

JOINT TRANSPORTATION RESEARCH PROGRAM

Principal Investigator: Mark D. Bowman, Purdue University, bowmanmd@purdue.edu, 765.494-2220

Program Office: jtrp@purdue.edu, 765.494.6508, www.purdue.edu/jtrp

Sponsor: Indiana Department of Transportation, 765.463.1521

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EVALUATION OF EFFECTS OF SUPER-HEAVY LOADING ON THE US-41 BRIDGE OVER THE WHITE RIVER

Introduction

Built in 1958, the US-41 White River Bridge is a two-girder, riveted steel structure located near Hazelton, IN. The bridge is comprised of two, sixteen span superstructures sharing a common substructure. Each superstructure also contains four pin and hanger expansion joint assemblies.



US-41 White River Bridge twin structures

Over a period from August 2009 to August 2010 a series of nearly one hundred super-heavy loads ranging in weight from 200,000 lbs to up over 1,000,000 lbs crossed the northbound superstructure of the bridge. The loads were moved to support the construction of a new power plant facility located in Edwardsport, IN. It was unknown what effect this number of super-heavy loading events, over a relatively short period, would have on the long-term performance of the US-41 White River Bridge. Therefore, long-term remote monitoring was used to quantify any negative effects due to the series of superloads. Five primary tasks were undertaken as part of this study:

1. Perform controlled load testing to gain insight on the typical behavior of the bridge.

2. Monitor the effect of individual superloads on the bridge structure to detect any notable damage.
3. Perform an in-depth fracture evaluation.
4. Evaluate the effects of multiple super-heavy loading events on the bridge.
5. Collect stress range histograms to be used as part of a fatigue life evaluation.

Findings

The results presented in this report show the following:

- The series of superloads had negligible long-term negative effects on the bridge.
- The CVN test results indicated the bridge material has very low fracture toughness.
- Fracture is unlikely to occur based on the in-depth fracture evaluation.
- If one of the components of the built-up member fractured, there is sufficient reserve capacity in the remaining components to carry the increase in stress.
- Sufficient remaining fatigue life was calculated for all critical details.



Static test configuration



Pin and hanger



Beam and dolly transporter for superload test

to the low live load stress ranges measured during normal daily traffic. Similar monitoring could be performed on other bridges to accurately establish their remaining fatigue life. This is especially true for those bridges currently showing a finite or negative fatigue life. Accurately quantifying the live load stress range of these bridges will not only provide for a much more accurate estimation of the remaining fatigue life but may show many of these bridge have very low live load stresses resulting in infinite or at a minimum sufficient remaining life.

References

Sherman, R. J., Mueller, J. M., Connor, R. J., Bowman, M. D. *Evaluation of Effects of Super-Heavy Loading on the US-41 Bridge over the White River*. Publication FHWA/IN/JTRP-2011/15. Joint Transportation Research Program, Indiana Department of Transportation and Purdue University, West Lafayette, Indiana, 2012. DOI: 10.5703/1288284314645

View the full text of this technical report here:
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Implementation Recommendations

Based on the results of the study, only two actions items were suggested: 1.) Perform an in-depth inspection of the pin and hanger assemblies; and 2.) Lubricate all pin and hanger expansion joints. This study was not able to evaluate the pins of these joints directly; therefore, an in-depth inspection of the pins by a qualified inspector is advisable in response to this series of super-heavy loadings. Also, during the long-term monitoring, bending was measured in the four hangers instrumented; thus, lubricating the joints should allow for better movement and in turn less bending.

Results of the fatigue evaluation indicated sufficient remaining fatigue life for all critical details. This was largely due

