AASHTOWare BrDR 7.5.0 Prestressed Concrete Structure Tutorial PS15 – Two Span PS adjacent Box With Straight Strands

BrDR Training

PS15 - Two Span PS Adjacent Box With Straight Strands Example

ridge ID: PSAdjBox1	FrainingBridge12	NBI structure	e ID (8): AdjBoxTrainin10		emplate ridge completely	defined	Superstructu	
Description Desc	cription (cont'd)	Alternatives	Global reference point	Traffic Custom	agency fields			
Name:	PS Adj Box Train	ing Bridge		Yea	ar built:]	
Description:	FAP Route 840 (Section 120 BR- Vermilion Count	1		~				
Location:				Ler	ngth:		ft	
Facility carried (7):				Rou	ute number:]	
Feat. intersected (6):				Mi.	post:]	
Default units:	US Customary	V						
Default units:	US Customary	×						
Default units:	US Customary	V						

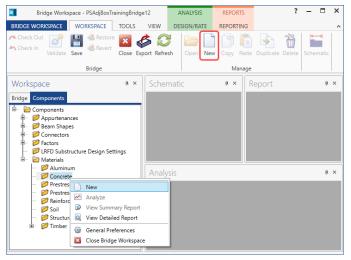
From the **Bridge Explorer** create a **new bridge** and enter the following description data:

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

Bridge Components

Bridge Materials - Concrete

To add a new concrete material, in the **Components** tab of the **Bridge Workspace**, expand the **Materials** node by clicking the 🗈 button, select **Concrete**, and select **New** from the **Manage** group of the **WORKSPACE** ribbon (or right mouse click on **Concrete** and select **New**).



The window shown below will open. Enter the values as shown above the **Compute** button and click the **Compute** button to compute the remaining values below them.

Bridge Ma	terials - Concrete		
Name:	6 ksi Beam Concrete		
Description:			
Compressive	e strength at 28 days (f'c):	6	ksi
Initial compr	ressive strength (f'ci):	5	ksi
Composition	of concrete:	Normal	~
Density (for dead loads):		0.15	kcf
Density (for modulus of elasticity):		0.15	kcf
Poisson's ratio:		0.2	
Coefficient of thermal expansion (α):		0.000006	1/F
Splitting ten	sile strength (fct):		ksi
LRFD Maxim	um aggregate size:		in
	Compute		
Std modulus	of elasticity (Ec):	4695.982325	ksi
LRFD modul	us of elasticity (Ec):	4877.010345	ksi
Std initial mo	odulus of elasticity:	4286.825749	ksi
LRFD initial r	modulus of elasticity:	4592.232476	ksi
Std modulus	of rupture:	0.580948	ksi
LRFD modul	us of rupture:	0.587878	ksi
Shear factor		1	

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

Bridge Materials – Prestress strand

To add a new prestress strand material, select **Prestress Strand** in the **Components** tree, and select **New** from the **Manage** group of the **WORKSPACE** ribbon (or right mouse click on **Prestress Strand** and select **New**).

Click on the Copy from library... button in this window and select 1/2" (7W-270) LR from the library and click OK.

Name	Description	Library	Units	Fy	Fu	Modulus of elasticity	Load per unit length	Diameter	Area	Transfer length (Std)	Transfer length (LRFD)	Strand type	Epoxy coated	
1/2" (7W-250) LR	Low relaxation 1/2"/Seven Wire/fpu = 250	Standard	US Customary	225.000	250.000	28500.00	0.490	0.5000	0.144	25.0000	30.0000	Low Relaxation	False	4
1/2" (7W-250) SR	Stress relieved 1/2"/Seven Wire/fpu = 250	Standard	US Customary	212.500	250.000	28500.00	0.490	0.5000	0.144	25.0000	30.0000	Stress Relieved	False	
1/2" (7W-270) LR	Low relaxation 1/2"/Seven Wire/fpu = 270	Standard	US Customary	243.000	270.000	28500.00	0.520	0.5000	0.153	25.0000	30.0000	Low Relaxation	False	
1/2" (7W-270) SR	Stress relieved 1/2"/Seven Wire/fpu = 270	Standard	US Customary	229.500	270.000	28500.00	0.520	0.5000	0.153	25.0000	30.0000	Stress Relieved	False	
1/4" (3W-250) LR	Low relaxation 1/4"/Three Wire/fpu = 250	Standard	US Customary	225.000	250.000	28500.00	0.130	0.2500	0.036	12.5000	15.0000	Low Relaxation	False	J
1/4" (7W-250) LR	Low relaxation 1/4"/Seven Wire/fpu = 250	Standard	US Customary	225.000	250.000	28500.00	0.122	0.2500	0.036	12.5000	15.0000	Low Relaxation	False	
1/4" (7W-250) SR	Stress relieved 1/4"/Seven Wire/fpu = 250	Standard	US Customary	212.500	250.000	28500.00	0.122	0.2500	0.036	12.5000	15.0000	Stress Relieved	False	
3/8" (3W-250) LR	Low relaxation 3/8"/Three Wire/fpu = 250	Standard	US Customary	225.000	250.000	28500.00	0.260	0.3750	0.075	18.7500	22.5000	Low Relaxation	False	
3/8" (7W-250) LR	Low relaxation 3/8"/Seven Wire/fpu = 250	Standard	US Customary	225.000	250.000	28500.00	0.272	0.3750	0.080	18.7500	22.5000	Low Relaxation	False	

The selected material properties are copied to the Bridge Materials - PS Strand window as shown below.

🗛 Bridge Materials - PS	Strand		-		×
Name: 1/2" (7W-	270) LR				
Description: Low relax	ation 1/2"/Seven Wire/fpu	ı = 270			
Strand diameter:	0.5000	in			
Strand area:	0.153	in^2			
Strand type:	Low Relaxation	~			
Ultimate tensile strengt	h (Fu): 270.000	ksi			
Yield strength (fy):	243.000	ksi			
Modulus of elasticity (E	28500.00	ksi			
[Compute				
Transfer length (Std):	25.0000	in			
Transfer length (LRFD):	30.0000	in			
Unit load per length:	0.520	lb/ft			
	Epoxy coated				
Copy to library	Copy from library	ОК	Apply	Canco	el

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

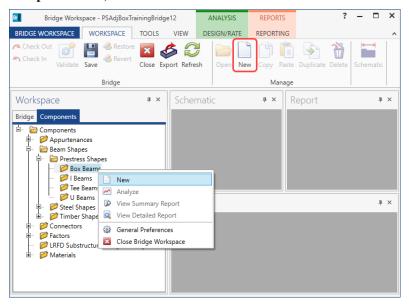
Description:					
	60 ksi reinforci	ing steel			
Material prope	erties				
pecified yield	strength (fy):	60.000087	ksi		
Modulus of ela	asticity (Es):	29000.004206	ksi		
Jltimate streng	gth (Fu):	90.0000131	ksi		
Type Plain Epoxy Galva					
Plain O Epoxy					

Add the following reinforcement steel in the same manner.

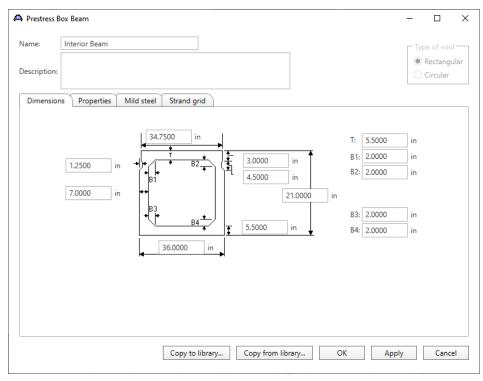
Click **OK** to apply the data and close the window.

Beam Shape

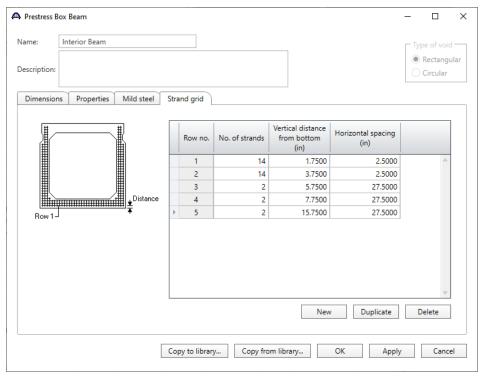
To enter a prestress beam shape to be used in this bridge expand the tree labelled **Beam Shapes** and **Prestress Shapes** as shown below and click on the **Box Beams** node in the **Components** tree, select **New** from the **Manage** group of the **WORKSPACE** ribbon (or right mouse click on **Box Beams** and select **New** or double click on **Box Beams** in the **Components** tree).



The **Prestress Box Beam** window shown below will open. Select the **Type of Void** as **Rectangular** and enter the data for the interior beam as shown below.



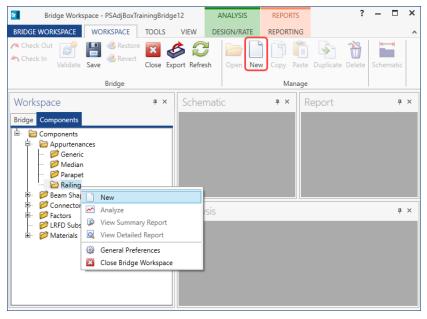
Navigate to the Strand grid tab and enter the data as shown below.



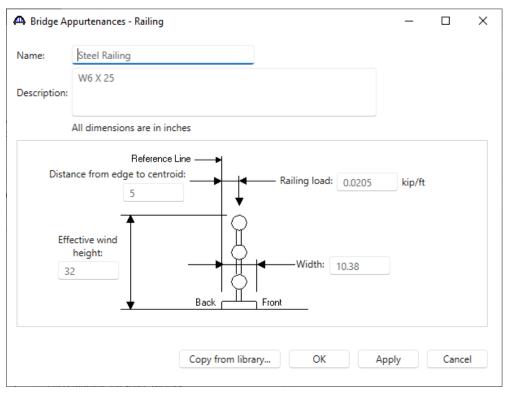
Click **OK** to apply the data and close the window.

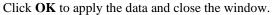
Bridge - Appurtenances

To enter the appurtenances to be used within the bridge expand the tree branch labeled **Appurtenances**. To define a steel railing, select **Railing** and click on **New** from the **Manage** button on the **WORKSPACE** ribbon (or right click on **Railing** in the **Components** tree and select **New**).



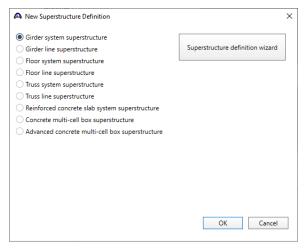
Enter the data as shown below.





Superstructure Definition

Returning to the **Bridge** tab of the **Bridge Workspace**, double click on **SUPERSTRUCTURE DEFINITIONS** (or click on **SUPERSTRUCTURE DEFINITIONS** and select **New** from the **Manage** group of the **WORKSPACE** ribbon or right mouse click on **SUPERSTRUCTURE DEFINITIONS** and select **New** from the popup menu) to create a new structure definition. The window shown below will appear.

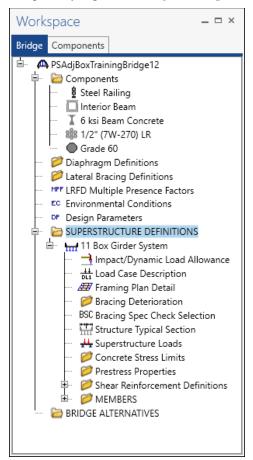


Select **Girder system superstructure**, click **OK** and the **Girder System Superstructure Definition** window will open. Enter the data as shown below.

	ngine			
me: 11 Box Girder Sys	tem			Modeling
				O Multi-girder system MCB
				With frame structure simplified definition
scription:				Deck type:
				Concrete Deck V
fault units: US Customary	 Enter span lengths 			For PS/PT only
mber of spans: 2 0	along the reference			Average humidity:
mber of girders: 11 0				%
	Span Length (ft)			
	> 1 45.43	27		Member alt. types
	2 45.43	27		Steel
				P/S
				R/C
				Timber
				P/T
		*		
Horizontal curvature	line Distance from PC to first supp	port line:	ft	
Horizontal curvature Superstructure alignment		port line:	ft ft	
Horizontal curvature Superstructure alignment Curved	Distance from PC to first supp	port line:		
Horizontal curvature Superstructure alignment Curved Tangent, curved, tangent	Distance from PC to first supp Start tangent length:	port line:	ft	
Horizontal curvature Superstructure alignment Curved Tangent, curved, tangent Tangent, curved	Distance from PC to first supp Start tangent length: Radius:		ft	
Horizontal curvature Superstructure alignment Curved Tangent, curved, tangent	Distance from PC to first supp Start tangent length: Radius: Direction:	Left 🗸	ft ft	
Horizontal curvature Superstructure alignment Curved Tangent, curved, tangent Tangent, curved	Distance from PC to first supp Start tangent length: Radius: Direction: End tangent length:	Left 🗸	ft ft ft	
Superstructure alignment Curved Tangent, curved, tangent Tangent, curved	Distance from PC to first supp Start tangent length: Radius: Direction: End tangent length: Distance from last support lin	Left 🗸	ft ft ft ft	

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

The partially expanded **Bridge Workspace** tree is shown below:



BRIDGE ALTERNATIVES

Navigate to the **BRIDGE ALTERNATIVES** node in the **Bridge Workspace** tree and create a new bridge alternative by double-clicking on **BRIDGE ALTERNATIVES** (or click on **BRIDGE ALTERNATIVES** and select **New** from the **Manage** group of the **WORKSPACE** ribbon).

Bridge Workspace - P BRIDGE WORKSPACE WOR		Bridge12 OLS VIEW	ANALYSIS DESIGN/RATE	REPORTS REPORTING	?	- 0	×
Check Out Check In Validate Save	 Restore Revert Redge 	Close Export Refresh	Open New	Copy Paste D Manage	uplicate Delet	e Schematic	-
Workspace		Ś	X Schema	tic ☆	× Report		\$ ×
Components Diaphragm Definition Diaphragm Definition Diaphragm Definition Director of the sector of the sec	tions ce Factors ions FINITIONS tem c New Manalyze View Sun	nmary Report ailed Report	Analysis				\$ X
	General	Preferences dge Workspace					

Iternative name: Brid	dge Alternative #1					
Description Subs	tructures					
Description:						
Horizontal curv	ature	Global pos	itioning -			
Reference line lengt	h: 90.77 ft	Distance:	0	ft		
O Start bearing	End bearing	Offset:	0	ft		
Starting station:	ft	Elevation:		ft		
Bearing:	N 90^ 0' 0.00" E					
Bridge alignment		Start tangent	length:		ft	
Curved		Curve length:			ft	
	ved, tangent	Radius:			ft	
Tangent, cur		Direction:		Left v	/	
Curved, tang	gent	End tangent I	ength:		ft	
Superstructure wizard	Culvert wizard					
		OK		Apply	Cano	cel

Enter the following data.

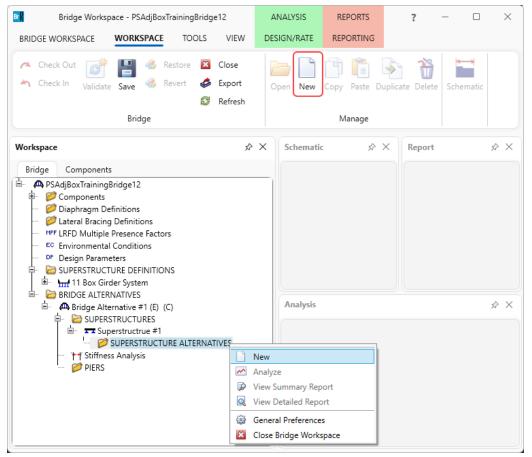
Click \mathbf{OK} to apply the data and close the window.

Expand the **Bridge Alternative #1** node in the **Bridge Workspace** tree by clicking the 🛨 button. Double-click on the **SUPERSTRUCTURES** node (or select **SUPERSTRUCTURES**, click **New** from the **Manage** group of the **WORKSPACE** ribbon) and enter the following new superstructure.

Bridge Worl BRIDGE WORKSPACE	kspace - PSAdj	BoxTrainingBridge		ANALYSIS ESIGN/RATE	REPORTS REPORTING	?	- 0	×	
A Check Out	ate Save Bridge	Revert 🤣	Close Export Refresh	Oper New	Copy Paste D Manage	uplicate Delete	Schematic		
Workspace			\$ X	Schematic	÷ 🖈	× Report		x x	
Bridge Compone			~ ~ ~		~ ~				
PSAdjBoxTrainii PSAdjBoxTrainii PostadjBoxTrainii PostadjBoxTraini PostadjBoxTrainii	ngBridge12 s Definitions ing Definitions ole Presence Fa tal Conditions meters CTURE DEFINI	actors							
🖶 🖶 HII Box (🖃 🗁 BRIDGE ALT				Analuria				* ×	
៉ – 🗛 Bridge A	Iternative #1 (Analysis				× ~	
···· ¥⁺ Stiffr	ERSTRUCTURE ness Analysis	New							
' 🧭 PIER	S	Analyze View Summa View Detaile							
		General PrefClose Bridge							
Superstructure Superstructure name:	Cuportructo	o #1						-	
			ine Substr	uctures					
Description:									
Reference line									
Distance:	0	ft							
Offset:	0	ft							
Angle:	0	Degrees							
Starting station:		ft							
						ОК	A	pply	Cancel

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

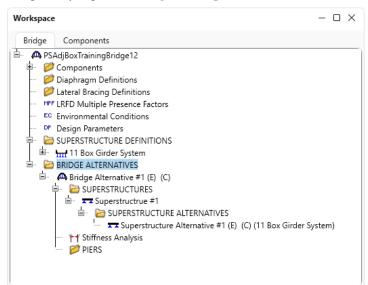
Expand the **Superstructure #1** node in the **Bridge Workspace** tree by clicking the + button. Double-click on the **SUPERSTRUCTURE ALTERNATIVES** node (or select **SUPERSTRUCTURE ALTERNATIVES** and click **New** from the **Manage** group of the **WORKSPACE** ribbon) and enter the following new superstructure alternative.



Select the **Superstructure definition 11 Box Girder System** as the current superstructure definition for this Superstructure Alternative.

A	Superstruc	ture Alternativ	/e									_		×
Alte	ernative na	me:	Supe	rstructi	ure Al	ternativ	/e #1							
Des	cription:													
Sup	perstructur	e definition:	11 Bo	x Girde	r Syst	em			~	1				
Sup	erstructur	e type:	Girde	er										
Nu	mber of m	ain members:	11											
	Span	Length (ft)												
	1	4	5.427	-										
	2	4	5.427											
									ОК		Арр	ly	Canc	el

The partially expanded Bridge Workspace tree is shown below.



The default impact factors, standard LRFD and LFR factors will be used.

Load Case Description

Navigate back to the superstructure definition **11 Box Girder System**. Double-click on the **Load Case Description** node in the **Bridge Workspace** tree to open the **Load Case Description window** and define the dead load cases as shown below. The completed **Load Case Description** window is shown below.

A	Load Case Description				-		×
	Load case name	Description	Stage	Туре	Time* (days)		
	Wearing Surface		Non-composite (Stage 1) *	D,DW -			-
	Parapets		Non-composite (Stage 1) *	D,DC -			
							~
*P	restressed members only	Add default load case descriptions		New	Duplicate	Dele	te
				ОК	Apply	Cano	el

Structure Framing Plan Detail – Layout

Double-click on **Framing Plan Detail** node in the **Bridge Workspace** tree to describe the framing plan in the **Structure Framing Plan Details** window. Enter the data as shown below.

A Structure Framing P	Plan Details									_		×
Number of spans: 2	Number of gi	rders:	11									
Layout Diaphrag												
	gnis											
				cing orientat								
	Skew egrees)) Perpend) Along s	licular to gir upport	der							
▶ 1	20.000	_					-					
2	20.000		Girder	Girder sp (ft)								
3	20.000		bay	Start of girder	End of girder							
		►	1	3.00	3.00		1					
			2	3.00	3.00							
			3	3.00	3.00							
			4	3.00	3.00							
			5	3.00	3.00							
			6	3.00	3.00							
			7	3.00	3.00							
			8	3.00	3.00							
			9	3.00	3.00							
			10	3.00	3.00							
	~					-						
							1					
								ОК	Арр	bly	Canc	el

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

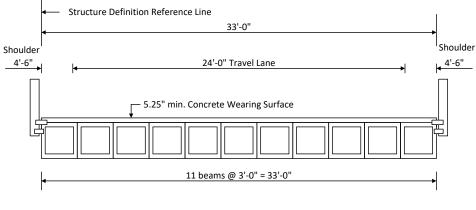
Structure Framing Plan Detail – Diaphragms

The **Diaphragms** tab of this window is used to enter data for exterior diaphragms, in other words diaphragms located between girders. Since an adjacent box beam structure does not have exterior diaphragms, no data will be entered in the **Diaphragms** tab.

Structure Typical Section - Deck

Next, define the structure typical section by double-clicking on the **Structure Typical Section** node in the **Bridge Workspace** tree. Input the data describing the typical section as shown below.

The basic deck geometry is shown below.



Typical Section

Input the data describing the typical section as shown below.

A Structure Typical Section	_		×
Distance from left edge of deck to Distance from right edge of deck to superstructure definition ref. line			
Deck Superstructure Definition thickness Reference Line			
Left overhang			
Deck Deck (cont'd) Parapet Median Railing Generic Sidewalk Lane position Striped lanes Wearing surface			
Superstructure definition reference line is within 🕑 the bridge deck.			
Start End			
Distance from left edge of deck to superstructure definition reference line: 0.00 ft 0.00 ft			
Distance from right edge of deck to superstructure definition reference line: 33.00 ft 33.00 ft			
Left overhang: 1.50 ft 1.50 ft			
Computed right overhang: 1.50 ft 1.50 ft			
ОК	Apply	Cance	!

Structure Typical Section – Railing

Add two steel railings as shown below. A Structure Typical Section _ Back Υ Front Deck (cont'd) Parapet Median Railing Generic Sidewalk Lane position Striped lanes Wearing surface Deck Edge of deck Distance at Distance at Front face dist. measured from start (ft) end (ft) Name Load case Measure to orientation Steel Railing \sim Parapets \sim Back \sim Left Edge 🛛 🗸 -0.865 -0.865 Right 🗸 Steel Railing Back Right Ed... 🗸 -0.865 -0.865 Left \sim Parapets \vee New Duplicate Delete OK Apply Cancel

Structure Typical Section – Lane Positions

Select the Lane position tab and add the travel lanes as shown below as per the typical section schematic.

 \times

Stru	cture Typical	Section				-		×
Ţ	Travelw		ure Definition Reference Line					
Deck	k Deck (co	nt'd) Parapet Median	Railing Generic Sidew	alk Lane position Striped	l lanes Wearing surface			
	Travelway number	Distance from left edge of travelway to superstructure definition reference line at start (A) (ft)	Distance from right edge of travelway to superstructure definition reference line at start (B) (ft)	Distance from left edge of travelway to superstructure definition reference line at end (A) (ft)	Distance from right edge of travelway to superstructure definition reference line at end (B) (ft)			
Þ	1	4.50	28.50	4.50	28.50		-	
[LRFD fatigue	ilable to trucks:						
		Fruck fraction:	Compute		New Duplic	ate	Delete	
					OK	Apply	Cance	el

Structure Typical Section – Wearing surface

Enter the data shown below.

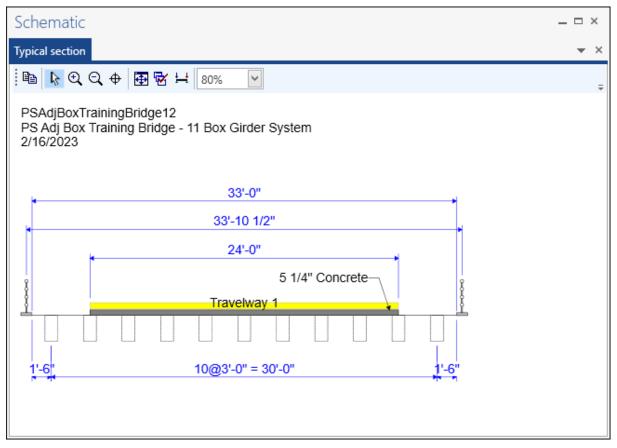
A Structure Typical Section	-		\times
Distance from left edge of deck to Distance from right edge of deck to superstructure definition ref. line superstructure definition ref. line			
Deck			
thickness i Hererence Line			
Left overhang			
Deck Deck (cont'd) Parapet Median Railing Generic Sidewalk Lane position Striped lanes Wearing surface			
Wearing surface material: Concrete			
5.25" min concrete wearing surface Description:			
Wearing surface thickness: 5.2500 in International Interna			
Wearing surface density: 150.000 pcf			
Load case: Wearing Surface V Copy from library			
OK A	pply	Cance	el

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

Schematic – Structure Typical Section

While the **Structure Typical Section** node is selected in the **Bridge Workspace** tree, open the schematic for the typical section by selecting the **Schematic** button on the **WORKSPACE** ribbon (or right click on **Structure Typical Section** in the **Bridge Workspace** and select **Schematic** from the menu).

Bridge Workspace - PSAdjBoxTra	iningBridge12	ANALYSIS	REPORTS	?	– 🗆 ×
BRIDGE WORKSPACE WORKSPACE	TOOLS VIEW	DESIGN/RATE	REPORTING		^
A Check Out Check In Validate	Close Export Re	Open Nev	Copy Paste	Duplicate Delete	Schematic
Bridge			Manage		
Workspace	# ×	Schematic	ųх	Report	а×
Bridge Components				1	
A FSAdj8o.TrainingBridge12 B	ıs				
🛲 Framing Plan Detail		Analysis			₽ ×
 Bracing Deterioration BSC Bracing Spec Check Sel Structure Typical Section 					
🚟 🚟 Superstructure Los	Open				
📁 Concrete Stress Lir 📈	Analyze				
🖶 🧭 Shear Reinforceme	View Summary R	· · · · ·			
🖻 📂 📂 MEMBERS	View Detailed Re	port			
BRIDGE ALTERNATIVES	Schematic				
	General Preferen				
	Close Bridge Wo	rkspace			



Since the member alternatives are not defined yet, the girders are displayed as dashed boxes. At this point BrDR does not know if the girders will be PS boxes, I-beams, steel rolled beams, etc.

Concrete Stress Limits

A Stress Limit defines the allowable concrete stresses for a given concrete material. Double click on the **Concrete Stress Limits** node in the **Bridge Workspace** tree to open the **Stress Limit Sets – Concrete** window. Enter data shown above the **Compute** button, select **Moderate** for the **Corrosion condition** and select the **6.0 ksi Beam Concrete** material from the drop-down menu of the **Concrete material**. Click the **Compute** button. Default values for the allowable stresses will be computed based on the **Concrete material** selected and the AASHTO Specifications. The default value for the **Final allowable slab compression** is not computed since the deck concrete is typically different from the concrete used in the beam. This value will be left blank since this example does not have a concrete deck.

A Stress Limit Sets -	Concrete							_		×
Name:	6 ksi Stress	Limit								
Description:										
Corrosion condition:	Moderate		~							
Final allowable te	ension stress	limit coef. (U	6) override:							
Concrete material:	6 ksi Beam (Concrete	~							
[Compute									
		LFD			LRFD					
Initial allowable comp	pression:	3	ksi	:	3.25	ksi				
Initial allowable tension	on:	0.2	ksi		0.2	ksi				
Final allowable comp	ression:	3.6	ksi		3.6	ksi				
Final allowable tensio	n:	0.4654031	ksi		0.4654031	ksi				
Final allowable DL co	mpression:	2.4	ksi		2.7	ksi				
Final allowable slab co	ompression:		ksi			ksi				
Final allowable comp (LL+1/2(Pe+DL))	ression:	2.4	ksi		2.4	ksi				
					C	Ж	Apply		Cance	2

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

Prestress Properties

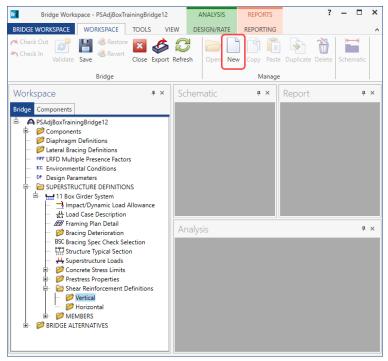
Double click on the **Prestress Properties** node in the **Bridge Workspace** tree to open the **Prestress Properties** window. Define the prestress properties as shown below. Since the **AASHTO Approximate** method is used to compute the losses, only the information on the **General P/S data** tab is required.

A Prestress Properties	_		×
Name: 1/2" LR AASHTO Loss			
General P/S data Loss data - lump sum Loss data - PCI			
General P/S data Loss data - lump sum Loss data - PCI P/S strand material: 1/2" (7W-270) LR Image: Understanding Loss method: AASHTO Approximate P/S transfer stress ratio: 0.750 P/S strand material: 1/2" (7W-270) LR Image: Understanding P/S transfer stress ratio: 0.750 Loss method: AASHTO Approximate Image: Understanding P/S transfer stress ratio: Image: Understanding Loss data - AASHTO Final age: 182500.00 Image: Understanding 182500.00 Loss data - AASHTO Image: Understanding Image: Understanding 182500.00 Image: 0.0 % Image: Understanding 182500.00] Hours Days Days		
ОК	Apply	Cance	21

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

Shear Reinforcement

Define the vertical shear reinforcement to be used by the girders. Expand the **Shear Reinforcement Definitions** node in the **Bridge Workspace** tree, select the **Vertical** node and click on **New** from the **Manage** group of the **WORKSPACE** ribbon (or double click on **Vertical**).

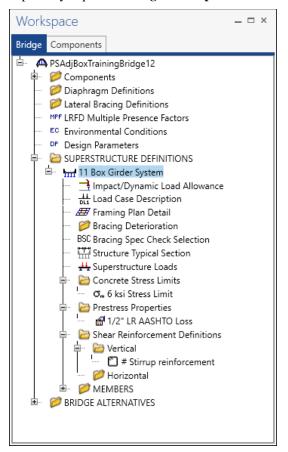


The I shape shown is for illustrative purposes only, it is not meant to display the actual beam shape. Enter the data as shown below.

A Shear Reinforcement Definition - Vert	ical		-		×
Name: # Stirrup reinforcement					
]				
	Material:	Grade 60		>	
	Bar size:	4 🗸			
	Number of legs:	2.00			
	Inclination (alpha):	90.0 Degrees			
Vertical Shear Reinforcemer	t				
hemoremen	nt				
		ОК Ар	ply	Cance	el l

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

A partially expanded **Bridge Workspace** is shown below.



Describing a member

The **Member** window shows the data that was generated when the structure definition was created. No changes are required in this window. The first member alternative created will automatically be assigned as the **Existing** and **Current member alternative** for this Member.

🗛 Member									-		×
Member name:	G1			Link with	h: None	\sim					
Description:											
	Existing	Currer	t Member alter	mative name	Description						
											v
Number of span	IS: 2 🗘	Spa no									
		> 1	45.427	-							
		2	45.427								
				-							
							ОК	Apply		Cance	el

Defining a Member Alternative

Expand node G2. Double-click on MEMBER ALTERNATIVES in the Bridge Workspace tree for member G2 to create a new member alternative. The New Member Alternative window shown below will open. Select Prestressed (pretensioned) concrete for the Material type and PS Precast Box for the Girder Type.

A New Member Alternative	×
Material type:	Girder type:
Post tensioned concrete	PS Precast Box
Prestressed (pretensioned) concrete	PS Precast I
Reinforced concrete	PS Precast Tee
Steel	PS Precast U
Timber	
	OK Cancel

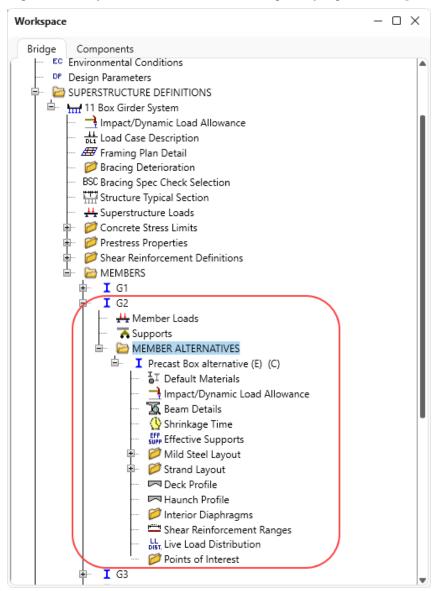
Click **OK** to close the window and create a new member alternative.

The **Member Alternative Description** window will open. Enter the data as shown below. The **Schedule based Girder property input method** is the only input method available for a prestressed concrete beam. Enter data as shown below.

Aember alternative Precast Box alternative Description Spes Factors Engine Import Control options Description:										
Description: Girder type: PS Precast Box Modeling type: PS Precast Box Modeling type: Multi Girder System Default units: US Customary Corss-section based Self load Load case: Engine Assigned Lifk Additional self load: Skip/ft Additional self load: Crack control parameter (Z) Exposure factor Use creep	ember alterna	tive: Pre	ast Box alte	rnative						
Girder type: PS Precast Box Modeling type: Multi Girder System Default units: US Customary V Girder property input method Schedule based Cross-section based Self load Load case: Engine Assigned Additional self load: % Crack control parameter (Z) Exposure factor V Use creep	Description	Specs	Factors	Engine	Import	Control options				
Girder property input method Schedule based Cross-section based Self load Load case: Engine Assigned Additional self load: % Crack control parameter (Z) Exposure factor	Description:					Material type:	Prestressed (Pretensio	ned)		
Girder property input method Image: Schedule based Cross-section based Self load Load case: Engine Assigned Image: Mail Construction Additional self load: % Crack control parameter (Z) Exposure factor Image: Mail Construction Image: Mail Constrest Constrest Constrest Construction						Girder type:	PS Precast Box			
Girder property input method Schedule based Cross-section based Default rating method: Load case: Engine Assigned LFR Crack control parameter (Z) Exposure factor Use creep						Modeling type:	Multi Girder System			
Girder property input method Scross-section based Load case: Engine Assigned LFR Crack control parameter (Z) Exposure factor Use creep						Default units:	US Customary	~		
Load case: Engine Assigned Additional self load: kip/ft Additional self load: %	Schedu	le based								
Additional self load: kip/ft Additional self load: % Crack control parameter (Z) Exposure factor	Self load					Default rating metho	od:			
Additional self load: %	Load case:		Engine Ass	igned	~	LFR	~			
Crack control parameter (Z) Exposure factor	Additional	self load:		kip/ft						
✓ Use creep	Additional	self load:		%						
				kip/in			Use creep			

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

Expand the newly added member alternative. The partially expanded Bridge Workspace tree is shown below.



Beam Details – Span detail

Next describe the beam by double clicking on the **Beam Details** node in the **Bridge Workspace** tree. Enter the data in each tab of the **Beam Details** window as shown below.

бра	an detail	Continuous support d	letail Stress limit ranges	Slab interface Con	tinuity dia	phragm		
	C		Girder	Prestress		Beam p	rojection	
	Span number	Beam shape	material	properties	Left end (in)	Right end (in)		
1 Interior Beam		Interior Beam 🔹	6 ksi Beam Concrete 🔻	1/2" LR AASHTO Loss 🔻	5.600	0.0000	7.0000	-
	2	Interior Beam 🔹	6 ksi Beam Concrete 👻	1/2" LR AASHTO Loss *	5.600	7.0000	0.0000	

Beam Details - Continuous support detail

Define the continuous support detail as shown below.

Beam	n Details							_		×
Span	detail	Continuous su	pport detail	Stress limit ranges	Slab interface	Continuity dia	phragm			
CL c on L	of Bearing '		CL of Bearing CL of Bearing on Right							
	Support number		Support distance on right, SR (in)							
÷.	2	7.5000	7.5000						-	
									v	
							ОК	Apply	Cance	el

Beam Details – Stress limit ranges

Note that the stress limit ranges are defined over the entire length of the precast beam as shown below for span 1 and span 2.

pan	deta	il	Continuous support detai	Stress lim	it ranges	Slab interface	Continuity diaphragm		
		an nber	Name	Start distance (ft)	Length (ft)	End distance (ft)			
>	1	\sim	6 ksi Stress Limit	/ 0	45.385333	45.385333			
	2	\sim	6 ksi Stress Limit	/ 0	45.385333	45.385333			

Since this example does not have a concrete deck, the **Slab interface** tab does not require input.

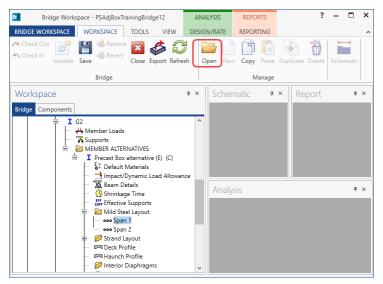
Beam Details – Continuity diaphragm

бра	an	deta	ail	Continuou	s su	pport detail	Stress In	mit ranges	Slab interf	ice Conti	nuity diaphra	igm _			
					_	Left sup	oport			Right su	pport				
		Spa num		Materia	al I	Distance (in)	Bar count	Bar size	Material	Distance (in)	Bar count	Bar si	ze		
Þ	1	1	Ŧ		Ŧ			-	Grade 60	4.0000	10	5	-		-
	2	2	*	Grade 60	Ŧ	4.0000	10	5 -	Grade 60				*		
						t supports i					Nev		Duplic	 Delete	~

Click **OK** to apply the beam details and close the window.

Mild Steel Layout – Span 1

Expand the **Mild Steel Layout** in the **Bridge Workspace** tree and double-click on **Span 1** (or select **Span 1** and click the **Open** button from the **Manage** group of the **WORKSPACE** ribbon) to open the **Mild Steel Layout – Span 1** window.



Enter the Span 1 details as shown below.

					Co	nsider mild	l steel in	initial allowable tens	sile stress li	nit					
• w`	\]	Vertical	Distance												
	Row no.	distance from bottom (in)	Bar count	Ba	ar size	Bar spacing (in)	Side cover (in)	Material	Start distance (ft)	Length (ft)	End distance (ft)	Fully developed at start	Fully developed at end		
	1	17.5	3	4	\sim	10	10	Grade 60 🛛 🗸	0	45.38533	45.38533				
	2	19.5	4	5	\sim	10	10	Grade 60 🗸 🗸	0	45.38533	45.38533				

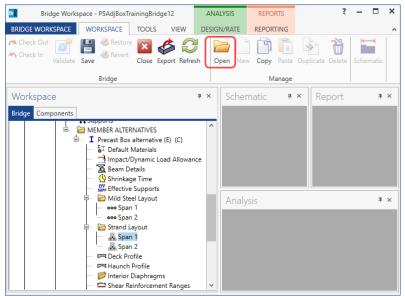
) 			Distance		Co	nsider mild	d steel ir	initial allowable te	nsile stress lii	mit					
	Row no.	Vertical distance from bottom (in)	Bar count	Bar	size	Bar spacing (in)	Side cover (in)	Material	Start distance (ft)	Length (ft)	End distance (ft)	Fully developed at start	Fully developed at end		
>	1	17.5	3	4	\sim	10	10	Grade 60 🗸 🗸	0	45.38533	45.38533				
	2	19.5	4	5	\sim	10	10	Grade 60 🔍 🗸	0	45.38533	45.38533				
												New	Duplicate	e De	elete

Similarly, enter the Mild Steel Layout – Span 2 as shown below.

Click **OK** to apply the beam details and close the window.

Strand Layout – Span 1

Expand the **Strand Layout** in the **Bridge Workspace** tree and double-click on **Span 1** (or select **Span 1** and click the **Open** button from the **Manage** group of the **WORKSPACE** ribbon) to open the **Stand Layout – Span 1** window.



Use the **Zoom** buttons to shrink/expand the schematic of the beam shape on the right side of the screen so that the entire beam is visible. Select the **Description type** as **Strands in rows** and the **Strand configuration type** as **Straight/Debonded**. The **Mid span** radio button will now become active. Strands can now be defined at the middle of the span by selecting strands on the right hand schematic. Select the following strands in the schematic so that the CG of the strands is 4.5 inches. Click the **Apply** button and then **OK** to apply this data. Repeat these steps for **Span**

2.	
🕰 Strand Layout - Span 1	– 🗆 X
Description type	E E Q Q ⊕ E S ∺ 160% ∨
○ P and CGS only	Notes: Strand positions generated by the REVISED method.
Strand configuration type	Please refer to Help for a description of this method.
Straight/Debonded	• • • •
Harped and straight debonded	
Mid span	
	$\widehat{\times} \bullet \bullet \times \times \bullet \bullet \bullet \bullet \times \times \bullet \bullet \widehat{\times}$
	$\times \bullet \bullet \times \times \times \bullet \bullet \times \times \bullet \bullet \times$
	Number of strands = 16
Debondina	Number of debonded strands (Total/Here/Other) = 0/0/0 CG of strands (measured from bottom of section) = 4.50 in
Left Section location (in) Measured and debonded from	Legend:
A	imes No strand at this position at the current section location. imes No strand at this position at the current location but a strand is harped to this position.
	 A strand occupies this position at the current section location. The strand is debonded from the end of the beam to the current section location.
· · · · · · · · · · · · · · · · · · ·	 The stand is debonded from the end of the outern to exist a content section location. The strand is debonded from the mid-span to the current section location. The strand is debonded at other section location. Hover over the strand for more information.
New Modify Delete	The harped position of a harped strand.
Right Section location (in) Measured and debonded from	The mid-span position of a harped strand. The mid-span position of one strand and the harped position of another strand.
	Mild steel.
New Modify Delete	
OK Apply Cancel	
on reprise Cancel	

Shear Reinforcement Ranges

Double-click on the **Shear Reinforcement Ranges** node in the **Bridge Workspace** tree to open the **PS Shear Reinforcement Ranges** window. The shear reinforcement ranges for each span are entered as described below.

Vertica Span:	Horizor	ce		Spacing	•								>
Vertica	Horizor	ntal	•	Spacing	•								
Vertica	Horizor	ntal	•	Spacing	 								
Vertica	Horizor	ntal	•	Spacing									
Span:	_												
Span:	_				'								
	1 ~												
> #			Сору	span to	o								
> #		News	_			Extends	Start distance	Number of	Spacing	Length	End		
> #		Name	e			into deck	(ft)	spaces	(in)	(ft)	distance (ft)		
	# Stirrup reinf	forceme	ent		~		0	1	0	0	0		
#	# Stirrup reinf	forceme	ent		~		0	45	12	45	45		
Stir	rrup wizard	Sti	tirrup	design	tool	View	calcs		New	Dupl	icate	Delete	
Stir	rrup wizard	Sti	tirrup	design	tool	View	calcs		New	Dupl	icate	Delete	
Stir	rrup wizard	Sti	tirrup	design	tool	View	calcs		New		icate Apply	Delete	
Stir	rrup wizard	Sti	tirrup	design	tool	View	calcs	(
					tool	View	calcs	(
	rrup wizard ear Reinforcer				tool	View	calcs	(Cance	
					tool	View	calcs					Cance	
PS She	ear Reinforcer	ment Ra	anges	5		View	calcs					Cance	
	ar Reinforcer	ment Ra	anges			View	calcs					Cance	4
PS She	ear Reinforcer	ment Rai	anges	5		View	calcs					Cance	4
PS She	ear Reinforcer	ment Rai	Binges	s		View	calcs					Cance	
PS She	ear Reinforcer	ment Rai	Binges	5							Apply	Cance	4
PS She	ear Reinforcer	ment Rai	anges	s		Extends	Start distance	Number of spares	OK	Length	Apply — End distance	Cance	,
PS She	ear Reinforcer Start Distance Horizor 2 ~	ment Rai	anges Copy e	s))	Extends	Start distance (ft)	spaces	OK Spacing (in)	Length (ft)	Apply — End distance (ft)	Cance	4
PS She	ear Reinforcer	ment Rai	Copy ee	s		Extends	Start distance		OK	Length	Apply — End distance	Cance	4

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

The description of an interior beam for this structure definition is complete. The member alternative can now be analyzed.

LRFR Rating

To perform an **LRFR** rating on **G2**, select the **Analysis Settings** button on the **Analysis** group of the **DESIGN/RATE** ribbon to open the window shown below.

Br	Bridge Worksp	ace - PSAdjBoxTraining	Bridge12	ANALYSIS	REPORTS	?	-	×
BRIDGE W	ORKSPACE	WORKSPACE TOO	LS VIEW	DESIGN/RATE	REPORTING			^
*	-		∽ >	< 📙				
Analysis A Settings	nalyze Analysis Events							
A	nalysis		Results					

Click the **Open Template** button and select the **LRFR Design Load Rating** to be used in the rating and click **OK**.

Templates	Description	Analysis	Owner	Public / Private	
HL 93 Design Review	HL 93 Design Review	LRFD		Public	
HS 20 LFD Rating	HS 20 LFD Rating	LFR		Public	
LRFR Design Load Rating	LRFR Design Load Rating	LRFR		Public	
LRFR Legal Load Rating	LRFR Legal Load Rating	LRFR		Public	

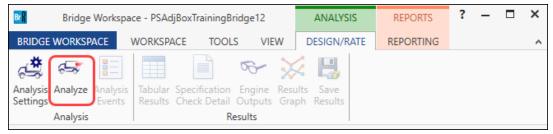
O Design review 💿 Rating	Rating method: LRFR 💌
halysis type: Line Girder v ne / Impact loading type: As Requested v Vehicles Output Engine Description	Apply preference setting: None
Traffic direction: Both directions	Refresh Temporary vehicles Advanced Vehicle summary
 ➡-Vehicles ➡-Standard ↓-EV2 ↓-EV3 ↓-H 15-44 ↓-H 20-44 ↓-H-93 (US) ↓-HS 15-44 ↓-HS 20-44 ↓-Lane-Type Legal Load ↓-LRFD Fatigue Truck (US) ↓-NRL ↓-SU4 ↓-SU4 ↓-SU5 ↓-SU6 ↓-SU7 ↓-Type 3. ↓-Type 3.S2 ➡-Agency ↓-LRFD Fatigue Truck (US)~1 ↓-User defined ↓-Temporary 	Add to Ad

The Analysis Settings window will be updated as shown below.

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

Tabular Results

With G2 member alternative **Precast Box alternative** selected, click the **Analyze** button on the **Analysis** group of the **DESIGN/RATE** ribbon to perform the rating.



When the rating is completed, the results can be reviewed by clicking the **Tabular Results** button on the **Results** group of the **DESIGN/RATE** ribbon.

Bridge Workspa	ce - PSAdjBoxTrainingBridge12	ANALYSIS	REPORTS	?	-	×
BRIDGE WORKSPACE	WORKSPACE TOOLS VIEW	DESIGN/RATE	REPORTING			^
Analysis Analyze Analysis Settings Analysis Analysis	Tabular Specification Engine Results Check Detail Outputs Gra Results					

The window shown below will open.

Analysis Res	ults - Precast Box alternat	ive								- 🗆	×
Print Print											
ort type:	⊂ La	ne/Impact loading	a type	Displa	y Format						
ing Results S		As requested		ad Singl	e rating level pe	r row	\sim				
			U beta								
						1	Leveller				
Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Limit State	Impact	Lane	
Live Load HL-93 (US)		Rating Method			Rating Factor 0.102			Limit State STRENGTH-I Concrete Flexure	Impact As Requested		
	Туре		Level	(Ton)		(ft)	Span-(%)				
HL-93 (US)	Type Truck + Lane	LRFR	Level Inventory	(Ton) 3.66	0.102	(ft) 45.43	Span-(%) 1 - (100.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested	•
HL-93 (US) HL-93 (US)	Type Truck + Lane Truck + Lane	LRFR LRFR	Level Inventory Operating	(Ton) 3.66 4.74	0.102	(ft) 45.43 45.43	Span-(%) 1 - (100.0) 1 - (100.0)	STRENGTH-I Concrete Flexure STRENGTH-I Concrete Flexure	As Requested As Requested	As Requested As Requested	
HL-93 (US) HL-93 (US) HL-93 (US)	Type Truck + Lane Truck + Lane 90%(Truck Pair + Lane)	LRFR LRFR LRFR	Level Inventory Operating Inventory	(Ton) 3.66 4.74 4.40	0.102 0.132 0.122	(ft) 45.43 45.43 45.43	Span-(%) 1 - (100.0) 1 - (100.0) 1 - (100.0)	STRENGTH-I Concrete Flexure STRENGTH-I Concrete Flexure STRENGTH-I Concrete Flexure	As Requested As Requested As Requested	As Requested As Requested As Requested	

LRFD Design review

To perform an **LRFD design review of G2** of this girder for HL93 loading, select the **Analysis Settings** button on the **Analysis** group of the **DESIGN/RATE** ribbon to open the window shown below.

Bridge Workspa	ce - PSAdjBoxTrainingBridge12	ANALYSIS	REPORTS	?	-	×
BRIDGE WORKSPACE	WORKSPACE TOOLS VIEW	DESIGN/RATE	REPORTING			^
Analysis Settings Analysis Analysis Analysis	Tabular Specification Engine Results Check Detail Outputs Gra Results					

Click the Open Template button and select the HL 93 Design Review to be used in the rating and click OK.

Templates	Description	Analysis	Owner	Public / Private	
HL 93 Design Review	HL 93 Design Review	LRFD		Public	
HS 20 LFD Rating	HS 20 LFD Rating	LFR		Public	
LRFR Design Load Rating	LRFR Design Load Rating	LRFR		Public	
LRFR Legal Load Rating	LRFR Legal Load Rating	LRFR		Public	

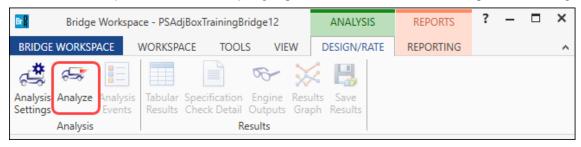
Design review Rating Rating Alysis type: Line Girder re / Impact loading type: As Requested	Design method:
ne / Impact loading type: As Requested	
	Apply preference setting: None
Vehicles Output Engine Description	
Traffic direction: Both directions	Refresh Temporary vehicles Advanced
Vehicle selection	Vehicle summary
	Add to

The Analysis Settings window will be updated as shown below.

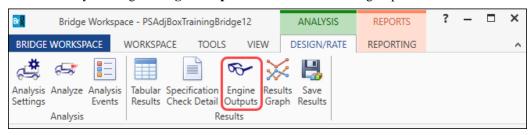
Click **OK** to apply the data and close the window.

Engine Outputs

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



AASHTO LRFD analysis will generate a **Spec Check Results** file. When the design review is finished, results can be reviewed by clicking the **Engine outputs** button on the **Results** group of the ribbon.



The following window opens.

A PSAdjBoxTrainingBridge12	_	×
PSAdjBoxTrainingBridge12 Image: Precast Box alternative Image: Precast Bo		

To view the spec check results, double click the Stage 3 Spec Check Results file in this window.

