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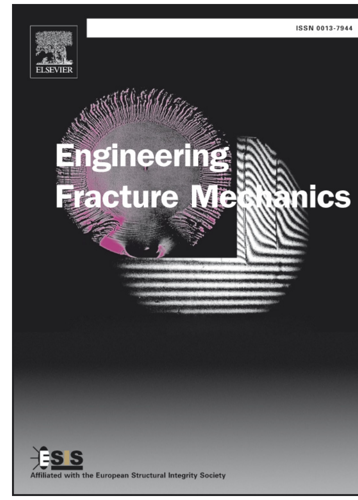

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The role of the constitutive model in creep crack growth modelling

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Abstract

Although high-temperature material response is known to be history-dependent, many models of creep crack growth assume the history-independent Norton constitutive law. Even so, these models capture the experimentally observed creep crack growth by adjusting only the damage model. This is explained presently by showing that the damage evolution ahead of a stationary crack in a material obeying a history-dependent unified creep-plasticity constitutive law due to Robinson can be 'fit' by simply adjusting the damage parameters in a model implementing Norton's law. The implication of this result to the case of propagating cracks is discussed.

Keywords: creep crack growth, constitutive law, stainless steel, continuum damage

1. Introduction

Crack growth in a creeping body has been the subject of a large number of theoretical, computational and experimental studies extending at least over the past five decades [1]. A number of models of creep crack growth, based on the local approach, have been proposed to predict the creep crack growth history in standard test specimen [2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12]. Many of these models successfully capture the experimentally observed creep crack growth rate in many high temperature materials including austenitic stainless steels.

Creep crack growth models based on the local approach are based on finite element analysis and continuum damage mechanics. The finite element analysis accurately predicts the spatiotemporal variation of all mechanical and damage fields for arbitrary inputs of inelastic constitutive law, and damage evolution law. The constitutive law typically accounts also for the current local damage. The exceedance of a threshold by the damage variable at select points in the

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