

STOCHASTIC CRACKING EVOLUTION IN MULTI-DIRECTIONAL LAMINATES UNDER FATIGUE LOADING

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Abstract

The cracking in off-axis plies occurs under a multi-axial stress state even when the external loading is unidirectional. Also, the cracking evolution is influenced by distributed manufacturing defects, which are random in nature, leading to a stochastic cracking process. A statistical model is developed to address this process under conditions of multi-axial fatigue. After the formation of the first few cracks, the multi-axial stress state is simulated with a FE model of a unit cell of the cracked laminates and used for predicting the formation of additional cracks under continued cycling. Equal strength-life assumption is made in utilizing the static strength distribution to characterize the fatigue strength of off-axis plies. The developed model correctly predicts the crack density as the function of fatigue cycles. The saturation cracking behavior at different load levels is also explained by the model.