Updating bridge axle loads using WIM in Switzerland

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Abstract

The Eurocode LM1 for traffic loads on bridges features side-by-side tandem axles, as well as uniformly distributed lane loads. This LM is mirrored in the Swiss code SIA 261, for new structures, as well as SIA 269, for existing structures, where updating is permitted based on existing traffic in the form of updated alpha factors, α_{Q1} and α_{Q2}. The research herein uses an extensive WIM database to update alpha factors for Swiss traffic. For the first (slow) lane, this is done using simple block maxima of tandem axle statistics (daily, weekly, and yearly block maxima results are compared) with log-normal fitting to the extreme value statistic. For the second lane, a novel approach is used which reconstructs real multiple-presence scenarios from the WIM data to predict the total joint load across both lanes. The result of the single lane and joint analyses are recommended updated alpha factors reduced by a factor of one third as compared to those mandated for new construction.

Keywords: bridges; weigh-in-motion; traffic; axle; reliability; loads; assessment; ultimate limit state.

1 Introduction

The current load model for traffic loads on bridges can be traced back to WIM data collected in 1986 over a period of less than 2 weeks in Auxerre, France. Since this time, many relevant changes have occurred including enhances in WIM technology, data storage and analysis methods, and changes in traffic conditions and vehicle characteristics. However, the use of the original load model 1 (LM1) found in Eurocode 1 (EN 1991) Part 2 persists, and is the load model used for the ultimate-limit-state (ULS) design of most bridges in Europe. A key feature of the load model is its ability to be updated with country-specific parameters; this allows it to represent a variety of traffic types. Indeed, all traffic loadings can be represented by an equivalent set of point loads and uniformly distributed loads (UDLs) as in LM1 [2]. A note in EN 1991-2 states that the loads in LM1 have been selected and calibrated so that their effects, with dynamic amplification included, represent the effects of actual traffic in European countries for the year 2000 [1].

The following article presents an approach for updating the axle load parameters of the Swiss Load Model 1 of SIA 261 for the assessment of structures (SIA 269), which is almost identical to the Eurocode LM1. A reliability-based approach is used to find updated α factors considering statistics of individual tandem axles collected over 15 years, as well as the side-by-side presence of multiple axles types in two adjacent lanes.

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