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NUMERICAL MODELLING OF FULL-SCALE AND SUB-COMPONENT TESTING OF WIND TURBINE BLADES

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Certification of wind turbine blades is performed according to industry standards IEC (2014) [1] and DNV GL AS (2015) [2], which include a final design validation through full-scale static and fatigue testing. To validate the assumptions made in the design and fulfill the requirements for certification, the blade is subjected to a test load distribution, which should be as close as possible to the required target load for all areas of the blade. Naturally, the minimization of overloading, i. e. test w. r. t. Target load, of the blade is desirable.

Due to energetic reasons, blades are tested in or close to resonance frequency. The resulting bending moment distribution can be modified by addition of mass along the blade. In the first part of this presentation, a numerical optimization scheme is introduced which allows to find a test setup with minimal overload by using virtual testing.

In addition to full-scale testing, sub-component testing are encouraged in the DNV GL guideline. In contrast to full-scale blade tests, sub-component testing allows for an increased test speed [3]. In addition, overloading can be reduced to a minimum and multiaxial stress states can be replicated in a much more accurate way compared to full-scale testing [4]. The latter is especially relevant for the most prevalent uni-axial full-scale test.

Using the example of a sub-component test for trailing edge bond lines, the general methodology to derive test boundary conditions for subsections from global blade models is shown in the second part of the presentation. The benefit of the proposed method is illustrated by comparison of resulting strain distribution in full-scale and sub-component test.

Finally, an outlook is given on how virtual testing can enhance physical testing of wind turbine blades in the coming years.

REFERENCES

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