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The Implementation of Braided Composite Materials in the Design of a Bend-Twist Coupled Blade

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Abstract

This report presents results for conceptual wind turbine blade designs that are manufactured using braided composite materials. The SERI-8 wind turbine blade was used to define a geometric model and establish the blade internal volume as well as the primary load-carrying box beam structure. The box beam was modeled in twelve pieces and characterized by its principal dimensions (height, width, and perimeter) at the different cross-sectional areas along the span of the blade. A composite beam theory model was used to parametrically evaluate design candidates. The bending stiffness of the SERI-8 blade was used as a constraint (or match parameter), and the wall thickness and twist angle results as the performance parameters. Internal loads were also computed as part of the parametric study. A design was chosen according to the more favorable parameters, and a detailed analysis was made in terms of braided composite final arrangement, number of braided preforms (or socks), wall thickness, induced twist angle, and internal loads. To evaluate the relative accuracy of the beam model, beam twist results were compared with finite element twist results. These preliminary results indicate that a braided composite box structure can be designed with the required stiffness properties and a high level of structural coupling.