U.S. Department of Transportation
Federal Highway Administration

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Technical Advisory

U.S. Department
of Transportation
**Federal Highway
Administration**

Subject
Load-carrying Capacity Considerations of Gusset Plates in Non-load-path-redundant Steel Truss Bridges

Classification Code	Date	Office of Primary Interest
T 5140.29	**January 15, 2008**	**HIBT**

Par.

1. **What is the purpose of this Technical Advisory?** The purpose of this Technical Advisory is to provide recommendations for supplementing the American Association of State Highway and Transportation Officials (AASHTO) procedures for load rating steel truss bridges with respect to gusset plate considerations.

2. **Does this Technical Advisory supersede another Technical Advisory?** No. This is a new Technical Advisory.

3. **What is this background of this Technical Advisory?**

   a. On August 1, 2007, the I-35W Interstate highway bridge over the Mississippi River in north Minneapolis, Minnesota, experienced a failure in the superstructure of the steel deck truss center portion of the 1,900-foot- long bridge. Approximately 1,000 feet of the deck truss portion collapsed with approximately 456 feet of the main span falling about 108 feet into the 15-foot-deep river. There were approximately 110 vehicles on the collapsed portion, with 17 vehicles falling into the water. Roadway construction was occurring on the deck truss portion of the bridge, and four of the eight lanes were closed for re-paving when the bridge collapsed. Machinery and paving materials were being parked and stockpiled on the center span.

   b. Physical examination of the recovered bridge structure showed that the gusset plates at the east and west joints, identified as U10, U10', L11, and L11', were fractured. The other major structural gusset plates in the main trusses were generally intact. The damage patterns and fracture features uncovered in the investigation to date suggest that the collapse of the deck truss portion of the bridge was related to the fractured gusset plates and, in particular, may have originated with the failure of the joint U10 gusset plates.

   c. So far, the design review has found that the superstructure of the bridge was generally built as designed, with no significant discrepancies between the design documents and the as-built condition of the bridge. Materials testing to-date has found no deficiencies in the quality of steel or concrete used in the bridge.

   d. Examination of the design methodology used at the time was found to be sound. Although no problems were identified with the design methodology used for the bridge, the investigation discovered that the gusset plates on the main trusses of the bridge at the east and west joints U10, U10', L11, and L11' were undersized.

   e. The bridge underwent two major renovations, one in 1977 and another one in 1998. The average thickness of the concrete deck was increased from 6.5 inches to 8.5 inches, and the center median barrier and outside barrier walls were increased in size. These changes added to the dead weight of

the structure. At this point in the investigation, it is not clear whether the general practice in the industry would include recalculating the capacity of gusset plates as part of the renovations.

f. As a result of this accident, the National Transportation Safety Board (NTSB) recommends that bridge owners conduct load capacity calculations for all non-load path-redundant steel truss bridges 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.

4. **What are the recommendations?**

a. Currently, per the National Bridge Inspection Standards (Title 23, Code of Federal Regulations, Section 650.313(c)), bridge owners are required to load rate each bridge as to its safe load-carrying capacity in accordance with the AASHTO Manual for Condition Evaluation of Bridges. As stated in the AASHTO Manual, bridge load rating calculations provide a basis for determining the safe load capacity of a bridge. A load rating result is used to maintain the safe use of a bridge and arrive at posting and permit decisions. The AASHTO Manual further states that bridge load ratings should be reviewed and updated to reflect any relevant changes in condition or dead load noted during inspections of existing bridges.

b. Accordingly, the following actions are recommended to supplement the provisions of the AASHTO Manual.

(1) **New or replaced non-load-path-redundant steel truss bridges.** Bridge owners are strongly encouraged to check the capacity of gusset plates as part of the initial load ratings.

(2) **Future recalculations of load capacity on existing non-load-path-redundant steel truss bridges.** Bridge owners are strongly encouraged to check the capacity of gusset plates as part of the load rating calculations conducted to reflect changes in condition or dead load, to make permit or posting decisions, or to account for structural modifications or other alterations that result in significant changes in stress levels.

(3) **Previous load ratings for non-load-path-redundant steel truss bridges.** Bridge owners are recommended to review past load rating calculations of bridges which have been subjected to significant changes in stress levels, either temporary or permanent, to ensure that the capacities of gusset plates were adequately considered.

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