RESEARCH
PROJECT CAPSULE [13-2ST]
October 2014
TECHNOLOGY TRANSFER PROGRAM

Live Load Monitoring for the I-10 Twin Span Bridge

JUST THE FACTS:

Start Date:
August 4, 2014

Duration:
24 months

End Date:
August 3, 2016

Funding:
SPR: TT-Fed/TT-Reg

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Sponsored jointly by the Louisiana Department of Transportation and Development and Louisiana State University

POINTS OF INTEREST:

Problem Addressed / Objective of Research / Methodology Used Implementation Potential

PROBLEM

Overloaded trucks often cause serious damage and safety threats to bridges. Compared to the standard traffic/live loads in the design specifications of the American Association of State Highway and Transportation Officials (AASHTO), e.g. HL-93, the actual characteristics of overloaded trucks are very difficult to predict or define in advance because they are site specific. Therefore, it is important to investigate the characteristics of overloaded trucks and their actual impact on bridges that have been typically designed for the standard design traffic loads.

Bridge condition assessment and live load capacity evaluation are the principal components of the Federal Highway Administration's (FHWA's) National Bridge Inspection Program (NBIP). The objective of the NBIP program is to more accurately evaluate bridge capacity in order to ensure the safety of the traveling public. Accurate bridge load rating is also an important factor for decision-making regarding bridge rehabilitation/replacement, load posting, and overloaded truck permitting.

AASHTO published the first edition of Manual for Bridge Evaluation (MBE) in 2008 to ensure the safety and serviceability of highway bridges. The Louisiana Department of Transportation and Development (DOTD) implemented the MBE Load and Resistance Factor Rating (LRFR) methodology in 2009. The intent of the LRFR was to be consistent with the Load and Resistance Factor Design (LRFD) specifications using a reliability-based philosophy and to extend the provisions of the LRFD specifications to the areas of inspection, load rating, posting, and permitting of existing bridges. In the LRFR methodology, structural performance is measured in terms of the reliability index, β. Though the LRFD specifications have been calibrated to provide a more uniform and acceptable level of safety and reliability, the application of reliability theory to bridge load rating is much more complex than the application of these principles in design due to site-specific conditions and time-dependent variations of existing bridges in service. In general, the bridge reliability index decreases with time due to deterioration, accident, fatigue, and growing traffic. For specific bridges, knowledge of the in-situ traffic data, performance data, and material and dimension data will greatly reduce the uncertainties. Incorporating those data into bridge load rating will greatly increase the reliability index β and extend the operational life of bridges.

To establish a site-specific database for bridge evaluation and future bridge design, DOTD established a long-term health monitoring system at the I-10 Twin Span Bridge. The bridge is instrumented from deck to piles to capture bridge response (both substructure and superstructure) to live loads. The purpose of this instrumentation is to perform structural health monitoring (SHM) of the bridge during normal traffic events as well as during extreme events, overloads, wave surges, or ship collision. This study is to provide field data-based support to DOTD to fully implement the SHM and determine the effects of traffic loads on instrumented components of the structure. In addition to instrumentations for structural response such as strains, an OSMOS weigh-in motion

(WIM) scale has been installed adjacent to pier M19 to collect live load information.

OBJECTIVE

The objectives of this project are to validate the performance of the monitoring system and the OSMOS WIM, develop a data interface tool to easily produce data downloads in table and graphical formats, and determine the effects of traffic loads on instrumented components of the structure. This project is to verify the installed monitoring system for the purpose of investigating the field performance of bridges at specific locations. The purpose of the monitoring system is to measure not only the strain/stress and deformation of the instrumented bridge components, but also the traffic/live loads to evaluate the existing practice and provide recommendations for future practice and design improvement. The ultimate goal of this project is to provide DOTD with more successful bridge constructions and maintenance, which will lead to a reduction of the related cost.

METHODOLOGY

To achieve the research objectives of this study, the proposed research work is classified into the following. The first part will verify the installation of instrumentations in collecting live load information and bridge performance, the second part will develop the data processing and visualization tools, the third part will analyze the field data and also conduct needed numerical analysis to understand the bridge performance, and the fourth part will develop recommendations for future practice of bridge design and maintenance and to disseminate the research results. The entire research plan is divided into the following tasks:

- Task 1—Conduct a literature review
- Task 2—Assess the current instrumentation system
- Task 3—Perform fieldwork
- Task 4—Prepare and submit an interim/progress report
- Task 5—Develop data interface tools
- Task 6—Compile and chart data
- Task 7—Evaluate the effect of traffic loads on instrumented components
- Task 8—Prepare a final report

IMPLEMENTATION POTENTIAL

The project is intended for a direct implementation that will affect bridge design, load rating/permitting, and maintenance in Louisiana. Therefore, research results dissemination and implementation is a very important part of the research program. A few venues that may be used for the dissemination of results in order to facilitate the implementation are the findings of the research will be made available in the form of a detailed project report; findings of the research will be disseminated through a workshop to train DOTD engineers, inspectors, and consultants; the research results will be presented to the state structural and bridge engineers and also at the Louisiana ASCE meeting, Louisiana Transportation Conference, TRB, FHWA and NCHRP sponsored conferences, etc.; and the recommendations and findings from this research will form the basis for peer-reviewed journal publications.

Dissemination of the research results will help the future implementation of policies related to bridge design, rating, and maintenance, and feedback from practicing engineers will help judge the progress of implementation. The findings from this study will provide insight into the performance of field bridges under site-specific live loads. Based on these findings, recommendations for implementation in future bridge projects will be provided. The DOTD bridge engineer will promote the implementation of research results.