

## **Mn/DOT's Response to National Transportation Safety Board Recommendations**

November 18, 2008

### **Background**

The National Transportation Safety Board determined that the probable cause of the Aug. 1, 2007 collapse of the Interstate 35W bridge in Minneapolis was the inadequate load capacity of the gusset plates at the structure's U10 nodes due to a design error by Sverdrup & Parcel and Associates, Inc. The gusset plates failed under a combination of (1) substantial increases in the weight of the structure from previous bridge modifications, and (2) traffic and concentrated construction loads on the bridge on the day of the collapse.

Contributing to the design error was the failure of Sverdrup & Parcel's quality control procedures to ensure that the appropriate main truss gusset plate calculations were performed for the I-35W bridge and the inadequate design review in 1965 by federal and state transportation officials. Also contributing to the accident was the generally accepted practice among federal and state transportation officials of giving inadequate attention to gusset plates during inspections for conditions of distortion, such as bowing, and of excluding gusset plates in load rating analyses.

As a result of its investigation, the NTSB made the following safety recommendations to the Federal Highway Administration on Nov. 14, 2008. Mn/DOT has already taken steps on many of these recommendations.

<b>NTSB Recommendation</b>	<b>Mn/DOT Response</b>
<p>1. Develop and implement, in conjunction with the American Association of State Highway and Transportation Officials, a bridge design quality assurance/quality control program, to be used by the States and other bridge owners, that includes procedures to detect and correct bridge design errors before the design plans are made final; and, at a minimum, provides a means for verifying that the appropriate design calculations have been performed, that the calculations are accurate, and that the specifications for the load-carrying members are adequate with regard to the expected service loads of the structure. (H 08-XX)</p>	<p>The Peer Review process Mn/DOT announced earlier in 2008 for major bridge designs was implemented for the very reasons stated in the NTSB recommendation: to detect and correct design errors before the plans are final.</p> <p>That process was employed on the new I-35W bridge and will also be used on bridges such as Hastings and Lafayette. Mn/DOT has existing QA design and checking processes within its own design units to ensure the quality of plans and also consultant plans for routine bridges.</p> <p>Mn/DOT will review any QA/QC information from AASHTO or FHWA for adoption of any beneficial practices.</p>
<p>2. Require that bridge owners assess the truss bridges in their inventories to identify locations where visual inspections may not detect gusset plate corrosion and where, therefore, appropriate nondestructive evaluation technologies should be used to assess gusset plate condition. (H-08-XX)</p>	<p>Mn/DOT is using non-destructive evaluation technology to assess gusset plate condition. In fact, the NTSB showed photos of the Winona Bridge and described Mn/DOT's use of ultrasonic testing to determine plate thicknesses in areas where visual inspection is not possible. Mn/DOT has ordered</p>

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	additional NDE equipment, which will be used by the expanded Fracture Critical inspection staff the department is adding. This technology was a routine part of Mn/DOT's gusset plate inspections in 2008 and will continue to be used.
<p>3. Modify the approved bridge inspector training as follows: (1) update the National Highway Institute training courses to address inspection techniques and conditions specific to gusset plates, emphasizing issues associated with gusset plate distortion as well as the use of nondestructive evaluation at locations where visual inspections may be inadequate to assess and quantify such conditions as section loss due to corrosion; and, (2) at a minimum, include revisions to reference material, such as the Bridge Inspector's Reference Manual, and address any newly developed gusset plate condition ratings in the American Association of State Highway and Transportation Officials commonly recognized (CoRe) structural elements. (H-08-XX)</p>	<p>While this recommendation is directed at the FHWA, Mn/DOT's inspection staff has already adopted the suggested practices.</p> <p>Mn/DOT inspectors are using NDE inspection technology as described above, and checking gusset plates for distortion using straight edges and other means. Gusset plate condition is being recorded as part of inspections.</p>
<p>4. Work with the Federal Highway Administration to develop and implement a bridge design quality assurance/quality control program, to be used by the States and other bridge owners, that includes procedures to detect and correct bridge design errors before the design plans are made final; and, at a minimum, provides a means for verifying that the appropriate design calculations have been performed, that the calculations are accurate, and that the specifications for the load-carrying members are adequate with regard to the expected service loads of the structure. (H-08-XX)</p>	<p>See Peer Review process discussion under NTSB Recommendation No. 1.</p>
<p>5. Revise your Manual for Bridge Evaluation to include guidance for conducting load ratings on new bridges before they are placed in service. (H-08-XX)</p>	<p>Mn/DOT typically load-rates a bridge when the design is complete and prior to the construction contract. The bridge rating is done before the bridge is placed in service and is shown on the design plan that goes to contract. The load rating is generally performed by the department's Bridge Rating Unit, which is separate from its Design Units or the consultant designer.</p>

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6. Modify the guidance and procedures in your Manual for Bridge Evaluation to include evaluating the capacity of gusset plates as part of the load rating calculations performed for non-load-path-redundant steel truss bridges. (H-08-XX)	The truss ratings and gusset plate ratings Mn/DOT conducted from fall 2007 to July 2008 fully addressed this recommendation. This action is completed for all 25 steel truss bridges on the state system. As future ratings are needed due to changes in condition, the gussets will be again reviewed for capacity evaluation.
7. When the findings of the Federal Highway Administration-American Association of State Highway and Transportation Officials joint study on gusset plates become available, update the Manual for Bridge Evaluation accordingly. (H-08-XX)	This requires action by FHWA and AASHTO. Mn/DOT is a participant in the joint study, providing its experience from conducting gusset plate evaluations on the state system.
8. Develop specifications and guidelines for use by bridge owners to ensure that construction loads and stockpiled raw materials placed on a structure during construction or maintenance projects do not overload the bridge's structural members or their connections. (H-08-XX)	Mn/DOT revised its construction specifications in April 2008 and further modified them in August 2008 to limit construction loads from stockpiles on bridges and include a process for engineering review of construction loads that exceed typical traffic loads.
9. Include gusset plates as a commonly recognized structural element (CoRe) and develop guidance for bridge owners in tracking and responding to potentially damaging conditions in gusset plates, such as corrosion and distortion; and revise the AASHTO Guide for Commonly Recognized (CoRe) Structural Elements to incorporate this new information. (H-08-XX)	Mn/DOT inspection staff has recorded the condition of gussets in the truss inspections it conducted in 2008 and will continue to do so in future inspections. Corrosion and any distortion was measured and noted. Furthermore, the condition of gussets was factored into the load ratings conducted for these trusses. Mn/DOT will implement whatever results come from AASHTO for CoRe element recording to ensure the state's current recording of this data is consistent with national practice.

**NTSB Recommendation to FHWA on January 15, 2008**

<b>NTSB Recommendation</b>	<b>Mn/DOT Response</b>
For all non-load-path-redundant steel truss bridges within the National Bridge Inventory, require that bridge owners conduct load capacity calculations to verify that the stress levels in all structural elements, including gusset plates, remain within applicable requirements whenever planned modifications or operational changes may significantly increase stresses. (H-08-1)	Mn/DOT has completed a review of trusses and, in fact, exceeded this recommendation. Even if no modifications have been made to a bridge since original construction, Mn/DOT has rated all trusses and included the gusset plates in those ratings. These ratings confirmed there were no errors similar to I35W in the original design of those trusses.
	Information about this extensive effort that was completed in summer 2008 is on Mn/DOT's Web site, <a href="http://www.mndot.gov">www.mndot.gov</a> .