Fatigue Life Evaluation of Welded Railway Bridges Based on Field Measurements

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Summary

Fatigue life evaluation of existing bridges is an important task especially for bridges reaching design life or subjected to increasing traffic volume. This paper presents probabilistic fatigue life assessment of welded railway bridge based on field measurement and numerical methods which can be applied to any fatigue sensitive structure. Due to the unavailability of details for setting up measuring devices, scope of the measurements etc., it is not always possible conduct measurements for all critical details. Field measurements in some critical details in the structure can give the basis for reliability analyses and fatigue life assessment in all critical details. In this paper fatigue life is defined as time when critical detail in structure reaches target reliability level. Fatigue reliability analysis is based on S-N concept and Miner's linear damage hypothesis taking into account model uncertainties and different probability density functions of stress ranges.

Keywords: fatigue, reliability, fatigue life, field measurements, finite element method

1. Introduction

Bridges play an important role in railway infrastructure throughout the world. After reconstructions of railway infrastructure and increasing traffic volume, some of existing steel railway bridges are still being used. With the increase of traffic on the railway network, fatigue can cause problems especially if bridges have reached or exceeded their original design life. Therefore, assessment of the current condition of steel railway bridges and their remaining fatigue life is a vital task, crucial for the development of railway transportation.

Probabilistic assessment of existing structures according to [1] can be carried out using the following steps: identification of critical limit states, (e.g. fatigue limit state), determination of limit state function, probabilistic modelling of basic variables and model uncertainties, calculation of reliability or failure probability, comparison with target values of reliability or failure probability. Based on these steps, this paper proposes a refined procedure with emphasis on the step of determining the basic variables and model uncertainties.

Stress ranges have a very large influence on the fatigue reliability. In this study, influence of stress ranges on the reliability level using two types of lognormal probability density function has been investigated.

Also, the fact is that the measurement of stress ranges should be conducted on all potentially critical details of the analysed structure. However, due to the unavailability of details for setting up measuring devices, scope of the measurements, costs etc., this is not always possible. Therefore, the paper proposes procedure for reliability analysis of such details based on FE analyses refined by field measurements. Reliability analysis is conducted for the detail which is part of railway bridge „Kupa-Karlovac" shown at *Fig. 1*. This detail is not available for setting up measuring devices.

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