

AASHTOWare BrDR 7.6.1

Feature Tutorial

MBE 2024 Spec Interim Update – Permit Rating Example

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AASHTOWare Bridge Design and Rating Training

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Summary

This tutorial demonstrates the provisions for permit vehicle loading as specified in the AASHTO MBE 3rd Edition with 2024 interims. A multi-span 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 3rd 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.

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LRFR Analysis – Permit Vehicle Rating

Start by importing the Permit-Rating-With-BrDR-7.6.1.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 3rd 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 'Permit Rating Training'. To the right, there are checkboxes for 'Template' and 'Bridge completely defined', both of which are unchecked. Further right is a 'Bridge Workspace View' panel with three options: 'Superstructures' (checked), 'Culverts' (unchecked), and 'Substructures' (unchecked).

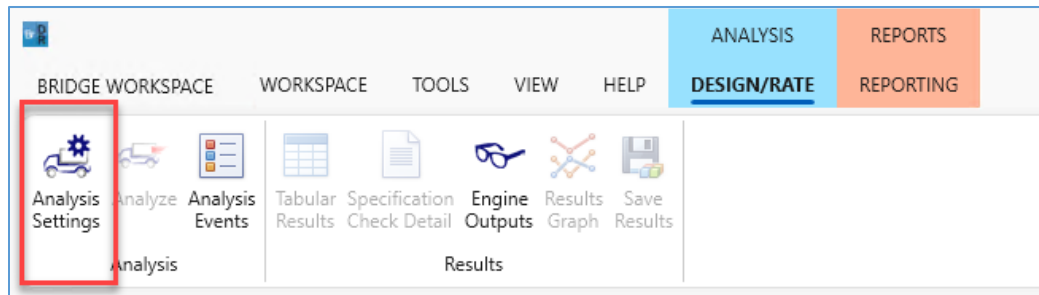
Below these fields is a tabbed interface with the following tabs: 'Description', 'Description (cont'd)', 'Alternatives', 'Global reference point', 'Traffic', and 'Custom agency fields'. The 'Description' tab is active, showing a form with the following fields:

- 'Name:' with a text box containing 'Permit Rating Training'.
- 'Year built:' with a text box containing '2024'.
- 'Description:' with a large empty text area.
- 'Location:' with a text box containing 'Pittsburgh, PA'.
- 'Length:' with a text box containing '576.00' and a unit dropdown set to 'ft'.
- 'Facility carried (7):' with an empty text box.
- 'Route number:' with a text box containing '376'.
- 'Feat. intersected (6):' with an empty text box.
- 'Mi. post:' with an empty text box.
- 'Default units:' with a dropdown menu set to 'US Customary'.

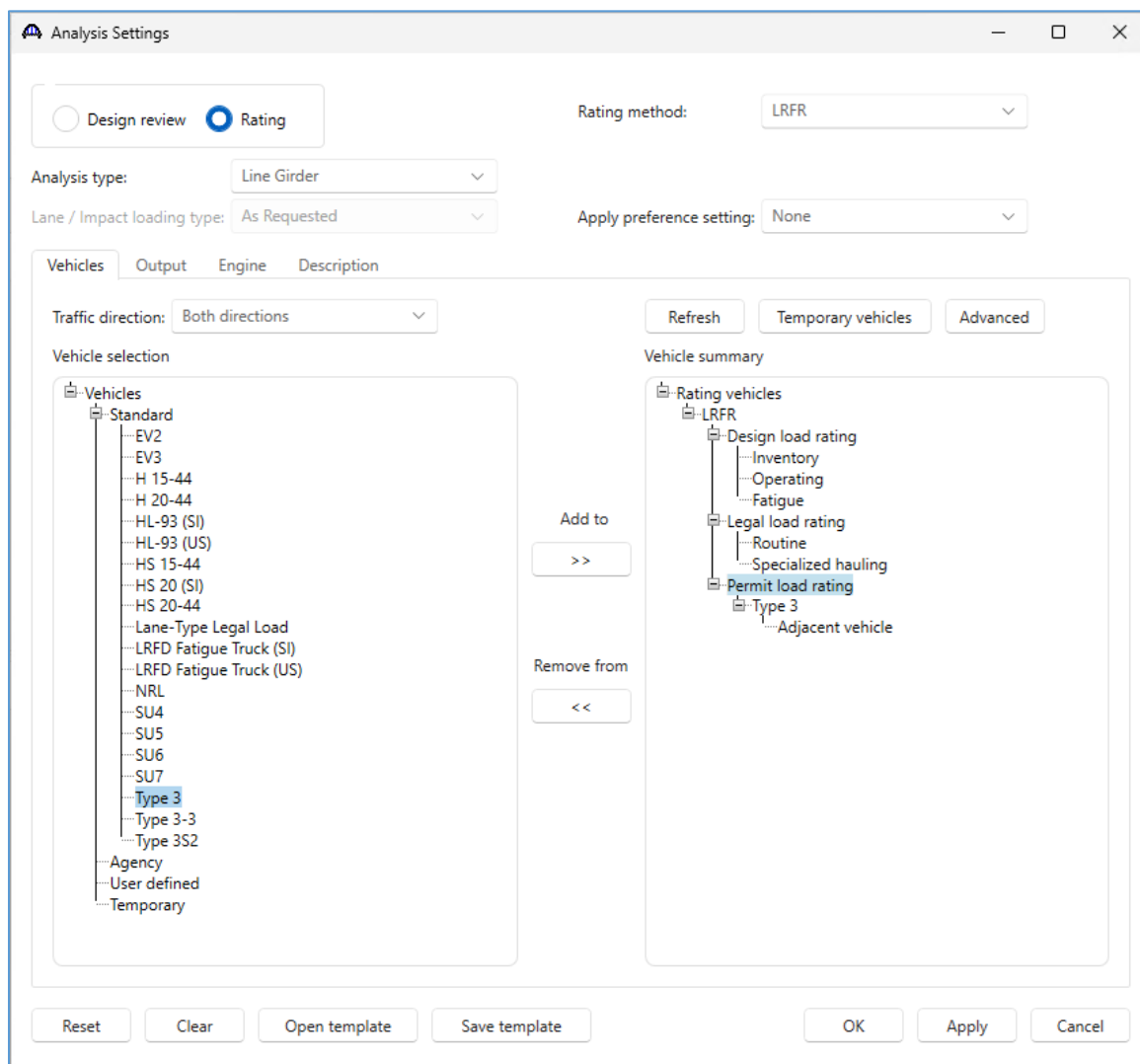
At the bottom of the form, there is a 'Bridge association...' button and three checkboxes: 'BrR' (checked), 'BrD' (checked), and 'BrM' (unchecked). At the very bottom right of the window are 'OK', 'Apply', and 'Cancel' buttons.

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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.

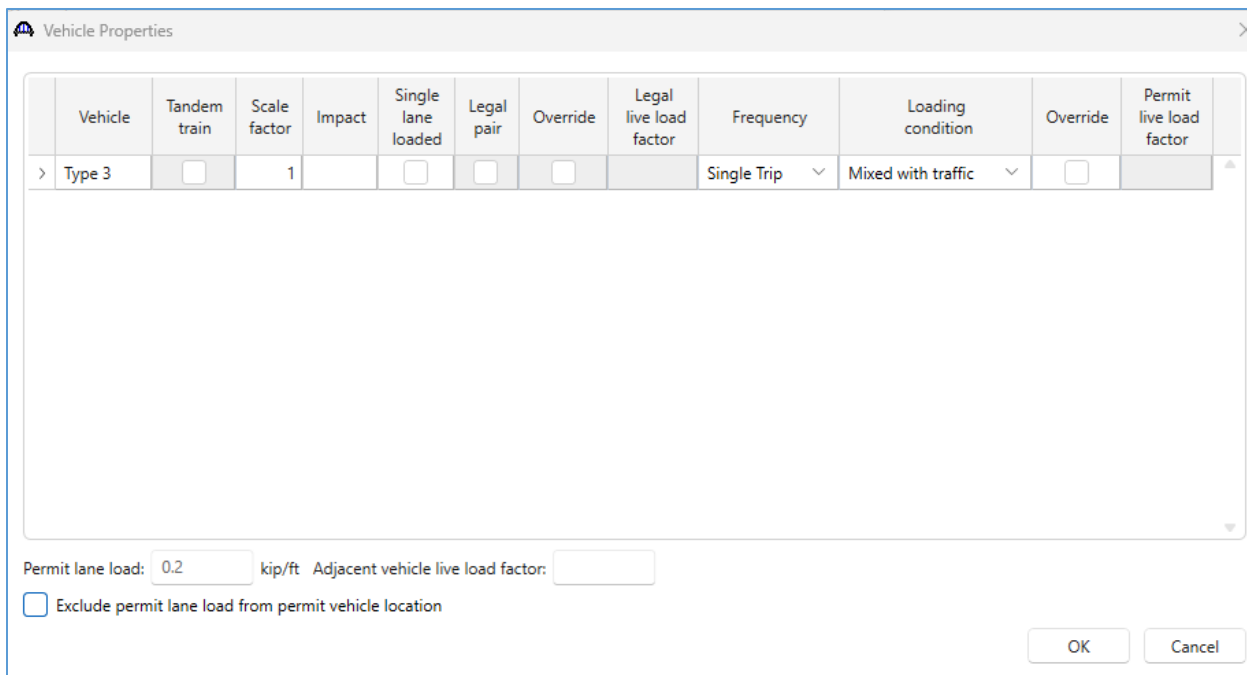


Assign the **Type 3** vehicle to the LRFR Permit load rating category in the **Analysis Settings** window as shown below.



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In the **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.



The **Vehicle Properties** dialog box is shown. It contains a table with the following columns: Vehicle, Tandem train, Scale factor, Impact, Single lane loaded, Legal pair, Override, Legal live load factor, Frequency, Loading condition, Override, and Permit live load factor. The first row is selected, showing 'Type 3' for Vehicle, '1' for Scale factor, 'Single Trip' for Frequency, and 'Mixed with traffic' for Loading condition. Below the table, there is a section for 'Permit lane load' with a value of '0.2' kip/ft and an 'Adjacent vehicle live load factor' field. There is also a checkbox for 'Exclude permit lane load from permit vehicle location'. The 'OK' and 'Cancel' buttons are at the bottom right.

Vehicle	Tandem train	Scale factor	Impact	Single lane loaded	Legal pair	Override	Legal live load factor	Frequency	Loading condition	Override	Permit live load factor
> Type 3	<input type="checkbox"/>	1		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		Single Trip	Mixed with traffic	<input type="checkbox"/>	

Permit lane load: 0.2 kip/ft Adjacent vehicle live load factor:

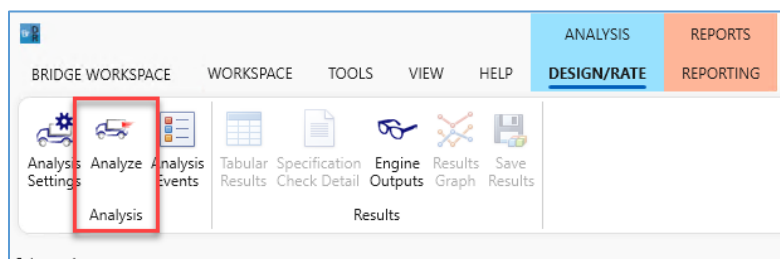
☐ Exclude permit lane load from permit vehicle location

OK Cancel

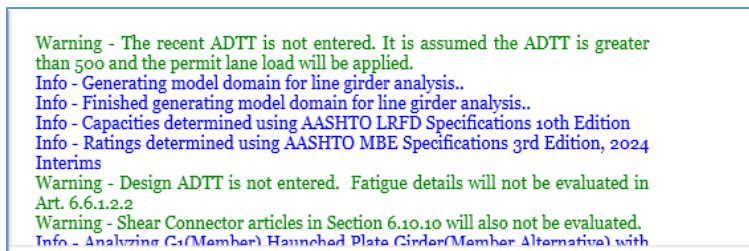
Click **OK** to apply the data and close the window.

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.



The analysis log window displays the following messages:

- Warning - The recent ADTT is not entered. It is assumed the ADTT is greater than 500 and the permit lane load will be applied.
- 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.
- Info - Analyzing G1(Member) Haunched Plate Girder(Member Alternative) with

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To define the ADTT, open the bridge description window by double clicking on the **Permit Rating Training** node in the bridge workspace tree. Open 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'. The 'Bridge completely defined' checkbox is unchecked. The 'Bridge Workspace View' section shows 'Superstructures' checked, while 'Culverts' and 'Substructures' are unchecked. The 'Traffic' tab contains several input fields: 'Truck PCT' (empty), 'ADT' (empty), 'Directional PCT' (empty), 'Recent ADTT' (50), 'Design ADTT' (empty), 'Exp. annual ADTT_{SL} growth rate' (empty), 'Fatigue importance factor' (Main Arterial, Interstate, Other), and 'Importance factor override' (unchecked). Below these are three more empty fields labeled '(ADTT_{SL})₀', '(ADTT_{SL})_{PRESENT}', and '(ADTT_{SL})_{LIMIT}'. At the bottom, there is a 'Bridge association...' button and three checkboxes: 'BrR' (checked), 'BrD' (checked), and 'BrM' (unchecked). The '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

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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 7.6.1.3001
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		
1	44.00	25.0	1112.99	-201.35	26.01	-10.12	0.00	0.00					0.0000	0.0000	0.0890	-0.2083		
1	49.50	28.1	1182.05	-226.52	24.56	-11.61	0.00	0.00					0.0000	0.0000	0.0983	-0.2264		
1	52.80	30.0	1217.24	-241.62	23.69	-12.50	0.00	0.00					0.0000	0.0000	0.1036	-0.2361		

AASHTO LRFR Engine Version 7.6.1.3001
Analysis preference setting: None

Close

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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 open the **Traffic** tab.

The screenshot shows the 'Permit Rating Training' dialog box with the 'Traffic' tab selected. The dialog has a title bar with a minus, maximize, and close button. Below the title bar, there are two input fields: 'Bridge ID: Permit Rating Training' and 'NBI structure ID (8): Permit Rating Training'. To the right of these fields are two checkboxes: 'Template' (unchecked) and 'Bridge completely defined' (unchecked). Further right is a 'Bridge Workspace View' section with three checkboxes: 'Superstructures' (checked), 'Culverts' (unchecked), and 'Substructures' (unchecked). Below these are five tabs: 'Description', 'Description (cont'd)', 'Alternatives', 'Global reference point', 'Traffic' (selected), and 'Custom agency fields'. The 'Traffic' tab contains several input fields and a dropdown menu. The 'Truck PCT:' field is followed by a '%' symbol. The 'ADT:' field is followed by a '%' symbol. The 'Directional PCT:' field is followed by a '%' symbol. The 'Recent ADTT:' field contains the value '750' and is followed by a 'Compute' button. The 'Design ADTT:' field is empty. The 'Exp. annual ADTT_{SL} growth rate:' field is empty. The 'Fatigue importance factor:' field is a dropdown menu with the value 'Main Arterial, Interstate, Other'. Below this is an 'Importance factor override' checkbox, which is unchecked. Below the dropdown are three input fields: '(ADTT_{SL})₀', '(ADTT_{SL})_{PRESENT}', and '(ADTT_{SL})_{LIMIT}'. At the bottom left, there is a 'Bridge association...' button and three checkboxes: 'BrR' (checked), 'BrD' (checked), and 'BrM' (unchecked). At the bottom right, there are three buttons: 'OK', 'Apply', and 'Cancel'.

Bridge ID: Permit Rating Training NBI structure ID (8): Permit Rating Training ☐ Template ☐ Bridge completely defined

Bridge Workspace View
☒ Superstructures
☐ Culverts
☐ Substructures

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

Truck PCT: %
ADT: %
Directional PCT: %
Recent ADTT: 750
Design ADTT:
Exp. annual ADTT_{SL} growth rate:
Fatigue importance factor: Main Arterial, Interstate, Other ▾
☐ Importance factor override
(ADTT_{SL})₀:
(ADTT_{SL})_{PRESENT}:
(ADTT_{SL})_{LIMIT}:

Bridge association... ☒ BrR ☒ BrD ☐ BrM

