Fatigue assessment of a steel truss bridge based on multi-dimensional finite element modelling

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Abstract

This paper presents a multidimensional finite element modelling approach for the fatigue assessment of welded railway bridges based on a case study of a railway bridge in Belgium. The nominal stress approach of Eurocode 3 is compared to a hot spot stress based fatigue life calculation for the standardized fatigue load models for railway traffic. Hot spot stresses are calculated with an in-house developed framework that allows automated determination of hot spot stresses. It is discussed how this work can fit in a larger decision support system in the scope of structural health monitoring. The presented approach proves to be better for decision support compared to the conventional approach in the Eurocode.

Keywords: fatigue assessment, hot spot stress, nominal stress, steel truss railway bridge, multidimensional finite element modelling

1 Introduction

Worldwide, authorities are dealing with an ageing infrastructure. During the 1950's and 1960's, a large number of steel bridges have been built due to the expansion of the road and railway network [1]. In 2004, a report of the Sustainable Bridges project showed that an estimated 31% of European bridges are between 50 and 100 years old and 35% are over 100 years old [2]. Since their original construction, there has been a major increase in traffic volume, vehicle weights and speeds. This means that for many structures the current loads are more severe than what they have been designed for [3,4]. A report by the Joint Research Centre of the European Union concluded that 38.3% of metallic bridge failures are caused by fatigue. As an increasing number of bridges are reaching their design lives, the importance of fatigue lifetime extension is becoming more and more important.

Fatigue of steel (railway) bridges has been studied extensively in literature. Zhang *et al.* [5] published

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