CORRELATIOIN AND PREDICTION OF FATIGUE CRACK GROWTH DATA FOR DIFFERENT R-RATIOS

Master Thesis - Sudip Dinda

Department of Mechanical and Aeronautical Engineering
Western Michigan University
Kalamazoo, Michigan 49008-5065

Abstract

The R-ratio effect on fatigue crack growth rate of structural materials is an important aspect by which one can predict the critical or safe crack length and therefore, avoid the sudden failure of components and structures.

There are numerous models which claim to predict the R-ratio effects, but with the exception of the crack closure methodology no other models lived up to the expectation of correlating and predicting the fatigue crack growth consistently. In spite of being effective in correlating the R-ratio effects, the crack closure model has considerable drawbacks or pitfalls associated with it. Therefore, a need has evolved to develop a simplified new method by which R-ratio effects on crack growth rate can be predicted effectively.

In order to find an effective solution to the above demand a study has been conducted to discuss the difficulties associated with the existing crack closure methodology. Then, recently proposed fatigue crack driving force parameter, K*= Kmax□ (□K+)(1- □), was investigated with respect to its ability to predict the crack growth rate for different R-ratios. A validation on the effectiveness of the K* parameter relative to the existing crack closure approach, □Keff, was conducted based on published experimental data. From the comparison between □Keff and K*, it is seen that the latter is equally effective or better than □Keff in correlating as well as predicting the R-ratio effects on crack growth rate.
In addition to K* analysis, a new model was developed called the “master curve” approach, which also accounts for the R-ratio effects on crack growth rate.

In this study, thirty five journal papers have been referred for experimental fatigue crack growth data, which were then analyzed using K* parameter and the “master curve” approach. Presented results demonstrated that both methods can be used to correlate and predict the fatigue crack growth rate for different R-ratios. The proposed methodologies are simple, effective and less time consuming then the □Keff approach.