Sensitivity Study of Stochastic Walking Load Models

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51. Bridges – System Identification

102 **Experimental Investigation of Reykjavik City Footbridge**
S. Živanović, The University of Warwick; E.T. Ingólfsson, Technical University of Denmark; A. Pavić, The University of Sheffield; G.V. Gudmundsson, Efla Consulting Engineers

This study describes experimental investigation of a 160m long footbridge in Reykjavik. The bridge is a continuous post tensioned concrete beam spanning eight spans, the longest being 27.1m. In plan, the structure has eye-catching spiral shape. Modal testing of the structure was conducted to identify its dynamic properties. As many as seven modes of vibration were identified in the low-frequency region up to 5Hz. After this a series of controlled tests involving up to 38 test subjects were performed. These were designed to test vibration performance of the footbridge under various loading scenarios such as: single person either walking or jumping, group of people walking, jogging or jumping and pedestrians arriving on the bridge according to the Poisson distribution. Vibration responses of the bridge for different scenarios were then compared and their severity was evaluated.

142 **Baseline Model Establishment for a Bridge I: Dynamic Testing**
K. Dai, S.-E. Chen, D. Boyajian, J. Scott, Y. Tong, University of North Carolina at Charlotte

A newly constructed bridge across interstate highway I-77 is a hybrid steel girder bridge using both HPS 70W and HPS 100W. The middle section of the steel girder with high-strength flanges is spliced with other parts of the girder. This hybrid bridge with high strength steel represents an increased effort in using high performance steel in civil construction. In order to ensure construction quality, a baseline finite element model was established and will be used as future references for long-term structural performance monitoring. To validate this model, modal tests using impact excitation were conducted on the bridge prior to its opening to traffic. The baseline finite element model generated in this paper was further verified and used for the static load testing comparison, which is reported in a companion paper.

145 **Baseline Model Establishment for a Bridge II: Static Load Testing**
J. Scott, W. Liu, D. Boyajian, K. Dai, S.-E. Chen, University of North Carolina at Charlotte

Truck load testing is a field experimentation used widely in the United States for bridge load rating. For new bridge infrastructure, a baseline model developed through dynamic or static load testing can be used as a reference for long-term structural performance monitoring. This paper presents a study of truck load testing on a hybrid steel girder bridge. The middle part of high-strength steel (HPS 100W) girder is spliced with other components of the girder made of HPS 70W steel. Non-contact laser sensing technique was relied on to measure bridge deformation under static loads. Experimental results were compared with numerical analysis for validation purpose. Static load testing, along with dynamic analysis reported in a companion paper, creates benchmark information for this structure useful for future bridge inspection.

170 **Sensitivity Study of Stochastic Walking Load Models**
L. Pedersen, C. Frier, Aalborg University

On flexible structures such as footbridges and long-span floors, walking loads may generate excessive structural vibrations and serviceability problems. The problem is increasing because of the growing tendency to employ long spans in structural design. In many design codes, the vibration serviceability limit state is assessed using a walking load model in which the walking parameters are modelled deterministically. However, the walking parameters are stochastic (for instance the weight of the pedestrian is not likely to be the same for every footbridge crossing), and a natural way forward is to employ a stochastic load model accounting for mean values and standard deviations for the walking load parameters, and to use this as a basis for estimation of structural response. This, however, requires decisions to be made in terms of statistical distributions and their parameters, and the paper investigates whether the outcome of vibration serviceability assessments is sensitive to some the decisions to be made by the engineer doing the analyses. For the paper a selected part of potential influences are examined and footbridge responses are extracted using Monte-Carlo simulations and focus is on estimating vertical structural response to single person loading.

87 **Identification of High-order Local Vibration Properties of RC Viaduct**
K. Matusoka, K. Kaito, Osaka University; T. Watanabe, M. Sogabe, Railway Technical Research Institute

In order to sustain the development of high-speed trains, it is necessary for railway bridges to grasp the dynamic behavior of bridge members precisely, by identifying not only whole bridge vibration properties but also local ones, and low-order to high-order mode vibration properties. Actually, there are common concerns over resonance and noises caused by the vibration of bridge members due to high-speed trains. However, there have been few vibration measurement experiments for carrying out identification of high-order member vibration properties. In this circumstance, the authors conducted the passing train experiment, measuring vibration concurrently at several points on the intermediate and projecting slabs of RC viaducts for high-speed trains. Through the vibration measurement experiment, the authors verified the possibility of detection of high-order vibration modes of members and identified the outstanding vibration mode when a high-speed train passes. This paper also includes a few discussions about the relation between vibration properties and the outstanding frequency induced by the multi-axle load of trains. By accumulating the data of actual measurements of local vibration, it would be possible to contribute to the sophistication of finite element analysis, etc.