Design of step-stress accelerated life tests for estimating the fatigue reliability of structural components based on a finite-element approach

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Abstract

This article describes how a step-stress accelerated life test (SSALT) can be designed for testing the fatigue life and reliability of structural components with a single failure mode. With simple numerical simulations of the crack's propagation in the notched area of the structural part for different loading levels, the slope of the S-N curve for a structural component is initially estimated. Then, a very few fatigue-life experiments are carried out in the high-cycle domain to determine the intercept of the structure's S-N curve. By considering the scatter from the material's P-S-N curve, different SSALT designs for the structural component can be composed and checked for their expected acceleration factor. The procedure is experimentally validated for the case of a notched specimen and two different SSALT designs. From the results it can be concluded that the predicted durations of the SSALT experiments correlate well with the real experiments.

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