Improvement of damage equivalence λ-factors for railway steel bridges

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Summary

For fatigue assessments of railway bridges improved load spectra are given in EN1991-2. This could have relevant consequences on design of new bridges as well as on the evaluation of residual fatigue life of existing bridges. As known, beside explicit damage calculations, fatigue can be assessed using the so-called λ method. In the study, the accuracy of damage equivalence factors λ given in EN1993-2 for railway steel bridges is discussed, pointing out that their values need some refinement, also in view of future improvements of the EN1993-2 itself.

Keywords: Eurocodes, fatigue, steel bridges, railway load spectra, damage equivalence factors.

1. Introduction

In Eurocode EN1991-2 [1] improved railway load spectra are given. This could have relevant consequences on fatigue assessment of new bridges as well as on the evaluation of the residual fatigue life of existing bridges. Fatigue checks of railway bridges are often simplified resorting to the so-called λ-method. In this method, described later on, instead of explicit fatigue damage, equivalent stress range are to be calculated by means of appropriate damage equivalence factors λ.

In the paper, in order to check the accuracy of damage equivalence λ-factors for railway steel bridges given in EN1993-2 [2], the damage equivalent stress ranges caused by EN1991-2 load spectra for steel details are compared with those calculated using the normative λ-values.

The comparisons, where normal stress spectra at midspan of simply supported girder bridges spanning between 1 m and 100 m are taken into account, demonstrate that λ-values require some refinement, also in view of future improvements of EN1993-2 itself.

2. Fatigue spectra for railway bridges in EN1991-2

In EN1991-2, static checks of bridges subject to normal railway traffic are carried out using load models *LM*71 and *SW*/0, or *SW*/2, while fatigue damage assessments are performed using the pertinent load spectrum. In EN1991-2, three different load spectra are given. These spectra, based on a reference annual traffic tonnage per track, *Vol*, equal to 25 Mt, pertain to normal traffic mix, traffic mix with 250 kN-axles or light traffic mix, respectively, depending on whether the structure carries standard traffic, predominantly heavy freight traffic or lightweight passenger traffic.

The standard load spectrum, with axle loads up to 225 kN, consists of 8 standardized real trains (fig. 1), for a total flow of 67 trains per day. It is the reference spectrum for main railway lines, characterized by typical mixed passenger and freight traffic.

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