Design of the Root of a 61.5 m Wind Turbine Blade

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INTRODUCTION

The root of a modern day wind turbine blade can be considered a primary structure. The bending moment is the greatest at the root and hence it would make intuitive sense that the root is the thickest part of the blade. For larger blades, there is a significant build up in this region, and special quality, low exotherm laminates must be used in this area. The root must be circular to accommodate pitch bearings and to prevent high stresses in this region.

This part accounts for nearly 20% of the cost of the blade and there has been recent trend for global blade manufacturers to sub contract these root segments to reduce cycle time.

PROJECT

In this project, current bushing concepts (i.e. the T bolt and the embedded carrot) and literature relating to materials and structures of the root of wind turbine blades will be reviewed. A coarse model (using SOLID 186 elements) of the root of a 61.5 m blade will be designed using the finite element program ANSYS.

The next stage of the project will comprise, multi scale modeling, where an alternative 3D concept for the root bushing (sub model) will be combined with the coarse model. The results from the coarse model will be mapped to the sub model.

Global cross sectional loads will obtained from the Horizontal Axis Wind Turbine Code (HAWC) develop by the DTU department of Wind energy. These will be applied at one end of the cross section and the effects of these global loads, on the bushings, will be carefully studied.

Once the vital loading conditions have been identified there will be the design of an experimental test setup.

SUSTAINABILITY

Most countries are trying to move towards renewable sources of energy, to gain energy independence and reduce their reliance on fossil fuels. Wind energy is a crucial part of the clean energy solution.

In recent times the trend in the wind industry has been towards designing blades with a larger swept area. As blades grow larger, they are going to comprise of several sub components with the root being an extremely critical region. The project involves optimization and analysis of a sub component of a wind turbine blade. It is mandatory to have a great deal of structural integrity in this region, to transfer the loads from the blade to the hub, else there could be catastrophic failure of the blade.