AASHTOWare BrDR 7.5.0 Feature Tutorial ADJ1 – Analysis with Routine Traffic in Adjacent Lane

Topics Covered

- Methodology implemented for considering routine traffic in adjacent lane
- Allow distribution factors to be used to compute effects of permit loads with routine traffic
- Specify adjacent vehicle in the Analysis Settings window
- Example 1: LFR analysis and LRFR analysis using BID 10 (Example 7)
- Example 2: LFR analysis using BID 19 (TrussTrainingExample)
- Example 3: LRFD design review using BID 1 (TrainingBridge1)

Methodology implemented for considering routine traffic in adjacent lane.

The release version 7.5.0 provides users with the capability to perform the design review and rating analysis for permit vehicles with routine traffic in adjacent lanes. When an adjacent vehicle is included in the rating analysis, the live load distribution factor approach specified in LRFD Article 4.6.2.2.5 will be used to deduct the adjacent vehicle live load demand from the capacity. Capacity articles that are dependent on the load applied will use the combined force effect when determining the capacity.

LRFD Article 4.6.2.2.5:

$$\label{eq:G} G = \ G_P\left(\frac{g_1}{Z}\right) + \ G_D\left(g_m - \frac{g_1}{Z}\right)$$

- G = Final force effect applied to a girder
- G_P= Force effect due to overload truck
- $g_1 =$ Single lane live load distribution factor
- $G_D =$ Force effect due to design loads
- g_m = Multiple lane live load distribution factor
- Z = A factor taken as 1.20 where the lever rule was not utilized, and 1.0 where the lever rule was used for a single lane live load distribution factor

The single lane live load distribution factor, $\mathbf{g_1}$, will be applied to the permit vehicle. The multiple lane live load distribution factor, $\mathbf{g_m}$, minus the single lane live load distribution factor, $\mathbf{g_1}$, will be applied to the adjacent vehicle. For Standard Specifications rating, the Z factor will be ignored.

Allow distribution factors to be used to compute effects of permit loads with routine traffic.

In the **Live Load Distribution** window, the **Allow distribution factors to be used to compute effects of permit loads with routine traffic** checkbox specifies whether the live load distribution factor approach in LRFD Article 4.6.2.2.5 is allowed.

	The Standar	d tab of the	Live Load	Distribution	window	is shown below.
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_											
Allow distribution factors to be used to compute effects of permit loads with routine traffic											
	Lanes		(wheels	factor 5)							
	loaded	Shear	Shear at supports	Moment	Deflection						
Þ	1 Lane	1.793	1.615	1.793	0.500						
	Multi-lane	1.793	1.731	1.793	1.350						

🕰 Live	e Load Distri	bution							_		×
Sta	ndard LF	RFD									
	Distribution	factor inpu	t method -								
	Use simp	' lified metho	d Ol	Jse advanced m	ethod						
\checkmark	Allow distri	bution fact	ors to be us	ed to compute	effects of p	ermit loads w	ith routine traffic				
Ac	tion: Defle	ction 🗸	Sut	fficiently connec	cted to act a	is a unit					
	Support	Start	Length	End distance	Distribut	tion factor					
	number	distance (ft)	(ft)	(ft)	(la 1 Jane	nes) Multi-lane					
	1 -	0.00	161.000	161.00	0.300	0.638					
0	Compute fro	m \	/iew calcs					New Du	plicate	Delete	
t	ypical sectio	n									
								OK	Apply	Canc	el

The **LRFD** tab of the **Live Load Distribution** window is shown below.

The **Compute from typical section...** button in this window will compute the live load distribution factors by checking the following two restrictions listed in LRFD Article 4.6.2.2.5:

The lever rule has been specified for both single lane and multiple lane loadings. The Library - LRFD DF
 Applicability Range Form allows the user to define the applicability ranges using the AASHTO LRFD
 Specification equations for live load distribution factors when the factors are computed by BrDR. A Standard
 applicability range from the AASHTO LRFD Specification is delivered with BrDR and set as the default in
 the System Defaults: Superstructure Analysis window. The Library - LRFD DF Applicability Range
 Form window allows users to create an Agency applicability ranges and assign it as the default in the System
 Defaults: Superstructure Analysis window. The System Default applicability range will be used when
 BrDR computes the LRFD and LRFR distribution factors. To view this default range, click on the
 Configuration button from the VIEW ribbon of the Bridge Explorer as shown below.



The **LRFD DF applicability ranges** can be selected from the drop down menu shown below.

CONFIGURATION BRIDGE EXPLORER CONFIGURATION	AASHTOWare Bridge Design and Rating ?	-	×
Image: Second			
Access Rights Access Rights Access Rights Bridge Check-Out Bridge Description Custom Agency Field Gridge Description Custom Agency Field Access Rights Bridge Description Custom Agency Field Access Rights Bridge List Bridge Li	System Defaults × General Bridge workspace Superstructure analysis Specifications Substructure analysis Tolerance Custom agency fields LRFD DF applicability ranges 2020 AASHTO LRFD Ranges 2020 AASHTO LRFD Ranges 2011 (2016 interim) AASHTO LRFD Ranges 2020 AASHTO RANGE		

• The special requirement for exterior girders of beam-slab bridge cross-sections with diaphragms specified in Article 4.6.2.2.2d has been utilized for simplified analysis.

If the live load distribution factors are not entered, the AASHTO Engine will compute the live load distribution factors and determine whether the live load distribution factor approach for analyzing the adjacent vehicle is allowed.

Specify adjacent vehicle in the Analysis Settings window.

In the **Analysis Settings** window, an adjacent vehicle can be specified in the **Legal operating**, **Permit inventory** and **Permit operating** categories for an **LFR** analysis. Inventory load factors are applied to the **Permit inventory** vehicles. Operating load factors are applied to the **Legal operating** and **Permit operating** vehicles. **Legal operating** analysis considers the legal train of vehicles with the adjacent vehicle requirement (MBE 6B.7.2).

See the LFR analysis options below.



For LRFR analysis, adjacent vehicle can be specified in the **Permit load rating** category. See LRFR analysis options below:



For an LRFD design review, an adjacent vehicle can be specified in the **Permit Loads** category as shown below.



The live load factor to be applied to the adjacent vehicle is entered in the **Vehicle Properties** window. If the **Adjacent vehicle live load factor** is not entered, the adjacent vehicle will not be included in the analysis. For an LRFR analysis, the adjacent vehicle will not be considered for permits that have **Unlimited Crossing** frequency.

Vehicle Properties

The Vehicle Properties window is accessible from the Analysis Settings window as shown below.

Analysis Settings						—]	×
Design review O Rating		Rating method:	LFR		~			
Analysis type: Line Girder	~							
ane / Impact loading type: As Requested	~	Apply preference	e setting: None		\sim			
Vehicles Output Engine Descr	iption					_		
Traffic direction: Both directions	~		Refresh	Temporary vehicles	Advanced			
Vehicle selection			Vehicle summary					
	Vehicle Properties	Scale factor	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	les / i g erating iventory			×	
-SU4 -SU5 -SU6 -SU7 -Type 3-3 -Type 3-3 -Type 3S2 -Agency -User defined -Temporary	Adjacent vehicle live load	factor:				~		
					ОК	Cancel		
Reset Clear Open to	emplate Save templat	e		C	ОК Арг	oly C	ancel	

А	Vehicle Prope	rties				×
	Vehicle	Tandem train	Scale factor	Impact	Single Iane Ioaded	
•	Type 3		1.000			A
						Ψ.
Å	djacent vehic	le live load	factor:	1.200		OK Cancel

The LFR Analysis version of the Vehicle Properties window is shown below.

The LRFR Analysis version of the Vehicle Properties window is shown below.

Vehicle	Tandem train	Scale factor	Impact	Single Iane Ioaded	Legal pair	Override	Legal live load factor	Frequency	Loading condition	Override	Permit live load factor	
Type 3		1.000						Single Trip *	Mixed with traffic $\ ^{\star}$			
								-				
nit lane load	:	kip	/ft Adja	cent vehic	le live lo	ad factor:	1.200]				

Example 1: LFR analysis and LRFR analysis using BID 10 (Example 7)

From the **Bridge Explorer**, open the bridge **BID 10 (Example7)**. Expand the **Bridge Workspace** and select member **G2**'s member alternative **Interior Member**. The **Bridge Workspace** for **BID10 (Example 7)** is shown below.



LFR analysis

Open the Analysis Settings window by clicking the Analysis Settings button on the Analysis group of the DESIGN/RATE ribbon.

Br Bridge	Workspace - Example7	ANALYSIS	REPORTS	?	-	×
BRIDGE WORKSPACE	WORKSPACE TOOLS VIEW	DESIGN/RATE	REPORTING			^
at 15	🔲 📄 🎯 🔆	2 📙				
Analysis Analyze Analysis Settings Events	Tabular Specification Engine Resu Results Check Detail Outputs Gra	ults Save ph Results				
Analysis	Results					

Select the **Rating Method** as **LFR** to perform an LFR rating, add the **Type 3** vehicle to the **Permit operating** category and the **HS 20-44** vehicle as the **Adjacent Vehicle**. Click the **Advanced** button to open the **Vehicle Properties** window as shown below.

Oesign review	Rating	Ratio	ng method:	LFR		\sim
alysis type: ne / Impact loading type:	Line Girder As Requested	~ Арр	ly preference setting:	None		~
Vehicles Output E Traffic direction: Both di	ngine Description		Refresh Ten	nporary vehicles	Advance	d
-Vehicles -StandardAlternate MilEV2EV3H 15-44HS 15-44HS 15-44HS 20 (SI)HS 20 (SI)	itary Loading	Add to >> Remove from <<	Rating vehicles Inventory I-Inventory I-HS 20-44 Operating Inventor Operating Inventor Operating Inventor Operating Inventor Operating Inventor Operating Inventor Inventor Inventor Operating Inventor Invento	ig bry ing		

۵	Vehicle Prope	erties					×
	Vehicle	Tandem train	Scale factor	Impact	Single Iane Ioaded		
1	Type 3		1.000				-
							*
1	Adjacent vehic	le live load	factor:	1.200			
						OK Cancel	

Enter 1.2 as the Adjacent vehicle live load factor.

Click **OK** to save the settings and close the window.

Next click the Analyze button on the Analysis group of the DESIGN/RATE ribbon to perform the rating.

Bridge Bridge	Workspace - Example7	ANALYSIS	REPORTS	?	-	×
BRIDGE WORKSPACE	WORKSPACE TOOLS VIEW	DESIGN/RATE	REPORTING			^
Analysis Settings	Tabular Specification Engine Results Check Detail Outputs Gra	ults Save ph Results				
Analysis	Results					

Specification Check Detail

When the rating is completed, click on the **Specification Check Detail** button on the **Results** group of the **DESIGN/RATE** ribbon to open the **Specification Checks** window.

Bridge Workspace - Example7	ANALYSIS	REPORTS	?	-	×
BRIDGE WORKSPACE WORKSPACE TOOLS VIEW	DESIGN/RATE	REPORTING			~
Analysis Analyze Analysis Events Analysis Analysis Analysis Analysis Events Analysis	esults raph Results				

Expand the tree and select the **Stage 3**'s **Span 1 - 60.00 ft** folder. Open the **Spec Check Detail** window for the **6B.5.3.3 PS Flexure Rating** specification reference to review the ratings.

specification Checks for Interior M	lember - 21 of 481							- (⊐ ×
Ar	ticles								
A 100 A	Il articles								
Properties Generate Fo	irmat								
B	ullet list								
Specification filter	Report								
Superstructure Component	Specification reference				Limit State	Flex. Sens	se Pass/	Fail	
Prestress Calculations	68.5.3.3 PS Concret 68.5.2.2 DS Concret	te Compressive Stre	ISS			N/A	Pass	ed	
Stage 1	68.5.3.3 PS Concret 68.5.3.3 PS Elevurs	Rating				N/A	Pass	ed ed	
▲ iiii Stage 3	6B.5.3.3 PS Mome	nt Capacity				N/A	Gene	eral Comp).
🔺 🚞 Interior Member	✓ 6B.5.3.3 PS Shear F	Rating				N/A	Pass	ed '	
🚞 Span 1 - 0.00 ft.	✓ 68.5.3.3 PS Steel Te	ensile Stress				N/A	Pass	ed	
i Span 1 - 0.82 ft.	🗎 8.16.2.7 Design As	sumptions				N/A	Gene	eral Comp	.
Span I - 1.58 ft.	9.15.2.3 Concrete	 Cracking Stress 				N/A	Gene	eral Comp	.
Span 1 - 12.00 ft.	 9.17 Flexural Stren 	gth				N/A	Pass	ed	
🚞 Span 1 - 24.00 ft.	9.18.2.1 Ductility L	imits - Minimum Ste	el			N/A	Gene	eral Comp).
🚞 Span 1 - 36.00 ft.	9.20.1.3 Nominal 3	near Capacity	oncrete			N/A	Gene	eral Comp eral Comr).
🚞 Span 1 - 48.00 ft.	9.20.2.7 Shear Stre	ngth Provided by C	oncrete			N/A	Gene	eral Comp	,).
Span 1 - 60.00 ft.	9.20.2.3 Shear Stre	ngth Provided by Co	oncrete			N/A	Gene	eral Comp).
Span 1 - 72.00 ft.	9.20.2.5 Shear Stre	ngth Provided by Co	oncrete			N/A	Gene	eral Comp).
Span 1 - 96.00 ft.	🔋 9.20.3.1 Shear Stre	ngth Provided by W	eb Reinforcem	ient		N/A	Gene	eral Comp	.
i Span 1 - 108.00 ft.	9.28 Embedment d	of Prestressed Strand	ł			N/A	Gene	eral Comp	
🚞 Span 1 - 120.00 ft.	Computation of V	p				N/A	Gene	eral Comp	
	PS Basic Properties	s Calculation				N/A	Gene	eral Comp),
	PS Gross Composi	te Section Propertie	s			N/A	Gene	eral Comp) .
	Stresses					N/A	Gene	eral Comp	
Spec Check Detail for 6B.5.3.3 PS	Flexure Rating							- [⊐ ×
Dart B _ ALLOWABLE STRESS	PATTNG AND LOAD F	ACTOR RATING							
6B.5 NOMINAL CAPACITY: C	KATING AND DOAD II	ACTOR INTINO							
6B.5.3 Load Factor Method 6B.5.3.3 Prestressed Conc	rete Flexure Ratin	a							
(AASHTO Manual for Bridge	Evaluation, Third	Edition with	2022 Inter	ims)					
PS I Wide - At Location =	60.0000 (ft) - Le:	ft Stage 3							
Flexure Rating Factor Calo	culations								
Input.									
Input.									
MDL1 = 1.0000 MDL1 = 3097.52 (kip-ft)									
MDL2 = 540.00 (kip-ft)	No								
Adjacent Vehicle II Factor	r: 1.200								
Aujacene veniere hi racco.									
Rajacent ventere hi racto.									
Note: If the capacity has	been overridden,	the Resistance	is comput	ed as overri	ide phi*ov	erride capac	ity.		
Note: If the capacity has Otherwise the Resist	been overridden, tance is computed	the Resistance as per the Spe	is comput cification	ed as overri	ide phi*ov	erride capac	ity.		
Note: If the capacity has Otherwise the Resist	been overridden, t tance is computed a	the Resistance as per the Spe	is comput cification	ed as overri	ide phi*ov	erride capac	ity.		
Note: If the capacity has Otherwise the Resist	been overridden, stance is computed a	the Resistance as per the Spe	is comput cification	ed as overri	ide phi*ov Over	erride capac ride	ity.		
Rajucent vehicle in factor, Note: If the capacity has Otherwise the Resist Rating Level Vehicle	been overridden, i tance is computed i ldj. LL LL	the Resistance as per the Spe Al	is comput cification A2	ed as overri	lde phi*ov Over Phi	erride capac ride Mn	ity. RF C	Capacit	¥
Rajucent vehicle in factors Note: If the capacity has Otherwise the Resist Rating Level Vehicle (1	been overridden, tance is computed Ådj. LL LL kip-ft) (kip-ft)	the Resistance as per the Spe Al	is comput cification A2	ed as overri Mn (kip-ft)	ide phi*ov Over Phi	erride capac ride Mn (kip-ft)	ity. RF (apacit (Ton)	9
Rating Level Vehicle PermitOpr 1 PermitOpr 1	been overridden, tance is computed LL LL kip-ft) (kip-ft) 1041.88 396.88 0.00 0.00	the Resistance as per the Spe A1 1.30	is comput cification A2	Mn (kip-ft) 10411.93	lde phi*ov Over Phi 	erride capac nide Mn (kip-ft) 	RF C	(Ton) 96.	y
Rating Level Vehicle PermitOpr 1 PermitOpr 1	Adj. LL LL kip-ft) (kip-ft) 1041.88 396.88 0.00 0.00	the Resistance as per the Spe A1 1.30 1.30	is comput cification A2 1.30 1.30	Mn (kip-ft) 10411.93 10411.93	.de phi*ov Over Phi 	erride capac ride Mn (kip-ft) 	RF 0 3.844 99.000	apacit; (Ton) 96. 2475.	y 11 00
Rating Level Vehicle PermitOpr 1 PermitOpr 1	been overridden, tance is computed LL LL kip-ft) (kip-ft) 1041.88 396.88 0.00 0.00	the Resistance as per the Spe Al 1.30 1.30	is comput cification A2 1.30 1.30	Mn (kip-ft) 10411.93 10411.93	.de phi*ov Over Phi 	erride capac ride Mn (kip-ft) 	RF 0	Capacit: (Ton) 96. 2475.	y 11 00
Rating Level Vehicle PermitOpr 1 PermitOpr 1 Load Combination Legend:	been overridden, tance is computed LL LL klp-ft) (klp-ft) 1041.88 396.88 0.00 0.00	the Resistance as per the Spe A1 1.30 1.30	is comput cification A2 1.30 1.30	Mn (kip-ft) 10411.93	.de phi*ov Over Phi 	erride capac ride Mn (kip-ft) 	RF 0	Capacit; (Ton) 96. 2475.	y 11 20
Rating Rating Level Vehicle PermitOpr 1 PermitOpr 1 Load Combination Legend: Code Vehicle	been overridden, tance is computed LL LL kip-ft) (kip-ft) 1041.88 396.88 0.00 0.00	the Resistance as per the Spe Al 1.30 1.30	is comput cification A2 1.30 1.30	Mn (kip-ft) 10411.93	Over Phi 	erride capac ride Mn (kip-ft) 	RF C 3.844 99.000	apacit: (Ton) 96. 2475.	y 11 00
Rating Rating Level Vehicle PermitOpr 1 PermitOpr 1 Load Combination Legend: Code Vehicle 1 Type 3 - Permit	been overridden, tance is computed LL LL kip-ft) (kip-ft) 1041.88 396.88 0.00 0.00	A1	is comput cification A2 1.30 1.30	ed as overri	.de phi*ov Over Phi 	erride capac ride Mn (kip-ft) 	RF C 3.844 99.000	apacit; (Ton) 96. 2475.	y 11 00
Rating Rating Level Vehicle PermitOpr 1 PermitOpr 1 Load Combination Legend: Code Vehicle 1 Type 3 - Permit	been overridden, tance is computed LL LL kip-ft) (kip-ft) 1041.88 396.88 0.00 0.00 Truck	A1	is comput cification A2 1.30 1.30	Mn (kip-ft) 10411.93	.de phi*ov Over Phi 	erride capac ride Mn (kip-ft) 	RF C 3.844 99.000	apacit; (Ton) 96. 2475.	y 11 20

Close the **Spec Check Detail** window.

LRFR analysis:

Expand the member alternative - Interior Member in the Bridge Workspace tree. Open the Live Load Distribution window and select the LRFD tab. Select the Allow distribution factors to be used to compute effects of permit loads with routine traffic checkbox. Click OK to close the Live Load Distribution window.

Use simplified method	with routine traffic
Allow distribution factors to be used to compute effects of permit loads with routine traffic Lettor: Ueflection Sufficiently connected to act as a unit Support Start distance End distance (ft) End distance 1 lane Multi-lane 1 0.00 120.000 0.200 0.433	with routine traffic
Allow distribution factors to be used to compute effects of permit backs with routine traffic Action: Deflection Sufficiently connected to act as a unit Support Start Length End distance Distribution factor (Innes) 1 Iane Multi-lane > 1 > 0.00 120.000 0.200 0.433	
Support Start distance (ft) Length (ft) End distance (ft) Distribution factor (lanes) 1 × 0.00 120.000 0.200 0.433	
Support number Start distance (ft) Length (ft) End distance (ft) Distribution factor (lanes) 1 0.00 120.000 120.00 0.200 0.433	
number (ft) (ft) 1 lane Multi-lane 1 * 0.00 120.000 0.200 0.433	
▶ <u>1 ~ 0.00 120.000 120.00 0.200 0.433</u>	
View calcs New Duplicate Delete	
typical section	New Duplicate Delete
Compute from Duplicate Delate	
typical section	New Duplicate Delete

Select member G2's member alternative Interior Member in the Bridge Workspace tree.

Open the **Analysis Settings** window by clicking the **Analysis Settings** button on the **Analysis** group of the **DESIGN/RATE** ribbon.



Select the **Rating Method** as **LRFR** to perform an LRFR rating, add the **Type 3** vehicle to the **Permit Load Rating** category and the **HL-93** (US) vehicle as the **Adjacent Vehicle**. Click the **Advanced** button to open the **Vehicle Properties** window and enter **1.2** as the **Adjacent vehicle live load factor**. (see below)

Design review	-					D-at-	un atlan al-	IDED				
alysis type:	O Rati	ng				Kating	method:			~		
	Line	Girder			\sim							
ne / Impact loading t	ype: As Re	equested				Apply	preference settin	g: None		~		
Vehicles Output	Engine	Desc	ription									
Traffic direction: Bo	th direction	ns		\sim			Refresh	Temporary vehicles		Advanced		
Vehicle selection							Vehicle summ	ary	<u> </u>			
 Standard EV2 EV3 H 15-44 H 10-34 (I H-1-93 (I 	I) S) 4 I) 4 Io E Legal Lo igue Truck igue Truck	ad (SI) (US)				Add to >> Remove from <<		esign load rating Inventory Operating Fatigue gal load rating Routine <u>Specialized hauling</u> rmit load rating Impe 3 Adjacent vehicle Impl - HL-93 (US)				
Reset Cle	ar	Open t	emplate		Save temp	plate		ОК	A	pply	Canc	el
			C 1									
	n Scale factor	Impact	lane loaded	Legal pair	Override	live load factor	Frequency	Loading condition		Override	live loa factor	d
Vehicle Tanden train								Mixed with traffic				

Click **OK** to save the settings and close the window.



Next click the Analyze button on the Analysis group of the DESIGN/RATE ribbon to perform the rating.

Specification Check Detail

When the rating is completed, click on the **Specification Check Detail** button on the **Results** group of the **DESIGN/RATE** ribbon to open the **Specification Checks** window.

Bridge Workspace - Example7	ANALYSIS	REPORTS	?	-	×
BRIDGE WORKSPACE WORKSPACE TOOLS VIEW	DESIGN/RATE	REPORTING			^
Analysis Analyze Analysis Settings Analysis Analysis Analysis Events Analysis Analysis Events	k Results				

Expand the tree and select the **Stage 3**'s **Span 1 - 60.00 ft** folder. Open the **Spec Check Detail** window for the **6A.4.2.1 General Load Rating Equation – Concrete Flexure** specification reference to review the ratings.

A Specification Checks for Interior M	ember - 26 of 0			- 0	×
Properties Generate B	ll articles ♥ mrat ullet list ♥				
pecification filter	leport				
Superstructure Component	Specification reference	Limit State	Flex. Sense	Pass/Fail	
Prestress Calculations	NA 5.5.3.2 Reinforcing Bars and Welded Wire Reinforcement		N/A	Not Required	
Stage 1	5.5.4.2 PS Strength Limit State - Resistance Factors		N/A	General Comp.	
Stage 2	5.6.2.2 Rectangular Stress Distribution		N/A	General Comp.	
▲ 🔛 Stage 3	5.6.3.2 PS Flexural Resistance (Prestressed Concrete)		N/A	Passed	
A Interior Member	 5.6.3.3 Minimum Reinforcement 		N/A	Passed	- 1
Span 1 - 0.00 ft.	 5.7.2.5 Minimum Transverse Reinforcement 		N/A	Passed	- 1
Span 1 - 0.82 ft.	 5.7.2.6 Maximum Spacing of Transverse Reinforcement 		N/A	Passed	- 1
Span I - 1.58 ft.	✓ 5.7.3.3 Nominal Shear Resistance		N/A	Passed	- 1
Span I - 3.33 π.	5.7.3.4 Procedures for Determining Shear Resistance		N/A	General Comp.	- 1
Span 1 - 12.00 ft.	 5.7.3.5 Longitudinal Reinforcement 		N/A	Passed	- 1
Span 1 - 24.00 π.	✓ 5.7.4 Interface Shear Transfer		N/A	Passed	- 1
Span 1 - 30.00 ft.	✓ 5.7.4.2 Minimum Area of Interface Shear Reinforcement		N/A	Passed	- 1
Span 1 - 46.00 ft.	✓ 5.9.2.3.2a Compressive Stresses		N/A	Passed	- 1
Span 1 - 72.00 ft	✓ 5.9.2.3.2b Tensile Stresses		N/A	Passed	- 1
Span 1 - 94.00 ft	5.9.4.3.2 Bonded Strand		N/A	General Comp.	- 1
Span 1 - 96.00 ft	✓ 6A.4.2.1 Design Load Rating Prestress Service III Tensile Stress		N/A	Passed	- 1
Span 1 - 108.00 ft	✓ 6A.4.2.1 General Load Rating Equation - Concrete Flexure		N/A	Passed	
Span 1 - 120.00 ft	✓ 6A.4.2.1 General Load Rating Equation - Concrete Shear		N/A	Passed	
_ span i i izoloo ia	Computation of Vp		N/A	General Comp.	- 1
	Cracked_Moment_of_Inertia Section Property Calculations		N/A	General Comp.	. 1
	PS Basic Properties Calculation		N/A	General Comp.	. 1
	PS_Gross_Composite_Section_Properties PS Gross Composite Section	i i	N/A	General Comp.	

📲 Spec Check De	tail for 6A.4	.2.1 General Loa	d Rating Equatio	n - Concrete Fle	xure										-		×
6A Load and H 6A.4 Load Rat 6A.4.2 Genera 6A.4.2.1 Cond (AASHTO Manual PS I Wide - 1	Resistand ting Proc al Load-F crete Fle al for Br At Locati	te Factor Ra tedures Rating Equat exure Genera ridge Evalua ion = 60.000	ting ion l tion, Third 1 0 (ft) - Lef	Edition with t Stage	2022 Inte	erims)											^
Input:																	
Condition Fac System Factor DC Moment (Mr DC Moment (Mr DW Moment (Mr DW -WS Moment DW-WS Moment Ignore Posit:	ctor r ax) in) ax) in) (Max) (Min) ive Momer	= 1.000 = 1.000 = 3277.500 = 3277.500 = 360.000 = 0.000 = 0.000 at = No	0 0 (kip-ft) 0 (kip-ft) 0 (kip-ft) 0 (kip-ft) 0 (kip-ft) 0 (kip-ft)														
Adjacent Veh:	icle LL H	Factor: 1.2	00														
Note: If the Otherw:	capacity ise the F	/ has been o lesistance i	verridden, t s computed a	he Resistanc s per the Sp	e is compu ecificatio	ited as o on.	verride p	hi*overrid	e capacit	у.	(119)	ride					
Note: If the Otherw: Load	capacity ise the F Load Combo	/ has been o Resistance i Limit State	LL (kip-ft)	he Resistanc s per the Sp Adj. LL (kip-ft)	e is compu ecificatio Load DC	uted as con. i Factors DW	verride p DW-WS	hi*overrid LL	e capacit Phi	y. Mn (kip-ft)	Over Phi	ride Mn (kip-ft)	К	RF	Capacit (Ton)	У	
Note: If the Otherw. Load PermitSpec PermitSpec	capacity ise the F Load Combo	y has been o Resistance i State STR-II STR-II	LL (kip-ft) 744.16 0.00	Adj. LL (kip-ft) 1154.68 0.00	e is compu ecificatio Load DC 1.25 1.25	ited as o on. d Factors DW 1.50 1.50	DW-WS	LL 1.20 1.20	e capacit Phi 1.00 1.00	Mn (kip-ft) 10597.85 10597.85	Over Phi 	Mn (kip-ft)	K 1.00 1.00	RF 5.124 99.000	Capacit (Ton) 128. 2475.	y 09 00	
Note: If the Otherw Load PermitSpec PermitSpec Legend: NA - Resistar * - Positive	Load Combo	/ has been o' Resistance i. State STR-II STR-II Live load ar rating igno	LL (kip-ft) 744.16 0.00 e of oppositored.	he Resistanc s per the Sp LL (kip-ft) 1154.68 0.00 e sign so ra	te is compu ecification Load DC 1.25 1.25 ting facto	ited as o on. if Factors DW 1.50 1.50 or is not	DW-WS 1.50 1.50	LL LL 1.20 1.20 le.	Phi 1.00 1.00	Mn (kip-ft) 10597.85 10597.85	Ove: Phi 	ride Mn (kip-ft) 	K 1.00 1.00	RF 5.124 99.000	Capacit (Ton) 128. 2475.	9 00	
Note: If the Otherw Load PermitSpec PermitSpec Legend: NA - Resistar * - Positive Load Combinat	Load Combo	/ has been or Resistance i. State STR-II STR-II Live load ar rating igno:	LL (kip-ft) 744.16 0.00 e of oppositi red.	he Resistance s per the Sp LL (kip-ft) 1154.68 0.00 e sign so ra	e is compression Load DC 1.25 1.25 ting facto	ited as o on. I Factors DW 1.50 1.50 or is not	DW-WS	LL 1.20 1.20 1.20	Phi 1.00 1.00	Mn (kip-ft) 10597.85	Ove: Phi 	ride Mn (kip-ft) 	K 1.00 1.00	RF 5.124 99.000	Capacit (Ton) 128 2475.	У 09 00	
Note: If the Otherw Load PermitSpec PermitSpec Isgend: NA - Resistar * - Positivy Load Combinat	Load Combo	y has been or Resistance i Limit State STR-II STR-II STR-II live load ar rating igno	LL (kip-ft) 744.16 0.00 e of oppositi	Adj. LL (kip-ft) 1154.68 0.00	e is compu- ecificatio Load DC 1.25 1.25 ting facto	ited as o nn. I Factors DW 1.50 1.50 or is not	DW-WS	LL 1.20 1.20 1.20	Ph1 1.00 1.00	Mn (kip-ft) 10597.85	Over Phi	ride Mn (kip-ft) 	K 1.00 1.00	RF 5.124 99.000	Capacit (Ton) 128. 2475.	00 09 2	
Note: If the Otherw Load PermitSpec PermitSpec Legend: NR - Resistar * - Positivu Load Combinat Code Ve 1 Typ	Load Combo Combo 1 1 e moment tion Lege ehicle	/ has been of legistance 1 Limit State STR-II STR-II Live load ar rating igno end:	LL (kip-ft) 744.16 0.00 e of oppositu	Adj. LL (kip-ft) 1154.68 0.00 e sign so ra	e is compu- ecificatio Load DC 1.25 1.25 ting facto	ited as contractions of the second se	DW-WS 1.50 applicab	LL 1.20 1.20	e capacit Phi 1.00 1.00	Mn (kip-ft) 10597.85 10597.85	Over Phi	ride Mn (kip-ft) 	K 1.00 1.00	RF 5.124 99.000	Capacit (Ton) 128. 2475.	у 99 90 90 90 90 90	v
Note: If the Otherw Load PermitSpec PermitSpec PermitSpec Legend: NR - Resistar * - Positive Load Combinat Code Ve 1 Typ <	Load Combo Combo 1 1 nce and l e moment tion Lege ehicle pe 3 - Pe	y has been or lesistance i State STR-II STR-II STR-II Live load ar rating igno end:	LL (kip-fc) 744.16 0.00 e of opposit	he Resistance s per the Sp LL (kip-fr) 1154.68 0.00 e sign so ra	e is compu ecificatio DC 1.25 1.25 ting facto	if Factors DW 1.50 1.50 or is not	DW-WS	LL 1.20 1.20 1.20	Phi 1.00 1.00	y. (kip-ft) 10597,85 10597,85	Over Phi 	ride Mn (Kip-ft) 	K 1.00 1.00	RF 5.124 99.000	Capacit (Ton) 128. 2475.	У 09 00	>

Close the **Spec Check Detail** window.

Example 2: LFR analysis using BID 19 (TrussTrainingExample)

From the **Bridge Explorer**, open the **Bridge Workspace** for **BID 19** (**TrussTrainingExample**). Expand the **Bridge Workspace** and select **Truss 1** as shown below.

Workspace	×
Bridge Components	
🖮 🕰 TrussTrainingE	xample
Dianhran	Definitions
🖉 Diaphragh	sing Definitions
	ast/Dynamic Load Allowance
	d Case Description
	ming Plan Detail
	icture Typical Section
	erstructure Loads
💋 Gu	set Plate Definitions
💋 She	ar Connector Definitions
🗈 💋 Stif	fener Definitions
FML Flo	orbeam Member Locations
🖶 🧭 ME	MBER DEFINITIONS
🖨 🔁 TRU	JSSES
	Truss 1
I I I I I	Truss 2
📄 🗄 💋 FLC	ORBEAM MEMBERS
🖶 🗁 BRIDGE AL	TERNATIVES
🗄 🛛 🕰 Bridge	Alternative (E) (C)

Open the **Analysis Settings** window by clicking the **Analysis Settings** button on the **Analysis** group of the **DESIGN/RATE** ribbon.



Select the **Rating Method** as **LFR** to perform an LFR rating, add the **Type 3** vehicle to the **Permit operating** category and the **HS 20-44** vehicle as the **Adjacent Vehicle**. Click the **Advanced** button to open the **Vehicle Properties** window as shown below.

Design review 🔾 Rating	Rating method:	LFR	~		
alysis type: Line Girder	~				
he / Impact loading type: As Requested	 Apply preference set 	etting: None	~		
Traffic disastian	Defea	h Tana ana ushida		7	
Vehicle selection	Vehicle su	immary	Advanced		
 Vehicles Standard Alternate Military Loading EV2 EV3 H 15-44 H 20-44 HS 20 (SI) HS 20-44 NRL SU4 SU5 SU6 SU7 Type 3 Type 3.3 Type 3S2 Agency User defined Temporary 	Add to	ig vehicles ventory operating egal operating ermit inventory ermit operating Type 3 Adjacent vehicle HS 20-44			

Vehicle Properties

Enter 1.2 as the Adjacent vehicle live load factor.

6	\$ V	ehicle Prop	erties				×
		Vehicle	Tandem train	Scale factor	Impact	Single lane loaded	
	>	Type 3		1			A
	Ad	jacent vehic	le live load	factor:	1.2		
							OK Cancel

Click **OK** to save the analysis settings and close the window.

Next click the Analyze button on the Analysis group of the DESIGN/RATE ribbon to perform the rating.

Bridge Works	pace - TrussTrainingExample	ANALYSIS	REPORTS	?	-	×
BRIDGE WORKSPACE	WORKSPACE TOOLS VIE	W DESIGN/RATE	REPORTING			^
Analysis Settings Analysis Analysis	Tabular Specification Engine Results Check Detail Outputs Results	Results Save Graph Results				

Engine Outputs

When the rating is completed, click on the **Engine Outputs** button on the **Results** group of the **DESIGN/RATE** ribbon to open the **Engine Outputs** window as shown below.

Bridge Works	pace - TrussTrainingExa	mple	ANALYSIS	REPORTS	?	-	×
BRIDGE WORKSPACE	WORKSPACE TOOL	S VIEW	DESIGN/RATE	REPORTING			~
Analysis Analyze Analysis Settings Analyze Analysis Analysis	Tabular Specification Results Check Detail	Engine Outputs esults	ults Save				

🗛 TrussTraining	Example	_	\times
ÈTrussTrainin ÈPony Tru ÈTrus: È4	gExample uss Example s 1 AASHTO_Truss_LFR Live Load Analysis Summary Live Load Analysis Impact Dead Load Analysis Report Dead Load FE Model Report Live Load FE Model Report 		

Open the Rating Results Report to review the ratings. (See below)



Example 3: LRFD design review using BID 1 (TrainingBridge1)

From the Bridge Explorer, open the Bridge Workspace for BID 1 (TrainingBridge1). Expand the Bridge Workspace and select member G2's member alternative Plate Girder.

Open the Analysis Settings window by clicking the Analysis Settings button on the Analysis group of the DESIGN/RATE ribbon.



Select the **Design review** button. **LRFD** is selected as the **Design method**. Add the **HS 20-44 3** vehicle to the **Permit Loads** category and the **HL-93 (US)** vehicle as the **Adjacent Vehicle**. Click the **Advanced** button to open the **Vehicle Properties** window.

alysis type: Line Girder ne / Impact loading type: As Requested Apply preference setting: None Vehicles Output Engine Description Traffic direction: Both directions Refresh Temporary vehicles Vehicle selection Vehicle summary Image: Parader of the selection Vehicle selection Image: Parader of the selection Add to Image: Parader of the selection Image: Parader of the selection Image: Parader of the selection Image: Parader of the selection Image: Parader of the selection Image: Parader of the selection Image: Parader of the selection Image: Parader of the selection Image:	O Design review Rating	Design method: LRFD ~
Traffic direction: Both directions	nalysis type: Line Girder ine / Impact loading type: As Requested Vehicles Output Engine Description	Apply preference setting: None
 ➡ Vehicles ➡ Standard ➡ Atternate Military Loading ➡ EV3 ➡ H-93 (IS) ➡ H-93 (IS) ➡ HS 20.5(I) ➡ HS 20.44 ➡ NS 20.44 ➡ Adjacent vehicle ➡ H-1+93 (IS) ➡ Acting Truck (SI) ➡ Arbon and the second seco	Traffic direction: Both directions Vehicle selection	Refresh Temporary vehicles Advanced
	 └Vehicles └Alternate Military Loading └EV2 └EV3 └HL-93 (SI) └HS 20 (SI) └HS 20-44 └LRFD Fatigue Truck (SI) └LRFD Fatigue Truck (US) └Agency └User defined Temporary 	Add to

Vehicle Properties

Enter **1.2** as the **Adjacent vehicle live load factor**.

	Vehicle	Tandem train	Scale factor	Impact	Single lane loaded			
,	HS 20-44		1					
d	jacent vehicle liv	e load factor	: 1.2					

Click **OK** to save the analysis settings and close the window.

Next click the Analyze button on the Analysis group of the DESIGN/RATE ribbon to perform the design review.



Specification Check Detail

When the design review is finished, click on the **Specification Check Detail** button on the **Results** group of the **DESIGN/RATE** ribbon to open the **Specification Checks** window.



Expand the tree and select the **Stage 3**'s **Span 1 – 80.50 ft** folder. Open the **Spec Check Detail** window for the **6.10.9 Shear Resistance** specification reference to review the article.

A Specification C	Checks for Plate (Girder -	43 of 1069			- 0	×
	1	Article	;				
		All ar	ticles 🗸				
Properties	Generate	Format					
Properties Generate			list 🗸				
Specification filter		Repo	rt				
🔺 🚞 Superstruc	ture Component	t	Specification reference	Limit State	Flex. Sense	Pass/Fail	^
🕨 🚞 Stage 1			✓ 6.10.2 Cross-Section Proportion Limits		N/A	Passed	
🕨 🚞 Stage 2			NA 6.10.4.2.2 Flexure		N/A	Not Applicable	
🔺 🚞 Stage 3			NA 6.10.5.3 Special Fatigue Requirement for Webs	N/A	Not Applicable		
🔺 🚞 Plat	te Girder		6.10.6.2.2 Composite Sections in Positive Flexure		N/A	General Comp	
	Span 1 - 0.00 ft.		6.10.6.2.3 Composite Sections in Negative Flexure and Noncomposite		N/A	General Comp	
i i i i i i i i i i i i i i i i i i i	Span 1 - 9.10 ft.		NA 6.10.7.1.1 General		N/A	Not Applicable	
	Span 1 - 16.10 ft	t.	NA 6.10.7.1.2 Nominal Flexural Resistance		N/A	Not Applicable	
	Span 1 - 18.21 ft	t.	× 6.10.7.2.1 General		N/A	Failed	
	Span 1 - 31.62 ft	t.	6.10.7.2.2 Nominal Flexural Resistance		N/A	General Comp	
	Span 1 - 32.20 ft	t.	✓ 6.10.7.3 Flexural Resistance - Ductility Requirement		N/A	Passed	
	Span 1 - 45.04 ft	t.	NA 6.10.8.1.1 Discretely Braced Flanges in Compression		N/A	Not Applicable	
	Span I - 48.30 π	ι.	NA 6.10.8.1.2 Discretely Braced Flanges in Tension		N/A	Not Applicable	
	Span 1 - 36,40 m		NA 6.10.8.1.3 Continuously Braced Flanges in Tension or Compression		N/A	Not Applicable	
	Span 1 - 71.87 ft		🖺 6.10.8.2.1 General		N/A	General Comp	
	Span 1 - 80 50 ft	+	6.10.8.2.2 Local Buckling Resistance		N/A	General Comp	
	Span 1 - 85.29 ft	t.	6.10.8.2.3 Lateral Torsional Buckling Resistance		N/A	General Comp	
l 🖷	Span 1 - 96.60 ft	t.	6.10.8.2.3.Cb Lateral Torsional Buckling Resistance - Cb Calculation		N/A	General Comp	
	Span 1 - 98.71 ft	t.	6.10.8.2.3.rt Lateral Torsional Buckling Resistance - rt and Lp Calculation	2	N/A	General Comp	
l 🖷	Span 1 - 112.12	ft.	6.10.8.3 Flexural Resistance Based on Tension Flange Yielding		N/A	General Comp	
i 🗀	Span 1 - 112.70	ft.	✓ 6.10.9 LRFD Shear Resistance		N/A	Passed	
i i i i i i i i i i i i i i i i i i i	Span 1 - 125.54	ft.	🖺 6.10.9.1 Shear Resistance - General		N/A	General Comp	
📋 👘 🛍	Span 1 - 128.80	ft.	× 6.10_General_Flexural_Results		N/A	Failed	
i i i i i i i i i i i i i i i i i i i	Span 1 - 138.96	ft.	NA 6.13.3.2.4 Fillet Welded Connections		N/A	Not Applicable	
	Span 1 - 144.90	ft.	APPD6.1 Plastic Moment		N/A	General Comp	
🗀	Span 1 - 152.37	ft.	APPD6.2 Yield Moment		N/A	General Comp	
🛄	Span 1 - 156.69	ft.	APPD6.3.1 In the Elastic Range (Dc)		N/A	General Comp	
🗀	Span 1 - 161.00	ft.	APPD6.3.2 Depth of the Web in Compression at Plastic Moment		N/A	General Comp	
			Steel Elastic Section Properties		N/A	General Comp	
			Unbraced Length Calculations		N/A	General Comp	
							~



Close the **Spec Check Detail** window. Perform another **LRFD Design Review** without the adjacent vehicle and review the **6.10.9 Shear Resistance** specification reference for comparison.