Researchers hope new bridge sensors will prevent disasters

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By Annika McGinnis | McClatchy Newspapers

Sensors installed on a bridge on Capital Beltway in the Washington D.C. area. | University of Maryland/McClatchy

WASHINGTON — Five years after the devastating collapse of an interstate bridge in Minneapolis, university researchers are developing new wireless technology that would warn of problems that could cause such disasters.

On Aug. 1, 2007, rush-hour traffic moved along the Interstate 35 West bridge in Minneapolis. Suddenly, most of the bridge broke off and fell into the Mississippi River, killing 13 people and injuring 145. It was one of the worst bridge disasters in U.S. history.

The bridge had passed federal inspections for years, the National Transportation Safety Board found.

As the nation's bridges age, they're becoming more dangerous, especially the "baby boomer bridges," the large number built during the 1950s and '60s, according to the American Association of State Highway and Transportation Officials. In 2010, the Federal Highway Administration labeled more than 11 percent of highway bridges – almost 70,000 – "structurally deficient," meaning the bridges had significant defects requiring major improvements or replacement.

As part of the push for increased bridge safety stemming from the Minneapolis disaster, separate engineering teams at the University of Maryland and North Carolina State University are designing wireless sensors that can detect problems early and alert authorities in time to prevent similar tragedies.

"You go to a checkup, you find a condition of your body," said Chung Fu, a University of Maryland engineering research professor who helps lead one of the teams. "So you put a sensor on the bridge and find the health of the bridges."

For instance, the tiny sensors are placed on areas of the bridge where there are cracks or that are prone to cracks, Fu said. Then the bridge's health can be monitored from computers at another site. In the event of an emergency, a text message or email alert would be sent to authorities, said Mehdi Kalantari, a University of Maryland research engineer who leads the other team.

One of the projects conducted by University of Maryland researchers has developed wireless sensors that can detect problems including strains, cracks, deformation, vibration, temperature and humidity – all aspects of bridge health, said Kalantari, who led the project and recently started a company to manufacture his systems. The project has been tested on an Interstate 495 bridge in Maryland for two years with great results, he said.

"We have detected certain changes on the bridge from time to time," Kalantari said, saying the sensors recognized changes that had come about through repair jobs. "Our system detected each and every structural modification, which means if these changes were due to a structural problem, that would've been detected."

In the future, Kalantari said, he hopes to gain official state and federal approval for the technology.

The other project, paid for by state and federal funding and conducted with North Carolina State University, is designing sensors that can detect bridge fatigue as part of "smart bridge" technology, said Fu, the project's leader. Unlike Kalantari's sensors, these aren't yet wireless, but hopefully they will be by November, when the researchers plan to test the technology on bridges, probably in Maryland and North Carolina, Fu said.

The wireless aspect, which North Carolina State researchers are designing, makes the new system more affordable than systems that require the presence of crews to track possible problems, Fu said.

Monitoring bridge health often is very expensive, Fu said, especially in this economy. He said bridge maintenance was "on the list" for all state governments but that it often was neglected because of the high price tag.

According to Kalantari, bridge safety is a huge problem that cannot be ignored, however. And he said most bridges relied only on visual inspections for safety monitoring.

Problematic metal plates, called gusset plates, on the Minneapolis bridge most likely caused the disaster, the National Transportation Safety Board wrote in its report on the collapse. There was an "inadequate use of technologies for accurately assessing the condition of gusset plates on deck truss bridges," the report said.

The new sensors are much more reliable, the researchers said. Fu said they might even have prevented the collapse of the Minneapolis bridge.

“You probably would have seen the sensors change, the signals become more intense, probably getting higher – and those are the signals we want to see, that’s all the warning message,” he said.

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