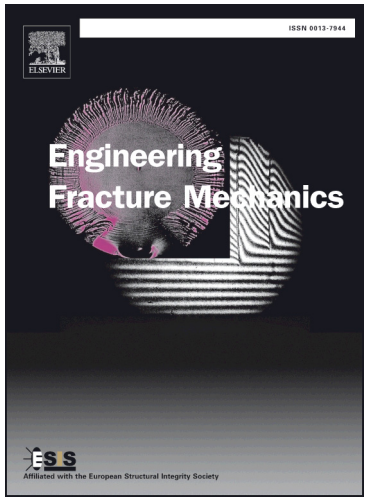

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AN ENGINEERING APPROACH TO THE FRACTURE ASSESSMENT OF HOPPER WAGONS

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ABSTRACT

A hopper wagon is a type of railroad freight car used to transport many types of materials such as coal, ore, grain, ballast and minerals and bulk cargo etc. It is a complicated welded structure. When performing a safety assessment of cracks in a hopper wagon, it is necessary to consider fatigue crack propagation and fracture among the possible modes of failure. In any such analysis the stress intensity factors at crack tips are important parameters for estimating both residual life and criticality (residual strength). The purpose of this paper is to present engineering fracture analysis method for calculating the stress intensities for cracks in a hopper wagon. The advantage of the present approach is that it negates the need to explicitly model cracks. A crack of any size can be analysed using the original (un-cracked) finite element model. Furthermore, as cracks are not modelled explicitly a coarse mesh can be used to minimise the number of degrees of freedom, thereby reducing the analysis time. As such solutions for the stress-intensity factors can then be obtained quickly and easily for a variety of cracks and crack lengths using the original uncracked finite element analysis. Comparison with the values of stress intensity factors computed using finite element results suggests that this approach is sufficiently satisfactory to enable engineering estimates for residual strength (safety) and residual life.

Keywords: hopper wagon, fracture mechanics, stress intensity factor.

1. INTRODUCTION

Australia is the world's largest coal and iron ore exporter. The vast majority of which is transported by rail from site to port. The aforementioned commodities are expected to