Collapse of a 47-meter composite blade under combined bending and torsion in a full-scale static test - DTU Orbit (18/04/2019)

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This study presents an investigation on structural collapse of a large composite wind turbine blade under combined bending and torsion in a static load test. The initial failure phenomenon prior to the blade collapse is investigated using video recorded images. Postcollapse characteristics of the blade are examined to identify the critical failure modes. A finite element model is constructed considering the constraint effect of loading saddles on the blade section. Structural response of the blade section during the loading process is investigated numerically. It is found that delamination and fracture of the spar cap are two critical failure modes responsible for the root causes of the blade collapse. These critical failure modes are evoked by local buckling of blade shells and shear webs. Numerical results show that the Brazier effect imposes significant crushing pressure to the blade cross section and contribute to local buckling. Moreover, it is found that torsion loads, although insignificant compared with the primary bending loads applied to the blade, affect postcollapse characteristics of the blade in this study.

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