Bend-twist coupling potential of wind turbine blades

In the present study an evaluation of the potential for bend-twist coupling effects in wind turbine blades is addressed. A method for evaluation of the coupling magnitude based on the results of finite element modeling and full-field displacement measurements obtained by experiments is developed and tested on small-scale coupled composite beams. In the proposed method the coupling coefficient for a generic beam is introduced based on the Euler-Bernoulli beam formulation. By applying the developed method for analysis of a commercial wind turbine blade structure it is demonstrated that a bend-twist coupling magnitude of up to 0.2 is feasible to achieve in the baseline blade structure made of glass-fiber reinforced plastics. Further, by substituting the glass-fibers with carbon-fibers the coupling effect can be increased to 0.4. Additionally, the effect of introduction of bend-twist coupling into a blade on such important blade structural properties as bending and torsional stiffness is demonstrated.

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