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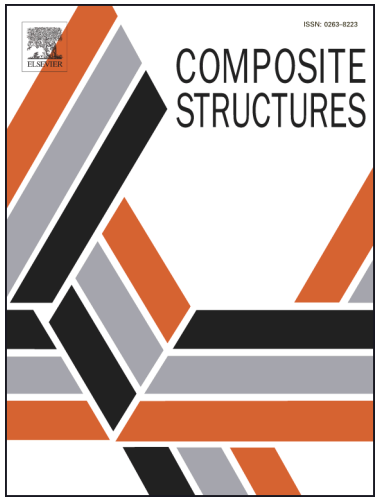

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Design and nonlinear structural responses of multi-bolted joint composite box-beam for sectional wind turbine blades

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Abstract

This paper deals with the nonlinear structural responses of multi-bolted joint box-beam under inadequate preload, the composite box-beam was designed to refer to a real blade. The simplified analytical, solid-shell finite element and experimental methods were jointly conducted to investigate additional bolt loads, clamped loads, and deflections of the sectional box-beam under flap-wise bending loads. The validation of the finite element model is confirmed by the good prediction of the natural frequencies, strains of composite spar caps and the additional bolt loads of the sectional box-beam. The numerical model shows superior precision in describing the structural responses of the sectional box-beam even after separation. The simplified analytical method offers a conservative solution to calculate bolt loads. The global movement at the divided section will not appear ideally due to continuous increase of the total clamped load. The slight jump of clamped load in PS implies the probability of residual deflection of the sectional box-beam. Meanwhile, the relative movement tends to brings about the bolt preload reduction in the case of periodic loading, and then fatigue failure rapidly under on-going reduction of preloads. This study provides a deep insight into the fatigue strength of bolted joint for sectional rotor blades.

Keywords: Sectional blades; sectional box-beam; multi-bolted joint; nonlinear structural responses; separation

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