An Advanced Structural Trailing Edge Modelling Method For Wind Turbine Blades

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An Advanced Structural Trailing Edge Modelling Method For Wind Turbine Blades

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Abstract

This study demonstrates an advanced blade modelling approach based on a combination of shell and solid elements which can enhance the reliability of structural predictions for wind turbine blades. The advanced blade modelling approach is based on a shell element model where the adhesive bondline in the trailing edge region is discretised by means of solid brick elements which are connected via Multi-Point-Constraint to the shell elements. The new approach overcomes the drawbacks of pure shell element simulations and can reliably predict the response of wind turbine blade structures which are exposed to ultimate loads. The prediction accuracy of the numerical simulations was compared to a certification load case and a full-scale ultimate limit state test of a 34m wind turbine rotor blade. The displacements, stresses and strains show reasonably good agreement and demonstrate the capabilities of the advanced blade modelling approach.

Keywords: Trailing edge modelling, buckling, shell elements, wind turbine rotor blade structure

1. Introduction

Blade design is an iterative process where several iterations loops are usually needed to define an optimal compromise between aerofoil geometry, structural design and aeroelastic response. An essential part of the design process for wind turbine blades is the use of *Finite Element Analyses* (FEA). Various different FEA specifically developed for wind turbine blades are usually conducted to optimise the aerodynamic, aeroelastic and structural behaviour, as well as the manufacturing processes.

Most of the published literature uses either beam model approaches or three-dimensional (3D) FEA based approaches to predict the structural response of wind turbine rotor blades. In theory, detailed 3D FEA based on solid brick elements reach the highest prediction accuracy, but come with high computationally costs and, therefore, are rarely used.

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