Traffic Load Effect Forecasting for Bridges

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Abstract

Traffic flows, as well as truck weights, increase with time. This must be taken into account in order to accurately assess traffic loading on bridges. The Eurocode Load Model 1 is used for the design of new bridges but a scaled down version of the model can be used for the assessment of existing bridges. This scaling is usually done by applying α–factors to the load model. The effect of traffic growth on these α–factors is assessed in this paper. Weigh-in-motion data from the Netherlands is used as the basis for traffic models which simulate year-on-year growth of both traffic flow and truck weights. A time-varying generalised extreme value distribution is then used to calculate the characteristic load effects and determine the α–factors. The effect of different traffic growth rates on these α–factors is then examined. It is found that an increase in truck weights has the most influence on the α–factors but that increased flow also has a significant effect.

Keywords: bridge; loading; traffic growth; simulation; Generalised Extreme Value distribution; Eurocode; load model 1.

1 Introduction

The Eurocode load model for normal traffic, Load Model 1 (LM1), is applicable for the design of new bridges [1]. A scaled down version of LM1 may be a suitable notional load model for the assessment of existing bridges and this scaling is generally done by applying α–factors to the original model. The Eurocode model can be scaled by estimating the characteristic maximum load effects and comparing the results to LM1.

Characteristic maximum load effects can be calculated in a number of ways. A popular approach is to use Weigh-In-Motion (WIM) technology to measure the weight of trucks as they travel along a road in normal traffic. Extrapolation from this measured WIM data to estimate the characteristic lifetime bridge load effects is an established procedure and has been used in many studies, both for site-specific assessment [2,3] and for the development of bridge design codes [1,4]. One commonly-used approach is to extrapolate using a statistical distribution fitted directly to the measured data. The Normal distribution has often been used for extrapolation, with the measured data being plotted on Normal probability paper [4] . The Generalized Extreme Value (GEV) distribution has also been used by many authors, both for site-specific assessment [2,3] and for the development of bridge design codes [1,4]. This family of distributions contains the Gumbel (type I), Fréchet (type II) and Weibull (type III) distributions. With this extreme value approach the distribution is fitted to block maxima, e.g., maximum daily or maximum weekly values. Other extrapolation approaches have also been used and the accuracy of different extrapolation approaches is compared in [5].