

# **INDOT BRIDGE INSPECTION MANUAL**

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## **Part 3**

### **Load Rating**

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

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<u>Appendix</u>	<u>Title</u>
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<u>Appendix A</u>	<u>Indiana Size and Weight Laws</u>
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<u>Appendix B</u>	<u>Restriction or Closure Protocol</u>
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### 3-1.0 INTRODUCTION

The primary purpose of this part of the manual is to establish a uniform policy of load rating procedures and standards for the posting of bridges within the state of Indiana. This will ensure every bridge is rated as to its safe load-carrying capacity. Bridges are to be load rated as per the guidelines in the AASHTO Manual of Bridge Evaluation (MBE) 2<sup>nd</sup> Edition with interim revisions up to the current year.

Refer to Section 3-10.0 for posting requirements.

This part of the manual is a reference tool for rating bridges. It outlines guidelines and procedures for load rating and the documentation required. Although this is intended to be used for the load rating of bridges, many of the processes and procedures can be applied to small structures not classified by 23CFR650 as a bridge.

### 3-2.0 REFERENCE MATERIAL

These references set forth procedures to be used in the load rating of bridges. Persons involved with load rating of bridges must be knowledgeable of these references. The information in this Bridge Inspection Manual supplements the information in these references.

CFR 650C, *National Bridge Inspection Standards*, Federal Register Vol. 69 No. 239, 14 December 2004, <http://www.fhwa.dot.gov/bridge/nbis.htm>

49 CFR 213, Appendix C, *Statement of Agency Policy on the Safety of Railroad Bridges*, Federal Register Vol. 74 No. 8, 13 January 2009, <http://www.fra.dot.gov/downloads/safety/SafetyRRBridges2009.pdf>

23 CFR Ch. 650.313, Code of Federal Regulations 23 CFR Ch. I (4–1–11 Edition)

MBE-2, 2011 with all interim revisions including 2016, AASHTO

Bridge rating BrR, AASHTOWare at <https://aashto.mbakercorp.com/Pages/default.aspx>

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FHWA-IF-09-014, *Load Rating Guidance and Examples for Bolted and Riveted Gusset Plates In Truss Bridges*, February 2009, [http://bridges.transportation.org/Documents/FHWA-IF-09-014\\_LoadRatingGuidanceandExamplesforGussetsFebruary2009rev3.pdf](http://bridges.transportation.org/Documents/FHWA-IF-09-014_LoadRatingGuidanceandExamplesforGussetsFebruary2009rev3.pdf)

FHWA-PD-96-001, *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges*, December 1995, with Errata Sheet, December 2003, Federal Highway Administration Office of Engineering, Bridge Division, Bridge Management Branch, Washington, DC 20590, <http://www.fhwa.dot.gov/bridge/bripub.htm>

FHWA-TA-5140.29, *Load-carrying Capacity Considerations of Gusset Plates in Non-load-redundant Steel Truss Bridges*, 15 January, 2008, <http://www.fhwa.dot.gov/bridge/t514029.cfm>

HB-17, *Standard Specifications for Highway Bridges*, 17<sup>th</sup> Edition, 2002, American Association of State Highway and Transportation Officials, 444 N. Capitol Street, N.W., Suite 249, Washington, DC 20001, [https://bookstore.transportation.org/item\\_details.aspx?ID=51](https://bookstore.transportation.org/item_details.aspx?ID=51)

*Indiana Code*, Indiana General Assembly, 2009, <http://www.in.gov/legislative/ic/code/>

*Indiana Design Manual 2009*, Indiana Department of Transportation (INDOT), <http://www.in.gov/dot/div/contracts/standards/dm/english/index.html>

*Indiana Manual of Uniform Traffic Control Devices for Streets and Highways*, 2008 Edition <http://www.in.gov/dot/div/contracts/design/mutcd/mutcd.html>

LRFDUS-5, *AASHTO LRFD Bridge Design Specifications, Customary U.S. Units*, 5<sup>th</sup> Edition, 2010, American Association of State Highway and Transportation Officials, 444 N. Capitol Street, N.W., Suite 249, Washington, DC 20001, [https://bookstore.transportation.org/item\\_details.aspx?ID=1560](https://bookstore.transportation.org/item_details.aspx?ID=1560)

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MBE-1, *The Manual for Bridge Evaluation*, 2nd Edition, 2011 WITH up to 2016 Interim Revisions, American Association of State Highway and Transportation Officials, 444 N. Capitol Street, N.W., Suite 249, Washington, DC 20001, [https://bookstore.transportation.org/item\\_details.aspx?ID=1343](https://bookstore.transportation.org/item_details.aspx?ID=1343)

*Manual on Uniform Traffic Control Devices for Streets and Highways*, 2009 Edition; Federal Highway Administration (FHWA), [http://mutcd.fhwa.dot.gov/pdfs/2009/pdf\\_index.htm](http://mutcd.fhwa.dot.gov/pdfs/2009/pdf_index.htm)

### 3-3.0 LOAD RATING POLICY STATEMENT

All state, county, toll road, and local agency bridges shall have a load rating performed in accordance with AASHTO MBE 2.0 and this manual. The Inspection Team Leader shall be responsible for ensuring that the Load Rating Team Leader has performed the load rating based on the current findings, and that they are developed in a timely fashion. Inspection Consultants may obtain the existing load ratings from the previous Inspection Consultant. It is the responsibility of the Inspection Team Leader to review, or have reviewed the previous load rating and verify the thoroughness and accuracy of the load rating. By re-using the existing load rating, the Inspection Team Leader accepts the responsibility and liability for the load rating and relieves the liability of the load rating from the previous Inspection Consultant.

This policy will be reviewed periodically as its implementation is assessed.

### 3-4.0 DEFINITIONS

**Bridge:** Bridges are defined by the National Bridge Inspection Standards (NBIS) published in the Code of Federal Regulations (23 CFR 650 Subpart C). See Part 1, Chapter 2 Section 2.2 for details. Small structures with spans less than or equal to 20 feet should be load rated using the same basic procedures set forth in this manual.

**Load Rating Team Leader:** The qualifications and responsibilities of the Load Rating Team Leader are defined in Part 1, Chapter 3, Section 2.4. The Load Rating Team Leader should use sound engineering judgment when completing load ratings and when

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using the provisions of this manual. The Load Rating Team Leader is responsible for completing quality control of the load ratings and the data that is submitted to the Indiana Department of Transportation (INDOT) for the National Bridge Inventory (NBI).

**Load Rating Levels:** Bridges are load rated to determine the safe live load capacity. Bridges are rated at two different load levels referred to as “Inventory” and “Operating.” Additionally, bridges are rated to determine posting requirements.

**Inventory Level:** The inventory rating level generally corresponds to the customary design level of stresses, but reflects the existing bridge and material conditions with regard to deterioration and loss of section. Load ratings based on the inventory level allow comparisons with the capacity for new bridges and, therefore, determine a live load which can safely utilize an existing bridge for an indefinite period of time. This approximates the design load level.

**Operating Level:** Load ratings based on the operating rating level generally describe the maximum permissible live load to which the bridge may be subjected. This is the overload permit maximum. Routine application of live loads at or near the operating level may shorten the life of the bridge.

**Posting Level:** Posting level is a load capacity selected by the governing agency for load posting bridges.

**Allowable Stress (AS):** This method compares un-factored load stresses to an allowable stress for a given material.

**Load Factor (LF):** This method compares factored load effects and stresses to the strength of a member of a given material, which typically is less than the material’s strength limit.

**Load and Resistance Factor Rating (LRFR):** This method compares factored load effects to the resistance of a member of a given material.

**Design Load Rating Check:** A load rating performed at Stage 3 in the plan development of newly designed or rehabilitated bridges for the design live loads specified in the design plans.

**Current Load Rating Check:** A load rating performed for a variety of state-specific rating vehicles to encompass all force effects from legal loads on an existing bridge that reflects the current condition of all primary structural components.

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### 3-5.0 ROLES AND RESPONSIBILITIES

#### **3-5.01 Bridge Owners**

Bridge owners in Indiana include the state, counties, toll roads, other local agencies, and private firms owning bridges open to public traffic without restriction. For bridges within their authority, bridge owners are responsible for the following items:

1. Ensuring all bridges within their jurisdiction are load rated
2. Ensuring new bridges are load-rated prior to opening to public traffic
3. Quality control of the load ratings
4. Maintaining complete bridge records in the bridge file
5. Properly posting bridges, as required.

Bridge owners and their Inspection Consultants are responsible for determining when a bridge must be re-rated in conjunction with these requirements. Bridge owners shall load a copy of the load rating summary in the Central Database and ensure a copy is in the official bridge file. The load rating summary requirements are discussed in Section 3-9.0.

#### **3-5.02 Indiana Department of Transportation**

The Indiana Department of Transportation (INDOT) is responsible for ensuring bridge owners are in compliance with the National Bridge Inspection Standards (NBIS) as given in CFR 650 Subpart C, Bridges, Structures, and Hydraulics. The Federal Highway Administration (FHWA) mandates that inventory and operating ratings be reported by INDOT yearly as part of the National Bridge Inventory (NBI).

#### **3-5.03 Consultants Performing Ratings**

Inspection Consultants are responsible for being familiar with the State Bridge Inspection Program policies and procedures. Inspection Consultants performing load ratings are responsible for the quality control of their work, checking both accuracy and completeness.

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Inspection Consultants are prequalified by INDOT to load-rate state-owned bridges and bridges being inspected using federal funds. This includes most county, toll road, and local agency bridges. Prequalification requirements are as follows:

1. Have at least one Registered Professional Engineer, licensed in the state of Indiana, qualified to oversee, review, and certify all load capacity ratings performed by that firm.
2. Have a load capacity rating program or method that produces all load rating results required by the federal regulations and INDOT. See Section 6 for details on requirements for software. As a minimum, this must check moments and shear. All calculations must be performed by an engineer or engineering intern (EI) and must be reviewed by a professional engineer (PE).

### 3-6.0 PROCEDURE

#### 3-6.01 Requirements

All load rating requests shall be made using the request form available on the editable forms page through coordinator 8. A copy of the request email with the Load Rating request form shall be sent to the Central Office Load Rating Engineer through coordinator 8.

AASHTO Manual of Bridge Evaluation (MBE) guidelines along with specific state guidelines shall be utilized to load rate bridges.

Federal bridge inspection regulations require that a bridge load capacity rating be performed for each bridge carrying vehicular traffic. A number of rating vehicles and rating methods have been identified by the Federal Highway Administration (FHWA) and the Indiana Department of Transportation (INDOT) as being required in order to meet federal regulations. Since July 2004, INDOT has required that state-owned bridges be load-rated in the design stage, as well as after being placed in service. Unless otherwise approved by the State Bridge Inspection Program Manager, AASHTOWare Bridge Rating or BrR shall be used. If other software is utilized, it shall be fully compliant to the latest MBE and approved by the State Load Rating Engineer. If BrR cannot be used to load rate a bridge, other software such as CANDE (arch underfill), Smartculvert (for Conspan type arches), MIDAS/CSI Bridge for FEM and

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Consplince for post-tensioned slab structures can be used. The load rating summary shall be furnished to Central Office Load Rating for review and approval. The xml file shall be submitted for inclusion in the State bridge file database.

New bridges and those with total superstructure replacement are to be rated using the LRFR methodology during the design load rating check. The load rating factor for the design load rating shall be greater than 1.06. Bridges designed using LRFD shall be evaluated for rating and posting using the LRFR provisions of the MBE. As directed by the MBE, both tandem and lane loads will also be utilized to perform load ratings. The rating analysis shall include HL93; all AASHTO legal loads (Type 3, Type 3S2, Type 3-3) and SHVs (see figure 3:7-12); and any Indiana legal load and Alternate Military load identified on Figure 3:7-2 for the route being analyzed.

For P3 or Design Build projects the bridge shall be checked for load rating at the final design stage by the designer as a part of the contractual process and the rating summary will furnished by the designer to Central Office Load Rating Engineer for review and approval and update of BIAS bridge file.

Bridges designed using LFD or ASD shall be evaluated for rating and posting during a current load rating check using the LFR provisions of the MBE. Bridges designed using LRFD shall be evaluated for rating and posting during a current load rating check using the LRFR provisions of the MBE. The rating analysis shall include H20, HS20, HS25, HL93, all AASHTO legal loads (Type 3, Type 3S2, Type 3-3) and SHVs; and any Indiana legal load and Alternate Military load identified on Figure 3:7-12 for the route being analyzed. For those route identified on Figure 3:1-12, the rating analysis shall also include the super load rating vehicles. The ratings for super load rating vehicles will serve as a check for the Permit Engineer.

Deterioration ratings, rehabilitation ratings, overlays, and re-ratings due to triggers are included in the current ratings.

Assigned Load Ratings as defined by sections C6A.1.1 and C6B.1 of the MBE shall not be used

Other analyses, such as fatigue and fracture analysis or bridge load testing, should be left to the discretion of the owner at this time.

### **3-6.02 Frequency of Load Ratings**

The following is a non-inclusive list of possible conditions that may trigger the need for performing a load rating check:

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1. All new bridge or superstructure replacements shall be rated within 90 days of opening the bridge to traffic.
2. The Indiana Design Manual requires that the load rating for state owned bridges shall be performed by INDOT's Central Office Load Rating Engineer within 30 days of receipt of INDOT Stage 3 Review Submission, with analysis results available to the designer prior to the final tracings submission.
3. When significant deterioration or damage is noted during an inspection, resulting in a National Bridge Inspection Inventory (NBI) rating of 4 or less for any primary superstructure member, the Inspection Team Leader shall immediately notify the Load Rating Team Leader. Special attention is required to capture dimensional details and section loss information during the inspection. The report shall include sketches showing details of section loss including dimensions, location of the section and relevant photographs. NDT tools may be used to provide detailed measurements.
4. Critical Finding by a bridge inspection team
5. A bridge shall be re-load-rated when it is reconstructed, repaired, or overlaid in a manner that would affect the existing load rating.
6. Utility additions.
7. Substructures shall be analyzed when they have a National Bridge Inspection Inventory (NBI) rating 3 or below.

### **3-6.03 Assumptions**

Due to the wide variety of structural materials available, the number of bridge types, and the variations in the quality and strength of the materials, assumptions have to be made in order to efficiently analyze bridges. These assumptions consider the policies and procedures with which the bridges were designed, the recommendations published by AASHTO MBE, and INDOT policies.

In case of bridges with unknown structural components where details, plans are not available such as reinforcement or field measurements are not possible, engineering judgment may be used for concrete bridges (MBE 6.1.4). A field inspection of the bridge by a qualified inspector and evaluation by a qualified professional engineer is sufficient to establish an approximate load rating based on rational criteria. The criteria established are a) There are no plans or details available b) It is a concrete

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superstructure c) The condition rating is at least 6 and there is no change in its condition from the previous inspection d) The physical inspection reveals that the bridge has been carrying normal traffic without distress due to live load e) It is evaluated and signed as well as sealed by a qualified PE (ATL-S) or a Load Rating Engineer (PE). A sample document is shown in Figure 3:6-4.

For bridge types, materials, and analysis methods not dealt with in this manual, please contact Load Rating Engineer, Central Office or the Bridge Inspection Manager, Central Office INDOT for assistance.

### **3-6.04 Conditions**

The safe load capacity of a bridge is to be based on existing structural conditions. Bridges with design plans and/or as-built plans with deterioration, or those where structural elements can be measured to determine structural capacity, should be load-rated using AASHTOWare Bridge Rating (BrR) except as noted in Section 6.3. All superstructure members should be checked for moment, shear, and where applicable, axial loading. Deck elements, substructure elements, and under-fill structures, such as pipes and boxes, should have their load capacities calculated or assessed in a systematic manner, especially when condition ratings indicate that there may be a structural capacity concern.

Although plans may indicate a bridge was designed for future load case possibilities, the bridge should be rated for the actual conditions. For example, if the plans state the bridge was designed for a load of 15 pounds per square foot for stay-in-place forms, the load should not be applied to the load rating model unless stay-in-place forms have been visually identified during the inspection.

### **3-6.05 Quality Control and Quality Assurance**

A number of bridges shall have their load ratings reviewed in detail each year to ensure the accuracy and consistency of bridge inspections and bridge inspection reports. Part 2 of this manual discusses the load rating quality control and quality assurance review processes.

In-house quality control should verify load rating computations and their consistency. All assumptions, and documentation of such, should be verified. This includes checking that any rehabilitation or deterioration of the structural members has been included.

QC/QA form shall be submitted with all load ratings. See Figure 3-6.1 QC/QA Form

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<b>Subject:</b>	Load Rating Analysis	<b>Page 3 of 3</b>		
<b>Bridge #:</b>				
<b>NBI #:</b>				
<b>Quality Assurance Review</b>				
<b>Stage I</b>				
Load rating performed (by summary or calculation)	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	
Professional Engineer Involved	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	
Calculations checked	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	
How was the load rating determined	using			
<b>Bridge File</b>				
Summary sheet and all supporting documents uploaded to BIAS	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	
Load ratings reflect current site conditions	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	
<b>Stage II</b>				
Adequate documentation of assumptions	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	
Deterioration of bridge accounted for	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	
<b>Stage III</b>				
Post-Inspection review performed on subject bridge	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	
Quality Assurance Officer's calculated Load Rating (Tons)				
Inspection Agency's Load Rating (Tons)				
Inspection Agency's load rating within two tons of QAO's Load Rating				

Figure 3-6.1 QC/QA Form

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### **3-6.06 Procedure**

#### Load Rating Equations

Bridges rated using LRFR shall use the basic rating equation 6A.4.2.1-1

Bridges rated using LFR shall use the rating equation 6B.4.1-1

While rating for LRFR for the Design Check, MBE advocates that the HL93 Inventory rating is greater than 1 and no further check for legal loads is necessary. The MBE also advocates that in no case shall the operating rating for a live load be less than 1.0. However, in Indiana the Design Loading as well as legal loads are rated to investigate the most critical load governing the rating for both inventory and operating. Rating factors are evaluated for Inventory and operating for all legal loads and the vehicle most critical rating load shall be considered for posting. While rating for LFR, the procedure is the same except the design vehicle is usually HS20. Posting procedure is described in detail in Section 3-10.

#### Load Factor Method

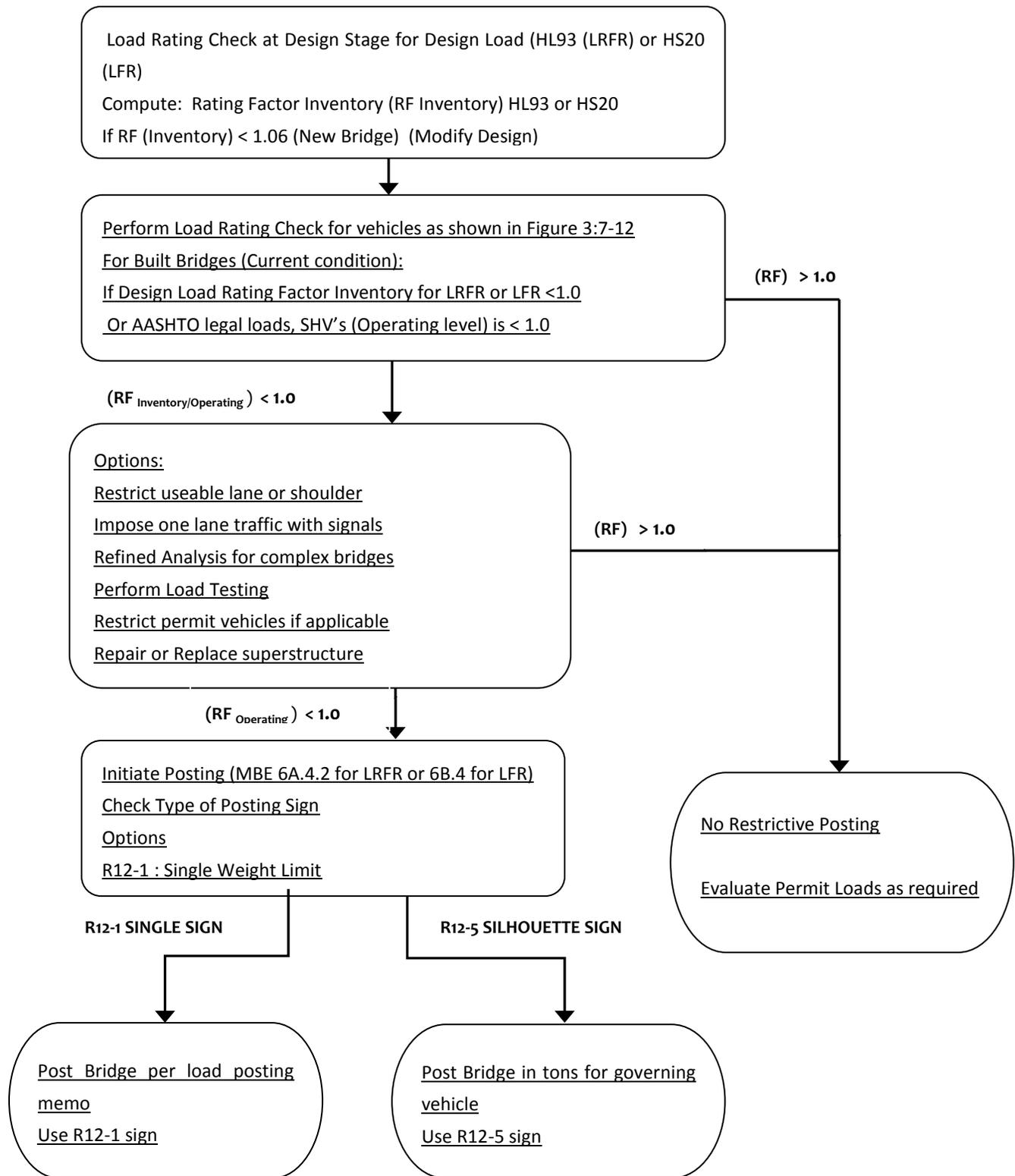
All bridge structures designed utilizing LFD or ASD shall be load rated using LFR as described in MBE Section 6B.

The procedure is illustrated in Figure 3-6.2 Load Rating Flow Chart (LRFR and LFR)

Figure 3-6.4 contains a sample engineering judgment justification.

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**Figure 3-6.2 Load Rating Flow Chart (LRFR and LFR)**

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**Str. No.**



**NBI:**

*Year Built:*

*Design Load:* Unknown

*Structure Type:*

Superstructure Condition Rating		
Inspection Date		

*Inspector:*

In accordance with “**Manual for Bridge Evaluation, Second Edition, 2010, including interims through 2015**”

*Section 6.1.4*

*Necessary details for this bridge are unavailable. A physical inspection of the bridge was performed by a qualified inspector and evaluated by a qualified engineer to establish an approximate load rating based on rational criteria.*

This structure has been carrying normal traffic for \_\_\_\_\_ years, and shows no increased signs of distress due to live load.

Notes/Comments:

Inventory Rating: **36 Tons**

Operating Rating: **45 Tons**

H Rating: **20 Tons**

Evaluated by:

**PE SEAL/STAMP**

**Figure 3-6.4 Sample Engineering Judgment Justification Document**

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### 3-7.0 VEHICLES

Load ratings are to be reported to the National Bridge Inventory (NBI) annually. For bridges designed using LRFD using HL-93 loading, load ratings are to be computed and reported as rating factor and must indicate the rating method used. Ratings shall be based on LRFR methods using HL-93 vehicular live load consisting of the design truck or design tandem and the design lane load.

Bridges designed using Allowable Stress Design shall have the load rating performed using the LFR method. For bridges designed using Allowable Stress Design (ASD) or Load Factor Design (LFD), load ratings are to be computed and reported in tons and must indicate the rating method used. Rating factors shall be based on LRFR methods using HL-93 loading or LFR methods based on the HS-20 vehicle. Bridges designed using LFD, and being rehabilitated, should be load-rated for the AASHTO LFD design vehicles. If the entire superstructure is replaced, the bridge shall be load rated using the LRFR method. Load ratings and respective locations should be entered into the Central Database for the vehicles shown in Figure 3-7.12.

#### **3-7.01 Legal Loads**

Load limits restrict how much weight can be carried on an axle, a single tire, a pair of tires, and on the vehicle or vehicle combination in total. Load limits are necessary for protecting bridges from structural weakening or fatigue, preventing unsafe conditions, and the early replacement of bridges.

Vehicles meeting Indiana Code Article 20, Size and Weight Restrictions, are considered legal loads and should be able to use any highway or bridge within the state (see Appendix A). Some routes, and many bridges, must be posted to protect them from possible damage. A posted bridge may restrict a legal load from use. Indiana legal loads are loads that are less than or equal to 80,000 lbs and subject to dimensional restrictions defined by IC-9-20-3.

AASHTO legal loads as shown in Figure 3-7.10 shall be utilized to perform a legal load rating check. See Figure 3-6.2 for procedure.

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### **3-7.02 Standard AASHTO Vehicles**

The following standard AASHTO vehicles are used in load rating structures:

1. H20-44 Truck/Lane
2. HS20-44 Truck/Lane
3. HS25 Truck/Lane
4. Fatigue Truck
5. HL-93 Design Truck
6. HL-93 Design Tandem
7. HL-93 Design Truck Pair

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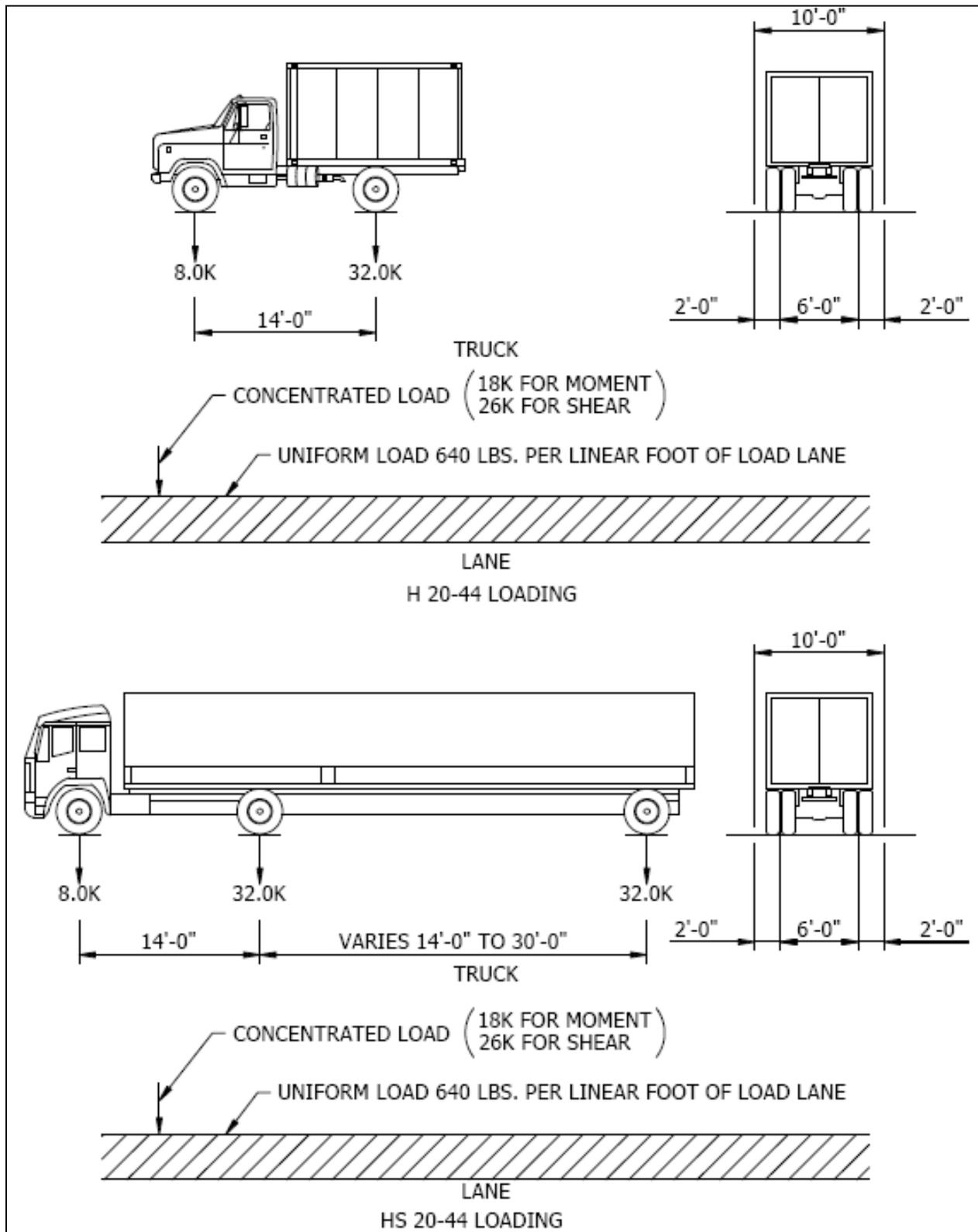


Figure 3-7.1 AASHTO H-20 and HS-20 Loads

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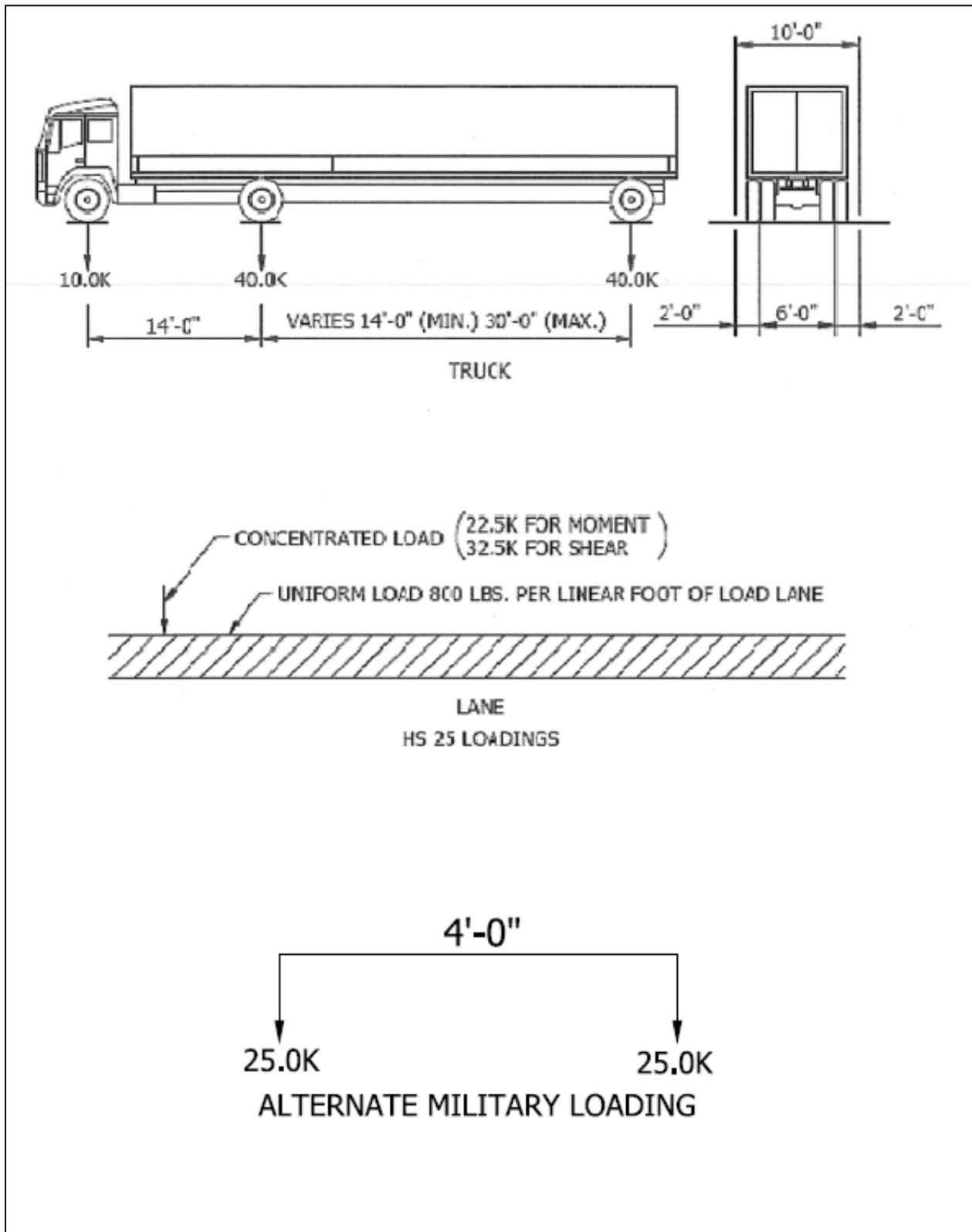


Figure 3-7.2 AASHTO HS-25 and Alternate Military Loading

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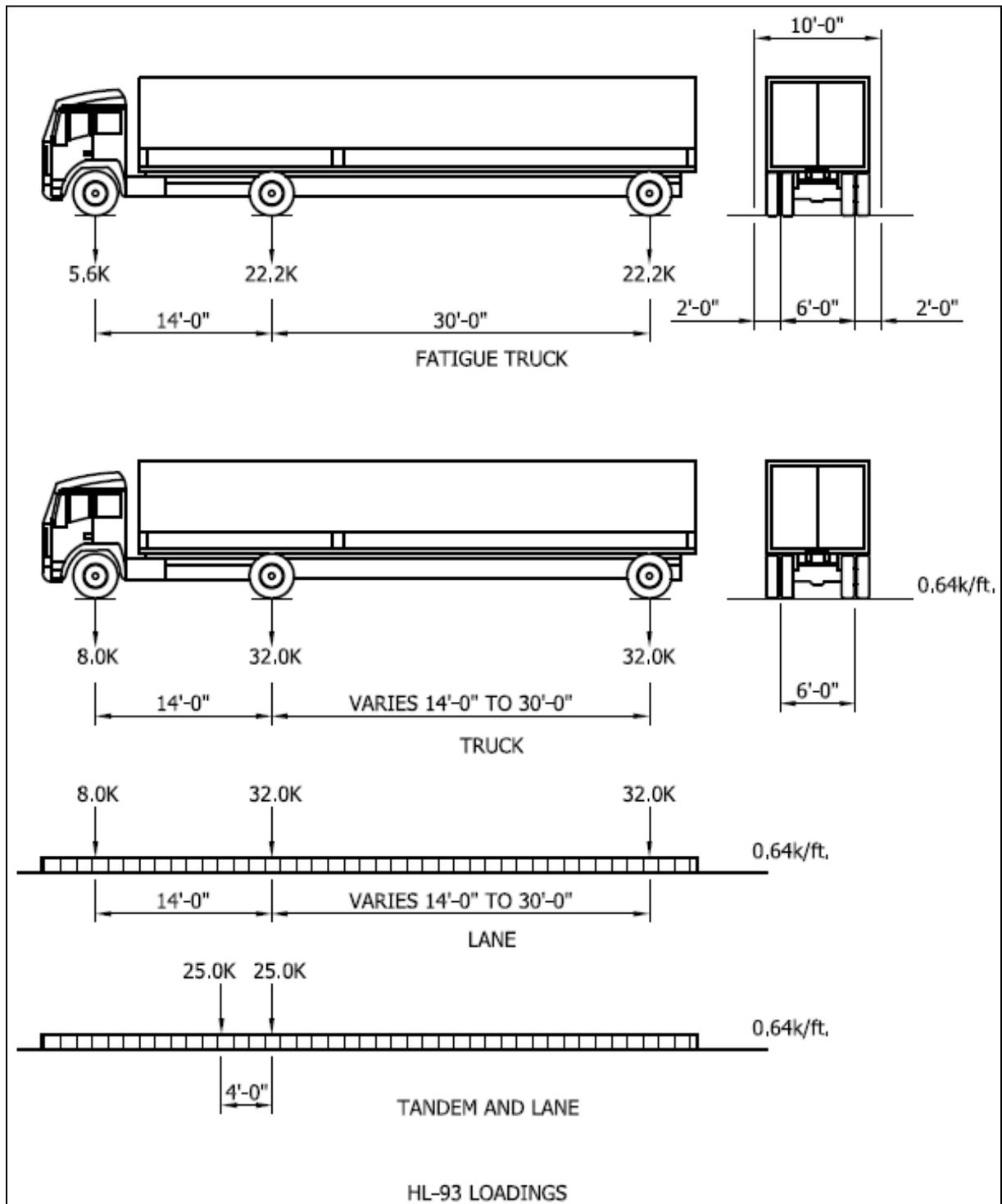


Figure 3-7.3 AASHTO Fatigue and HL-93 Loads

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### **3-7.03 Special Route Vehicles**

Special Route Vehicles are identified in the Indiana Code and can change annually depending on state legislature.

1. The Alternate Military Loading should be applied for any route falling on the National Highway System (NHS) and for bridges falling within military installations and reserve areas (STRAHNET).
2. In addition to the legal loads, the Indiana Toll Road live load (Heavy Duty Highway) should apply to each state highway bridge located within 15 miles of an Indiana Toll Road entrance or exit. A single truck with the design lane load should be used in each design lane. Factors for multiple presence and dynamic load allowance should be the same as those used for regular design trucks and per MBE. The Toll Road Truck configuration is shown in Figure 3-7.4.
3. In addition to the legal loads, the Michigan Truck Train live load (Extra-Heavy-Duty Highway) should apply to each bridge located on the Indiana Extra Heavy Duty Highway system. A single truck with design lane load should be limited to one design lane located to cause extreme force effects, while the other design lanes are occupied by regular design loads. Factors for multiple presence and dynamic load allowance should be the same as those used for regular design trucks. The truck configurations are shown in Figure 3-7.5 thru Figure 3-7.8. Figure 3-7.6 shows the Extra Heavy Duty Highway routes.
4. There are two additional types of truck configurations that operate on Indiana highways. They are Michigan truck #5 and #8 and toll road trucks 89.4K and 90K. The Michigan trucks operate on specified extra heavy duty highways as listed in Figure 3-7.5 thru Figure 3-7.8 (Ref IC 9-20-5-3 and IC 9-20-5-4) and the toll road trucks operate in the defined toll road corridor. All bridges falling in the above corridor and within 15 miles of a toll road exit are to be load rated for toll road trucks. Indiana issues route specific single trip permits. There are no specific routine annualized permits that can operate anywhere at any time. The Michigan truck #5 and #8 as well as toll road trucks 89.4K, 90K and 126 K permit load ratings are available for related bridges as they are load rated routinely. There may be bridges that fall within the 15 mile zone of a toll road and an extra heavy duty highway. These bridges shall be load rated for both toll road and Michigan Trucks #5 and #8 in addition to the loads specified in Figure 3-7.12

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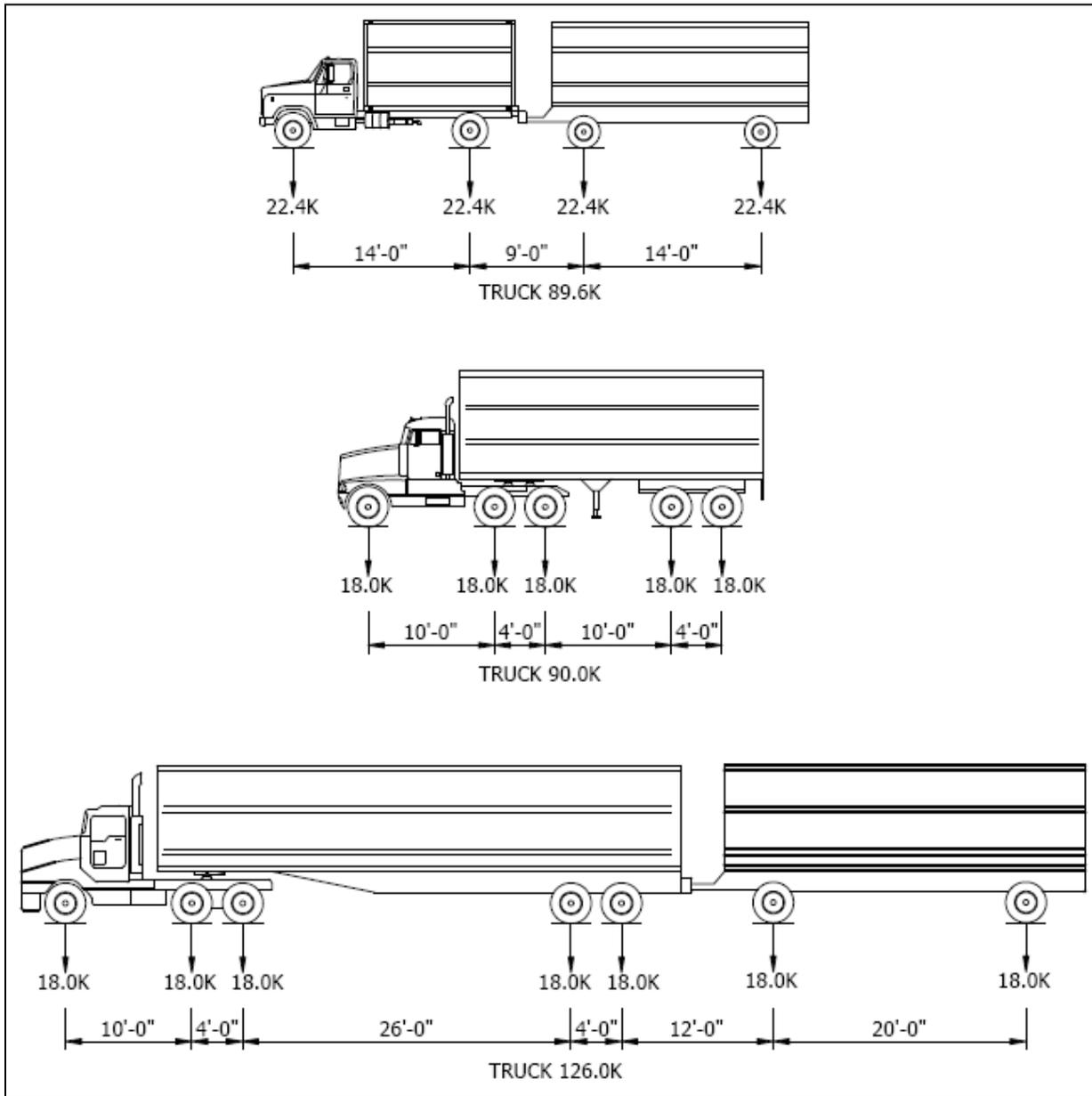
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Permit loadings: There are five special superloads permit vehicle configurations that are used to perform load ratings shown Figures 3-7.7 and 3-7.8. All state bridges and applicable Toll Roads, Extra Heavy Duty Highways and any special local bridges that may have such permit loads plying shall be load rated for operating rating values and forms a reference for the Permit Analysis by the Permit Engineer.

For reporting National Bridge Inventory Data, See FHWA Coding Guide and NBI Memorandum.

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING



**Figure 3-7.4 Toll Road Truck Loads**

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

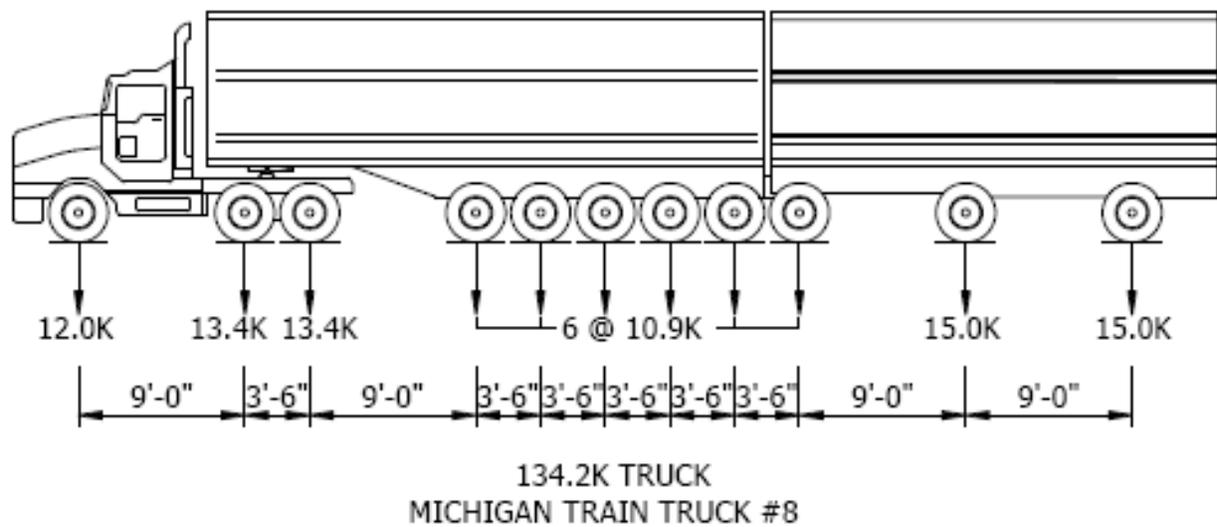
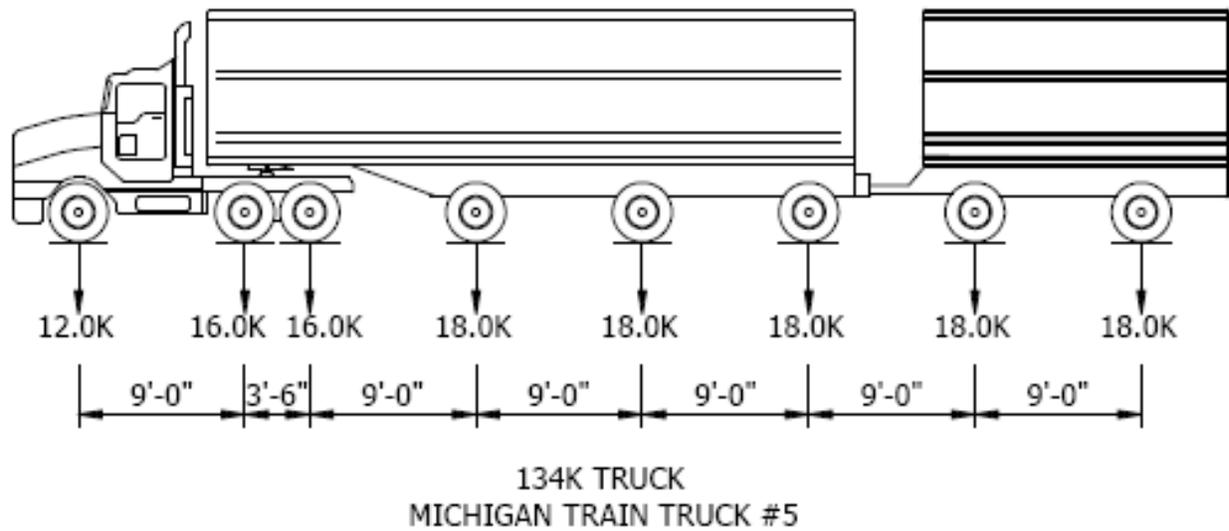


Figure 3-7.5 Michigan Train Truck Loads

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

- (1) Highway 41, from 129th Street in Hammond to Highway 312.
- (2) Highway 312, from Highway 41 to State Road 912.
- (3) Highway 912, from Michigan Avenue in East Chicago to the U.S. 20 interchange.
- (4) Highway 20, from Clark Road in Gary to Highway 39.
- (5) Highway 12, from one-fourth (1/4) mile west of the Midwest Steel entrance to Highway 249.
- (6) Highway 249, from Highway 12 to Highway 20.
- (7) Highway 12, from one and one-half (1 1/2) miles east of the Bethlehem Steel entrance to Highway 149.
- (8) Highway 149, from Highway 12 to point thirty-six hundredths (.36) of a mile south of Highway 20.
- (9) Highway 39, from Highway 20 to the Michigan state line.
- (10) Highway 20, from Highway 39 to Highway 2.
- (11) Highway 2, from Highway 20 to Highway 31.
- (12) Highway 31, from the Michigan state line to Highway 23.
- (13) Highway 23, from Highway 31 to Olive Street in South Bend.
- (14) Highway 35, from South Motts Parkway thirty-four hundredths (.34) of a mile southeast to the point where Highway 35 intersects with the overpass for Highway 20/Highway 212.
- (15) State Road 249 from U.S. 12 to the point where State Road 249 intersects with Nelson Drive at the Port of Indiana.
- (16) State Road 912 from the 15th Avenue and 169th Street interchange one and six hundredths (1.06) miles north to the U.S. 20 interchange.
- (17) U.S. 20 from the State Road 912 interchange three and seventeen hundredths (3.17) miles east to U.S. 12.
- (18) U.S. 6 from the Ohio state line to State Road 9.
- (19) U.S. 30 from Allen County/Whitley County Line Road (also known as County Road 800 East) to State Road 9.
- (20) State Road 9 from U.S. 30 to U.S. 6.
- (21) State Road 39 from Interstate 80 to U.S. 20.
- (22) State Road 3 north from U.S. 6 to U.S. 20, U.S. 20 west from State Road 3 to State Road 9, State Road 9 north from U.S. 20 to the Michigan state line. However, the total gross weight, with load, of a vehicle or combination of vehicles operated with a special weight permit on these highways may not exceed ninety thousand (90,000) pounds.

**Figure 3-7.6 Indiana Extra-Heavy Duty Highway System (IC 9-20-5-4)**

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

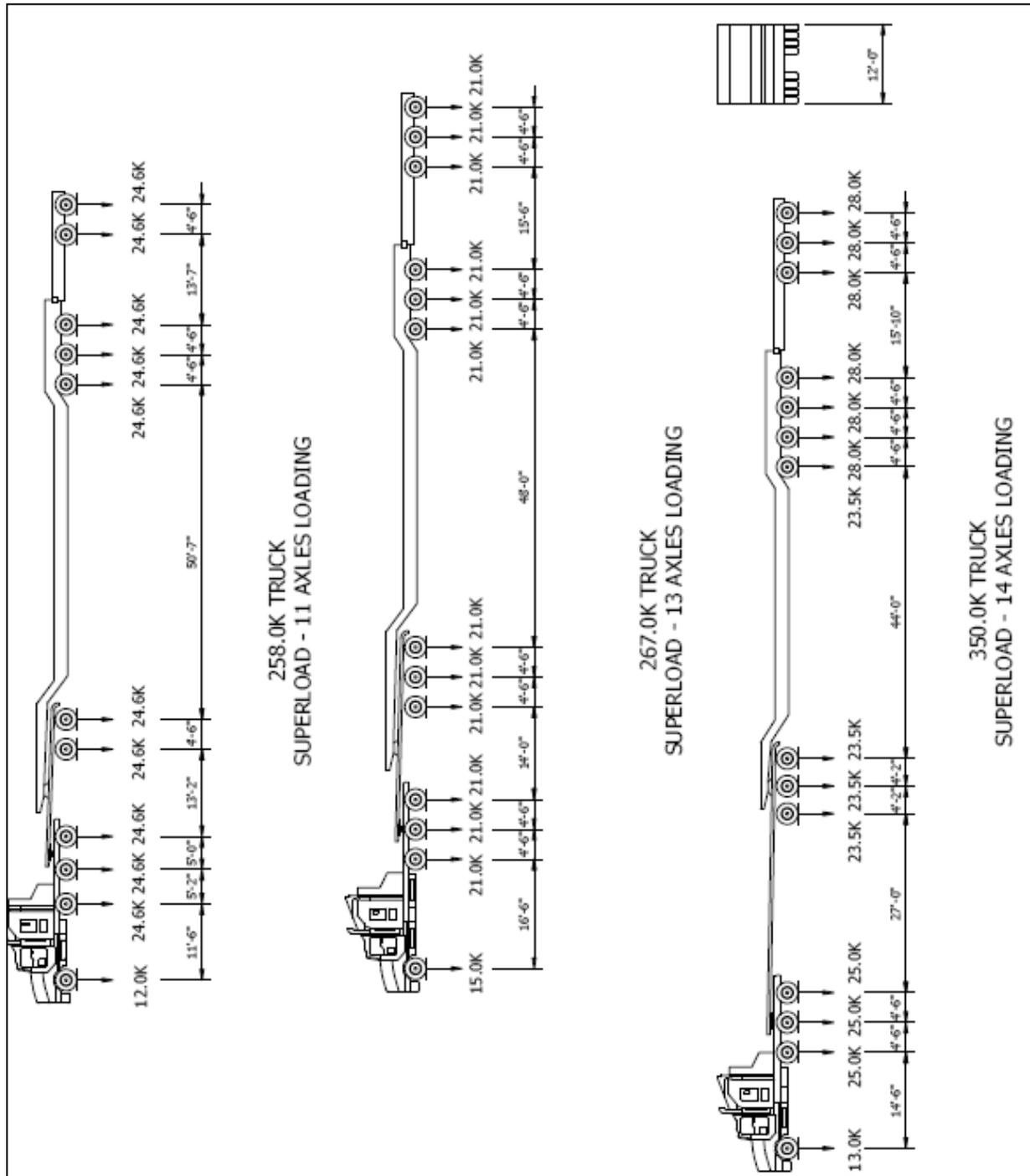


Figure 3-7.7 11-Axle, 13-Axle, and 14-Axle Superload Vehicles

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

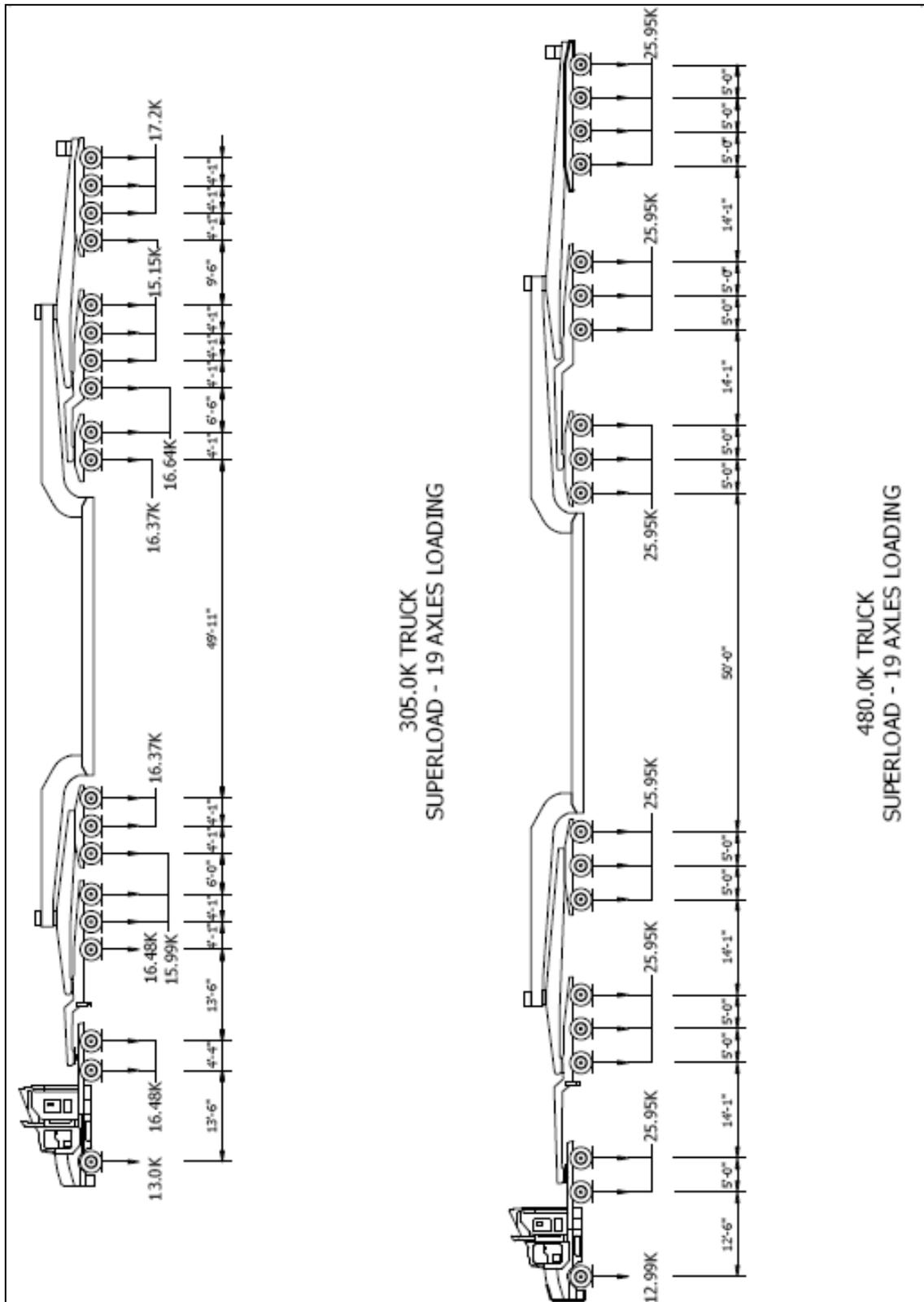


Figure 3-7.8 19-Axle Superload Vehicles

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

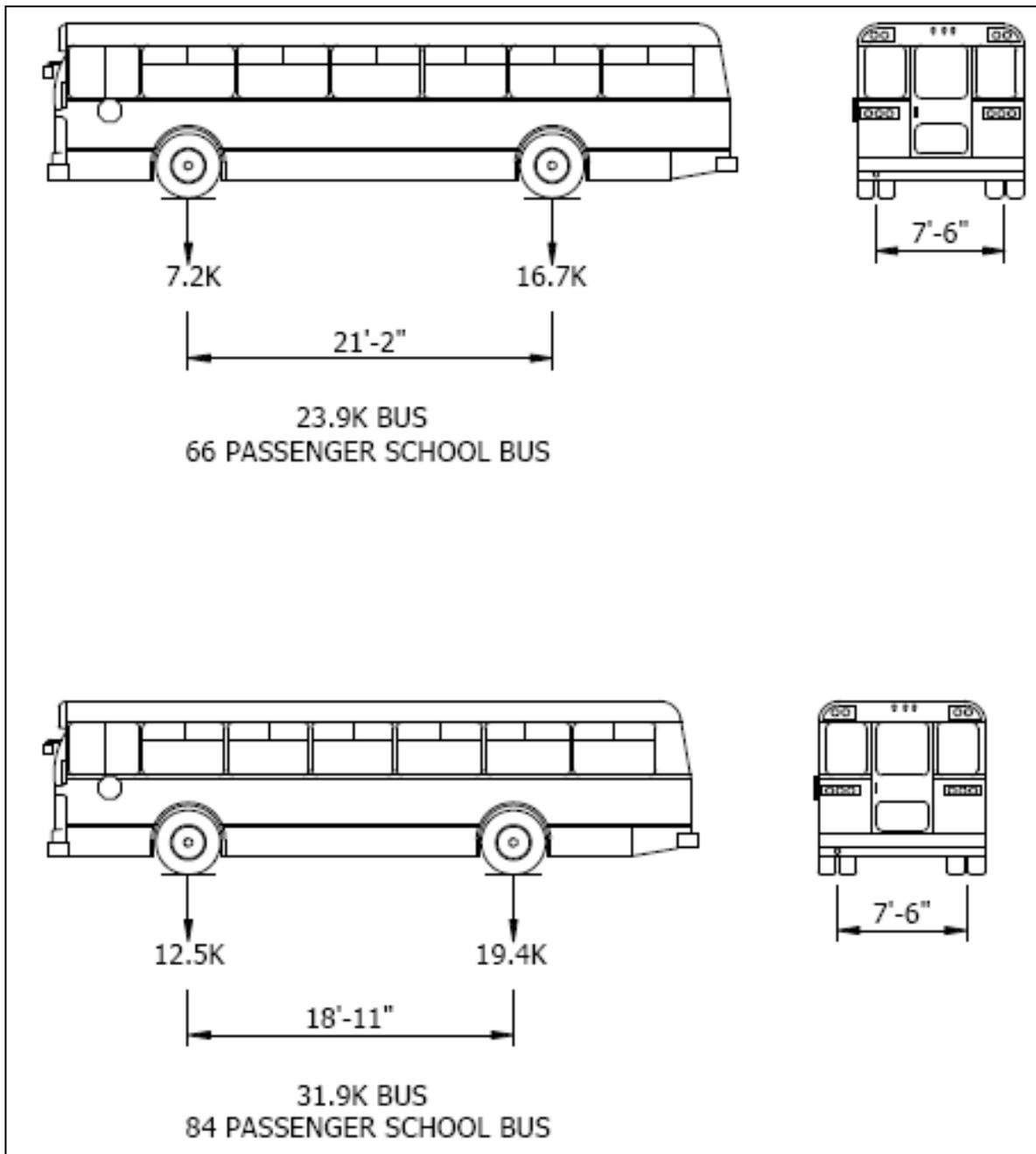


Figure 3-7.9 School Buses

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

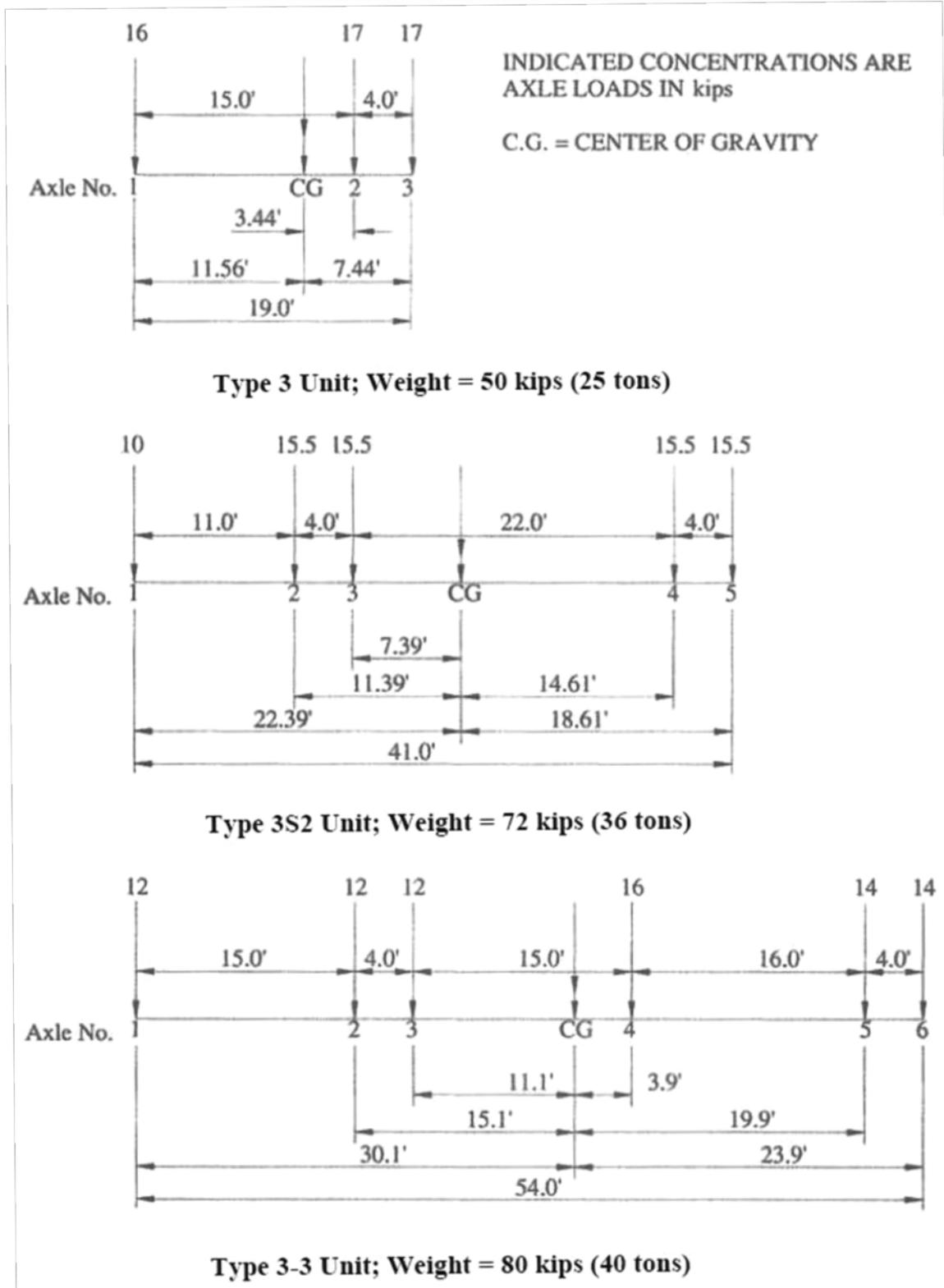


Figure 3-7.10 AASHTO Legal Loads

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

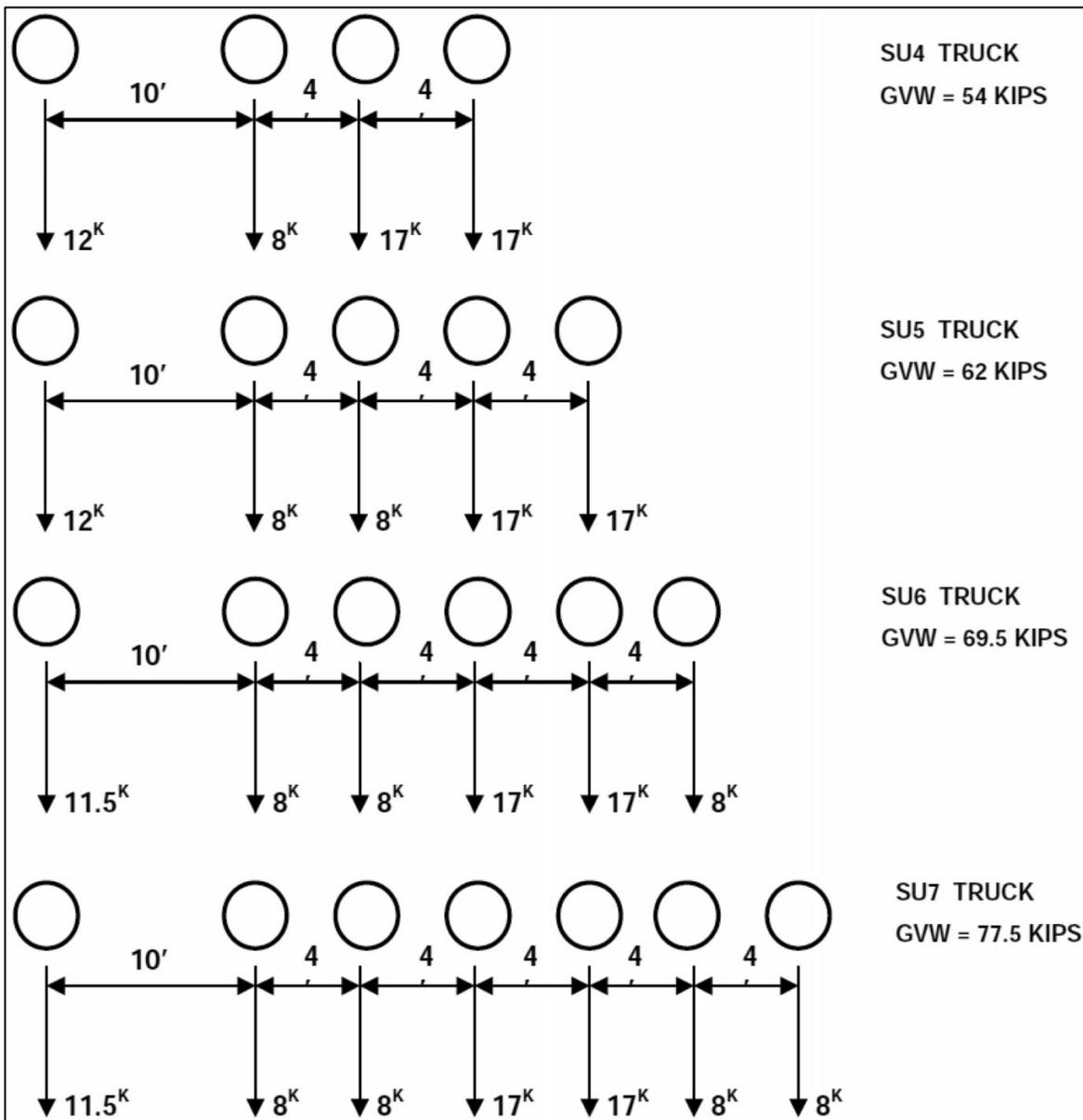


Figure 3-7.11 Specialized Hauling Vehicles (SHVs)

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

	State (non- STRAHNET)	Local (non- NHS)	Local (NHS)	Extra Heavy Duty Highway System	Toll Road and all state and local roads within 15 miles of a Toll Gate	STRAHNET or NHS
H-20	X	X	X	X	X	X
HS-20 *	X	X	X	X	X	X
HL-93 **	X	X	X	X	X	X
HS25	X	X	X	X	X	X
AASHTO Legal Type 3	X	X	X	X	X	X
AASHTO Legal Type 3S2	X	X	X	X	X	X
AASHTO Legal Type 3-3	X	X	X	X	X	X
Special Haul Vehicle SU4	X	X	X	X	X	X
Special Haul Vehicle SU5	X	X	X	X	X	X
Special Haul Vehicle SU6	X	X	X	X	X	X
Special Haul Vehicle SU7	X	X	X	X	X	X
Alternate Military			X			X
Toll Road 89.4 K					X	
Toll Road 90 K					X	
Toll Road 126 K					X	
Michigan Train Truck #5				X	X	
Michigan Train Truck #8				X	X	
Super Load 11 Axle 258 K Loading	X		X	X	X	X
Super Load 13 Axle 267 K Loading	X		X	X	X	X
Super Load 14 Axle 350 K Loading	X		X	X	X	X
Super Load 19 Axle 305 K Loading	X		X	X	X	X
Super Load 19 Axle 480 K Loading	X		X	X	X	X

\* Load Factor Rating (LFR) Design Loadings

\*\* Load Resistance Factor Rating (LRF) Design Loading

**Figure 3-7.12 Application of Rating Vehicles**

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

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### 3-8.0 LOAD RATING GUIDELINES

#### 3-8.01 Analysis

Load rating requires engineering judgment in determining a rating value that is applicable to maintaining the safe use of the bridge and arriving at posting and permit decisions. Parameters such as load factors and distribution factors should be determined by the Load Rating Team Leader using the latest American Association of State Highway and Transportation Officials (AASHTO) MBE manual. Stress levels for operating and inventory ratings should be determined by the Load Rating Team Leader using the latest AASHTO MBE manual. All superstructure elements for each bridge type should be load-rated in accordance with the latest AASHTO manuals.

#### 3-8.02 Bridge Cross Section and Geometry

The following guidelines should be used when computing load ratings:

1. A bridge with a sidewalk or shoulder without a barrier on the traffic side will be analyzed for moment and shear capacity as though the entire bridge width were available for traffic.
2. The distance between the centerlines of bearing is to be used for the span length for analysis purposes.
3. In spans with variable stringer/beam spacing, live load distribution factors should be computed based on the average of the stringer spacing on either side. If an average spacing is used, this must be noted since a more exact model may be needed to rate a permitted vehicle.

#### 3-8.03 Deck Section Adjustment

The following guidelines should be used when considering the role of the deck in load ratings:

1. When computing section properties on a bridge with a one-course concrete deck, the Load Rating Team Leader will determine if it is appropriate to deduct the sacrificial wear surface thickness shown on the plans. Take note of all rehabilitations to ensure total sacrificial depth does not exceed the design sacrificial wear thickness. If the overall sacrificial depth exceeds the sacrificial wear thickness, the remaining deck thickness is to be used as the structural depth. Adjust the distance to the top reinforcing bars to represent final cover.

# BRIDGE INSPECTION MANUAL

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2. A concrete overlay or bridge deck wearing surface should be considered as composite dead load, but is ignored as a structural slab on the initial rating calculations.
3. If the overlay is needed to get realistic ratings, this may be used on subsequent calculations.
4. When analyzing a bridge with precast concrete deck panels, it is state policy to treat the panel as being monolithic with the deck and analyzed as if it were a one-course pour.

### **3-8.04 Substructures**

Substructures generally do not control the load rating. Therefore a complete load rating analysis of the substructure is not required using engineering judgment if the condition rating of the substructure is greater than 3. Substructures may be analyzed when they have a National Bridge Inventory (NBI) rating 3 or below and have conditions not limited to:

1. Extensive section loss from corrosion or rot especially in timber or steel piles.
2. Scour, undermining or settlement that may affect the bearing capacity of the footing or a column's unbraced length (geotechnical analysis shall be required).

See Section 3-6.02 for additional information.

### **3-8.05 Reinforced Concrete**

If details are not available for the reinforcing steel in reinforced concrete decks or girders, it is acceptable to assume 75 percent balanced design procedures were used.

See Section 3-6.03 for bridges with unknown structural components.

### **3-8.06 Prestressed or Post-Tensioned Concrete**

The following guidelines should be used when load rating prestressed or post-tensioned concrete bridges:

1. Previous codes should not be used to determine the prestressed shear capacity.
2. If the inspection of a prestressed box-beam bridge indicates longitudinal cracking, the cracked beam should be evaluated with a reduced number of strands. Using engineering judgment, assume that at least one strand on each

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

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- side of the crack is not functioning. If rust is visible, it may be appropriate to assume that two or more rows of strands on each side of the rust stain are not functioning.
3. Review box beam standards for depth and strand configuration based on the span length and spacing if details are not provided.
  4. The Indiana Department of Transportation (INDOT) no longer allows the use of a transformed section in design without permission from the design manager. Currently, INDOT code requires that a note on the plans indicates when a transformed section was used for the design of the beams. However, prior to this code change, designs may have incorporated the transformed section without any indication on the plans. A load rating assuming a non-transformed section may result in a lower rating than the original design capacity.

### **3-8.07 Structural Steel**

The following guidelines should be used when load rating steel bridges:

1. Stiffeners should be included in the determination of the shear capacity.
2. Girders that have been made with plates, angles, and channels may be modeled as equivalent plate girders.
3. When load rating gusset connections for non-load-path-redundant steel truss bridges, reference FHWA-IF-09-014, *Load Rating Guidance and Examples for Bolted and Riveted Gusset Plates In Truss Bridges*, February 2009

### **3-8.08 Fracture Critical Bridges**

The following guidelines should be used when load rating fracture critical bridges:

1. The load rating for steel fracture critical bridges with fatigue-prone *connection* details (pins, welds on fracture critical members in tension, E & E' fatigue details, etc.) will be rated if the connection shows any sign of deterioration, or if the dead load supported by the bridge has increased since the bridge was built.
2. For load rating bolted or riveted gusset plates in truss bridges, reference FHWA-TA-5140.29, *Load-carrying Capacity Considerations of Gusset Plates in Non-*

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*load-redundant Steel Truss Bridges*, 15 January, 2008. Accordingly, the following actions are recommended to supplement the provisions of the AASHTO manual:

- a. Bridge owners are strongly encouraged to check the capacity of gusset plates in new or replaced non-load-path-redundant steel truss bridges as part of the initial load ratings.
  - b. Bridge owners are strongly encouraged to check the capacity of gusset plates as part of the load rating calculations of existing non-load-path-redundant steel truss bridges conducted to reflect changes in condition or dead load, to make permit or posting decisions, or to account for structural modifications or other alterations that result in significant changes in stress levels.
  - c. It is recommended that bridge owners review past load rating calculations of non-load-path-redundant steel truss bridges which have been subjected to significant changes in stress levels, either temporary or permanent, to ensure that the capacities of gusset plates were adequately considered.
3. When load rating gusset connections of non-load-path-redundant steel truss bridges, reference the analysis as described in FHWA-IF-09-014, *Load Rating Guidance and Examples for Bolted and Riveted Gusset Plates In Truss Bridges*, February 2009.

### **3-8.09 Timber**

The following guidelines should be used when load rating timber bridges:

1. Design stress values should be based on species and grade as given in AASHTO when they are known or when they can be readily established. Assumptions can be made based on typical species within the area.
2. Impact allowances shall not be applied to timber bridges.

### **3-8.10 Truss Bridge with Timber Deck**

For truss bridges with timber decks, the following elements should be load-rated as a minimum:

1. Timber deck

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

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2. Steel stringers
3. Floor beams
4. Steel truss members

### **3-9.0 DOCUMENTATION**

The documentation of the load rating for each bridge must be a complete record of the load rating. This will ensure that concise and complete data is available in the future should the bridge need to be re-rated for bridge retrofit, modification, age, or deterioration.

#### **3-9.01 Submittal Requirements**

Load Rating submittals for each bridge shall include a load rating summary containing details such as bridge name, bridge number, date of rating, load rating method, program used for rating, data sources used, live loads for rating, field measurements and sketches, photographs and if requested, calculations. Refer to figures 3:9-1 through 3:9-4 that show sample load rating summary sheets for submittal. The load rating summary shall be signed and sealed by a registered Indiana State Professional Engineer approved for load ratings. For State Bridges, the submittals shall be made electronically through email to the Load Rating Engineer, INDOT for review and approval. The approved load rating summary shall be uploaded to the appropriate folder (“other folder”) of the Bridge Inspection Database BIAS. Approved load rating data shall be uploaded into the load rating database by the Load Rating Engineer or designee. For county, toll road and other agency bridges, the same load rating summary shall be used and the responsible load rating team leader shall sign, date and seal the summary and update BIAS county database.

Keeping this information in the BIAS will allow inspectors to have access to detailed load rating information in the field during inspections, and help them gather important measurements on deteriorated and damaged structural members. This information can also be used when load rating information must be accessed in an emergency.

#### **3-9.02 Load Rating Summary**

See Figure 3-9.1 for Load Rating Summary Sheets. Completed Sheets shall be signed, sealed and dated by a State of Indiana Professional Engineer.

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

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**BRIDGE RATING DATA/OUTPUT**  
**For**  
**BRIDGE LOAD CAPACITY RATING**

BRIDGE NUMBER

NBI NUMBER



**Figure 3-9.1 Load Rating Summary (pg 1 of 4)**

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## PART 3: LOAD RATING

Bridge #:	_____		
NBI #:	_____		
Structure Type:	_____		
Description:	_____ _____		
By:	_____	Date:	_____
Checked:	_____	Date:	_____
Load Rating Method:	_____	(LFR/LRFR/Bridges with unknown components (MBE 6.1.4))	
Load Rating Program:	_____		
Year Built:	_____	<u>Location Information</u>	
Year Reconstructed:	_____	County:	_____
Design Loading:	_____	District:	_____
Units:	_____	Reference Post:	_____
<u>Bridge Geometry</u>			
Spans:	_____		
Girder Spacing:	_____		
O-To-O Coping:	_____		
Clear Roadway:	_____		
Left Overhang:	_____		
Skew:	_____		
<u>Slab</u>		<u>Materials</u>	
Total Depth =	_____	Resteel:	_____
Structural Depth =	_____	Deck Concrete:	_____
Wearing Surface:	_____	Beam:	_____
SIP:	_____	Beam Concrete:	_____
		Strands:	_____
Rehab Summary:	_____		
Notes:	(comments by the Engineer, information from drawings, field measurements, material and load test results, sketches, beam typical cross sections, Bridges with unknown structural components (MBE 6.1.4))		

Figure 3-9.1 Load Rating Summary (pg 2 of 4)





# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

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### 3-10.0 POSTING

In Indiana, a number of bridges cannot carry legal loads for various reasons. These include deterioration of load-carrying members, increases in dead load from overlays or other alterations, and design for loads that were lower than what is currently legal. Since most of these bridges need to be kept open to traffic, load posting guidelines have been developed by the Indiana Department of Transportation (INDOT).

#### **3-10.01 Posting Guidelines**

The main objective of this guideline is to ensure the safety of the public. The guidelines must not conflict with Indiana vehicle and traffic laws, or federal regulations. This means that the following minimum criteria must always be met:

1. Bridges shall never be posted for a load that will cause the operating stress level, as defined by American Association of State Highway and Transportation Officials (AASHTO), to be exceeded.
2. The minimum load posting value is three tons. Bridges not capable of carrying a minimum gross live load weight of three tons must be closed.
3. Load posting signs shall conform to the INDOT standards or the minimum requirements of the current *Indiana Manual of Uniform Traffic Control Devices (IMUTCD) for Streets and Highways*.
4. Bridge files should contain all pertinent posting information, along with photographs of the postings in place at both ends of the bridge.

A bridge must be posted to restrict the gross vehicle weight and/or axle weight when the bridge can no longer safely support the maximum legal vehicle weight. *Any bridge that has a H20 inventory load capacity rating factor less than 0.8 or an operating load capacity rating factor less than 1.0 for HS-20, HS25, HL93, AASHTO legal loads (Type 3, Type 3S2, Type 3-3 and SHV's) and any other Indiana legal load shall be posted at the bridge site with a load limit sign equal to the lower value of the vehicle that did not rate at operating or H-20 inventory rating, in tons.* The maximum weight restrictions for vehicles are described in the Indiana Code, Title 9, Article 20 (see Appendix A). *A bridge may be posted with more restrictive load levels if deemed appropriate by the*

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

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*owner.* Factors that may influence posting levels include traffic volume, traffic character, and the likelihood of overweight vehicles.

The Load Rating Team Leader notifies the bridge owner of posting requirements. INDOT reserves the right to withhold federal funding if bridge owners are not posting in accordance with this posting policy.

Posting bridges for load limit is a serious matter. Doing so can create a hardship on the motoring public and industry in the vicinity of the bridge. Bridges that rate low using Allowable Stress (AS) should be re-rated using Load Factor (LF) or Load and Resistance Factor Rating (LRFR) to determine if the bridge can accommodate higher loads based on currently accepted code criteria. Similarly, bridges that rate low using LF should be re-rated using LRFR prior to posting. To ensure that posting is justified, an inspection should be conducted by the Inspection Team Leader to visually confirm the condition, measurements, and other properties of the bridge. When appropriate, a more in-depth analysis of live load distribution should be conducted to assure that the capacity is truly valid.

A one-lane alternative may be considered when evaluating for posting. Normally a bridge will be rated for the normal number of traffic lanes it is capable of carrying; however, if the capacity is less than lower value of H20 Inventory and HS20 Operating, AASHTO Legal Loads, Indiana Legal Loads, the bridge may be checked for a reduced number of lanes. Reducing the number and locations of loaded lanes, and restricting lanes with barrels or stop lights, can keep a bridge from being posted with a weight restriction.

### **3-10.02 Posting Procedure**

If posting is required or warranted for state, county, toll road, or other local agency bridges, the signs should conform and be installed in accordance with the IMUTCD. Signs should be legible from a distance of no less than 50 feet. Additional advance signage shall be placed at the intersection with the last state road prior to the bridge. Advance signage shall be located as necessary to provide prohibited vehicles the opportunity to detour.

Signs must be maintained during the life of the bridge or until repairs have been made to remove the restriction. Postings or closings on state routes should be done according to INDOT's current Bridge Restriction or Closure Protocol (see Appendix B). It is recommended that counties, the toll road, and other local agencies follow a similar

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

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protocol. An official posting/closure letter, signed by a designated official, should be added to the bridge file.

The gross vehicle weight and/or axle weight allowed should be indicated on signs at each end of the bridge *The R12-1 sign is recommended and should be used where weight restrictions exist.* Posting of specific load limits should be accomplished using an R12-1 sign, containing the legend "WEIGHT LIMIT" on the top two lines and the applicable weight limit on the bottom two lines. The weight limits shall be shown as "X TONS." Weight limit signage shall be used to indicate restrictions pertaining to total vehicle weight, including cargo. *The single gross tonnage value shown represents the lowest of all of the legal loads* Failure to post bridges that have capacities less than the posting value can result in a loss of federal bridge funds.

Posting of a bridge closure may be accomplished by the use of an R11-2, "ROAD CLOSED" sign. In addition to signage, significant non-moveable barriers shall be placed at each end of the closed bridge, restricting crossing. A permanent barricade shall be built across both ends of the bridge to prevent vehicles from crossing.

In order to document proper posting of a bridge, photos of the posting shall be taken at each end of the bridge. Photos shall be submitted when they are installed, and at each inspection. An updated Structure Inventory and Appraisal (SI&A) Report shall be submitted and the Central Database shall be updated immediately following any load rating or posting change. These are major National Bridge Inspection Standards (NBIS) compliance review items and the use of federal bridge funds can be suspended for noncompliance.

### 3-11.0 PERMITTING

Except for certain vehicles, which are given a permit exemption, any transport exceeding the maximum legal size and weight limits as established by Indiana law [IC 9-20-3, IC 9-20-4] must obtain a permit prior to moving on Indiana highways. In general, vehicles that exceed these dimensions and weights will require additional efforts and engineering judgment. The Indiana Department of Transportation (INDOT)/Indiana Department of Revenue (IDOR) can only permit vehicles to travel on Interstates and U.S. and State Highways. Local roads, streets, and bridges must be permitted and load-rated through local agencies.

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

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Load ratings shall be done on the individual permitted vehicles for all bridges they will cross, taking into account axle weight, spacing, and impact. Impact effects may be minimized by requiring the vehicle to slow down to five miles per hour (mph) or 10 mph. The trucking company may be required to use a longer trailer with more axles to cross some bridges.

Once the permit vehicle has been analyzed for the intended route, one of four conditions will apply to each individual bridge on the route:

**NO RESTRICTION** – The bridge may be crossed at the maximum allowable speed with no restrictions.

**ONE LANE DISTRIBUTION** – The bridge must be crossed at the maximum allowable speed, travelling in the center of the travel lanes while alone on the bridge.

**SLOWDOWN** – The bridge must be crossed at a reduced speed in the center of the travel lanes while alone on the bridge.

**FAILURE** – The bridge may not be crossed by this particular vehicle. The trucking company may be required to use a longer trailer with more axles to cross some bridges. Additional information regarding weight restrictions and oversize limits can be found in IDOR's Oversize/ Overweight Vehicle Permitting Handbook found at: <http://www.in.gov/dor/files/osowhandbook.pdf>.

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

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### APPENDICES

#### Appendix A Indiana Size and Weight Laws

##### Summary of Indiana Size and Weight Laws under TITLE 9 Article 20

Except for Interstate highway travel, the following vehicles are exempt from size and weight requirements:

1. Machinery or equipment used in highway construction or maintenance by the Indiana department of transportation, counties, or municipalities.
2. A highway construction vehicle when engaged in highway construction and **movement is restricted** to areas under construction and **not open** to public is exempt from size and weight.
3. Farm drainage machinery.
4. Implements of **husbandry** when used **during** farming operations or when so constructed can be moved without damage to the highway.
5. **Firefighting** equipment owned or operated by a political subdivision or volunteer fire department.
7. And **except** for interstate highways does not limit the width or height of a farm vehicle loaded with a farm product, which would include unprocessed leaf tobacco.
8. **Recovery vehicles** are exempt from size and weight requirements **when moving a disabled vehicle** or combination of vehicles for a distance **not exceeding 50 miles**. However, these vehicles **must meet** requirements of **IC 9-20-9-9 and IC 9-20-9-10**.

With some exceptions, the maximum legal weights, with load, allowed under the law can be summarized as follows.

Maximum possible gross weight:	80,000 pounds
Maximum single axle weight:	20,000 pounds
Maximum tandem axle weight:	34,000 pounds
Maximum tri axle weight:	50,000 pounds
Maximum wheel weight:	800 pounds per inch of tire width measured between the flanges of the rim.

For anything beyond these maximum weights, a permit has to be obtained from the Indiana Department of Revenue and certain requirements have to be met. For further information on permits and other information the Indiana Department of Revenue maintains a website at <http://www.state.in.us/dor> or at (317) 615-7320.

#### Vehicle License Plates and Registered Weight

Indiana has a registered weight limit, which is based on the **declared gross weight** (referred to as **registered weight**) for a vehicle when it is registered with the Bureau of Motor Vehicles or International Registration Plan (IRP) and only refers to the amount of registration fee paid according to the amount of weight declared on the registration.

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### Appendix A Indiana Size and Weight Laws

#### **Weight limits for vehicles; rules**

In 1975, Indiana adopted the "Bridge Formula" as state law as stipulated in IC 9-20-40-1.

The formula is used to calculate the maximum legal gross weight and axle weights allowed for a vehicle or combination of vehicles.

$$W = 500 \{[(LN) \div (N-1)] + 12N + 36\}$$

W = the overall gross weight on any group of two or more consecutive axles, to the nearest 500 pounds.

L = the distance between the extreme of any group of two or more consecutive axles. (The measurement is taken at center of the wheel hubs).

N = the number of axles in the group under consideration, except that two consecutive sets of tandem axles may carry a gross load of 34,000 pounds each, providing the first and last axles of the consecutive sets of tandem axles are at least 36 feet apart or more.

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

### Appendix A Indiana Size and Weight Laws

#### FEDERAL BRIDGE FORMULA

Permissible gross loads for vehicles in regular operation.

Based on weight formula  $W=500\left(\frac{LN}{N-1}+12N+36\right)$

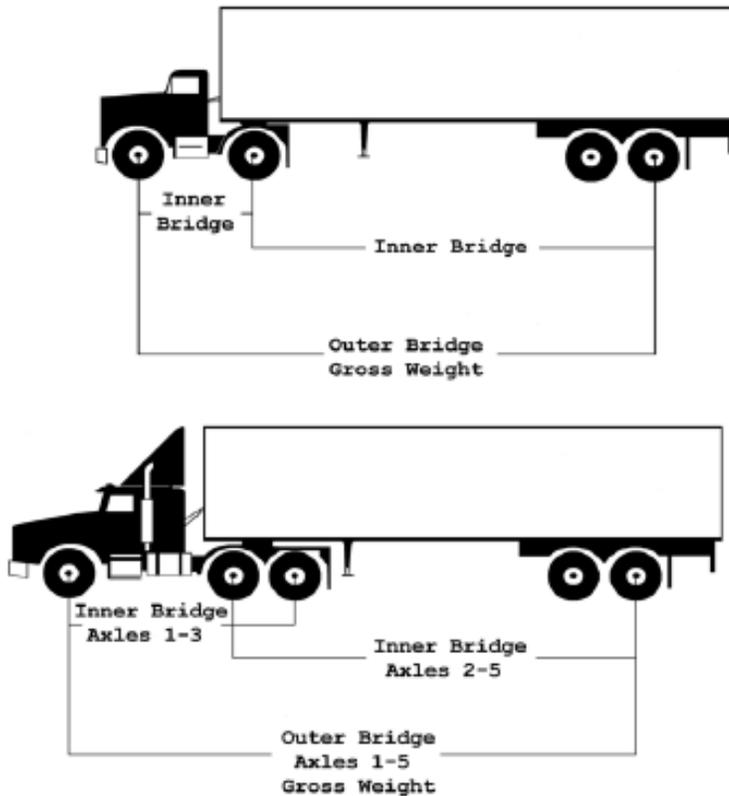
Distance in feet between the extremes of any group of 2 or more consecutive axles	Maximum load in pounds carried on any group of 2 or more axles.							
	2 axles	3 axles	4 axles	5 axles	6 axles	7 axles	8 axles	9 axles
4	34,000							
5	34,000							
6	34,000							
7	34,000							
8 and less	34,000	34,000						
More than 8	38,000	42,000						
9	39,000	42,500						
10	40,000	43,500						
11		44,000						
12		45,000	50,000					
13		45,500	50,500					
14		46,500	51,500					
15		47,000	52,000					
16		48,000	52,500	58,000				
17		48,500	53,500	58,500				
18		49,500	54,000	59,000				
19		50,000	54,500	60,000				
20		51,000	55,500	60,500	66,000			
21		51,500	56,000	61,000	66,500			
22		52,500	56,500	61,500	67,000			
23		53,000	57,500	62,500	68,000			
24		54,000	58,000	63,000	68,500	74,000		
25		54,500	58,500	63,500	69,000	74,500		
26		55,500	59,500	64,000	69,500	75,000		
27		56,000	60,000	65,000	70,000	75,500		
28		57,000	60,500	65,500	71,000	76,500	82,000	
29		57,500	61,500	66,000	71,500	77,000	82,500	
30		58,500	62,000	66,500	72,000	77,500	83,000	
31		59,000	62,500	67,500	72,500	78,000	83,500	
32		60,000	63,500	68,000	73,000	78,500	84,500	90,000
33			64,000	68,500	74,000	79,000	85,000	90,500
34			64,500	69,000	74,500	80,000	85,500	91,000
35			65,500	70,000	75,000	80,500	86,000	91,500
36			66,000	70,500	75,500	81,000	86,500	92,000
37		Exception Indiana Code 9-20-4-1	66,500	71,000	76,000	81,500	87,000	93,000
38			67,500	71,500	77,000	82,000	87,500	93,500
39			68,000	72,500	77,500	82,500	88,500	94,000
40			68,500	73,000	78,000	83,500	89,000	94,500
41			69,500	73,500	78,500	84,000	89,500	95,000
42			70,000	74,000	79,000	84,500	90,000	95,500
43			70,500	75,000	80,000	85,000	90,500	96,000
44			71,500	75,500	80,500	85,500	91,000	96,500
45			72,000	76,000	81,000	86,000	91,500	97,500
46			72,500	76,500	81,500	87,000	92,500	98,000
47			73,500	77,500	82,000	87,500	93,000	98,500
48			74,000	78,000	83,000	88,000	93,500	99,000
49			74,500	78,500	83,500	88,500	94,000	99,500
50			75,500	79,000	84,000	89,000	94,500	100,000
51			76,000	80,000	84,500	89,500	95,000	100,500
52			76,500	80,500	85,000	90,500	95,500	101,000
53			77,500	81,000	86,000	91,000	96,500	102,000
54			78,000	81,500	86,500	91,500	97,000	102,500
55			78,500	82,500	87,000	92,000	97,500	103,000
56			79,500	83,000	87,500	92,500	98,000	103,500
57		Gross Weight Limit Indiana Code 9-20-4-1	80,000	83,500	88,000	93,000	98,500	104,000
58				84,000	89,000	94,000	99,000	104,500
59				85,000	89,500	94,500	99,500	105,000
60				85,500	90,000	95,000	100,500	105,500

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

### Appendix A Indiana Size and Weight Laws

#### EXAMPLES OF BRIDGE FORMULA MEASUREMENTS



Indiana has a “grandfather law” built into its weight law retaining the weight limits that were in effect on January 4, 1975.

This retention protects vehicles from losing weight capability based upon their configuration when the bridge formula is applied to them.

The maximum gross weight, with load, under this subsection is seventy-three thousand two hundred eighty (73,280) pounds.

The maximum weight on an individual axle of a tandem axle group is sixteen thousand (16,000) pounds for each axle.

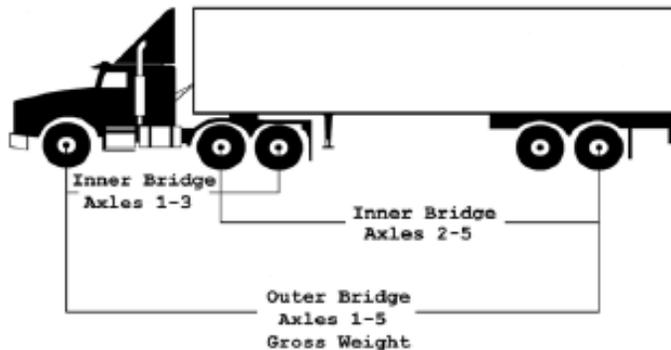
And limited to a maximum wheel weight of eight hundred (800) pounds per inch width of the tire measured between the flanges of the rim, or a maximum axle weight of eighteen thousand (18,000) pounds.

# BRIDGE INSPECTION MANUAL

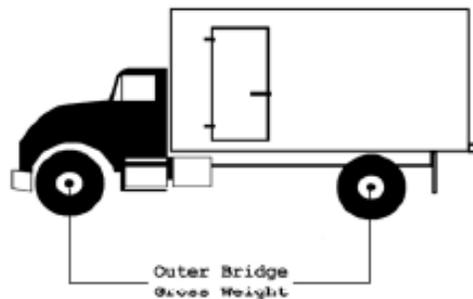
## PART 3: LOAD RATING

### Appendix A Indiana Size and Weight Laws

Examples of vehicles where the “grandfather law”, applies are:



When the outer bridge measurement is less than 40 feet for total gross weight and the tandem axles or inner bridge measurement between axles 2-5 is less than 36 feet, one set of tandems will get at least thirty four thousand (34,000) pounds, but both sets of tandem axles (axles 2-5) would not be able to gross more than sixty four thousand (64,000) pounds when added together as combination axle weight.



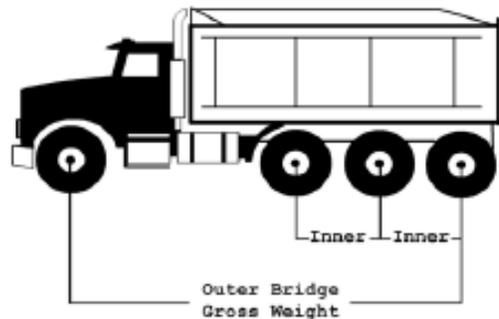
In this example, this vehicle would be penalized for allowable gross weight if the bridge formula were applied; the “grandfather law” allows both axles the potential to weigh twenty thousand (20,000) pounds depending on the size of the rims (tires) and effects potential gross weight.

# BRIDGE INSPECTION MANUAL

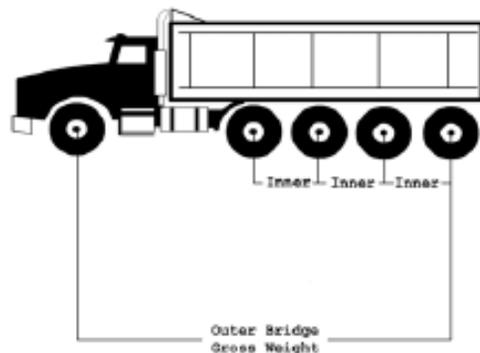
## PART 3: LOAD RATING

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### Appendix A Indiana Size and Weight Laws



While this vehicle would be penalized for total gross weight if the bridge formula were applied, under the “grandfather law” it has the potential to have a gross weight of no more than seventy thousand (70,000) pounds. The tri-axle assembly itself can weigh fifty thousand (50,000) pounds. This can be broken down to thirty-four thousand (34,000) pounds on the tandem and sixteen thousand (16,000) pounds on the single axle, or thirty-two thousand (32,000) pounds on the tandem axle and eighteen thousand (18,000) pounds on the single axle. Again, size of the rim determines wheel weight and gross weight.



This vehicle is also penalized for gross weight if the bridge formula was applied to it. Depending on wheel and axle configuration it has the potential to gross no more than seventy three thousand two hundred eighty (73,280) pounds under the “grandfather law”. And again rim size determines wheel weight and gross weight.

#### **Exceptions: farm commodities and the weight law.**

A vehicle or combination of vehicles transporting farm commodities from the place of production to the first point of delivery where the commodities are weighed and title to the commodities are transferred are allowed ten percent additional weight to the maximum gross weight. For example, if a combination vehicle is allowed a gross weight under the Bridge Formula of eighty thousand (80,000) pounds, with this exception of ten percent, the total gross allowed would be eighty-eight thousand (88,000) pounds.

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

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### Appendix A Indiana Size and Weight Laws

However, this increase in weight is not applicable when the following apply:

1. Weight limits imposed for bridges or sections of highways under IC 9-20-1-4.
2. A vehicle operated on any part of an interstate system.

Axle weights and registered weight is not applicable as long as the two aforementioned instances are not involved, or the vehicle does not exceed the 10 percent tolerance.

Farm commodities include logs, wood chips, bark, sawdust, and bulk milk. In the case of wood chips, bark, and sawdust, the ten percent tolerance is applicable at all times for gross weight and axle weights

#### **Exceptions: Refuse vehicles and the weight law**

Special restrictions apply to a garbage truck, truck-trailer combination, or a truck-wagon combination that is either:

1. A municipal waste collection and transportation vehicle:
  - a. Specially designed and equipped with a self-compactor or detachable container;
  - b. Used exclusively for garbage, refuse, or recycling operations; and
  - c. Laden with garbage, refuse, or recyclables; or
2. A disposal plant transporting vehicle certified under IC 15-2.1-16 that is laden with dead animals or animal parts.

**Except** for Interstate highway travel the maximum allowable gross weight shall not exceed:

1. Twenty four thousand (24,000) pounds on a single axle; and
2. Forty two thousand (42,000) pounds on a tandem axle.

This exception does not exempt trucks, laden or unladen, from the limitations on wheel weights imposed by IC 9-20-11-4.

#### **THE BASIC LEGAL DIMENSIONS ALLOWED ARE:**

Limitations to height, width and length include vehicle and load.

Generally the maximum width is 8'6" except for width exclusive devices as specified in 23 CFR 658, for example, exterior rear view mirrors.

The following are **exceptions** to the **width** requirement:

1. Machinery or equipment used in utility construction or maintenance if the violation is the result of oversize tires
2. A recreational vehicle with appurtenances making the vehicle wider than allowed
  - a. The appurtenances do not extend more than the factory installed exterior rear view mirrors
  - b. And the mirrors only extend to the distance necessary to afford the required field of view.

There is **no exemption** to the legal **height** of 13'6".

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

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### Appendix A Indiana Size and Weight Laws

Maximum length of a single vehicle operating under its own power is 40 feet, except for length exclusive devices as set forth in 23 CFR 658.13.

#### Exemptions

1. A recreational vehicle may measure a maximum of 45 feet.
2. A vehicle used by the railroad companies to transport steel rails in connection with a railroad construction, reconstruction or maintenance project may not exceed 40 feet.
3. A bus (9-20-8-2) must meet one of the following length measurements:
  - a. An articulating bus used for public transportation can be a maximum of 65 feet.
  - b. A conventional school bus can measure 38 feet.
  - c. A transit school bus can be 42 feet.
  - d. All other buses, 45 feet.
4. A single vehicle equipped with a permanently installed specialized equipment used for lifting, reaching, pumping or spraying, is allowed an additional 5 feet overhang of the equipment as long as it is not used to haul cargo.

A combination of two vehicles coupled together, **including load**, may not exceed a total length of sixty feet, except for the following:

1. Constructed to transport other vehicle or boats.
2. A combination of two vehicles coupled together being transported in a drive away or tow away service.
3. A pole trailer owned by or operated for a public utility while the pole trailer is being used in connection with the utility services of the public utility.
4. Trailers used in transporting oil field equipment or pipe for the transportation oil or gas.

A combination of three or more vehicles coupled together, **including load**, may not exceed a total length of sixty-five feet.

Any number of vehicles in a combination coupled together:

1. that are especially constructed to transport other vehicles or boats; and
2. by the tow bar, saddle mount, or full mount methods;

may not exceed a total length of seventy-five feet.

The maximum length of a combination of two vehicles coupled that are commonly referred as “stinger-steered” vehicles and are;

1. especially constructed to transport other vehicles or boats; and
2. a stinger-steered vehicle;

is seventy-five feet.

The maximum length of a trailer used in a truck-tractor-semitrailer-semitrailer combination is twenty-eight feet, six inches.

A maximum overall length limit is not imposed on a truck-tractor-semi trailer-semi trailer combination.

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

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### Appendix A Indiana Size and Weight Laws

The maximum length of a semi trailer, including the load, in a truck-tractor combination is fifty-three feet.

A maximum overall length limit is not imposed on a truck-tractor-semi trailer or truck-tractor semi trailer-trailer combination

The maximum length of a semi trailer or trailer operating in a truck-tractor-semi trailer-trailer combination is twenty-eight feet, six inches.

The maximum length of a maxi-cube vehicle combination is sixty-five feet and the maximum length of the separable cargo-carrying unit is thirty-four feet.

Maximum distance between kingpin and rearmost axle of a semi trailer measuring longer than forty-eight feet, six inches, operating on highway that is part of the state highway system is forty-three feet.

Maximum length of truck-trailer or truck-wagon combinations used in refuse operations is limited to sixty-eight feet.

For further information on Title 9 Article 20, and additional information on size and weight requirements the Indiana General Assembly may be referenced at <http://www.in.gov/legislative/ic/code/title9/ar20/>.

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

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### Appendix B Restriction or Closure Protocol

#### Emergency Bridge Restriction or Closure Protocol (Effective October 1, 2008)

The protocol details the required actions to restrict/close a bridge structure or roadway below a bridge structure due to an unsafe condition brought about by collision, deterioration or other factor and lists the necessary personnel to be notified of the subsequent intervention.

- 1.) District is made aware of an unsafe condition; district radio room contacts the District Bridge Inspection Engineer or designee and the appropriate Subdistrict Manager. The Subdistrict coordinates with the District Bridge Inspection Section to determine equipment needs and traffic control requirements to perform the immediate inspection.
- 2.) The District Bridge Inspection Section informs by telephone and e-mail the Office of Structural Services (George Snyder, Bridge Rehab Unit Supervisor 317-232-5163, 317-370-3603) of the condition. (If determination of an immediate dangerous situation is made by District forces, they should take action as appropriate.)
  - a. The Deputy Commissioner of Highway Management, the Deputy Commissioner of Planning Operations, the Division Director of Production Management and the Bridge Inventory Section in the Bridge Programs Section of the Engineer Program Division are notified of the situation by the Bridge Rehab Unit.
- 3.) If District determines that additional input is required, the District Bridge Inspection Section and the Bridge Rehab Unit inspect the bridge structure as soon as possible to determine the need for restriction/closure and to determine the need for non-INDOT assistance.

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

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### Appendix B Restriction or Closure Protocol

- a. If no restriction/closure is required, no further protocol activity is required. (Subsequent plan development may be undertaken by a District assigned consultant or the Bridge Rehab Unit)
  - b. If closure is required, an official detour is determined by the District. Any computations required to justify the closing will be performed/reviewed and maintained by the Office of Structural Services. (Subsequent plan development may be undertaken by a District assigned consultant or the Bridge Rehab Unit)
  - c. If restriction is required, appropriate action is taken i.e. lane closure, shoulder closure, load restriction, etc. (Subsequent plan development may be undertaken by a District assigned consultant or the Bridge Rehab Unit) In the case of a load restriction, the Office of Structural Services will perform/review any necessary load rating activities and maintain all required computations; the District will develop and sign the appropriate Official Action for the legal weight restriction.
- 4.)The District will inform the following parties of closure or restriction information:
- a. Office of Communications
  - b. Commissioner and Chief of Staff
  - c. Bridge Inventory Section
  - d. Deputy Commissioner of Highway Management
  - e. Deputy Commissioner of Planning Operations
  - f. Prod Management Division Director/Office of Str. Services
  - g. Deputy Commissioner of Highway Operations
  - h. Permits Section Supervisor of Maintenance Administration
  - i. Traffic Management Centers Director

# BRIDGE INSPECTION MANUAL

## PART 3: LOAD RATING

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### Appendix B Restriction or Closure Protocol

- 5.) A brief written action plan will be prepared within one business day by the District and distributed to all mentioned parties. If requested by the District, the Office of Structural Services will assist in the preparation.

 11/20/08  
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Gary Mroczka, Director  
Production Management Division