



A bridge inspection in progress.

Inside bridge sufficiency ratings

BRIDGE SAFETY made major news last summer with the collapse of the I-35W Bridge over the Mississippi River in Minneapolis. Media reports at the time reflected public concern about the structural status of highway bridges nationwide. Federal and state officials at the scene and in subsequent press conferences quoted the technical terminology of bridge ratings until words like “deficient” and “critical” began to lose their meaning.

The job of communicating accurate information about bridge safety to constituents and journalists also falls to local officials. In Wisconsin, they are the people responsible for monitoring 8,700 bridges across the state. **Crossroads** goes inside the terms of bridge rating to clarify what they mean and highlight the state program for bridge improvement assistance.

Rating methodology

Transportation authorities in every state and municipality rely on a Federal Highway Administration methodology to calculate bridge highway sufficiency ratings. Bruce Karow, Chief Structure Maintenance Engineer with the Wisconsin Department of Transportation, says WisDOT looks at about 75 factors that measure bridge adequacy, from traffic volume and road widths to national security. Those factors become a sufficiency number between 0 and 100. This measure of bridge condition helps set priority rankings for replacement and rehabilitation, and eligibility for state or federal funds.

Four definitions

Karow recalls his department’s response to media inquiries about state bridges after the Minnesota bridge collapse. They made it clear, he says, that ominous-sounding terms associated with sufficiency ratings have logical engineering definitions. “We explained, for example, that ‘structurally deficient’ does not mean a bridge is unsafe, and that if we found it to be so, we would post it or close it immediately.” Karow here outlines the four terms that emerge most often in sufficiency rating discussions.

Structurally deficient This rating signals the need for monitoring and/or repair of some bridge elements. On a scale of 0 (failed) to 9 (excellent), a bridge earns the structurally deficient rating when the riding surface, the supports beneath the surface, or the foundation, supporting posts and piers achieve a 4 (poor) rating or less. The rating does not imply an unsafe bridge but one that requires more frequent inspection and timely repair or replacement. Authorities may reduce weight limits and post the bridge and, if an inspection warrants, close it down. Karow notes this rating automatically excludes a bridge from the **functionally obsolete** category.

Functionally obsolete Out-of-date but not-out-of service, a bridge rated functionally obsolete is older and built to standards not used today. These bridges often have narrower lanes and shoulders than newer bridges or inadequate horizontal or vertical clearances. A bridge with this rating often cannot handle current traffic volume. To achieve a functionally obsolete rating, Karow says a bridge must rate a 3 (serious) or less on the scale in one of several areas, including deck geometry, under clearance and approach alignment.

Fracture critical Bridge design influences the fracture critical rating. Typically, a fracture critical bridge has a steel superstructure with load-carrying components arranged in a way that, if one component fails, total or partial collapse of the bridge is likely. Two-girder bridges and most truss bridges are examples. In contrast, redundancy is a staple of most new bridge construction today. If one component fails, other bridge elements handle the load and prevent collapse. The fracture critical designation does not mean a bridge is unsafe, however, only that it lacks the strength of redundancy in its design.

Scour critical Heavy rains in southwestern Wisconsin last August washed out roads and bridges and brought attention to spans at risk of high water. Karow describes a scour critical bridge as one with abutment or pier foundations rated as unstable based on two measures: (1) observations of the scour, or erosion, from water around the substructure, or (2) scour potential based on an evaluation study that uses mathematical models to estimate scour depth. WisDOT Bridge Hydraulic Engineer Najoua Ksontini is studying data from the summer rains to identify the severity of flood events and the impact on bridge structures. Her initial review of how high and how fast the rivers ran as a result of the rainfall indicates severely affected counties experienced anything from a 25-year flood event to flooding that exceeded a 100-year event. “The information we’re gathering is important in determining how to make scour critical bridges stable again and safe,” Ksontini says. “It also helps in the planning of new structures where our goal is to build bridges that can withstand a 500-year flood event.”

Contacts

Bruce Karow
WisDOT Chief Structure
Maintenance Engineer
bruce.karow@dot.state.wi.us

Michael Erickson
WisDOT Local Bridge
Program Manager
michael.erickson@dot.state.wi.us

Resources

Updated bridge page on
WisDOT website with infor-
mation on inspections, terms
and links to relevant sources.

[www.dot.wisconsin.gov/
projects/bridges/index.
htm#inspections](http://www.dot.wisconsin.gov/projects/bridges/index.htm#inspections)

Federal Highway
Administration
information on bridge
technology and ratings.
www.fhwa.dot.gov/bridge/



Planning bridge replacement or rehab

Understanding sufficiency terms well enough to communicate local bridge facts to the public is essential. It also helps local officials identify the structures that qualify for replacement or repair.

WisDOT administers the Local Bridge Improvement Assistance program combining dollars from a federal highway bridge improvement program (the Highway Bridge Replacement and Rehabilitation Program) with state funds to help local governments cover the costs of replacing or renovating eligible structures.

Each county receives a proportional share of the estimated \$66.2 million available for the program through 2012. Approved projects are funded 80 percent by the Local Bridge Program, 20 percent by local governments.

Michael Erickson, Local Bridge Program Manager for WisDOT, says bridges eligible for funding are those included on a federal list at the time of design or construction. Bridges constructed or reconstructed within the last ten years do not qualify.

Bridges with ratings less than 80 are eligible for rehabilitation if it makes economic sense. Erickson

emphasizes local authorities must do an independent engineering study to establish the rating and show rehabilitation will correct existing deficiencies and extend bridge life by at least 10 years.

A sufficiency rating less than 50 may qualify a bridge on the federal list for rehab *or* replacement and also must meet criteria consistent with study results.

WisDOT approved local bridge projects last summer for the 2009-2012 program. It will solicit projects for the next cycle in spring 2009. ■

Ratings review prompts postings

CROSSROADS reported a year ago on the impact of new higher legal truckloads on bridge ratings monitored by local agencies. We discussed inspection programs and the critical need to screen over 1,000 local bridges for possible updated postings. Daniel J. Fedderly, Executive Director for the Wisconsin County Highway Association, notes that the costs for doing a load rating analysis vary based on factors like the number and type of structures in the study, the length of each structure and the number of spans under review. "Generally, you can expect to pay approximately \$500 to \$2000 per bridge for a typical single-span structure when it's rated with a group of other structures," he says. "Signage and installation costs, should the structure need posting after the rating is done, can run a few hundred dollars more."

Fedderly encourages local governments to do the studies and keep their bridge inventory up to date. Officials in two counties that conducted ratings reviews in 2007 tell us what they found.

Lincoln County

Out of 98 bridges monitored by highway authorities in this northeast Wisconsin county, WisDOT earmarked 33 for closer review in light of the new 98,000-pound legal loads. Highway Commissioner Randy Scholz says an analysis of the identified structures did prompt new lower postings on 16 bridges, including one due for replacement in 2009. Two other bridges posted at lower limits are on the list for replacement in the near future. Structures affected are a mix of multi-span and single-span bridges, steel girder and wood. Updated postings on the six county and ten town bridges range from 12 tons to 45 tons. Scholz says it was interesting to find so few bridges on the target list needed new postings, a fact he attributes in part to original ratings that far exceeded existing loads. He adds that local officials acted quickly to alert truckers and the community at large about the change in posted weight limits after finalizing the list in August.



*The six-span steel truss CTH M Bridge over the Chippewa River has a new load rating and posting **BELOW** after a review in 2007.*



Chippewa County

This northwest Wisconsin county monitors 259 county and local bridges. County Highway Department Operations Superintendent Pat Calabrese says they

categorized all aid-eligible bridges and off-system structures in response to WisDOT recommendations for local bridge owners by reviewing load ratings on file and identifying any bridges that needed closer scrutiny. A total of 45 bridges reviewed in 2007 received first-time postings. Using WisDOT guidelines for categorizing by superstructure type and aspect ratio, county staff determined four structures required closer analysis—a six-span steel truss crossing the Chippewa River, a single-span timber slab, a two-span steel deck girder and a two-span haunched concrete slab. Evaluation showed two of the four (the steel deck girder and concrete slab) capable of carrying the higher loadings. The other two needed posting. Calabrese says one thing they found from doing the load ratings was that it is important to evaluate both substructure and superstructure. The posting of one bridge analyzed was newly set at 35 tons based on the condition of the timber piling.

*The CTH J Bridge in Lincoln County, **LEFT** due for replacement next year, has an updated posting after the 2007 review, as does the Axen Road Bridge, **RIGHT** which remains in good shape.*