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

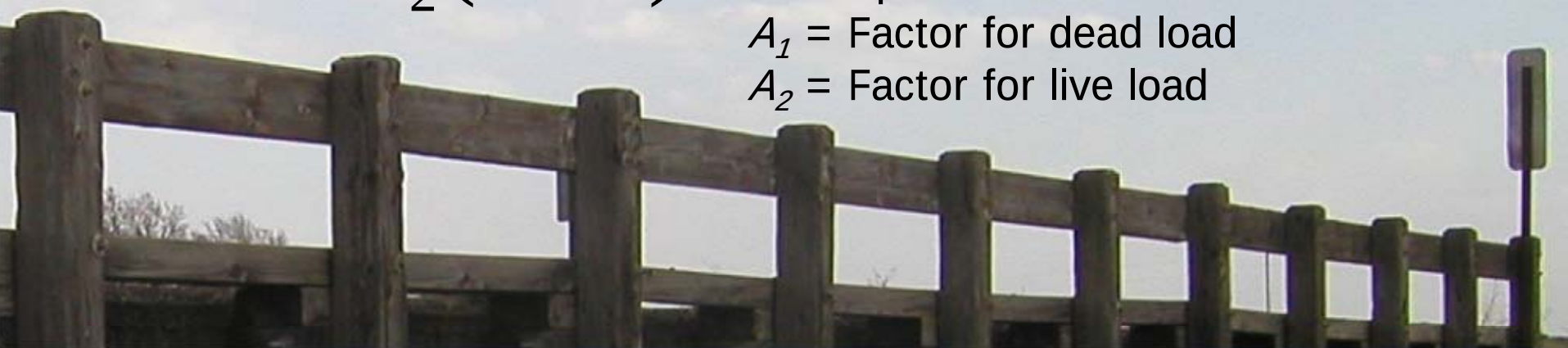
General Equation

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

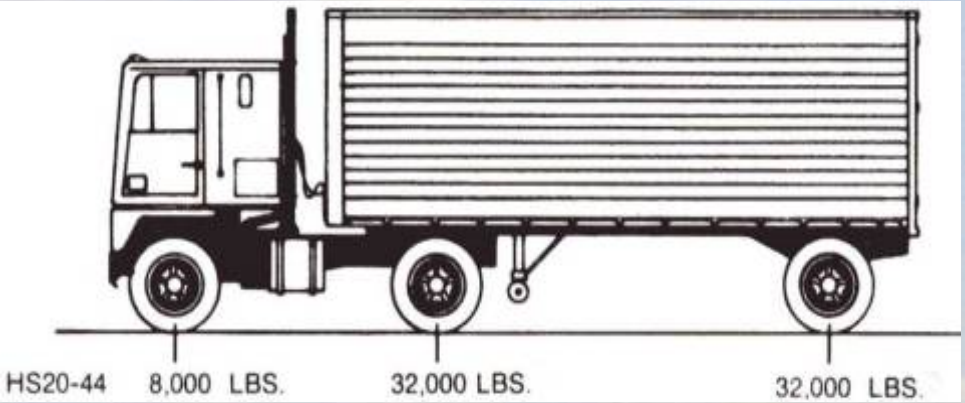


Determine the Loads

- **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

EXAMPLE

FORM RC–CL Revised Feb. 2005

Mn/DOT BRIDGE RATING AND LOAD POSTING REPORT FOR COUNTY AND LOCAL AGENCIES

Bridge Location and Description

Hwy. No. 56 (over) under Upper Iowa River — Bridge No. 5905

Year Built 1940 — Year Remodeled ____ — Replaces Br. ____

Type 301 — County Mower — Ref. Pt. ____

Description 2 span 24'-2" Roadway width, 2 concrete railings, no sidewalk W24x80 at 6'-4" spacing

Location 2.6 miles west of Jct CSAH 8 near Tappi

Data for Basis of Report (Check all that apply)

- ☐ Bridge Inventory File
- ☐ Previous Bridge Rating and Load Posting Report
- ☒ Bridge Plans
  - ☒ New ☐ Overlay
  - ☐ Repair/Reconstruction ____
  - ☐ Other Dead Load Modifications ____
- ☒ Bridge Inspection Report, by ____, date ____
  - ☐ Damaged Component ____
  - ☒ Deteriorated Component Interior beam bottom flange det. 50% at midspan

Type of Analysis:

☒ Manual ☐ Computer* ☐ BARS ☐ Virtis, V.____ ☐ Other*

*____

Method of Rating (Check appropriate box)

- ☒ Load Factor (LF)
- ☐ Allowable Stress (AS) (Timber only)
- ☐ Load & Resistance Factor (LRFR)
- ☐ Load Testing
- ☐ No Rating Computations Performed

Design Load HS15

Design Method ASD

Summary of Rating and Load Posting Analysis

Load Posting Limits (Posting: ☒ Required ☐ Not Required)			Bridge Rating	
Vehicle Type M3	Semi-Trailer Type M3S2	Truck-Full Trailer Type M3-3	Inventory Rating	Operating Rating
8 Tons	14 Tons	14 Tons	5 HS	10 HS

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Signature: County Engr — Date: 3/5/05

Typed or Printed Name: County Engineer — Reg. No. 12345

BR3939.doc

FORM RD–CL Revised Feb. 2005

BRIDGE RATING DETAILS

Bridge Type 301 — Bridge No. 5905

Rating Method LFD — Design Load: HS15

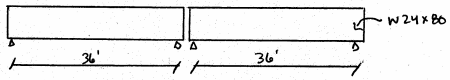
Roadway Width 24'-2" — Inventory Rating: HS - 5

☐ Curved ☐ Tapered — Operating Rating: HS - 10

Beam Spacing 6'-4" — Rated EAL Checked AAA

Live Load Distribution Lane Width — Date 3/7/05

Single 14' Multiple 11' — Sheet 2 of 2



BEAM ELEVATION ②

Show Span Lengths and Structure / Beam Depths

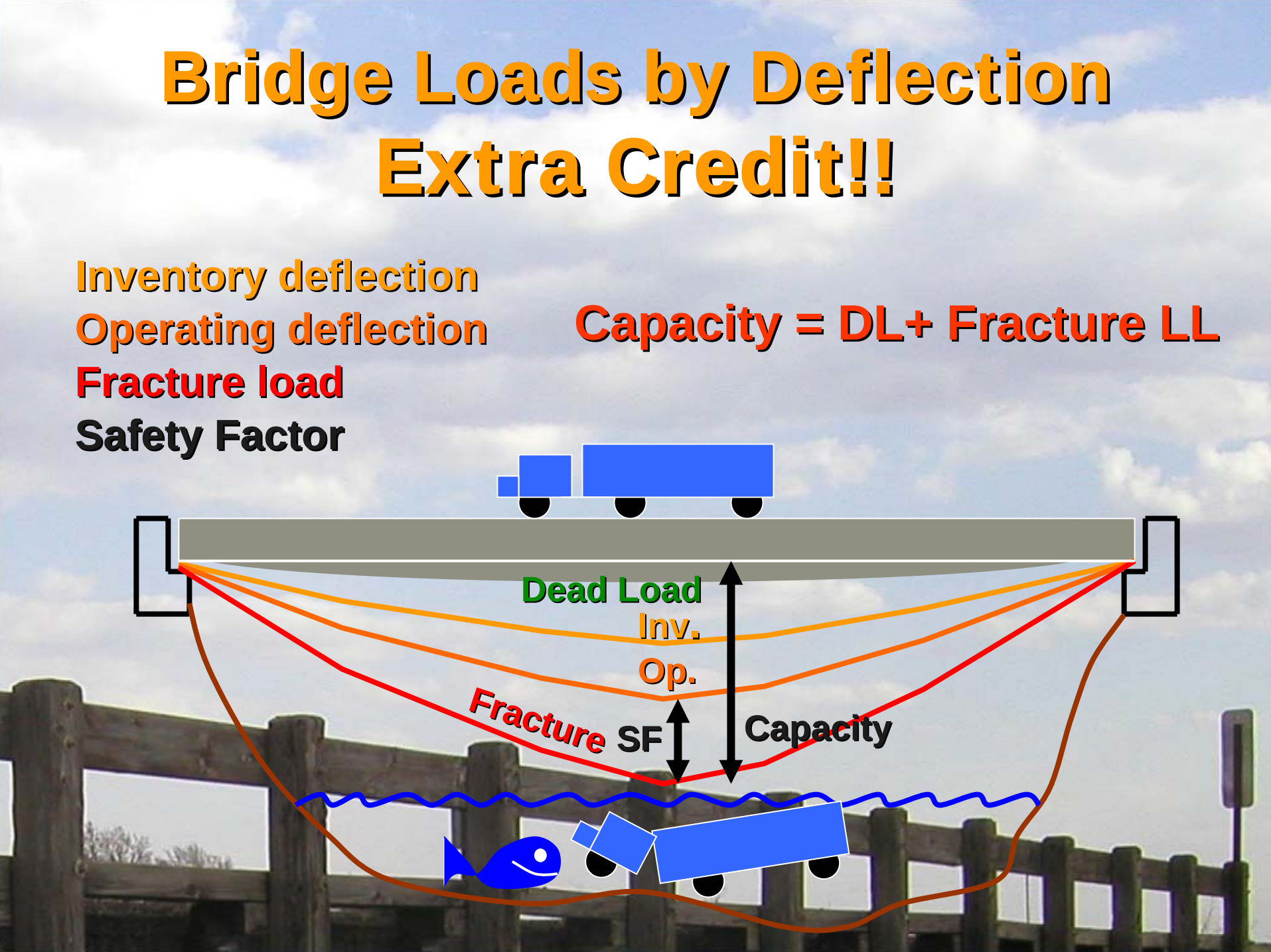
Truck	Rating Factor	Location	Limit State ①	Notes / Comments
HS 20 Inventory	0.25	50%	Ult. Moment	
HS 20 Operating	0.50	50%	Ult. Moment	
Post, M 3	0.69	50%	Ult. Moment	
Post, M 3S2	0.74	50%	Ult. Moment	
Post, M 3-3	0.73	50%	Ult. Moment	

① Choose from: service or ultimate; shear or moment.
② Elevation may be on back or another sheet if it won't fit here.

BR3942b.doc

Bridge Management
Attn: Jim Pierce
3485 Hadley Ave N
Oakdale MN 55128

Bridge Loads by Deflection
Extra Credit!!

Inventory deflection
Operating deflection
Fracture load
Safety Factor

Capacity = DL+ Fracture LL