

# JOINT TRANSPORTATION RESEARCH PROGRAM

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SPR-3474

2012

## Evaluation of Effects of Fire on the I-465 Mainline Bridges—Volume II

### Introduction

Steel bridges are occasionally subjected to fire events due to accidents or explosions of vehicles containing flammable materials. Significant bridge fire events have occurred in the recent past. In order to assist with the investigation of damaged bridges, a method of testing has been developed that allows researchers to extract flange and web sections from a bridge girder and test them in real fire scenarios. The test setup allows researchers to examine the differences in outcomes due to a variety of parameters such as paint coatings on the steel, thickness of steel, temperature and duration of fire exposure. After each test, material properties may be determined and compared to virgin or unexposed steel and AAS-HTO specifications to see if the material properties have changed or if the material is below minimum standards. An inspection manual was developed from this testing to assist with diagnosing bridges after fire events based on visual inspections.

### Findings

The results presented in this report show the following:

- Fire exposures have only a minor effect on the steel yield strength, ultimate strength, elongation at rupture, and surface hardness. This is irrespective of the steel surface temperature and duration and steel plate thickness.
- Fire exposures have only a slight reduction in the CVN fracture toughness values for steel. In some cases the fracture toughness is seen to increase as in part four of this report. This could be because the steel is being heated for 20 minutes and allowed

to cool. This is very similar to a process known as tempering, where heating of steel is utilized to make it tougher.

- Fire exposures do not have a statistically significant effect on the CVN fracture toughness of steels (after running a T-test on the CVN data, there seems to be no correlation between the values), which will continue to numerically satisfy the 15 ft-lb limit for Zone 2 if the control specimen satisfies the Zone 2 requirement.

### Implementation

If a bridge has sustained a fire load and is visually distorted, the recommendations of what must be done to repair the bridge may be intuitive; but when no apparent deformations are visible, a way of inspecting the bridge should be uniform and easily performed. The implementation of the findings of the report and the included inspection guide will provide inspectors with a general idea of the changes in material properties of the bridge steel, based on the visual appearance of the steel. Having this preplan will allow bridges to be inspected and reopened in a more timely manner.

Testing allowed researchers to examine the differences in outcomes due to a variety of paint coatings on the steel, thickness of steel, temperature and duration of fire exposure. Each specific test is photographed at certain stages that would be seen in the field after a bridge is involved in a fire. These photographs can then be compared to actual bridge damage and a method of repair, if required, can be decided.

## Recommended Citation

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Bradt, T. G., B. Rankin, R. J. Connor, and A. H. Varma. *Evaluation of Effects of Fire on the I-465 Mainline Bridges—Volume II*. Publication FHWA/IN/JTRP-2012/13. Joint Transportation Research Program, Indiana Department of Transportation and Purdue University, West Lafayette, Indiana, 2012. doi: 10.5703/1288284314976.

View the full text of this technical report here:  
<http://dx.doi.org/10.5703/1288284314976>

Published reports of the Joint Transportation Research Program are available at: <http://docs.lib.purdue.edu/jtrp/>



Jet flame test setup.