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Fatigue accumulation comparison of simulated traffic flow and design loads

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Abstract

The authors present a fatigue load analysis parallel to their previous studies on simulated site-specific traffic flow and its comparison to static design load models (IABSE, Stockholm 2016, Lunabba et.al.) and fatigue load models (IABSE, Copenhagen, 2018, Lunabba et.al). This research paper expands the previous study to fatigue accumulation analysis of bridges with varying span lengths and transversal stiffness and presents a method where a typical site-specific traffic flow can be compared to Eurocode design load models for fatigue assessment. The accumulated fatigue damage (for typical material dependent SN-curves) of simulated traffic was firstly compared to the characteristic static load model LM1 and secondly to accumulated fatigue damage caused by design fatigue load models FLM1 and FLM3. The study was conducted to one, two and three span bridges having variable span lengths and transversal stiffness characteristics. The study took into account the differences of the load placement (according to Eurocode design loads are placed on the notional lane, but simulated load is placed on the real traffic lanes of the bridge). The study gives guidance to national authorities to pinpoint the most vulnerable bridge types in the bridge stock and the bridges sensitivity to frequent heavy special transportations. In addition, important information about the behaviour and functionality of Eurocode's fatigue design approach is gained.

Keywords: fatigue, eurocode, traffic simulation, steel structures, bridges, traffic loads

1. Introduction

Comparison of the fatigue strength of a structural material exposed to a varying number of stress cycles with variable peak values with the fatigue strength of a material exposed to a number of constant stress cycles can be done mathematically with commonly known equations.

Since bridges are generally behaving linearly in service limit state the comparison may be based on calculated bending moments (and shear forces) instead of stresses that are normally used in fatigue assessment.

In this study, the constant fatiguing stress level having the same resistance against fatigue failure as the variating stress cycles is called an "equivalent stress".

The fatiguing effect of the simulated traffic is compared to the fatiguing effect of the fatigue load

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