NORTH Dakota | Transportation
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NDDOT Load Rating Manual

Version 2.4

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1.1 Introduction

Load rating is the determination of the live-load carrying capacity of a bridge. The primary purpose of a complete and accurate load rating is for the safety of the travelling public and to support the NDDOT's mission to safely move people and goods. Secondary uses of the load rating data are:

- To determine posting needs
- To process overload permit requests
- To provide input to rehabilitation and replacement decisions
- To Comply with Federal Regulations

Load ratings are required as part of the National Bridge Inspection Standards (NBIS) as part of Title 23, CFR §650.313 part (c). Load ratings and FHWA submittals are also governed by Metric # 13, as part of the Metrics for the Oversite the National Bridge Inspection Program.

1.1.1 Reference Material

FHWA and AASHTO have published several publications to implement the NBIS. Use the following additional publications in conjunction with this manual:

For the Code of Federal Regulations:

- *Code of Federal Regulations 23 CFR 650 Subpart C.*

For Load Rating Procedures

- *(MBE) The American Association of State Highway and Transportation Officials Manual for Bridge Evaluation Current Version*

For FHWA Technical Guidance:

- *The FHWA Load Rating Website - https://www.fhwa.dot.gov/bridge/loadrating/.*
- *FHWA 2006 Policy Memo - https://www.fhwa.dot.gov/bridge/nbis/103006.cfm*

For NBI Coding guidance:

- *FHWA Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges.*

For NBIS Oversight Program:

- *FHWA Metrics for the Oversight of the National Bridge Inspection Program*

The North Dakota Department of Transportation has additional requirements governing the load rating of bridges within the State. For additional information use the following guidance documents in conjunction with this manual.

North Dakota Truck Regulations:

- North Dakota Vehicle Size and Weight Guide
  https://www.nd.gov/ndhp/sites/www/files/documents/MC/Legal.size_.weight.Guide_.pdf
- North Dakota Weight Limitations Chart
  https://www.nd.gov/ndhp/sites/www/files/documents/Permits/Weight_Limitations_Chart_.pdf
- Multiple Vehicle Combinations Regulations
  https://www.nd.gov/ndhp/sites/www/files/documents/Permits/9-1-a%20handout.pdf

1.1.2 Definitions

ASR
Allowable Stress Rating

LFR
Load Factor Rating

LRFR
Load and Resistance Factor Rating

Inventory Rating (LFR/ASR)
Load ratings based on the inventory level allow comparisons with the capacity for new structures and therefore, results in a live load, which can safely utilize an existing structure for an indefinite period of time.

Operating Rating (LFR/ASR)
Load ratings based on the operating rating level generally describe the maximum permissible live load to which the structure may be subjected. Allowing unlimited numbers of vehicles to use the bridge at operating level may shorten the life of the bridge.

Design Inventory Level Rating (LRFR)
Generally corresponds to the rating at the design level of reliability for new bridges in the AASHTO LRFD Bridge Design Specifications.

Design Operating Level Rating (LRFR)
Maximum load level to which a structure may be subjected. Generally corresponds to the rating at the operating level of reliability in past load rating practice.

Legal Level Load Rating (LRFR)
This rating level provides a single safe load capacity (for a given truck configuration) applicable to AASHTO and state legal loads.

Permit Level Load Rating (LRFR)
Permit load rating checks the safety and serviceability of bridges in the review of permit applications for the passage of vehicles above the legally established weight limitations.

1.2 Qualifications and Responsibilities

The Bridge Management Section is responsible for the North Dakota Bridge Inspection program in compliance with 23 CFR §650 Subpart C.

1.2.1 Program Manager

The Program Manager oversees compliance of the National Bridge Inspection Standards (NBIS).

1.2.1.1 Program Manager Qualifications

- Serve as the Bridge Inspection Program Manager for the implementation of the NBIS, Program Manager as defined by NBIS 23 CFR §650 Subpart C
- Be a registered professional engineer (PE); or have a minimum of ten years of bridge inspection experience
- Successfully complete NHI Course No. 130055 or 130056 Safety Inspection of In-Service Bridges
- Complete a cumulative total of 18 hours of FHWA approved bridge inspection refresher training over each 60-month period

1.2.1.2 Program Manager Responsibilities (As Related to Load Rating)

- Ensure compliance with federal load rating directives (CFR & MBE)
- Ensure compliance with North Dakota load rating policies and procedures contained in this manual
- Coordinate and conduct load rating training
- Perform quality assurance audits on load rating reports

1.2.2 Load Rating Engineer

1.2.2.1 Load Rating Engineer Qualifications

- Registered PE
- Completed the FHWA approved National Highway Institute (NHI) load rating course number 130092. (Preferred but not required.)

1.2.2.2 Load Rating Engineer Responsibilities

- Overall responsibility for load rating of bridges
- Develop and maintain load rating manuals and standards
- Load rate structures in accordance with the MBE and this manual
- Review load ratings prepared by consultants
- Prepare and/or verify load rating reports for in house load ratings
- Review load rating reports prepared by consultants

1.2.3 Load Rating Committee

Structures in the North Dakota Bridge Inventory have been built across the State during a period of over 100 years, with a variety of owners/designers and a series of evolving specifications. Therefore, there are a wide variety of design methods, construction methods, material options, in-service deterioration, damage, and repair methods in the inventory. This variety creates unique sets of conditions that may manifest themselves in ways that are not explicitly addressed in this manual or the MBE. At the discretion of the Load Rating Engineer, the Load Rating Committee will meet to discuss unique or unusual conditions and make decisions on any assumptions made or clarifications needed to complete a load rating. Resolutions to issues encountered will be included in the load rating report, and if necessary, revisions or additions to this manual will be created using Errata.

1.2.3.1 Members

- Load Rating Engineer
    - The Load Rating Engineer is responsible for setting the agenda, scheduling, and leading the meeting.
- Bridge Management Engineer
- Bridge Design Engineer
- Asst. Bridge Engineer
- Bridge Engineer (Optional)

1.2.4 Consultant Load Rating

1.2.4.1 Consultant Load Rating Engineer Qualifications

- Registered PE
- Completed the FHWA approved National Highway Institute (NHI) load rating course number 130092. (Preferred but not required.)

1.2.4.2 Consultant Load Rating Engineer Responsibilities

Load rating shall be completed using an electronic model created with the AASHTOWare Bridge Rating Software (BrR) as indicated in Section 1.4 of this manual. For bridge types that are incompatible with BrR, an alternate software may be used with approval by the Load Rating Engineer.

Load ratings shall be reported to the Department using the Load Rating Report Summary Template and a Load Rating Detailed Report as described in Section 1.7.2 and Section 1.7.3.

Following completion of the load rating, the electronic model will be submitted to and become the property of the Department. The Department reserves the right to use the model for future load rating.

All load ratings must be independently reviewed prior to submission to the Department. Provide routine and consistent checks for data integrity, correctness, and completeness. Identify and address errors and omissions.

1.3 Load Rating Policy

The NDDOT load rating policies are governed by the MBE. The NDDOT Load Rating Manual is intended to supplement and provide additional guidance and clarification as needed.

All structures greater than 20' and open to public vehicle travel must be load rated. See the NDDOT Bridge Inspection Manual, Section 1.3, for guidance on bridge length multiple pipe configurations for load rating purposes.

1.3.1 Load Rating Methods

FHWA has defined which load rating methodologies are allowable for structures based on structure type and year of design as follows:

For structures designed using the Load & Resistance Factor Design (LRFD) methodology, rate the structures using the Load & Resistance Factor Rating (LRFR) method.

For structures designed with Allowable Stress Design (ASD), Load Factor Design (LFD), or an unknown method, rate the structures using the Load Factor Rating (LFR) method. It is also acceptable to rate using LRFR, but this shall be approved in advance by the NDDOT Bridge Division.

If an existing bridge was designed using Allowable Stress Design (ASD) methodology, it shall be rated using LFR. It is also acceptable to rate using LRFR, but this shall be approved in advance by the NDDOT Bridge Division. There is an exception for bridges with timber or concrete masonry superstructures. For these types only, it is acceptable to utilize Allowable Stress Rating (ASR).

For additional guidance see the FHWA 2006 Load Rating Memo.

1.3.2 Load Rating Intervals

Load rating shall be completed at the following intervals:

1. **Design Phase.** All new structures shall be load rated during the design phase. Load ratings in the design phase shall be submitted to the Load Rating Engineer prior to the submittal of the final plan set. For precast items, the load rating must be updated prior to fabrication of the prefabricated elements.

   For load ratings calculated during the design phase, the Design Level Inventory Rating must be greater than or equal to 1.0. If the Design level Inventory Rating is less than 1.0, the design must be revised to increase the capacity until the Design Level Inventory Rating is greater than or equal to 1.0.

2. **In Service Phase**. Load ratings shall be reviewed by the Load Rating Engineer after construction of the bridge to incorporate any changes in the design details as noted on as-built plans, change orders, construction inspection, and initial inspection reports.

3. **Maintenance Phase**. The load rating shall also be reviewed when the NBI ratings decline to the values listed in the Table 1.3.1 below.

Load Rating Review Table	
Component	**NBI rating**
Deck	4
Super	4
Sub	4
Culvert	4

Table 1.3-1 NBI Load Rating Review Triggers

After review, the Load Rating Engineer will determine if the bridge needs to be re-rated.

In addition, load ratings shall be updated by the Load Rating Engineer when a meaningful change in condition or service of the structure occurs. A meaningful change is defined as:

- Bridge rehabilitation that affects structural components
- A significant change in the live load on the bridge due to a change in the use of the bridge
- Increase in dead load on the bridge
- A change in state or federal laws regulating truck weights
- Structural damage resulting from a bridge hit, ice damage, flood damage, fire damage, or other cause
- Deterioration that affects structural capacity of the superstructure including but not limited to:
  - Rotated or displaced beams
  - Steel section loss or cracking
  - Severed rebar or prestressed strands in concrete beams
  - Splitting, cracking, or rot of timber members

1.4 Software

All load ratings shall be calculated using AASHTOWare Bridge Rating (BrR) Software Version 6.8.2, 6.8.3, or 6.8.4. An electronic model of the structure must be developed for future use.

For bridge types that are incompatible with BrR, an alternate software may be used with approval by the Load Rating Engineer.

For complex bridges or bridges that require posting, a refined analysis may be required. Approval to proceed with a refined analysis must be obtained in advance by the NDDOT Bridge Division.

1.5 Load Rating Procedures

The identification information for each structure entered into BrR must match the identification information in the NDDOT Bridge Management System (BMS).

In general, primary load-carrying members are required to be load rated. Secondary elements may be load rated if there is significant deterioration or if there is a question regarding the original design capacity. The load rating engineer is responsible for the decision on load rating secondary elements.

Rate both interior and exterior girders. For bridges with a curved edge of deck and chorded girders, set one overhang to the maximum overhang within the span.

Other features that must be load rated include:

- Fracture critical members or components with fatigue prone details
- Gusset plates and connection elements for nonredundant steel truss bridges

The NDDOT currently uses ASR, LFR, and LRFR load rating methods. See Section 1.3.1 for guidance for when each method can be used.

1.5.1 Load Factor Rating (LFR)

Check all structures for shear (except for concrete slabs) and bending moment.

Use the live load models as indicated in Section 1.6 Load Rating Vehicles.

1.5.2 Load and Resistance Factor Rating (LRFR)

Check all structures for shear (except for concrete slabs) and bending moment.

Use the live load models as indicated in Section 1.6 Load Rating Vehicles.

1.5.2.1 Limit States

Use the following limit states as defined by the LRFD specifications and the MBE.

Strength I: Load combination used to determine the flexural and shear demands without wind.

Strength II: Load combination used to determine the flexural and shear demands of a structure subject to a permit vehicle or a special design vehicle specified by the owner.

Service I: Load combination used for the design of many elements. It is used for service load stress checks (prestressed concrete), deflection checks, crack control checks in reinforced concrete, etc.

Service III: Load combination used to check nominal tension in prestressed concrete structures.

1.5.2.2 Condition Factor

Use table 1.5-1 to select the condition factor (ϕ_c).

Condition Factor	
General Superstructure or Culvert Condition Rating (Item 59 or 62)	**ϕ_c**
6 or Higher	1.0
5	0.95
4 or lower	0.85

Table 1.5-1 Condition Factor

1.5.2.3 Dynamic Load Allowance

Use full AASHTO dynamic load allowance (33%).

1.5.2.4 Live Load Distribution

Concrete Slabs and Timber Decks

Concrete slabs and timber decks, the LRFD Specifications provide equations for live load distribution factors (LLDF) that result in equivalent strip widths, E, that are assumed to carry one lane of traffic. The equivalent strip width shall be converted to a live load distribution factor for the unit strip by taking the reciprocal of the width. LLDF = 1/E.

Girder Bridges

Some structures may not have been designed with a 1.2 multiple presence factor multiplier for one lane loaded on the exterior beam, which may cause the exterior beam to control. If this should occur on a bridge that would require posting, review the configuration of the bridge to determine if the 1.2 multiplier should be reconsidered for the load rating.

1.5.2.5 Prestressed Losses

Use the approximate method for estimating time-dependent losses in prestressing steel. Do not consider any elastic gains in prestressing steel in determining losses. Use an average annual ambient relative humidity of 70% in calculating prestressing losses due to concrete creep and shrinkage as per AASHTO Figure 5.4.2.3.3-1.

1.5.3 Allowable Stress Rating (ASR)

The allowable stress rating method can only be used for timber structures.

1.5.4 Bridge Specific Load Rating Procedures

The following section contains details unique to specific bridge types.

1.5.4.1 Prestressed Concrete Bridges

For prestressed concrete bridges designed continuous, rate the bridge as continuous. If the continuity steel in the deck over the pier controls the rating and would require the bridge to be posted, then rate the bridge as simple spans. Provide documentation in the load rating report that the deck steel controlled, and a simple span rating was completed.

1.5.4.2 Timber Bridges

For timber members see LFD Table 13.5.1A *Tabulated Design Values for Visually Graded Lumber and Timbers* or LRFD Table 8.4.1.1.4-1 *Reference Design Values for Visually Graded Sawn Lumber*. If the timber material Species and Grade cannot be determined, use the material properties provided in Table 1.5-2. Alternatively, physical testing may be used to refine load rating calculations when applicable.

ASD Design Values for Timber of Unknown Species & Grade (ksi)						
Shape	Bending Stress (F_b)	Tension Stress (Parallel)	Shear Stress (Parallel)	Compression Stress (Perp.)	Compression Stress (Parallel)	Modulus of Elasticity
Beam	1.2	0.675	0.085	0.625	0.925	1600
Plank	1.2	0.675	0.090	0.565	1.450	1700

Table 1.5-2 ASD Design Values for Timber of Unknown Species and Grade

1.5.4.3 Concrete Box Culverts

Multiple-span culverts with a depth of fill that exceeds the distance between faces of end walls do not need to be load rated for live loads as the live load effects are negligible, per LRFD specifications.

Distribution of wheel loads for culverts with less than 2.0 ft of fill shall be taken as specified in LRFD Design Article 4.6.2.10.

Distribution of wheel loads to culverts with 2.0 ft or more of cover shall be as specified in LRFD Design Article 3.6.1.2.6.

If adequate soil information cannot be obtained, use 'Standard Soil 1' that is included in the BrR software.

1.5.4.4 Substructures

Substructure load ratings are not routinely completed. The following guidance should be used in determining when a substructure load rating is necessary:

- If a poor substructure is observed (NBI rating of 4 or lower), and it is determined that the defect is detrimental to the substructure's load carrying capacity. For instance, a high degree of rot or section loss, changes in timber pile end conditions due to deterioration, and changes in timber pile bracing conditions.
- Concrete substructures may not require load rating, even if the condition is rated 4 or lower, if the engineer, using sound engineering judgement, believes that this rating will not control (be lower than the superstructure rating). This determination, along with supporting justification, needs to be documented and included with the load rating report
- Piles should be rated if a significant amount of soil has been lost by scour or other means around the pile that could cause a buckling issue, if there is significant pile deterioration (decay or brooming of timber piles) that could affect load carrying capacity, or if loss of soil around the piles would preclude adequate support of friction piles. It is not expected that the CONDITION of piling be evaluated below the ground line to determine load carrying capacity.

- Pier caps shall be rated if there is deterioration or other structural issues present that would have an effect on the capacity of the cap. Consideration shall also be given to the structural geometry present and its impact on the load rating. For example, load rating of timber bent caps may govern when the pile spacing is excessive or when there is loss of support by individual timber piles due to rot or decay that would increase the effective span of the timber bent cap.

Only the portion(s) of the substructure causing the poor condition rating (NBI 4 or less) and that would result in the controlling load rating, shall be rated.

1.5.5 Bridges Without Plans

Structural dimensions and material properties are needed to perform load ratings. However, some existing bridges may not have all the necessary information to complete a load rating.

Before continuing with an alternate load rating process, the load rater must explore all possible sources of information about the bridge. These include:

- NDDOT Bridge Division files
- County Bridge files
- Pre-cast fabricator records
- NDDOT microfilm archives
- Standard Plans

For structures with no plans or other as-built information, the necessary details may be determined by engineering judgement of comparable structures with known standard plans, or plans of other similarly constructed bridges, such as parallel bridges. When the as-built plans cannot be located, the following process may be used to determine similarly constructed bridges:

1. Search for plans for any structures that were built of a similar design and time period.
2. Search for any common items or reinforcement details.
3. Use the collected information to complete the load rating.
4. Document the process used in the final report.

For structures that have no plans available and no similar bridges could be identified, provide documentation that all sources have been explored. Load rate the structure according to Section 1.5.6.1 or Section 1.5.6.2 based on the material type of the superstructure.

1.5.5.1 Steel and Timber Superstructures

Steel and timber structures can be rated using BrR software using field dimensions and the year of construction. Detailed field measurements are required including span length, girder dimension, girder spacing, diaphragm dimensions and locations, deck width, deck overhang, and deck thickness. Material properties can be selected using the MBE and LRFD Specifications; for steel members see MBE Table 6A.6.2.1-1 *Minimum Mechanical Properties of Structural Steel by Year of Construction*; For Timber bridges see Section 1.5.4.2

For steel super structures with a concrete deck, assume that the girders act non-compositely with the deck.

1.5.5.2 Concrete Superstructures & Concrete Box Culverts

Given that North Dakota has many local agency bridges and bridge length culverts without plans, a risk-based criterion must be applied to complete load ratings. The MBE in Section 6.1.4 states "A concrete bridge with unknown details need not be posted for restricted loading if it has been carrying normal traffic for an appreciable period and shows no distress. The bridge shall be inspected regularly to verify satisfactory performance". Therefore, concrete bridges with unknown details can be assumed to have sufficient live load capacity for the vehicle for which it was designed if the following criteria can be met:

- ADT ≤ 1000
- Physical inspection of the bridge by a qualified inspector and evaluation by a qualified load rating engineer.
- Superstructure (NBI 59) or culvert (NBI 62) rating of 5 or higher as of the most recent inspection.
- No available documentation such as plans or shop drawings.
- Bridge is open without restriction (not posted).

If all the above criteria are met the operating and inventory rating shall be given a judgement load rating (NBI 63/65 = 0) based on the design load.

For structures with a design load with an 'HS' configuration, the Inventory rating (NBI 66) shall be equal to the design load in tons. The Operating rating (NBI 64) shall be equal to the inventory rating multiplied by the ratio of the inventory load factor (2.17) divided by the operating load factor (1.3) according to the LFD design specifications. See Table 1.5-1 for more information.

For structures with a design load with an 'H' configuration (Such as H10, H12, H15, & H20), the Inventory Rating (NBI 66) shall be equal to 21 tons and the Operating Rating (NBI 64) shall be equal to 36 tons.

If this design load is unknown use H15 for bridges built before 1978 and use HS20 for bridges built after 1978. See Table 1.5-1 for more information.

Design Load	Inventory Rating	Operating Rating
HXX	21 tons	36 tons
HS15	27 tons	45 tons
HS20	36 tons	60 tons
HS25	45 tons	75 tons

Table 1.5-3 Engineering Judgment Ratings for Concrete Bridges with Unknown Details

If the superstructure (NBI 59) or culvert (NBI 62) rating, as of the most recent inspection, is less than 5; then multiply the inventory and operating ratings by the rating reduction factor as indicated in Table 1.5-2.

Engineering Judgement Rating Reduction Values	
General Superstructure or Culvert Condition Rating (Item 59 or 62)	**Rating Reduction Factor**
≥ 5	1.0
4	0.7
3	0.4
≤ 2	Recommend closure and immediate repair or replacement

Table 1.5-4 Condition Rating Reduction values for Engineering Judgement Ratings for Concrete Bridges with Unknown Details

Alternatively, the design vehicle can be used to back-calculate (reverse engineer) the reinforced and/or the prestressed steel area. Contact the Load Rating Engineer prior to implementing this process.

1. Obtain detailed field measurements, including span length, girder dimension, girder spacing, diaphragm dimensions and locations, deck width, deck overhang, and deck thickness.
2. Determine the material properties and design vehicle based on year of construction.
3. Based on the field girder dimensions, determine the cracking moment (M_{CR}) of the concrete girders.
4. Determine the factored moment (LL + DL) using the multi-lane design vehicle with full impact.
5. Estimate the reinforcing area or pre-stressed steel area based on the greater of the factored moment (LL + DL) and the cracking moment.
6. The back calculated reinforcing steel area and field dimensions shall be used for the load rating with BrR software.

1.6 Load Rating Vehicles

The vehicles included in this section are the vehicles that are required to be rated. The list includes vehicles required by the MBE and ND state specific vehicles[1]. The level of analysis is different for the LFR/ASR method and the LRFR method. Schematics and axle loads for the ND state specific vehicles are located in Appendix A. Refer to the MBE for a description of the AASHTO and SHV vehicles.

The design vehicle for the LFR/ASR method is the HS-20 vehicle. This vehicle must be rated at both the inventory and operating level. All other vehicle types must be rated at the operating level.

The design vehicle for the LRFR method is the HL-93 vehicle. This vehicle must be rated at design inventory and design operating level. All other vehicle types must be rated at the legal level.

LFR/ASR Method

- Inventory Level
  - HS-20
- Operating Level
  - HS-20
  - AASHTO Type 3
  - AASHTO Type 3S2
  - AASHTO Type 3-3
  - Notional SHV (NRL)
  - SHV 4
  - SHV 5
  - SHV 6
  - SHV 7
  - ND 1[1]
  - ND 2[1]
  - EV 2[2]
  - EV 3[2]

LRFR Method

- Design Inventory Level
  - HL-93
- Design Operating Level
  - HL-93
- Legal level
  - HS-20
  - AASHTO Type 3
  - AASHTO Type 3S2
  - AASHTO Type 3-3
  - Lane-Type Legal Load[3]
  - Notional SHV (NRL)
  - SHV 4
  - SHV 5
  - SHV 6
  - SHV 7
  - ND 1[1]
  - EV 2[2]
  - EV 3[2]
- Permit Level
  - ND 2[1]

[1]ND state specific vehicles are only for bridges on the state highway system.
[2]Emergency vehicles (EV) only need to be rated on Interstate bridges and bridges within 1 mile of the Interstate.
[3]The Lane-Type Legal Load is only used for bridges over 200’ and for checking negative bending over the piers of continuous span bridges.

The lowest rating for the HS-20 vehicle and the HL-93 vehicle for the respective method shall be coded in NBI Item 66 Inventory Rating and Item 64 Operating Rating in the Bridge Management System (BMS). Note: The controlling rating for bridge posting may not always be the HS-20 or HL 93 design vehicle. See Section 1.8 for posting requirements.

1.7 Submittal of Load Rating and Transfer of Structure Model

The AASHTOWare BrR electronic model, the completed Load Rating Report Summary Template, and a detailed load rating report shall be sent to the Bridge Division. If the size of the documents exceeds the capacity of email, then the NDDOT MFT site should be used to complete the transfer. For guidance on using the MFT site see: http://mydot.nd.gov/divdist/itd/docs/UsingMFT.pdf

1.7.1 Transfer of the BrR Structure Model

To export the bridge in BrR, select the bridge and go to File>Batch Export>Export. BrR will ask for a target directory to store the bridge as an XML file.

1.7.2 Load Rating Report Summary Template

Use the NDDOT load rating report summary template. A copy of the Xcel file of this template can be obtained on request from the NDDOT Bridge Management Section.

A sample of the completed load rating report summary is included in Appendix B.

1.7.3 Detailed Load Rating Report

A detailed report load rating shall accompany the load ratings. The load rating detailed report must contain any field measurements and engineering judgements. The report must include enough detail that a new model and analysis can be re-created from information contained within the report, when supplemented with information from the design plans and shop drawings.

1.8 Posting Requirements

Notify the structure management engineer immediately if a structure requires posting, as identified below.

LRFR Method

For bridges evaluated with the LRFR method, with a legal rating less than 1.00, the bridge must be posted. The safe posting load shall be determined by Eq. 6A.8.3-1 in the MBE

$$Safe\ Posting\ Load\ = \frac{W}{0.7}[(RF) - 0.3] \qquad \text{(MBE 6A.8.3-1)}$$

Where:

RF = Legal Load Factor

W = Weight of rating vehicle (Tons)

Bridges that are not capable of carrying a minimum gross weight of 3 tons must be closed.

LFD/ASR Method

For bridges evaluated with the LFD/ASR method, with an operating rating of less than 1.00, the bridge must be posted. The bridge must be posted at tonnage equal to or less than the operating rating (in tons). A posting lower than the operating rating may be selected at the discretion of the bridge owner.

Bridges that are not capable of carrying a minimum gross weight of 3 tons must be closed.

1.8.1 Signing Requirements

Regulatory signs must conform to the requirements of the MUTCD manual. All bridges must be posted using one of the following sign types.

R12-1

R12-4

To calculate the maximum axle weight, use the following equation:

(0.444) x (Max Gross Weight) = Max Axle Weight.

Example:

If the maximum safe posting load is 10 Tons:

Then sign R12-1 would read “WEIGHT LIMIT 10 TONS”

AND

Sign R12-4 would read “WEIGHT LIMIT 4 TONS PER AXLE 10 TONS GROSS”.

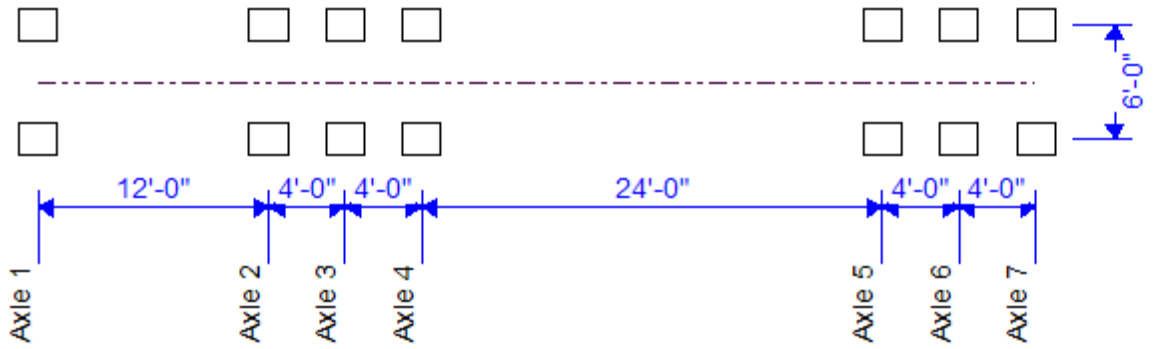
1.9 Permit Load Rating

For permit load rating, the LFR method will be used for the automated routing system. For loads larger than 300,000 lbs. or vehicles with a non-standard gauge, the rating shall be verified by the Load Rating Engineer. Load ratings should be verified using the same load rating method that was used for NBI Item 63/65.

For P/S Concrete bridges, include analysis of the Service 1 check.

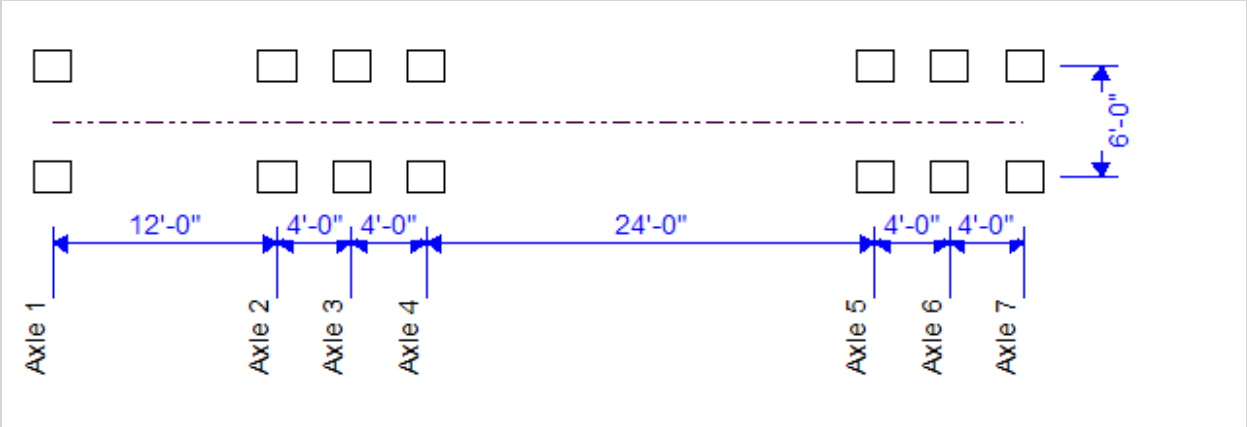
Appendix A: ND Defined Trucks

ND 1 – 105,500 lb. Screening Load



Axle 1	9,500 lbs
Axle 2	16,000 lbs
Axle 3	16,000 lbs
Axle 4	16,000 lbs
Axle 5	16,000 lbs
Axle 6	16,000 lbs
Axle 7	16,000 lbs
GVW	105,500

ND 2 –Seasonal 10% Load Limit Increase



Axle 1	13,200 lbs
Axle 2	17,600 lbs
Axle 3	17,600 lbs
Axle 4	17,600 lbs
Axle 5	17,600 lbs
Axle 6	17,600 lbs
Axle 7	17,600 lbs
GVW	118,800