STRUCTURES COMPLETED RESEARCH PROJECT

PROJECT NAME: LOW-COST MODAL IDENTIFICATION SENSORS OF BRIDGE FIELD TESTING

PROJECT NUMBER: SPR-P1(20) M105

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PROJECT ABSTRACT

This report provides a framework for experimental load rating of bridges via inclusion of low-cost dynamic sensors and dynamic tests. Currently 25% of the bridges in Nebraska are posted for live load. According to the National Bridge Inventory (NBI) in 2012, 93% of all postings in the US were based analytical load ratings, 7% were posted using field evaluation and engineering judgement, and 1% were posted using experimental load rating methods.

Instrumentation costs and traffic interruptions can be problematic when load testing is necessary to accurately assess in-situ bridge live load capacity. Recent advances in (i) sensing technology and (ii) numerical methods used to process test data permit more cost-effective data-enabled decision making. According to the AASHTO Manual for Bridge Evaluation (MBE), dynamic tests can be used for calibration of bridge numerical models which could enhance the value of a diagnostic load test. This project helps engineers select and use inexpensive, off the shelf dynamic sensors for dynamic testing and load rating of bridges in Nebraska and elsewhere.

To help identify low-cost dynamic sensors suitable for Operational Modal Analysis (OMA), a set of bridges featuring various construction materials, span lengths, and structural systems were selected for vibration tests. Via tests conducted on the bridges, two low-cost sensors were down selected from five initial candidates. To ensure applicability of vibration tests to perform experimental load ratings, bridges were chosen as test beds for conducting vibration-based load ratings under operational conditions with results compared to data produced from strain measurements from controlled live load testing using. It was shown that vibration tests conducted using low-cost sensors and OMA can help engineers accurately complete bridge load ratings.

As quoted by P.I. Daniel Linzell, in the May 2021 final report abstract