

## Michigan Gains Valuable Experience from Demonstration of Rapid Bridge Construction

*Successful research outcomes can take many forms. Even a project that encounters significant bumps along the way can be considered a success when the experience provides Michigan DOT with critical firsthand knowledge. This was the case with the Parkview Bridge in Kalamazoo, which Michigan DOT rebuilt with rapid construction techniques and fitted with a system of structural health monitoring sensors. Michigan DOT learned important do's and don'ts of rapid construction, and the agency stands to learn more about the bridge's performance in the coming years.*



*Kalamazoo's Parkview Bridge, which was rebuilt using rapid construction techniques, undergoes rigorous load testing.*

### Problem

Rapid bridge construction is becoming increasingly common in the United States. Preconstructing bridge components and then assembling them on-site can reduce road closure time dramatically and minimize the associated costs to road users. However, until recently the technology and its potential benefits were untested in Michigan. In addition, Michigan DOT needed to monitor the performance of bridges constructed with these new techniques.

### Approach

Michigan DOT established ambitious plans for a project that would address several research questions simultaneously. First, the agency planned to construct a bridge with all of its major bridge elements prefabricated. The assembled deck panels, after post tensioning, would be designed to behave and perform like a traditional span.

Second, Michigan DOT planned to instrument the bridge with a structural health monitoring system. The

measurements collected from this system would validate and verify the design assumptions for the bridge and ensure it was performing to specification.

Finally, over the course of constructing the bridge, the agency sought to compare rapid construction with conventional construction, determining the savings of both time and user costs.

### Research

In 2008 Michigan DOT built the four-span, three-lane Parkview Bridge in Kalamazoo using rapid construction techniques. Piers, abutments, I-beam girders and full-depth deck panels were all prefabricated off-site.

Researchers from Western Michigan University compared the costs, construction time and work flow of the Parkview Bridge with the comparable Lovers Lane Bridge in Portage, which was constructed in 2006 using traditional techniques.

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### Project Information

**Report Name:** A Sensor Network System for the Health Monitoring of the Parkview Bridge Deck  
**Start Date:** December 2005  
**Report Date:** January 2010  
**Research Report Number:** RC-1536  
**Total Cost:** \$224,522  
**Cost Sharing:** 20% MDOT, 80% FHWA through the SPR, Part II, Program

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Researchers also instrumented the prefabricated deck panels with a structural health monitoring system; the remaining prefabricated parts had been used with success in other Michigan structures, so they were not similarly monitored. As part of this project, this system recorded strain and temperature data for the one-year period following completion of the Parkview Bridge.

## Results

This project proved the concept of rapid construction in Michigan. Side-by-side analysis of rapid and traditional construction techniques for bridges of this size and scope showed an overall user time savings of 45 days with rapid construction, or a reduction of 42 percent in project duration, compared with traditional techniques.

The sensor system also performed as intended, demonstrating that each joint between panels behaved according to design specification and that the structure acted as a unit. Michigan DOT will continue to collect and analyze health monitoring data on this structure in a follow-up project.

Michigan DOT and the prestressed concrete fabricator also learned some valuable lessons in fabrication of complex bridge deck components. Due to several factors, chief among these a complicated geometry of the bridge and the initial casting bed setup, the post tensioning ducts on the bridge deck panels did not align properly in the field. This error was noted when the deck panels had already been transported more than 160 miles to the site and placed.

As a result, all 48 deck panels were rejected and needed to be reconstructed and instrumented, adding to the contractor's cost and extending the project timeline by 60 days. (These added costs and project delays were not included in the comparison of rapid construction to traditional techniques, because Michigan DOT was not liable for the expenses and delays due to fabrication errors.)

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*“Rapid construction looks great on paper, but this field demonstration revealed complexities we need to know about.”*

*Steven Kahl, P.E.  
Project Manager*

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## Value

Technical challenges are common in the course of assessing new construction methods. The rejection and replacement of the bridge deck panels demonstrated the need for improved quality assurance procedures and planning, and Michigan DOT will have a clear path forward for new rapid bridge construction projects now under consideration. Even with the delays, the project was still completed more quickly than a comparable conventional bridge.

The agency came away from this research with several new tools in its toolbox: know-how on rapid construction techniques and structural health monitoring, and mounting data that rapid construction makes sense for Michigan. ■

## Michigan Department of Transportation



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