Workshop Agenda

I. Introductions
II. Load Rating Basics
III. General Equations
IV. Load Rating Procedure
V. Incorporating Member Distress
VI. Posting, SHV’s and Permitting
VII. Load Rating Example #1
   ▪ Simple Span Non-composite Steel
Load Rating Procedure

- Gather Bridge Data
- Collect Information From On-site Inspections
- Determine Applied Loads
- Determine Capacity of Member
- Conduct Load Rating Calculations
- Submit Results to MnDOT
Gather Bridge Data

- Bridge design plans
- Bridge fabrication drawings
- Design calculations
- All repair plans for structure
- Most recent Structure Inventory Report
Collect info from on-site inspections

- Changed conditions
  - Damage
  - Repairs
  - Section loss
  - Traffic
Bridge Inspection

• When design plans or fabrication drawings for a bridge are unavailable or unreadable, or when conditions change from those detailed in the plans, field measurements are required.

• Field measurements should be made only with sufficient precision to serve the purpose for which they are intended.
Bridge Inspection

• The following limits of accuracy are generally ample for field measurements:
  - Timber members - Nearest ¼”
  - Concrete members - Nearest ½”
  - Asphalt surfacing - Nearest ½”
  - Steel rolled sections
    • Necessary accuracy to identify section
    • More precise measurements warranted for determination of section loss
  - Span Lengths - Nearest 0.1 foot
General Equation

Reserve Capacity for Live Load

Maximum Design (HS) or Legal Live Load

\[ RF = \frac{C - A_1 D}{A_2 (L + I)} \]

- \( RF \): Rating factor for live load capacity
- \( C \): Capacity of the member
- \( D \): Dead load effect on member
- \( L \): Live load effect on member
- \( I \): Impact Factor
- \( A_1 \): Factor for dead load
- \( A_2 \): Factor for live load
Determine the Loads

- **Dead Loads**
  - **Compute according to existing conditions**
    - Point loads – pilasters, lighting, diaphragms, etc.
    - Line loads – Beams, stool, etc.
    - Distributed loads – Slab, sidewalk, railings, overlay, gravel, etc.
    - Material unit weight must be at least the value specified in the AASHTO Design Specs.
Determine the Loads

- **Live Loads**
  - AASHTO HS20 Truck Live Load
Determine the Loads

- **Live Loads**
  - Standard AASHTO HS lane loads may be used for all span lengths where it will result in greater effects than the standard HS truck (simple span greater than 140’)
- **Legal Trucks**
  - (Type M3, Type M3S2, Type M3S3 and new Single Unit (SU) trucks)
- **Permit Trucks**
Determine the Loads

- **Live Loads**
  - Number of loaded lanes and transverse placement of wheels shall be in accordance with AASHTO Design Specs (Section 3).
  - Roadway widths 18-20 ft, 2 design lanes, each half the width, centered live load
  - Widths less than 18 ft, 1 design lane
Determine the Loads

- **Live Loads**
  - For vehicle load distribution (Consult Section 3 of AASHTO Standard Specs)
    - **Steel Beams**
    - **Concrete beams**
    - **Concrete Slabs**
    - **Longitudinal and Transverse Timber Deck**
    - **Floor Beams**
Impact

- Impact Factor (I) is added to all live loads to account for the speed, vibration, and momentum of vehicular traffic.
- Per AASHTO 3.8.1.2 – Impact not considered for Timber members
Determine Capacity of Member

- Nominal capacity based on Load Factor section of AASHTO Standard Specs 17th ed.
  - Structural steel
  - Reinforced concrete
  - Prestressed concrete
Determine Capacity of Member

- Load Factor methods for timber and masonry are not available – Use ASR
- MUST include the affects of deteriorated or damaged sections
Determine Capacity of Member

- **Calculate section properties**
  - Incorporate distress
  - Composite properties
  - Non-composite properties
Select Safety Factors

- Select Factors for Rating Method used:
  - Allowable Stress Rating Method (ASR)
  - Load Factor Rating Method (LFR)
  - Load and Resistance Factor Rating Method (LRFR)
Conduct Live Load Analysis

- AASHTO Manual for Condition Evaluation of Bridges Tables (Appendix)
  - Simple spans
    - HS-20 truck
    - Legal trucks
  - Continuous spans need computer program
Conduct Load Rating Calculations

• Inventory Rating (*frequent loads*)
  - Load the bridge can carry for extended periods
  - Design Load (live load for which bridge was originally intended)
Conduct Load Rating Calculations

- Operating Rating (*less frequent loads*)
  - Absolute maximum permissible load.
  - Unlimited vehicles operating at this level may reduce bridge life.
Conduct Load Rating Calculations

- Typically the superstructure is the only component rated.
- If other portions of the bridge system are deteriorated, they should be fully analyzed and considered in the load rating calculations.
Rating Members

• Typically not checked
  ▪ Splices or connections
  ▪ Fatigue
  ▪ Concrete deck
  ▪ Local failure (bearing, yielding)
  ▪ Shear for slabs
  ▪ Substructure (bearings, piles, movement)
  ▪ Secondary members (diaphragms, wind bracing)
Submit Results to MnDOT

Bridge Management
Attn: Jim Pierce
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Bridge Loads by Deflection
Extra Credit!!

Inventory deflection
Operating deflection
Fracture load
Safety Factor

Capacity = DL + Fracture LL