The new Minnesota smart bridge

Kistler helps avoid desasters like the August 1, 2007 collapse by providing vital parts of the new bridge's early warning and security system.

Josh Sebasky of Kistler's local representative Minnesota Measurement Engineering had an early inkling that, with the planning of the new bridge, a breakthrough-application of our accelerometers was in the making. He has been highly instrumental in the project's thorough success.

The US has 578 000 highway bridges, which are the lifelines of US commerce. The average life span of highway bridges is about 70 years and the majority of bridges currently in use were built after 1945.

Spence Wende, Chris Smyth (KNA)

However, significant environmental damage requiring repair typically occurs before the average bridge reaches mid-life. Corrosion, cracking and other damage can all affect a bridge's load carrying capacity. Therefore, all of the elements that directly affect performance of the bridge including the footing, substructure, deck, and superstructure must be periodically inspected or monitored. Mere visual inspection is the primary method used to evaluate the condition of the majority of the nation's highway bridges. Inspectors periodically (about every two years) pay each bridge a visit to assess its condition.

In the aftermath of the Minneapolis disaster, the official enquiries into the causes of the bridge's collapse soon disclosed hints that some vital parts of the structure, dating from the early sixties, had been grossly undersized due to some obvious design flaws. Several court cases are expected to be filed revolving around the critical issue of state liability. It's no secret that the I-35W bridge collapse was no isolated incident, but that much of the US' infrastructure in general is in a deplorable state, a large part of bridges, dams, power supply lines etc. being near to or over 100 years old. An MIT estimate says that, over the next few years, costs for repairs and refits amount to roughly 600 billion dollars a year.

The disaster...

On August 1, 2007 the I-35W bridge over the Mississippi River in Minneapolis, MN collapsed during rush hour, plunging dozens of cars and their occupants into the river. Thirteen people were killed and 145 were injured. The calamity disrupted transportation and aimed a spotlight on public infrastructure, specifically methods of inspection.

... and its teachings

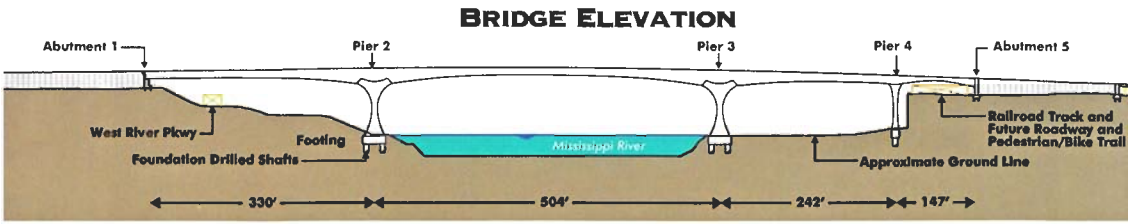
In the aftermath of this event, the Minnesota Department of Transportation decided to design a replacement bridge that could easily and accurately detect structural issues.

The Kistler portion of the project began when the bridge contractors placed a call to Minnesota Measurement Engineering (the local Kistler sales representative). They were looking for accelerometers. In true sales fashion, Minnesota Measurement Engineering also uncovered requirements for data acquisition, linear potentiometers and sensor installation assistance. Working with the contractors, Kistler Type 8310B2 accelerometers were chosen – primarily for their low frequency range.

In the hollow space under the deck MME installed and wired 12 accelerometers Type 8310B2, each one at the midpoint of the girders, for constant vibration monitoring. A further 14 accelerometers will be used for modal analyses. The Kistler equipment is part of the first US smart bridge's impressive safety system.

The new bridge

The replacement bridge consists of separate north and south lanes supported by common piers. Each lane has three main spans composed of two hollow concrete box girders. Twelve Type 8310B2 accelerometers are used to monitor the vibration at the mid point of each concrete box girder. Accelerometer cables ranged in length from 10 to 39 meters. The remaining 14 accelerometers are used for periodic modal studies.



Typical sensor installation in a girder (above); one of the time-synchronized data acquisition modules.

When the new Interstate 35W bridge opened on September 18, 2008, it included safety features exclusive to this project. The SmartBridge technology has 300 sensors that monitor the structure of the bridge. The various sensors are buried in the concrete, across the expansion joints, attached to bridge girders and attached to wires routed to a central computer.

Engineers from the Minnesota Department of Transportation and the University of Minnesota will monitor the information to detect any early warning signs of problems and advance the art of bridge design.

The sensors measure how much the bridge moves or compresses from traffic, wind or air temperature. They can also measure the level of corrosion.

With the success of this project, along with the increased awareness of technology available for long-term structural monitoring, we anticipate further business in this industry in the years to come.

The new I-35W bridge over the Mississippi river in Minneapolis was opened on 18 September 2008.