



# Investigation on the fatigue life modelling of CSM-GRP laminates at elevated temperatures

J.H. Sul<sup>1</sup> and B.G. Prusty<sup>1\*</sup>

*<sup>1</sup>School of Mechanical and Manufacturing Engineering, University of New South Wales, Sydney, NSW 2052 Australia.*

*\*Corresponding author: g.prusty@unsw.edu.au (Fax : +61 2 9663 1222)*

## Abstract

Theoretical and empirical approaches to fatigue life prediction of CSM (Chopped Strand Mat)-GRP (Glass-Reinforced Plastic) are studied to describe temperature-dependent behaviour under fatigue loadings. Based on extensive experimental data, major difficulties in modelling fatigue damage of short-fibre composites at elevated temperatures are presented. A fatigue damage model is proposed using a phenomenological approach in conjunction with stiffness degradation. Reasonably good agreements are made between experimental and predicted data. This study introduces Poisson's ratio as a promising damage variable in order to boost phenomenological fatigue prediction.

**Key words:** *E-glass fibre-reinforced, Fatigue, Elevated temperatures*

## 1. Introduction

Composite materials, comprise of two or more different materials with better properties than that of the constituent material, are ever-increasingly used in weight-critical structural applications due to their high specific strength and stiffness, corrosion resistance, and their mechanical properties to be tailored so as to meet the requirements of any given applications (Surgeon *et al.*, 1999). Some of these applications involve components that are subjected to cyclic loading which causes damage and material property degradation in a cumulative manner. It is, therefore, desirable to evaluate the performance of the structure beforehand so that the maintenance or

replacement of components can be scheduled before catastrophic failure. In addition, since the first application of composite materials in rotor blades of an aircraft in the 1960s, composites have become widely applicable in even more severe conditions. There is a tendency of over-design of components or structures made out of composite, due to lacking assurance of fatigue life of composite materials under harsh circumstances, especially in case of thermoset composites that degrade their properties under high temperatures.

Short fibre reinforced composites in particular have gained its popularity, because they are relatively easy to manufacture and economical to use in not just industrial application, but in daily use such as sports gears and household applications. However, the detailed nature of