Structural Engineering Community Offers Assistance for I-35 Bridge Collapse

All of us at STRUCTURE® magazine, NCSEA, SEI, CASE, the Editorial Board, and staff, offer our condolences and sympathy to the victims of the tragic collapse of the I-35W Bridge in Minneapolis in early August.

Any speculation as to the cause of the collapse is premature and inappropriate. However, the structural engineering community immediately offered assistance. NCSEA provided access for the media to experts in bridge design and construction. Assistance with recovery, site inspections and forensic investigation was offered from structural engineers around the world.

As has been reported, the National Transportation Safety Board (NTSB) is investigating the collapse, with assistance from the Federal Highway Administration (FHWA) and the Minnesota Department of Transportation. Structural analysis of the bridge will use computational Finite Element Analysis methods. Data collected at the accident scene, with the help of the FBI's 3-D laser scanning device, will be used in the model. This work is expected to take several months.

The inspection and rating of the I-35W Bridge, and the nation's infrastructure in general, has been a topic of both discussion and speculation in the mainstream media. Structural engineers in the bridge design/construction community remind us that inspections are a federally mandated part of the maintenance of bridges.

In 1967, the catastrophic collapse of the Silver Bridge over the Ohio River, at Point Pleasant, WV, set into motion federal legislation to establish safety inspection and maintenance standards for bridges nationwide. The fracture of an eyebar at a pin connection during rush hour traffic caused 31 of 37 cars on the bridge at the time to plunge into the frigid river, resulting in 46 fatalities.

The National Bridge Inspection Standards (NBIS) were implemented as a Federal regulation establishing requirements for:

1) inspection procedures,
2) frequency of inspections,
3) qualifications of personnel,
4) inspection reports, and
5) inventories.

All bridges are mandated to be inspected on a biennial basis, with frequency of inspection type clearly defined in the NBIS. Inspectors at all levels must complete FHWA approved training. Each bridge is rated based on findings, and inspection reports are filed after each inspection. Any problems identified are monitored.

As stated previously, it is premature to speculate as to the cause of the I-35W collapse. The bridge community, from structural engineers to industry/material representatives, will be watching the process closely. When the investigation is complete, it is certain that findings will be scrutinized closely and that codes, standards and procedures may be adjusted if needed.

This tragedy has, however, highlighted the aging state of our nation's infrastructure. Although the National Bridge Inspection Standards program is in place to monitor bridges, it is incumbent on our national and state leaders, with input from the bridge design/construction community, to ensure that necessary support is available to address needs.▪

Photographs courtesy of FEMA/Todd Swain

Bridge Inspection Procedures

Brian J. Leshko, P.E., a Professional Associate and the National Bridge Inspection Program Leader with HDR Engineering, Inc. in Pittsburgh, as well as a member of STRUCTURE® magazine's Editorial Board, provided us with a brief overview relative to bridge inspection procedures:

- Complex inspections include fracture-critical member inspections for a bridge that has some non-redundancy built into it, like a truss bridge. Any of the tension members must be inspected at arm's length.
- Beyond visual inspections, nondestructive techniques are utilized. Examples include:
  - o **Dye-Penetrant Testing** – When a crack is observed, it is further tested to determine if it is a crack in the paint, or is in the base metal. After scraping the paint to reveal bare metal, a cleaner is applied. Then a red dye sprayed on the area. Finally, a developer (like white foam) is applied and let set. If there is a crack in the metal, the dye will go into that crack and the developer will pull the dye out. A red line will appear in the white foam.
  - o **Magnetic Particle Testing** – A magnetized yoke is placed on either side of a potential crack. The yoke polarizes one side from the other. Metal filings are sprinkled on the surface. Magnetizing polarizes the filings, and they "line up". At a crack, there will be a discontinuity, or an area where there aren't any filings.
  - o **UltrasonicTesting** – Ultrasound is used to inspect for cracks that are deeper in the steel. Sound waves can detect flaws or anomalies. Results are viewed on an oscilloscope and interpreted at the site.
  - o **RadiographicTesting** – Similar to taking an X-ray of a member, this process can be both cumbersome and expensive. This method utilizes a radioactive source. Unlike ultrasonic testing, results are collected on X-ray films which become a permanent record.
- For complicated trusses, use of a structural analysis program is critical. Fracture-critical members are "zeroed out" in a computer simulation. The entire structure is modeled, a load applied, and distribution of stresses through the member is analyzed.▪