AASHTOWare BrDR 7.5.0 Prestress Tutorial 11 PS-11 Bridge Over Shoal Creek

BrDR Superstructure Training

PS11 - Bridge Over Shoal Creek

Bridge Over Shoal Creek

- Bridge Sheet No. 2 General Plan and Elevation
- Bridge Sheet No. 3 Span No's. 1, 2, & 3 Details
- Bridge Sheet No. 5 Girder Details Span No's. 1, 2, & 3

BrDR Modeling Strategy

- 1. Create one BrDR superstructure definition (Span 1 and Span 3 Definition) for Span No. 1 and Span No. 3
 - Complete one exterior girder (G1)
 - Copy the exterior girder to an interior girder (G2) and check the Deck Profile and Haunch Profile.
 - Link all other interior girders (G3, G4 and G5) to G2.
 - Link the other exterior girder (G6) to G1.
- 2. Create another BrDR Superstructure Definition (Span 2 Definition) for Span No. 2 by copying Span 1 and 3 Definition.
 - Modify the span length in Superstructure Definition.
 - Repopulate the diaphragm spacing using the Diaphragm Wizard.
 - Modify the length of the range in Beam Details, Deck Profile and Haunch Profile.
 - Modify the harp point distance in Strand Layout.
 - Reenter Shear Reinforcement Ranges.
- 3. Create one Bridge Alternative and three superstructures. The first superstructure is for Span No. 1, the second superstructure is for Span No. 2 and the third superstructure is for Span No. 3.
- 4. Assign Span 1 and 3 Definition to the first and third superstructure and assign Span 2 definition to the second superstructure.







The completed Bridge Workspace tree for this bridge is as shown below.







Create one BrDR superstructure definition (Span 1 and Span 3 definitions) for Span No. 1 and

Span No. 3

Br AASHT	AASHTOWare Bridge Design and Rating ? -								
BRIDGE EXPLORER BRIDGE	FOLDER	RAT	E	TOOLS	VIEW	/			
New Open Open	Find Cop	y Pas	te (Copy Rem To • Fro	iove De	elete			
Bridge			Man	age		_			
Favorites Folder		E		В	ridge II				
Recent Bridges		÷.	1 T	rainingBrid	lge1			-	
All Bridges			2 T	rainingBrid	lge2				
Emplates			3 T	rainingBrid	lge3				
Deleted Bridges			4 P	CITraining	Bridge1				
			5 P	CITraining	Bridge2			-	
			6 P	CITraining	- Bridge3				
			7 P	CITraining	Bridae4			Ŧ	
							•	,	
	Total Bridg	e Cour	ıt:	33					

From the **Bridge Explorer** create a **new bridge**.

Enter the following bridge description data.

A	New Bridge											-		×
В	Bridge ID: PS11			NBI structur	re ID (8):	PS11		Te	mplate idge comple	tely defined		Superst Culvert Substru	tructures s ictures	
ſ	Description	Description	n (cont'd)	Alternatives	Globa	al reference point	Traffic	Custom	agency field	Is				
	Name:	Bride	ae Over Sho	oal Creek			7	Yea	ır built:		1			
		Proje	- ect No. BR-	0053(513)					1					
	Description:													
	Location:	St. C	lair County					ler	ath:	165.00	ft			
	Facility carried	(7): SR-5	3					Roi	ute number:	SR-53	1			
	Feat. intersecte	ed (6):						Mi.	post:		ī			
	Default units:	US C	ustomary	~							_			
ſ	Bridge a	ssociation	V 8	BrR 🗹 BrD	BrM	Sync with BrM								
									OK	A	pply		Cancel	

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

Bridge Components

To enter the materials to be used by members of the bridge, open the **Components** tab, and click on the \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 6.0 Ksi					
Description:	Girder Concrete					
Compressive	strength at 28 days (f'c):	6	ksi			
Initial compre	essive strength (f'ci):	5	ksi			
Composition	of concrete:	Normal ~				
Density (for o	lead loads):	0.15	kcf			
Density (for r	nodulus of elasticity):	0.145	kcf			
Poisson's rati	0:	0.2				
Coefficient of	f thermal expansion (α):	0.000006	1/F			
Splitting tens	ile strength (fct):		ksi			
LRFD Maxim	um aggregate size:		in			
	Compute					
Std modulus	of elasticity (Ec):	4463.150877	ksi			
LRFD modulu	us of elasticity (Ec):	4557.295222	ksi			
Std initial mo	dulus of elasticity:	4074.280688	ksi			
LRFD initial n	nodulus of elasticity:	4291.186125	ksi			
Std modulus	of rupture:	0.580948	ksi			
LRFD modulu	is of rupture:	0.587878	ksi			
Shear factor:		1				
	Copy 1	to library Copy	from library OK	Apply	Canc	el

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

Similarly add another concrete material for the deck. Select a library concrete material by clicking on the **Copy from library...** button in the **Bridge Materials – Concrete** window. The following window opens.

4	Library Data:	Materials - Concrete												- [×
	Name	Description	Library	Units	f'c	f'ci	alpha	DL density	Modulus density	Std modulus of elasticity	LRFD modulus of elasticity	Poisson's ratio	Std Modulus of rupture	LRFD Modulus of rupture	
	Class A	Class A cement concrete	Standard	SI / Metric	28.00		0.0000108000	2400.00	2320.00	25426.08	27730.36	0.200	3.33	3.33	
	Class A (US)	Class A cement concrete	Standard	US Customary	4.000		0.000060000	0.150	0.145	3644.15	3986.55	0.200	0.48	0.48	
	Class B	Class B cement concrete	Standard	SI / Metric	17.00		0.0000108000	2400.00	2320.00	19811.84	23520.23	0.200	2.60	2.60	
	Class B (US)	Class B cement concrete	Standard	US Customary	2.400		0.0000060000	0.150	0.145	2822.75	3368.12	0.200	0.37	0.37	
	Class C	Class C cement concrete	Standard	SI / Metric	28.00		0.0000108000	2400.00	2320.00	25426.08	27730.36	0.200	3.33	3.33	
	Class C (US)	Class C cement concrete	Standard	US Customary	4.000		0.0000060000	0.150	0.145	3644.15	3986.55	0.200	0.48	0.48	
	PS 6.5 ksi	PS 6.5 ksi (f'ci=5.5 ksi)	Agency	US Customary	6.500	5	0.0000060000	0.150	0.150	4887.73	5007.55	0.200	0.60	0.61	
															-
													ОК	Apply	Cancel

Select the **Class A** (**US**) material and click **OK**. The selected material properties are copied to the **Bridge Materials** - **Concrete** window.

🕰 Bridge Mat	terials - Concrete			_		×
Name:	Class A (US)					
Description:	Class A cement concrete	2				
Compressive	strength at 28 days (f'c):	4.0000006	ksi			
Initial compre	essive strength (f'ci):		ksi			
Composition	of concrete:	Normal ~				
Density (for o	lead loads):	0.15	kcf			
Density (for r	nodulus of elasticity):	0.145	kcf			
Poisson's rati	0:	0.2				
Coefficient of	f thermal expansion (α):	0.000006	1/F			
Splitting tens	ile strength (fct):		ksi			
LRFD Maxim	um aggregate size:		in			
	Compute					
Std modulus	of elasticity (Ec):	3644.147704	ksi			
LRFD modulu	us of elasticity (Ec):	3986.548657	ksi			
Std initial mo	dulus of elasticity:	0	ksi			
LRFD initial n	nodulus of elasticity:	0	ksi			
Std modulus	of rupture:		ksi			
LRFD modulu	is of rupture:	0.48	ksi			
Shear factor:		1				
	Сору т	to library Copy	from library OK App	ly	Cance	el

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

Add the following reinforcement material (**Grade 60**) and prestress strand (**1/2**" (**7W-270**) **LR**) using the same **Copy from library** technique. The windows will be populated as shown below.

🕰 Bridge Mat	erials - Reinforci	ng Steel					_		×
Name:	Grade 60								
Description:	60 ksi reinforcir	ng steel							
Material prop	erties								
Specified yiel	d strength (fy):	60.000087	ksi						
Modulus of e	lasticity (Es):	29000.004206	ksi						
Ultimate stre	ngth (Fu):	90.0000131	ksi						
Type Plair Epo Galv	n sy anized Copy to	o library Cop	y from library	·	ОК	Ар	ply	Canc	el
🕰 Bridge M	laterials - PS St	rand					_		×
Name:	1/2" (7W-2	70) LR							
Description	: Low relaxat	ion 1/2"/Seven W	Vire/fpu = 2	70					
Strand dian	neter:	0.5000		in					
Strand area	i:	0.153		in^2					
Strand type	2:	Low Relaxa	ation	~					
Ultimate te	nsile strength	(Fu): 270.000		ksi					
Yield streng	gth (fy):	243.000		ksi					
Modulus of	f elasticity (E):	28500.00		ksi					
		Compute							
Transfer ler	ngth (Std):	25.0000		in					
Transfer ler	ngth (LRFD):	30.0000		in					
Unit load p	er length:	0.520		lb/ft					
		Epoxy co	pated						
Сор	y to library	Copy from li	brary	OK		Apply		Cance	2

Beam Shapes

To enter a prestress beam shape to be used in this bridge, expand the **Beam Shapes** node and **Prestress Shapes** node in the **Componenets** tree as shown below.



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). The window shown below will open.

Bridg Bridg	e Workspace - PS11		ANALYSIS	REPORTS	?	-		×
BRIDGE WORKSPACE	WORKSPACE TOC	LS VIEW	DESIGN/RATE	REPORTING				^
Check Out Check In Validate Sa	Restore Revert Clos	e Export Refre	sh Open Net	Copy Paste	Duplicate Delete	Scher	+ natic	
	Bridge			Manage				
Workspace	ц×	Schema	atic	я × Re	port		щ	×
Bridge Components								
Components	hapes ams New Analyze							
🖶 🧭 Steel Shap	View Summary	Report					4	×
E Onnectors	View Detailed I	Report	_					
B ··· ∅ Factors ···· ∅ LRFD Substruc B ··· ∅ Materials	 General Prefere Close Bridge W 	ences /orkspace						



Select the **Top flange type** as **Narrow** and click the **Copy from library...** button. Select **AASHTO Type II** and click **OK**.

•	A	Library Data: Prest	ress I Beam Shapes									- 0	×
		Name	Description	Library	Units ⁹	Depth	Top flange thickness	Top flange width	Bottom flange thickness	Bottom flange width	Top hauch height	Bottom haunch height	
		AASHTO TYPE I	AASHTO TYPE I	Standard	US Customary	28	4.0000	12.0000	5.0000	16.0000	3.0000	5.0000	-
	Þ	AASHTO TYPE II	AASHTO TYPE II	Standard	US Customary	36	6.0000	12.0000	6.0000	18.0000	3.0000	6.0000	
		AASHTO TYPE III	AASHTO TYPE III	Standard	US Customary	45	7.0000	16.0000	7.0000	22.0000	4.5000	7.5000	
		AASHTO TYPE IV	AASHTO TYPE IV	Standard	US Customary	54	8.0000	20.0000	8.0000	26.0000	6.0000	9.0000	
													-
										0	К	Apply	ancel



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

Select the Strand grid tab and modify the possible prestress strand locations as shown below.

🕰 Prestress Beam						- O >
Name: AASHTO TYPE II						Top flange type
AASHTO TYPE II Description:						NarrowWide
Dimensions Properties Mild :	teel	Strand	grid			
		Row no.	No. of strands	Vertical distance from bottom (in)	Horizontal spacing (in)	
	Þ	1	8	3.0000	2.0000	A
JIII		2	6	5.0000	2.0000	
Distance		3	4	7.0000	2.0000	
		4	4	9.0000	2.0000	
Row 1—J +		5	2	11.0000	2.0000	
		6	2	13.0000	2.0000	
		7	2	15.0000	2.0000	
		8	2	17.0000	2.0000	
		9	2	19.0000	2.0000	
		10	2	21.0000	2.0000	
		11	2	23.0000	2.0000	
		12	2	25.0000	2.0000	
		13	2	27.0000	2.0000	
		14	2	29.0000	2.0000	
		15	2	31.0000	2.0000	
		16	2	34.0000	2.0000	
					New D	uplicate Delete
		Сор	y to library	Copy from library	ОК	Apply Cancel



Bridge - Appurtenances

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



Enter the parapet details as shown below.

🕰 Bridge Ap	opurtenances - Parapet				– [X
Name:	Barrier Rail					
Description:	Standard Drawing I-13	1				
	All dimensions are in in	ches				
[6.0000 eference		0.0000 0.0000 19.0000 10.0000	kip/ft Boadway Surface	Parapet unit load: 0.1500 kcf Calculated properties Net centroid (from reference line): 5.078 in Total load: 0.305 kip/ft	
	Back	Front Ţ	3.0000			
			[Copy from library	OK Apply	Cancel



The default LRFD dynamic load allowance and default LRFD factors will be used.

Workspace -	- 🗆 ×
Bridge Components	
Components Components Sarrier Rail AASHTO TYPE II FS 6.0 Ksi Class A (US) SI 1/2" (7W-270) LR Grade 60 Components Diaphragm Definitions Diaphragm Definitions SUPERSTRUCTURE DEFINITION BRIDGE ALTERNATIVES	٩S

The partially expanded Bridge Workspace tree is 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.

efinition Analy	sis Specs	Engine			
ame:	Span 1 and 3	Definition			Modeling Multi-girder system MCB With frame structure simplified definition
escription:					Deck type: Concrete Deck
efault units: umber of spans: umber of girders:	US Customary	 Enter span lengths along the reference line: Span Length (ft) X 1 52.125 	Å		For PS/PT only Average humidity: % Member alt. types Steel Ø P/S R/C Timber Ø P/T
Horizontal curvatu	ire along refere	ence line			
	alignment	Distance from PC to first support line		n .	
Curved		Start tangent length:		n .	
🔿 Tangent, cur	ved, tangent	Nacius:	1-6	n	
O Tangent, cur	ved	End tangent length	Leit 🗸	6	
Curved, tang	gent	Distance from last support line to DT		ft	
		Design speed		mph	
		Superelevation:		%	
		•			

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

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. Click on the Add default load case descriptions button to create the following load cases.

Load case name	Description	Stage	Туре	Time* (days))
DC1	DC acting on non-composite section	Non-composite (Stage 1)	D,DC	*	
DC2	DC acting on long-term composite section	Composite (long term) (Stage 2) *	D,DC	*	
DW	DW acting on long-term composite section	Composite (long term) (Stage 2) 🔹	D,DW	*	
SIP Forms	Weight due to stay-in-place forms	Non-composite (Stage 1)	D,DC	-	

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.

Str	ucture Frami	ng Plan Details	;									-	-		×
Numl	ber of spans:	1	Number of gir	ders:	6										
Lay	yout Diap	ohragms													
				G	rder spa	cing orien	tation								
	Support	Skew (degrees)		C) Perpend	dicular to g upport	girder								
	▶ 1	0.000							_						
	2	0.000			Girder	Girder : (f	spacing t)								
					bay	Start of girder	End of girder								
				X	1	7.8333	7.83								
					2	7.83	7.83								
					3	7.83	7.83								
					4	7.83	7.83								
					5	7.83	7.83								
L			*					~	1						
										O	(Apply		Cance	el 🛛

Structure Framing Plan Detail – Diaphragms

Switch to the **Diaphragms** tab to enter 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.

🕰 Diaphragm Wizard	×
Select the desired framing plan system:	
a sub a ment a sub a	
🕰 Diaphragm Wizard	×
Diaphragm spacing Enter number of equal spaces per span Enter equal spacing per span Enter groups of equal spacing Support diaphragm load: kip Interior diaphragm load: kip	
Span Length Number of (ft) equal spaces	
1 52.13 2	
< Back Finish Cancel	

Click the **Finish** button to add the diaphragms. The **Diaphragm Wizard** will create diaphragms for all the girder bays in the structure.

sumber of spans: 1 Number of girders: 6 Layout Diaphragms Diaphragm wizard Support Start distance (ft) Diaphragm spacing (ft) Number of spaces (ft) Length of spaces (ft) End distance (ft) Load distance Diaphragm > 1 0 0 1 0 0 Not Assigned 1 0 0 1 0 0 Not Assigned 1 52.125 52.125 0 1 0 52.125 Not Assigned	struc	ture	Frami	ng Plan Detail	5								-	Ц
Layout Diaphragms Sirder bay: $1 \\ \hline \\ \\ \hline \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	mbe	er of	spans:	1	Number of	girders: 6								
Sirder bay: I Copy bay to Diaphragm wizard Support number Start distance (ft) Diaphragm spacing (ft) Number of spaces Length (ft) Load (ft) Load (kip) Diaphragm Diaphragm of spaces Length distance Load (ft) Load (kip) Diaphragm Diaphr	.ayo	ut	Diap	hragms										
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Sirde	er ba	iy: 1		× (Copy bay to.		Diaphra wizaro	agm d					
Interface Right girder Right girder <td></td> <td>Su</td> <td>pport</td> <td>St dist (</td> <td>art ance ft)</td> <td>Diaphragm spacing</td> <td>Number</td> <td>Length</td> <td>Er dista (f</td> <td>id ince t)</td> <td>Load (kin)</td> <td>Diaphragm</td> <td></td> <td></td>		Su	pport	St dist (art ance ft)	Diaphragm spacing	Number	Length	Er dista (f	id ince t)	Load (kin)	Diaphragm		
> 1 ✓ 0 0 1 0 0 0 Not Assigned ✓ 1 ✓ 0 0 26.0625 1 26.0625 26.0625 Not Assigned ✓ 1 ✓ 52.125 52.125 0 1 0 52.125 52.125 Not Assigned ✓		110	moer	Left girder	Right girder	(ft)	or spaces	(14)	Left girder	Right girder	(kip)			
1 ∨ 0 0 26.0625 1 26.0625 26.0625 Not Assigned ∨ 1 ∨ 52.125 52.125 0 1 0 52.125 52.125 Not Assigned ∨	>	1	~	0	0	0	1	0	0	0		Not Assigned	\sim	-
1 × 52.125 52.125 0 1 0 52.125 52.125Not Assigned ×		1	~	0	0	26.0625	1	26.0625	26.0625	26.0625		Not Assigned	\sim	
		1	~	52.125	52.125	0	1	0	52.125	52.125		Not Assigned	\sim	
New Duplicate Delete											New	Duplicate		Delete

The diaphragms created for Girder bay 1 are shown below.

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

Schematic - Framing Plan Detail

While **Framing Plan Detail** is selected in the **Bridge Workspace** tree, open the schematic for the framing plan by selecting the **Schematic** button on the **WORKSPACE** ribbon (or right click on **Framing Plan Detail** in the Bridge Workspace and select **Schematic** from the menu).



The following schematic will be displayed.



Structure Typical Section - Deck

Next define the structure typical section by double-clicking on Structure Typical Section node 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 Distance from right edge of deck to superstructure definition ref. line			
Deck in Superstructure Definition thickness i Reference Line			
Left overhang			
Deck (cont'd) Parapet Median Railing Generic Sidewalk Lane position Striped lanes Wearing surface			
Superstructure definition reference line is $within$ \lor the bridge deck.			
Start End Distance from left edge of deck to 23.375 ft			
superstructure definition reference line:			
superstructure definition reference line:			
Left overhang: 3.7917 ft 3.7917 ft			
Computed right overhang: 3.7918 ft 3.7918 ft			
OK	Apply	Canco	el
	777		

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 Total deck thickness is used to compute the dead load for the deck. The material to be used for the deck concrete is selected from the list of bridge materials. Enter the data as shown below.

A Structure Typical Section	-		×
Distance from left edge of deck to j Distance from right edge of deck to superstructure definition ref. Ine superstructure definition ref. Ine			
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: 7.0000 in			
Load case: Engine Assigned			
Deck crack control parameter: kip/in			
Sustained modular ratio factor: 3.000			
Deck exposure factor:			
	Apply	Cance	
	ULAUX	cance	-1

Structure Typical Section – Parapets

Add two parapets as shown below.

	-											ure Typical Section	ruc
												Front	<
		ring surface	Wea	d lanes	Striped	Lane position	Sidewalk	Generic	Railing	Median	Parapet	Deck (cont'd)	ck
			face ation	Front orient	istance at end (ft)	Distance at Di start (ft)	ge of deck . measured from	ire to dist	Measu	Load case	1	Name	
			-	Right	0.00	0.00	Edge -	* Left	Back		DC2	larrier Rail	Þ
			-	Left	0.00	0.00	t Edge 🔹	* Righ	Back		DC2	larrier Rail	
v													

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.



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

Schematic – Structure Typical Section

While **Structure Typical Section** is selected in the **Bridge Workspace** tree, open the schematic for the structure 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).





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 the data shown above the **Compute** button and select the **PS 6.0 ksi** 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.

A Stress Limit Sets - Concre	te				_		×
Name: 6.0 K	si Stress Limit						
Description:							
Corrosion condition: Mode	rate	\sim					
Final allowable tension	stress limit coef. (U	6) override:					
Concrete material: PS 6.0	Ksi	~					
Com	ipute						
	LFD		LRFD				
Initial allowable compression	n: 3	ksi	3.25	ksi			
Initial allowable tension:	0.2	ksi	0.2	ksi			
Final allowable compression	3.6	ksi	3.6	ksi			
Final allowable tension:	0.4654031	ksi	0.4654031	ksi			
Final allowable DL compress	ion: 2.4	ksi	2.7	ksi			
Final allowable slab compres	ssion:	ksi		ksi			
Final allowable compression (LL+1/2(Pe+DL))	2.4	ksi	2.4	ksi			
			0	K A	pply	Cance	el

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 L	.055					
General P/S data Los	ss 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:	21.00	Days		
		Final age:	36525.00	Days		
Loss data - AASHTO Percentage DL: 0.0	%					
			OK	Apply	Cance	4

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**).



Name: #5 Stirrup Material: Grade 60 Bar size: 5 V Number of legs: 2.00 Inclination (alpha): 90.0 Degrees Shear Reinforcement	A Shear Reinforcement Definition - Vertic	al		_		×
Material: Grade 60 Bar size: 5 Number of legs: 2.00 Inclination (alpha): 90.0 Degrees Shear Reinforcement	Name: #5 Stirrup					
	Vertical Shear Reinforcement	Material: Bar size: Number of legs: Inclination (alpha):	Grade 60 5 v 2.00 90.0 Degrees		>	



A partially expanded Bridge Workspace is shown below.



Describing a member

Double-click on the member G1 in the Bridge Workspace tree to open the Member window. 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:	G1			Link with:	None	\sim				
Description:										
	Existin	ng Current	Member alterna	ative name	Description					
Number of span	IS: 1 ↓	Span no.	Span length (ft)							
		> 1	52.125	A						
				w.			04	Analy	Care	al
							UK	Арріу	Canc	ei

Defining a Member Alternative

Double-click on **MEMBER ALTERNATIVES** in the **Bridge Workspace** tree for member **G1** 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. Enter the data as shown below. The **Schedule based Girder property input method** is the only input method available for a prestressed concrete girder.

ember alternative: Exterior Girder Description Specs Factors Engine Material type: Prestressed (Pretensioned) Girder type: PS Precast I 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 V Additional self load: kip/ft Additional self load: % Crack control parameter (Z) Top of beam: kip/in Bottom of beam: Kip/in Bottom of beam: Kip/in	wiemper Aiternative L	escription							_		
Description Specs Factors Engine Import Control options Description:	ember alternative: Ex	terior Girder									
Description: Material type: Prestressed (Pretensioned) Girder type: PS Precast I Modeling type: Multi Girder System Default units: US Customary v Girder property input method Self load Cross-section based Self load Load case: Engine Assigned v Additional self load: kip/ft Additional self load: % Crack control parameter (Z) Exposure factor Top of beam: kip/in Bottom of beam: kip/in	Description Specs	Factors	Engine	Import	Control options						
Girder property input method Schedule based Cross-section based Self load Load case: Engine Assigned V Additional self load: Kip/fit Additional self load: % Crack control parameter (Z) Top of beam: kip/in Bottom of beam: Use creep	Jescription:				Material type: Girder type: Modeling type:	Prestressed (Pretensi PS Precast I Multi Girder System	oned)				
Girder property input method Schedule based Cross-section based Self load Load case: Engine Assigned Additional self load: kip/ft Additional self load: % Crack control parameter (Z) Exposure factor Top of beam: kip/in Bottom of beam: kip/in					Default units:	US Customary	~				
Additional self load: kip/ft Additional self load: % Crack control parameter (Z) Exposure factor Top of beam: kip/in Bottom of beam: Bottom of beam:	 Schedule based Cross-section b Self load Load case: 	Engine Ass	signed	~	Default rating metho	od:					
Top of beam: kip/in Top of beam: Use creep Bottom of beam: kip/in Bottom of beam: Image: Section of beam:	Additional self load Additional self load	l:	kip/ft %	Exposure	factor						
	Top of beam: Bottom of beam:		kip/in kip/in	Top of be Bottom c	am:	Use creep					
								OK	Apply	Can	ce

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

Beam Details – Span Detail

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

Span number Beam shape Girder material Prestress properties n Beam projection I AASHTO TYPE II * PS 6.0 Ksi 1/2* LR AASHTO Loss * . 7.5000 7.5000 *	бра	n detail	Stress limit ranges Slab	interface Web end block						
Span number Beam shape Glider material Presuress properties n Left end (in) Right end (in) ▶ 1 AASHTO TYPE II ▼ PS 6.0 Ksi ▼ 1/2" LR AASHTO Loss ▼ 7.5000 7.5000		S		Girden	Deastroom			Beam p	projection	
N 1 AASHTO TYPE II V PS 6.0 Ksi V 1/2* LR AASHTO Loss V 7.5000 7.5000		number	Beam shape	material	properties		n	Left end (in)	Right end (in)	
	Þ	1	AASHTO TYPE II 🗸	PS 6.0 Ksi -	1/2" LR AASHTO Loss	-		7.5000	7.5000	-

Beam Details – Stress limit ranges

Select the **Stress limit ranges** tab and enter the data as shown below. Note that stress limit ranges are defined over the entire length of the precast girder, including the projections of the girder past the centerline of bearing which were entered on the **Span detail** tab.

ocar																	
Spar	n c	detai	i	Stress I	imit ran	iges	Slab	interface	۷	Neb end blo	ck						
		Spa num	an ber		Nar	me		Start distand (ft)	e	Length (ft)	End distance (ft)						
>	Г	1	\sim	6.0 Ks	Stress	Limit	\sim		0	53.375	53.37	5					1
													New	Duplic	ate	Delete	

Beam Details – Slab interface

Beam Details			_		×
Span detail Stress limit ranges SI	ab interface	Web end block			
Interface type:	Intentionally	Roughened V			
Default interface width to beam widths:	~				
Interface width:		in			
Cohesion factor:	0.280	ksi			
Friction factor:	1.000				
K1:	0.300				
K2:	1.800	ksi			
		ОК Арр	ly	Cance	9

Select the **Slab interface** tab and select **Intentionally Roughened** as the **Interface type**.

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

Strand Layout

Expand the **Strand Layout** node in the **Bridge Workspace** tree and open the **Span 1** window. Use the **Zoom** buttons on the right side of this window to shrink/expand the schematic of the beam shape so that the entire beam is visible.

Select the **Description type** as **Strands in rows** and the **Strand configuration type** as **Harped**. Define the following strand layout at midspan by selecting the strand positions in the right hand schematic.

Strand Layout -	Span 1			- [
 Description type 				🗈 💫 🔍 🗢 🖶 🗟 🗮 160% 🔽
O P and CGS or	nly 💿 Strands in ro	ws		Notes:
- Strand configura	ation type			Strand positions generated by the REVISED method. Please refer to Help for a description of this method.
Straight/Deh	onded	Symmetry		
Harned	onaca			••
Harped and	straight debonded			$\times \times$
) Mid span				1 × ×
Left end		Harp point locations		
Right end	Harp	Distance	Radius	
_	Left	(it) 0.00	(in) 0.0000 -	$\times \times$
	Right	0.00	0.0000	
				Number of strands = 24 Number of harped strands = 0 CG of strands (received from bottom of section) = 0.08 in
				No strand at this position at the current section location.
				X 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 strand is debonded from the end of the beam to the current section location. The strand is debonded from the mid-span to the current section location.
				The strand is debonded from the end of the beam to the current 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.
				 The strand is debonded from the end of the beam to the current 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 informa The harped position of a harped strand. The mid-nam oncition of a harped strand.
		ОК Ар	ply Cancel	The strand is debonded from the end of the beam to the current 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 informa The harped position of a harped strand. The mid-span position of a harped strand. The mid-span position of one strand and the harped position of another strand.

Now select the **Left end** radio button and enter the following harped point locations at the left end of the precast girder. The harped strands can be defined at the left end of the span by selecting harped strand locations in the right hand schematic. Define the following harped strands in the position as shown below.



Click **OK** to apply the data 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.

🕰 Dec	ck Pi	rofile													-		×
Type: Dec	e PS	5 Precast oncrete	l Reinf	orcement													
		Mate	rial	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				
>	PS	S 6.0 Ksi	\sim	1 ~	0	52.125	52.125	7	90	90	90	90	8				-
	Contyp	mpute fr	om on										New		uplicate	Delete	Ŧ
														ок	Apply	Can	cel

No deck reinforcement is described. Close the window by clicking OK.

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.



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

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 PS 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. Create a new row after completing the current row. The **Start distance** of the new row will be populated with the **End distance** of the current row.

PS S	ihear Reinforcemer	t Ranges						- 0	;
4	Start Distance		Spacing						
Spar	n: 1 v								
	Name		Extends into deck	Start distance (ft)	Number of spaces	Spacing (in)	Length (ft)	End distance (ft)	
>	#5 Stirrup	~		0	1	1.5	0.125	0.125	-
	#5 Stirrup	~		0.125	13	3	3.25	3.375	
	#5 Stirrup	~	 Image: A start of the start of	3.375	5	6	2.5	5.875	
	#5 Stirrup	~	 Image: A set of the set of the	5.875	6	12	6	11.875	
	#5 Stirrup	~		11.875	9	18	13.5	25.375	
	#5 Stirrup	~	\checkmark	25.375	2	15.75	2.625	28	
	#5 Stirrup	~		28	9	18	13.5	41.5	
	#5 Stirrup	~	\checkmark	41.5	6	12	6	47.5	
	#5 Stirrup	\sim	\checkmark	47.5	5	6	2.5	50	
	#5 Stirrup	\sim		50	13	3	3.25	53.25	
	Stirrup wizard	Stirrup	design tool	View calcs		N	ew Dup	licate Delete	2
	Stirrup wizard	Stirrup	design tool	View calcs		Ne	ew Dup	Apply Ca	e ncel

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

The description of the exterior girder for this superstructure definition is completed.

Schematic – Exterior Girder (E) (C) (member alternative)

While Exterior Girder (E) (C) member alternative is selected in the Bridge Workspace tree, open the schematic for the member alternative by selecting the Schematic button on the WORKSPACE ribbon (or right click on Exterior Girder (E) (C) in the Bridge Workspace and select Schematic from the menu).





Copy of exterior girder to an interior girder (G2) and check the Deck Profile and Haunch Profile

Create a copy of the **Exterior Girder** member alternative. To make a copy, click on the **Exterior Girder (E) (C)** member alternative in the **Bridge Workspace** tree and click the **Copy** button from the **Manage** group of the **WORKSPACE** ribbon (or right-click on **Exterior Girder** and select **Copy** from the menu).



Now click on the **MEMBER ALTERNATIVES** node under the member **G2** in the **Bridge Workspace** tree and click the **Paste** button from the **Manage** group of the **WORKSPACE** ribbon (or right-click on **MEMBER ALTERNATIVES** and select **Paste** from the drop-down menu).

Bridge Workspace - PS11		ANA	YSIS	REPO	RTS	?	-		×
BRIDGE WORKSPACE WORKSPACE TOOLS	S VIEW	DESIGN	I/RATE	REPOR	TING				^
Check Out Check In Validate Save Close	Export Refre	esh Op	en Nev	Copy	Paste Du	plicate Delete	Sche	matic	
Bridge				М	anage				
Workspace Bridge Components		ųх	Sche	matic	т×	Report		џ	×
BSC Bracing Spec Check Selection Structure Typical Section Superstructure Loads Concrete Stress Limits Prestress Properties Shear Reinforcement Definition MEMBERS GI GI Supports	IS	^							
	s C)	- 11	Anal	ysis				щ	×
G2				_					
I G3 I G4	Paste								
ia⊡ IG5 I G6	Analyze	2							
BRIDGE ALTERNATIVES	View St	ummary R	eport						
	View D	etailed Re	port						
	Close B	ridge Wo	ces kspace						

Import Girder Description Specs Factors Engine Import Control options Description: Girder type: PS Precast I Modeling type: Multi Girder System Default units: US Customary Image: Girder property input method Image: Schedule based Corss-section based Self load Load case: Engine Assigned Image: Kip/ft Additional self load: Top of beam: kip/in Bottom of beam: kip/in									
Description Specs Factors Engine Import Control options Description: Material type: Prestressed (Pretensioned) Girder type: MS Precast 1 Modeling type: Multi Girder System Default units: US Customary Girder property input method Schedule based Corss-section based Self load Load case: Engine Assigned Additional self load: % Crack control parameter (Z) Exposure factor Top of beam: kip/in Bottom of beam: kip/in	ember alterna	tive: Inte	rior Girder						
Description: Material type: Prestressed (Pretensioned) Girder type: PS Precast I 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: kip/ft Additional self load: % Crack control parameter (Z) Crack control parameter (Z) Crack control parameter (Z) Top of beam: kip/in Bottom of beam: bip/in	Description	Specs	Factors	Engine	Import	Control options			
Girder type: PS Precast I Modeling type: Multi Girder System Default units: US Customary Officer property input method Schedule based Cross-section based Self load Load case: Engine Assigned Lipft Additional self load: % Crack control parameter (Z) Exposure factor Top of beam: kip/in Bottom of beam: Use creep	Description:					Material type:	Prestressed (Pretensioned)		
Girder property input method Schedule based Cross-section based Self load Load case: Engine Assigned Icad case: Engine Assigned V Crack control parameter (Z) Top of beam: kip/in Bottom of beam: kip/in Bottom of beam: Kip/in Bottom of beam: Kip/in Set of beam: Kip/in Bottom of beam: Kip/in Setom of beam: Kip/in Setom of beam: Kip/in Setom of beam: Kip/in Setom of beam: Setom of bea						Girder type:	PS Precast I		
Girder property input method ● Schedule based ○ Cross-section based Self load Load case: Engine Assigned ▲ Additional self load: kip/ft Additional self load: % Crack control parameter (Z) Exposure factor Top of beam: kip/in Bottom of beam: kip/in Bottom of beam: kip/in						Modeling type:	Multi Girder System		
Girder property input method Schedule based Cross-section based Self load Load case: Engine Assigned IFR Additional self load: kip/ft Additional self load: % Crack control parameter (Z) Top of beam: kip/in Bottom of beam: kip/in Bottom of beam: kip/in 						Default units:	US Customary		
	Self load - Load case: Additional Additional Crack cont Top of bea Bottom of	self load: self load: rol param m:	eter (Z)	signed kip/ft % kip/in kip/in	Exposure Top of be Bottom o	Default rating meth	od:		

Double click on the copied member alternative and rename it as shown below.

The Bridge Workspace tree will be updated with the new copy as shown below.



Link all other interior girders (G3, G4 and G5) to G2

To link the interior girder G3 to G2, double click on the G3 node in the Bridge Workspace tree (or select G3 and click the Open button from the Manage group of the WORKSPACE ribbon). This opens the Member window for this girder as shown below.



A Member					-		Х
Member name:	G3	Link with:	None 🗸]			
			None				
Description:			G1				
	Fristing Current Member alte	rnative name	G2 G4	Description			
	Existing current Member are		G5	Jeschphon			
			G6				
Number of spar	ns: 1 O Span Iength						•
	Image: No. (ft) ▶ 1	13					
				OK Apply	(Cance	ł

From the menu options under Link with, select G2 as shown below.

The following warning message shows up. Review the message and click **Continue** to link the member.

🕰 Warnir	ng	×
1	Linking of a member to another member should only be done if all member properties, loads, spacing, and distribution factors are identical.	
	All of the calculations for this member will be based on the original member properties and loads.	
	Select Continue to link the member, or select Cancel if you don't want to link the member.	
🗌 Do not	show this message again Cancel Continue	

The **Member** window for **G3** will now be updated with the details from girder member **G2** indicating that the member has been linked. (See below)

A Member					-		×
Member name:	G3	Link with:	G2 🗸				
Description:							
	Existing Current Member all	ernative name		Description			4
Number of span	s: 1) Span lengti (ft) 1 52	.13		OK A	pply	Cance	-1

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

Repeat this process for the remaining interior girders (G4 and G5)

Link other exterior girders (G6) to G1

Linking exterior girder follows the same procedure as shown previously to link the interior girder. Open the **Member** window for girder **G6** by double clicking on the **G6** node in the **Bridge Workspace** tree (or select **G6** and click the **Open** button from the **Manage** group of the **WORKSPACE** ribbon).

Bridge Workspace - PS11	ANALYSIS	REPORTS	?	– 🗆 ×
BRIDGE WORKSPACE WORKSPACE TOOLS VIEW	DESIGN/RATE	REPORTING		^
Check Out Check In Validate Save Close Export Refre	esh Open New	Copy Paste	Duplicate Delete	Schematic
Bridge		Manage		
Workspace # × S	chematic	щ×	Report	μ×
Bridge Components Image: Components Image: Components Image: Diaphragm Definitions Image: Components Image: Components Image: Components				
A Superstructure Loads Concrete Stress Limits Prestress Properties MEMBERS I G1 I G2 I G2 I G3 (G2) I G4 (G2) I G6 MEMBER ALTERNATIVES BRIDGE ALTERNATIVES	analysis			# ×

In the Member window, under Link with, select G1. The options will not include the other interior girder (G3, G4 and G5) since they are already linked with girder G2.

A Member								-		×
Member name:	G6		Link w	vith:	None	~				
					None					
Description:					G1					
					G2					
	Existing Current	Member alte	ernative name			[Description			
										-
										-
Number of span	is: 1 ♢ Spa no	n Span length (ft) 52	13							
							ОК Арр	ly	Cance	el

The following warning message shows up. Review the message and click **Continue** to link the member.

🗛 Warnir	ng	×
1	Linking of a member to another member should only be done if all member properties, loads, spacing, and distribution factors are identical.	
	All of the calculations for this member will be based on the original member properties and loads.	
	Select Continue to link the member, or select Cancel if you don't want to link the member.	
Do not	show this message again Cancel Continue	

The **Member** window for **G6** will now be updated with the details from girder member **G1** indicating that the member has been linked. (See below)

A Member					_		×
Member name:	G6	Link wi	ith: G1 🗸				
Description:							
	Existing Current Member alter	native name		Description			
	Exterior Girder						-
							-
Number of span	s: 1 Span length no. (ft) 1 52.	3					
				ОК	Apply	Cance	el

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

Create another BrDR Superstructure Definition (Span 2 Definition) for Span No. 2 by copying Span 1 and 3 Definition

To copy a superstructure definition, select the **Span 1 and 3 Definition** node in the **Bridge Workspace** tree and click the **Copy** button from the **Manage** group of the **WORKSPACE** ribbon (or right-click on **Span 1 and 3 Definition** and select **Copy** from the menu) as shown below.

BRIDGE WORKSPACE WORKSPACE TOOLS VIEW DESIGN/RATE REPORTING Check Out Image	Bridge Workspa	ce - PS11	ANALYSIS	REPORTS	?	- 🗆	×
Check Ut Validate Sav Revert Close Export Refresh Bridge Components Bridge Components	BRIDGE WORKSPACE WORKSPACE	TOOLS VIEW	DESIGN/RATE	REPORTING			^
Bridge Manage Workspace # × Schematic # × Bridge Components Components Components SubrestRucture SubrestRucture SubrestRucture Sepand Branch Copy Collapse Branch Copy Duplicate Duplicate Delete Manalyze Components View Summary Report View Summary Report View Summary Report View Summary Report View Detailed Report Export to PS Design Tool	A Check Out Check In Validate Save	vert Close Export Refre	esh Open Net	Copy Paste	Duplicate Delete	Schematic	
Workspace # × Bridge Components Schematic # × Pridge Components Print Print Pridge Components Print Print Print Pridge Components Print Print Print Print Print Print Print Print Print Print Print Print Print Print Print Print Print Print Print Print Print Print Print Print Print Print Print Print Print Print Print <t< td=""><td>Bridge</td><td></td><th></th><td>Manage</td><td></td><td></td><td></td></t<>	Bridge			Manage			
♀ Collapse Branch ▷ Open ↓ × ○ Copy ▷ Duplicate ※ Delete ✓ Analyze ○ Validate ☞ View Summary Report Q View Detailed Report ▶ Export to PS Design Tool	Workspace Bridge Components Image: PS11 Image: PS11 Image:		chematic	# × R	Report	ц ,	×
Copy Copy		Collapse Branch					_
Image: Delete Image: Delete <t< td=""><td></td><td>Сору</td><th></th><td></td><td></td><td>4</td><td></td></t<>		Сору				4	
Close Rridge Workspace		 Duplicate Duplicate Delete Analyze Validate View Summary Report View Detailed Report Export to PS Design General Preferences Cloce Bridge Works 	ort rt 1 Tool 5				

Now click on the **SUPERSTRUCTURE DEFINITIONS** node in the **Bridge Workspace** tree and click the **Paste** button from the **Manage** group of the **WORKSPACE** ribbon (or right-click on **SUPERSTRUCTURE DEFINITIONS** and select **Paste** from the menu) as shown below.

Bridge Workspace - PS1	11	ANALYSIS	REPORTS	?	- 🗆	×
BRIDGE WORKSPACE WORKSPACE	TOOLS VIEW	DESIGN/RATE	REPORTING			^
A Check Out Check In Validate Save	🔀 🎸 🕄 Close Export Refre	esh Open New	Copy Paste	Duplicate Delete	Schematic	c
Bridge			Manage			
Workspace	<mark>я</mark> × S	chematic	й х [Report	д	×
Bridge Components						
Components Diaphragm Definitions Diaphragm Definitions Diaphragm Definitions Polateral Bracing Definitions Polateral Bracing Definitions Polateral Definition Doesign Parameters SUPERSTRUCTURE DEFINITIONS Doesign 1 and 3 Definition Doesign Definition Doesign Definition Doesign Definition Doesign Definition Doesign Definition Doesign Definition	♀ Expand Bran ♀ Collapse Bra ○ New	ch nch	_			
	📋 Paste				щ	×
	Analyze	any Report				
	View Detaile	d Report				
	🔲 Wizard					
	🏴 Import Desig	in Tool File	-			
	General Pref	erences				
		workspace				

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



Double click on the newly created **Span 1 and 3 Definition ~ 1** superstructure definition to open the **Girder System Superstructure Definition** window. Rename this superstructure definition to **Span 2 Definition** as shown below.

Girder System Superstructure Defini Definition Analysis Specs	Engine		×
Definition Analysis Specs Name: Span 2 Definit Description:	Engine ion Enter span lengths along the reference line: Span Length (ft) 1 52.13 I I I I I I I I I I I I I I I I I I I	ft ft ft Left	Modeling ● Multi-girder system ○ MCB □ With frame structure simplified definition Deck type: Concrete Deck ▼ For PS/PT only Average humidity: ◎ % Member alt types ○ Steel ♥ P/S ○ R/C □ Timber □ P/T
Curved, tangent	Distance from last support line to PT:	ft	
	Superelevation:	%	
L			OK Apply Cancel

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

Modify the span length in Superstructure Definition

Double click on the **Span 2 Definition** node in the **Bridge Workspace** tree to open the **Girder System Superstructure Definition** window. Change the span length of this superstructure as shown below.

Girder System Super	rstructure Definition	- D X
Definition Analy	rsis Specs Engine	
Name:	Span 2 Definition	Modeling
D		With frame structure simplified definition
Description:		Deck type: Concrete Deck 🔍
Default units: Number of spans: Number of girders:	US Customary	For PS/PT only Average humidity: % Member alt. types Steel P/S R/C Timber P/T
Horizontal curvatu	ure along reference line	
Horizontal cun	vature Distance from PC to first support line:	ft
Superstructure	alignment Start tangent length:	ft
Tangent cu	Radius:	ft
Tangent, cui	rved Direction: Left	~
O Curved, tan	gent End tangent length:	ft
	Distance from last support line to PT:	ft
	Design speed:	mph
	Superelevation:	%
		OK Apply Cancel

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

Repopulate the diaphragm spacing using the Diaphragm Wizard

Double-click on **Framing Plan Detail** in the **Bridge Workspace** tree to describe the framing plan in the **Structure Framing Plan Details** window. Switch to the **Diaphragms** tab to enter diaphragm spacing. Click the **Diaphragm wizard...** button to add diaphragms for the entire structure. A window appears warning the user that continuing with the wizard will delete the existing diaphragms. Click **Yes** to continue as shown below.

nb ay	out	spans Diap ny: 1	phragms	Number o	f girders: 6 Copy bay t	:0	Diaphragm wizard	
	Sup	port nber	Si dist (tart tance (ft)	Diaphragm spacing (ft)	Number of spaces	Length distance Load Diaphragm	
	1	-	Left girder	Right girder	0.00	Bridge D	Design & Rating X	
	1	Ŧ	0.00	0.00	rt nce Diaphragm spacing (ft) Number (ft) Length distance Load Diaphragm Bridge Design & Rating Diaphragms already exist for this structure! Continuing with the wizard will delete these existing diaphragms! Do you want to continue with the wizard? Yes No			
	1	Ŧ	52.13	52.13				
							Yes No 2	
							New Duplicate Delet	e

Select the desired framing plan system and click the Next button. Enter the following data on the window shown below.

🕰 Diaphragm Wizard	×
Select the desired framing plan system:	
< Back Next >	Cancel
🕰 Diaphragm Wizard	×
Diaphragm spacing Diaphragm spacing Enter number of equal spaces per span Enter equal spacing per span Enter groups of equal spacing	
Interior diaphragm load: kip	
Span Length Number of (ft) equal spaces	
x 1 53.00 2	A.
< Back Finish	Cancel

Click the **Finish** button to add the diaphragms. The **Diaphragm Wizard** will create diaphragms for all the girder bays in the structure.

irder	r bay: 1		>	Copy bay t	to	Dia	iphragm vizard				
9	Support number	S dis	tart tance (ft)	Diaphragm spacing	Number of spaces	Length (ft)	E dist (nd ance ft)	Load (kip)	Diaphragm	
		Left girder	Right girder	(π)			Left girder	Right girder			
1	-	0.00	0.00	0.00	1	0.00	0.00	0.00		Not Assigned 🔹	
1		0.00	0.00	26.50	1	26.50	26.50	26.50		Not Assigned 🔻	
1	*	53.00	53.00	0.00	1	0.00	53.00	53.00		Not Assigned 🔻	

The diaphragms created for **Girder bay 1** are shown below.

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

Modify the length of the range in Beam Details, Deck Profile and Haunch Profile.

Expand **MEMBERS**, **G1**, **Exterior Girder** (**E**)(**C**) nodes in the **Bridge Workspace** tree to modify data of the exterior girder of the **Span 2 Definition** superstructure as shown below.



Beam Details

Double click on the **Beam Details** node in the **Bridge Workspace** tree to open the **Beam Details** window. Navigate to the **Stress limit ranges** tab and modify the **Length** as shown below.

_									
spa	n detail	Stress limit ranges Slab	interface Web e	end block					
	Span number	Name	Start distance (ft)	Length (ft)	End distance (ft)				
Þ	1 *	6.0 Ksi Stress Limit	- 0.00	54.25	54.25				4
1									
						New	Duplicate	Delete	
						New	Duplicate	Delete	

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

Deck Profile

Double click on the **Deck Profile** node in the **Bridge Workspace** tree to open the **Deck Profile** window. Modify the **Length** as shown below.

ck	con	ncrete	Rei	inforce	ement	t															
		Ma	aterial		Sup	port nber	St dist (tart tance (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					
F	PS 6	6.0 Ksi		Ŧ	1	÷		0.00	53.00	53.00	7.0000	90.0000	90.0000	90.0000	90.0000	8.000					
C	Comp	ipute fi	from																		
	Comp		from														New	Duplic	ate	Delete	(e

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

Haunch Profile

Double click on the Haunch Profile node in the Bridge Workspace tree to open the PS Haunch Profile window.

Modify the **Length** as shown below.

PS F	Haunch Pro	file								-	- 0	×
171			Y3I	1 								
	Support number	Start distance (ft)	Length (ft)	End distance (ft)	Z1 (in)	Z2 (in)	Z3 (in)	Z4 (in)	Y1 (in)	Y2 (in)	Y3 (in)	
•	1 *	0.00	53.00	53.00	0.0000	0.0000	0.0000	39.5000	2.0000	2.0000	0.0000	
									ew	Duplicate	Delet	te
									ОК	Apply	Car	ncel

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

Modify the harp point distance in Strand Layout

Expand the **Strand Layout** node in the **Bridge Workspace** tree and double click on **Span 1** to open the **Strand Layout – Span 1** window. Modify the **Harp point locations** as shown below.



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

Re-enter the Shear Reinforcement Ranges

Double click on the **Shear Reinforcement Ranges** window in the **Bridge Workspace** tree to open the **PS Shear Reinforcement Ranges** window. Re-enter the shear reinforcement ranges as shown below.

Verti	ical Horizontal								
Span	n: 1 v Name		Extends into deck	Start distance (ft)	Number of spaces	Spacing (in)	Length (ft)	End distance (ft)	
>	#5 Stirrup	~		0	1	1.5	0.125	0.125	-
	#5 Stirrup	~		0.125	13	3	3.25	3.375	
	#5 Stirrup	~	 Image: A set of the set of the	3.375	5	6	2.5	5.875	
	#5 Stirrup	~	 Image: A set of the set of the	5.875	5	12	5	10.875	
	#5 Stirrup	~	 Image: A second s	10.875	10	18	15	25.875	
	#5 Stirrup	~	 Image: A start of the start of	25.875	2	15	2.5	28.375	
	#5 Stirrup	~	 Image: A set of the set of the	28.375	10	18	15	43.375	
	#5 Stirrup	~	 Image: A set of the set of the	43.375	5	12	5	48.375	
	#5 Stirrup	~	 Image: A set of the set of the	48.375	5	6	2.5	50.875	
	#5 Stirrup	\sim		50.875	13	3	3.25	54.125	

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

Make sure to modify these for the interior girder (G2) of the Span 2 Definition superstructure.

Create one Bridge Alternative and three superstructures.

The first superstructure is for Span No. 1, the second superstructure is for Span No. 2 and the third superstructure is for Span No. 3

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.

iternative name: Bridge	Alt 1			
Description Substrue	ctures			
Description:				
Horizontal curvature	e	Global positioning		
Reference line length:	ft	Distance:	ft	
Start bearing	O End bearing	Offset:	ft	
Starting station:	ft	Elevation:	ft	
Bearing:	N 90^ 0' 0.00" E			
Bridge alignment		Start tangent length:		ft
Curved		Curve length:		ft
Tangent, curved, t	angent	Radius:		ft
Iangent, curved Curved tangent		Direction:	Left v	
O contes, tangent		End tangent length:		ft
Superstructure wizard	Culvert wizard			

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

Expand the **Bridge Alt 1** node in the **Bridge Workspace** tree by clicking the \pm button. 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.

Bridge Workspace	e - PS11	AI	NALYSIS	REPORT	TS	?	- 🗆	×
BRIDGE WORKSPACE WORKSPAC	E TOOLS	VIEW DES	GIGN/RATE	REPORTI	NG			^
A Check Out Check In Validate Save	rert Close Expo	ort Refresh	Open Nev	Copy F	Paste Duplicate	Delete S	Schematic	
Bridge				Mar	nage			
Workspace		Schematic		щ×	Report		щ ;	×
Bridge Components								
Organization Organization	actors							
E 🖉 SUPERSTRUCTURE DEFIN	TIONS	Analysis					平 >	×
BRIDGE ALTERNATIVES Bridge Alt 1 (E) (C) Bridge Alt 1 (E) (C) Bridge Alt 1 (E) Pristance Pristance Piers	New Analyze View Sumn View Detail General Pre Close Bridg	nary Report led Report eferences ge Workspace						

uperstructure							_		
erstructure name	e: Superstru	cture 1							
Description A	lternatives	Vehicle path	Engine	Substructures					
Description:									
Reference line									
Distance:	0.00	ft							
Offset:	0.00	ft							
Angle:	0.00	Degrees							
Starting statio	n: 0.00	ft							
						ОК	Apply	Cance	e

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

Similarly create two other superstructures for Span No. 2 and Span No. 3 as shown below.

structure name	: Superstru	icture 2					
escription A	Iternatives	Vehicle path	Engine	Substructures			
escription:							
Reference line							
Distance:	0.00	ft					
Offset:	0.00	ft					
Angle:	0.00	Degrees					
Starting station	n:	ft					

Superstructure	1				-		
perstructure na	me: Superstru	icture 3					
Description	Alternatives	Vehicle path	Engine	Substructures			
Description:							
Reference li	ine						
Distance:	0.00	ft					
Offset:	0.00	ft					
Angle:	0.00	Degrees					
Starting stat	tion:	ft					
				OK Ann	v	Cance	el
				ОК Арр	7	Cance	-

The partially expanded Bridge Workspace tree is shown below.



Assign Span 1 and 3 Definition to the first and third Superstructures and assign Span 2 Definition to the second

superstructure

Expand the **Superstructure 1** node in the **Bridge Workspace** tree by clicking the + button. Double-click on **SUPERSTRUCTURE ALTERNATIVES** (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 Span 1 and 3 Definition as the current superstructure definition for this

Superstructure Alternative.

A Superstructure Alternativ	e	_	
Alternative name:	Superstructure Alt 1		
Description:			
Superstructure definition:	Span 1 and 3 Definition		
Superstructure type:	Girder		
Number of main members:	6		
Span Length (ft)			
	22.13		
	ОК	Apply	Cancel

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

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

A Superstructure	-	-		×
Superstructure name:	: Superstructure 1			
Description Alt	ternatives Vehicle path Engine Substructures			
Existing Cu	urrent Superstructure alternative name Description			
> V	Superstructure Alt 1			
			_	
	OK Apply		Cance	1

Similarly add two other SUPERSTRUCTURES and assign Span 2 Definition to Superstructure 2 and Span 1

and 3 Definition to Superstructure 3 as shown below.

Superstructure 2

A Superstructure Alternativ	e	_		×
Alternative name:	Superstructure Alt 1			
Description:				
Superstructure definition:	Span 2 Definition			
Superstructure type:	Girder			
Number of main members:	6			
Span Length (ft)	33.00			
	ОК	Apply	Cance	el

Superstructure 3

A Superstructure Alternativ	e	_		×
Alternative name:	Superstructure Alt 1			
Description:				
Superstructure definition:	Span 1 and 3 Definition			
Superstructure type:	Girder			
Number of main members:	6			
Span Length (ft)	52.13			
	OK	Apply	Cance	el

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



LRFD Design Review

To perform an LRFD design review of this exterior girder, select **Exterior Girder** under member **G1** of the **Span 1** and **3 Definition** superstructure in the **Bridge Workspace tree** and select the **Analysis Settings** button on the **Analysis** group of the **DESIGN/RATE** ribbon. The window shown below opens.





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

Д	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	
						~
	Delete				Open	Cancel

The Analysis Settings window will be updated as shown below.

🕰 Analysis Settings			_		×
Design review Rating	Design method:	LRFD	~		
Analysis type: Line Girder Lane / Impact loading type: As Requested	Apply preference setting	: None	~		
Vehicles Output Engine Description Traffic direction: Both directions	Refresh	Temporary vehicles	Advanced]	
	Add to	ry liads 93 (US) loads !oads D Fatigue Truck (US)			
Reset Clear Open template Save te	mplate	ОК	Apply	Cance	2



Specification Checks

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



After the analysis is complete, review the information and the warning messages on the Analysis window.



Click on the **Specification Check Detail** button from the **Results** group of the **DESIGN/RATE** ribbon to open the **Specification Checks** window.



The details for one of the specification chec	cks is	shown	below.
---	--------	-------	--------

Specification Che	cks for Exteri	r Girder - 25 of 762	- 0
		Articles	
		All articles	
Properties	Generate	Format	
		Bullet list	
pecification filter		Report	
🔺 🚞 Superstructure	e Component	Specification reference Limit State Flex. S	Sense Pass/Fail
Prestress (Calculations	✓ 2.5.2.6.2 Criteria for Deflection N/A	Passed
🕨 🚞 Stage 1		✓ 5.4.2.1 Compressive Strength N/A	Passed
🕨 🚞 Stage 2		5.4.2.5 Poisson's Ratio N/A	General Comp.
🔺 🚞 Stage 3		5.4.2.6 Modulus of Rupture N/A	General Comp.
🔺 🚞 Exterio	or Girder	5.4.2.8 Concrete Density Modification Factor N/A	General Comp.
🚞 Spa	an 1 - 0.00 ft.	✓ 5.5.3.1 Fatigue Limit State - General N/A	Passed
🚞 Spa	an 1 - 1.88 ft.	NA 5.5.3.2 Reinforcing Bars and Welded Wire Reinforcement N/A	Not Required
🚞 Spa	an 1 - 3.26 ft.	5.5.4.2 PS Strength Limit State - Resistance Factors N/A	General Comp.
🛄 Spa	an 1 - 5.21 ft.	5.6.2.2 Rectangular Stress Distribution N/A	General Comp.
🛄 Spa	an 1 - 10.43 fi	✓ 5.6.3.2 PS Flexural Resistance (Prestressed Concrete) N/A	Passed
Spa	an 1 - 15.64 ft	✓ 5.6.3.3 Minimum Reinforcement N/A	Passed
Spa	an I - 16.06 ft	✓ 5.7.2.5 Minimum Transverse Reinforcement N/A	Passed
Spa	an I - 20.85 fi	✓ 5.7.2.6 Maximum Spacing of Transverse Reinforcement N/A	Passed
Spa	an I - 20.00 fi	✓ 5.7.3.3 Nominal Shear Resistance N/A	Passed
i spa	an 1 - 36.06 fl	5.7.3.4 Procedures for Determining Shear Resistance N/A	General Comp.
i Spa	an 1 - 36.00 fi	✓ 5.7.3.5 Longitudinal Reinforcement N/A	Passed
Spa	an 1 - 41.70 fi	✓ 5.7.4 Interface Shear Transfer N/A	Passed
🛄 Spa	an 1 - 46.91 fi	✓ 5.7.4.2 Minimum Area of Interface Shear Reinforcement N/A	Passed
🛄 Spa	an 1 - 48.86 fi	✓ 5.9.2.3.2a Compressive Stresses N/A	Passed
🚞 Spa	an 1 - 50.25 fi	✓ 5.9.2.3.2b Tensile Stresses N/A	Passed
🚞 Spa	an 1 - 52.13 fi	5.9.4.3.2 Bonded Strand N/A	General Comp.
		Computation of Vp N/A	General Comp.
		Cracked_Moment_of_Inertia Section Property Calculations N/A	General Comp.
		PS_Basic_Properties Calculation N/A	General Comp.
		PS Gross Composite Section Properties PS Gross Composi N/A	General Comp.

Spec Check Detail for 5.6.3.2 PS Flexural Resistance (Prestressed Concrete)	-	
<pre>5.6 Design for Flexural and Axial Effects - B Regions 5.6.3 Flexural Members 5.6.3.2 Flexural Resistance (AASHTO LRFD Bridge Design Specifications, Ninth Edition) PS I Narrow - At Location = 26.0625 (ft) - Left Stage 3</pre>		
Cross Section Properties		
Name: AASHTO TYPE II Girder f'c = 6.00(ksi) Slab f'c = 6.00(ksi)		
Effective Slab Width = 90.00(in) Effective Slab Thickness = 7.00(in) Haunch Width = 31.75(in) Haunch Thickness = 2.00(in) Beam Height = 36.00(in)		
Total Aps = 3.67(in^2) Total CGS = 9.08(in)		
Eff Aps = 3.67(in^2) Eff CGS = 9.08(in)		
Note: If the capacity has been overridden, the Resistance is comp Otherwise the Resistance is computed as per the Specificati	uted as override phi*override capac on.	ity.
<		>
	[OK