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ABSTRACT

This paper proposes a generalization of the Castillo and Fernández-Canteli probabilistic fatigue model and shows how most fatigue models can be obtained as particular cases. Models that include mean-stress effects and multiaxial loading conditions are considered as examples of this general framework. Several fatigue damage parameters such as the Smith-Watson-Topper, the Walker-like strain, energy-based parameter in uniaxial and multiaxial loading conditions, and multiaxial critical plane parameters are proposed as reference parameters for the probabilistic model. It is shown that the Castillo & Fernández-Canteli probabilistic approach can be successfully extended to these advanced fatigue models.

KEYWORDS: Fatigue, Probabilistic fatigue model, Fatigue damage parameter, Multiaxial fatigue, Mean-stress effects.

1. INTRODUCTION

Probabilistic fatigue models are very important as they are able to incorporate different sources of uncertainty arising in the prediction procedures such as material properties and microstructures (e.g. large inclusions or defects) or geometrical features of a component. Most of the current fatigue damage models have essentially a deterministic basis. However, their application for design purposes requires subsequently additional statistical arguments in order to establish appropriate safety margins, not always based on rigorous criteria. In addition, in order to carry out reliability analyses the fatigue damage must be established in an appropriate probabilistic form. As a consequence, failure prediction, engineering design and risk analysis in fatigue are not possible without the support of probabilistic fatigue models.