Special Hauling Vehicles (SHV) Load Rating Update

Amjad Waheed, PE
Assistant Administrator OSE
Ohio Department of Transportation

Columbus, OH
August 18, 2016

2016 CEAO Bridge Conference
What is a SHV?

- Special Hauling Vehicle
- It is a legal truck
- SU designation = Single Unit
Load Rating for SHV

**Federal Bridge Formula**

**Permissible Gross Loads for Vehicles In Regular Operation**

Based on weight formula

\[ W = 500 \left( \frac{LN + 12N + 36}{N-1} \right) \]

**Limits**

- Single Axle (max) = 20,000 lbs.
- Tandem Axle (max) = 34,000 lbs.
- Gross Weight (max) = 80,000 lbs.

Enacted 1975
What is a SHV?
What is a SHV?
What is a SHV?
What is a SHV?
What is a SHV?
What is a SHV?
What is Required?

- NCHRP 12-63 showed current AASHTO truck configurations don’t capture demand from the SHV’s.
- A simple comparison of ODOT Legal trucks with SHV’s shows a need to load rate for these vehicles.
What is required?

- FHWA requires load rating for these vehicles to be completed.

- ODOT has prepared a proposed plan to load rate for SHV’s.
  - Plan is posted on ODOT’s OSE web site.
What is Required?

Memorandum

Subject: ACTION: Load Rating of Specialized Hauling Vehicles

Date: November 15, 2013

/s/ Original Signed by

From: Joseph S. Krolak
Acting Director, Office of Bridge Technology

In Reply Refer To:

To: Federal Lands Highway Division Engineers
Division Administrators

The purpose of this memorandum is to clarify FHWA’s position on the analysis of Specialized Hauling Vehicles (SHVs) as defined in the AASHTO Manual for Bridge Evaluation (MBE) during bridge load rating and posting to comply with the requirements of the National Bridge Inspection Standards (NBIS). The intent of the load rating and posting provisions of the NBIS is to insure that all bridges are appropriately evaluated to determine their safe live load carrying capacity considering all unrestricted legal loads, including State routine permits, and that bridges are appropriately posted if required, in accordance with the MBE.

The SHVs are closely-spaced multi-axle single unit trucks introduced by the trucking industry in the last decade. Examples include dump trucks, construction vehicles, solid waste trucks and other hauling trucks. SHVs generally comply with Bridge Formula B and are for this reason considered legal in all States, if a State’s laws do not explicitly exclude the use of such vehicles.

NCHRP Project 12-63 (Report 575, 2007) studied the developments in truck configurations and State legal loads and found that AASHTO Type 3, 3-S2 and 3-3 legal vehicles are not representative of all legal loads, specifically SHVs. As a result, legal load models for SHVs were developed and adopted by AASHTO in 2005, recognizing that there is an immediate need to incorporate SHVs into a State’s load rating process, if SHVs operate within a State. The SHV load models in the MBE include SU4, SU5, SU6 and SU7 representing four- to seven-axle SHVs respectively, and a National Rating Load (NRL) model that envelopes the four single unit load models and serves as a screening load. If the load rating factor for the NRL model is 1.0 or greater, then there is no need to rate for the single-unit SU4, SU5, SU6 and SU7 loads. However, if the load rating factor for the NRL is less than 1.0, then the single-unit SU4, SU5, SU6 and SU7 loads need to be considered during load rating and posting.

Load Rating for SHV
What is Required?

The SHVs create higher force effects, and thus result in lower load ratings for certain bridges, especially those with a shorter span or shorter loading length such as transverse floor beams, when compared to AASHTO Type 3, 3-S2 and 3-3 legal loads and HS20 design load. Therefore, SHVs, i.e., SU4, SU5, SU6 and SU7 or NRL, are to be included in rating and posting analyses in accordance with Article 6A.2.3 and Article 6B.9.2 of the 1st Edition of the MBE (Article 6B.7.2 of the 2nd Edition of the MBE), unless one of the following two conditions is met:

Condition A: The State verifies that State laws preclude SHV use; or

Condition B: The State has its own rating vehicle models for legal loads and verifies that the State legal load models envelope the applicable AASHTO SHV loading models specified in Appendix D6A and Figure 6B.9.2-2 of the 1st Edition of the MBE (Figure 6B.7.2-2 of the 2nd Edition of the MBE), and the State legal load models have been included in rating/posting analyses of all bridges. The SHV types, e.g. six- or seven-axle SHVs, precluded by State laws need not be considered.

The SHV load models apply to Allowable Stress Rating, Load Factor Rating, and Load and Resistance Factor Rating in accordance with Section 6A and 6B of the MBE.

The FHWA recognizes that there are bridges in the inventory that have not been rated for SHVs and that it is not feasible to include SHVs in the ratings for the entire inventory at once. FHWA is establishing the following timelines for rating bridges for SHVs, if neither Condition A or B is met:
What is Required?

**Group 1:** Bridges with the shortest span not greater than 200 feet should be re-rated after their next NBIS inspection, but no later than December 31, 2017, that were last rated by:

a) either Allowable Stress Rating (ASR) or Load Factor Rating (LFR) method and have an operating rating for the AASHTO Routine Commercial Vehicle either Type 3, Type 3S2, or Type 3-3 less than 33 tons (English), 47 tons (English), or 52 tons (English) respectively; or

b) Load and Resistance Factor Rating (LRFR) method and have a legal load rating factor for the AASHTO Routine Commercial Vehicle, either Type 3, Type 3S2 or Type 3-3, less than 1.3.

**Group 2:** Rate those bridges not in Group 1 no later than December 31, 2022.

For either group, if a re-rating is warranted due to changes of structural condition, loadings, or configuration, or other requirements, the re-rating should include SHVs.

The selection of load rating method should comply with FHWA’s Policy Memorandum Bridge Load Ratings for the National Bridge Inventory, dated October 30, 2006.

A State may utilize an alternative approach in lieu of the above to address the load rating for SHVs for bridges in their inventory; however, the approach must be reviewed and formally accepted by FHWA.

The timeline presented above will be incorporated into the review of Metric 13 under the National Bridge Inspection Program (NBIP); specifically, it is expected that all bridges meeting Group 1 criteria be load rated for SHVs by the end of 2017. Please work with your State to assist them in developing appropriate actions to meet those timelines. If your State is currently developing or implementing a Plan of Corrective Actions (PCA) for load rating bridges, the PCA should be reviewed and modified as necessary to take into account the rating of SHVs for those bridges and these timelines.

We request that you share this memorandum with your State or Federal agency partner. All questions that cannot be resolved at the Division Office level should be directed to Lubin Gao at lubin.gao@dot.gov or at 202-366-4604.
AASHTO SHV Configurations

27T; 18'
SU4

31T; 22'
SU5

Load Rating for SHV
AASHTO SHV Configurations

Load Rating for SHV
Ohio Legal Loads

2F1
15 T
10’ (3.05m)

3F1
23 T
10’ 4’ (1.22m)

Load Rating for SHV
Ohio Legal Loads

4F1
12 kips
27 T
10’

5C1
12 kips
40 T
(3.66m)

14 kips
17 kips
17 kips
17 kips

14 kips
14 kips
14 kips
17 kips

4’
4’
31’
4’
(9.45m)

Load Rating for SHV
Ohio Legal Loads

Ohio Legal Loads

AASHTO SHV

Load Rating for SHV
SHV Configurations

Notional Rating Load (NRL); 40T; 30’- 38’

6k  8k  8k  17k  17k  8k  8k  8k  8k
6’-14’ Varies  4’  4’  4’  4’  4’  4’  4’

Load Rating for SHV
Load Rating – New Bridges

Legal and Posting Load Rating Trucks

All new legal & posting load ratings performed after December 1, 2015 shall include SHVs (SU4, SU5, SU6 & SU7) as well as current Ohio Legal Loads (2F1, 3F1, 4F1, 5C1)
Load Rating – Existing Bridges

Group Inventory into 3 Groups:

- **Group A** – Ohio Legal RF $\geq 1.35$
- **Group B** – Ohio Legal RF $\geq 1.0$ and RF $< 1.35$
- **Group C** – Ohio Legal RF $< 1.0$ (posted bridges)
Load Rating – Existing Bridges

**Group A**

- No Action Required
- ODOT to prepare and submit study to FHWA to verify Ohio Legal Loads RF threshold of 1.35
- A research project is underway with Universities
Load Rating – Existing Bridges

**Group B**

- Re-rate per current method of analysis (LFR or LRFR)
- Prepare an updated BR-100
- Update Bridge Inventory
- Post the bridge if needed
- Complete by Dec. 31, 2022
Load Rating – Existing Bridges

**Group C**

- Re-rate per current method of analysis (LFR or LRFR).
- Prepare an updated BR-100
- Update Bridge Inventory
- Install new posting sign
- Complete by December 31, 2017
### Load Rating – Existing Bridges

#### Group C - NBI Bridges only

<table>
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<tr>
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<tr>
<td>CEAO</td>
<td>1,191</td>
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<tr>
<td>MUNI</td>
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Load Rating – Existing Bridges

Group B - NBI Bridges only

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<tr>
<td>CEAO</td>
<td>2300</td>
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<tr>
<td>MUNI</td>
<td>335</td>
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</table>
SHV Configurations

Notional Rating Load (NRL): 30’-38’

6k 8k 17k 17k 8k 8k

6’-14’ Varies

4’ 4’ 4’ 4’
WEIGHT
LIMIT
15T
16T
17T
30T
## New Load Posting Sign

<table>
<thead>
<tr>
<th>Axles</th>
<th>Load Rating</th>
</tr>
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<tbody>
<tr>
<td>2</td>
<td>10T</td>
</tr>
<tr>
<td>3</td>
<td>14T</td>
</tr>
<tr>
<td>4</td>
<td>18T</td>
</tr>
<tr>
<td>5</td>
<td>22T</td>
</tr>
<tr>
<td>6+</td>
<td>24T</td>
</tr>
</tbody>
</table>

*NEW BRIDGE LOAD POSTING SIGN*
*(Size: 36 inches by 60 inches)*
Load Rating – Existing Bridges

Proposed Plan

- ODOT will identify bridges in Groups A, B, & C (first cut)
- ODOT will keep track of completed load ratings
- Counties/Cities/Consultants will update SMS
- All completed work will be notified:
  - OTPC will notify Amjad Waheed (ODOT)
  - Counties will notify Mark Stockman (CEAO)
  - Cities will notify Omar Abu-Hajar (ODOT)
Load Rating – Existing Bridges

Proposed Plan For ODOT

- All ODOT bridges will be load rated by ODOT Central Office

- Expectations
  - ODOT Districts will assist in providing the plans and information
  - ODOT expects to meet the deadlines
Load Rating – Existing Bridges

Proposed Plan For OTPC

- The Ohio Turnpike Commission will have their bridges rated for SHV

- Expectations
  - Consultants hired by OTPC will assist in load rating
  - OTPC will meet the deadlines
Load Rating – Existing Bridges

Proposed Plan For Counties

- Additional funds of $460,000 have been approved by ODOT/FHWA to reanalyze Group C bridges
- CEAO will manage the projects for bridges that were previously load rated by a consultant
- Counties may hire consultants individually to complete the work
Load Rating – Existing Bridges

Proposed Plan For Counties

- ODOT’s assumption is that Counties will use the same consultants who did original load rating of their bridges.
- ODOT and County will split the cost of load rating equally (50% SP&R + 50% County).
- Funds are solely for load rating for SHV.
- **Inspections cannot be done using these funds.**
- Recommend to use separate contracts for any work other than load rating for SHV.
Load Rating – Existing Bridges

Proposed Plan For Counties

- Michele Risko (CEAO) will accept applications from Counties
- CEAO will prepare a template of the Scope for counties as a starting point
- Counties will negotiate contracts with the Consultants. Cost proposals to be sent to Cindy Wang (ODOT) through Michele Risko for review.
- ODOT will reimburse 50% of the cost of rating
Load Rating – Existing Bridges

Proposed Plan For Cities

- ODOT/Cities will manage the projects for bridges that were previously load rated by a consultant
- Cities may hire consultants individually to complete the work

Expectations

- Use same consultant who originally load rated a bridge wherever and whenever it is possible
Load Rating – Existing Bridges

How will ODOT help?

- Spread Sheets have been updated
  - Posted to ODOT FTP site

- BR-100 Load Rating Summary Form has been updated
  - Posted to ODOT FTP site
Load Rating – Existing & New Bridges

How will ODOT help?

- Load rating requirements for SHV have been incorporated in the Bridge Design Manual (BDM) - July 2016 release.

- New Load Posting Signs are included in the Ohio Manual of Uniform Traffic Control Devices (MUTCD) - January 2016 release.
New BR-100

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

<table>
<thead>
<tr>
<th>SFN</th>
<th>BRIDGE NUMBER</th>
<th>DISTRICT</th>
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<tbody>
<tr>
<td>6800203</td>
<td>FRED-033-063</td>
<td>8</td>
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<table>
<thead>
<tr>
<th>ORIGINAL CONSTRUCTION</th>
<th>REHABILITATION YEAR</th>
<th>OVERALL STRUCTURE</th>
<th>FEATURE INTERSECTION</th>
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<tbody>
<tr>
<td>1982</td>
<td>22/1</td>
<td>Trill of Seven Mile Creek</td>
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</table>

SPECIAL ASSUMPTIONS & COMMENTS
It is a CONSPAN culvert built in 1982. It was not load rated at that time. No software available to accurately model it. The culvert is in very good shape with GA=8 and performing well. A load rating is being assigned to this structure based on the original design load.

LOAD RATING PURPOSE:
1 - Initial Load Rating

LOAD RATING SOFTWARE:
0 - Assigned rating (No calculations were done)

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 LOADING:
6 - HS20-44 & Alternate Military Loading

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STRUCTURE RATING SUMMARY

<table>
<thead>
<tr>
<th>Loading Type</th>
<th>GVW (Tons)</th>
<th>Rating Factor - RF</th>
<th>Legal Weight (Tons)</th>
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<tbody>
<tr>
<td>HS20 Loadin</td>
<td>36</td>
<td>1.000</td>
<td>1258</td>
</tr>
<tr>
<td>Ohio - 2F1</td>
<td>15</td>
<td>1500</td>
<td>15.00</td>
</tr>
<tr>
<td>Ohio - 3F1</td>
<td>23</td>
<td>1508</td>
<td>23.00</td>
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<tr>
<td>Ohio - 4F1</td>
<td>27</td>
<td>1508</td>
<td>27.00</td>
</tr>
<tr>
<td>Ohio - 5C1</td>
<td>40</td>
<td>1508</td>
<td>40.00</td>
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<table>
<thead>
<tr>
<th>Specialized Hauling Vehicles (SHV)</th>
<th>Loading Type</th>
<th>GVW (Tons)</th>
<th>Rating Factor - RF</th>
<th>Legal Weight (Tons)</th>
</tr>
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<tbody>
<tr>
<td>SU4</td>
<td>27</td>
<td>1500</td>
<td>15.00</td>
<td></td>
</tr>
<tr>
<td>SU5</td>
<td>31</td>
<td>1500</td>
<td>31.00</td>
<td></td>
</tr>
<tr>
<td>SU6</td>
<td>34.75</td>
<td>1500</td>
<td>34.75</td>
<td></td>
</tr>
<tr>
<td>SU7</td>
<td>38.75</td>
<td>1500</td>
<td>38.75</td>
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</tr>
</tbody>
</table>

Overall Postage Rating: 150%

BRIDGE POSTING REQUIRED BY RATING:
No load posting is recommended

AGENCY/FIRM
OSE, ODOT

REPORT DATE: 7/20/2016

RATED BY
Amjad I. Aheedi
PE # 55005
PHONE NUMBER 514 (752) 3972
EMAIL amjad_aheedi@dot.ohio.gov

REVIEWED BY
PE # 40
PHONE NUMBER
EMAIL
### Load Rating Summary - Ohio Legal Trucks

<table>
<thead>
<tr>
<th>Loading Type</th>
<th>GVW (Tons)</th>
<th>Rating Factor - RF</th>
<th>Safe GVW (Tons)</th>
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<tbody>
<tr>
<td>HL-93</td>
<td>36</td>
<td>0.319</td>
<td>0.413</td>
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<td><strong>Ohio Legal</strong></td>
<td></td>
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<tr>
<td>2F1</td>
<td>15</td>
<td>0.900</td>
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<td>3F1</td>
<td>23</td>
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<tr>
<td>4F1</td>
<td>27</td>
<td>0.555</td>
<td>15</td>
</tr>
<tr>
<td>5C1</td>
<td>40</td>
<td>0.633</td>
<td>25</td>
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</table>

**Ohio Legal Loads Overall Minimum Rating Factor**

55%

**Ohio Legal Loads Overall Controlling Truck**

Ohio Legal - 4F1

### Load Rating Summary - Specialized Hauling Vehicles (SHV)

<table>
<thead>
<tr>
<th>Loading Type</th>
<th>GVW (Tons)</th>
<th>Rating Factor - RF</th>
<th>Safe GVW (Tons)</th>
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<tbody>
<tr>
<td>SU4</td>
<td>27</td>
<td>0.550</td>
<td>15</td>
</tr>
<tr>
<td>SU5</td>
<td>31</td>
<td>0.510</td>
<td>16</td>
</tr>
<tr>
<td>SU6</td>
<td>34.75</td>
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<td>16</td>
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<tr>
<td>SU7</td>
<td>38.75</td>
<td>0.432</td>
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New BR-100
No Posting Required

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<th>Loading Type</th>
<th>GVF (Tons)</th>
<th>Rating Factor - RF</th>
<th>Legal Weight (Tons)</th>
<th>GVF (Tons)</th>
<th>Rating Factor - RF</th>
<th>Legal Weight (Tons)</th>
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<td>36.00</td>
<td>SU4</td>
<td>27</td>
<td>27.00</td>
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<tr>
<td>Ohio - 2F1</td>
<td>15</td>
<td>1.500</td>
<td>15.00</td>
<td>SU5</td>
<td>31</td>
<td>31.00</td>
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<tr>
<td>Ohio - 3F1</td>
<td>23</td>
<td>1.500</td>
<td>23.00</td>
<td>SU6</td>
<td>34.75</td>
<td>34.75</td>
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<tr>
<td>Ohio - 4F1</td>
<td>27</td>
<td>1.500</td>
<td>27.00</td>
<td>SU7</td>
<td>38.75</td>
<td>38.75</td>
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<tr>
<td>Ohio - 5C1</td>
<td>40</td>
<td>1.500</td>
<td>40.00</td>
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Overall Posting Rating
150%

BRIDGE POSTING REQUIRED BY RATING
No load posting is recommended

Sign Posting Recommendation:
# New BR-100 Posting Required

## Structure Rating Summary

<table>
<thead>
<tr>
<th>Loading Type</th>
<th>GVW (Tons)</th>
<th>Rating Factor - RF Inv.</th>
<th>Rating Factor - RF Oper.</th>
<th>Legal Weight (Tons)</th>
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<tbody>
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<td>0.244</td>
<td>0.408</td>
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<td>11.80</td>
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<td>Ohio - 5C1</td>
<td>40</td>
<td>0.490</td>
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<td>19.60</td>
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## Specialized Hauling Vehicles (SHV)

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<th>Rating Factor - RF Oper.</th>
<th>Legal Weight (Tons)</th>
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<td>34.75</td>
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<tr>
<td>SU7</td>
<td>38.75</td>
<td>0.391</td>
<td>15.15</td>
</tr>
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## Overall Posting Rating

40%

## Bridge Posting Required by Rating

**Load Posting is Recommended**

## Weigh Limit

**AXLES**

- 2: 10 T
- 3: 11 T
- 4: 11 T
- 5: 13 T
- 6+: 14 T

### Agency/Firm

**Rated By**

- Cindy Wang
  - PE #: 67618
  - Phone Number: (614) 466-1973
  - Email: cindy.wang@dot.ohio.gov

**Reviewed By**

- PE #: [Blank]
  - Phone Number: [Blank]
  - Email: [Blank]

**Report Date:** 7/27/2016
New BR-100 SMS Coding Input

| BR-100 | SMS Coding Input |

# Load Rating

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Design Load</td>
<td>6 - HS20-44 &amp; Alternate Military Loading</td>
</tr>
<tr>
<td>Operation Rating Method</td>
<td>6 - Load Factor (LF) rating reported by rating factor (RF)</td>
</tr>
<tr>
<td>Operating Rating Factor</td>
<td>1.500</td>
</tr>
<tr>
<td>Operating Rating Load</td>
<td>HS20 Loading</td>
</tr>
<tr>
<td>Inventory Rating Method</td>
<td>6 - Load Factor (LF) rating reported by rating factor (RF)</td>
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<td>Inventory Rating Factor</td>
<td>1.250</td>
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<tr>
<td>Inventory Rating Load</td>
<td>HS20 Loading</td>
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**User must select from dropdown list**

# Ohio Legal Loads

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<th>Value</th>
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<tr>
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<tr>
<td>Ohio Legal Load 4, Rating Factor</td>
<td>34.75</td>
</tr>
<tr>
<td>Ohio Legal Load 5</td>
<td>1250</td>
</tr>
<tr>
<td>Ohio Legal Load 5, Rating Factor</td>
<td>0.850</td>
</tr>
<tr>
<td>Ohio Legal Load 6</td>
<td>0</td>
</tr>
<tr>
<td>Ohio Legal Load 6, Rating Factor</td>
<td>0.850</td>
</tr>
</tbody>
</table>

**Open, Posted or Closed:**

- **Open**
- **Posted**
- **Closed**

**Load Rating Date:** 4/12/2016

**Load Rating Software:** AASHTO Br R (VIRTIS)

**Rating Source:** Plan information available for load rating analysis

**Rating Percent Legal:**

- BR-100: 85%
Load Rating – Flowchart

Flow Chart for Load Rating Analysis
(Continued on next page)

Load Rating for SHV
Load Rating – Flowchart

Legal and Posting Loads Analysis

Perform load rating for 2F1, 3F1, 4F1, 5C1, SU4, SU5, SU6, & SU7 Trucks*

* Use the same method of analysis as used for Inventory and Operating Rating Analysis

Are all RF ≥ 1.00?

Yes

Prepare BR-100 for bridge file

No

Determine the “Controlling” RF for 2, 3, 4, 5 & 6 axle trucks (select controlling one for each 4F1 vs SU4, 5C1 vs SU5 & SU6 vs SU7)

STOP

Load Rating for SHV
Load Rating – Flowchart

Flow Chart for Load Rating Analysis
(Continued from previous page)
Special Cases of Load Ratings

- **Trusses**
  - Treat them like other bridge types

- **Gusset Plate Analysis**
  - If gusset plate analysis controls the bridge rating, re-analyze for SHVs

- **Special Bridge Postings**
  - No change in policy

- **Bridges Exempt from Load Rating**
  - No change in policy

- **Non-Highway Bridges**
  - No change in policy
Update on Load Rating for SHV
As of August 12, 2016

- ODOT Inspected Bridges (Group C)
  - Total bridges: 19
  - 1 bridge replaced and posting rescinded
  - 6 bridges are scheduled to be replaced by December 31, 2017
  - 1 bridge posted due to damage and scheduled to be replaced
  - 8 bridges are being reviewed
  - 3 bridges remaining to be worked at
Update on Load Rating for SHV
As of August 12, 2016

- Ohio Turnpike Inspected Bridges (Group C)
  - 1 bridge replaced and posting rescinded
  - 100% complete
Update on Load Rating for SHV
As of August 12, 2016

- ODOT Inspected Bridges (Group B)
  - Total bridges =~ 583
  - 139 bridges are scheduled to be replaced by December 31, 2022
  - 19 bridges have been re-analyzed
  - 73% of bridges need to be re-analyzed

- Ohio Turnpike Inspected Bridges (Group B)
  - Total bridges =~ 100
  - No updates available at this time
Update on Load Rating for SHV
As of August 12, 2016

- **County Inspected Bridges (Group C)**
  - Total bridges = ~1191
  - ~415 will be replaced by end of 2017
  - ~50 bridges have been reanalyzed

- **City Inspected Bridges (Group C)**
  - Total bridges = ~52
  - No updates available at this time
Update on Load Rating for SHV
As of August 12, 2016

- County Inspected Bridges (Group B)
  - Total bridges =~ 2300
  - ~284 will be replaced by end of 2022
  - 18 bridges have been reanalyzed

- City Inspected Bridges (Group B)
  - Total bridges =~ 335
  - No updates available at this time
Questions?

Amjad Waheed, PE
Bridge Management and Load Rating Engineer
Ohio Department of Transportation

Amjad.Waheed@dot.ohio.gov
(614) 752-9972
Load Rating for SHV