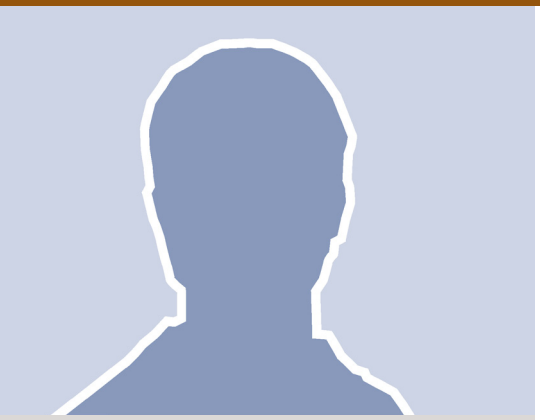
MASTER'S DISSERTATION AT STRUCTURAL MECHANICS

DEPARTMENT OF CONSTRUCTION SCIENCES | FACULTY OF ENGINEERING LTH | LUND UNIVERSITY



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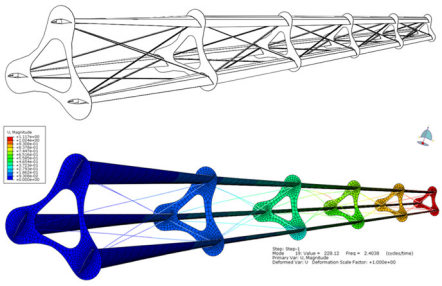
STRUCTURAL ANALYSIS OF TRUSS CONSTRUCTION FOR WIND TURBINE BLADES



The usage of wind turbines during the latest years has grown substantially and are becoming an increasingly important source of renewable energy, as many countries are trying to reduce their reliance on fossil fuels. In order to increase the effect of the wind turbines the length of the blades has been increased, which has also led to an increase of the cross-section dimensions. This has led to making the weight of the blade a more dominating load. Therefore, it is of great interest to reduce the weight of wind turbine blades to continue constructing longer blades. To accomplish this Winfoor are developing a wind turbine blade that combines traditional horizontal-axis wind turbine (HAWT), with a truss system containing truss bars and a plate connected to the blades. Winfoor has the ambition to evolve the wind blade industry by modify the shape of a HAWT blade into a Triblade. The results and conclusions form this thesis are one of many things that has to be taken into account when the final design is developed.

As the truss bars are long and slender, the bars that are being compressed are more likely to buckle. The structural response of a dynamic load applied to the structure was also studied in this thesis.

Identification and evaluation of the variables, such as Young's module, influence on the load capacity was computed with non-linear numerical analysis. In order to find a design proposal containing both section dimensions and material properties was two parameter studies completed. In structural design, the load capacity was often evaluated using finite element method (FEM). This thesis includes non-linear FE analysis, which considers large deformations.

The blades structural dynamic response was evaluated using both modal, and frequency response analysis. Additionally are the response of an impulse studied using full transient analysis.

The main conclusion from this thesis where that buckling truss bars are problematic when an impulse was added to the structure. The impulse created from the tower passage was big enough to change the buckling mode of the truss bar. This generates a great variation in stresses for these truss bars, which cause it to that fatigue, damage, and this may decrease its life span.

An additionally conclusion was that the eigenfrequency for each truss bar should not overlap with the eigenfrequency for the global bending mode of the Triblade.

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