ASSESSMENT OF FATIGUE CRACK RATE UNDER CYCLIC LOADING

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ABSTRACT

Fatigue crack growth (FCG) in structures subjected to variable amplitude (VA) loading is a complex phenomenon. Analysing of FCG rate is important for the reliable life of engineering structures. It is difficult to model all the parameters influence FCG correctly due to the random nature of the VA loading as well as the number and complexity of the mechanisms involved in the FCG problems. . It has been found from the literature review that no universal model has been developed to analyse the crack growth condition under VA loading. In addition, no general understanding has also been agreed among researchers for any available models. Therefore, the main objective of this work is to investigate the FCG under VA loading based on FCG models also to propose a suitable model for VA loading. The work describes some of the FCG models for predicting the fatigue lives and FCG rates. For the simulation part of this study, towards prediction of crack propagation under cyclic, variable and random loading were used. The results had been carried out based on the Austen, modified Forman and NASGRO models. There are many factors affecting the FCG, which shown with great influence such as; initial crack length, load sequence, aspect ratio and stress ratio.

Keyword: Fatigue crack growth (FCG), variable amplitude (VA), finite element method (FEM)

INTRODUCTION

The phenomenon of fatigue has been discovered in the post-incident findings of the Versailles incident in 1842. Since then, engineers and scientists have developed models to predict the fatigue life of components and to incorporate the fatigue analysis in the design. When pressure vessels and piping are subjected to fluctuations in stress, they may lead to the development of fatigue cracks. Fatigue cracks extend slowly, and this is generally with a very small increment of crack growth occurring with each cycle, and with little or no evidence of plastic deformation. The cracks can continue to grow until they completely cause failure of the component, member or structure by fast fracture, plastic collapse or other mode, which prevent service duties being performed. The service load histories may completely in random pattern. It is either to be simple and repetitive or at the other extreme. In general, prediction models published in the literature employ basic material fatigue data as references. Such data can be fatigue limits, stress-life (S-N) data, fatigue diagrams, crack growth data, and fracture toughness for the final failure. These prediction models that are used for crack growth under variable amplitude (VA) loading vary from simple modifications on the constant amplitude (CA) baseline up to the complex models with detailed descriptions of relevant fracture mechanisms. For instance, some models calculate