



**NTSB** National Transportation Safety Board

---

*Office of Highway Safety*

# Bridge Load Rating

Dan Walsh



# Presentations

1. Bridge description and collapse
2. Construction activities on bridge at time of collapse
3. Gusset plate inadequacy
4. Finite element analysis
5. Design and review process
6. Bridge load rating and bridge load analysis
7. Bridge inspections
8. Gusset plate inspections

# Overview

- Terms used in load rating a bridge
- Overview of load ratings for I-35W bridge
- Load rating programs
- Guidance used for load ratings
- AASHTO guidance used by states to conduct load ratings
  - Does not consider gusset plates
  - Does not provide information on how to evaluate gusset plates

# Definition of Load Rating

- Safe load capacity of bridge
- Maintain safe use of bridge
- Arrive at posting and permit decisions

# Purpose of Load Rating

- Used by State DOTs
- Determine whether loads larger than legal loads can travel over bridge
- Legal weight limit for Interstate system is 40 tons
- Loads may be redirected to other routes

# Load Rating Requirements

- Significant change occurs that affects load-carrying capacity
- Renovation or rehabilitation project that increases dead load
- Inspection reveals deterioration that questions bridge safety

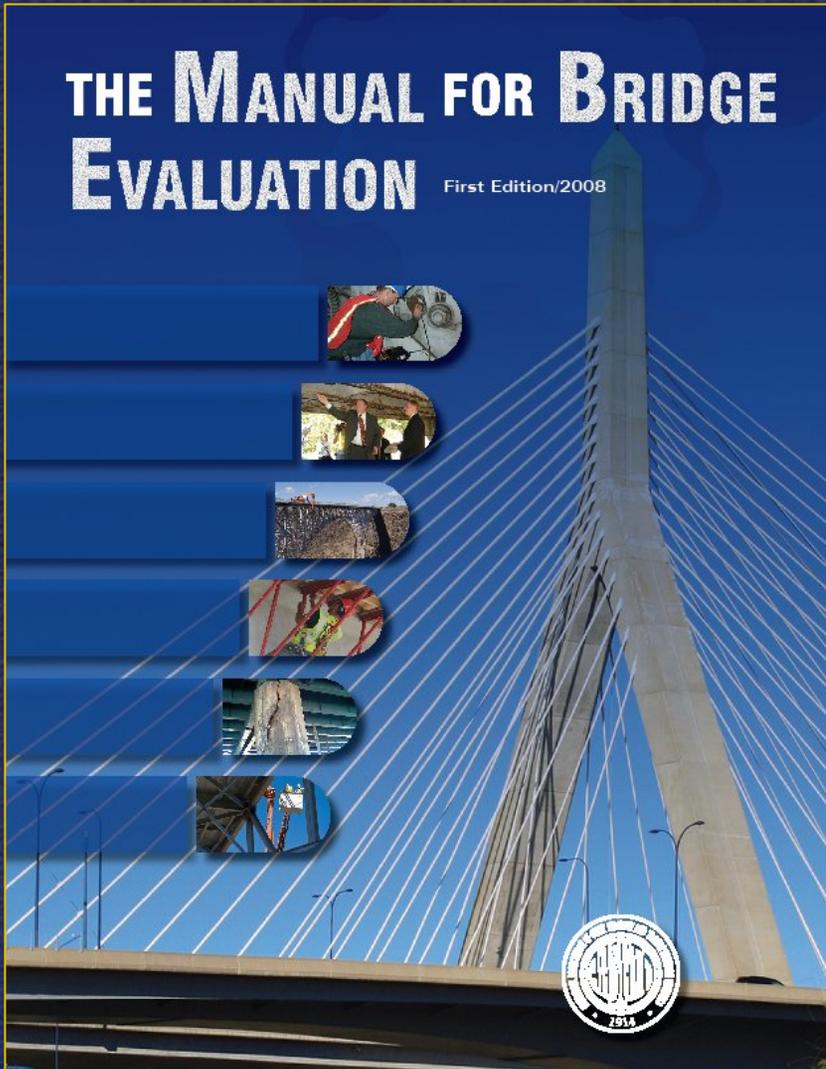
# Load Rating Terms

- Inventory - design level of stress
- Operating – maximum live load stress
- Expressed relative to legal load
- Lowest load rating referred to as controlling member of bridge
- Controlling members continue to be basis for subsequent load ratings

# Load Rating Methods

- Load ratings first introduced in 1970 AASHTO manual
  - Established terms inventory and operating stress levels
- Allowable stress method – 1970
- Load factor method – 1978
- Load and resistance factor rating method - 2003

# 2008 AASHTO Manual



- Does not consider gusset plates
- No information on how to evaluate gusset plates
- Does not require load ratings on new bridges

# 1967 Sverdrup & Parcel Rating

- Opened to traffic in 1967, prior to first edition of 1970 AASHTO manual
- No documentation found to show that Sverdrup & Parcel calculated load rating
- Construction plans
  - Capacity of each member
- No information found on capacity of gusset plates

# 1979 Mn/DOT Load Rating

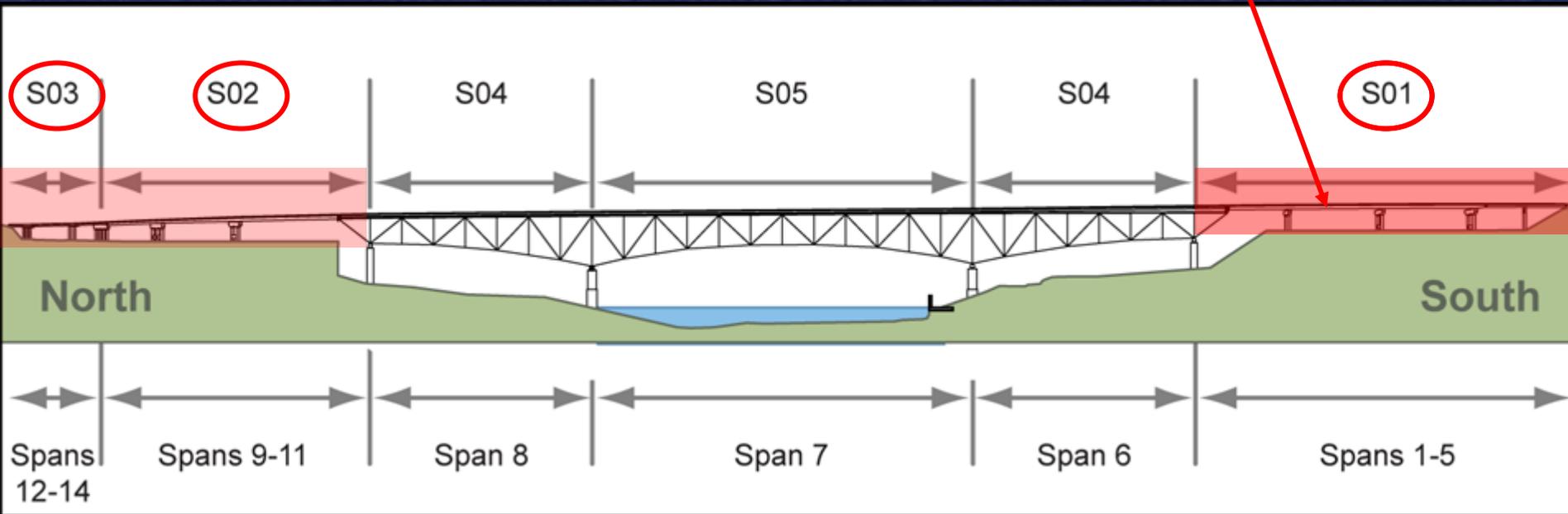
- First load rating performed in 1979, 12 years after bridge put in service
- Reflect increased dead load
  - Added 2 inches of concrete
- Only documentation found was 1- page summary report
- No information found on capacity of gusset plates

# 1995 Mn/DOT Load Rating

- Second load rating performed in 1995
- Based on BARS load rating program
  - Used for 3 critical sections of bridge
- BARS program does not have capability of analyzing connections
- BARS program did not include or consider strength of gusset plates

# 1995 Mn/DOT Load Rating

Controlling member located in Span 4

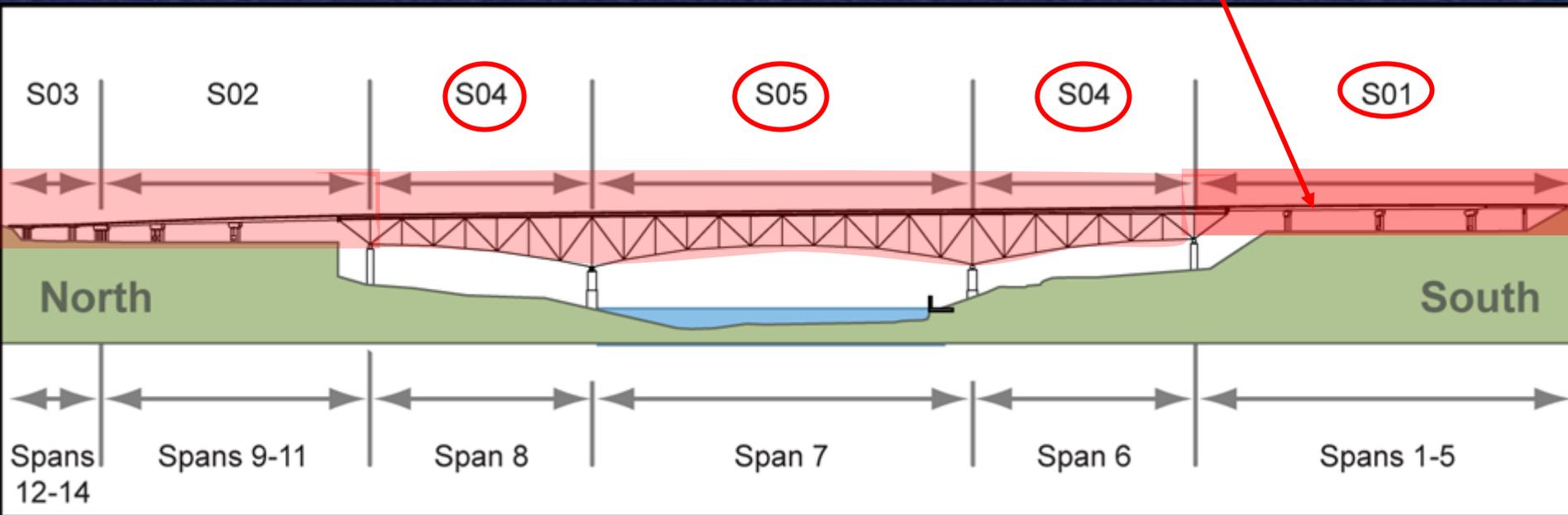


# 1997 Mn/DOT Load Rating

- Third load rating performed in 1997
- Based on BARS load rating program
  - New median barrier and outside traffic railings
- BARS program did not include or consider strength of gusset plates

# 1997 Mn/DOT Load Rating

Controlling member located in Span 4



# Load Ratings for I-35W Bridge

- If gusset plates had been included in Mn/DOT load ratings
  - Should have revealed improperly designed gusset plates
  - Might have determined that improperly designed gusset plates were controlling members
- Mn/DOT believed controlling member was in south approach span

# Gusset Plate Treatment

- Gusset plates are assumed stronger than members they connect
- Survey of 14 State DOTs
  - 15 different load rating programs in use
  - None of these programs considered strength of gusset plates
- Bridge owners do not have opportunity to verify original design

# Load Ratings on New Bridges

- In 2007, Mn/DOT instituted policy to load rate new bridges
- AASHTO guidance: load rate bridges only when significant change occurs
- Had a load rating been performed, the design error might have been detected
- Might result in bridge owners not verifying load-carrying capacity of bridges before opening them to traffic

# FHWA Technical Advisory

- Issued in response to Safety Recommendation H-08-1
- Take certain actions to supplement AASHTO manual
  - New – *“Check capacity of gusset plates as part of initial load ratings”*
  - Existing – *“Check capacity of gusset plates as a result of changes in bridge condition”*
  - Review previous load ratings



# FHWA – AASHTO Joint Study

- Proposed in May 2008
- Guidance for developing proper design and rating of gusset plates
- Estimated to be completed in 24 months
- Will help ensure safety of new and existing bridges

# Concerns

- Long-term implementation of second item in FHWA's Technical Advisory
- Guidance would go further if this item was included in the AASHTO manual
- The National Bridge Inspection Standards incorporate by reference the AASHTO *Manual for Condition Evaluation of Bridges*
- Replaced by AASHTO's 2008 *Manual for Bridge Evaluation*

# Summary

- AASHTO load rating manuals do not consider gusset plates
- No requirement to perform initial load ratings on new bridges
- Important opportunity to detect design defects

