

2016 CCAO/CEAO Bridge Conference

Bridge Load Rating Updates Load Rating for Emergency Vehicles

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Office of Structural Engineering
Ohio Department of Transportation

Columbus, OH
December 5, 2016



Topics to be covered

1. Load Rating for Emergency Vehicles (EV)

- a) FHWA Requirements
- b) Emergency Vehicles Configurations

2. ODOT Plan for EV load rating

- a) EV load rating - New Bridges
- b) EV load rating - Existing Bridges
- c) Timeline for EV load rating
- d) Revised load rating spreadsheets
- e) Revised BR-100



Topics to be covered

3. EV Rating Impact on SHV Rating Contracts for Local Bridges

- a) Local bridges to be rated for EV
- b) Change in Scope to include EV
- c) Additional cost of rating for EV
- d) ODOT Share & Availability of Funds



Topics to be covered

- 4. Old Legal Load Posting Sign**
- 5. New Legal Load Posting Sign**
- 6. EV Load Posting Sign (not final)**
- 7. Saving Load Rating Factors for EV**
- 8. Special Cases**



Load Rating for EV – FHWA Requirements



Memorandum

Subject: **ACTION:** Load Rating for the FAST Act's Emergency Vehicles Date: November 3, 2016

From: /Original signed by/
Joseph L. Hartmann, Ph.D., P.E.
Director, Office of Bridges and Structures In Reply Refer To: HIBS-1

To: Division Administrators
Federal Lands Highway Division Directors

On December 4, 2015, the President signed into law the *Fixing America's Surface Transportation Act* (FAST Act) (Pub. L. 114-94). Section 1410 of the FAST Act amended 23 U.S.C. 127, *Vehicle weight limitations—Interstate System*, by revising the weight limits for certain vehicles on the Interstate System. The purpose of this memorandum is to provide guidance on maintaining compliance with the load rating and posting requirements of 23 CFR Part 650—specifically for the amended weight limits in 23 U.S.C. 127(r), *Emergency Vehicles*, for bridges on the Interstate System and within reasonable access to the Interstate System. Reasonable access is defined in a September 30, 1992 Non-Regulatory Supplement to 23 CFR Part 658 as at least one-road-mile from access to and from the National Network of highways, which includes the Interstate System, or further if the limits of a State's reasonable access policy for food, fuel, repairs, and rest extend to facilities beyond one-road-mile.

An emergency vehicle as defined in the FAST Act is designed to be used 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 gross vehicle weight limit for emergency vehicles is 86,000 pounds under section 127(r). The statute imposes the following additional limits, depending upon vehicle configuration:

- 24,000 pounds on a single steering axle
- 33,500 pounds on a single drive axle
- 62,000 pounds on a tandem axle
- 52,000 pounds on a tandem rear drive steer axle

Emergency vehicles are typically operated by fire departments and are primarily equipped for firefighting, but are also used to respond to and mitigate other hazardous situations in

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an emergency. These vehicles may not meet Federal Bridge Formula B. They can create higher load effects compared to the AASHTO legal loads (i.e., Types 3, 3S2, 3-3, and SU4 to SU7) which are currently included in the AASHTO Manual for Bridge Evaluation (MBE). The Federal Highway Administration (FHWA) has determined that, for the purpose of load rating, two emergency vehicle configurations produce load effects in typical bridges that envelop the effects resulting from the family of typical emergency vehicles that is covered by the FAST Act:

1. Type EV2 - for single rear axle emergency vehicles

Front Single Axle: 24,000 pounds
Rear Single Axle: 33,500 pounds
Wheelbase: 15 ft.

2. Type EV3 – for tandem rear axle emergency vehicles

Front Single Axle: 24,000 pounds
Rear Tandem Axle: 62,000 pounds (two 31,000 pound axles spaced at 4 ft.)
Wheelbase: 17 ft. (distance from front axle to the centerline of rear tandem axle)

Load ratings (or rating factors) should be determined for these emergency vehicle configurations i.e., Types EV2 and EV3, at the operating or legal load rating level in accordance with the methods specified in the AASHTO MBE, First Edition with two exceptions:

1. Multiple presence: If necessary, when combined with other unrestricted legal loads for rating purposes, the emergency vehicle needs only to be considered in a single lane of one direction of a bridge.
2. Live load factor: A live load factor of 1.3 may be utilized in the Load and Resistance Factor Rating (LRFR) or Load Factor Rating (LFR) method.

Under 23 CFR 650.313(c), all highway bridges must be load rated and, if necessary, posted in accordance with the MBE. Recognizing that States and Federal agencies cannot immediately load rate every Interstate System bridge and bridges within reasonable access to the Interstate, FHWA recommends utilizing the following approach to prioritize load rating and posting for emergency vehicles:

Group 1: Bridges that meet any one of the following criteria do not need to be immediately load rated for emergency vehicles.

- a. An operating or legal load rating factor for the AASHTO Type 3 vehicle of at least 1.85;
- b. an inventory rating factor for the HS 20 design load of at least 1.0 using the LFR method, or



Load Rating for EV – FHWA Requirements

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- c. an inventory rating factor for the HL-93 design load of at least 0.9 using the LRFR method.

However, the bridges in this group shall be rated for the emergency vehicles when a normal re-rating is warranted, including changes in structural condition and other loadings.

Group 2: Bridges not in Group 1 should be rated for the emergency vehicles following their next inspection to incorporate the latest condition of the bridge, but no later than December 31, 2019. Emergency vehicles should be included in any new load ratings for these bridges when the load ratings occur before December 31, 2019.

If a State or Federal agency wants to utilize an alternative approach in lieu of the above to group bridges in an inventory for the purpose of prioritization, it should seek FHWA's review and concurrence of the alternative approach. Regardless of the prioritization approach used, 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*](#).

When a load rating results in an operating rating factor less than 1.0 for the emergency vehicles, the bridge shall be appropriately posted for both the governing single axle weight limit and tandem axle weight limit derived from the above emergency vehicle configurations, i.e., Types EV2 and EV3 (23 CFR 650.313(c)). When posting is necessary, the following sign format, using the appropriate weight limits, should be considered:

EMERGENCY VEHICLE	
AXLE WEIGHT LIMIT	
SINGLE	13 T
TANDEM	17 T

If a State law allows or exempts emergency vehicles to operate without restriction off the Interstate System as legal loads, 23 CFR 650.313(c) requires bridges on these highways to be load rated and posted, if necessary, for these vehicles. Unless State law relies on a different definition of emergency vehicle than that included in the FAST Act (23 U.S.C. 127(r)(2)), States can perform load ratings on these highways using the two emergency vehicle configurations included in this memorandum.

Division Offices should work with their State DOT or Federal agency partners to develop

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an action plan by March 31, 2017, with defined tasks, completion dates, and progress reporting requirements. Although this guidance focuses on highway bridges, 23 CFR 650.513(g) also requires States and Federal agencies to load rate and post highway tunnels, if necessary. Therefore, the action plan should also incorporate highway tunnels. States and Federal agencies should load rate tunnels for the emergency vehicle configurations above by December 31, 2019. Each Division Office should coordinate this action plan with its Bridge Safety Engineer.

We request that you share this memorandum with your State DOT or Federal agency partners immediately. If you have any questions or need more information, please contact Lubin Gao at (202)366-4604 or Lubin.Gao@dot.gov, or your Bridge Safety Engineer.

cc:
Directors of Field Services
Director of Technical Service
HIBS-10
HIBS-30
HRDI-1
Team Manager, RC Structures TST
Branch Chief, FLH Bridge Engineer

<http://www.fhwa.dot.gov/bridge/loadrating/161103.cfm>



Load Rating for EV – FHWA Requirements

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AXLE WEIGHT LIMIT	
SINGLE	13 T
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ODOT Plan for Load Rating

Task 1:

Emergency Vehicle Configurations (EV2 & EV3)

Task 2:

Modify ODOT load rating spreadsheets and Rating Summary form BR-100



ODOT Plan for Load Rating

Task 3:

Complete the initial identification of routes & existing bridges which will require load rating for EV2 & EV3

- a. Bridges carrying Interstate mainline traffic including ramp traffic on all Interstate Interchanges
- b. Bridges on the Interstate System & within one road mile from the exterior ramp gore point

Task 4:

Finalize the set of load rating vehicles for all new EV-qualified bridges to be rated at the time of design



ODOT Plan for Load Rating

Task 5:

Finalize the spreadsheet to track EV bridges & rating values

Task 6:

- a) Identify bridges in EV-Group 1 (Inventory Rating Factor for HS20 ≥ 1.000 or for HL93 ≥ 0.900)
- b) Identify bridges in EV-Group 2 (not in Group 1)

Task 7:

Finalize the Posting Sign for EVs



ODOT Plan for Load Rating

Task 8:

Propose an EV Plan of Action (EV-POA) to complete load rating of existing bridges in EV-Group 2

Task 9:

Approval of the EV-POA; identification of resources for EV-POC

Task 10:

Implementation of the EV-POA



Tentative Timeline for EV Load Rating

Tasks	ODOT Plan for EV-Rating	Tentative_dates
Task 1	EV2 & EV3 Configurations	12/15/2016
Task 2	Modified ODOT rating spreadsheets and BR-100	2/15/2017
Task 3	Identification of routes & bridges	4/15/2017
Task 4	New load ratings start using EV	5/1/2017
Task 5	Spreadsheet to track EV ratings	4/30/2017
Task 6	Identification of bridges in Groups 1 & 2	5/15/2017
Task 7	EV Posting sign	4/30/2017
Task 8	EV-POA completion	5/30/2017
Task 9	EV-POA approval	6/30/2017
Task 10	EV-POA implementation completion	10/15/2019



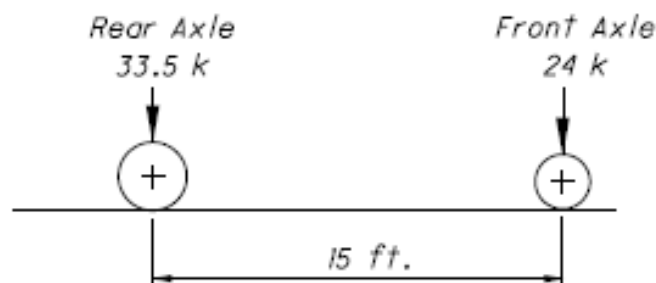
Emergency Vehicles

EMERGENCY VEHICLES

ALL AXLE LOADINGS

EV2

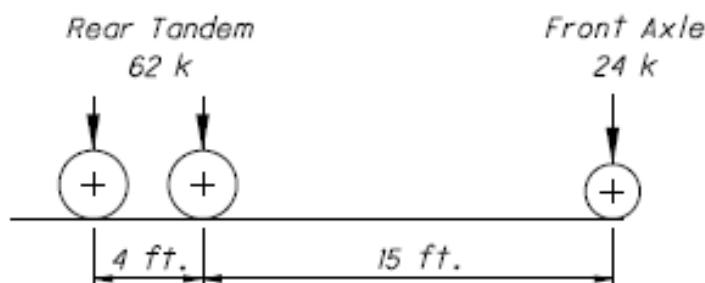
28.75T; 15 ft.



Conversion
1 kip = 1,000 lbs.
1 T = 2,000 lbs.
1 kip = 4.448 kN
1 m = 3.2808 ft.

EV3

43T; 19 ft.



Revised Rating Spreadsheets

LFR and LRFR Load Rating Spreadsheets will be modified to include EV loading of bridges:

1. Steel beams with non-composite concrete deck simple
2. Steel beams with composite concrete deck simple
3. RC slab simple
4. Pre-stressed precast box-beams simple
5. Composite pre-stressed box-beams simple
6. RC precast box-beams simple
7. RC T-beam simple
8. CMP Modified minimum cover

And more

Tentative Completion Date: February 15, 2017



Revised BR-100

Load Rating Summary Form (BR-100) will be modified to include EV loading

Tentative Completion Date: February 15, 2017



EV Rating Impact on SHV Rating Contracts for Local Bridges

Verify if the bridge under contract is qualified for EV rating

If a bridge is NOT qualified for EV load rating (Groups 1 & 2) proceed with the current scope & contract



EV Rating Impact on SHV Rating Contracts for Local Bridges

**If a bridge is qualified for EV load rating
(Groups 1 & 2) then:**

- a) Change in Scope to include EV2 & EV3 with SHV & Old Ohio Legal Loads
- b) Re-write the contract, if needed
- c) Additional cost will be shared by ODOT
- d) Additional funds are available from ODOT



EV Load Rating – New Bridges

Load Rating Requirements for New EV-qualified Bridges

All new EV-qualified bridges shall be analyzed and rated for EV2 and EV3 vehicles; also

All new EV-qualified bridges shall be designed to have a rating factor of at least 1.000 for both EV2 and EV3 vehicles



EV Load Rating – New Bridges

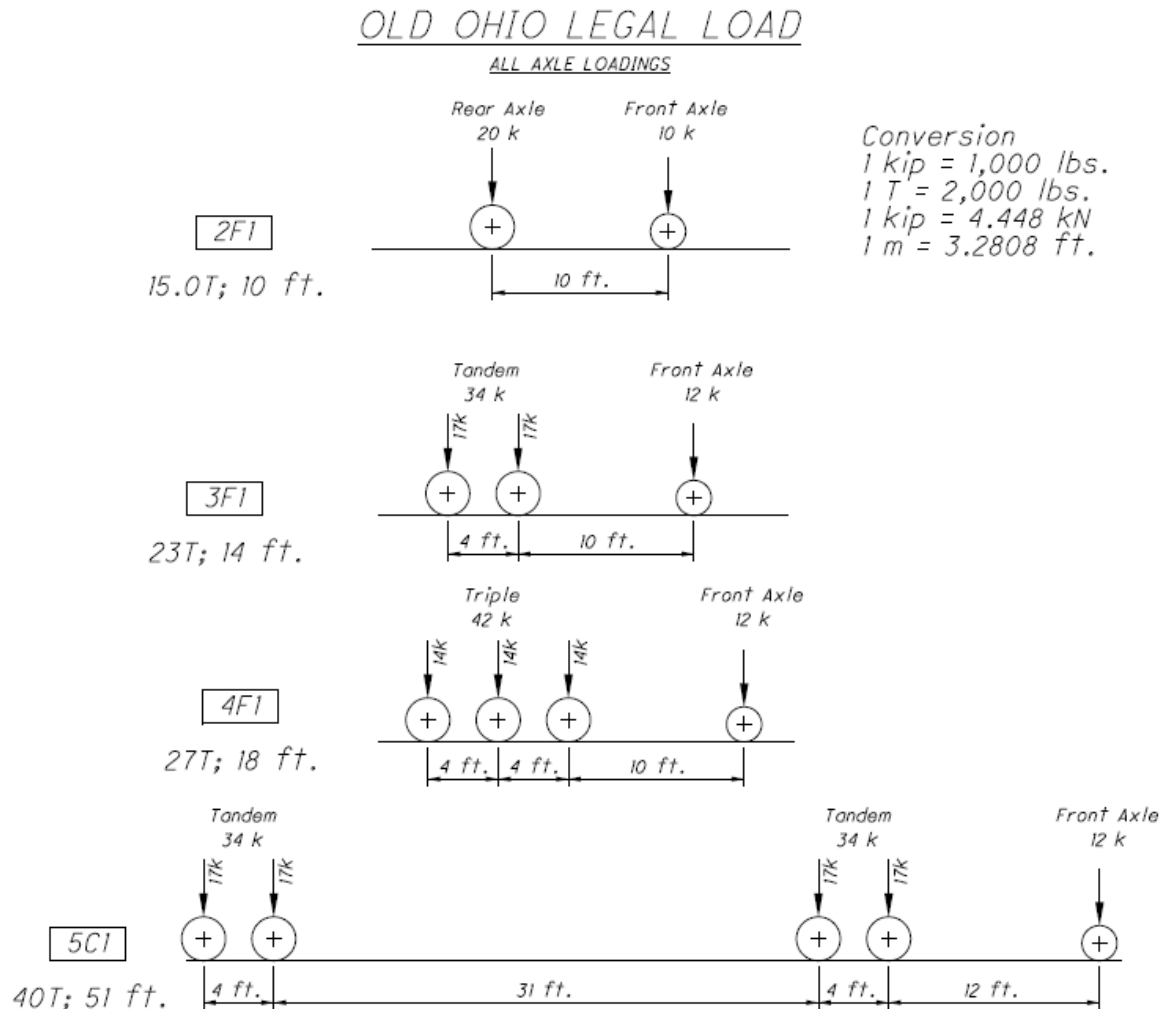
Load Rating Requirements for New EV-qualified Bridges

Rating Loads:

- 1) HS20 or HL93
- 2) Current Ohio Legal Loads
 - a. Old Ohio Legal Loads (2F1, 3F1, 4F1 & 5C1)
 - b. AASHTO SHVs (SU4, SU5, SU6 & SU7)
- 3) Emergency Vehicles (EV2 & EV3)



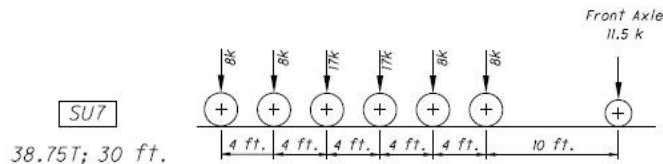
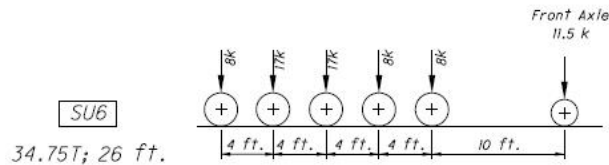
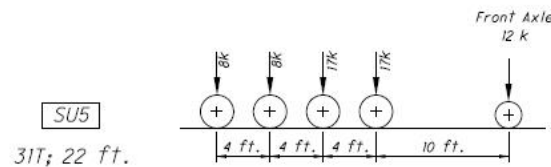
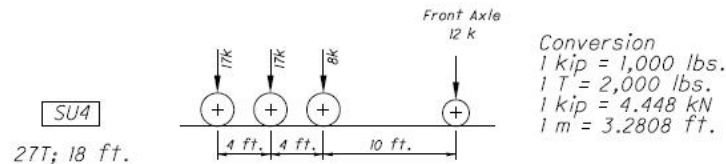
Old Ohio Legal Loads



AASHTO SHV Configurations

SPECIAL HAULING VEHICLES (SHV)

ALL AXLE LOADING



ODOT Share and Availability of Funds

- Funds are available from ODOT to cover the additional cost of including load rating for EV in the current SHV rating contracts
- ODOT will share 50% of the cost of SHV & EV load rating contracts



Saving Results of Load Rating for EV

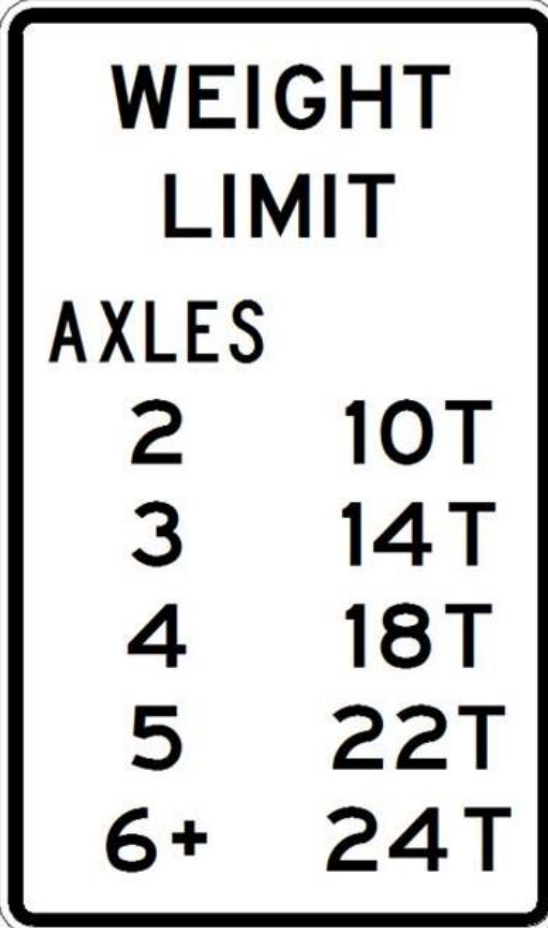
- Current SMS cannot store the Rating Factors (RF) of EV₂ & EV₃
- Save the final load rating summary form (BR-100) in your bridge files; &
- Also, store the RFs in a spreadsheet



Old Legal Load Posting Sign



New Legal Load Posting Sign



A rectangular white sign with a black border. The text is in bold, black, sans-serif capital letters. At the top, it says 'WEIGHT LIMIT'. Below that, it says 'AXLES'. Then, it lists five rows of axle counts and their corresponding weight limits: 2 axles for 10T, 3 axles for 14T, 4 axles for 18T, 5 axles for 22T, and 6+ axles for 24T.

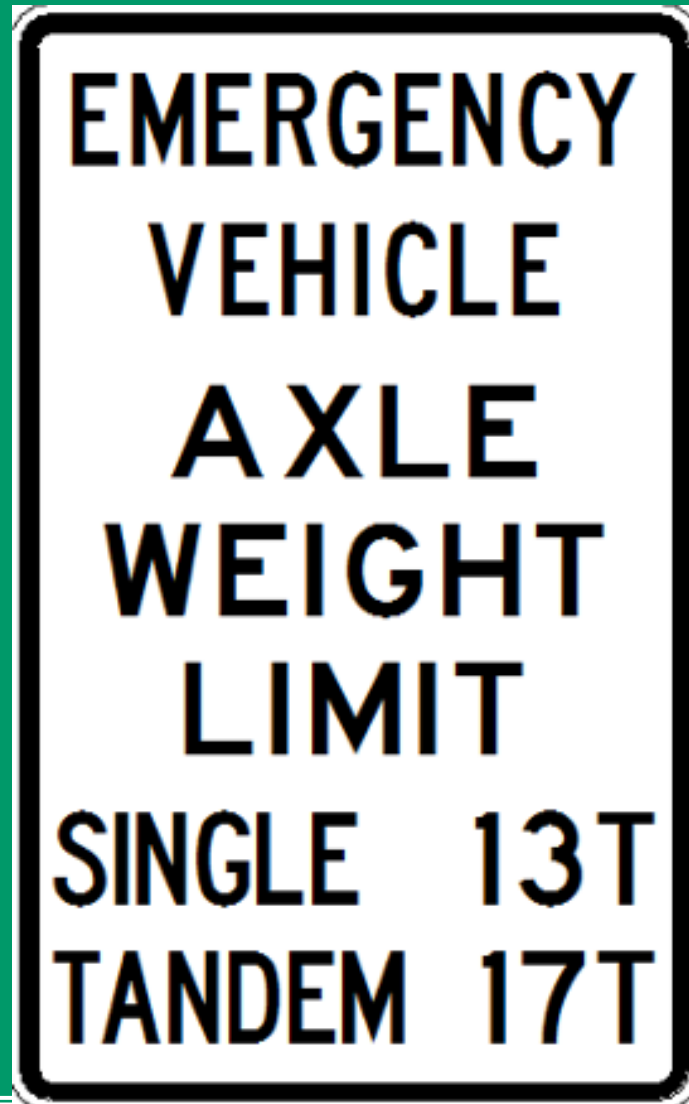
WEIGHT LIMIT	
AXLES	
2	10T
3	14T
4	18T
5	22T
6+	24T

NEW BRIDGE LOAD POSTING SIGN

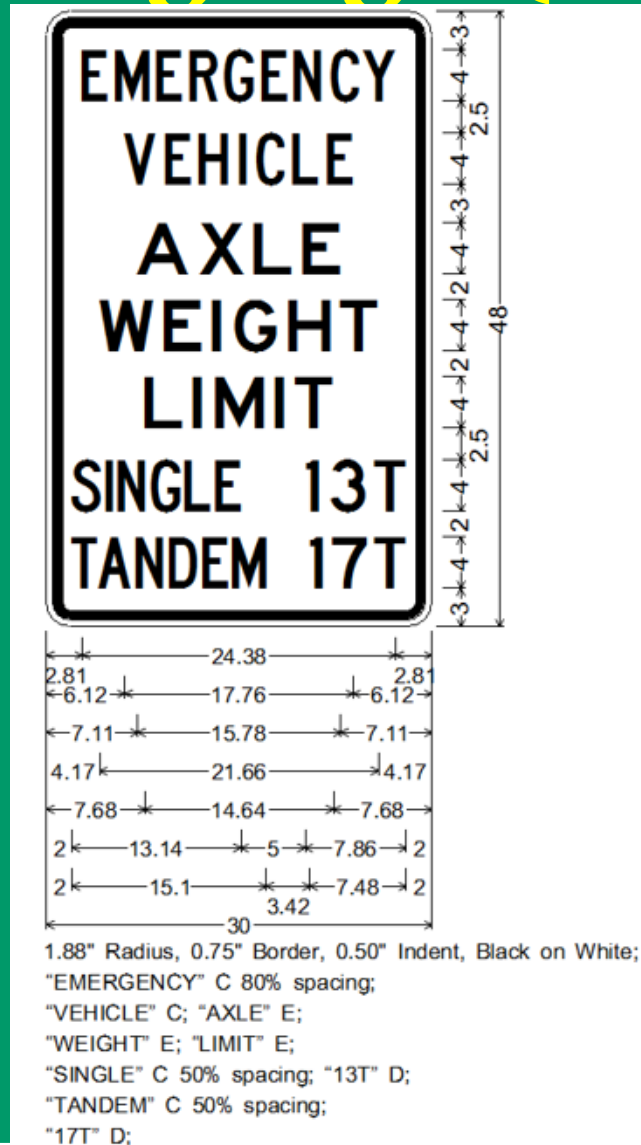
(Size: 36 inches by 60 inches)



EV Posting Sign (Not final)



EV Posting Sign (Not final)



Special Cases

- Trusses
 - Treat them like other bridge types
- Gusset Plate Analysis
 - If gusset plate analysis controls the bridge rating, re-analyze for EVs
- Special Bridge Postings
 - No change in policy
- Bridges Exempt from Load Rating
 - No change in policy
- Non-Highway Bridges
 - No change in policy



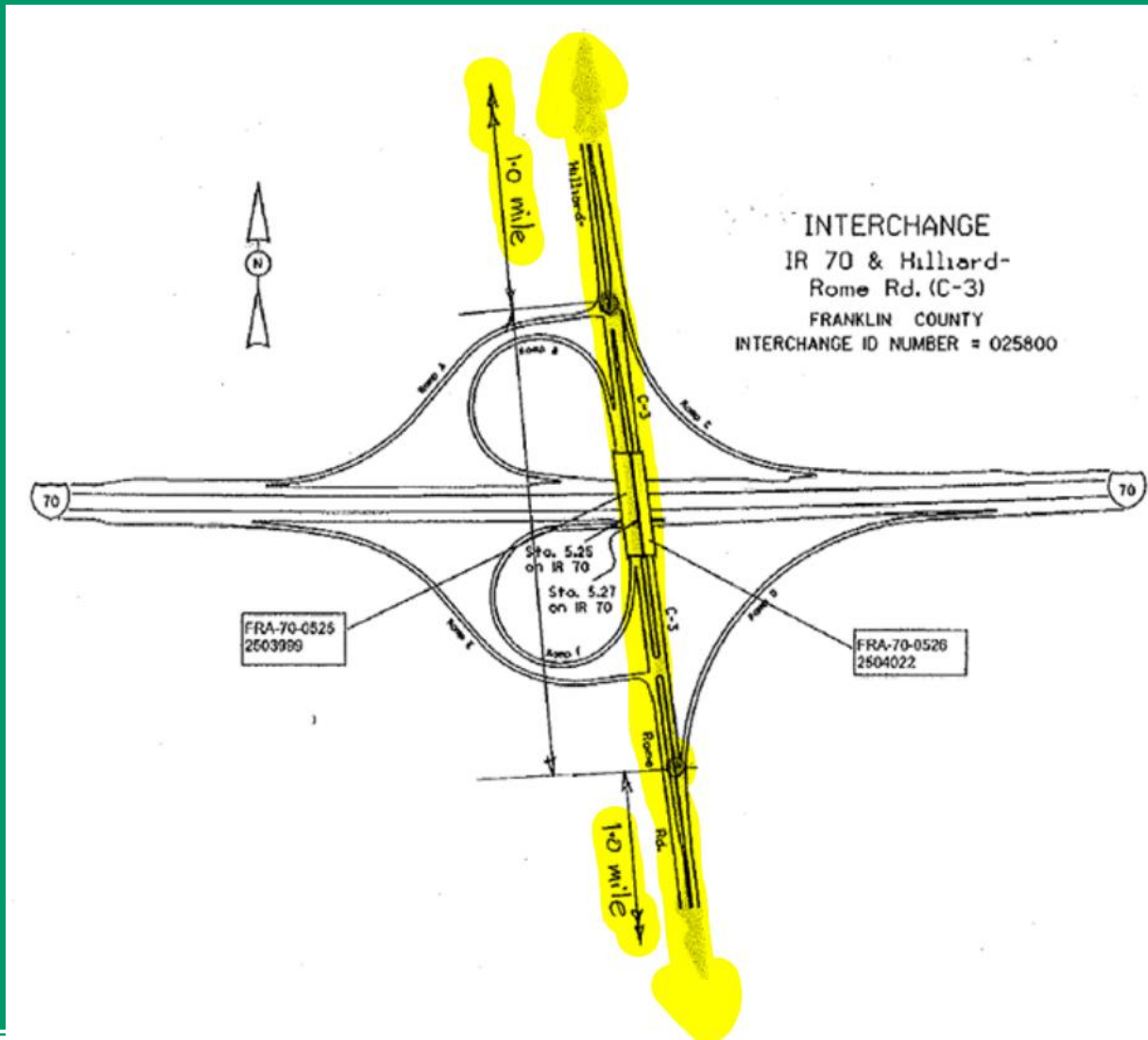
Questions?

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

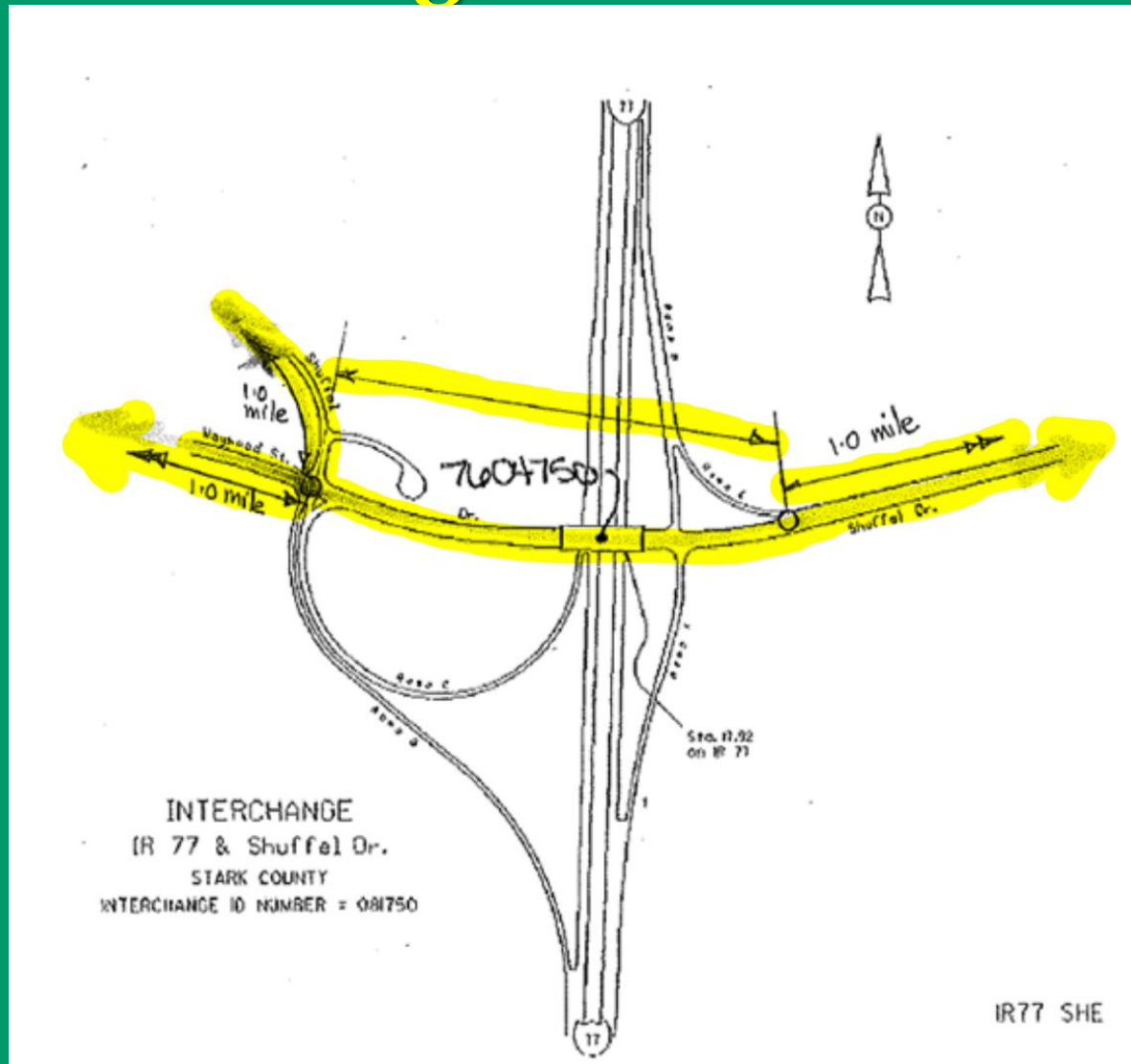
Amjad.Waheed@dot.ohio.gov
(614) 752-9972



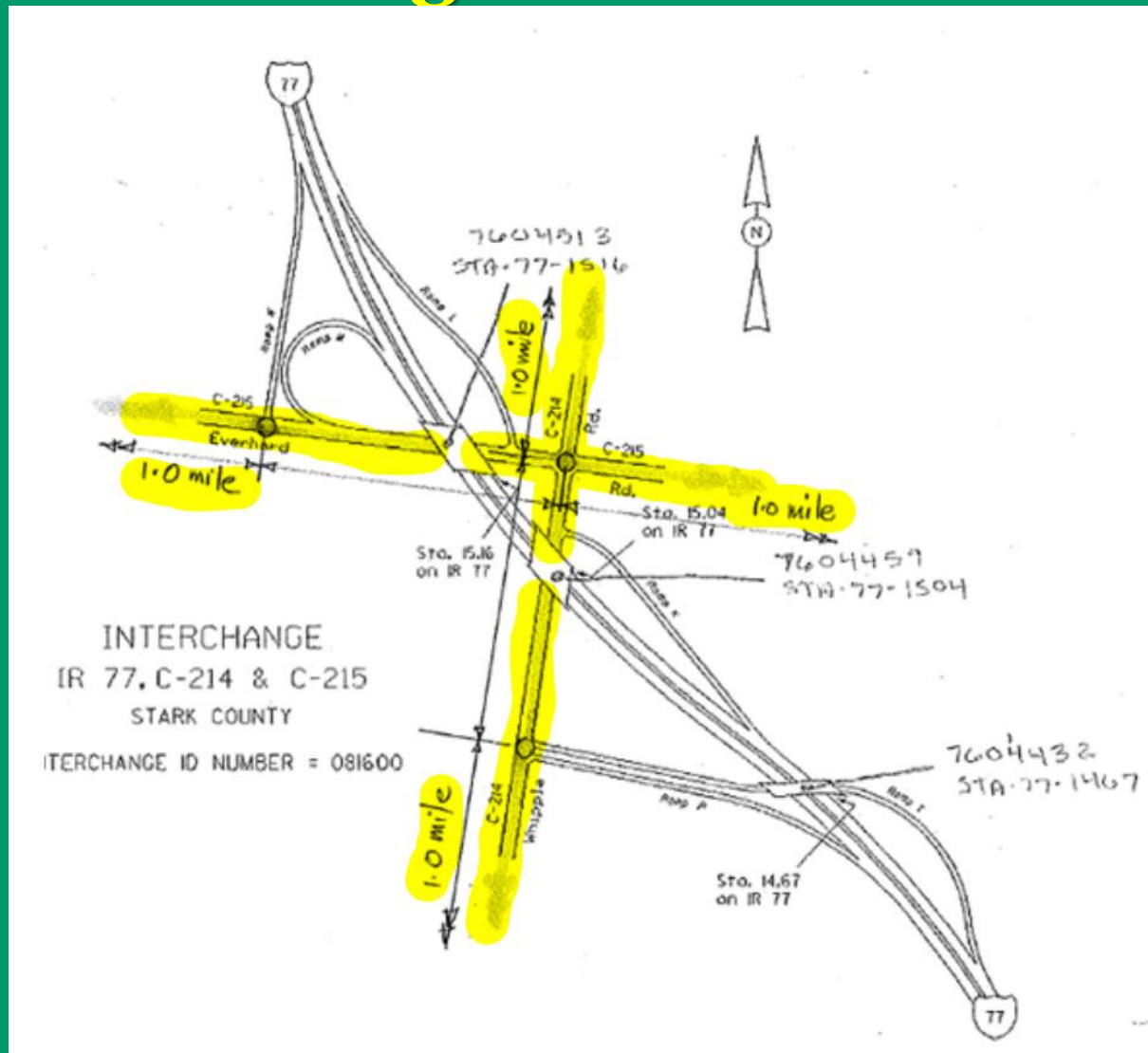
Interchanges on the Interstate



Interchanges on the Interstate



Interchanges on the Interstate




Examples of Load Rating from Inventory Coding Guide

Appendix L of the Inventory Coding Guide



Example of Load Rating Summary Form BR-100

 BRIDGE LOAD RATING SUMMARY REPORT OFFICE OF STRUCTURAL ENGINEERING OHIO DEPARTMENT OF TRANSPORTATION							
SFN 2901110		BRIDGE NUMBER GRE-68-0084		DISTRICT 8			
ORIGINAL CONSTRUCTION YEAR 1958	REHABILITATION YEAR 2016	OVERALL STRUCTURE LENGTH 106 ft		FEATURE INTERSECTION Painters Creek			
SPECIAL ASSUMPTIONS & COMMENTS		Three span (32'-40'-32' c-c bearings) continuous RC slab superstructure reconstructed on existing foundations. The deck is 20" deep and 44' out-out and face-face of TST rail. Tangent alignment, 30 degree RF skew.					
PLEASE SELECT ON RIGHT, WHERE APPROPRIATE, BY USING THE DROP DOWN ARROW BUTTON							
LOAD RATING PURPOSE:		8 - Update Analysis Model and Software					
LOAD RATING SOFTWARE:		3 - AASHTO BrR (VIRTIS)					
RATING SOURCE:		1 - Plan information available for load rating analysis (Default)					
RATING METHOD:		8 - Load & Resistance Factor Rating (LRFR) reported by rating factor (RF)					
ORIGINAL DESIGN LOADING:		A - HL93					
STRUCTURE RATING SUMMARY							
OHIO LEGAL					SPECIALIZED HAULING VEHICLES (SHV)		
Loading Type	GVW (Tons)	Rating Factor - RF		Legal Weight (Tons)	Loading Type	GVW (Tons)	Rating Factor - RF
		Inv.	Oper.				Oper.
HL93 Loading		1.437	1.862				
Ohio - 2F1	15		3.705	15.00	SU4	27	2.407
Ohio - 3F1	23		2.668	23.00	SU5	31	2.275
Ohio - 4F1	27		2.446	27.00	SU6	34.75	2.113
Ohio - 5C1	40		2.618	40.00	SU7	38.75	2.002
Overall Posting Rating					Sign Posting Recommendation:		
150%							
BRIDGE POSTING REQUIRED BY RATING							
No load posting is recommended							
AGENCY/FIRM	ODOT - Office of Structural Engineering			REPORT DATE:	11/18/2016		
RATED BY	PE #	PHONE NUMBER	EMAIL				
Andrea Parks	54304	614-752-6932	Andrea.Parks@dot.ohio.gov				
REVIEWED BY	PE #	PHONE NUMBER	EMAIL				

SFN: 2901110

BRIDGE NUMBER: GRE-68-0084

BR-100_SMS (05/2016)

SMS Load Rating Screen

LOAD RATING

(31) Design Load:	A - HL93	(703) Inventory Rating Load GVW:	36	tons
(63) Operating Rating Method:	8 - Load & Resistance Fac	(704) Load Rating Date:	11/18/2016	
(64) Operating Rating Factor:	1.862	(705) Load Rater First Name:	Andrea	
(700) Operating Rating Load:	3 - HL93 Loading	(706) Load Rater Last Name:	Parks	
(701) Operating Rating Load GVW:	36	(707) Load Rater Ohio PE Number:	54304	
(65) Inventory Rating Method:	8 - Load & Resistance Fac	(708) Load Rating Software:	3 - AASHTO BrR (VIRTIS)	
(66) Inventory Rating Factor:	1.437	(709) Rating Source:	1 - Plan information avail	
(702) Inventory Rating Load:	3 - HL93 Loading	(711) Live Load Response:	S - Satisfactory	
(41) Open Posted or Closed:	A - OPEN, NO RESTRICTI			

OHIO LEGAL LOADS

(715) Ohio Legal Load 1:	2F1	(724) Ohio Legal Load 4:	SU5	
(716) Ohio Legal Load 1 GVW:	15.000	(725) Ohio Legal Load 4 GVW:	31	tons
(717) Ohio Legal Load 1, Rating Factor:	3.705	(726) Ohio Legal Load 4, Rating Factor:	2.275	
(718) Ohio Legal Load 2:	3F1	(727) Ohio Legal Load 5:	SU6	
(719) Ohio Legal Load 2 GVW:	23.000	(728) Ohio Legal Load 5 GVW:	34.75	tons
(720) Ohio Legal Load 2, Rating Factor:	2.668	(729) Ohio Legal Load 5, Rating Factor:	2.113	
(721) Ohio Legal Load 3:	SU4	(730) Ohio Legal Load 6:	SU7	
(722) Ohio Legal Load 3, GVW:	27.000	(731) Ohio Legal Load 6, GVW:	38.75	
(723) Ohio Legal Load 3, Rating Factor:	2.407	(732) Ohio Legal Load 6 Rating Factor:	2.002	
(70) Bridge Posting:	5 - Equal to or above legal	(733) Posting Required by Rating:	N - No	
		(734) Ohio Percent Legal:	150	%

