

Increased Strength in Wind Turbine Blades through Innovative Structural Design^{*}

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Abstract:

When a system design approach is applied to wind turbine blades, manufacturing and structural requirements are included along with aerodynamic considerations in the design optimization. The resulting system-driven design includes several innovative structural features such as flat-back airfoils, a constant thickness carbon spar-cap, and a thin, large diameter root. Subscale blades were manufactured to evaluate the as-built integrated performance. The design resulted in a 22% reduction in mass, but withstood over 300% of its design load during testing. Compressive strains of nearly 0.9% were measured in the carbon spar-cap. The test results from this and an earlier design are compared, as are finite element models of each design. Included in the analysis is a review of the acoustic emission events that were detected through the use of surface mounted microphones.

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[‡] Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin company, for the U.S. Department of Energy under contract DE-AC04-94AL85000