A probabilistic approach to calculate the reliability and probability of failure of scharf adhesive Joints

Kimiaeifar, Amin; Toft, Henrik Stensgaard; Lund, Erik; Thomsen, Ole Thybo; Sørensen, John Dalsgaard

Publication date:
2011

Document Version
Early version, also known as pre-print

AMIN KIMIAEIFAR (M-TECH, AAU, 15 minutes)

A probabilistic approach to assess the reliability and probability of failure of adhesive scarfed lap joints in composite materials

A probabilistic model for the reliability analysis of adhesive scarfed lap joints subjected to static loading representative for a main laminate in a wind turbine blade subjected to flapwise bending is developed using three-dimensional finite-element calculations. The von Mises, a modified von Mises and the maximum stress failure criteria are chosen to assess the reliability level of the scarfed lap joint, and this is compared with the implicitly required target reliability level defined in the wind turbine standard IEC 61400-1. The probability of failure for the different failure criteria is calculated and compared for different number of numerical simulations. A convergence study is performed to validate the FE model, and a sensitivity analysis on the influence of various geometrical parameters and material properties on the maximum stress is conducted. A design equation is used where partial safety factors are introduced together with characteristic values. Because the yield behavior of many polymeric structural adhesives is dependent on both deviatoric and hydrostatic stress components, different ratios of the compressive to tensile adhesive yield stresses in the failure criterion are considered. It is shown that the failure criterion and the number of simulations are the two main effective factors on the probability of failure.