

## I-435 Missouri River Bridge

Fracture Critical Examination, Instrumentation, and Retrofit Installation

Kansas City, Missouri



### CLIENT

HNTB Corporation

### CHALLENGE

Significant fatigue cracking had developed in the steel superstructure of a major interstate highway crossing of the Missouri River serving the Kansas City region. The cracking was of particular concern due to the lack of structural redundancy provided by the two-girder configuration of the typical spans. The Missouri Department of Transportation, which owns and operates the bridge, sought a comprehensive evaluation and remediation of the cracking problems.

### STRUCTURE

The I-435 Bridge features seven bridge units and comprises parallel two-girder spans with a total length of 3,619 feet.

### SOLUTION

WJE performed a comprehensive evaluation of the bridge that included inspection, field testing, structural evaluation, and development of retrofit details. Hands-on inspections were performed using visual and magnetic particle test methods. Light grinding was performed at locations where paint or weld overlaps obscured visual inspection access. Cracking was identified at more than seventy-five locations, including some locations with multiple cracks. A testing program was then carried out to measure the live load response of the structure at selected details. This program included instrumentation to monitor more than 150 strain gage and displacement channels during twenty-one separate test setups located throughout the bridge. Measurements were made under both control truck loadings and normal traffic.

Based on the inspection and testing results, we concluded that the cracking resulted from out-of-plane displacement and restraint forces at connections of various floor beams and lateral members to the main girders. We then developed redundancy retrofit options as well as long-term fatigue and fracture retrofits to address fatigue-sensitive details.

In the final phase of the project, we were retained under a specialty engineering contract to retrofit details susceptible to distortion-induced cracking or fracture due to high residual stresses or embedded defects. WJE crews installed several hundred retrofits throughout the bridge, including crack arrest holes, weld repairs, and core drilling of connection elements.

