AASHTOWare BrDR 7.5.0

Prestress Tutorial 6 PS6 – Skewed, Simple Span Prestressed I Beam Example

BrDR Training

PS6 – Skewed, Simple Span Prestressed I Beam Example

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

PS6TrainingBri	dge					- 0	×
Bridge ID: PS6	TrainingBridge	NBI structur	e ID (8): PS6TrainingBrid		Template Bridge completely defined	 Superstructures Culverts Substructures 	
Description	Description (cont'd)	Alternatives	Global reference point	Traffic	Custom agency fields		
Name:	Skewed PS I B	eam Bridge			Year built:		
Description:							
Location:					Length:	ft	
Facility carried	1 (7):				Route number:		
Feat. intersect	ed (6):				Mi. post:		
Default units:	US Customary	~					
Bridge	association	BrR 🗹 BrD 🗌	BrM Sync with BrM				
					ОК	Apply Cancel	

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

Bridge Materials - Concrete

To enter the materials to be used by members of the bridge, open the **Components** tab, and click on the $\textcircled{\pm}$ button to expand the tree for **Materials**. The tree with the expanded **Materials** branch is shown below.



To add a new concrete material, in the **Components** tab of the **Bridge Workspace**, click on **Materials**, **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 shown above the **Compute** button and click the **Compute** button to compute the remaining values below them.

🕰 Bridge Mat	terials - Concrete			_		×
Name:	PS 6.5 Ksi					
Description:	f'ci =5.525 ksi					
Compressive	strength at 28 days (f'c):	6.5	ksi			
Initial compre	essive strength (f'ci):	5.525	ksi			
Composition	of concrete:	Normal ~				
Density (for d	lead loads):	0.15	kcf			
Density (for n	nodulus of elasticity):	0.15	kcf			
Poisson's rati	0:	0.2				
Coefficient of	f thermal expansion (α):	0.000006	1/F			
Splitting tens	ile strength (fct):		ksi			
LRFD Maximu	um aggregate size:		in			
	Compute					
Std modulus	of elasticity (Ec):	4887.73337	ksi			
LRFD modulu	us of elasticity (Ec):	5007.548587	ksi			
Std initial mo	dulus of elasticity:	4506.26751	ksi			
LRFD initial m	nodulus of elasticity:	4746.06211	ksi			
Std modulus	of rupture:	0.604669	ksi			
LRFD modulu	us of rupture:	0.611882	ksi			
Shear factor:		1				
	Сору	to library Copy	from library OK App	ly	Cance	<u>!</u>

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

Add concrete material for the deck , using the same technique.	Enter the data for deck concrete as shown below.
---	--

eck Concrete ength at 28 days (f'c): ive strength (f'ci):	4.5				
ength at 28 days (fc): ive strength (f'ci):	4.5				
ength at 28 days (f'c): ive strength (f'ci):	4.5				
ive strength (f'ci):		ksi			
		ksi			
concrete:	Normal ~				
d loads):	0.15	kcf			
dulus of elasticity):	0.145	kcf			
	0.2				
ermal expansion (α):	0.000006	1/F			
strength (fct):		ksi			
aggregate size:		in			
Compute					
elasticity (Ec):	3865.20204	ksi			
of elasticity (Ec):	4144.549969	ksi			
lus of elasticity:		ksi			
lulus of elasticity:		ksi			
rupture:	0.503115	ksi			
of rupture:	0.509117	ksi			
	1				
	rulus of elasticity): ermal expansion (α): strength (fct): aggregate size: Compute elasticity (Ec): f elasticity (Ec): us of elasticity: ulus of elasticity: rupture: f rupture:	unus of elasticity): 0.145 0.2 0.2 ermal expansion (α): 0.000006 strength (fct): aggregate size: Compute 2 elasticity (Ec): 3865.20204 f elasticity (Ec): 4144.549969 us of elasticity: 1 ulus of elasticity: 0.503115 f rupture: 0.509117 1 1	uius of elasticity): 0.145 kcr 0.2 0.2 ermal expansion (α): 0.000006 1/F strength (fct): aggregate size: in Compute in compute elasticity (Ec): 3865.20204 ksi us of elasticity: ksi ksi ulus of elasticity: ksi ksi ulus of elasticity: ksi ksi ulus of elasticity: ksi ksi 1 1 1	uius of elasticity): 0.145 kct 0.2 0.2 ermal expansion (a): 0.000006 1/F strength (fct): ksi aggregate size: in Compute strength (fct): elasticity (Ec): 3865.20204 ksi still gus of elasticity: ksi ulus of elasticity: ksi ulus of elasticity: ksi rupture: 0.503115 f rupture: 0.509117 tuit 1	unus of elasticity; 0.145 kct 0.2 0.2 ermal expansion (α): 0.000006 1/F strength (fct): aggregate size: in Compute in compute elasticity (Ec): 3865.20204 ksi gus of elasticity: 4144.549969 ksi uus of elasticity: ksi ulus of elasticity: ksi f rupture: 0.503115 f rupture: 0.509117 1 1

Bridge Materials – Reinforcement steel

To add a new reinforcement steel material, select **Reinforcement Steel** in the **Components** tree, and select **New** from the **Manage** group of the **WORKSPACE** ribbon (or right mouse click on **Reinforcement Steel** and select **New**).



Click on the Copy from	library butto	n in this window	and select Grade 6	0 from the library	and click OK .
chek on the copy nom	i indi ul j ···· d'ullo		and beleet Grade o	o nom me norm y	

l	Name	Description	Library	Units	Fy	Fu	Es	
	Grade 300	300 MPa reinforcing steel	Standard	SI / Metric	300.00	500.00	199948.00	
	Grade 350	350 MPa reinforcing steel (rail-steel)	Standard	SI / Metric	350.00	550.00	199948.00	
	Grade 40	40 ksi reinforcing steel	Standard	US Customary	40.000	70.000	29000.00	
	Grade 400	400 MPa reinforcing steel	Standard	SI / Metric	400.00	600.00	199948.00	
	Grade 50	50 ksi reinforcing steel (rail-steel)	Standard	US Customary	50.000	80.000	29000.00	
	Grade 500	500 MPa reinforcing steel	Standard	SI / Metric	500.00	700.00	199948.00	
,	Grade 60	60 ksi reinforcing steel	Standard	US Customary	60.000	90.000	29000.00	
	Grade 75	75 ksi reinforcing steel	Standard	US Customary	75.000	100.000	29000.00	
	Structural or unknown grade prior 1954	Structural or unknown grade prior to 1954	Standard	US Customary	33.000	60.000	29000.00	

The selected material properties are copied to the Bridge Materials – Reinforcing Steel window as shown below.

🕰 Bridge Mat	erials - Reinforc	ing Steel				_		×
Name:	Grade 60							
Description:	60 ksi reinforci	ng steel						
Material prop	perties							
Specified yiel	d strength (fy):	60.000087	ksi					
Modulus of e	lasticity (Es):	29000.004206	ksi					
Ultimate stre	ngth (Fu):	90.0000131	ksi					
Туре								
O Plair	ı							
() Epos	ky .							
Galv	anized							
	Copy to	o library	Copy from	library	ОК	Apply	Canc	el

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	als - Prestress Strand 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		-
	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		
	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		*
													ОК	Apply	Ca	incel

🗛 Bridge Mat	terials - PS Strand			_		×
Name:	1/2" (7W-270) L	R				
Description:	Low relaxation 1	/2"/Seven Wire/fpu =	270			
Strand diame	eter:	0.5000	in			
Strand area:		0.153	in^2			
Strand type:		Low Relaxation	~			
Ultimate tens	sile strength (Fu):	270.000	ksi			
Yield strengt	h (fy):	243.000	ksi			
Modulus of e	lasticity (E):	28500.00	ksi			
	Com	pute	-			
Transfer leng	th (Std):	25.0000	in			
Transfer leng	th (LRFD):	30.0000	in			
Unit load per	length:	0.520	lb/ft			
		Epoxy coated	a			
Сору	to library	Copy from library	ОК	Apply	Canc	el

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

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

Beam Shapes

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

Bridge Wo	orkspace - PS6TrainingBridge		ANALYSIS	REPORTS		? – 🗆	×
BRIDGE WORKSPACE	WORKSPACE TOOLS	VIEW	DESIGN/RATE	REPORTING			^
Check Out Check In Validate	Save	ort Refresh	Open Ne	Copy Pas	te Duplicate Del	tete	
	Bridge			Manag	e		
Workspace	л ×	Schem	natic	ųх	Report	th	×
Bridge Components							
	s Shapes eeems Stepand Branch Collapse Branch New Analyze		is			*	×
Errors CRFD Substr Errors Materials	View Summary Report View Detailed Report General Preferences Close Bridge Workspace						



The Prestress I Beam window shown below will open.

Select the **Top flange type** as **Wide** and click the **Copy from library...** button. Select **AASHTO TYPE VI** and click **OK**.

ø	+ Library Data Prestress 1 Beam Shapes —													-							
	Name	Description	Library	Units	Depth	Top flange thickness	Top flange width	Bottom flange thickness	Bottom flange width	Top hauch height	Bottom haunch height	Top haunch 2 height	Top haunch 2 width	Deck included	Top flange ext. width	Radius fillet	Top flange radius fillet	Bottom flange radius fillet	Top web radius fillet	Bottom w radius fill	eb et
ľ	AASHTO TYPE V	AASHTO TYPE V	Standard	US Customary	63.0000	5.0000	42.0000	8.0000	28.0000	3.0000	10.0000	4.0000	4.0000	False		False					
ľ	AASHTO TYPE VI	AASHTO TYPE VI	Standard	US Customary	72.0000	5.0000	42.0000	8.0000	28.0000	3.0000	10.0000	4.0000	4.0000	False		False					
	BT-54	AASHTO-PCI Bulb-Tee BT-54	Standard	US Customary	54.0000	3.5000	42.0000	6.0000	26.0000	2.0000	4.5000	2.0000	2.0000	False		False					- U
	BT-63	AASHTO-PCI Bulb-Tee BT-63	Standard	US Customary	63.0000	3.5000	42.0000	6.0000	26.0000	2.0000	4.5000	2.0000	2.0000	False		False					_
I	BT-72	AASHTO-PCI Bulb-Tee BT-72	Standard	US Customary	72.0000	3.5000	42.0000	6.0000	26.0000	2.0000	4.5000	2.0000	2.0000	False		False					
				2												i		OK	A	pply	Cancel

The beam properties are copied to the Prestress I Beam window as shown below.



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

Bridge – Appurtenances

Steel Railing

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



Enter the railing details as shown below.



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

Concrete curb

To define the concrete curb, select **Generic** and click on **New** from the **Manage** button on the **WORKSPACE** ribbon (or right click on **Generic** and click on **New**).

Bridge Wor	rkspace - PS6Traini	ngBridge	ANALYSIS	REPORTS	?	– 🗆 ×
BRIDGE WORKSPACE	WORKSPACE	TOOLS VIEW	DESIGN/RATE	REPORTING		^
Check Out	Restore	🔀 🎸 💭 Close Export Refre	sh Open New	Copy Paste	Duplicate Delete	Schematic
	Bridge			Manage		
Workspace		🛛 🗙 🛛 Schem	atic	₽ × R	eport	щ×
Bridge Components	New Analyze					
<u><u></u> <u></u> </u>	View Summary I	Report	S			Ψ×
Beam Sha Beam Sha Connecto Factors LRFD Sub Beam Sha Factors LRFD Sub Beam Sha Factors Materials	General Preferen	orkspace				

Enter the concrete curb details as shown below.



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

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



The default impact factors, standard LRFD and LFR factors will be used. Bridge Alternatives will be added after entering the Structure Definition.

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.

×
ard
cel

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

	Engine		
ame: 1 Span, 5 Gir	rder System		Modeling Multi-girder system MCB
escription:	ny V Enter span lengths along the reference		UWth trane structure simplified definition Deck type: Concrete Deck V For PS/PT only
umber of spans: 1	line: Span Length (ft) ▶ 1 121.75		Average humidity: 70.000 % Member alt. types Steel Ø P/S R/C Timber P/T
Horizontal curvature along refe	rence line		
Horizontal curvature along refe	rence line Distance from PC to first support line:	ft	
Horizontal curvature along refe Horizontal curvature Superstructure alignment	rence line Distance from PC to first support line: Start tangent length:	ft ft	
Horizontal curvature along refe Horizontal curvature Superstructure alignment © Curved	rence line Distance from PC to first support line: Start tangent length: Radius:	ft ft ft ft	
Horizontal curvature along refe Horizontal curvature Superstructure alignment Curved Tangent, curved, tangent Tangent curved	rence line Distance from PC to first support line: Start tangent length: Radius: Direction:	ft f	
Horizontal curvature along refe Horizontal curvature Superstructure alignment Curved Tangent, curved, tangent Curved, curved Curved, tangent	rence line Distance from PC to first support line: Start tangent length: Radius: Direction: End tangent length:	ft f	
Horizontal curvature along refe Horizontal curvature Superstructure alignment © Curved Tangent, curved, tangent Curved, tangent Curved, tangent	rence line Distance from PC to first support line: Start tangent length: Radius: Direction: End tangent length: Distance from last support line to PT:	ft ft Left v ft	
Horizontal curvature along refe Horizontal curvature Superstructure alignment Curved Tangent, curved, tangent Curved, tangent	rence line Distance from PC to first support line: Start tangent length: Radius: Direction: End tangent length: Distance from last support line to PT: Design speed:	ft ft Left v ft ft ft ft ft ft	

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

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). Enter the following data.

Global positioning -	
Distance: 0	ft
Offset: 0	ft
Elevation:	ft
Start tangent length:	ft
Curve length:	ft
Radius:	ft
Direction:	~
End tangent length:	ft
	Global positioning Distance: 0 Offset: 0 Elevation: Start tangent length: Curve length: Radius: Direction: End tangent length:

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

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

A Superstructure	:								_		×
Superstructure na	me:	Superstru	icture #1								
Description	Alte	rnatives	Vehicle path	Engine	Substructures						
Description:											
Reference l	ine –					-					
Distance:		0	ft								
Offset:		0	ft								
Angle:		0	Degrees								
Starting sta	ation:		ft								
							OK	Ap	ply	Canc	el

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

Expand the **Superstructure #1** node in the **Bridge Workspace** tree. 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 **1 Span**, **5 Girder System** as the current superstructure definition for this Superstructure Alternative.

🗛 s	uperstru	ucture Alternati	ve		_) ;	×
Alter	rnative r	name:	Superstructure Alternative #1					
Desc	ription:							
Supe	erstructu	ure definition:	1 Span, 5 Girder System 🗸 🗸	ā				
Supe	erstructu	ure type:	Girder					
Num	iber of i	main members	5					
	Span	Length (ft)						
>	1	121.75						
			ОК		Apply	C	ancel	

Re-open the **Superstructure #1** window and navigate to the **Alternatives** tab. The **Superstructure Alternative #1** will be shown as the **Existing** and **Current** alternative for **Superstructure #1**.

									_
uperstructure	:							_	
arstructure na	me: Super	structure #1							
erstructure na	ine. Super								
Description	Alternative	s Vehicle path	Engine	Substructures					
Existing	Current	Superstructure alter	native name	Description					
> 🔽		Superstructure Alter	mative #1						
_									
						ОК	Αρρί	v	Can

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



Load Case Description

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.

Load case name	Description	Stage		Туре	Time* (days)	
DC DL2	Parapets	Composite (long term) (Stage 2) 🔹	D,DC	-		
DW DL2	Future wearing surface	Composite (long term) (Stage 2) 🔹	D,DW	Ψ.		

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

Structure Framing Plan Detail – Layout

Double-click on Framing Plan Detail in the Bridge Workspace tree to describe the framing plan in the Structure

Framing Plan Details window. Enter the data as shown below.

Structure Framing Plan Details		- 🗆
Number of spans: 1 Number	of girders: 5	
Layout Diaphragms		
	Girder spacing orientation	
Show	O Perpendicular to girder	
Support (degrees)	Along support	
1 15		
> 2 15	Girder spacing (ft)	
	bay Start of End of	
	girder girder	
	> 1 9.0833 9.0833	
	2 9.0833 9.0833	
	3 9.0833 9.0833	
	4 9.0833 9.0833	
	v	
	0	K Apply Cancel

Structure Framing Plan Detail – Diaphragms

Switch to the **Diaphragms** tab to enter the diaphragm spacing. Click the **Diaphragm wizard...** button to add diaphragms for the entire structure. **Select the desired framing plan system** and click the **Next** button. Enter the following data on the window shown below.

A Diaphragm Wizard X	A Diaphragm Wizard X
Select the desired framing plan system:	Diaphragm spacing Diaphragm spacing Enter equal spacing per span Enter groups of equal spacing Interior diaphragm along skew
	Left girder Support diaphragm load:kip Interior diaphragm load:kip Equal sparing
	Span Length (ft) Distance D (ft) Length S (ft) Distance D S (ft) I 121.75 60.88 60.875 A
	~
< Back Next > Cancel	Sack Finish Cancel

Click the **Finish** button to add the diaphragms. The **Diaphragm Wizard** will create diaphragms for all the girder bays in the structure. The diaphragms created for **Girder bay 1** are shown below.

Layout Diaphragms Girder bay:	_	_		
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$				
Left girder Right girder (ft) Anno 1 Left girder Right girder Right girder 1 ✓ 0 0 0 1 0 0 0 1 ✓ 60.875 63.30863 0 1 0 60.875 63.30863 1 ✓ 121.75 121.75 0 1 0 121.75 121.75	Diaphragm			
> 1 ∨ 0 0 0 1 0 0 0 1 ∨ 60.875 63.308863 0 1 0 60.875 63.308863 1 ∨ 121.75 121.75 0 1 0 121.75 121.75				
1 60.875 63.308863 0 1 0 60.875 63.308863 1 121.75 121.75 0 1 0 121.75 121.75	Not Assigned	\sim		ĥ
1 V 121.75 121.75 0 1 0 121.75	Not Assigned	\sim		
	Not Assigned	~		
New	Duplicate		Delete	

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

Schematic – Framing Plan Detail

A schematic view of the framing plan can be viewed by selecting the **Framing Plan View** node in **the Bridge Workspace** tree and clicking on the **Schematic** button from the **WORKSPACE** ribbon (or by right clicking on the **Framing Plan View** node and selecting **Schematic** from the menu) as shown below.



Notice that the span length is displayed along the first girder in the plan. Until the **Structure Typical Section** window is visited, the **Superstructure Definition Reference** line that was entered as span length in the **Girder System Superstructure Definition** window is located under the first girder.



Structure Typical Section - Deck

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

A Structure Typical Section		-		×
Distance from left edge of deck to superstructure definition ref. line superstructure definition ref. line				
Deck Line Line Line				
Left overhang				
Deck Deck (cont'd) Parapet Median Railing Generic Sidewalk Lane position Striped lanes Wearing sur	rface			
Superstructure definition reference line is within 🕑 the bridge deck.				
Start End				
superstructure definition reference line:				
Distance from right edge of deck to superstructure definition reference line: 25.67 ft 25.67 ft				
Left overhang: 4.50 ft 4.50 ft				
Computed right overhang: 4.51 ft 4.51 ft				
OK	ĸ	Apply	Cano	:el

In this example, the **Structure Definition Reference** line is located at the construction CL in the typical section.



*The construction CL is used as the Structure Definition Reference line in this example

Structure Typical Section – Deck (cont'd)

The **Deck (cont'd)** tab is used to enter information about the **Deck concrete** and the **Total deck thickness**. The material to be used for the deck concrete is selected from the list of bridge materials. Enter data as shown below.

A Structure Typical Section	-		×
Distance from left 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			
Deck concrete:			
Total deck thickness: 8.5000 in			
Load case: Engine Assigned			
Deck crack control parameter: 130.000 kip/in			
Sustained modular ratio factor: 2.000			
Deck exposure factor:			
	Apply	Cance	1
Ŭ,	עיקקר	cance	

Structure Typical Section – Railing

Add two steel railings as shown below.

Stru	cture Typical Section									-		
	Front											
) Deck	: Deck (cont'd) Parapet	Median	Railing	Gen	eric Sidewalk	Lane position	on Striped	lanes We	aring surface			
	Name	Load ca	se Mea	sure to	Edge of deck dist. measured from	Distance at start (ft)	Distance at end (ft)	Front face orientation				
Þ	Two Tube Bridge Rail 🔹	DC DL2	* Fron	t -	Left Edge 🔹	1.67	1.67	Right -				4
	Two Tube Bridge Rail	DC DL2	* Fron	t -	Right Edge 🔹	1.67	1.67	Left -				
									New Du	plicate	Delete	
									OK	Apply	Can	

Structure Typical Section – Generic

Add two generic curbs as shown below.

	<	- Generic	Shape									
ck	Deck (cont'd)	Parapet	Median	Railing	Gen	eric Sidewalk	Lane positi	on Striped	d lanes	Wearing surface		
	Name	L	oad case	Measu	re to	Edge of deck dist. measured from	Distance at start (ft)	Distance at end (ft)	Front fa orientat	ce		
Þ	Curb -	DC DL	2 -	Back	*	Left Edge 🛛 👻	0.00	0.00	Right	•		
	Curb -	DC DL	2 *	Back	*	Right Edge 🛛 👻	0.00	0.00	Left	*		
_										New	Duplicate	Delete

Structure Typical Section – Lane Positions

Select the **Lane position** tab and use the **Compute...** button to compute the lane positions. A window showing the results of the computation opens. Click **Apply** to apply the computed values.

A	Compute La	ne Positions				×
	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)	
)	1	-18.00	24.00	-18.00	24.00	-
					Apply Ca	- ncel

Struc	Travely Travely	Section	are Definition Reference Line tavelway 2	slk Lane position Striped	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)		
+	1	-18.00	24.00	-18.00	24.00		Â
	RFD fatigue						Ŧ
[Lanes ava	Truck fraction:	Compute		New Dupl	icate	Delete
					ОК	Apply	Cance

The Lane Position tab is populated as shown below.

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

Schematic – Structure Typical Section

A schematic view of the structure typical section can be viewed by selecting the **Structure Typical Section** node in **the Bridge Workspace** tree and clicking on the **Schematic** button from the **WORKSPACE** ribbon (or by right clicking on the **Structure Typical Section** node and selecting **Schematic** from the menu) as shown below.



Schematic	_ 🗆 ×
Typical section	▼ ×
	÷
PS6TrainingBridge Skewed PS I Beam Bridge - 1 Span, 5 Girder System 2/3/2023	
45'-4 1/16"	
1'-1 3/16" 43'-1 3/4" 1'-	3/16"
42'-0"	
Deck Thickness 8 1/2"	
Travelway 1	
<u>4'-6"</u> <u>4@9'-1" = 36'-4"</u> <u>4'-6 1/1</u>	6"

The beams are displayed as dashed boxes since the beams are not defined yet.

Navigate back to the **Schematic** for the **Framing Plan Detail**. It now shows the span length along the superstructure definition reference line.



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 **PS 6.5 ksi** 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. A 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. Manually enter these values as shown below. The **Final allowable tension** values are calculated using the default stress limit coefficient if the **Final allowable tension stress limit coef. (US) override** checkbox is not checked on this window. This coefficient is dependent on the moderate or severe corrosion condition to which the members are exposed.

A Stress Limit Sets - Co	oncrete						-	_		×
Name:	6.5 Ksi Stres	is Limit								
Description:										
Corrosion condition:	loderate		~							
Final allowable ten	sion stress	limit coef. (US	6) override:							
Concrete material:	S 6.5 Ksi		\sim							
ſ	Compute	ר								
		LFD		L	RFD					
Initial allowable compre	ession:	3.315	ksi	3.5	9125	ksi				
Initial allowable tensior	1:	0.2	ksi	0.2		ksi				
Final allowable compre	ssion:	3.9	ksi	3.9		ksi				
Final allowable tension:		0.4844069	ksi	0.4	844069	ksi				
Final allowable DL com	pression:	2.6	ksi	2.9	25	ksi				
Final allowable slab cor	npression:	2.7	ksi	2.7		ksi				
Final allowable compre (LL+1/2(Pe+DL))	ssion:	2.6	ksi	2.6		ksi				
					0	ĸ	Apply		Cance	<u>+</u>

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" Starand A	ASHTO Loss					
General P/S data	Loss data - lump sum Loss data - PCI)				
P/S strand material:	1/2" (7W-270) LR	Jacking stress ratio:	0.750]		
Loss method:	AASHTO Approximate	P/S transfer stress ratio:				
		Transfer time:	24.0	Hours		
		Age at deck placement:	30.00	Days		
		Final age:	18250.00	Days		
Loss data - AASHT Percentage DL: 0.	0% 0%					
			OK	Apply	Cance	el

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

Shear Reinforcement

Define shear reinforcement to be used by the girders. Expand the **Shear Reinforcement Definitions** on 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**).



Define the stirrup as shown below. Click **OK** to save and close the window.

🕰 Shear	Reinforcement Definition - Vertical	-		×
Name:	#4 Stirrups			
	Material: Grade 60		~	
	Bar size: 4			
	Number of legs: 2.00			
	Inclination (alpha): 90.0 Degrees			
	Reinforcement			
	OK	Apply	Cance	:I

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.

A Member	-		×
Member name: G2 Link with: None			
Description:			
Existing Current Member alternative name Description			
			-
			_
Number of spans: 1 Span length no. length (ft)			
OK A	Apply	Canc	el

Defining a Member Alternative

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 I** 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 as shown below. Enter the data as shown below and click **OK** to save to memory and close the window. The **Schedule-based Girder property input method** is the only input method available for a prestressed concrete beam.

lember alter	native: Typ	e VI Beam							
Description	Specs	Factors	Engine	Import	Control options				
Description:					Material type:	Prestressed (Pretens	ioned)		
					Girder type:	PS Precast I			
					Modeling type:	Multi Girder System			
					Default units:	US Customary	~		
Cross-	-section ba	sed			Default rating meth	od:			
Load case Additiona Additiona	e: al self load: al self load:	Engine As	signed kip/ft %	~	LFR	~			
Crack co	ntrol param	eter (Z)	kip/in	Exposur Top of b	e factor	Use cree	0		
Top of be	ann.								
Top of be Bottom o	of beam:		kip/in	Bottom	of beam:				

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

Beam Details

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.

			Side interface	thes chief bio			1		
	Span number	Beam shape	Girc mate	der erial	Prestress properties	n	Beam p Left end (in)	Right end (in)	
Þ	1	AASHTO TYPE VI	PS 6.5 Ksi	*	1/2" Starand AASHTO Loss 👻		7.0000	7.0000	

Note that the **Stress limit ranges** are defined over the entire length of the precast beam, including the projections of the beam past the centerline of bearing which were entered on the **Span detail** tab of this window.

				Start		End					
r	Span number	Name		distance (ft)	Length (ft)	distance (ft)					
1	1 ~	6.5 Ksi Stress Limit	\sim	0	122.9167	122.9167					
								New	- East	Delat	

🕰 Beam Details								-		×
Span detail	Stress limit ranges	Slab interface	Web end block)						
Interface type	:	Monolithic	\sim							
Default interf	ace width to beam wid	ths: 🖌								
Interface widt	th:		in							
Cohesion fact	tor:	0.400	ksi							
Friction factor	r:	1.400								
K1:		0.250]							
K2:		1.500	ksi							
					[OK	Ap	ply	Cance	2

The defaults on the **Slab interface** tab are acceptable.

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

Strand Layout

Expand the **Strand Layout** in the **Bridge Workspace** tree and double-click on **Span 1**. Select the **Description type** as **P and CGS only**. The schematic of the beam shape is no longer displayed on the right side of this window. Since the center of gravity of the strands needs to be entered, it is not required to specify the location of each strand. Enter the following data to describe the prestress strand configuration.

🕰 Strand Layout - Span	n1 —								
Description type P and CGS only Strands in rows									
Left harp pt. dist. (X1):	49.00	ft							
Left harp pt. radius:] in							
Right harp pt. dist. (X2):	49.00	ft							
Right harp pt. radius:		in							
Force:	1859.00	kip							
Left CGS:	20.8700	in							
Mid CGS:	6.4700	in							
Right CGS: 20.8700 in									
ОК Ар	ply C	ancel							

Click **OK** to save this data to memory and close the window.

Deck Profile

Next open the **Deck Profile** window by double-clicking the **Deck Profile** node in the **Bridge Workspace** tree and enter the data describing the structural properties of the deck. The window is shown below.

e:	PS Precast													
d	k concrete	Reinforce	ment											
	Mate	erial	Support number	Start distance (ft)	Length (ft)	End distance (ft)	Structural thickness (in)	Start effective flange width (Std) (in)	End effective flange width (Std) (in)	Start effective flange width (LRFD) (in)	End effective flange width (LRFD) (in)	n		
	Deck Concr	rete 🔹	1 -	0.00	121.75	121.75	8.5000	102.0000	102.0000	109.0000	109.0000			

No reinforcement is described.

Haunch Profile

The haunch profile is defined by double-clicking on the **Haunch Profile** node in the **Bridge Workspace** tree. Enter data as shown below and Click **OK** to apply the data and close the window.

A PS Haunch Pr	ofile									-		×
	IY3	n] 										
Support number	Start distance (ft)	Length (ft)	End distance (ft)	Z1 (in)	Z2 (in)	Y1 (in)	Y3 (in)					
▶ 1	0.00	121.75	121.75	0.0000	0.0000	2.0000	0.0000					-
								New	Dunlicate		Delete	Ŧ
								New	Duplicate		Delete	
								OK	Appl	у	Cano	el

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 are entered as described below. The vertical shear reinforcement is defined as extending into the deck on the **Vertical** tab of this window. This indicates composite action between the beam and the deck. Data does not have to be entered on the Horizontal tab to indicate composite action since that has been defined by extending the vertical bars into the deck.

PS S	ihear Reinforcement	Ranges	i					- 0	2
- Vert	Start Distance		Spacing						
Spar	n: 1 ~								
	Name		Extends into deck	Start distance (ft)	Number of spaces	Spacing (in)	Length (ft)	End distance (ft)	
>	#4 Stirrups	~		0.17	1	0	0	0.17	-
	#4 Stirrups	~	\checkmark	0.17	4	3	1	1.17	
	#4 Stirrups	~		1.17	1	4	0.333333	1.503333	
	#4 Stirrups	~		1.503333	120	12	120	121.503333	
	#4 Stirrups	~	\sim	121.503333	1	4	0.333333	121.836666	
	#4 Stirrups	\sim		121.836666	4	3	1	122.836666	
									•
9	Stirrup wizard	Stirrup	design tool	View calcs	;	Ne	ew Dupl	icate Delete	•
							ОК	Apply Car	ncel

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

Live Load Distribution

Double click on the Live Load Distribution node in the Bridge Workspace tree for member G2 to open the Live Load Distribution window.

On the **Standard** tab of this window, click the **Compute from typical section**... button to compute the standard live load distribution factors. BrDR will compute the distribution factors based on the girder type, girder spacing, deck geometry and lane position as per the AASHTO Standard Specification for Highway Bridges.

VEL		tion					_		
	.oau Distribu	lion							
and	lard LRFI	D							
- Di	stribution fa	ctor input r	nethod						
(Use simp	lified meth	nd O	Use advanc	ed method	Use advanced method with 1994 guide specs			
	000 000								
/ /	Allow distrib	ution facto	rs to be use	d to compu	te effects of p	ermit loads with routine traffic			
			Distribu	tion factor					
	Lanes		(wł	neels)					
	loaded	Shear	Shear at supports	Moment	Deflection				
>	1 Lane	1.297614	1.339447	1.297614	0.4				
	Multi-lane	1.651509	1.899079	1.651509	1.08				
Cor	mpute from	. Vie	w calcs						
Cor	mpute from ical section	. Vie	w calcs						Ţ
Cor	mpute from ical section	. Vie	w calcs						The second se
Cor	mpute from ical section	. Vie	w calcs			OK	Apply	Ca	ncel

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

The description of this structure definition is complete.

LFR Analysis

The member alternative can now be analyzed. To perform an **LFR** rating, select the **Analysis Settings** button on the **Analysis** group of the **DESIGN/RATE** ribbon. The window shown below opens.

Bridge Wor	kspace - PS6TrainingBridge	ANALYSIS	REPORTS	?	-	×
BRIDGE WORKSPACE	WORKSPACE TOOLS VIEW	DESIGN/RATE	REPORTING			^
a	📄 🕞 🇞	2 📙				
Analysis Analyze Analysis Settings Events	Tabular Specification Engine Rest Results Check Detail Outputs Gra	ults Save ph Results				
Analysis	Results					

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

A	Open Template					×
	Templates	Description	Analysis	Owner	Public / Private	
	HL 93 Design Review	HL 93 Design Review	LRFD		Public	
	HS 20 LFR Rating	HS 20 LFR Rating	LFR		Public	
	LRFR Design Load Rating	LRFR Design Load Rating	LRFR		Public	
	LRFR Legal Load Rating	LRFR Legal Load Rating	LRFR		Public	
						v.
	Delete				Open	Cancel

The Analysis Settings window will be populated as shown below.

Design review Rating Rating method: LFR Analysis type: Line Girder ane / Impact loading type: As Requested Vehicles Output Traffic direction: Both directions Vehicle selection Vehicle summary Image: Provide the selection Vehicle selection Image: Provide the selection Provide the selection Image: Provide the sele	Analysis Settings				-	×
Analysis type: Line Girder ane / Impact loading type: As Requested Vehicles Output Engine Description Traffic direction: Both directions Vehicles selection Vehicles	O Design review	Rating met	hod:	LFR	~	
Tarfic direction Both directions Nethods Refresh Temporary vehicles Advanced Vehicle selection Vehicle summary Vehicle summary Vehicle summary Vehicle summary Petrate Military Loading	Analysis type: Line Girder Lane / Impact loading type: As Requested Vehicles Output Engine Description	Apply prefe	erence setting:	None	>	
 ➡ Vehicles ➡ Standard → EV2 → FV3 → H 15-44 → H 515-44 → H 520-44 → H 520-44 → H 515-44 → H 520-44 → H 100-100 → H 200-44 → H 100-100 → H 200-44 → H 100-100 → H 100-100	Traffic direction: Both directions	V	Refresh ehicle summar	Temporary vehicles	Advanced	
	Berlief Vehicles Vehicles Standard	Add to >> Remove from <<	⊟ Rating vehic ⇒ Inventor ↓ -HS2 ⇒ Operatin -HS2 - Legal op - Permit o	les y 0-44 ig 0-44 verating wentory perating		

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

Tabular Results

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



When the rating is finished results can be reviewed by clicking the Tabular Results button on the Results group of

the **DESIGN/RATE** ribbon.

Bridge Workspace - PS6TrainingBridge	ANALYSIS	REPORTS	?	-	×
BRIDGE WORKSPACE WORKSPACE TOOLS VIEW	DESIGN/RATE	REPORTING			^
Analysis Analyze Analysis Events Analysis Analysis Analysis Events Analysis Events Analysis Events Analysis Analysis Analysis Analysis Results	sults Save Paph Results				

The window shown below will open.

A	Analysis Re	sults - Type	VI Beam								- 🗆	×
	Print Print											
Rep	oort type:		- Lane/	Impact load	ing type	Display	Format					
Ra	ting Results	Summary	~ O	As requeste	ed ODetail	ed Single	rating leve	l per row	\sim			
	Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Limit State	Impact	Lane	
	HS 20-44	Axle Load	LFR	Inventory	62.41	1.734	118.31	1 - (97.2)	Design Shear - Concrete	As Requested	As Requested	i
	HS 20-44	Axle Load	LFR	Operating	104.22	2.895	118.31	1 - (97.2)	Design Shear - Concrete	As Requested	As Requested	1
	HS 20-44	Lane	LFR	Inventory	64.81	1.800	3.44	1 - (2.8)	Design Shear - Concrete	As Requested	As Requested	ł
	HS 20-44	Lane	LFR	Operating	108.24	3.007	3.44	1 - (2.8)	Design Shear - Concrete	As Requested	As Requested	1
AA	SHTO LFR En	igine Versior	n 7.5.0.3001									
Ana	alysis prefere	ence setting:	None									
											CI	ose