Numerical calibration of railway bridge based on measurement data

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Abstract

Bridges rarely behave precisely according to design assumptions. In most cases, they have some hidden reserves and behave preferable under traffic loads. To take these benefits into consideration numerical models can be calibrated based on measured structural response. The case study presented herein shows the calibration process for a railway truss bridge in Austria and the comparison of calibration results obtained by two individual teams. Each team did an individual and independent calibration based on different finite element models based on measured train passages. Both calibrations improved the precision of the calculated model response compared to the initial model, but also showed that the calibration parameters must be chosen with care to ensure plausibility of the results.

Keywords: Railway, Measurements, Influence Lines, Model Calibration, Optimization, B-WIM

1 Introduction

Model calibration (also known as model updating) is a well-known technique used to improve numerical models to show more realistic behaviour. In practice model calibration is often done by manual refinement of parameters in the numerical model. This approach is good for adjusting basic differences and simple models. But for more complex models and a larger set of parameters an automated optimization routine is necessary for the calibration process.

To depict this process and show advantages and disadvantages of different approaches, a railway bridge in Austria which was extensively tested and used for calibration by two individual expert teams. The results of both calibration processes are compared in this work.

The measured response of the structure was taken from static and dynamic testing. For the static response inclinations and strains were used, and accelerometers for the dynamic response, e.g. resonance frequencies and mode shapes. Static testing was done using a test train with known axle loads. For the dynamic response, two portable electrodynamic shakers have been used for forced excitation of different mode shapes. Both teams performed the measurements in parallel. Sensor data for inclinations and accelerations were shared to both teams, for strains each team used their own equipment and data for the calibration process. The two independent FE-Models where at different detail

https://doi.org/10.2749/ghent.2021.1264
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