AASHTOWare™ BRIDGE DESIGN AND RATING

MoDOT “Cheat Sheets” for Routine Bridge Load Rating Using BrR

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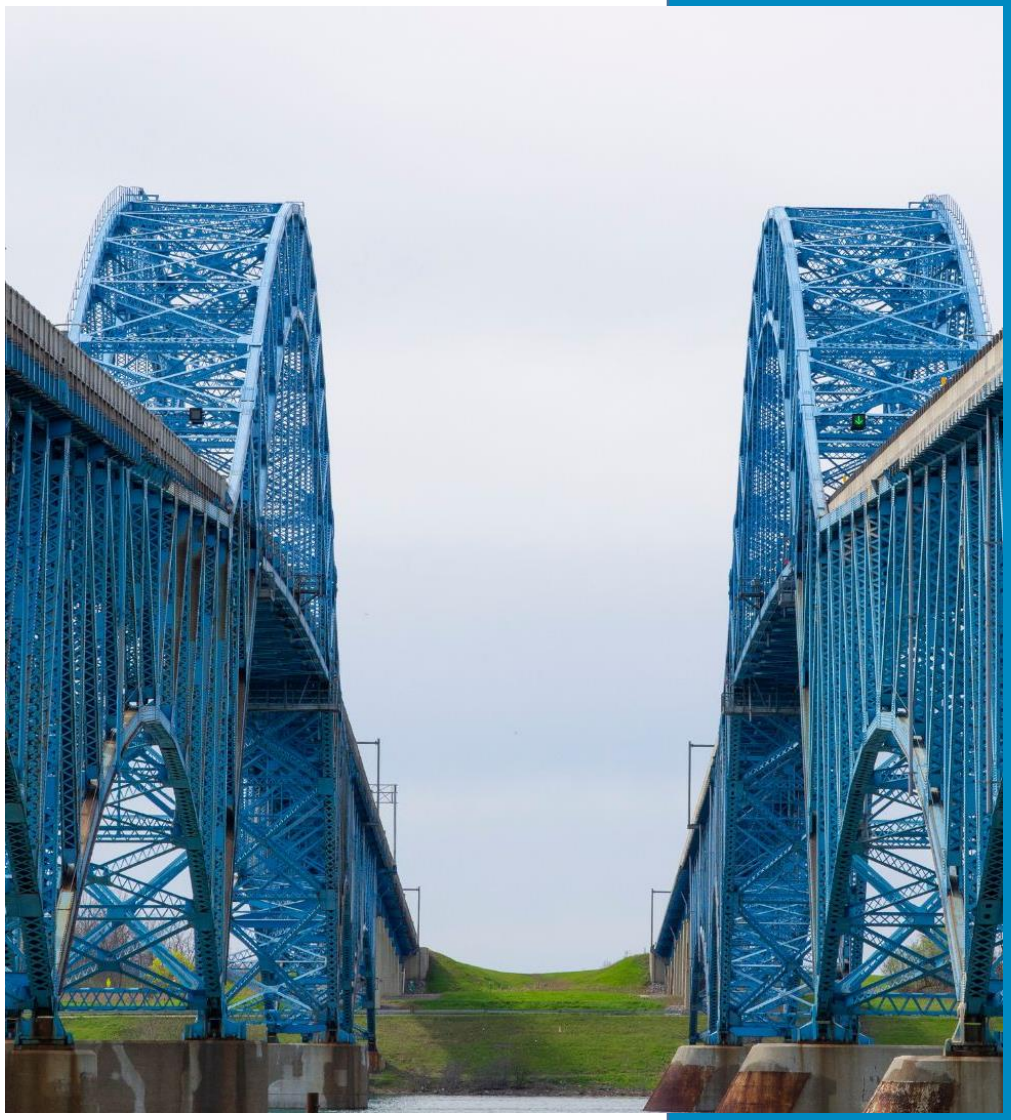

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Plan Overview

- Background
  - In 2019, FHWA reviewed Metric 13 and found Missouri's load rating/posting policy to be out of compliance.
  - December 22, 2022 — MoDOT reached agreement with FHWA on a Load Rating Update Plan for National Bridge Inventory structures in Missouri.
    - **10,387** — MoDOT
    - **14,154** — Local
- Plan is a **Ten-Year Timeline**
- MoDOT is contracting consultants to perform a large portion of the load rating update effort.

Load Rating Guidance

- Concerns for Load Rating Effort
  - Consultants have done some rating for MoDOT in the past, but it was very sporadic.
  - MoDOT did not give much guidance for consultants
  - MoDOT has AASHTOWare examples, but they were created over 20 years ago.
  - Additional guidance was developed for internal staff to fill in the gaps. Worked Ok with experienced staff but no longer a good option.

Load Rating Guidance

- What we Need
  - Documentation that consultants could follow
  - Help our many newer users
  - Something our experienced users could reference quickly
  - We do not have the time to create a bunch of examples.

Load Rating Guidance

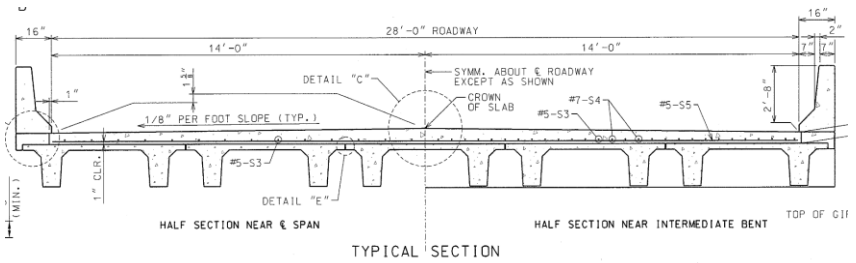
- Cheat Sheets
  - Geared toward consultants but created with new and existing staff in mind
  - Not a tutorial, more like a checklist (four pages)
  - Easier to digest and maintain than full-blown examples
  - A lot of good feedback from consultants, impression is that DOTs are not very good at explaining what they need from consultants

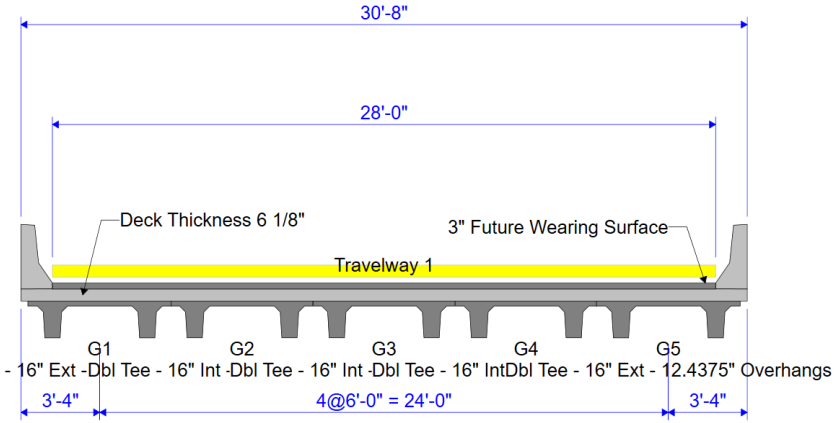
Load Rating Guidance

- Cheat Sheets
  - Set up for routine ratings. One cheat sheet can cover multiple types of bridges. Example: Steel Rolled Shapes or Plate Girders.
  - The Cheat Sheet hits every window in AASHTOWare BrR that a user would typically need to address.
  - Gives guidance specific to MoDOT policies
  - Very few screenshots
  - Can set one up in a couple of days

MoDOT "Routine" Load Ratings

- Michael Baker one of 14 consultants working for MoDOT
- Work began for Michael Baker in January 2024
- Load rating analysis for 100 Prestressed Concrete Double Tee Girder Bridges
  - 39 existing models
    - 6 checked by MoDOT
    - 33 unchecked
  - 61 no models
- AASHTOWare BrR



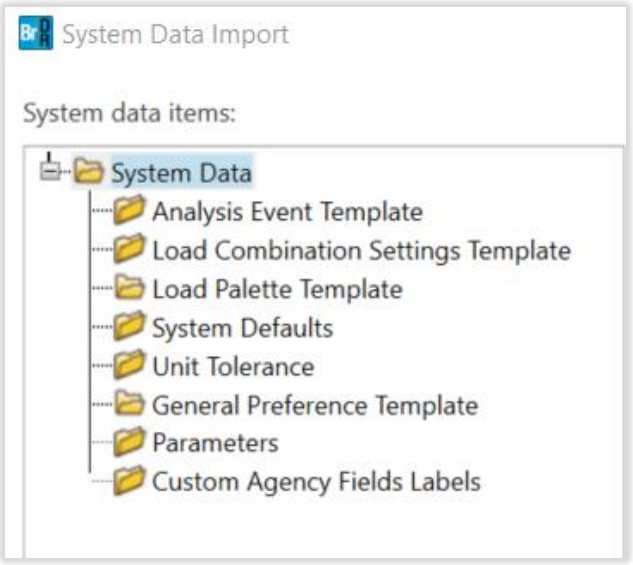


MoDOT "Routine" LRs

- Initial submittal of five structures for MoDOT review
- Other 95 structures staggered in three additional submittals of 30+ structures per submittal
- Deliverables include:
  - Exported electronic AASHTOWare model for each structure
  - Simplified rating summary table per MoDOT's spec
  - Summary list of structures indicating whether posting is required
  - Calculation summary when manual calculations for input into AASHTOWare are necessary
  - Signed and sealed summary letter of the load rating results

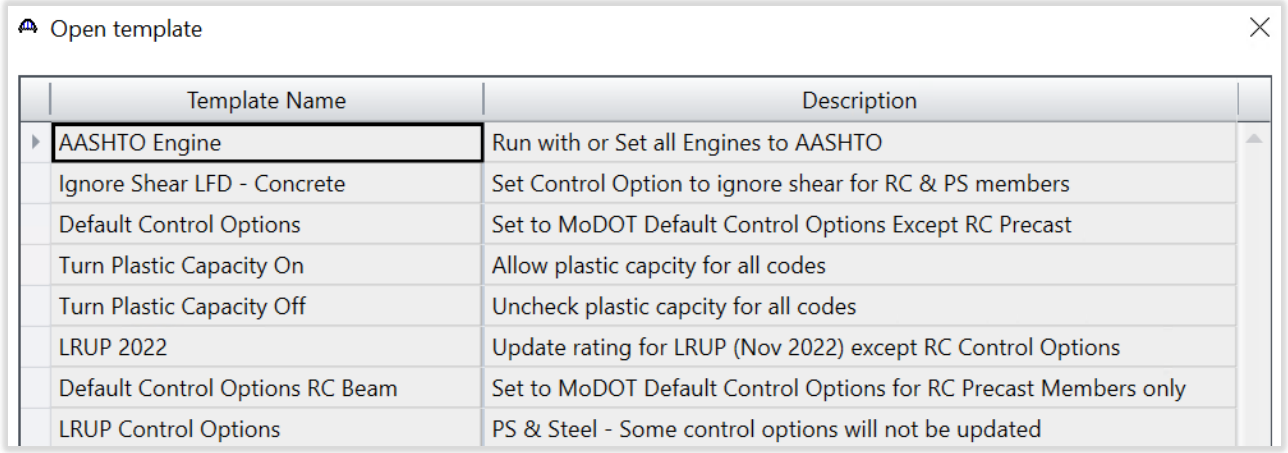
MoDOT BrR Setting

- BrR Version: 7.3.2.3001
- BrR System File (.brsx):
  - Analysis Event Template
  - System Defaults
  - Unit Tolerance
  - General Preference Template
  - Parameters
  - Custom Agency Fields Labels



MoDOT BrR Setting

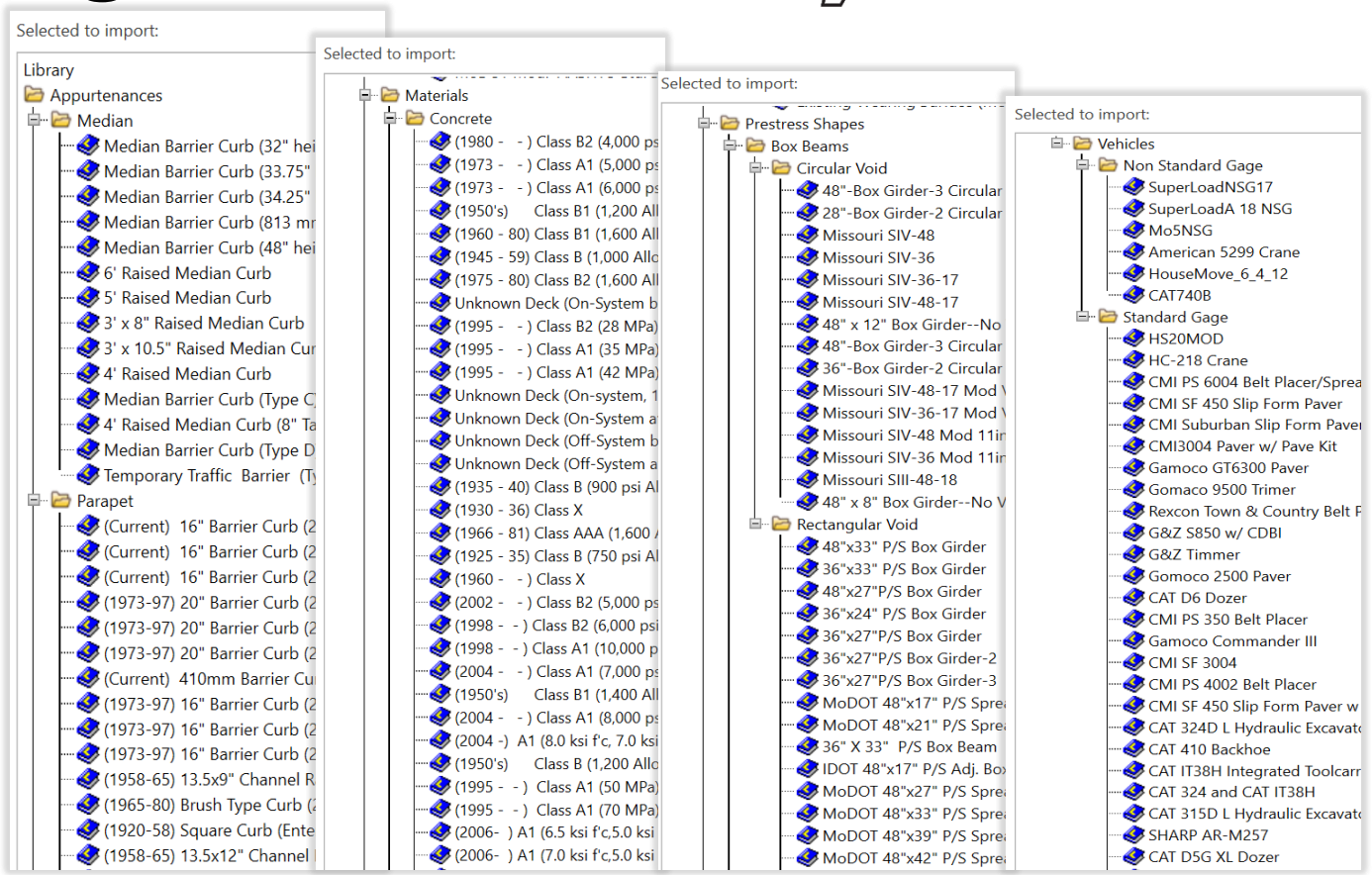
- BrR System File:
  - Eight Customized General Preference Templates
  - Template can be applied to existing models to update the setting inside the models without manual adjustments
  - Bridges can be rated using General Preference Template with the intended setting without modifying the model itself.



MoDOT BrR Setting

- BrR Library File (.brlx):
  - Appurtenances
  - Load Factors
  - Materials
  - Prestress Shapes
  - Steel Shapes
  - Vehicles

★ Total 566 MoDOT Specific Library Items.



MoDOT BrR "Cheat Sheets"

- Five "Cheat Sheets" for Missouri Routine Bridges:
  - Steel Girder or Rolled Shape Beam
  - Prestressed Beam
  - Reinforced Concrete Deck Girder
  - Reinforced Concrete Multicell Box Girder
  - Reinforced Concrete Slab System

MoDOT BrR “Cheat Sheets”

- Provide Clear Directions on:
  - BrR File Naming Convention
  - BrR NBI/SNBI Data Entries
  - BrR Traffic Data Entries
  - BrR Control Options
  - BrR Analysis Settings
  - BrR Other Inputs

MoDOT BrR “Cheat Sheets”

- Benefits includes:
  - System approach on initial conventions and parameters to align with the asset data in MoDOT Transportation Management System (TMS)
  - Consistent nomenclature in BrR input tree
  - Consistent BrR inputs, especially the inputs with multiple options. For example:
    - Prestress Properties
    - Linking Members
    - Load Case Description
    - Control Options
    - Live Load Distribution

MoDOT BrR “Cheat Sheets”

Benefits includes:

- Effective communication of MoDOT intentions and reasoning to consultants
- Consultant feedback
- Update can be applied systematically in BrR

Task Order to Consultant

- A Group of bridges sent to each consultant:
  - Same structure type
  - Existing plans
  - BrR models: some have existing models, some do not
  - Bridges' NBI and traffic data

Record_Number	Bridge_# (Bridge ID)	Federal_ID (NBI Structure II	Name	Year_Built	Length	Route (Facility Carried)	Feature Intersected	Log Mile	District	County
77	A0160	134	A01601	1957	83.3	RT W E	DRAIN DTCH #45	15.45	SE	NEW MADRID
993	A1879	1570	A18791	1966	85.0	RT M E	CORN CR	8.43	CD	PHELPS
1469	A2558	2214	A2558	1984	97.1	MO 20 E	FK OF ELM BR	12.84	KC	LAFAYETTE
1660	A2880	2478	A2880	1988	82.0	MO 116 E	STEVENSON CR	50.92	NW	CALDWELL
1749	A3015	2585	A30151	1972	109.9	RT RA E	E BRUSHY CR	0.62	NW	DAVIESS
1789	A3063	2633	A3063	1986	90.9	RT U S	S FK MID FABIUS RV	4.55	NE	SCHUYLER
1808	A3090	2654	A3090	1989	171.9	MO 210 E	RUSH CR	12.49	KC	CLAY
1810	A3094	2657	A3094	1984	129.9	MO 3 S	MUNCAS CR	50.48	NE	RANDOLPH
1811	A3095	2658	A3095	1986	210.9	MO 3 S	MID FK CHARITON RV	47.50	NE	RANDOLPH
1859	A3168	2713	A3168	1990	142.0	MO 210 E	KEENEY CR	27.53	KC	RAY
1865	A3191	2721	A3191	1985	107.9	US 59 N	CRD 427	37.48	NW	ANDREW
2140	A3685	3065	A3685	1993	227.0	BU 60 W	FLOOD RELIEF CHNL	1.76	SE	BUTLER
2142	A3687	3067	A3687	1993	151.9	BU 60 W	FLOOD RELIEF CHNL	1.53	SE	BUTLER
2158	A3710	3089	A3710	1982	143.0	RT D E	NORTH CUT DTCH	0.41	SE	SCOTT
2205	A3786	3148	A3786	1983	109.9	RT B S	MAIN DTCH	2.93	SE	DUNKLIN
2273	A3939	3249	A3939	1982	103.0	US 54 E	LIT WEABLEAU CR	64.75	SW	HICKORY
2276	A3950	3256	A3950	1983	195.8	MO 106 E	LIT SHAWEE CR	23.47	SE	SHANNON
2300	A4009	3297	A4009	1981	105.9	MO 79 S	TANYARD BR	30.94	NE	PIKE
2315	A4037	3318	A4037	1983	195.8	RT J S	NS RR	1.16	NE	RALLS
2319	A4048	3324	A4048	1981	105.0	MO 34 E	CLARK'S CR	29.36	SE	WAYNE
2321	A4051	3326	A4051	1983	206.0	US 54 E	BR OF DRYWOOD CR	7.10	SW	VERNON
2322	A4054	3328	A4054	1984	181.1	US 24 E	NS RR	174.72	NE	MONROE
2323	A4055	3329	A4055	1984	149.9	US 24 E	INDIAN CR	179.21	NE	MONROE
2332	A4063	3338	A4063	1985	161.0	US 50 E	SCHULTE CR	181.18	CD	GASCONADE
2354	A4099	3366	A4099	1982	76.1	MO 79 S	HORN BR	22.60	NE	PIKE
2381	A4163	3405	A4163	1983	323.1	RT C S	BIG BARREN CR	11.18	SE	CARTER
2385	A4169	3409	A4169	1983	181.1	RT F E	CALLAWAY FK	8.13	SL	ST. CHARLES
2398	A4186	3423	A4186	1987	116.1	US 50 W	CRD BIG HORN DR	127.64	CD	COLE
2399	A4187	3424	A41871	1987	107.9	US 50 E	CRD BIG HORN DR	133.68	CD	COLE

Task Order to Consultant

- Worksheet created to link MoDOT NBI data with
  - BrR Inputs in Bridge Description Window
  - Load Rating Summary Report
  - Load Rating Posting Summary

Record_Number	Bridge_# (Bridge ID)	Federal_ID (NBI Structure II	Name	Year_Built	Length	Route (Facility Carried)	Feature Intersected	Log Mile	District	County
77	A0160	134	A01601	1957	83.3	RT W E	DRAIN DTCH #45	15.45	SE	NEW MADRID

Description | Description (cont'd) | Alternatives | Global reference point | Traffic | Custom agency fields

Name: A30151 Year built: 1972

Description: 3-Span Continuous Composite P/S Concrete Double Tee Girders
Input Method: Girder System
Copied From: None

Location: Length: 109.90 ft

Facility carried (7): RT RA E Route number:

Feat. intersected (6): E BRUSHY CR Mi. post: 0.62

Default units: US Customary

Load Rating Summary Sheet for AASHTOWare BrR Files

District: Central District
Route: RT WW E
Commercial Zone (Yes/No): Yes
County: Boone
Bridge Number: A4612
Interstate/Overpass (Yes/No): No
ADTT: 132
Project Number: ST0009
Local Agency: N/A
Consultant Firm: Michael Baker International
Rating Engineer: Hao Wei Low
W.S. Thickness: 3 IN
BrR Version: 7.3.2.3001
Rating Date: 6/29/2024

SUMMARY

Posting Vehicles Rating Summary

Vehicle	Level	DF Type	Rating Factor	Tonnage Value	Posting Type	Posting Wt. Limit (Ton) Reg	Posting Wt. Limit (Ton) CZ	Posting Req. Reg	Posting Req. CZ	Posting Req. Ton
H20L	Posting	Single Lane	1.80	36.0	Single	30	45	-	Yes	36.0
H20L	Posting	Multi Lane	1.80	36.0						
MO3S2	Posting	Single Lane	1.76	64.6	Combo	45	70	-	Yes	64.6
MO3S2	Posting	Multi Lane	1.76	64.6						
CZSU	Posting	Single Lane	0.98	40.1	Single	-	45	-	Yes	40.1
CZSU	Posting	Multi Lane	0.98	40.1						
CZRT	Posting	Single Lane	1.12	56.9	Combo	-	70	-	Yes	56.9
CZRT	Posting	Multi Lane	1.12	56.9						
EV3	Operating	Single Lane	1.06	45.6	General	43	-	-	-	-

Consultant Deliverable

- BrR model (.xml)
- Standard Load Rating Summary Report
- Load Posting Summary Report
- Supporting calculation of BrR inputs

Load Rating Summary Sheet for AASHTOWare BrR Files

District:	Southwest District	**County:**	Christian
Route:	MO 125 S	**Bridge Number:**	A4448
Commercial Zone (Yes/No):	No	**Interstate/Overpass (Yes/No):**	No
		ADTT:	125
Project Number:	ST0009	**W.S. Thickness:**	3 IN
Local Agency:	N/A	**BrR Version:**	7.3.2.3001
Consultant Firm:	Michael Baker International		
Rating Engineer:	Matthew Koenig	**Rating Date:**	4/4/2024

Vehicle	Level	LRFR Limit State	Failure Mode	DF Type	Structure ID	Member ID	Controlling Location (1.0, 1.5, etc.)	Rating Factor (x.xx)	Tonnage Value (xxx.x)
HL93	Inventory			Controlling					-
HL93	Operating			Controlling					-
HS20	Inventory		Flexure	Controlling	1	G1	1 - (100.0)	1.24	44.6
HS20	Operating		Flexure	Controlling	1	G1	1 - (100.0)	2.07	74.5
H20L	Posting		Flexure	Single Lane	1	G1	1 - (40.0)	2.99	59.7
H20L	Posting		Flexure	Multi Lane	1	G2	1 - (40.0)	2.62	52.5
MO3S2	Posting		Flexure	Single Lane	1	G1	1 - (100.0)	1.89	69.4
MO3S2	Posting		Flexure	Multi Lane	1	G1	1 - (100.0)	1.89	69.4
CZSU	Posting		Flexure	Single Lane	1	G1	1 - (100.0)	1.56	63.7
CZSU	Posting		Flexure	Multi Lane	1	G2	1 - (40.0)	1.54	62.7
CZRT	Posting		Flexure	Single Lane	1	G1	1 - (100.0)	1.35	68.7
CZRT	Posting		Flexure	Multi Lane	1	G1	1 - (100.0)	1.35	68.7
EV3	Operating		Flexure	Single Lane	1	G1	1 - (100.0)	1.64	70.6

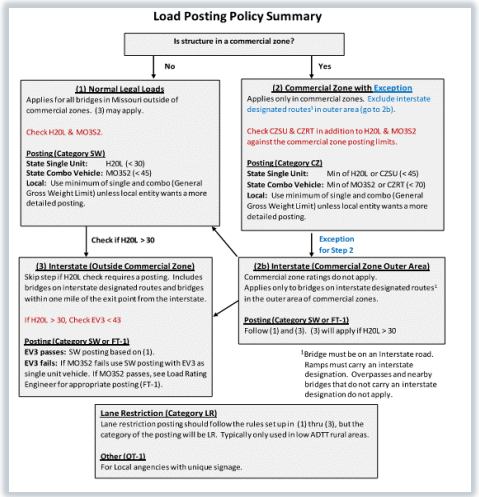
HL93 ratings are LRFR. All other ratings are LFR. Posting = 0.86*Operating

Consultant Deliverable

- Load Posting Summary

  Worksheet was created to evaluate posting criteria:

  - Commercial Zone or Non-CZ
  - Interstate or Non-Interstate
  - ADTT
  - Clear Roadway Width



MoDOT Load Posting Flow Chart

Load Posting Policy Evaluation (EPG 753.15.11.6)

Commercial Zone (Yes/No):	Yes		
ADTT:	132		*Use future ADTT per MoDOT*
Interstate Bridge (Yes/No):	No		*Not including overpass over interstate*
Roadway Width:	32.83	ft	*Clear Roadway Width*

Posting Considerations Based on Roadway Width and ADTT

Roadway Width (ft)	ADTT	Single Lane DF*	Multi-Lane DF
≤ 18.0	≤ 100	Yes	----
	> 100	Yes	----
> 18.0	≤ 100	Yes	----
	> 100	----	Yes

*For emergency vehicle posting considerations, always use the single lane DF

Lane DF: Multi Lane DF

(1) Normal Legal Loads - Not in Commercial Zone

H20L <	30 Ton	-
MO3S2 <	45 Ton	-
Posting:	Not Required	
Category:	-	

(2) Commerical Zone with Exception

H20L <	45 Ton	Yes	36.0 Ton
MO3S2 <	70 Ton	Yes	64.6 Ton
CZSU <	45 Ton	Yes	40.1 Ton
CZRT <	70 Ton	Yes	56.9 Ton
Posting:	Required		
Category:	CZ		

(2b) Interstate (Commerical Zone Outer Area)

Commercial Zone ratings do not apply

Applies only to bridges on interstate designated routes in the outer area of commercial zones.

Posting - Follow (1) & (3)

(3) Interstate (Outside Commercial Zone)

EV3 <	43 Ton	-
Posting:	Not Required	
Category:	-	

Teamwork and Collaboration

- MoDOT
  - Provides clear directions on modeling and formatting for final product
  - Groups the same type of bridges
  - Provides BrR setting files to ensure consistency among different consultants
  - Simplifies updates by creating customized templates and applies systematically

Teamwork and Collaboration

- Consultants:
  - Clear understanding of MoDOT's intent and expectations
  - Generate internal worksheets and templates to streamline the process
  - Minimize error inputs to reduce MoDOT review time
  - Reduce back-and-forth communication between MoDOT and consultants
  - Ensure better quality in the final product
  - Simplify the load rating process
  - Stay under budget and meeting deadlines

Discussion/Questions?

Thank You!