OHIO DEPARTMENT OF TRANSPORTATION
CENTRAL OFFICE, 1980 W. BROAD ST., COLUMBUS, OHIO 43216-0899

July 21, 2017

To: Users of the Bridge Design Manual

From: Tim Keller, Administrator, Office of Structural Engineering

By: Sean Meddles, Assistant Administrator, Office of Structural Engineering

Re: 2017 Third Quarter Revisions

Revisions have been made to the ODOT Bridge Design Manual, January 2004. These revisions shall be implemented on all Department projects that begin Stage 2 plan development date after July 21, 2017. Implementation of some or all of these revisions for projects further along the development process should be considered on a project-by-project basis.

This package contains the revised pages. The revised pages have been designed to replace the corresponding pages in the book and are numbered accordingly. Revisions, additions, and deletions are marked in the revised pages by the use of one vertical line in the right margin. The header of the revised pages is dated accordingly.

To keep your Manual correct and up-to-date, please replace the appropriate pages in the book with the pages in this package.

To ensure proper printing, make sure your printer is set to print in the 2-sided mode.

The January 2004 edition of the Bridge Design Manual may be downloaded at no cost using the following link:

http://www.dot.state.oh.us/Divisions/Engineering/Structures/Pages/default.aspx

Attached is a brief description of each revision.

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Summary of Revisions to the January 2004 ODOT BDM

BDM Section	Affected Pages	Revision Description
301.4.3.2.b	3-3.2	Design guidance has been provided for the use of Fiber Reinforced Polymer (FRP) wrap systems to improve the ductility of existing concrete columns.
412.2	4-21	Clarification has been provided for estimating the quantity for hand chipping pay items.
900	9-1 through 9-54	The entirety of Section 900 has been revised. Listed below is a summary of major items: • Fixing America's Surface Transportation Act (FAST Act) introduced new legal vehicles that encompass the fleet of emergency vehicles. This section has defined two new legal vehicles, EV2 & EV3, which shall be rated where applicable. • Provided clarifying figures for all eight rating vehicles (2F1, 3F1, 4F1, 5C1, SU4, SU5, SU6 & SU7) and two new emergency vehicles (EV2 & EV3) • Clarified that structures which are not in a travel lane are exempt from load rating. • Provided some guidance for using OSE spreadsheets where applicable. • Introduced a new load posting sign for non-emergency vehicles. • Introduced posting requirements for emergency vehicles including new emergency vehicle posting sign. • Introduced AASHTO BrD software (formerly Opis). • Added a requirement to include Future Wearing Surface loading in load rating calculations with a minimum acceptable inventory RF for new bridges. • Added a requirement for the designer to provide the load rating for new buried precast concrete boxes with spans greater than 20-ft. • Added a requirement for the designer to provide the load rating for new flat tops, catch basins and inlet tops where applicable.

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301.4.3.2 EXISTING STRUCTURES

Seismic vulnerability of a structure shall be considered for rehabilitation projects requiring complete deck or superstructure replacements. New substructure units shall be designed in accordance with *LRFD 3.10.9.2, 4.7.4.4* and *AASHTO Standard Specification 8.18.2*. If sufficient geotechnical information is not available, Designers may assume:

A. $A_S > 0.05$

B. $S_{D1} < 0.10$.

301.4.3.2.a SUPERSTRUCTURE

For projects where seismic vulnerability is considered, at bearing locations that will transmit the horizontal connection force from the substructure to the superstructure, crossframes designed to resist the horizontal connection force shall be provided to create a direct load path to the deck. For supports not in compliance with *LRFD 4.7.4.4*, seismic restrainers designed for the Horizontal Connection Force, specified in BDM Section 301.4.3.1.b, shall be provided.

301.4.3.2.b SUBSTRUCTURE

For projects where seismic vulnerability is considered, concrete columns at piers that transfer the seismic horizontal connection force, according to BDM Section 301.4.3.1.b, shall meet the spiral and tie ductility requirements of *AASHTO Standard Specification 8.18.2*. Designers may consider releasing restraint provided by existing pier bearings as a viable seismic retrofit provided the abutments can accommodate the additional horizontal Strength and Service loadings. Otherwise, Designers shall provide the required confinement of the primary steel in the axially loaded substructure members.

One acceptable method to increase the amount of confinement provided in an existing concrete column is through the use of Fiber Reinforced Polymer (FRP) wrap systems. These systems are a viable alternative for dry columns supported on pile caps, spread footings and drilled shafts. Research has shown that providing a confining stress of 0.300 ksi in regions where plastic hinges may form at the top and bottom of columns as defined in *LRFD 5.10.11.4.1e* and providing a confining stress of 0.150 ksi outside of the plastic hinge regions is sufficient to prevent buckling of the longitudinal reinforcement.

ODOT has a Proposal Note for Composite Fiber Wrap Systems which references the International Code Council Evaluation Service website (www.icc-es.org) for acceptable FRP wrap products. Refer to the Designer Notes for plan information associated with this work.

For bridges located in regions with an acceleration coefficient, $S_{D1} < 0.10$, Designers shall specify a confining stress due to FRP jacket (f_1) of 0.150 ksi for the entire height of the column from the top of the footing/drilled shaft to the bottom of the cap. For bridges located in regions with an acceleration coefficient, $S_{D1} \geq 0.10$, Designers shall specify a confining stress due to FRP jacket (f_1) of 0.300 ksi in the plastic hinge regions as defined in *LRFD 5.10.11.4.1e* and 0.150 ksi in the remaining portions of the columns. The plans shall show an elevation view of the columns with these confining stress regions clearly defined.

301.5 REINFORCING STEEL

Reinforcing steel - ASTM A615 or A996, Grade 60, F_y = 60,000 psi.

Reinforcing steel - ASTM A615M or A996M, Grade 420, F_y= 420 MPa

All reinforcing steel shall be epoxy coated.

301.5.1 MAXIMUM LENGTH

Generally maximum length of reinforcing steel should be 40 feet [12.2 meters]. This limit is for both transit purposes and construction convenience. The maximum length before a lap splice is required is 60 feet [18.4 meters]. To facilitate an economical design using 60 foot bar stock, where multiple sets of lapped bars are required (i.e. longitudinal slab reinforcement) consideration should be given to using multiple sets of 30 foot long bars.

The length of the short dimension of L-shaped bars should be limited in order not to extend beyond the sides of a highway vehicle of maximum legal width. The short dimension should preferably be not greater than 7'-6" [2300 mm], and in no case greater than 8'-0" [2450 mm].

301.5.2 BAR MARKS

Bar marks shall be used on detail plans to identify the bar's size and general location and to reference the bar to the reinforcing bar list.

Letters should be incorporated into the bar marks to help identify their location in the detail plans: "A" for abutments, "P" for piers, "S" for superstructure, “SP” for spirals, “DS” for drilled shafts, etc.

The following bar mark represents a #5 [16M] abutment bar .... <u>A</u>501 [<u>A</u>16M01]
The following bar mark represents a #4 [13M] spiral bar .... <u>SP</u>401 [<u>SP</u>13M01]
The following bar mark represents a #9 [29M] drilled shaft bar .... <u>DS</u>901 [<u>DS</u>29M01]

A note or legend within the bar list sheet in the plans shall describe each bar mark's meaning. See Figure 302.

301.5.3 LAP SPLICES

Bar splice lengths shall be shown on the plans.

Development and splice lengths shall conform to AASHTO requirements.

Reinforcing steel at construction joints should extend into the next pour only by the required

Hand chipping bid items for overlay projects are associated with variable thickness quantities. Using 10% of the variable thickness surface area for quantities is one alternative, but other methods may be acceptable. Take note that this percentage is based on the variable thickness surface area and not the entire deck surface area. Another method would be to get local experience from the District Maintenance and Construction personnel as to what percentage would be best to use.

Accurate records of actual quantities shall be maintained for each bridge.

It is recommended that the Districts review any criteria for selecting rehabilitation and replacement projects with the Offices of Maintenance Administration and Structural Engineering to help assure statewide consistency on rehabilitation or replacement deck projects.

It should be noted that in all cases, maintaining the structural integrity of the structure is of prime importance. The effects of exposing large areas of the top mat of reinforcing in areas such as cantilevered parapets, negative moment reinforcing over beams on stringer bridges and over piers on continuous slab bridges and in other areas of a critical nature shall be clearly understood from a design standpoint.

413 REFERENCES

A. FHWA-RD-78-133, “Extending the Service Life of Existing Bridges by Increasing Their Load Carrying Capacity,” 1978

B. NCHRP Report 206, “Detection and Repair of Fatigue Damage in Welded Highway Bridges,” 1978

C. NCHRP Report 222, “Bridges on Secondary Highways and Local Roads -- Rehabilitation and Replacement,” 1980

D. NCHRP Project 12-17 Final Report, “Evaluation of Repair Techniques for Damaged Steel Bridge Members: Phase l,” 1981

E. NCHRP Report 243, “Rehabilitation and Replacement of Bridges on Secondary Highways and Local Roads,” 1981

F. NCHRP Report 271, “Guidelines for Evaluation and Repair of Damaged Steel Bridge Members,” 1984

G. NCHRP Report 293, “Methods of Strengthening Existing Highway Bridges,” 1987

H. NCHRP Report 333, “Guidelines for Evaluating Corrosion Effects in Existing Steel

Bridges," 1990

I. Park, Sung H., "Bridge Rehabilitation and Replacement (Bridge Repair Practice)," S. H. Park, P.O. Box 7474, Trenton, N.J., 08628- 0474, 1984

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SECTION 900 – BRIDGE LOAD RATING

901 PURPOSE

The purpose of this Section is to provide consistency and uniformity in the procedures, guidelines and policies for determining safe live load carrying capacity or load rating of the highway bridges in the State of Ohio.

902 SCOPE

The guidelines, policies and recommendations provided in this Section are meant to assist bridge owners and bridge raters by establishing evaluation practices that meet the Ohio Revised Code (ORC), the National Bridge Inspection Standards (NBIS), ODOT Bridge Design Manual (BDM) and American Association of State Highway Transportation Officials (AASHTO). The intent of this Section is to establish standardized load rating procedures conforming to FHWA reporting requirements and posting of bridges in the State of Ohio.

903 APPLICABILITY

903.1 APPLICABILITY OF AASHTO DESIGN SPECIFICATIONS

BDM Section 900 is consistent with the current AASHTO LRFD Bridge Design Specifications and Standard Specifications for Highway Bridges (14th Edition). Where this Section is silent, the current AASHTO LRFD Bridge Design Specifications or Standard Specifications for Highway Bridges shall govern for LRFR and LFR methods respectively.

903.2 APPLICABILITY TO HIGHWAY BRIDGES

The provisions of this Section apply to all highway structures in Ohio that qualify as bridges in accordance with the definition for a bridge set herein. These provisions may be applied to smaller structures which do not qualify bridges, as such.

904 QUALITY MEASURES

To maintain the accuracy and consistency of load rating, bridge owners should implement appropriate quality assurance and quality control (QA/QC) measures. Typical quality control procedures include the use of checklists to ensure uniformity and completeness, the review of reports and computations by a person other than originating individual and periodic field review of the inspection teams and their work.

Each load rating analysis shall be performed under the supervision of an Ohio registered professional engineer (i.e. the load rater) who will sign and stamp (seal) the final load rating report before submission to the bridge owner.

905 DEFINITIONS AND TERMINOLOGY

ASR: Allowable Stress Rating (also known as Working Stress Rating)

ADT: Average Daily Traffic volume

ADTT: Average Daily Truck Traffic volume

BR100: A load rating summary form (spreadsheet) internally developed by ODOT.

Bridge: A structure, including supports, erected over a depression or an obstruction such as water, highway, bikeway or railway; and having a roadway to carry vehicular traffic and having an opening measured along the centerline of the roadway of 10-ft or more between under-copings of abutments or spring lines of arches or extreme ends of openings for multiple boxes. It may also include multiple pipes where the clear distance between openings is less than half that of the smaller contiguous opening.

Bridge Number: A combination of 3-letter County Abbreviation − Route Number − County Log Point, in miles, followed by parallel designation, if any (e.g., HAM-00071-10.680R); 3-letter County Abbreviations are given in ODOT L&D Manual, Volume I

Bridge Management System (BMS): A system designed to optimize the use of available resources for the inspection, maintenance, rehabilitation, and replacement of bridges

Bridge Owner: A public or private entity that has jurisdiction over the bridge or an agency having major maintenance responsibility for a bridge. Generally, an entity responsible for the major maintenance of a bridge is considered owner of the bridge.

Buried Structure: A structure, including a flat slab, an arch, a frame, a box section, etc. that has a fill or pavement material of 2-ft or more on top of it

Collapse: A major change in the geometry of the bridge rendering it unfit for its intended use

Condition Rating: The result of the assessment of the functional capability and the physical condition of a bridge’s components by considering the extent of deterioration and other defects. Generally, Condition Rating is evaluated on a scale “0” through “9” (where “9” is the best).

Control Authority Program Manager (CAPM): The designated person at a public transportation entity (Control Authority) responsible for overseeing FHWA's National Bridge Inspection Program for that entity

County Log Point: Distance in miles from the point where a route enters the county or the starting point of a route within the county traveling in the up-station direction from south-to-north or west-to-east

Emergency Vehicle (EV): An emergency vehicle as defined in the *Fixing America's Surface Transportation Act* (FAST Act) is designed to use under emergency conditions to transport personnel and equipment to support the suppression of fires and mitigation of other hazardous situations (23 U.S.C. 127(r)(2)). The GVW limit for an EV is 86,000 pounds. The statute imposes the following additional limits:

(A) 24,000 pounds on a single steering axle;

(B) 33,500 pounds on a single drive axle;

(C) 62,000 pounds on a tandem axle; or

(D) 52,000 pounds on a tandem rear drive steering axle.

For the purpose of load rating, two EV configurations are shown in Figure 908.3-3.

EV-Qualified Bridge: A bridge which is required to be load rated for the EVs shall meet the following criteria:

(A) NBI length;

(B) Carries Interstate state mainline traffic, or is a ramp bridge on an interstate interchange or is located within one mile from an entrance or exit point of an interstate interchange.

Exemption List: A list of structures exempt from the requirements of load rating given in this section

Failure: A condition where a limit state is reached or exceeded. This may or may not involve collapse or other catastrophic occurrences.

FHWA: Federal Highway Administration – U.S. Department of Transportation

General Appraisal (GA): The lowest of the Condition or Appraisal Summary Rating of the substructure and the superstructure of a bridge; or in case of a culvert the Summary Rating of the culvert.

GVW: Gross Vehicle Weight

Inventory Rating: Load ratings based on the inventory level allow comparisons with the capacity for new structures and, therefore, result in a live load that can safely utilize a structure for an indefinite period of time

Health Index: An indicator of the structural health of an element, a bridge or a group of bridges expressed as a value (0 to 100), where 100 corresponds to best possible condition

Legal Weight: Rating Factor (RF) times legal GVW of truck; legal weight cannot be more than the GVW of the legal load

LFR: Load Factor Rating

Limit State: A condition beyond which a bridge or a component ceases to satisfy the criteria for which it was designed

Load Effect: The response (axial force, shear force, bending moment, torque, etc.) in a member or an element due to the loading

Load Factor: A load multiplier accounting for the variability of the loads, the lack of accuracy in analysis and the probability of simultaneous occurrence of different loads

Load Rater: An individual person responsible for the load rating of a bridge. The Load Rater shall be a professional engineer registered in the State of Ohio.

Load Rating: The determination of the safe live-load carrying capacity of a bridge

Long Span Bridge: Any single or multi-span bridge that has at least one span greater than 200-ft

LRFD: Load and Resistance Factor Design

LRFR: Load and Resistance Factor Rating

MBE: AASHTO Manual for Bridge Evaluation

NBI: National Bridge Inventory; the aggregation of structure inventory and appraisal data collection to fulfill the requirements of National Bridge Inspection Standards (NBIS).

NBI Bridge: A structure including supports over a depression or an obstruction such as water, highway, or railway; having a roadway to carry vehicular traffic and having an opening measured along the centerline of the roadway of more than 20-ft. between under-copings of abutments or spring lines of arches or extreme ends of openings for multiple boxes. It may also include multiple pipes, where the clear distance between openings is less than half that of the smaller contiguous opening.

NBIS: National Bridge Inspection Standards; Federal regulations establishing requirements for the bridge inspection organization, its inspection procedures, the frequency of inspection, the qualification of personnel, inspection reports, and preparation and maintenance of bridge inventory records. The NBIS applies to all structures defined as NBIS bridges located on or over all public roads.

Nominal Resistance: Resistance of a component or connection to load effect, based on its geometry, permissible stresses and specified strength of materials

Non-Buried Structure: A structure, including a flat slab, an arch, a frame, a box section, etc., that has a fill or pavement material of less than 2-ft on top of it

Non-ODOT Bridge: A bridge on which ODOT does not have jurisdiction or major maintenance responsibility

ODOT: Ohio Department of Transportation

ODOT Bridge: A bridge on which ODOT has jurisdiction or major maintenance responsibility

Operating Rating: 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.

ORC: Ohio Revised Code (as amended and adopted)

OSE: ODOT Office of Structural Engineering

Pavement of a Roadway: The pavement of a roadway includes all the paved or unpaved portions of a roadway including graded shoulders that may support vehicular traffic

PDF: Portable Document Format, a type of industry standard electronic file format developed by the Adobe Corporation

Posting: Signing a bridge for load restriction

Posting Load: Rating Factor (RF) times legal GVW of Ohio Legal Load; posting load cannot be more than the GVW of the legal load

Preliminary Design Date: The date when Federal-aid funds are obligated for the studies or design activities related to identification of the type, size, and/or location of bridges. For ODOT projects following the Project Development Process (PDP), this date corresponds to the initiation of Step 1 for a Minimal Project, Step 3 for a Minor Project or Step 6 for a Major Project.

Quality Assurance: The use of sampling and other measures to assure the adequacy of quality control procedures in order to verify and measure the quality level of the entire bridge inspection and load rating program

Reliability Index: A computed quantity defining the relative safety of a structural element or structure expressed as the number of standard deviations that the mean of the margin of safety falls on the safe side

Resistance Factor: A resistance multiplier accounting for the variability of material properties, structural dimensions, workmanship and the uncertainty in the prediction of resistance

RF: Rating Factor, an indicator of live load carrying capacity of a member or a bridge for a specific truck or load

Safe Load Capacity: A live load that can safely utilize a bridge repeatedly over the duration of a specified inspection cycle

Service Limit State: Limit state related to stress, deformation and cracking

Serviceability: A term that denotes restrictions on stress, deformation, and crack opening under regular service conditions

Serviceability Limit State: Collective term for service and fatigue limit states

Strength Limit State: Safety limit state relating to strength and stability

Structurally Deficient (SD): Starting January 1, 2018, when the lowest rating of the 3 NBI Items 58-Deck, 59-Superstructure, 60-Substructure for a bridge or the Item 62-Culvert for a culvert is 4, 3, 2, 1, or 0, the bridge or culvert shall be classified as Poor or Structurally Deficient.

Structure Management System (SMS): ODOT's new Bridge Information & Collection System which replaced the old BMS, designed to optimize the use of available resources for the inspection, maintenance and rehabilitation of structures. SMS is based on Bentley's Inspect Tech System.

Superload: In Ohio, a Superload is any highway vehicular load with the total gross load equal to or more than 120,000 pounds (60 tons)

Target Reliability: A desired level of reliability in a proposed evaluation

906 REFERENCES FROM OHIO REVISED CODE

References from the ORC related to bridge load rating and posting are as follows:

5577.042 [Effective 6/29/2011] Weight provisions for farm, log and coal trucks and farm machinery

(A) As used in this section:

(1) "Farm machinery" has the same meaning as in section 4501.01 of the Revised Code.

(2) "Farm commodities" includes livestock, bulk milk, corn, soybeans, tobacco, and wheat.

(3) "Farm truck" means a truck used in the transportation from a farm of farm commodities when the truck is operated in accordance with this section.

(4) "Log truck" means a truck used in the transportation of timber from the site of its cutting when

the truck is operated in accordance with this section.

(5) “Coal truck” means a truck transporting coal from the site where it is mined when the truck is operated in accordance with this section.

(6) “Solid waste” has the same meaning as in section 3734.01 of the Revised Code.

(7) “Solid waste haul vehicle” means a vehicle hauling solid waste for which a bill of lading has not been issued.

(B)(1) Notwithstanding sections 5577.02 and 5577.04 of the Revised Code, the following vehicles under the described conditions may exceed by no more than seven and one-half per cent the weight provisions of sections 5577.01 to 5577.09 of the Revised Code and no penalty prescribed in section 5577.99 of the Revised Code shall be imposed:

(a) A coal truck transporting coal, from the place of production to the first point of delivery where title to the coal is transferred;

(b) A farm truck or farm machinery transporting farm commodities, from the place of production to the first point of delivery where the commodities are weighed and title to the commodities is transferred;

(c) A log truck transporting timber, from the site of its cutting to the first point of delivery where the timber is transferred;

(d) A solid waste haul vehicle hauling solid waste, from the place of production to the first point of delivery where the solid waste is disposed of or title to the solid waste is transferred.

(2) In addition, if any of the vehicles listed in division (B) (1) of this section and operated under the conditions described in that division does not exceed by more than seven and one-half per cent the gross vehicle weight provisions of sections 5577.01 to 5577.09 of the Revised Code, no wheel or axle-load limits shall apply and no penalty prescribed in section 5577.99 of the Revised Code for a wheel or axle overload shall be imposed.

(C) If any of the vehicles listed in division (B) (1) of this section and operated under the conditions described in that division exceeds by more than seven and one-half per cent the weight provisions of sections 5577.01 to 5577.09 of the Revised Code, both of the following apply without regard to the seven and one-half per cent allowance provided by division (B) of this section:

(1) The applicable penalty prescribed in section 5577.99 of the Revised Code;

(2) The civil liability imposed by section 5577.12 of the Revised Code.

(D) (1) Division (B) of this section does not apply to the operation of a farm truck, log truck, or farm machinery transporting farm commodities during the months of February and March.

(2) Regardless of when the operation occurs, division (B) of this section does not apply to the

operation of a vehicle on either of the following:

(a) A highway that is part of the interstate system;

(b) A highway, road, or bridge that is subject to reduced maximum weights under section 4513.33, 5577.07, 5577.071, 5577.08, 5577.09, or 5591.42 of the Revised Code.

Amended by 129th General Assembly File No. 7, HB 114, § 101.01, eff. 6/29/2011.

Effective Date: 03-31-2003; 09-16-2004

This section is set out twice. See also § 5577.042, effective until 6/29/2011.

5577.043 [Effective 6/29/2011] Permissible weight variations for certain vehicles

(A) Notwithstanding sections 5577.02 and 5577.04 of the Revised Code, the following vehicles under the described conditions may exceed by no more than five per cent the weight provisions of sections 5577.01 to 5577.09 of the Revised Code and no penalty prescribed in section 5577.99 of the Revised Code shall be imposed:

(1) A surface mining truck transporting minerals from the place where the minerals are loaded to any of the following:

(a) The construction site where the minerals are discharged;

(b) The place where title to the minerals is transferred;

(c) The place of processing.

(2) A vehicle transporting hot mix asphalt material from the place where the material is first mixed to the paving site where the material is discharged;

(3) A vehicle transporting concrete from the place where the material is first mixed to the site where the material is discharged;

(4) A vehicle transporting manure, turf, sod, or silage from the site where the material is first produced to the first place of delivery;

(5) A vehicle transporting chips, sawdust, mulch, bark, pulpwood, biomass, or firewood from the site where the product is first produced or harvested to first point where the product is transferred.

(B) In addition, if any of the vehicles listed in division (A) of this section and operated under the conditions described in that division does not exceed by more than five per cent the gross vehicle weight provisions of sections 5577.01 to 5577.09 of the Revised Code, no wheel or axle load limits shall apply and no penalty prescribed in section 5577.99 of the Revised Code for a wheel or axle overload shall be imposed.

(C) If any of the vehicles listed in division (A) of this section and operated under the conditions described in that division exceeds by more than five per cent the weight provisions of sections 5577.01 to 5577.09 of the Revised Code, both of the following apply without regard to the allowance provided by division (A) of this section:

(1) The applicable penalty prescribed in section 5577.99 of the Revised Code;

(2) The civil liability imposed by section 5577.12 of the Revised Code.

(D) Divisions (A) and (B) of this section do not apply to the operation of a vehicle listed in division (A) of this section on either of the following:

(1) A highway that is part of the interstate system;

(2) A highway, road, or bridge that is subject to reduced maximum weights under section 4513.33, 5577.07, 5577.071, 5577.08, 5577.09, or 5591.42 of the Revised Code.

Added by 129th General Assembly File No. 7, HB 114, § 101.01, eff. 6/29/2011.

5577.071 Reduction of weight of vehicle or load or speed on deteriorated or vulnerable bridge

(A) When deterioration renders any bridge or section of a bridge in a county insufficient to bear the traffic thereon, or when the bridge or section of a bridge would be damaged or destroyed by heavy traffic, the board of county commissioners may reduce the maximum weight of vehicle and load, or the maximum speed, or both, for motor vehicles, as prescribed by law, and prescribe whatever reduction the condition of the bridge or section of the bridge justifies. This section does not apply to bridges on state highways.

(B) A schedule of any reductions made pursuant to division (A) of this section shall be filed, for the information of the public, in the office of the board of county commissioners in each county in which the schedule is operative. A board of county commissioners that makes a reduction pursuant to division (A) of this section shall, at least one day before a reduction becomes effective, cause to be placed and retained on any bridge on which a reduction is made, at both ends of the bridge, during the period of a reduced limitation of weight, speed, or both, signs of substantial construction conspicuously indicating the limitations of weight or speed or both which are permitted on the bridge and the date on which these limitations go into effect. No person shall operate upon any such bridge a motor vehicle whose maximum weight or speed is in excess of the limitations prescribed. The cost of purchasing and erecting the signs provided for in this division shall be paid from any fund for the maintenance and repair of bridges and culverts.

(C) Except as otherwise provided in this division, no reduction shall be made pursuant to division (A) of this section on a joint bridge as provided in section 5591.25 of the Revised Code unless the board of county commissioners of every county sharing the joint bridge agrees to the reduction, the amount of the reduction, and how the cost of purchasing and erecting signs indicating the limitations of weight and speed is to be borne. A board of county commissioners may make a reduction pursuant to division (A) of this section on a section of a joint bridge, without the agreement [of] any other county sharing the bridge, if the section of the bridge on which the reduction is to be made is located solely in that county.

5591.42 Carrying capacity of bridges - warning notice

The board of county commissioners together with the county engineer or an engineer to be selected by the board, or the director of transportation, may ascertain the safe carrying capacity of the bridges on roads or highways under their jurisdiction. Where the safe carrying capacity of any such bridge is ascertained and found to be less than the load limit prescribed by sections 5577.01 to 5577.12 of the Revised Code, warning notice shall be conspicuously posted near each end of the bridge. The notice shall caution all persons against driving on the bridge a loaded conveyance of greater weight than the bridge's carrying capacity.

Effective Date: 11-02-1989

907 BRIDGE FILES (RECORDS)

Bridge owners shall maintain a complete, accurate and current record of each bridge under their jurisdiction. Complete information, in good usable form, is vital to the effective management of bridges. Such information provides a record that may be important for repair, rehabilitation, replacement and future planning.

Items that shall be assembled as part of the bridge record are discussed below. Some or all of the information pertaining to a bridge may be stored in electronic format as part of a bridge management system.

907.1 CONSTRUCTION PLANS

Each bridge record should include one clear and readable set of all drawings used to construct, repair and/or rehabilitate the bridge. In lieu of hard copies, the construction plans may be stored in an electronic format in such a way that clear and readable paper copies can easily be reproduced from the electronic records.

907.2 CONSTRUCTION & MATERIAL SPECIFICATIONS

Each bridge record should include the reference to the construction and material specification used during the construction of the bridge. Where general technical specifications were not used, only the special technical provisions need to be incorporated in the bridge record.

907.3 SHOP AND WORKING DRAWINGS

One set of all shop and working drawings approved for the construction or repair of a bridge should be saved or preserved as a part of the bridge record.

907.4 AS-BUILT DRAWINGS

Each bridge record should include one set of final drawings showing the "as-built" condition of the bridge, complete with signature of the individual responsible for recording the as-built conditions.

907.5 CORRESPONDENCE

Include all pertinent letters, memoranda and notices of project completion, telephone memos and other related information directly concerning the bridge in chronological order in the bridge record.

907.6 INVENTORY DATA

A complete inventory of a bridge in the ODOT BMS/SMS shall be done as soon as a bridge is open to traffic. FHWA mandates an ODOT bridge shall be inventoried within 90 days and a non-ODOT bridge shall be inventoried within 180 days from the day the bridge was open to traffic. The same rule applies to modifications in the inventory record of replaced bridges or bridges that have been reopened after repairs are done. Initial inventory can be completed using the bridge plans. However, a history of dates of physical closing or opening of the traffic on the bridge should be maintained in the bridge record.

907.7 INSPECTION HISTORY

Each bridge record shall include a chronological record of the date and the type of all inspections performed on the bridge. When available, scour, seismic, wind and fatigue evaluation studies; fracture critical information; deck evaluations; field load testing, and; corrosion studies should be part of the bridge record.

907.8 PHOTOGRAPHS

Each bridge record shall at least contain photographs of the bridges showing top view, approach views and the elevation. Other photos necessary to show major defects, damages or other important features such as utilities on or under the bridge should also be included.

907.9 RATING RECORDS

The bridge record shall include a complete record of the determination of bridge's load-carrying capacity.

907.10 ACCIDENT DATA

Details of accidents or damage occurrences including date, description of accident, member damage and repairs, as supported by photographs and investigation reports, shall be included in the bridge record.

907.11 MAINTENANCE AND REPAIR HISTORY

Each bridge record shall include a chronological record documenting the maintenance and repairs that have occurred since the initial construction of the bridge. Include details such as date, description of project, contractor cost and related data for in-house projects as well as contracted work.

907.12 POSTING HISTORY

Each bridge record shall include a summary of all load posting and rescinding actions taken for the bridge, including load capacity calculations, date of posting and description of signing used.

908 GENERAL

908.1 APPLICATION

The provisions of BDM Section 900 apply to ODOT bridges. All provisions of BDM Section 900 may also be applied to non-ODOT bridges at the discretion of the bridge owner. Refer to BDM Section 928.

For load rating of new bridges, BDM Sections 911 through 926 shall apply.

For load rating of existing bridges, BDM Sections 911 through 925 and 927 shall apply.

908.2 INVENTORY AND OPERATING RATING LOADS

Inventory and Operating Rating Loads are shown in Figures 908.2-1 and 908.2-2.

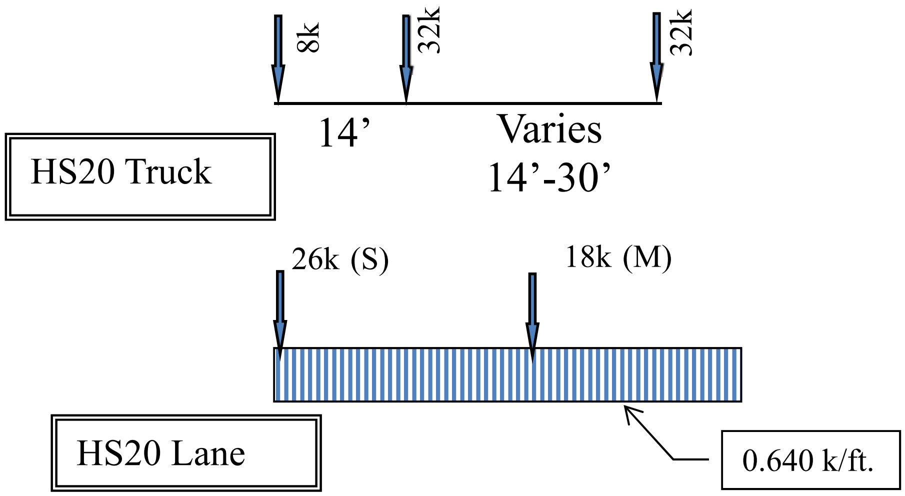


Figure 908.2-1: AASHTO HS20 LOADING

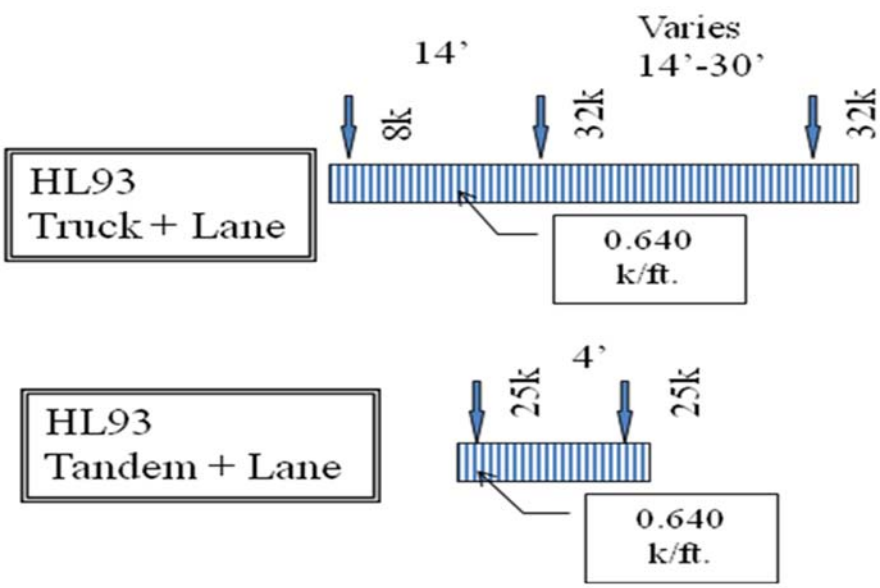


Figure 908.2-2: AASHTO HL93 LOADING

908.3 RATING LOADS

A. LEGAL LOADS: The Ohio Legal Trucks 2F1, 3F1, 4F1 & 5C1 (Figure 908.3-1) and AASHTO Specialized Hauling Vehicles SU4, SU5, SU6 & SU7 (Figure 908.3-2) form Ohio Legal Loads. All bridges shall be load rated for all 8 Ohio Legal Loads.

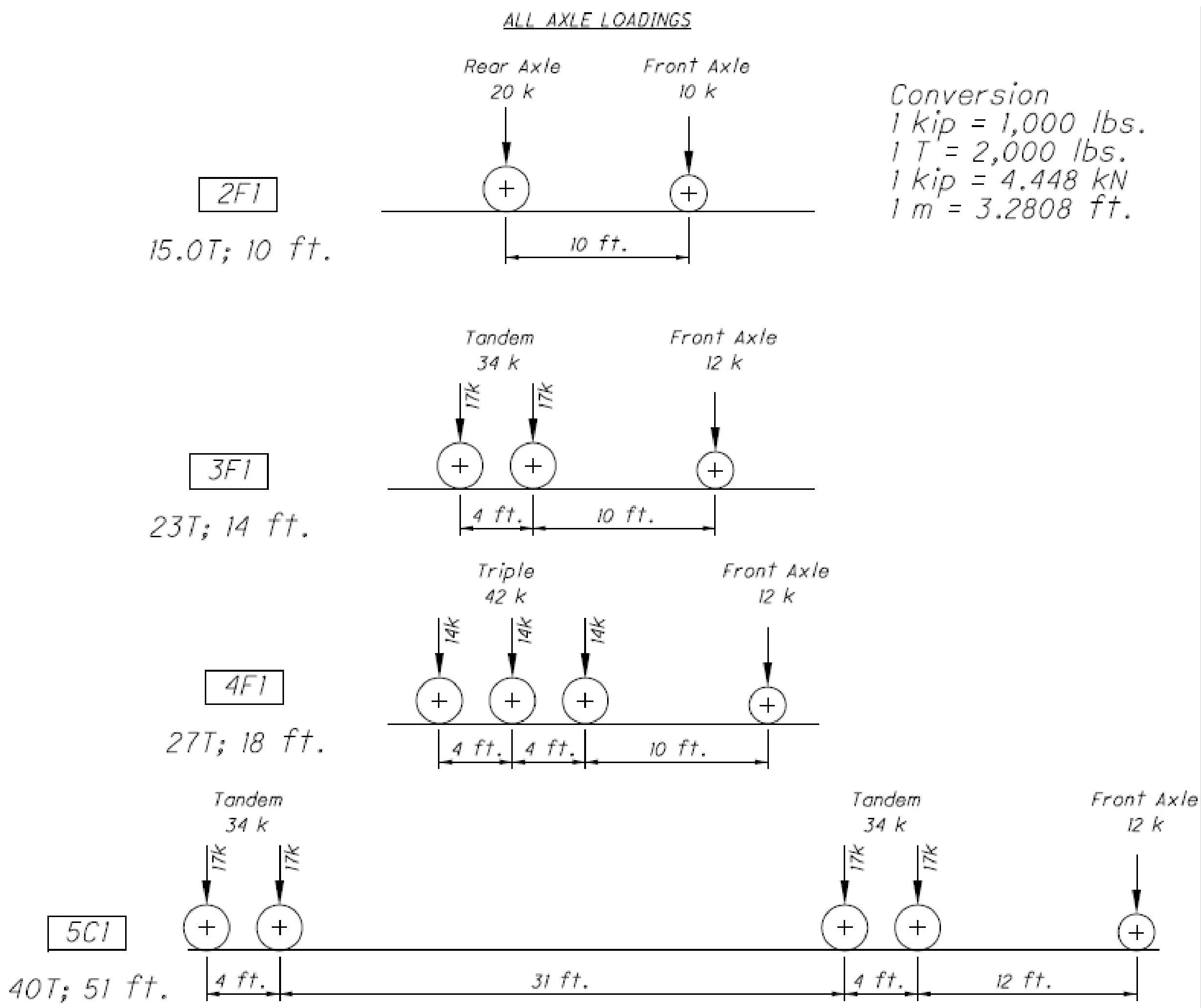


Figure 908.3-1: OHIO LEGAL TRUCKS

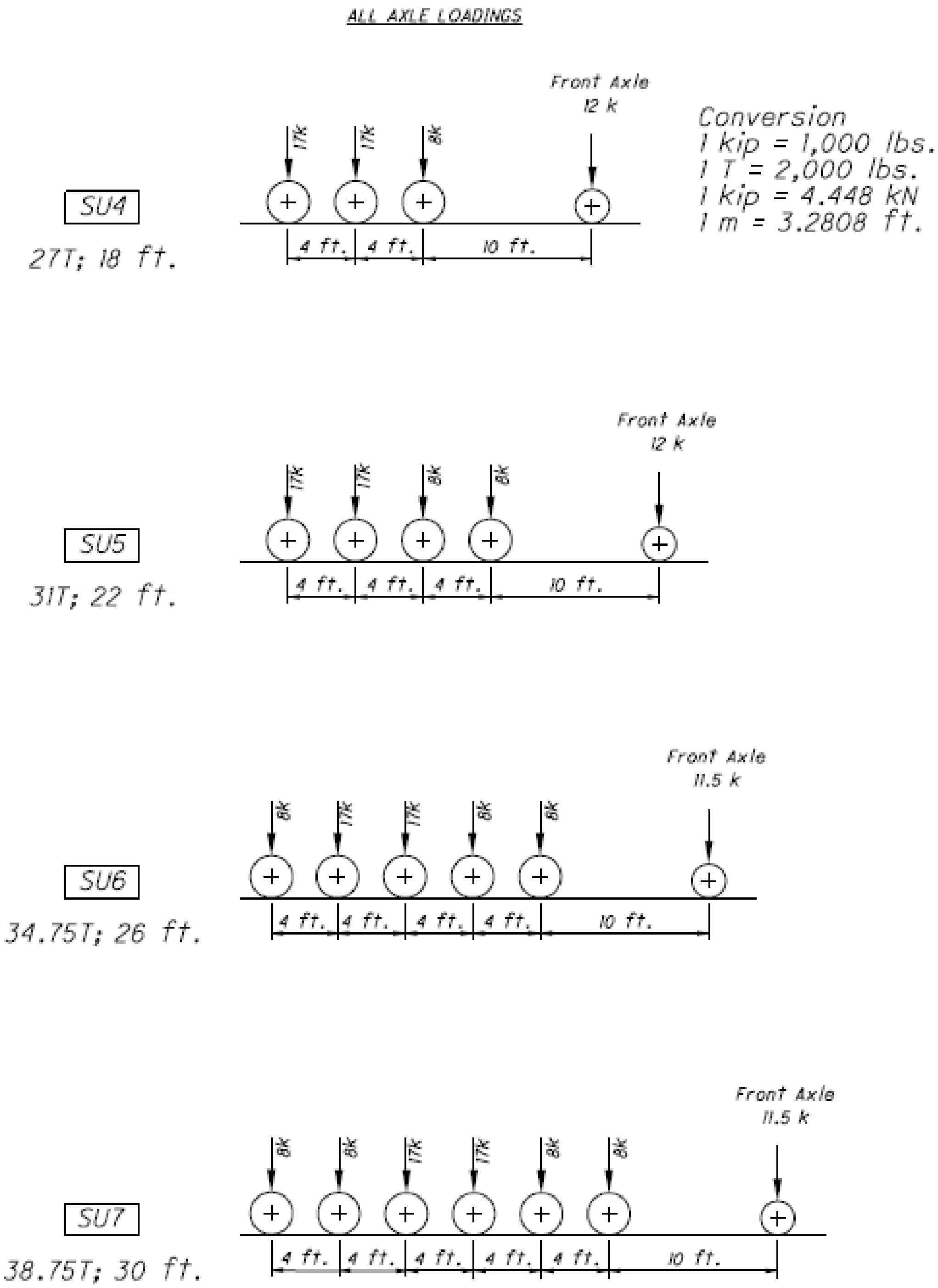


Figure 908.3-2: SPECIAL HAULING VEHICLE (SHV)

B. Emergency Vehicles: All EV-Qualified bridges shall also be load rated for EVs shown in Figure 908.3-3.

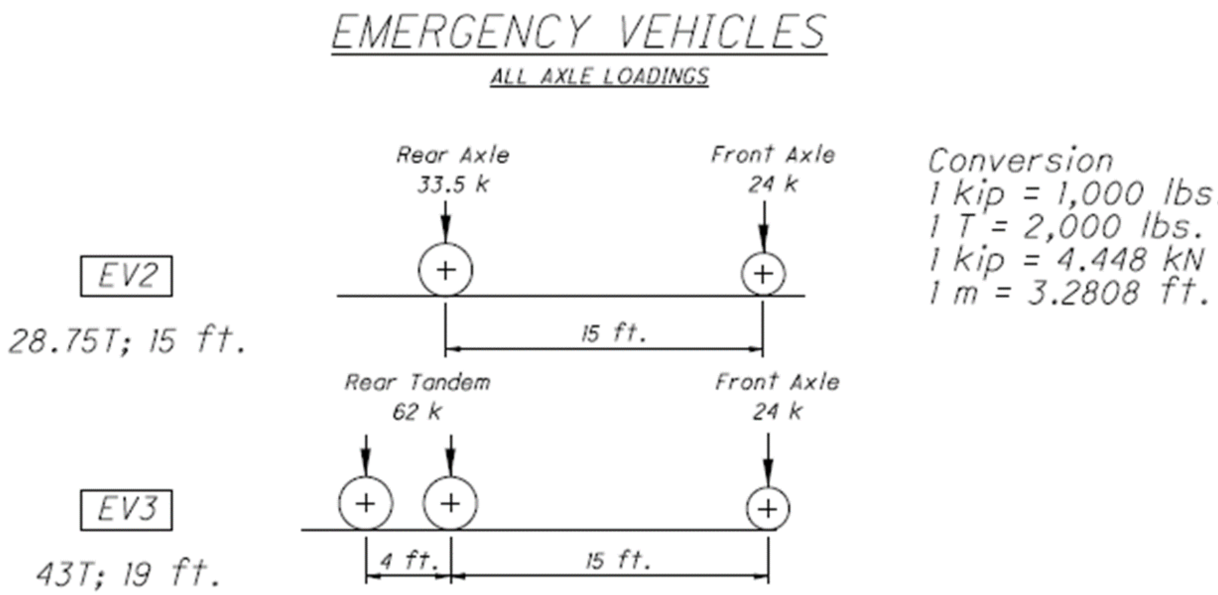


Figure 908.3-3: EMERGENCY VEHCILES (EV)

909 UNIT WEIGHTS & DENSITIES

The following assumptions should be made while performing the load rating analysis unless more accurate site information is available:

A. Unit weight of asphalt....................145 lb. /ft^3

B. Unit weight of concrete....................150 lb. /ft^3

C. Unit weight of latex modified concrete....................150 lb. /ft^3

D. Unit weight of soil....................120 lb. /ft^3

E. Unit weight of steel....................490 lb. /ft^3

F. Water density....................62.4 lb. /ft^3

910 STRUCTURES EXEMPT FROM LOAD RATING

The following types of buried structures are exempt from load rating under the provisions of this Section:

A. Circular plastic pipes

B. Concrete pipes (circular, or elliptical)

C. Buried metal frames

D. Junction chambers

E. Any structure which are not in travel lanes of vehicular traffic

911 STRUCTURES UNDER 6.5-FT OR MORE FILL

A research conducted by the Ohio State University (sponsored by ODOT) has concluded that when a buried structure has 6.5-ft (2 m) or more fill on the top, the live load effect on the structure due to vehicular traffic is negligible.

Ref: http://cdm16007.cotentdm.olclc.org/cdm/ref/collection/P267401ccp2/id/4590). In such case, a load rating analysis of the structure is not needed provided there are no other signs of distress, structural damage or deterioration. Load rating factors of 1.000 for inventory, 1.300 for operating and 1.500 for Ohio legal loads will be assigned.

912 WHICH PORTION OF BRIDGES SHALL BE LOAD RATED

Any structural member of a bridge that could carry vehicular traffic shall be load rated. Typically, the structural members of only the bridge superstructure are load rated. Substructure elements, such as pier caps and columns, should be analyzed for their load carrying capacity in situations when they are either scoped to be analyzed or when the bridge owner or the rating engineer has reason to believe that the capacity of a substructure element may control the capacity of the bridge.

913 PROCEDURE FOR LOAD RATING

A. New Bridges

1. Load rate new (proposed) bridges at the design stage per BDM Section 926.
2. The Project Manager shall forward the load rating report, bridge structure plans and data input files to the OSE Load Rating Engineer for review.

B. Existing Bridges

1. Perform a field inspection of the existing bridge according to the ODOT Manual of Bridge Inspection to determine its condition and the percent of effectiveness of the various members for carrying load, if included in the scope. All information shown in the Bridge Inventory and the Inspection Reports shall also be carefully checked.
2. If a field inspection of the bridge is not a part of the Scope of Services, as a minimum, review the most current inspection report (and inspection notes, if available).
3. Use the date of construction to determine the yield stresses for the construction materials in older bridges for which plan information is not available.
4. For a load rating analysis request on an existing ODOT bridge, the District Bridge Engineer shall submit to the OSE Load Rating Engineer, a complete inspection report (including comments), bridge photographs, field measurements and a copy of the previous rating calculation sheets. OSE will review the submitted material, analyze the bridge and return a copy of the final calculations or computer output to the District Bridge Engineer, along with any recommendations concerning the proposed ratings.
5. The District Bridge Engineer/Bridge Owner shall keep the final calculations or computer output along with any recommendations concerning the proposed ratings on file.
6. Using pertinent current information and load rating analysis, the District Bridge Engineer/Bridge Owner shall determine and record the Inventory, Operating and Ohio Legal Load Ratings.

C. Influence Line Connected Rating Spreadsheets

1. If directed and included in the Scope of Services, prepare Excel spreadsheets connected to influence lines/surfaces to analyze a permit vehicle of up to 25 axles.

2. The Project Manager shall forward the load rating report, bridge structure plans, data input files and spreadsheets to the OSE Load Rating Engineer for review.

914 WHEN LOAD RATING SHALL BE REVISED

The load rating of a bridge should be revised when:

A. There is a physical change in the condition of a structural member of the bridge
B. Rusting or damage to a slab, beam, girder or other structural element has resulted in section loss
C. There is structural damage to steel, like a hit by a vehicle or excessive deflection or elongation under temperature or highway loads
D. When the inspection GA rating of the superstructure of a bridge drops below 5
E. There is an addition of a new beam or girder
F. A new deck is added or the existing deck width is changed
G. There is a change in the dead load on the superstructure, like addition or removal of wearing surfaces, addition or removal of sidewalks, parapets, railings, etc.

The load rating of a bridge does not need to be revised when:

A. The change in the thickness of external wearing surface is less than 1-inch
B. The change in the dead load on a beam member is not more than 10-lbs/ft.

915 ANALYSIS OF BRIDGES WITH SIDEWALKS

Pedestrian loads on sidewalks are not typically considered in a load rating analysis of a highway bridge, regardless of if a sidewalk on the bridge is present or not. If a bridge owner has reasons to believe that the sidewalk loads shall be included in the load rating analysis of a bridge, a pedestrian load of 75-lbs/ft^2 shall be applied to all sidewalks wider than 2-ft and considered simultaneously with the live load in the vehicle lane.

When pedestrian load is present, the pedestrian load effect multiplied with applicable load factor should be subtracted from the capacity of the member at the location being investigated when calculating the RF.

For bridges load rated according to the AASHTO Standard Specifications for Highway Bridges, AASHTO Table 3.22.1A applies. For bridges load rated according to the AASHTO LRFD Bridge Design Specifications, refer to BDM Section 925.2.

Pedestrian loads shall not be considered when performing Special or Permit Load Analysis as per BDM Section 917.

916 ANALYSIS OF MULTILANE LOADING

Traffic lanes to be used for rating purposes shall be in accordance with AASHTO Specifications.

For rating analysis of floor beams, trusses, non-redundant girders or other non-redundant main structural members, position identical rating vehicles in one or more of the through traffic lanes on the bridge, spaced and shifted laterally on the deck within the traffic lanes so as to produce the maximum stress in the member under consideration.

Apply the multiple presence factors of AASHTO Standard Specification for Highway Bridges, Section 3.12 or AASHTO LRFD Bridge Design Specification, Section 3.6.1, accordingly.

917 ANALYSIS FOR SPECIAL OR PERMIT LOAD

When the Scope of Services requires a structure to be analyzed for a special or permit load vehicle, two analysis shall be performed. First, analysis shall be performed as for a normal load rating analysis at operating level using Special or Permit Load. A second analysis shall be performed for a single lane loading of the special or permit load vehicle condition with the special or permit load vehicle placed laterally on the structure to produce maximum stresses in the critical member under consideration.

The analysis for special or permit load vehicle shall be performed at the operating level only. Multilane loading factors shall be applied, as applicable per AASHTO Specifications.

917.1 FIRST ANALYSIS OF BRIDGES WITH THREE OR MORE LANES

A. In the right-most lane, place the permit load vehicle positioned to produce the maximum live load effect on the component to be rated vehicle. No partial 5C1 vehicles shall be used.

B. In all adjacent lanes in the same direction, simultaneously place single 5C1 vehicles. These vehicles shall be positioned to produce the maximum live load effect on the component to be rated. Apply the multiple presence factors, per AASHTO Standard Specification for Highway Bridges - Section 3.12, accordingly.

C. For bridges with two-way traffic, place the permit load vehicle in the right-most lane in the direction of travel. In all other lanes, simultaneously place single 5CI vehicles in the direction of traffic positioned to produce maximum live load effect. No partial 5C1 vehicles shall be used. Apply the multiple presence factors, per AASHTO Standard Specification for Highway

Bridges - Section 3.12, accordingly.

917.2 FIRST ANALYSIS OF BRIDGES WITH TWO LANES

A. In the right-most lane, place one permit load vehicle positioned to produce the maximum live load effect on the component to be rated.

B. In the other lane, place a series of Ohio 5C1 vehicles. The 5C1 vehicles should be spaced such that the distance between the rear axle of the leading vehicle and the front axle of trailing vehicle shall be 36-ft. Place as many 5C1 vehicles as necessary to produce the maximum load effect on the component to be rated. No partial 5C1 vehicles shall be used.

917.3 FIRST ANALYSIS OF BRIDGES WITH A SINGLE LANE

The live load shall be the one permit vehicle positioned to produce the maximum live load effect on the component to be rated.

918 LOAD RATING OF LONG SPAN BRIDGES

918.1 WHEN THE LOAD RATING SHALL BE DONE

Perform the load rating of long span bridges according to BDM Sections 926.3.3, 927.2.2, or 927.3.2.

918.2 HOW THE LOAD RATING SHALL BE DONE

918.2.1 INVENTORY & OPERATING LEVEL RATING USING HL93 LOADING

The HL93 live load, shown in Figure 908.2-2, shall be used and applied as per AASHTO LRFD Design Specification.

Multilane loading factors shall be applied as per BDM Section 916.

918.2.2 INVENTORY & OPERATING LEVEL RATING USING HS20 TRUCK

The HS20 live load, shown in Figure 908.2-1, shall be applied as follows:

A. In the right-most lane, place a series of HS20 trucks to simulate a train of vehicles. The vehicle train shall consist of the HS20 trucks spaced with 30-ft clear distance between the rear axle of the leading vehicle and the front axle of the trailing vehicle. The distance between the second axle and the rear axle shall be fixed at 14-ft. Place as many fixed-axle spacing HS20 trucks as necessary to produce the maximum load effect on the component to be rated. No partial HS20 trucks shall be used.

B. In all other lanes in the same direction, simultaneously place single, variable-axle spacing HS20 trucks positioned to produce the maximum load effect on the component to be rated.

C. For bridges with two-way traffic, apply the live load as described in A. and B. above to the lanes in the opposite direction.

D. Multilane loading factors shall be applied as per BDM Section 916.

918.2.3 LOAD RATING FOR OHIO LEGAL LOADS

The Ohio Legal Loads shown in Figure 908.3-1 & Figure 908.3-2 shall be used. The provisions of BDM Sections 912 through 916 and 918 shall apply.

Multilane loading factors shall be applied as per BDM Section 916.

918.2.3.1 BRIDGES WITH THREE OR MORE LANES

A. In the right-most lane, place a series of Ohio 5C1 vehicles. The 5C1 vehicles should be spaced such that the distance between the rear axle of the leading vehicle and the front axle of trailing vehicle shall be 36-ft. Place as many 5C1 vehicles as necessary to produce the maximum load effect on the component to be rated. No partial 5C1 vehicles shall be used.

B. In all other lanes in the same direction, simultaneously place single 5C1 vehicles. These vehicles shall be positioned to produce the maximum live load effect on the component to be rated.

C. For bridges with two-way traffic, apply the live load for the opposing traffic in the same manner as the one-way traffic.

918.2.3.2 BRIDGES WITH TWO LANES

A. In the right-most lane, place a series of Ohio 5C1 vehicles. The 5C1 vehicles should be spaced such that the distance between the rear axle of the leading vehicle and the front axle of trailing vehicle shall be 36-ft. Place as many 5C1 vehicles as necessary to produce the maximum load effect on the component to be rated. No partial 5C1 vehicles shall be used.

B. For bridges with one-way traffic, in the other lane simultaneously place a single 5C1 vehicle positioned to produce the maximum live load effect on the component to be rated.

C. For bridges with two-way traffic, in the other lane place a series of Ohio 5C1 vehicles. The 5C1 vehicles should be spaced such that the distance between the rear axle of the leading vehicle and the front axle of trailing vehicle shall be 36-ft. Place as many 5C1 vehicles as necessary to produce the maximum load effect on the component to be rated. No partial 5C1 vehicles shall be used.

918.2.3.3 BRIDGES WITH A SINGLE LANE

The live load shall be a series of Ohio 5C1 vehicles. The 5C1 vehicles should be spaced such that the distance between the rear axle of the leading vehicle and the front axle of trailing vehicle shall be 36-ft. Place as many 5C1 vehicles as necessary to produce the maximum load effect on the component to be rated. No partial 5C1 vehicles shall be used.

919 BRIDGE POSTING FOR REDUCED LOAD LIMITS

919.1 PURPOSE

The Procedure outlined in this section is to be followed for posting or rescinding warnings of bridge strength deficiencies on ODOT bridges. Owners of non-ODOT bridges may modify and adapt the guidelines given in this section to post or rescind warnings of bridge strength deficiencies on their bridges.

919.2 REFERENCE

Ohio Revised Code, Section 5591.42:

919.3 PROCEDURE FOR BRIDGE POSTING

919.3.1 BRIDGE POSTING FOLLOWING LOAD RATING ANANLYSIS

A. A load rater performs the bridge load rating per the ODOT Bridge Design Manual (BDM).

B. For an existing or in-service bridge, the bridge shall be load rated based on current dead loads and the last field inspection report. The current operating status, inspection comments, photographs, and condition rating of structural elements shall be considered in the load rating.

C. Any structural deficiencies discovered during the most current field inspection, as recorded on the Bridge Inspection Report (BIR),) shall be considered during the load rating process. The Control Authority Program Manager (CAPM) shall contact the load rater to request to reanalyze a bridge in service.

D. If load rating is performed by load testing, the test load configuration shall be noted.

E. The Load Rating Report shall be signed, sealed and dated by an Ohio registered Professional Engineer. The load rating results shall be communicated to the CAPM who will enter/update the load rating results in the ODOT SMS.

F. Subsequent to load rating, if it is determined that the bridge needs to be posted for reduced loads (i.e., below Ohio Legal Loads), the CAPM shall mark in the SMS, “Bridge Posting Required.” The CAPM shall initiate the process to have the posting and early warning signs made and erected on the bridge no later than 90 days from the date of load rating.

G. It will be the responsibility of the CAPM to periodically verify that the posting signs are in place.

Table 919.3-1: ODOT Bridge Posting Policy

Controlling RF = Min. Calculated RF of Ohio Legal Loads % Ohio Legal Value = Controlling RF x 100		
% Ohio Legal Value	**Reported % Ohio Legal in SMS**	**Posting for Reduced Loads Needed**
≥150%	150%	NO
≥100% and <150%	Actual percentage rounded to the nearest 5 (i.e., 100, 115, etc.)	NO
<100%	**Actual percentage rounded to the nearest 5 (i.e., 95%, 30%, etc.)**	**YES**

919.3.2 PROCEDURE FOR PLACING POSTING ON ODOT BRIDGES

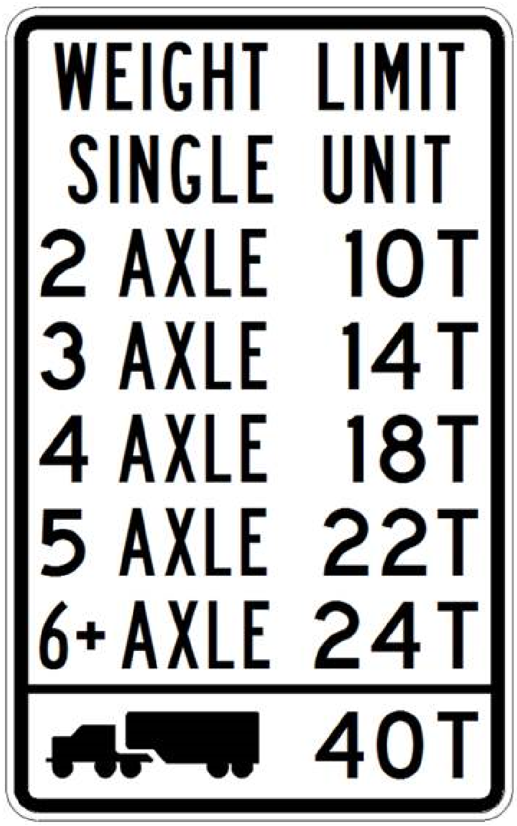
A. The ODOT District Bridge Engineer shall submit a written bridge posting request according to BDM Section 919.6 to the OSE Bridge Rating Engineer.

B. After the Director signs the posting request:

1. The OSE Bridge Rating Engineer shall send a copy to each of the following:
    a. District Bridge Engineer
    b. Manager, ODOT Special Hauling Permits
    c. Superintendent of State Highway Patrol
    d. Executive Director Ohio Trucking Association
    e. Board of County Commissioners
    f. Respective County Engineer's Office
2. The District Roadway Services Manager shall prepare, erect and maintain all necessary signs until the bridge is either strengthened or replaced.
3. The District Bridge Engineer shall update all Bridge Inventory and Inspection records to show the latest official posted capacity.

C. Where posting of a bridge is determined necessary and no unusual or special circumstance at the bridge dictates otherwise, Ohio standard regulatory signs (as per the Ohio Manual of Uniform Traffic Control Devices, an example of the standard wording to be used on the signs is given in Figure 919.3.2-1), shall be placed in sufficient numbers and at the specific locations required below:

1. AHEAD signs shall be erected at intersecting state roads located just prior to the bridge to allow approaching vehicles to by-pass the bridge or turn around safely with a minimum of interference to other traffic.
2. Bridge Weight Limit signs shall be erected at each end of the bridge.
3. Weight limits on the sign shown in Figure 919.3.2-1 (R12-H5) are safe loads allowed for Single Unit trucks except the silhouette near bottom which represents the safe load allowed for 5-axle 5C1 truck shown in Figure 908.3-1.



WEIGHT LIMIT Sign R12-H5

Figure 919.3.2-1: NEW LOAD POSTING SIGN

R3-17a
Sec. 9B.04

Figure 919.3.2-2: AHEAD Sign

D. **<u>Bridges that are determined to be incapable of carrying vehicles of GVW of 3 tons shall be closed for all traffic.</u>**

919.4 PROCEDURE FOR RESCINDING POSTING OF ODOT BRIDGES

A. When a posted bridge has been strengthened or replaced and no longer needs posting, the District Bridge Engineer shall forward to the Bridge Rating Engineer a written request to rescind the existing signed posting. The request shall include a complete statement of the reason for the action as specified in BDM Section 919.6.

B. The Bridge Rating Engineer shall review the data submitted by the District Bridge Engineer and upon concurrence, shall forward to the Director a request to rescind the posting.

C. The Bridge Rating Engineer shall distribute copies of the rescind notice as described in Section 919.3.2.B.1.

919.5 PROCEDURE FOR CHANGING POSTING OF ODOT BRIDGES

When the rated capacity of a posted bridge changes, so as to require a revised posting level, the procedures in BDM Section 919.3 apply. Additionally, the existing posting must be rescinded as set forth in BDM Section 919.4.

919.6 REQUIRED INFORMATION FOR POST, RESCIND AND CHANGE REQUESTS FROM DISTRICTS

The following minimum information is required on all post, rescind and change requests:

A. Posting Request (Reduction in Load Limits)

1. Current Bridge Number
2. Structure File Number

3. Feature intersected (over or under bridge)
4. Posting Load for each Ohio Legal Load
5. Rating of the bridge expressed as a percent of legal loads
6. Explanation as to why the posting is required
7. Attach copies of all official documentation for any associated actions by involved agencies other than the state

B. Rescinding Request (Removal of Existing Load Limits)
    1. Current Bridge Number
    2. Structure File Number
    3. Feature intersected (over or under bridge)
    4. Existing posting (% reduction or weight limit currently in effect for each of the Ohio Legal Loads)
    5. Date existing posting was effective
    6. Explanation as to why the posting restrictions can now be removed (include: contract project numbers or indicate force account or other work method used to correct problem, if applicable)
    7. New load rating for the rehabilitated or new structure (for each Ohio Legal Load)

C. Change Request (Revision of Existing Posted Limits)
    1. Current Bridge Number
    2. Structure File Number
    3. Feature intersected (over or under bridge)
    4. Existing posting (% reduction or weight limit currently in effect for each of the Ohio Legal Loads)
    5. Revised posting request (revised weight limit for each of the Ohio Legal Load)
    6. Date of existing posting
    7. Explanation as to why posting change is necessary (include project numbers etc., involved, if applicable)

919.7 POSTING FOR EMERGENCY VEHICLES (EV)

When a bridge is analyzed or evaluated and determined to be incapable of carrying 100% of the load of the EVs (shown in Figure 908.3-3), and the bridge is not already posted for the reduced legal loads, it shall then be posted for the reduced weights of EVs. The single axle weight limit shall be for the maximum weight of the single axle of EV2, which can safely be carried, and the tandem weight limit shall be the maximum weight of the tandem of EV3, which can safely be carried on the bridge. Ohio Sign R12-H17 (shown in Figure 919.3.2-2) shall be used.

If a bridge is posted for reduced Ohio legal loads, it shall be load rated for EVs, but will not be posted for EVs simultaneously.

Figure 919.3.2-3: Emergency Vehicle Sign

(R12-H17 30”x30” or 48”x48”)

920 SOFTWARE TO BE USED FOR LOAD RATING OF ODOT BRIDGES

920.1 LIST OF ODOT PREFERRED LOAD RATING PROGRAMS

A. AASHTO BrR (formerly Virtis): BrR is a load rating and analysis program developed and licensed by AASHTO. BrR can rate the bridges by LRFR and LFR methods. BrR can load rate a variety of bridge types including reinforced concrete box culverts and curved beam bridges. ODOT has a site license for AASHTO BrR. Through a special pricing option, Counties, Cities and Consultants working on bridges in Ohio can obtain a stand-alone single user license of the BrR program from AASHTO. Please contact the ODOT Load Rating Engineer in the Central Office for a reference email.

B. AASHTO BrD (formerly Opis): BrD is a bridge design check program developed and licensed by AASHTO. BrD can perform design check of a bridge by LRFR and LFR methods for compliance with current AASHTO Specifications. BrD program is fully compatible with BrR program, as data files created in BrD program can be used in BrR program to load rate a bridge. ODOT has a site license for AASHTO BrD from AASHTO. Through a special pricing option, Counties, Cities and Consultants working on bridges in Ohio can obtain a stand-alone single user license of the BrD program from AASHTO. Please contact the ODOT Load Rating Engineer in the Central Office for a reference email.

920.2 OTHER LOAD RATING PROGRAMS

For the analysis of the structures that cannot be accurately modeled using ODOT's Preferred Load Rating Programs stated in 920.1, contact the OSE Load Rating Engineer for software pre-approval prior to performing any load rating. The Department will not accept load rating performed using any software not on ODOT's preferred load rating program list or pre-approved for a bridge. Currently, ODOT licenses following additional bridge analysis programs:

A. Bentley LARS Bridge: LARS Bridge is a bridge analysis program maintained and licensed by Bentley Systems. It can load rate bridges by LRFR and LFR methods. Through a special pricing option, Counties, Cities and Consultants working on bridges in Ohio can obtain a stand-alone single user license of the LARS Bridge program. Please contact the ODOT Load Rating Engineer in the Central Office for a reference email. (http://www.bentley.com)

B. WYDOT BRASS-Culvert: BRASS-Culvert can load rate reinforced concrete flat-topped 3-sided frames and 4-sided boxes buried under the fill by LRFR and LFR methods. The BRASS family of programs is developed, maintained and licensed by the Wyoming Department of Transportation. Technical support on BRASS-Culvert program is available to the BRASS licensed users from the Wyoming DOT.

(http://www.dot.state.wy.us/wydot/engineering_technical_programs/bridge/brass)

C. MDX Software: MDX software can only be used to load rate ODOT slab-girder/beam bridges that have horizontal curvature of more than 4 degrees. This program supports Load Factor or Load and Resistance Factor methods. Do not use this program to load rate straight or low curvature bridges that can be accurately modeled using the AASHTO BrR.

(http://www.mdxsoftware.com/)

D. DESCUS I: Design and Analysis of Curved I-girder Bridge Systems, marketed by OPTI-MATE, Inc. Use the most current version of the software; (www.opti-mate.com)

E. Midas Civil: Midas Civil is a finite element analysis program by Midas IT Co., Ltd., Use this program to load rate only complex bridges that cannot be accurately modeled using the AASHTO BrR. (http://www.midasuser.com).

921 LOAD RATING REPORT SUBMISSION

The load rating report shall be submitted to the ODOT project manager, ODOT District Bridge Engineer or the respective owner (in case of a non-ODOT bridge). The submission shall include:

A. Two printed copies of the Load Rating Report with the Summary Sheet. The Load Rating Reports shall be signed, sealed and dated by an Ohio Registered Professional Engineer.

B. One electronic copy of the Load Rating Report in PDF format

C. One copy of all electronic input data files

For an ODOT-bridge, the District Bridge Engineer or the Project Manager will send one printed copy, an electronic copy of the report, all the electronic data files and a copy of the final bridge plans to the OSE for review.

The report summary must list final inventory and operating ratings of each structure unit, and the final ratings of the entire bridge summarized in a tabular form. The ratings of each member and the overall ratings of the structure shall be presented for each Ohio Legal Load and either AASHTO HS20 or HL93 live load.

An example of a Bridge Load Rating Report Summary is given as Figure 921-1.

For existing bridges, the report shall state how the material properties were determined. Any specific details about the current conditions and bridge geometry shall be listed.

All calculations related to the load rating should be included with the load rating report.

Submit copies of the input and output computer files in electronic format. Input files must be error free and ready to be run. The engineer who performed the load rating shall be responsible to incorporate any changes in the input files recommended by ODOT subsequent to its review.

BRIDGE LOAD RATING SUMMARY REPORT
OFFICE OF STRUCTURAL ENGINEERING
OHIO DEPARTMENT OF TRANSPORTATION

SFN	BRIDGE NUMBER		DISTRICT
			From BRIDGE NUMBER or Enter District
ORIGINAL CONSTRUCTION	REHABILITATIO N YEAR	OVERALL STRUCTURE	FEATURE INTERSECTED
SPECIAL ASSUMPTIONS & COMMENTS			
	SELECT ON RIGHT, WHERE APPROPRIATE, BY USING THE DROP DOWN ARROW		
LOAD RATING PURPO!	5 - Deterioration or GA Dropped Below 5		
LOAD RATING SOFTW/	3 - AASHTO BrR (VIRTIS)		
RATING SOURCE:	1 - Plan information available for load rating analysis (Default)		
RATING METHOD:	6 - Load Factor (LF) rating reported by rating factor (RF)		
ORIGINAL DESIGN LO/	6 - HS20-44 & Alternate Military Loading		

STRUCTURE RATING SUMMARY

OHIO LEGAL VEHICLES			
Loading Type	GVW (Tons)	Operating RF	Legal Weight
2F1	15	1.065	15.00
3F1	23	0.717	16.49
4F1	27	0.640	17.28
5C1	40	0.733	29.32
SPECIALIZED HAULING VEHICLES (SHV)			
SU4	27	0.634	17.12
SU5	31	0.581	18.01
SU6	34.75	0.522	18.14
SU7	38.75	1.000	38.75
EMERGENCY VEHICLES (EV) - Check box to include ☑			
EV2	28.75	0.631	18.14
EV3	43	0.410	17.63

DESIGN VEHICLE		
Loading Type	Design Rating - RF	
	Operating	Inventory
HS20 Loading	1.250	1.000
Overall Legal Posting Rating	50%	
BRIDGE POSTING RECOMMENDED BY RATING	LOAD POSTING IS RECOMMENDED	
Sign Posting Recommendation:	WEIGHT LIMIT SINGLE UNIT 2 AXLE 15 T 3 AXLE 16 T 4 AXLE 17 T 5 AXLE 18 T 6+ AXLE 18 T 29 T	

AGENCY/FIRM/OFFICE			REPORT DATE:	5/26/2017
RATED BY	PE NUMBER	PHONE NUMBER	EMAIL	
REVIEWED BY	PE NUMBER	PHONE NUMBER	EMAIL	

Figure 921-1: BR100 - LOAD RATING SUMMARY FORM

922 LOAD RATING USING AASHTO BrR PROGRAM

922.1 GENERAL

BrR (formerly Virtis) is a load rating program licensed from AASHTO. BrR runs on Microsoft Windows and can load rate a variety of bridges by LFR as well as LRFR methods.

The BrR Vehicle library can be customized to include ODOT Legal Loads. Alternatively, ODOT's BrR library can be requested from OSE or downloaded using the web address below.

ftp://ftp.dot.state.oh.us/pub/structures/bms/Web_download_files/ODOT_Custom_Files/

922.2 BrR LOAD RATING REPORT SUBMISSION

The load rating report shall be submitted to the Project Manager, the District Bridge Engineer or the non-ODOT bridge owner.

922.3 BrR COMPUTER INPUT AND OUTPUT FILES

Submit the error-free and working electronic copies of the input file exported as an "XML" file. To get the electronic copy of a bridge data file in BrR, open the "Bridge Workspace," select File>Export from the main menu and save the export when prompted to do so by BrR.

923 LOAD ANALYSIS USING LARS PROGRAM

923.1 GENERAL

LARS (Load Analysis and Rating System) is a family of bridge load analysis and rating programs maintained and licensed by Bentley Systems.

LARS can run on any Microsoft Windows compatible machine.

LARS Vehicle library can be customized to include ODOT Legal Loads.

923.2 LARS LOAD RATING REPORT SUBMISSION

The load rating report shall be submitted to the Project Manager, the District Bridge Engineer or the non-ODOT bridge owner.

923.3 LARS COMPUTER INPUT AND OUTPUT FILES

Submit the error-free and working electronic copies of all the input and output files of LARS program.

924 LOAD ANALYSIS USING BRASS-CULVERT PROGRAM

924.1 GENERAL

Wyoming DOT BRASS-Culvert program can be used to analyze reinforced concrete three-sided flat-topped frames and four-sided box sections.

If haunch dimensions are not constant, use the smallest dimension in the analysis.

BRASS can run on any Microsoft Windows compatible machine.

The BRASS Vehicle library can be customized to include ODOT Legal Loads. An ODOT customized BRASS-Culvert Vehicle library is available on the ODOT FTP which can be downloaded and copied in the C:\\BRASS\Culvert folder.

924.2 BRASS-CULVERT LOAD RATING REPORT SUBMISSION

The load rating report shall be submitted to the Project Manager, the District Bridge Engineer or the non-ODOT bridge owner.

924.3 BRASS COMPUTER INPUT AND OUTPUT FILES

Use the Structural File Number (SFN) of the bridge with prefix "R" to name and appropriate extension to name the input and output files. For example, if the SFN of a bridge is 4729854, the input and output file names should be "R4729854.dat" and R4729854.cus and R4729854.xml, etc.

925 LOAD RATING OF BRIDGES USING LRFR SPECIFICATIONS

925.1 APPLICABILITY OF AASHTO DESIGN SPECIFICATIONS

This Section is consistent with the current AASHTO LRFD Bridge Design Specifications. Where this Section is silent, the current AASHTO LRFD Bridge Design Specification shall govern.

925.2 GENERAL LOAD RATING EQUATION

The following general equation shall be used in determining the load rating of each component and connection subject to a single force effect (axial force, flexure or shear) [MBE 6A.4.2]:

$$\mathrm{RF} = \frac{\mathrm{C} - (\gamma_{\mathrm{DC}})(\mathrm{DC}) - (\gamma_{\mathrm{DW}})(\mathrm{DW}) \pm (\gamma_{\mathrm{P}})(\mathrm{P}) - (\gamma_{\mathrm{PL}})(\mathrm{PL})}{(\gamma_{\mathrm{LL}})(\mathrm{LL})(1 + \mathrm{IM}/100)}$$

For Strength Limit States:

$C = \varphi_c \cdot \varphi_s \cdot \varphi \cdot R_n$

Where the following lower limit shall apply:

$\varphi_c \cdot \varphi_s \geq 0.85$

For Service Limit States:

$C = f_R$

Where:

C = Capacity

DC = Dead load effect due to structural components and attachments

DW = Dead load effect due to wearing surface and utilities

f_R = Allowable stress specified in LRFD Code

IM = Dynamic load allowance expressed as percentage (%)

LL = Live Load effect

P = Permanent loads other than dead loads, such earth pressure, shrinkage etc.

PL = Pedestrian Load effect only to be applied when a sidewalk is present

RF = Rating Factor

R_n = Nominal member resistance

γ_{DC} = Load factor for DC load

γ_{DW} = Load factor for DW load

γ_p = Load factor for P load = 1.0

γ_{LL} = Evaluation live load factor

γ_{PL} = Load factor for Sidewalk load = 1.0

φ_c = Condition factor

φ_s = System factor

φ = LRFD Resistance factor

For Limit States and factors see BDM Section 925.3.

925.3 LIMIT STATES AND LOAD FACTORS FOR LOAD RATING

Strength is the primary limit state for load rating; service and fatigue limit states are selectively applied in accordance with the provisions of AASHTO Manual of Bridge Evaluation [MBE 6A.4.2]:

For Inventory and Operating Rating for AASHTO HL93 Loading, use the following limit states and load factors:

Table 925.3-1: LRFR Design Load Limit States and Load Factors [MBE 6A.4.2.2-1]

Bridge Type	Limit State	Dead Load γ_{DC}	Dead Load γ_{DW}	HL93 Loading Inventory γ_{LL}	HL93 Loading Operating γ_{LL}
Steel	Strength I	1.25	1.50	1.75	1.35
	Service II	1.00	1.00	1.30	1.00
	Fatigue	0.00	0.00	0.75	
Reinforced Concrete	Strength I	1.25	1.50	1.75	1.35
Prestressed Concrete	Strength I	1.25	1.50	1.75	1.35
	Service III	1.00	1.00	0.80	
Wood	Strength I	1.25	1.50	1.75	1.35

For Rating for Ohio Legal Loads, use the following limit states and load factors:

Table 925.3-2: Legal Loads Limit States and Load Factors [MBE 6A.4.4.2.3a-1]

Bridge Type	Limit State	Dead Load γ_{DC}	Dead Load γ_{DW}	Ohio Legal Loads γ_{LL}
Steel	Strength I	1.25	1.50	1.40
	Service II	1.00	1.00	1.30
Reinforced Concrete	Strength I	1.25	1.50	1.40
	Service I	1.00	1.00	------
Prestressed Concrete	Strength I	1.25	1.50	1.40
	Service III	1.00	1.00	1.00
Wood	Strength I	1.25	1.50	1.40

For Rating for Special and Permit Loads, use the following limit states and load factors:

Table 925.3-3: Permit Load Limit States and Load Factors [MBE 6A.4.5.4.2a-1]

Bridge Type	Limit State	Dead Load γDC	Dead Load γDW	Permit or Special Loads γ_{LL}
Steel	Strength II	1.25	1.50	1.35
	Service II	1.00	1.00	1.00
Reinforced Concrete	Strength II	1.25	1.50	1.35
	Service I	1.00	1.00	1.00
Prestressed Concrete	Strength II	1.25	1.50	1.35
	Service I	1.00	1.00	1.00
Wood	Strength II	1.25	1.50	1.35

925.4 DYNAMIC LOAD ALLOWANCE (IM)

A. A dynamic load allowance of 33% shall be used for all non-buried bridges, except for fatigue evaluation.

B. For fatigue evaluation, a dynamic load allowance of 15% shall be used.

C. Dynamic load allowance shall only be applied to the truck or tandem portion of HL93 loading (dynamic load allowance shall not be provided to the lane portion).

D. Dynamic load allowance shall not be applied to wood components of a bridge.

E. Dynamic allowance may be ignored for slow moving (speed less than 10 mph), special or permit loads under controlled conditions.

F. For buried bridges, dynamic allowance (IM) shall be taken as:

   $IM = 33\ (1.0 - 0.125\ DE) \geq 0\%$ .... [AASHTO 3.6.2.2-1]

   Where:

   DE = the minimum depth of cover above the structure (ft.)

925.5 CONDITION FACTOR (φ_c)

A Condition Factor shall be applied to the calculated capacity of the structure, as follows:

Table 925.5-1: Condition Factors [MBE 6A.4.2.3]

Structural Condition of a Member	NBI General Appraisal	Condition Factor φ_c
Good or Satisfactory	6 or higher	1.00
Fair	5	0.95
Poor	4 or lower	0.85

925.6 SYSTEM FACTOR (φ_S)

System factors are multiplied to the nominal resistance to reflect the level of redundancy of the complete superstructure [MBE 6A.4.2.4]. Bridges that are less redundant will have their factored member capacities reduced.

The following system factors may be used for Flexural and Axial Effects:

Table 925.6-1: System Factors [MBE 6A.4.2.4]

Superstructure Type	φ_S
Welded members in two-girder/truss/arch bridges	0.85
Riveted members in two-girder/truss/arch bridges	0.90
Multiple eye bar members in truss bridges	0.90
Three-girder bridges with girder spacing 6-ft.	0.85
Four-girder bridges with girder spacing ≤ 4-ft.	0.95
Floor beams with spacing > 12.0-ft. and non-continuous stringers	0.85
Redundant stringer subsystems between floor-beams	1.00
All other girder and slab bridges	1.00

925.7 RESISTANCE FACTOR (φ)

Resistance factor (φ) for the load rating has the same value as for a new design as given in AASHTO LRFD Specification. Also, $\varphi = 1.0$ for all non-strength limit states [MBE C6A.4.2.1]. See appropriate section in the LRFD Specification for recommended values for resistance factors [LRFD 5.5.4.2, 6.5.4.2, 8.5.2, 12.5.5].

Some of the commonly used Resistance Factors are given here:

Table 925.7-1: Resistance Factors

Type	φ
Tension controlled reinforced concrete section	**0.90**
Tension controlled prestressed concrete section	**1.00**
Shear and torsion in normal weight concrete	**0.90**
Flexure in steel	**1.00**
Shear in steel	**1.00**
Axial Compression in steel only	**0.90**
Axial Compression in composite	**0.90**
Shear connectors, steel	**0.85**
Web crippling, steel	**0.80**
For block shear	**0.80**
For shear rupture in connection element	**0.80**
For weld metal in partial penetration and fillet weld	**0.80**
Flexure in wood	**0.85**
Shear in wood	**0.75**
Wood connections	**0.65**
RC cast-in-place buried box structures in flexure	**0.90**
RC cast-in-place buried box structures in shear	**0.85**
RC precast buried box structures in flexure	**1.00**
RC precast buried box structures in shear	**0.90**
RC precast buried 3-sided structures in flexure	**0.95**
RC precast buried 3-sided structures in shear	**0.90**
Structural steel pipe, minimum wall area & buckling	**1.00**
Structural steel pipe, minimum longitudinal seam strength	**0.67**

925.8 EFFECT OF SKEW

Effect of skew on the distribution of live loads shall be considered according to AASHTO LRFD Specifications (LRFD 4.6.2.2.2 and 4.6.2.2.3).

926 LOAD RATING OF NEW BRIDGES

926.1 LOADS TO BE USED FOR LOAD RATING

A. All new and replacement bridges, whose preliminary design was started **after October 1, 2010** and requiring load rating, shall be load rated by the AASHTO LRFR method to comply with FHWA requirements. The load to be used for inventory and operating rating based on the LRFR method shall be AASHTO's HL93 loading (truck and lane or tandem and lane), according to

Figure 926.1-1.

B. All bridges shall be load rated for the eight Legal Loads (2F1, 3F1, 4F1, 5C1, SU4, SU5, SU6 and SU7 as shown in Figures 908.3-1 and 908.3-2) using LRFR method.

C. If a bridge is determined to be an EV-Qualified bridge, it shall also be load rated for EV2 and EV3 loads (Figure 908.3-3), using LRFR method.

D. Future wearing surface dead loads shall be applied in load rating calculations unless directed otherwise.

E. Newly designed timber bridges shall be load rated using the LRFR method.

F. All trucks used for analysis shall have transverse spacing, between centerline of wheels and wheel-groups of 6-ft.

G. For a bridge being designed, if the rating factor (RF) at inventory level (for design load) is less than 1.00, the design shall be revised to bring up the RF to 1.0 or higher. The minimum acceptable RF for AASHTO design load at inventory level is 1.000.

H. Long span bridges shall use the special load configurations given in BDM Section 918.

I. The inventory and operating ratings for the AASHTO HL93 loading shall be expressed in terms of rating factors, rounded to the nearest third decimal point.

J. The operating ratings for each of the Ohio Legal Loads shall also be expressed in terms of rating factors of respective legal load rounded to the nearest third decimal point. The Ohio Legal Loads Rating shall be the smallest rating factor of the four legal loads expressed as a percentage rounded off to the nearest 5 (i.e. smallest RF multiplied by 100).

K. The Bridge Owner may also require load rating to be done for special loads in addition to those specified above. The owner shall include full configurations of the special load used in the analysis, including, but not limited to, axle weights and spacing, number of tires on each axle, tire gauges and overall dimensions of the load. All special loads are to be analyzed by the LRFR method of analysis at the operating level as per BDM Section 917 unless specified otherwise by the Owner.

926.2 LOAD RATING OF NEW BURIED BRIDGES

926.2.1 CAST-IN-PLACE CONCRETE BOX & FRAME STRUCTURES

A. Cast-in-place bridges shall be load rated by the designer of the bridge.

B. The AASHTO BrR or the BRASS-Culvert program shall be used to load rate the structure.

926.2.2 PRECAST CONCRETE BOXES

926.2.2.1 PRECAST CONCRETE BOXES OF SPAN GREATER THAN 12-FT

A. The load rating analysis for precast concrete box culverts of spans up to 20 feet is provided in SS940.

B. The load rating analysis for precast concrete box culverts of spans greater than 20 feet shall be performed by the designer.

926.2.2.2 PRECAST BOXES OF SPAN EQUAL TO OR LESS THAN 12-FT

A. The manufacturer shall submit the actual information about the dimensions and reinforcing bars/cage to the OSE along with the shop drawings before the placement of structure.

B. The load rating analysis will be performed by the OSE using AASHTO BrR or the BRASS-Culvert program.

926.2.3 PRECAST FRAMES, ARCHES, AND CONSPANS & BEBO TYPE STRUCTURES

A. The load rating analysis will be performed by the manufacturer.

B. The load rating report shall be submitted along with the shop drawings before the placement of the precast units.

C. Use the design software to load rate the bridge.

926.2.4 ANALYSIS OF CONCRETE BOX SECTIONS & FRAMES

A. Unless more accurate soil data exists, calculate the rating based on a lateral pressure as specified in AASHTO.

B. Apply a live load surcharge as per AASHTO.

C. The effect of soil-structure interaction shall be taken into account as per AASHTO.

D. Assume hinged connections between the walls and the top and bottom slabs unless there is adequate reinforcing steel continuous between the slab and the walls at the joint. In that case, continuity between the slab and the walls can be assumed.

926.2.5 ANALYSIS OF FLAT TOPS, CATCH BASINS, INLET TOPS

A. The load rating analysis shall be performed by the designer.

B. Unless more accurate soil data exists, calculate the rating based on a lateral pressure as specified in AASHTO.

C. Apply a live load surcharge as per AASHTO.

D. The effect of soil-structure interaction shall be taken into account as per AASHTO.

E. Assume hinged connections between the walls and the top and bottom slabs unless there is adequate reinforcing steel continuous between the slab and the walls at the joint. In that case, continuity between the slab and the walls can be assumed.

926.3 LOAD RATING OF NON-BURIED STRUCTURES

926.3.1 GENERAL

All structures, including flat slabs, arch structures, frames, box sections, etc., having a fill or pavement material of less than 2-ft on top shall be load rated according to the provisions of this Section.

All main structural members of the superstructure affected by live load shall be analyzed.

926.3.2 HOW THE LOAD RATING SHALL BE DONE

The designer shall analyze and load rate all spans that are designed to carry vehicular traffic.

The load rating analysis shall be based on the final design plans. At the inventory level, the load rating shall be equal to or greater than the design loading.

All members shall have actual net section and current conditions incorporated into the member analysis.

Bridge members designed as non-composite with the deck slab should be analyzed as non-composite.

All dead loads are to be calculated based on the actual field conditions. Future dead loads shall not be applied unless directed otherwise.

The total thickness of the composite concrete slab shall be used in load rating for the calculations of section properties. Do not subtract for the monolithic wearing surface.

Live load distribution factors, as defined in the current AASHTO LRFD, shall be used.

926.3.3 WHEN THE BRIDGE LOAD RATING SHALL BE DONE

The load rating of new bridges shall be done as per the following sub-sections:

926.3.3.1 BRIDGES DESIGNED UNDER MAJOR OR MINOR PLAN DEVELOPMENT PROCESS

For bridges designed under the Major or Minor Plan Development Process (PDP), perform the load rating and include the load rating report in the Stage 2 Detail Design Submission. When design modifications that affect the previously submitted load rating analysis occur after Stage 2 and prior to contract sale, revise and resubmit the load rating report to the District Project Manager. The District Project Manager will forward the final load rating report to the District Bridge Engineer.

926.3.3.2 BRIDGES DESIGNED UNDER MINIMAL PLAN DEVELOPMENT PROCESS

For bridges designed under the Minimal Plan Development Process (PDP), perform the load rating and include the load rating report in the Stage 3 Detail Design Submission. When design modifications that affect the previously submitted load rating analysis occur after Stage 3 and prior to contract sale, revise and resubmit the load rating report to the District Project Manager. The District Project Manager will forward the final load rating report to the District Bridge Engineer.

926.3.3.3 BRIDGES DESIGNED UNDER DESIGN-BUILD PROCESS

Unless otherwise indicated in the project scope, include the load rating report for bridges designed as part of a Design Build project with the Stage 2 Detail Design Submission. When design modifications that affect the previously submitted load rating analysis occur after Stage 2, revise and resubmit the load rating report to the District Project Manager. The District Project Manager will forward the final load rating report to the District Bridge Engineer.

926.3.3.4 BRIDGES DESIGNED UNDER VALUE ENGINEERING CHANGE PROPOSAL

For bridges re-designed under a Value Engineering Change Proposal (VECP), perform a load rating of the altered bridge design and submit the load rating report to the District Construction Engineer (DCE) with the Final VECP submission. The DCE will supply this information to the District Bridge Engineer.

927 LOAD RATING OF EXISTING BRIDGES

927.1 LOADS TO BE USED FOR LOAD RATING

A. Existing bridges may be load rated at inventory and operating rating by either LFR or LRFR method with the prior approval of the bridge owner. When the LFR method is used, the load for inventory and operating rating shall be AASHTO HS20. When the LRFR method is used, the load for inventory and operating rating shall be AASHTO HL93.

B. If a bridge is determined to be an EV-Qualified bridge, it shall also be load rated for EV2 and EV3 loads (Figure 908.3-3) by either LFR or LRFR method.

C. Existing timber bridges shall be load rated using the ASR method.

D. All bridges shall also be load rated for the Ohio Legal Loads using the same method of analysis as used for the inventory and operating ratings.

E. All legal loads used for analysis shall have transverse spacing, between centerline of wheels or wheel-groups, of 6-ft.

F. For long span bridges, as defined in BDM Section 905, use the special load configurations given in BDM Section 918.

G. The inventory and operating ratings for the AASHTO HL93 or HS20 loading shall be expressed in terms of rating factors, rounded to the nearest three decimal points.

H. The operating ratings for each of the Ohio Legal Loads shall also be expressed in terms of rating factors of the respective legal loads, rounded to the nearest three decimal points. The Ohio Legal Loads Rating shall be the smallest rating factor of the four legal loads expressed as a percentage rounded to the nearest 5 (i.e. smallest RF multiplied by 100).

I. The Bridge Owner may also require load rating to be done for special loads in addition to those specified above. The Owner shall include full configurations of the special load used in the analysis, including but not limited to, axle weights and spacing, number of tires on each axle, tire gauges and overall dimensions of the load. All special loads are to be analyzed by the LRFR method of analysis at the operating level as per BDM Section 917 unless specified otherwise by the Owner.

927.2 LOAD RATING OF BRIDGES TO BE REHABILITATED

927.2.1 HOW THE LOAD RATING SHALL BE DONE

A. The designer shall analyze and load rate all spans that are designed to carry vehicular traffic.

B. The load rating analysis shall be based on the final design or as-built plans.

C. Future wearing surface dead loads shall be applied in load rating calculations unless directed otherwise.

D. All members shall have actual net section and current conditions incorporated into the member’s analysis. Any known section losses, defects or damage to the existing structural members shall be considered in the rating analysis.

E. Bridge members designed as non-composite with the deck slab should be analyzed as non-composite.

F. Structures to be rehabilitated shall be analyzed using the original design plans, the actual field conditions, and all major changes in the final rehabilitation plans.

G. A complete review of all the available inspection information, as well as a thorough site inspection of the existing bridge, must be performed to establish the current conditions prior to proceeding with the analysis.

H. The total thickness of the composite concrete slab shall be used in load rating for the calculations of section properties. Do not subtract for the monolithic wearing surface.

I. Live load distribution factors, in accordance with the governing AASHTO specifications, shall be used.

J. For existing bridges, the rater should review the original design plans as the first source of information for material strengths and stresses. If the material strengths are not explicitly stated on the design plans, ODOT Construction and Material Specifications (C&MS) applicable at the time of the bridge construction shall be reviewed. This may require investigations into old ASTM or AASHTO Material Specifications active at the time of construction.

K. Ultimate or yield strengths of materials shall be as specified on the original design plans unless it is required in the scope of services to conduct specific tests to determine the material strengths.

L. General information about Allowable Stresses in bending and shear and material strengths based on the year of construction provided in Tables 927.2.1-1 and 927.2.1-2. Any material stresses and strengths specified on the design plans shall supersede the values given in Tables 927.2.1-1 and 927.2.1-2 & 927.2.1-3.

M. The rater is cautioned to pay extra attention to the design plans and the year of construction when determining material strengths for structures built during the transition years of Tables 927.2.1-1, 927.2.1-2 and 927.2.1-2 (e.g. for member type SS, years 1964-68, or 1988-93, etc.), as materials of the newer (or older) specifications may have been substituted.

Table 927.2.1-1: Custom Allowable Stresses in Bending

		Type of Rating							
Material of Construction	Year of Construction	Fy / Fc' (ksi)	Fy / Fc' (MPa)	Inventory (ksi)	Inventory (MPa)	Operating (ksi)	Operating (MPa)	Posting (ksi)	Posting (MPa)
Structural Steel (SS),(CSC)	< 1900	26.00	179	14.00	97	19.00	131	19.00	131
	1901 To 1930	30.00	207	16.00	110	22.00	152	22.00	152
	1931 To 1965	33.00	228	18.00	124	25.00	172	25.00	172
	1966 To 1990	36.00	248	20.00	138	27.00	186	27.00	186
	1991 To Date	50.00	345	27.00	186	37.50	259	37.50	259
Reinforcing Steel (RC)	< 1935	32.00	221	16.00	110	24.00	165	24.00	165
	1936 To 1950	36.00	248	18.00	124	27.00	186	27.00	186
	1951 To 1983	40.00	276	20.00	138	30.00	207	30.00	207
	1984 To Date	60.00	414	24.00	165	36.00	248	36.00	248
Prestress. Strands (Fs') (CPS),(PSC)	All Years	270.0	1862	-	-	-	-	-	-
Cast-in-Place Reinf. Conc. (Compression in Bending) (RC),(CSC)	< 1930	2.00	14	0.70	5	1.30	9	1.30	9
	1931 To 1950	3.00	21	1.00	7	1.50	10	1.50	10
	1951 To 1980	4.00	28	1.30	9	2.00	14	2.00	14
	1981 To Date	4.50	31	1.50	10	2.20	15	2.20	15
Prestressed Concrete (Fc') (PSC),(CPS)	All Years	5.50	38	-	-	-	-	-	-
Cast-in-Place Comp. Slab for Prestress. Conc. (Fc') (CPS)	All Years	4.00	28	-	-	-	-	-	-
Timber (fb) (TMB)	All Years	-	-	1.6	11	2.128	15	2.128	15
Cast-in-Place Slab for Composite Reinforced Concrete	< 1930	2.00	14	0.70	5	1.30	9	1.30	9
	1931 To 1950	3.00	21	1.00	7	1.50	10	1.50	10
	1951 To 1980	4.00	28	1.30	9	2.00	14	2.00	14
	1981 To Date	4.50	31	1.50	10	2.20	15	2.20	15

Table 927.2.1-2: Custom Allowable Stresses in Shear

		Type of Rating							
Material of Construction	Year of Construction	Fy / Fc' (ksi)	Fy / Fc' (MPa)	Inventory (ksi)	Inventory (MPa)	Operating (ksi)	Operating (MPa)	Posting (ksi)	Posting (MPa)
Structural Steel (SS),(CSC)	< 1900	26.00	179	8.50	59	11.50	79	11.50	79
	1901 To 1930	30.00	207	9.50	66	13.50	93	13.50	93
	1931 To 1965	33.00	228	11.00	76	15.00	103	15.00	103
	1966 To 1990	36.00	248	12.00	83	16.00	110	16.00	110
	1991 To Date	50.00	345	17.00	117	22.50	155	22.50	155
Reinforcing Steel (RC)	< 1935	32.00	221	16.00	110	24.00	165	24.00	165
	1936 To 1950	36.00	248	18.00	124	27.00	186	27.00	186
	1951 To 1983	40.00	276	20.00	138	30.00	207	30.00	207
	1984 To Date	60.00	414	24.00	165	36.00	248	36.00	248
Cast-in-Place Reinforced Conc. (RC),(CSC)	< 1930	2.00	14	0.70	5	1.30	9	1.30	9
	1931 To 1950	3.00	21	1.00	7	1.50	10	1.50	10
	1951 To 1980	4.00	28	1.30	9	2.00	14	2.00	14
	1981 To Date	4.50	31	1.50	10	2.20	15	2.20	15
Prestressed Concrete (Fc') (PSC),(CPS)	All Years	5.50	38						
Timber (Horizontal Shear Stress) (fb) (TMB)	All Years	-	-	0.09	1	0.12	1	0.12	1

Table 927.2.1-3: Custom Allowable Stresses for Fasteners

Material	Constructed	LRFR	ASD		
		ΦF_v	Inventory	Operating	Posting
Riveted	<1939	18.0 ksi	9.5 ksi	12.5 ksi	12.5 ksi
	1936 to 1950	21.0 ksi	11.0 ksi	15.0 ksi	15.0 ksi
	1950 to Date	25.0 ksi	13.5 ksi	18.0 ksi	18.0 ksi
Bolted – Bearing	< 1965	17.0 ksi	11.0 ksi	15.0 ksi	15.0 ksi
	1965 to Date	36.5 ksi *	NA	NA	NA
		32.0 ksi **	NA	NA	NA
Bolted – Slip Critical	< 1965	NA	NA	NA	NA
	1965 to Date	17.0 ksi *	15.0 ksi *	20.0 ksi *	20.0 ksi *
		15.0 ksi **	13.0 ksi **	17.5 ksi **	17.5 ksi **

* Diameter ≤ 1”.
** Diameter > 1”.

927.2.2 WHEN THE BRIDGE LOAD RATING SHALL BE DONE

The load rating of bridges to be rehabilitated shall be done as per following:

927.2.2.1 BRIDGES DESIGNED UNDER MAJOR OR MINOR PLAN DEVELOPMENT PROCESS

For bridges designed under the Major or Minor Plan Development Process (PDP), perform the load rating and include the load rating report in the Stage 2 Detail Design Submission. When design modifications that affect the previously submitted load rating analysis occur after Stage 2 and prior to contract sale, revise and resubmit the load rating report to the District Project Manager. The District Project Manager will forward the final load rating report to the District Bridge Engineer.

927.2.2.2 BRIDGES DESIGNED UNDER MINIMAL PLAN DEVELOPMENT PROCESS

For bridges designed under the Minimal Plan Development Process (PDP), perform the load rating and include the load rating report in the Stage 3 Detail Design Submission. When design modifications that affect the previously submitted load rating analysis occur after Stage 3 and prior to contract sale, revise and resubmit the load rating report to the District Project Manager. The District Project Manager will forward the final load rating report to the District Bridge Engineer.

927.2.2.3 BRIDGES DESIGNED UNDER DESIGN-BUILD PROCESS

Unless otherwise indicated in the project scope, include the load rating report for bridges designed as part of a Design Build project with the Stage 2 Detail Design Submission. When design modifications that affect the previously submitted load rating analysis occur after Stage 2, revise and resubmit the load rating report to the District Project Manager. The District Project Manager will forward the final load rating report to the District Bridge Engineer.

927.2.2.4 BRIDGES DESIGNED UNDER VALUE ENGINEERING CHANGE PROPOSAL

For bridges re-designed under a Value Engineering Change Proposal (VECP), perform a load rating of the altered bridge design and submit the load rating report to the District Construction Engineer (DCE) with the Final VECP submission. The DCE will supply this information to the District Bridge Engineer.

927.2.3 LOAD RATING OF BURIED BRIDGES

927.2.3.1 CAST-IN-PLACE STRUCTURES

A. Cast-in-place bridges shall be load rated by the designer of the bridge.

B. The AASHTO BrR or the BRASS-Culvert program shall be used to load rate the structure. For information on the BRASS-Culvert Analysis, also see BDM Section 924.

927.2.3.2 PRECAST BOXES OF SPAN GREATER THAN 12-FT.

A. The load rating analysis will be performed by the OSE.

B. The AASHTO BrR or the BRASS-Culvert program shall be used to load rate the structure. For information on the BRASS-Culvert Analysis, see BDM Section 924.

927.2.3.3 PRECAST BOXES OF SPAN EQUAL TO OR LESS THAN 12-FT

The load rating analysis will be performed by the OSE using AASHTO BrR or the BRASS-Culvert program.

927.2.3.4 PRECAST FRAMES, ARCHES, AND CONSPANS & BEBO TYPE STRUCTURES

A. The load rating analysis for any new or replacement precast sections will be performed by the manufacturer; otherwise, the load rating analysis will be performed as per the scope of services.

B. The load rating report shall be submitted along with the shop drawings before the placement of the units.

C. The design software shall be used to load rate the bridge.

927.2.3.5 ANALYSIS OF CONCRETE BOX SECTIONS & FRAMES

Unless more accurate soil data exits, calculate the rating based on a lateral pressure as specified in AASHTO.

Apply a live load surcharge according to AASHTO.

The effect of soil-structure interaction shall be taken into account according to AASHTO.

Assume hinged connections between the walls and the top and bottom slabs unless there is adequate reinforcing steel continuous between the slab and the walls at the joint. In that case, continuity between the slab and the walls can be assumed.

927.2.4 LOAD RATING OF NON-BURIED STRUCTURES

All structures, including flat slabs, arch structures, frames, box sections, etc., having a fill or pavement material of less than 2-ft on top shall be load rated according to the provisions of BDM Sections 912 through 925 (as applicable).

927.3 LOAD RATING OF EXISTING BRIDGES WITH NO REPAIR PLANS

927.3.1 HOW THE LOAD RATING SHALL BE DONE

The rater shall analyze and load rate all spans that are designed to carry vehicular traffic.

Existing structures shall be analyzed using the information from the original design plans and the actual field conditions.

A complete review of all the available inspection information, as well as a thorough site inspection of the existing bridge, must be performed to establish the current conditions prior to proceeding with the analysis.

The bridges rated using design plans shall be noted as such in the load rating report.

Allowable stresses for the working stress and the ultimate or yield strengths of materials for Load Factor ratings shall be as specified on the original design plans unless it is required in the scope of services to conduct specific tests to determine the material strengths.

For existing bridges, the rater should review the original design plans as the first source of information for material strengths and stresses. If the material strengths are not explicitly stated on the design plans, ODOT Construction and Material Specifications (C&MS) applicable at the time of the bridge construction shall be reviewed. This may require investigations into old ASTM or AASHTO Material Specifications active at the time of construction.

The total thickness of the composite concrete slab shall be used in load rating for the calculations of section properties. Do not subtract for the monolithic wearing surface.

General information about ODOT Allowable Stresses in bending and shear and material strengths based on the year of construction is provided in Tables 927.2.1-1 and 927.2.1-2.

The rater is cautioned to pay extra attention to the design plans and the year of construction, when determining material strengths for bridges built during transition years of Tables 927.2.1-1 and 927.2.1-2 (e.g., for member type SS, years 1964-68, or 1988-93, etc.), as materials of the newer (or older) specification may have been substituted.

Any material stresses and specifications specified on the design plans shall supersede the values given in Tables 927.2.1-1 and 927.2.1-2.

927.3.2 WHEN THE BRIDGE LOAD RATING SHALL BE DONE

The load rating of existing bridges shall be done as per the Scope of Services.

927.3.3 LOAD RATING OF EXISTING BURIED BRIDGES

A. The load rating analysis will be performed as per the Scope of Services.

B. Unless specified otherwise, structures shall be load rated for the Loads as per BDM Section 927.2.3.

927.3.4 LOAD RATING OF NON-BURIED STRUCTURES

All structures, including flat slabs, arch structures, frames, box sections, etc., having a fill or pavement material of less than 2-ft on top of the structures shall be load rated according to the provisions of BDM Sections 911 through 925 (as applicable).

928 LOAD RATING OF NON-ODOT BRIDGES

Provisions of BDM Section 900 may also be applied to load rating of Non-ODOT buried and non-buried bridges at the discretion of the respective bridge owners.

The load rating files and reports of a Non-ODOT bridge shall be submitted to the respective bridge owners. The bridge owner shall keep the bridge load rating report in the bridge file for future reference and use.

Based on the field conditions and the load rating calculations, if the rating engineer determines a bridge should be posted for reduced load capacity, the engineer shall forward the recommendation to the respective bridge owner. Applicable portions of BDM Section 918, Bridge Posting for Reduced Load Limits may be followed.

It is the responsibility of the respective bridge owner (or designated consultant/rating engineer) to ensure that the load rating information is finally updated in the ODOT SMS.

929 CULVERT TYPE BRIDGES DESIGNED USING ASTM C1577 (LRFD), C1433 (LFD), C789 (LFD) AND C850 (LFD)

When all of the following conditions apply:

A. A structure is designed and manufactured by an AASHTO method using any of the above referred ASTM Specifications;

B. The ASTM Specifications are referenced via pay item in the design plans and the structure was built in accordance with the ASTM Specifications;

C. No changes to loading conditions or the structure conditions have occurred that could reduce the load rating below the design load level;

D. In case of an existing structure, a field evaluation has been completed and the structure has not developed excessive cracks, deflections or signs of deterioration;

E. The design plans and the relevant ASTM Specification are accessible and referenced or included in the individual bridge records to form a basis for assigned load rating under FHWA 23 CFR 650.309(c);

F. The main structural members of the bridge have not been damaged or repaired since the structure was originally built;

G. During the last inspection, the General Appraisal (GA) was not less than 5 and the bridge was neither posted nor closed.

Appropriate load rating factors may be assigned to the structure, as follows:

- Inventory Rating Factor for HL93 loading = 1.00
- Operating Rating Factor for HL93 loading = 1.30
- Ohio Legal Loads Rating Factor = 1.50 (150%)
- Method of Rating = Assigned Load & Resistance Factor Rating (LRFR) using HL93 loadings

OR

- Inventory Rating Factor for HS20 loading = 1.00
- Operating Rating Factor for HS20 loading = 1.30
- Ohio Legal Loads Rating Factor = 1.50 (150%)
- Method of Rating = Assigned Load Factor Rating (LFR) using HS20 loadings

A load rating summary of the assigned load rating (using BR100 Form, given as Figure 921.1-1) demonstrating above conditions are met, is to be included in the bridge records. An Ohio PE shall sign, seal and date the Load Rating Summary Sheet.

If any of the above conditions (A through G) cannot be met for a bridge at any point during its service life, load ratings cannot be assigned and must be determined by the methods defined elsewhere in the BDM Section 900.

930 REFERENCES

A. AASHTO, LRFD Bridge Design Specifications, most current Edition and all subsequent Interims

B. AASHTO, the Manual for Bridge Evaluation, 2nd Edition and all subsequent Interims

C. AASHTO, Standard Specifications for Highway Bridges, 17th Edition

D. AASHTO, Guide Specifications for Fatigue Evaluation of Existing Steel Bridges, most current Edition and all subsequent Interims

E. AASHTO, Guide Specifications for Strength Evaluation of Existing Steel and Concrete Bridges

F. AASHTO, Manual for Maintenance Inspection of Bridges

G. AASHTO, Guide Specifications for Fracture Critical Non-Redundant Steel Bridge Members, most current Edition and all subsequent Interims

H. AASHTO Bridge Rating and AASHTO Bridge Design Software, developed by Baker Corp, Moon Township, Pittsburgh

I. WYDOT, BRASS-Culvert software developed by the Wyoming Department of Transportation

J. Duncan, J.M., 1979, “Design Studies For Aluminum Structural Plate Box Culverts,” Kaiser Aluminum and Chemical Sales, Inc.

K. FHWA, 1995, “Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation’s Bridges, Report No. FHWA-PD-96-001, December 1995

L. NCSPA, “Load Rating & Structural Evaluation of In-Service Corrugated Steel Structures,” & Design Data Sheet No. 19, National Corrugated Steel Pipe Association (NCSPA, 202-452-1700)

931 LOAD RATING FLOW CHART

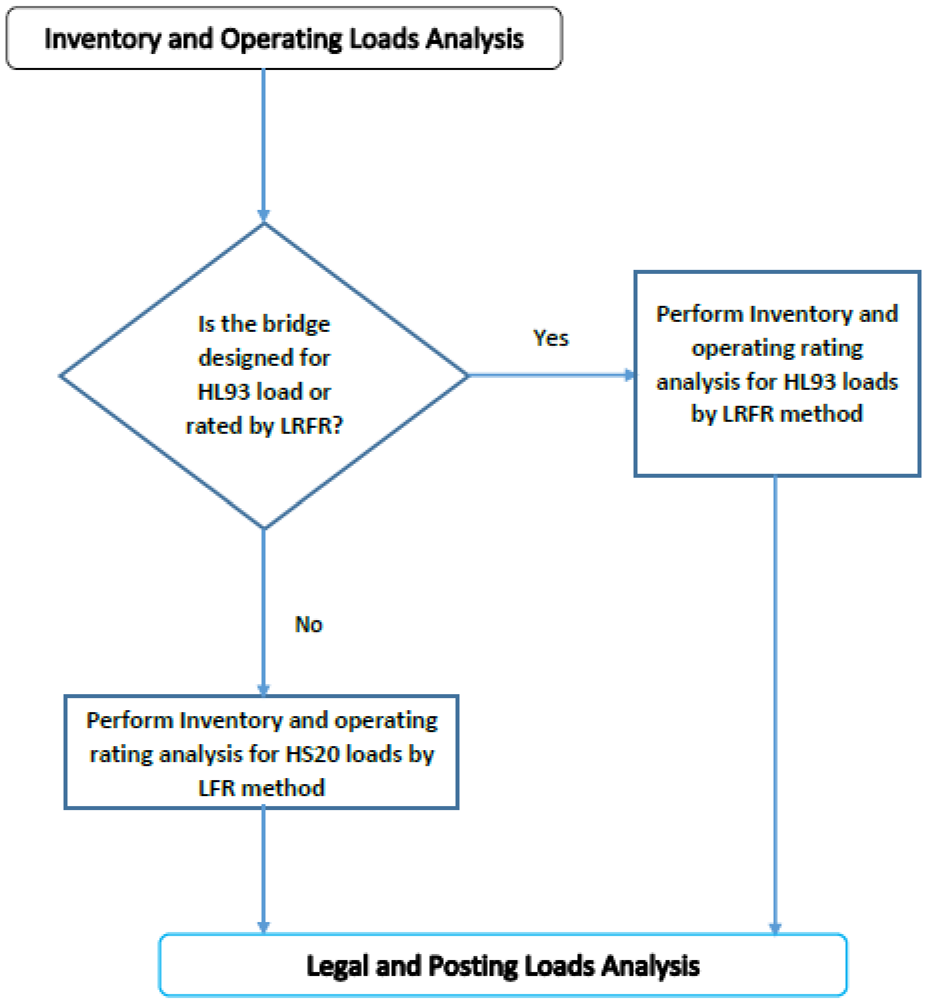


Figure 931-1: Inventory and Operating Load Rating Flow Chart

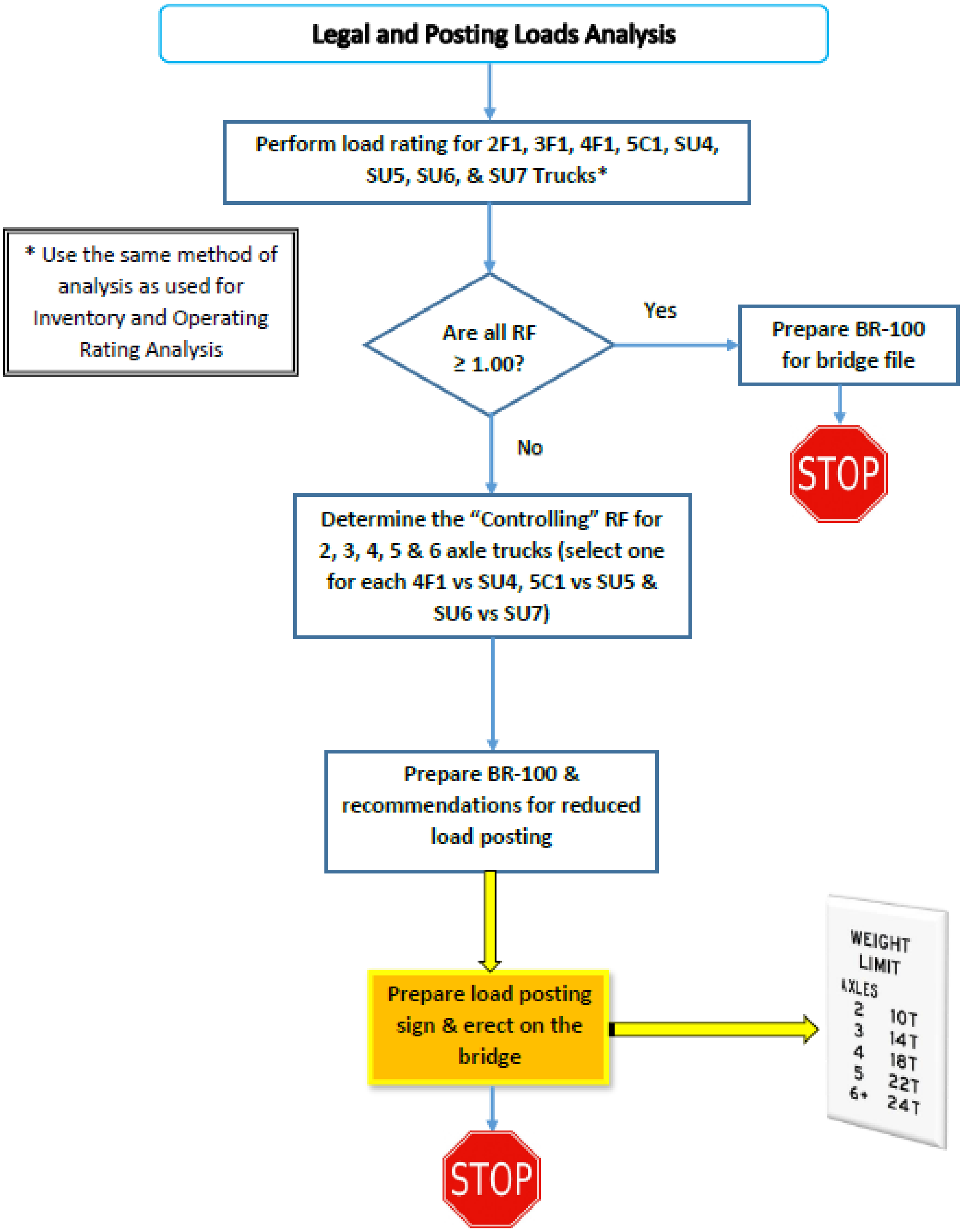


Figure 931-2: Ohio Legal and Posting Load Rating Flow Chart