

*AASHTOWare BrDR 7.6.0*

*Feature Tutorial*

*MBE 2024 Spec Interim Update – Permit Rating Example*

## MBE 2024 Spec Interim Update – Permit Rating Example

### AASHTOWare Bridge Design and Rating Training

#### MBE 2024 Spec Interim Update – Permit Rating Example

##### Summary

This tutorial demonstrates the provisions for permit vehicle loading as specified in the AASHTO MBE 3<sup>rd</sup> Edition with 2024 interims. A multispan steel superstructure is used to illustrate several aspects of the new provisions. The process for permit vehicle loading is similar for all line girder, 3D and truss analysis methods.

The permit vehicle definition can describe an actual permit vehicle with its exact wheel weights or can describe a collection of permit vehicles as indicated by the notional vehicle selection. For a notional permit vehicle, only axles which contribute to the maximum force effect are considered.

An additional permit lane load can be assigned with the advanced analysis settings options. When a permit lane load is defined, the program applies the load as described in the AASHTO MBE 3<sup>rd</sup> Edition with 2024 interims. The permit lane load is only applied to bridges with an average daily truck traffic (ADTT) greater than 500. If the recent ADTT is not input for a bridge, the program assumes it to be greater than 500 and applies the lane load. For spans between 200 and 300 ft. the permit lane load contributes to all load effects, and for other span lengths it only contributes to negative moments, shears and reactions between contraflexure points over interior supports.

For truss structures the lane load is applied to the truss members as follows:

- To all truss members when the span length is between 200 and 300 ft.
- Truss chord members between points of contraflexure near intermediate piers.
- Diagonals and vertical members within the first panel adjacent to an interior pier.

# MBE 2024 Spec Interim Update – Permit Rating Example

## LRFR Analysis – Permit Vehicle Rating

Start by importing the Permit-Rating-With-BrDR-7.6.0.xml example file. This is a three span steel plate girder bridge. The first and third spans are less than 200 ft., and the second span is greater than 200 ft. This configuration will illustrate several aspects of the permit lane application using the AASHTO MBE 3<sup>rd</sup> Edition with 2024 interims.

The screenshot shows the 'Permit Rating Training' software window. At the top, there are input fields for 'Bridge ID' and 'NBI structure ID (8)', both containing the text 'Permit Rating Training'. To the right, there are two checkboxes: 'Template' (unchecked) and 'Bridge completely defined' (unchecked). Further right is a 'Bridge Workspace View' panel with three checkboxes: 'Superstructures' (checked), 'Culverts' (unchecked), and 'Substructures' (unchecked).

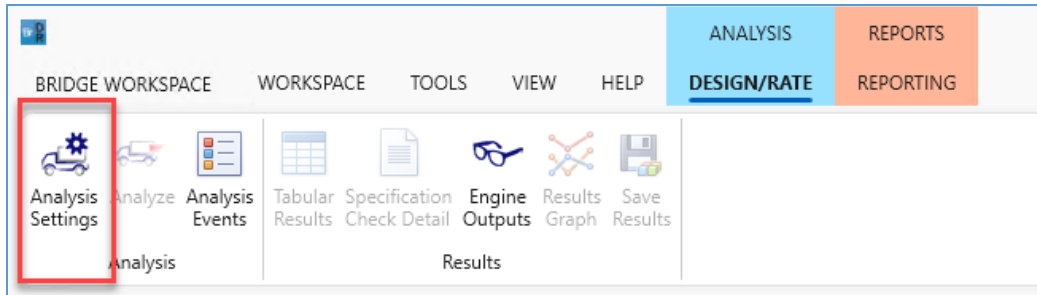
Below these fields is a tabbed interface with the following tabs: 'Description', 'Description (cont'd)', 'Alternatives', 'Global reference point', 'Traffic', and 'Custom agency fields'. The 'Description' tab is active, showing a form with the following fields:

- Name:** Permit Rating Training
- Year built:** 2024
- Description:** A large empty text area.
- Location:** Pittsburgh, PA
- Length:** 576.00 ft
- Facility carried (7):** An empty text field.
- Route number:** 376
- Feat. intersected (6):** An empty text field.
- Mi. post:** An empty text field.
- Default units:** US Customary (with a dropdown arrow)

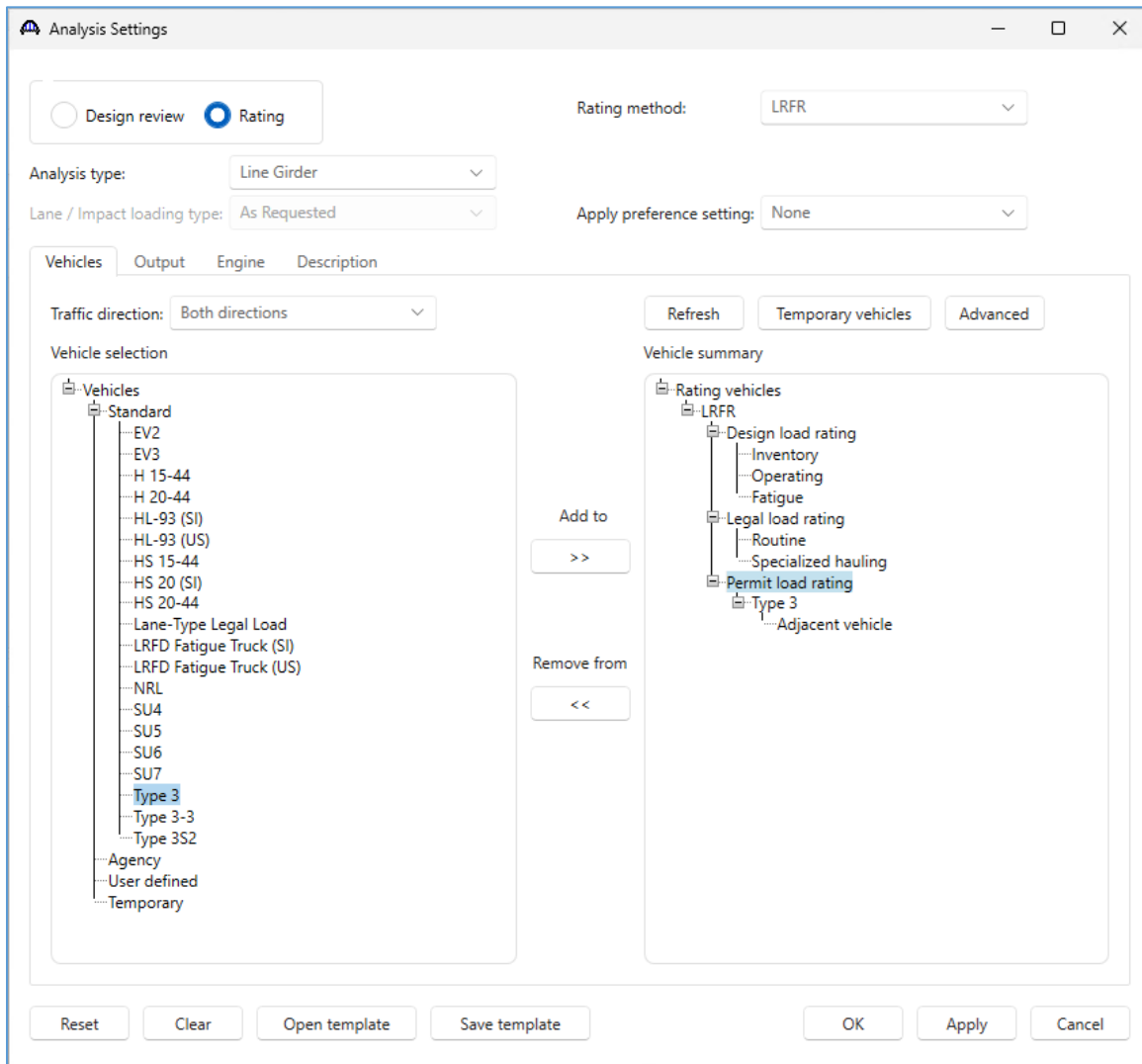
At the bottom of the window, there is a 'Bridge association...' section with three radio buttons: 'BrR' (checked), 'BrD' (checked), and 'BrM' (unchecked). At the very bottom right, there are three buttons: 'OK', 'Apply', and 'Cancel'.

# MBE 2024 Spec Interim Update – Permit Rating Example

Analyze the **Haunched Plate Girder** member alternative for **G1**. To perform an **LRFR** rating, select the **Analysis Settings** button on the **Analysis** group of the **DESIGN/RATE** ribbon. The window shown below opens.

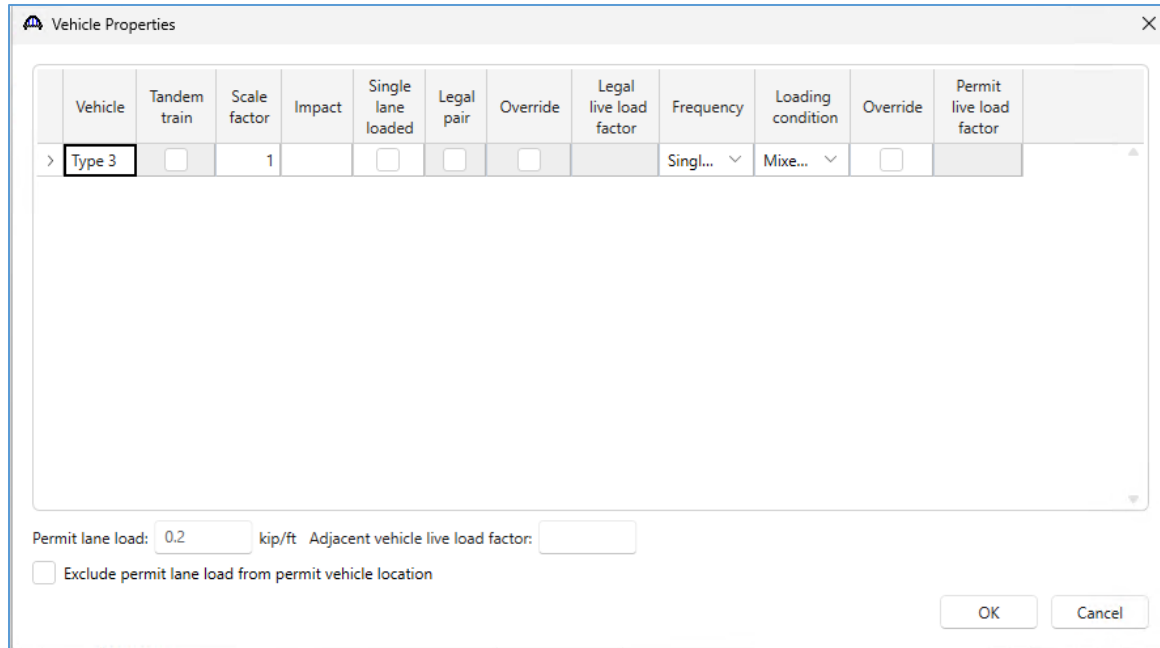


Assign the **Type 3** vehicle to the LRFR Permit load rating category in the **Analysis Settings** window as shown below.



## MBE 2024 Spec Interim Update – Permit Rating Example

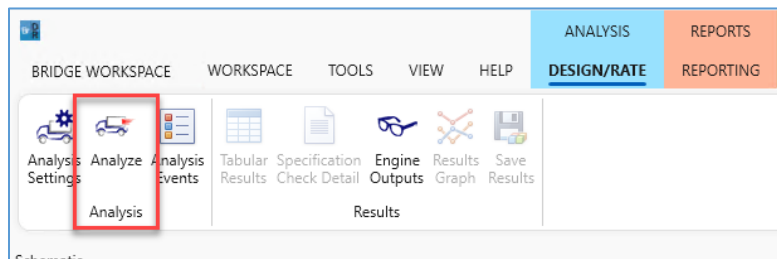
In the **Advanced Vehicle Properties** window, add a 0.2 kip/ft **Permit lane load**. This indicates that the permit lane load should be considered during the analysis and defines the magnitude of the load. The application of this load depends on the recent ADTT and the span configuration of the structure.



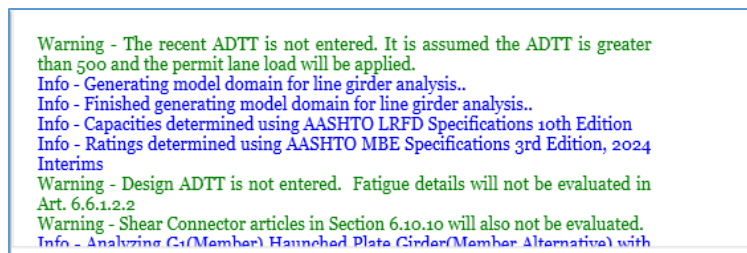
Click **OK** to apply the data and close the window.

### Tabular Results

With **G1** member alternative – **Haunched Plate Girder** selected, click the **Analyze** button on the **Analysis** group of the **DESIGN/RATE** ribbon to perform the rating.



The analysis log indicates that the permit lane load is assumed to apply since the ADTT is not defined.



## MBE 2024 Spec Interim Update – Permit Rating Example

To define the ADTT, open the bridge description window by double clicking on the **Permit Rating Training** node in the bridge workspace tree. Navigate to the **Traffic** tab.

Input a recent ADTT of 50.

The screenshot shows the 'Permit Rating Training' dialog box with the 'Traffic' tab selected. The 'Bridge ID' and 'NBI structure ID (8)' are both set to 'Permit Rating Training'. There are checkboxes for 'Template' and 'Bridge completely defined', both of which are unchecked. A 'Bridge Workspace View' panel on the right has 'Superstructures' checked and 'Culverts' and 'Substructures' unchecked. The 'Traffic' tab contains several input fields: 'Truck PCT' (empty), 'ADT' (empty), 'Directional PCT' (empty), 'Recent ADTT' (50) with a 'Compute' button, 'Design ADTT' (empty), 'Exp. annual ADTT<sub>SL</sub> growth rate' (empty), 'Fatigue importance factor' (Main Arterial, Interstate, Other) with a dropdown arrow, and an 'Importance factor override' checkbox (unchecked). Below these are three more input fields: '(ADTT<sub>SL</sub>)<sub>0</sub>', '(ADTT<sub>SL</sub>)<sub>PRESENT</sub>', and '(ADTT<sub>SL</sub>)<sub>LIMIT</sub>', all of which are empty. At the bottom, there is a 'Bridge association...' button and three checkboxes: 'BrR' (checked), 'BrD' (checked), and 'BrM' (unchecked). 'OK', 'Apply', and 'Cancel' buttons are at the bottom right.

Reanalyze **G1**. The analysis log shows the permit lane load is not applied.

Warning - The LRFR permit lane load will not be applied because the recent ADTT is 50. The AASHTO MBE specifies the permit lane load shall be applied for bridges that have ADTT greater than 500.

Info - Generating model domain for line girder analysis..

Info - Finished generating model domain for line girder analysis..

Info - Capacities determined using AASHTO LRFD Specifications 10th Edition

Info - Ratings determined using AASHTO MBE Specifications 3rd Edition, 2024 Interims

Warning - Design ADTT is not entered. Fatigue details will not be evaluated in Art. 6.6.1.2.2

Warning - Shear Connector articles in Section 6.10.10 will also not be evaluated

# MBE 2024 Spec Interim Update – Permit Rating Example

The tabular results window shows a critical rating factor of 2.138.

Analysis Results - Haunched Plate Girder

Print

Report type: Rating Results Summary

Lane/Impact loading type:  As requested  Detailed

Display Format: Single rating level per row

Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Limit State	Impact	Lane
Type 3	Axle Load	LRFR	Permit	53.45	2.138	576.00	3 - (100.0)	STRENGTH-II Steel Shear	As Requested	As Requested

AASHTO LRFR Engine Version 7.6.0.3001  
Analysis preference setting: None

Close

The live load actions table shows only an axle load component computed for the Type 3 permit vehicle.

Analysis Results - Haunched Plate Girder

Print

Report type: Live Load Actions

Stage: Composite (short term) (Stage)

Live Load: Type 3

Live Load Type: Axle Load

Span	Location (ft)	% Span	Positive Moment (kip-ft)	Negative Moment (kip-ft)	Positive Shear (kip)	Negative Shear (kip)	Positive Axial (kip)	Negative Axial (kip)	Positive Torsion (kip-ft)	Negative Torsion (kip-ft)	Positive Reaction (kip)	Negative Reaction (kip)	Positive X Deflection (in)	Negative X Deflection (in)	Positive Y Deflection (in)	Negative Y Deflection (in)	% Impact Pos Reaction	% Impact Neg Reaction
1	0.00	0.0	0.00	0.00	38.06	-4.71	0.00	0.00			38.06	-4.71	0.0000	0.0000	0.0000	0.0000	33.000	33.000
1	5.50	3.1	195.38	-25.17	36.53	-4.71	0.00	0.00					0.0000	0.0000	0.0119	-0.0297		
1	11.00	6.2	374.40	-50.34	35.00	-4.71	0.00	0.00					0.0000	0.0000	0.0238	-0.0590		
1	16.50	9.4	537.16	-75.51	33.48	-4.71	0.00	0.00					0.0000	0.0000	0.0355	-0.0876		
1	17.60	10.0	567.77	-80.54	33.17	-4.71	0.00	0.00					0.0000	0.0000	0.0378	-0.0932		
1	22.00	12.5	683.81	-100.67	31.96	-4.71	0.00	0.00					0.0000	0.0000	0.0470	-0.1151		
1	27.50	15.6	814.51	-125.84	30.46	-5.59	0.00	0.00					0.0000	0.0000	0.0581	-0.1413		
1	33.00	18.7	929.43	-151.01	28.96	-7.11	0.00	0.00					0.0000	0.0000	0.0689	-0.1657		
1	35.20	20.0	971.03	-161.08	28.37	-7.72	0.00	0.00					0.0000	0.0000	0.0731	-0.1749		
1	38.50	21.9	1028.86	-176.18	27.48	-8.62	0.00	0.00					0.0000	0.0000	0.0792	-0.1881		
1	40.00	22.7	1053.29	-183.04	27.08	-9.03	0.00	0.00					0.0000	0.0000	0.0820	-0.1938		

AASHTO LRFR Engine Version 7.6.0.3001  
Analysis preference setting: None

Close

# MBE 2024 Spec Interim Update – Permit Rating Example

Change the ADTT to 750. Open the bridge description window by double clicking on the **Permit Rating Training** node in the bridge workspace tree and navigate to the **Traffic** tab.

The screenshot shows the 'Permit Rating Training' dialog box with the 'Traffic' tab selected. The 'Bridge ID' and 'NBI structure ID (8)' are both set to 'Permit Rating Training'. The 'Bridge completely defined' checkbox is unchecked. The 'Bridge Workspace View' section has 'Superstructures' checked, while 'Culverts' and 'Substructures' are unchecked. The 'Traffic' tab contains the following fields:

- Truck PCT: [ ] %
- ADT: [ ]
- Directional PCT: [ ] %
- Recent ADTT: 750 [Compute]
- Design ADTT: [ ]
- Exp. annual ADTT<sub>SL</sub> growth rate: [ ]
- Fatigue importance factor: Main Arterial, Interstate, Other [v]
- Importance factor override: [ ]
- (ADTT<sub>SL</sub>)<sub>0</sub>: [ ]
- (ADTT<sub>SL</sub>)<sub>PRESENT</sub>: [ ]
- (ADTT<sub>SL</sub>)<sub>LIMIT</sub>: [ ]

At the bottom, the 'Bridge association...' section has 'B&R' and 'B&D' checked, and 'B&M' unchecked. The 'OK', 'Apply', and 'Cancel' buttons are at the bottom right.



# MBE 2024 Spec Interim Update – Permit Rating Example

## Reanalyze G1.

The tabular results window shows a critical rating factor of 2.138. This is the same controlling rating as without the permit lane applied, but this time the live load type is shown as Truck + Lane. The controlling location is span 3 – 100%. The permit lane load is considered during the analysis, but not at this POI because this POI is not in a span between 200 and 300 ft. or in a negative contraflexure region over an interior support.

Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Limit State	Impact	Lane
Type 3	Truck + Lane	LRFR	Permit	53.45	2.138	576.00	3 - (100.0)	STRENGTH-II Steel Shear	As Requested	As Requested

AASHTO LRFR Engine Version 7.6.0.3001  
Analysis preference setting: None

The live load actions table shows both axle load and lane components for the Type 3 permit vehicle. The lane load portion of the permit vehicle shows all actions are considered in span 2 because the length of span 2 is between 200 and 300 ft. Since the length of span 3 is less than 200 ft., all actions are not always considered from the lane load. The portion of the span in the negative contraflexure region considers negative moments, shears and reactions and the portion of the span in the positive contraflexure region does not consider any actions from the lane load.

Span	Location (ft)	% Span	Positive Moment (kip-ft)	Negative Moment (kip-ft)	Positive Shear (kip)	Negative Shear (kip)	Positive Axial (kip)	Negative Axial (kip)	Positive Torsion (kip-ft)	Negative Torsion (kip-ft)	Axle Load	Lane	Live Reaction (k)	Negative X Deflection (in)	Positive Y Deflection (in)	Negative Y Deflection (in)	% Impact Pos Reaction	% Impact Neg Reaction
2	180.48	88.9	67.28	-330.64	1.70	-12.66	0.00	0.00										
2	182.70	90.0	66.15	-351.41	1.68	-12.94	0.00	0.00										
2	186.11	91.7	65.29	-385.30	1.65	-13.36	0.00	0.00										
2	191.74	94.5	66.12	-446.50	1.62	-14.08	0.00	0.00										
2	197.37	97.2	69.74	-514.23	1.61	-14.90	0.00	0.00										
2	201.00	99.0	73.59	-561.38	1.60	-15.38	0.00	0.00										
2	203.00	100.0	76.23	-588.54	1.60	-15.65	0.00	0.00										
3	0.00	0.0	0.00	-588.54	14.96	-0.40	0.00	0.00			29.11	-1.85	0.0000	0.0000	0.0000	0.0000	0.000	0.000
3	2.00	1.0	0.00	-559.92	14.72	-0.40	0.00	0.00					0.0000	0.0000	0.0033	-0.0040		
3	6.16	3.1	0.00	-503.83	14.22	-0.40	0.00	0.00					0.0000	0.0000	0.0115	-0.0125		
3	12.31	6.3	0.00	-429.38	13.50	-0.42	0.00	0.00					0.0000	0.0000	0.0115	-0.0125		
3	18.47	9.4	0.00	-366.33	12.79	-0.46	0.00	0.00					0.0000	0.0000	0.0115	-0.0125		
3	19.70	10.0	0.00	-355.38	12.65	-0.47	0.00	0.00					0.0000	0.0000	0.0115	-0.0125		
3	24.63	12.5	0.00	-317.64	12.09	-0.51	0.00	0.00					0.0000	0.0000	0.0115	-0.0125		
3	30.79	15.6	0.00	-285.25	11.41	-0.57	0.00	0.00					0.0000	0.0000	0.0115	-0.0125		
3	36.94	18.8	0.00	-269.52	10.75	-0.65	0.00	0.00					0.0000	0.0000	0.0115	-0.0125		
3	39.40	20.0	0.00	-265.39	10.49	-0.69	0.00	0.00					0.0000	0.0000	0.0508	-0.0791		
3	43.10	21.9	0.00	-259.15	10.11	-0.75	0.00	0.00					0.0000	0.0000	0.0534	-0.0855		
3	48.76	24.8	0.00	-0.00	-0.00	-0.00	0.00	0.00					0.0000	0.0000	0.0000	0.0000		
3	49.26	25.0	0.00	0.00	-0.00	-0.00	0.00	0.00					0.0000	0.0000	0.0000	0.0000		
3	51.36	26.1	0.00	0.00	-0.00	-0.00	0.00	0.00					0.0000	0.0000	0.0000	0.0000		

AASHTO LRFR Engine Version 7.6.0.3001  
Analysis preference setting: None