# Load Rating in Michigan

February 22, 2006

## Why Load Rate Bridges

- Public Safety
- Federal and State Requirements
- Bridge Preservation
- Load Rating Influences:
  - NBI Item 67 (Structural Evaluation)
  - Structurally Deficient / Functionally Obsolete Status
  - Apportionment
  - Michigan Local Bridge Program Points

## Legal Requirements

- 23 CFR Part 650 NBIS regulations
- 650.313 (c) “Rate each bridge as to its safe loading capacity in accordance with the AASHTO manual. Post or restrict the bridge in accordance with the AASHTO Manual or in accordance with state law, when the maximum unrestricted legal loads or State routine permit loads exceed that allowed under the operating rating or equivalent rating factor.”

## When To Load Rate Bridges

- Replaced or Newly Constructed Bridges
- Reconstruction That Affects Load Rating (Deck Replacement, Superstructure Replacement, etc.)
- New Overlays
- Inspector Reports of Deterioration
- Specific Overload Permit Requests

## Updating Inventory

- 650.315 (c) and (d):

For new bridges, modifications to existing bridges that affect inventory (and load rating) data, or changes in load restriction or closure status, have:

- 90 days for State or Federal bridges
- 180 days for all other bridges

## Objectives of Load Rating

- Correct load capacities entered in bridge database
- Documentation of load rating calculations in bridge file with the owner
- Ability to handle overload permit requests
- Ensure that bridge is not overstressed by heavy trucks

## Responsibilities of Load Rater

- Ensure that ALL of the 28 legal vehicles from the Bridge Analysis Guide have a Rating Factor > 1 and thus can safely use the bridge
- If ANY of the legal vehicles have RF < 1, must compute appropriate load posting ratings for load limit signs

## Capacity-Related Inventory Items

- Operating Rating Method (Item 63)
- Federal Operating Rating (Item 64F)
- *Michigan Operating Rating (Item 64M)*
- Inventory Rating Method (Item 65)
- Inventory Rating (Item 66)
- Open, Posted, Closed Status (Item 41)
- Bridge Posting (Item 70)
- *Overload Classification (Item 193)*

## The Basic Equation

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

- RF = Rating Factor
- C = Member Capacity
- D = DL, L=LL, I=Impact
- A1=1.3 for Inventory and Operating Rating
- A2 = 2.17 for Inventory and 1.3 for Operating

## Inventory Rating

- Defined as the live load which can safely use the structure or an extended period of time.
- Must use the HS20 vehicle
- Must use load factor method when possible (see FHWA SI&A Coding Guide)
- Report in metric tons

## Inventory Rating Example

- Assume member capacity = 1500 ft-k
- Assume Dead Load = 400 ft-k
- Assume HS20 LL = 250 ft-k
- Assume Impact = 30 %

## Inventory Rating Example

$$RF = \frac{1500 - 1.3(400)}{2.17(250)(1.30)} = 1.39$$

- HS20 truck weighs 36T
- 1.39(36) = 50.0 T
- 50.0 T = ***45.4 metric tons***

## Federal Operating Rating

- Describes the maximum permissible live load to which the structure may be subjected
- Must use the HS20 vehicle
- Must use load factor method when possible (see FHWA SI&A Coding Guide)
- Report in metric tons

## Federal Operating Rating Example

- Assume member capacity = 1500 ft-k
- Assume Dead Load = 400 ft-k
- Assume HS20 LL = 250 ft-k
- Assume Impact = 30 %

## Federal Operating Rating Example

$$RF = \frac{1500 - 1.3(400)}{1.3(250)(1.30)} = 2.32$$

- HS20 truck weighs 36T
- 2.32(36) = 83.5 T
- 83.5 T = ***75.7 metric tons***

## Michigan Operating Rating

- Purpose: to provide a comparative measure of the structure's capability to carry Michigan legal loads
- Not required by FHWA
- May use any recognized methodology (Working Stress, Load Factor, LRFR, Load Testing)
- Vehicle selection for reporting depends on capacity
- Does NOT eliminate requirement to verify that all 28 Michigan legal vehicles can be carried

## Michigan Operating Rating Vehicle Selection

| Vehicle from Bridge Analysis Guide | Lower Limit of Applicability |
|---|---|
| 18DL (2 Unit 77T) | 40 T |
| 27 (AASHTO 3S-2) | 25 T |
| 26 (AASHTO Type 3) | 12 T |
| H 20 | No lower limit |

## Posting Load Rating

- Purpose: prevent trucks that exceed computed weight limits from crossing bridges
- May use any methodology (WS, LF, LRFR)
- May use inventory or operating factors
- Expressed in US tons for 1 unit, 2 unit, and 3 unit vehicles

## Posted Load Rating

- There are 28 truck configurations in Bridge Analysis Guide
- 5 One-unit trucks
- 13 Two-unit trucks
- 10 Three-unit trucks
- If Rating Factor (RF) > 1.00 for all 28 trucks, posting is not required

## Posted Load Rating

- If any RF < 1.00, then must find lightest allowable load for the each family (1 unit, 2 unit, 3 unit) of vehicles
- For simple spans where moment controls, can use tables in Bridge Analysis Guide to select vehicles with highest M / W ratio
- For continuous spans need to rate all 28 trucks and choose lightest allowable load for each family of vehicles

## Overload Permits

- Full impact of the new NBIS regulations still undetermined
- MDOT uses 20 standard axle configurations and has assigned axle weights for each configuration for class A, B, and C overloads
- Can use any methodology and can use one-lane distribution factors

## Overload Permits

- Practice is to compute RF for all 20 class A overload trucks. If all RF > 1.00, then bridge is class A. If not, then class B loads are checked and if those do not pass, class C loads are checked.
- Bridges not meeting class C are put into class D
- Room for some engineering judgment if only a few trucks are barely short of RF = 1.00

## Relevant Documents

- NBIS Regulations
- AASHTO Manual for Condition Evaluation of Bridges
- AASHTO Standard Specifications for Highway Bridges
- FHWA SI&A Coding Guide
- Michigan Bridge Analysis Guide
- Michigan SI&A Coding Guide

## Computation Techniques

- NO requirements mandating use of software, spreadsheets, hand calculations, etc.
- MDOT subscribes to AASHTOWare product Virtis
- MDOT license does NOT include distribution to local agencies and/or consultants

## Available Software

- MDOT licensing does enable local agencies to license Virtis at a reduced rate
- AASHTOWare Contact:
  Jose Aldayuz
  (202) 624-3610
  jaldayuz@aashto.org

## Other Software

- See Bridge Analysis Guide
- Spreadsheets and hand calculations are permissible

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Questions