replace with aluminum alloy at different speeds(150, 180 & 220 rpm) of the turbine rotor. Static analysis to determine the deformation stress and strain of the wind turbine.

Keywords: Structural and RPM.

I. INTRODUCTION

An example of a wind turbine, this 3 bladed turbine is the classic design of modern wind turbines.

A. Wind turbine design is the process of defining the form and specifications of a wind turbine to extract energy from the wind. A wind turbine installation consists of the necessary systems needed to capture the wind’s energy, point the turbine into the wind, convert mechanical rotation into electrical power, and other systems to start, stop, and control the turbine. This article covers the design of horizontal axis wind turbines (HAWT) since the majority of commercial turbines use this design. In 1919 the physicist Albert Betz showed that for a hypothetical ideal wind-energy extraction machine, the fundamental laws of conservation of mass and energy allowed no more than 16/27 (59.3%) of the kinetic energy of the wind to be captured. This Betz’ law limit can be approached by modern turbine designs which may reach 70 to 80% of this theoretical limit. In addition to aerodynamic design of the blades, design of a complete wind power system must also address design of the hub, controls, generator, supporting structure and foundation. Further design questions arise when integrating wind turbines into electrical power grids.

Wind turbine components: 1-Foundation, 2-Connection to the electric grid, 3-Tower, 4-Access ladder, 5-Wind orientation control (Yaw control), 6-Nacelle, 7-Generator, 8-Anemometer, 9-Electric or Mechanical Brake, 10-Gearbox, 11-Rotor blade, 12-Blade pitch control, 13-Rotor hub.

II. LITERATURE REVIEW

This paper presents an optimization model for rotor design of 750 kW horizontal axis wind turbine. The wind turbine blade is a very important part of the rotor. In this work a blade of length 21.0 m is taken and airfoil for the blade is S809. The airfoil taken is same from root to tip. The model refers to a design method based on Type Approval Provision Scheme TAPS-2000. All the loads caused by wind and inertia on the blades are transferred to the hub. The stress and deflection were calculated on blades and hub by Finite element analysis method. Result obtained from ANSYS is compared with the existing design.

III. INTRODUCTION TO CAD/CAE

Computer-aided design (CAD), also known as computer-aided design and drafting (CADD), is the use of computer technology for the process of design and design-documentation.

A. Introduction to Pro-Engineer

Pro/ENGINEER Wildfire is the standard in 3D product design, featuring industry-leading productivity tools that promote best practices in design while ensuring compliance with your industry and company standards. Integrated Pro/ENGINEER CAD/CAM/CAE solutions allow you to design faster than ever, while maximizing innovation and quality to ultimately create exceptional products.
Different modules in pro/engineer
Part design, Assembly, Drawing& Sheet metal.

B. Introduction To Finite Element Method
Finite Element Method (FEM) is also called as Finite Element Analysis (FEA). Finite Element Method is a basic analysis technique for resolving and substituting complicated problems by simpler ones, obtaining approximate solutions Finite element method being a flexible tool is used in various industries to solve several practical engineering problems. In finite element method it is feasible to generate the relative results.

IV. RESULTS AND DISCUSSIONS:
A. Models of Wind turbine blade 3D model

B. Static Analysis of Wind Turbine Blade

Fig2. Imported model.

Fig3. Meshed model.

Fig4. Deformation.

Fig5. Stress.

Fig6. Strain.
Wind Turbine Speed = 180rpm

![Image of Deformation]

Fig.9. Deformation.

![Image of Stress]

Fig.10. Stress.

![Image of Strain]

Fig.11. Strain.

V. RESULTS AND DISCUSSIONS

Table 1. Static Analysis Result

<table>
<thead>
<tr>
<th>Material</th>
<th>Speed (rpm)</th>
<th>Deformation (mm)</th>
<th>Stress (MPa)</th>
<th>Strain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galvanized iron</td>
<td>150</td>
<td>0.005036</td>
<td>0.0164</td>
<td>7.637e-6</td>
</tr>
<tr>
<td></td>
<td>180</td>
<td>0.0074093</td>
<td>1.2305</td>
<td>1.1187e-5</td>
</tr>
<tr>
<td></td>
<td>220</td>
<td>0.11069</td>
<td>1.9383</td>
<td>1.6712e-5</td>
</tr>
<tr>
<td>Aluminum alloy</td>
<td>150</td>
<td>0.0030282</td>
<td>0.31893</td>
<td>4.492e-6</td>
</tr>
<tr>
<td></td>
<td>180</td>
<td>0.0043608</td>
<td>0.43929</td>
<td>6.468e-6</td>
</tr>
<tr>
<td></td>
<td>220</td>
<td>0.0063147</td>
<td>0.68613</td>
<td>9.6639e-6</td>
</tr>
</tbody>
</table>

VI. CONCLUSION

In this thesis, the wind turbine blade modeling in CREO parametric software and analyzed for its strength using Finite Element analysis software ANSYS. Structural, modal and fatigue analysis will be done in ANSYS on the different materials (aluminum alloy, galvanized iron) turbine blade material galvanized iron replace with aluminum alloy at different speeds (150, 180 & 220rpm) of the turbine rotor. By observing the static analysis the stress, deformation and strain values are increased by increasing the speed of the wind turbine rotor. The stress values are less for used aluminum alloy material. So it can be conclude the aluminum alloy material is the better material for wind turbine blade.

VII. REFERENCE


Author Profile:

DR. CH. S. Naga Prasad received his M.Tech Degree on Heat power Refrigerator and AC from JNTU, Anantapur in 2002 and Ph.D on IC Engines (Thermal Engg) from JNTU, Hyderabad in 2011. He is currently working as Professor & Principal in Gonna Institute of Information Technology and sciences, Aganampudi, Visakhapatnam, A.P, INDIA.