Load Rating – Additional Guidance

This document is intended to address frequently asked questions as they are encountered. This guidance will be reviewed and incorporated into interim guidance or manual updates as deemed appropriate.

Table of Contents

Emergency Vehicles – LRFR Rating Template

Background:

Per FHWA's Memorandum "Load Rating for the FAST Act's Emergency Vehicles" dated November 3, 2016, two FAST Act vehicles (EV2 and EV3) have been added to MDT's load rating template. They comply with the MBE, with the following exceptions (per FHWA's 2016 Memo and March 2017/ 2018 Q&A):

1. Multiple presence - To account for the low probability of side by side presence of two heavy EVs on a bridge, the load rating analysis may consider only one EV in one lane loaded simultaneously with other unrestricted legal vehicles in other lanes. *This exception allows consideration of only one EV on a bridge when combining with other legal loads, which are typically not as heavy as the EV.*
2. Live load factor: A live load factor of 1.3 may be utilized in the Load and Resistance Factor Rating (LRFR) or Load Factor Rating (LFR) method. *Note – this does not apply to buried structures – see MBE Article 6A.5.12.10.3*

Guidance:

To comply with FHWA and MBE, two sets of EV2 and EV3 trucks need to be added to AASHTO BrR's vehicle analysis template:

EV2

- Single-lane EV2
- EV2 with an adjacent unrestricted legal vehicle (Type 3-3)

EV3

- Single-lane EV3
- EV3 with an adjacent unrestricted legal vehicle (Type 3-3)

The EV vehicles are legal vehicles, but due to BrR program limitations adjacent vehicles cannot be added under the legal load category. For that reason, the adjacent lane version of both the EV2 and EV3 are added under the permit load category and settings are overridden in the Vehicle Analysis Template's advanced settings:

- The single lane version of each truck (added to the legal load category) is set to 'single lane'
- The adjacent lane version of each truck has a live load override of 1.3, independent of ADTT

Per FHWA's Q&A document for the FAST Act Vehicles (published in March 2017, updated in March 2018), AASHTO LRFD Section 3.6.1.2.5 may be used in lieu of better information to calculate the tire contact width. BrR input for Wheel Contact Width should be as follows. Calculations are based on P/0.8, where the number of tires per axle are taken as 2 for the front axle and 2* for the rear and/or tandem axles.

**For simplicity, the gap between tandem tires is ignored and assumed 2 wider tires per axle versus 4 narrower tires with a gap.*

<u>Tire Contact Area/Wheel Contact Width:</u>

EV2

- Front Axle: $\frac{24}{(2)(0.8)} = 15\ in$
- Rear Axle: $\frac{33.5}{(2)(0.8)} = 20.94\ in \rightarrow use\ 21\ in$

EV3

- Front Axle: $\frac{24}{(2)(0.8)} = 15\ in$
- Rear/Tandem Axle: $\frac{31}{(2)(0.8)} = 19.38\ in \rightarrow use\ 19\ i$

LRFR Analysis - Multi-Lane EVs as Permit Vehicles

Background:

EVs are technically legal vehicles, but due to BrR limitations (adjacent vehicles cannot be added under the legal load category) they are included under the permit load category for multi-lane scenarios. This introduces a couple of complications in respect to which limit states are checked. The live load factors themselves are not of great concern, because the Vehicle Analysis Template overrides the values that would have been pulled from different tables (i.e. Strength I vs. Strength II). The greater concern is limit state checks that are performed based on type of load category (i.e. permit vs. legal), and the potential to miss checking limit state checks that should be done or visa versa. MDT wants to avoid a default practice of revising load factor tables to force legal load checks on permit vehicles, because that will introduce issues when trying to run a true permit vehicle.

Guidance:

Until BrR introduces functionality to address multi-lane EVs, MDT guidance is to use the default load factor table while watching for the following situations which may warrant modification. Any modifications that need to be made should be documented in load rating report and the BrR model (*General Bridge Description)*

- Prestressed Concrete
  - Watch for controlling limit state Service I on multi-lane EVs (not a required check for legal loads)
  - Watch for segmental concrete bridges - will need to check Service III for permit loads to cover multi-lane EVs (the Service III check is a requirement for legal loads)
- Reinforced Concrete
  - Watch for controlling limit state Service I on multi-lane EVs (not a required check for legal loads)
- Steel
  - n/a (No real impact to change in limit state check for permit vs. legal loads)
  - Note that 2019 Interim revision is not yet incorporated for Fatigue Limit State (Design Load Inventory LL factor = 0.75 vs. 0.80)
  -

Table 6A.4.2.2-1—Limit States and Load Factors for Load Rating

Bridge Type	Limit State*	Dead Load γ_{DC}	Dead Load γ_{DW}	Design Load Inventory γ_{LL}	Design Load Operating γ_{LL}	Legal Load γ_{LL}	Permit Load γ_{LL}
Steel	Strength I	1.25	1.50	1.75	1.35	Tables 6A.4.4.2.3a-1 and 6A.4.4.2.3b-1	—
	Strength II	1.25	1.50	—	—	—	Table 6A.4.5.4.2a-1
	Service II	1.00	1.00	1.30	1.00	1.30	1.00
	Fatigue	0.00	0.00	0.80	—	—	—
Reinforced Concrete	Strength I	1.25	1.50	1.75	1.35	Tables 6A.4.4.2.3a-1 and 6A.4.4.2.3b-1	—
	Strength II	1.25	1.50	—	—	—	Table 6A.4.5.4.2a-1
	Service I	1.00	1.00	—	—	—	1.00
Prestressed Concrete	Strength I	1.25	1.50	1.75	1.35	Tables 6A.4.4.2.3a-1 and 6A.4.4.2.3b-1	—
	Strength II	1.25	1.50	—	—	—	Table 6A.4.5.4.2a-1
	Service III	1.00	1.00	Table 6A.4.2.2-2	—	1.00	—
	Service I	1.00	1.00	—	—	—	1.00
Wood	Strength I	1.25	1.50	1.75	1.35	Tables 6A.4.4.2.3a-1 and 6A.4.4.2.3b-1	—
	Strength II	1.25	1.50	—	—	—	Table 6A.4.5.4.2a-1

* Defined in the *AASHTO LRFD Bridge Design Specifications*

Notes:

- Gray shaded cells of the table indicate optional checks.
- Service I is used to check the 0.9 F_y stress limit in reinforcing steel.
- Load factor for DW at the strength limit state may be taken as 1.25 where thickness has been field measured.
- Fatigue limit state is checked using the LRFD fatigue truck (see Article 6A.6.4.1).

EV Live Load Factors

Background:

MDT practice has been using a live load factor of 1.3 for EVs, independent of ADTT (per FHWA Q&A guidance). In March 2019, NCHRP published a research report that recommends alternate live load factors to be modified in AASHTO MBE (NCHRP 20-07 Task 410) .

To incorporate these alternate live load factors, individual values would need to be manually entered based on the traffic conditions (ADTT) and estimated number of EV crossings per day for each bridge. This interferes with efficiency of batch analysis, as each Vehicle Analysis Template would need to be overridden.

Guidance:

Until BrR introduces functionality to reference live load factors, MDT will continue to use a default live load factor of 1.3 for both EVs **unless** posting is triggered. If posting is triggered, determine the appropriate live load factor value as recommended by NCHRP, and adjust the live load factor override in the Vehicle Analysis Template's advanced settings. Provide full documentation in the load rating report (including reference to the table/reasoning behind the selection) and ensure that the vehicle analysis template screenshot reflects the change in live load factor override.

Clarification on Emergency Vehicle definitions in Vehicle Analysis Templates

Background:

AASHTO BrR standard library vehicle definitions use one of the following code references for tire contact width:

AAHSTO Standard Specifications for Highway Bridges (i.e. HS20, Type 3, Type 3S2, Type 3-3)

3.30 TIRE CONTACT AREA 1998 - STD Spec

The tire contact area shall be assumed as a rectangle with an area in square inches of 0.01P, and a Length in Direction of Traffic/Width of Tire ratio of 1/2.5, in which P = wheel load in pounds.

or

3.30 TIRE CONTACT AREA 1999 - Interim

The tire contact area for the Alternate Military Loading or HS 20-44 shall be assumed as a rectangle with a length in the direction of traffic of 10 inches, and a width of tire of 20 inches. For other design vehicles, the tire contact should be determined by the engineer.

AASHTO LRFD Bridge Design Specifications (i.e. SU4, SU6, SU6, SU7)

3.6.1.2.5—Tire Contact Area

The tire contact area of a wheel consisting of one or two tires shall be assumed to be a single rectangle, whose width is 20.0 in. and whose length is 10.0 in.

The tire pressure shall be assumed to be uniformly distributed over the contact area. The tire pressure shall be assumed to be distributed as follows:

On continuous surfaces, uniformly over the specified contact area, and

On interrupted surfaces, uniformly over the actual contact area within the footprint with the pressure increased in the ratio of the specified to actual contact areas.

For the design of orthotropic decks and wearing surfaces on orthotropic decks, the front wheels shall be assumed to be a single rectangle whose width and length are both 10.0 in. as specified in Article 3.6.1.4.1.

C3.6.1.2.5

The area load applies only to the design truck and tandem. For other design vehicles, the tire contact area should be determined by the engineer.

As a guideline for other truck loads, the tire area in in.[2] may be calculated from the following dimensions:

Tire width = $P/0.8$

Tire length = $6.4\gamma(1 + IM/100)$

where:

γ = load factor
IM = dynamic load allowance percent
P = design wheel load (kip)

The standard library vehicle definitions for EV2 and EV3 use a tire contact width of 10”x20”, which appears to be in accordance with *AASHTO Standard Specifications for Highway Bridges (17th Edition)* for Allowable Stress and Load Factor Rating. Per FHWA’s Q&A document for FAST Act Vehicles, a modified tire contact with can be used for EV2 and EV3 per *AASHTO LRFD Specifications* Section 3.6.1.2.5. To avoid mixing references (i.e. using LRFD for ASR/LFR), MDT guidance is to use tire contact width as specified in the methodology’s specific design code. *Commentary – the nature of this issue is minor, as it is really only prevalent on timber deck structures where the deck is rated (corrugated steel has tire patch specified per MDT Manual)*

Guidance:

- LRFR – use Agency-Defined Emergency Vehicle definitions in analysis template
  - Modified tire contact area (wheel contact width) per LRFD
  - Include screenshots of agency-defined vehicles in load rating report (*see Vehicle Analysis Template Example on MDT’s Load Rating Website*)
- ASR/LFR – use Standard Library Emergency Vehicle definitions in analysis template
  - Standard 10"x20" tire contact width
  - No additional vehicle definition screenshots necessary in analysis template, please note that standard library definitions are used for all vehicles (*see Vehicle Analysis Template Example*)

Service III Limit State – Prestressed Concrete Bridges

Background:

Per MBE 6A.5.4.2.2a, the Service III Limit State check for prestressed concrete is optional for legal loads (except for segmentally constructed bridges). This limit state serves as a serviceability check on existing bridges under current loads, and is optional in the sense that a load posting decision is not required based on its result. This serviceability check can be valuable in helping to inform decisions to limit stresses, deformation and cracking; however, posting to satisfy serviceability criteria is generally not economically justifiable. For these reasons, MDT generally incorporates the Service III Limit State check in load rating analysis unless it triggers posting.

Guidance:

As a rule of thumb, use the default load factor table that incorporates the optional Service III Limit State check for all structures. Modify the table to remove this check if the following criteria are met:

- Posting is triggered for any of the legal loads (RF < 1.0), and Service III is the controlling limit state
- The current bridge inspection shows no signs of shear or flexural cracking

If it's appropriate to disregard the optional Service III Limit State, include the following documentation components. If shear or flexural cracking is present, contact MDT's Load Rating Engineer for additional discussion.

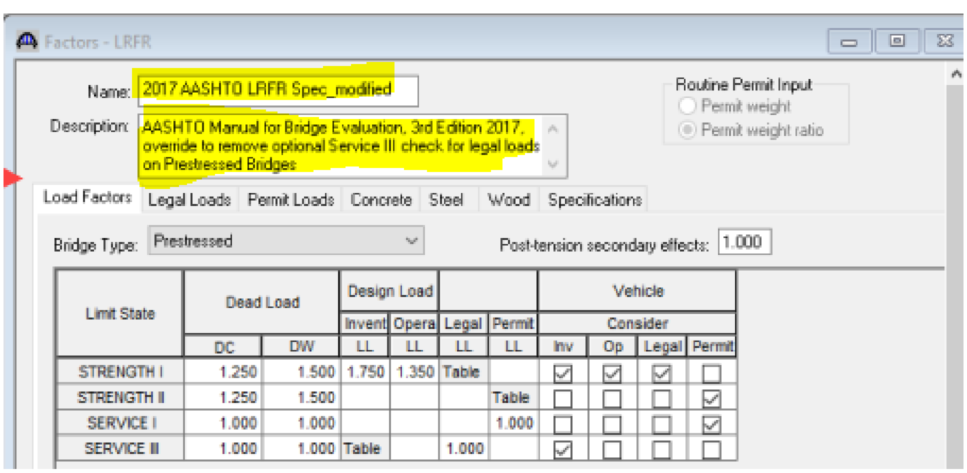
<u>Load Rating Report *(Comments/Assumptions section)*</u>

- Indicate that the Service III Limit State check was not incorporated, and document justification behind application of guidance (bridge specific)

  i.e. The xxxx bridge inspection report does not indicate signs of shear or flexural cracking. Per MDT guidance, in accordance with MBE 6A.5.4.2.2a, the optional Service III Limit State check for legal loads is not evaluated in this load rating analysis.

<u>BrR Model</u>

- Include note in *General Bridge Description*
  Tip – this can be the same note that's included in the load rating report
- Override the load factor table – include note in the name and description to indication modification (see example below)
  *****Note –** the optional check only applies to legal loads – it's still required for HL-93 Inventory Design Load*



Limit State	Dead Load DC	Dead Load DW	Design Load Invent LL	Design Load Opera LL	Legal LL	Permit LL	Vehicle Consider Inv	Vehicle Consider Op	Vehicle Consider Legal	Vehicle Consider Permit
STRENGTH I	1.250	1.500	1.750	1.350	Table		☑	☑	☑	☐
STRENGTH II	1.250	1.500				Table	☐	☐	☐	☑
SERVICE I	1.000	1.000				1.000	☐	☐	☐	☑
SERVICE III	1.000	1.000	Table		1.000		☑	☐	☐	☐

NBI 70 Legal Load Status

Background:

- Per FHWA [Recording and Coding Guide](), dated December 1995
  The National Bridge Inspection Standards require the posting of load limits only if the maximum legal load configurations in the State exceeds the load permitted under the operating rating. If the load capacity at the operating rating is such that posting is required, this item shall be coded 4 or less. If no posting is required at the operating rating, this item shall be coded 5.
- Per FHWA Memo on [Bridge Load Ratings for the National Bridge Inventory](), dated October 30, 2006
  As in the past, the load rating used to report NBI Item 70, Bridge Posting may be computed either by LRFR, LFR, or ASR methods using the maximum unrestricted legal loads to establish load limits for the purpose of load posting. Item 70 evaluates the load capacity of a bridge in comparison to the State legal loads. For load ratings based on LRFR methods using an HL-93 loading, this item represents the minimum LRFR of all legal load configurations in the State (e.g. if the minimum LRFR of all State legal loads = 0.85, then by using the current Coding Guide table, Item 70 would be coded a 3).
- Per 'Help' document on SMS
  Item 70:
  If the operating rating (or the LRFR rating) for the type 3-3 truck is greater than 40 tons, code this item at 5 – Equal to or above legal loads.
  If the operating rating (or the LRFR rating) for the type 3-3 truck is less than 40 tons, use the equation below to calculate this item.
  % below = 100[(40-R)/40]*
  Where R is the operating rating or LRFR rating of the type 3-3 truck in tons.

Guidance:

**Supersedes current 'Help' document on SMS*

- Consider all legal loads when coding NBI Item 70:
  - Type 3
  - Type 3S2
  - Type 3-3
  - SU4
  - SU5
  - SU6
  - SU7
  - EV2**
  - EV3**

  ***Only consider Emergency Vehicles as legal loads if bridge is within 1 mile of the interstate*
- For LRFR, code Item 70 in accordance with current Coding Guide table, based on the minimum LRFR rating of all legal loads (i.e. if minimum LRFR rating factor is 0.85, Item 70 would be coded a 3)
- For ASR/LFR, code Item 70 in accordance with the current Coding Guide table, based on the minimum operating rating of all legal loads (i.e. if minimum operating rating factor is 0.92, Item 70 would be coded a 4)

Code	Relationship of Operating Rating to Maximum Legal Load
5	Equal to or above legal loads
4	0.1 - 9.9% below
3	10.0 - 19.9% below
2	20.0 - 29.9% below
1	30.0 - 39.9% below
0	> 39.9% below

(Item 70 table excerpt from 1995 FWHA Recording and Coding Guide)

Low Rating Exterior Girders

Background:

For some structures, exterior girders control the analysis with very low capacities. Often times, these are situations in which exterior components are channels or fascia girders, and were never designed or intended to carry live load. Additionally, this issue is often seen with the lack of curb presence.

Guidance:

1. The first option MDT wants to explore in these situations is an alternate rating that assumes the exterior girders aren't contributing any capacity. Sometimes the deck, even with an increased overhang, will rate higher than the exterior girders. Model this with two superstructure alternatives – one that includes the girders, and one that doesn't – and document accordingly in the load rating report and BrR *General Bridge Description.*
2. Another option is to restrict the traveled way using the 'striped lanes' provision in the MBE. This is something that MDT would like to avoid, or leave as a last option, because such structures typically don't carry paved roads with painted lanes. Discussion will likely need to be had about putting up physical barriers or other indication to the traveling public to ensure that assumptions are accurate to field conditions.

Dummy Brace Points for Two Girder Systems

The following guidance addresses the use of dummy brace points for the Missouri River Bridge, and is applicable to other similar two girder system bridges.

Missouri River Bridge @ Cascade.

This bridge is a 2 girder system that has floor beams and stringers. The controlling members for rating are the stringers. The controlling condition is Lateral Torsional Buckling (LTB) of the stringers based on the unbraced length on the bottom flange.

The Stringers are a W18x50 section that is continuous over the floor beams between bridge substructure units. The continuous stringers have either 6 spans at 24.0 feet or 8 spans at 22.5 feet. The controlling case will have the longer spans at 24 feet.

The original design called for embedding the top flange into the concrete deck 1/2 inch. That provides continuous support for the top flange so LTB based on positive bending is not an issue and the full strength of the stringer section can be used.

The original design ignored LTB due to negative bending and assumed that the full strength of the stringer section could be used. The only bracing points for the bottom flange are the floor beam locations. The bottom flange has an unsupported length equal to the stringer span length. The worst case is 6 spans at 24.0 feet.

An unbraced length, L_b = 24.0 feet puts the W18x50 stringer in the Elastic LTB range as shown in Figure 1 below. That potential for LTB results in a large reduction in available strength.

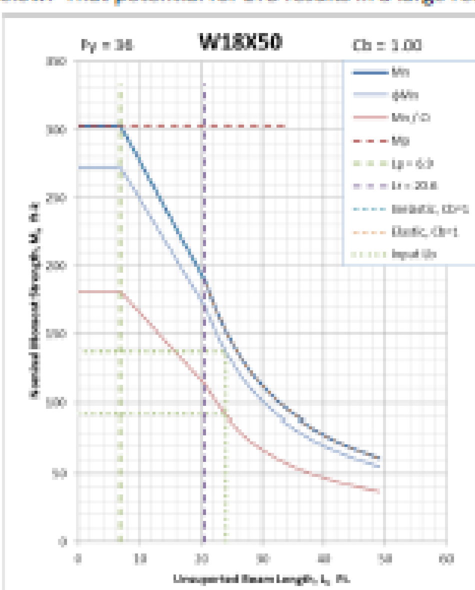


Figure 1 W18x50, C_b = 1.0

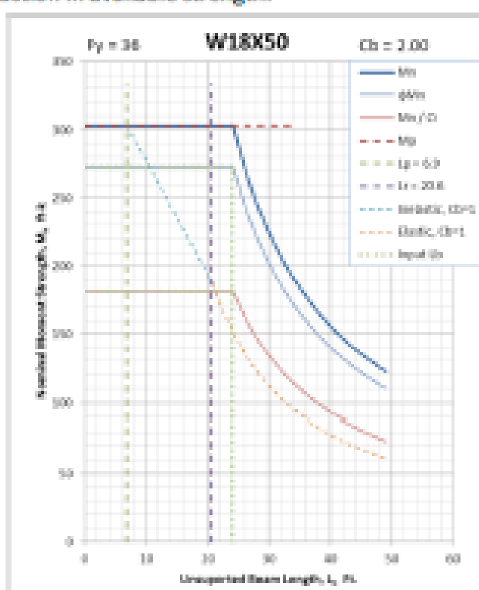


Figure 2 W18x50, C_b = 2.0

1

Figure 1 is based on a "C_b" factor of 1.0. The C_b factor is a modifier to account for non-uniform moments between support points. Figure 2 uses a C_b factor of 2.0. For a W18x50 with a 24 foot unbraced length, a $C_b \geq 2.0$ allows for utilization of the full section strength.

The original designers didn't consider LTB of the bottom flange. Figure 2 demonstrates that when $C_b \geq 2.0$ the full section strength is available to the designer.

Figures 1 & 2 assume the steel yield strength is 36 ksi. I didn't look up the actual steel used. A higher yield strength will result is a higher C_b for utilization of full section strength and a lower yield strength will result is a lower C_b for utilization of full section strength.

The load rating software checks LTB of the bottom flange and using C_b factors. There are two primary issues with the checks the software performs.

1. The assumptions inherent to the C_b equation used.
2. The use of "envelope" moments in the C_b equation.

The C_b Equation. AASHTO LRFD currently says, "In lieu of an alternate rational analysis, C_b may be calculated as follows:"

$$C_b = 1.75 - 1.05\left(\frac{f_1}{f_2}\right) + 0.3\left(\frac{f_1}{f_2}\right)^2 \leq 2.3 \qquad Eq\ (6.10.8.2.3-6)\ page\ 6-145$$

Where;

f_1 = smaller compression stress an end of unbraced length for the flange considered calculated from the critical moment envelope value.

f_2 = larger compression stress an end of unbraced length for the flange considered calculated from the critical moment envelope value.

The equation assumes a straight line distribution of stress between the brace points and uses the envelope value. The stress distribution can be significantly different then this assumed straight line. The straight line assumption and moment envelope values work well for short braced lengths within a longer span. This case has bracing only at the ends of the span and the spans are short.

Additionally, the equation assumes no other resistance to LTB between the brace points. In this case, the embedded top flange provides some bracing to the bottom flange. LTB requires both translation and rotation of the section. The embedded top flange partially restrains translation and, to a lesser extent, rotation of the bottom flange. Accounting for this partial restraint will usually result in a higher C_b factor

Use of Envelope Moments. The use of envelope moments is a simple approach that works well for most cases. For the short, continuous spans of these stringers, it ignores significant changes in moment within the span (unbraced length) that would be apparent in individual live load cases. Using envelope moments and the AASHTO equation, the computed C_b for the end spans will be $C_b = 1.75$ since the

2

envelope negative moment goes from zero at one end to a maximum at the first support. For the interior spans, $C_b \approx 1.0$ since the envelope will give nearly equal maximum negative moments at each end. The controlling case will be an interior span near the center where C_b =1.0.

Elements of an "Improved" C_b Factor. An improved C_b factor for this case should include these 3 elements.

1. Moment gradients including changes in gradient slope between the brace points.
2. Partial restraint provided by the embedded top flange.
3. Consideration of the effects of individual load cases.

The first 2 consideration can be accounted for directly in the C_b equation. AISC gives an equation for the case of reverse curvature with one flange continuously braced. (AISC Steel Construction Manual, 14th Edition, p 16.1-305, Eq (C-F1-5)) That equation is given below.

$$C_b = 3.0 - \frac{2}{3}\left(\frac{M_1}{M_0}\right) - \frac{8}{3}\left[\frac{M_{CL}}{(M_0 + M_1)^*}\right] \quad Eq\ (C - F1 - 5)$$

$$* (M_0 + M_1) = M_0 \quad if \quad M_1\ is\ positive$$

M_0 = End moment that produced the largest compression stress in the bottom flange.
M_1 = Moment at other end of the unbraced length.
M_{cl} = Moment at the middle of the unbraced length.
(Moments producing bottom flange compression are negative.)

The last condition can be met by a simple analysis of a several span continuous beam with a few loading cases applied to simulate the effects of actual truck point loads.

We did a simple analysis to look at the actual loading effects.

We found that the largest negative moment occurred over the first interior support when there were axel loads in both span 1 and 2. For this loading, the second span was the worst case since it had negative moments over both supports. The AISC equation gave $C_b \approx 4.3$ for this load case. Since 4.3 > 2.0, the full section strength can be utilized.

Other cases were also considered. All of these had lower negative moments but different moment distributions. To handle the cases we looked only at cases where;

$$Actual\ Negative\ Moment > \frac{Maximum\ Negative\ Moment}{Required\ C_b\ for\ using\ full\ section\ Strength}$$

This screening identified load cases where a C_b > 1.0 was needed. For each of these load cases, we computed a *Load Case Required C_b* and the *Load Case Actual C_b*. The ratio of these numbers was used to compare individual load cases.

$$Ratio = \frac{Load\ Case\ Actual\ C_b}{Load\ Case\ Required\ C_b}$$

The load case with the lowest ration is the controlling case. We found that load case to be a span 2 when there is a single axel load in span 1. The moment at the brace point is lower but the lack of an axel load in span 2 give a different moment gradient and a lower C_b factor. For this case we found *Load Case Required* $C_b \approx 1.3$ and the *Load Case Actual* $C_b \approx 2.2$ for a *Ratio* = 1.7.

Conclusion. Based on this work, we concluded that this is a rational method of addressing the C_b factor and LTB strength for this case and that the stringer is not at risk of LTB due to negative bending. Any ratings for the bridge may use "dummy" brace points so that the rating software will use the full section strength in the rating calculations.

The analysis was based on a 36 ksi yield steel. Since the controlling *Ratio* = 1.7, this analysis is valid for a broad range of steel yields.

For the specific case of the Transporter/Erector vehicle, since their analysis only showed a need to add lateral torsional bracing to the stringers, that bracing is not needed.

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July 12, 2013

Other Load Rating Program Guidance

SMS Upload

- *(MDT022) Name of Load Rater* – enter the full name of the load rater of record (not initials)
- *(MDT 016) Date of Load Rating* – this should match the date the load rating report was finalized (internal) or stamped (consultant) by the load rater of record
- *NBI 31 Design Load* – Verify/enter the live load for which the structure was designed (can be found on plans). If plans are not available, enter 0-Unknown.
- *NBI 63 and 65 Method Used to Determine Inventory and Operating Ratings* – These should be 1, 2, or 3, depending on rating methodology (i.e. ASR, LFR, LRFR).
- *Inventory, Operating and LRFR Ratings* – enter safe load capacity values in these attribute fields
- *(MDT124-132) Safe Posting Load* – enter recommended posting load values from the summary sheet, if applicable. If a vehicle doesn't trigger posting, its safe posting load attribute can be left blank. Only enter safe posting loads for EVs if the bridge is within 1 mile of the interstate.
    - *Commentary – a supplemental posting approval document is in development and is intended to be filled out by the Bridge Management Engineer for any bridges that require posting. This falls in line with the posting authority stated in new guidance coming out, and will allow some flexibility to document reasoning and deviate from the default posting values and post at safe load capacity levels (LRFR) or above inventory levels (ASR/LFR). At that point, the Bridge Management Section will likely take over the population of posting load attributes and this section will be updated.*
- *MDT(133) Bridge Within Reasonable Access of Interstate* – Please update this attribute when updating load rating information if it's easily apparent.
    - Version 1.2 and newer includes a cell that specifically designates "Yes" or "No".
    - For previous versions – the bridge is within reasonable access if either EV rating factor is < 1.0 (LRFR RF or ASR/LFR Operating RF) and the "EV Posting Required" cell is "Yes". If the EV rating factors are < 1.0 and the Posting Required cell is "No," the bridge is not within reasonable access.

- Upon approval of MDT's load rating engineer, upload stamped/signed load rating report as a pdf document under Inventory → Documents
    - File Type → Load Rating Document
    - Name → <*MDT ID*> Load Rating (*i.e. 01234 Load Rating)*
    - Date → This should match the date that the load rating report was finalized stamped, and *MDT016*
    - Comments → <*Rating Method*> Analysis - <*Consultant*> *(i.e. LRFR Analysis – ABC Engineering)*

Load Rating Reports

- See *Report Requirements* and *Summary Sheet Guidance* on MDT's Load Rating Website for additional requirements on documentation, and preferred location within the report

BrR Model

- Concrete slabs – MDT preference is to model these as a slab system superstructure where possible (rather than girder line superstructure)
    - There is currently no guidance/preference on number of slab strips to use, as long as assumptions comply with MBE/LRFD and logic is sound and well-documented in the load rating report.
- If there's anything unique about the model or the process of rating the structure (i.e. additional superstructure definition for alternate rating, process to check for failed girder condition), please detail in the *General Bridge Description* within the BrR .xml model (in addition to the load rating report - see note above)
- Naming conventions – (additional to/supersedes section 8.2.7 in *MDT Bridge Inspection and Rating Manual*
    - In Description, note the following:
        - Simple Bridge Description
        - Input by *"Consultant Name"*
        - Contract/project load rating is associated with
        - Anything unique about the model or process of rating the structure (i.e. additional superstructure definition for alternate rating, process to check for failed girder condition, BrR bug workaround)
    - See below for Bridge ID and NBI Structure ID Input

8.2.7.1 Naming Convention

8.2.7.1.1 Bridge Definition
Bridge ID: MDT Bridge ID
NBI Structure ID: NBI Structure ID (item 8)
See figure 8.2.7.1-1.

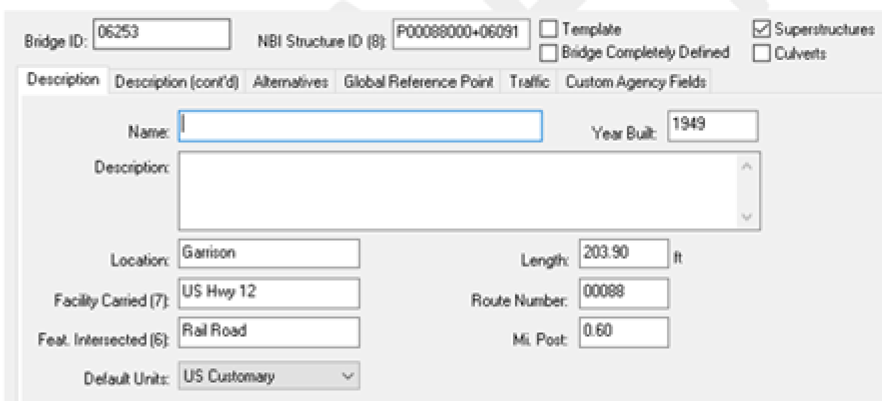

Figure 8.2.7.1-1

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    - Bridge Definition - input all fields in both 'Description' Tabs
        - Information for existing bridges can be found on the load rating summary sheet or in SMS (MDT's Structure Management System)
        - Contact MDT's Load Rating Engineer for new bridges that don't have an SMS asset record
    - Timber-specific material and superstructure naming convention – see *Interim Timber Guidance*
- Program Tolerances (*Configuration Browser > System Defaults > Tolerance)*

Units	Tolerance
ft	0.01
in	0.10
mi	0.01

- MDT preference is to purge all unused material properties/factors/member or superstructure definitions. If there's a definition that's included as an alternate check or workaround, make sure to include explanation of unused definition in the *General Bridge Description.*
- Name Superstructure Alternative *Rated XXXXXX* – MDT will change this to the stamped date on the rating once it's finalized.
- Current manual guidance indicates to link similar girders to the worst-case scenario/highest distribution factors (section 8.2.7.2.2a) – that guidance is outdated and will be revised in future manual updates. MDT preference is to define each girder with that has a substantially different spacing (i.e. helper/sister girders) with the correct distribution factor. For variable spacings that are within a reasonably small tolerance, it's acceptable to use judgement and assume that spacing is consistent between girders (make sure to document accordingly).
- Define exterior members with correct distribution factors even if they don't see any live load due to bridge geometry. MDT preference is to input 0.0001 and include a comment in the load rating report (*i.e. Due to bridge geometry, exterior girders do not see any live load. The LLDF was input as 0.001 to allow exterior girders to run)*

Mixed Materials

- See *Additional Report Guidance (pdf document)* and *Examples (zipped file)* on MDT's Load Rating Website

Timber

- Madero does not evaluate shear on timber decks. A separate calculation for deck shear is not required.
- All controlling timber deck ratings should be reported on the summary sheet.
- For reduction of member bending capacity, timber guidance notes to *"use engineering judgement to determine how to most appropriately account for defects and deterioration, and clearly document logic in assumptions and comments section of the load rating report"* (i.e. *Span xx Girder xx bending capacity was reduced by xx% due to xx reasons*). This will typically be included on an additional page within the report – if so, include a note on the summary sheet to help flag that capacity has been reduced. This note can be more general – *i.e. Span xx Girder xx capacity is reduced, see xxx for further details).*
- Clarification on splits
  - Generally, splits don't affect the bending capacity unless they're determined to be 'severe' (i.e. full-length). Sometimes there's a discrepancy between terminology used in inspections, and actual condition. If photos are available, reference them to help inform your assumption. If there's not enough detail in the inspection, please contact MDT's Load Rating Engineer. See example below:
    - Bridge inspection calls out "full-length split" but photo indicates an intermediate, partial depth checking along the full length of the neutral axis. This would not warrant a reduction in F_b.