

Smart bridges: Engineers load new bridge with damage-detection gauges

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Justin Dahlberg of Iowa State University's Bridge Engineering Center installs sensors on the US Highway 65/Oak Street bridge near downtown Iowa Falls. Credit: Bridge Engineering Center/Iowa State University

The new bridge over the Iowa River near downtown Iowa Falls is a major upgrade over the 1928 concrete arch structure it replaced last fall, once the longest arch span bridge in the state.

The new U.S. Highway 65/Oak Street [bridge](#) is stronger. Its foundation is more secure. Its roadway is 18 feet wider. The steel arch maintains some of the aesthetics of the old bridge. And all over the new bridge are gauges, sensors and other technologies installed by Iowa State University researchers that will be used for continuous, real-time monitoring of the [structural health](#), behavior and security of the structure.

"There are more than 100 individual gauges on the bridge," said Justin

Dahlberg, a research engineer for the Bridge Engineering Center, a part of Iowa State University's Institute for Transportation.

Those sensors will provide a tremendous amount of quantitative information about the bridge's performance and condition, said Brent Phares, the interim director of the Bridge Engineering Center. It's a model that could be used for other new bridges, including much larger ones.

Those gauges take 100 readings a second for corrosion, strain, surface conditions, moisture within the steel arch and structure movements over time. The bridge is also equipped to monitor the security of the structure and to record surveillance video.

"This is a whole distributed network," Phares said. "There is an impressive information transfer infrastructure at that bridge."

Iowa State researchers are now working to set up the hardware that will collect data from the bridge gauges. The accompanying software will scan the data and trigger an emergency message to researchers, transportation officials or police whenever there are unusual readings. The system will also display real-time data readings and video feeds on a website. This phase of the project is expected to be completed by the middle of this summer.

The monitoring project is supported by a grant of \$300,000 from the Iowa Department of Transportation. Iowa State engineers have worked on bridge-monitoring projects with the department for the past 10 years.

Ahmad Abu-Hawash, the chief structural engineer for the Iowa DOT, said the Iowa Falls project is a prototype for a system that will monitor a new Interstate 74 bridge over the Mississippi River between Bettendorf and Moline, Ill., when it is eventually constructed.

He also said the Iowa Falls project was a chance to combine various monitoring technologies the department and Iowa State researchers have developed and tested over recent years. And, it gives researchers and engineers the data they need to verify the assumptions used to design a steel arch bridge, which can be more complicated than designing a traditional bridge.

"This was a good opportunity to test the concept and work out any bugs," Abu-Hawash said.

The Iowa Falls project is also unique because the Iowa State researchers had complete access to the bridge during its construction, from the fall of 2010 to fall 2011. That's because the monitoring system was part of the bridge project from the beginning.

"This is the first time in all the work we've done that a monitoring system was included in the bridge plans," Phares said. "We've never been in the contract documents to this level."

As a result, the project's contractor, Cramer & Associates Inc. of Grimes, worked closely with the researchers to install all the gauges and sensors. While that resulted in an "inconvenience cost" the contractor charged back to the transportation department, Phares said the fee was far smaller than it would have been to complete the project independently of the bridge contractor.

"That special provision put into the original contract documents was extremely valuable," Phares said. "We didn't realize how valuable it would be. It gave us such easy access to the bridge when we needed it. And it opened up the lines of communication between the contractor and our team from day zero."

So, for example, when the construction crew accidentally cut through a

sensor wire, the contractor contacted Iowa State researchers so it could be fixed.

And now, researchers are hoping this kind of planning process, contracting agreement and [monitoring system](#) can be built into more bridge projects.

"I'm not sure how this could have gone any better," Phares said.

"Hopefully, a statement has been made for using this process when other bridges are built in the state."

Provided by Iowa State University

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