

AASHTOWare BrDR 7.5.0

Prestress Tutorial 6

PS6 – Skewed, Simple Span Prestressed I Beam Example

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BrDR Training

PS6 – Skewed, Simple Span Prestressed I Beam Example

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

PS6TrainingBridge

Bridge ID: PS6TrainingBridge NBI structure ID (8): PS6TrainingBrid

Template Superstructures
 Bridge completely defined Culverts
 Substructures

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

Name: Skewed PS I Beam Bridge Year built:

Description:

Location: Length: ft

Facility carried (7): Route number:

Feat. intersected (6): Mi. post:

Default units: US Customary

Bridge association... BrR BrD BrM Sync with BrM

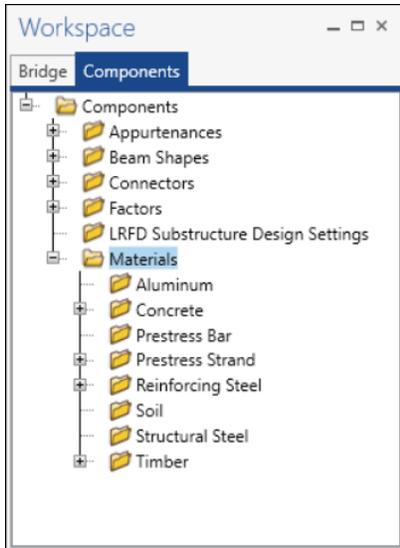
OK Apply Cancel

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

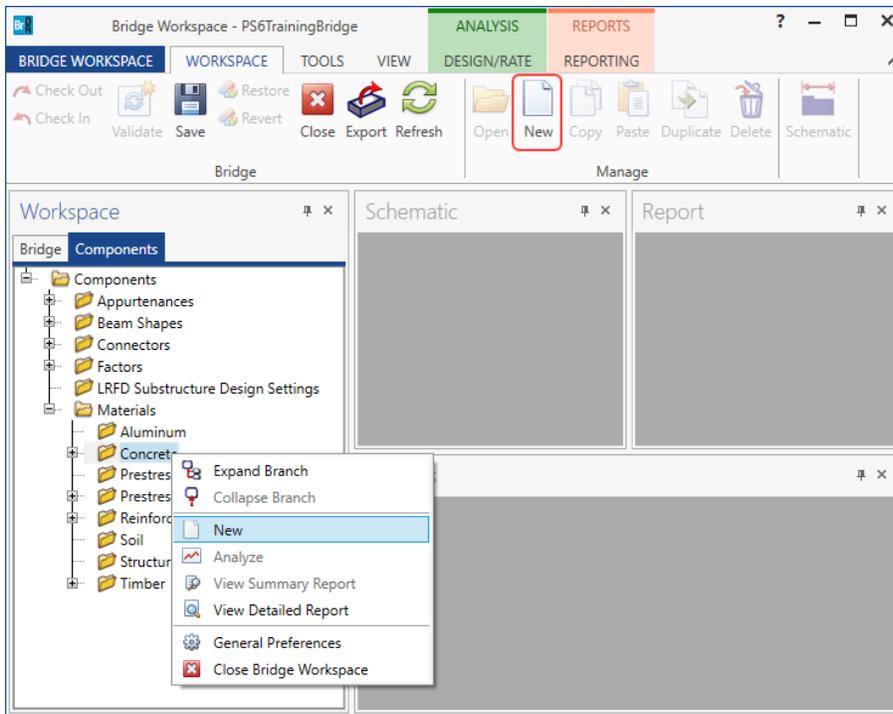
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Bridge Materials - Concrete

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

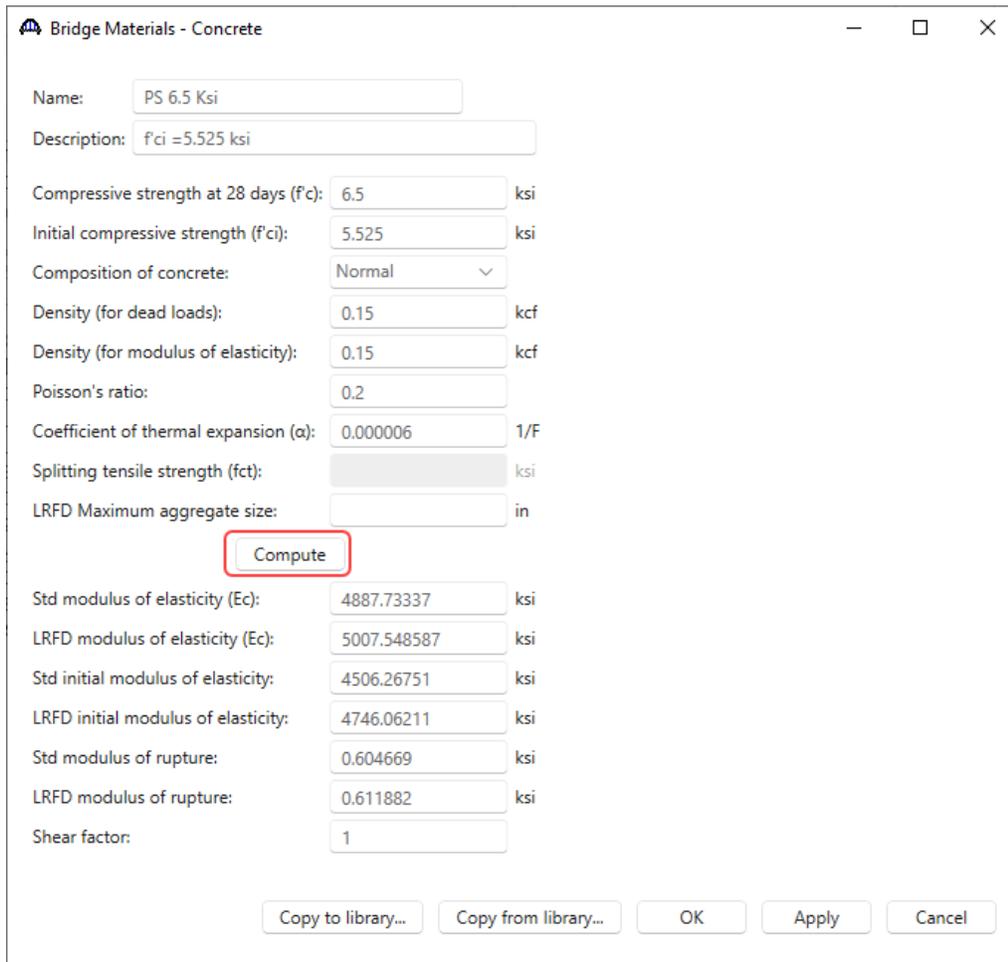


To add a new concrete material, in the **Components** tab of the **Bridge Workspace**, click on **Materials**, **Concrete**, and select **New** from the **Manage** group of the **WORKSPACE** ribbon (or right mouse click on **Concrete** and select **New**).



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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 Materials - Concrete

Name: PS 6.5 Ksi

Description: f'ci = 5.525 ksi

Compressive strength at 28 days (f'c): 6.5 ksi

Initial compressive strength (f'ci): 5.525 ksi

Composition of concrete: Normal

Density (for dead loads): 0.15 kcf

Density (for modulus of elasticity): 0.15 kcf

Poisson's ratio: 0.2

Coefficient of thermal expansion (α): 0.000006 1/F

Splitting tensile strength (f'ct):

LRFD Maximum aggregate size:

Compute

Std modulus of elasticity (Ec): 4887.73337 ksi

LRFD modulus of elasticity (Ec): 5007.548587 ksi

Std initial modulus of elasticity: 4506.26751 ksi

LRFD initial modulus of elasticity: 4746.06211 ksi

Std modulus of rupture: 0.604669 ksi

LRFD modulus of rupture: 0.611882 ksi

Shear factor: 1

Copy to library... Copy from library... OK Apply Cancel

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

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

Bridge Materials - Concrete

Name: Deck Concrete

Description:

Compressive strength at 28 days (F'c): 4.5 ksi

Initial compressive strength (f'ci): ksi

Composition of concrete: Normal

Density (for dead loads): 0.15 kcf

Density (for modulus of elasticity): 0.145 kcf

Poisson's ratio: 0.2

Coefficient of thermal expansion (α): 0.000006 1/F

Splitting tensile strength (f'ct): ksi

LRFD Maximum aggregate size: in

Compute

Std modulus of elasticity (Ec): 3865.20204 ksi

LRFD modulus of elasticity (Ec): 4144.549969 ksi

Std initial modulus of elasticity: ksi

LRFD initial modulus of elasticity: ksi

Std modulus of rupture: 0.503115 ksi

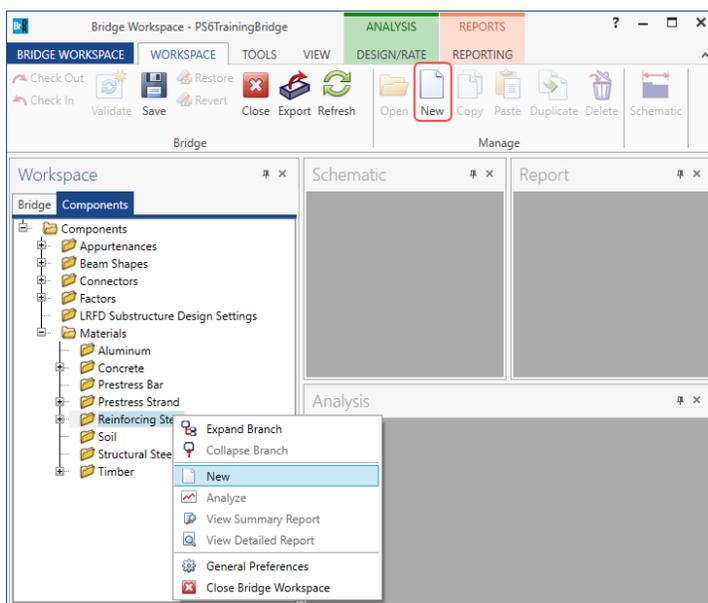
LRFD modulus of rupture: 0.509117 ksi

Shear factor: 1

Copy to library... Copy from library... OK Apply Cancel

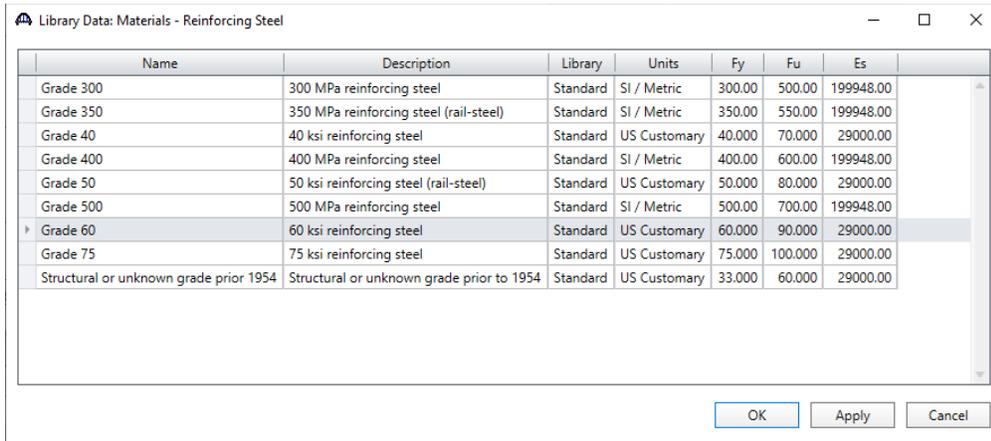
Bridge Materials – Reinforcement steel

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**).

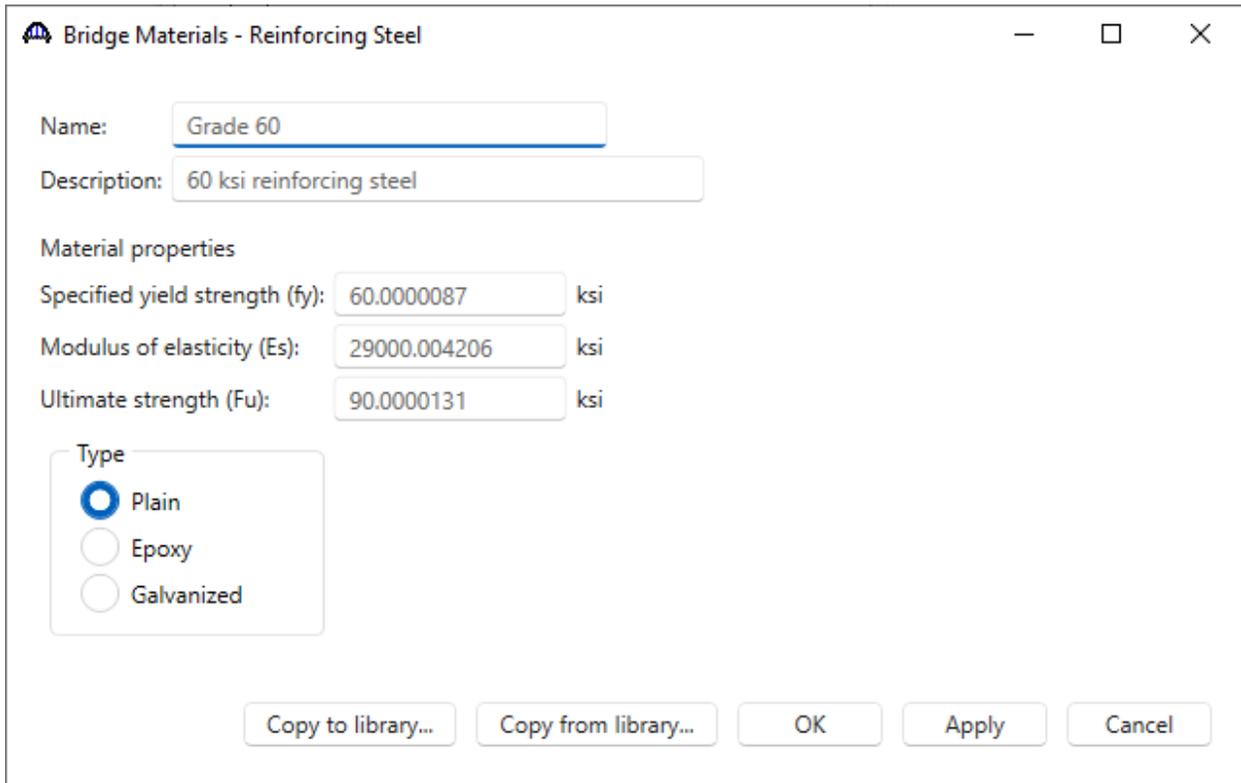


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Click on the **Copy from library...** button in this window and select **Grade 60** from the library and click **OK**.



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

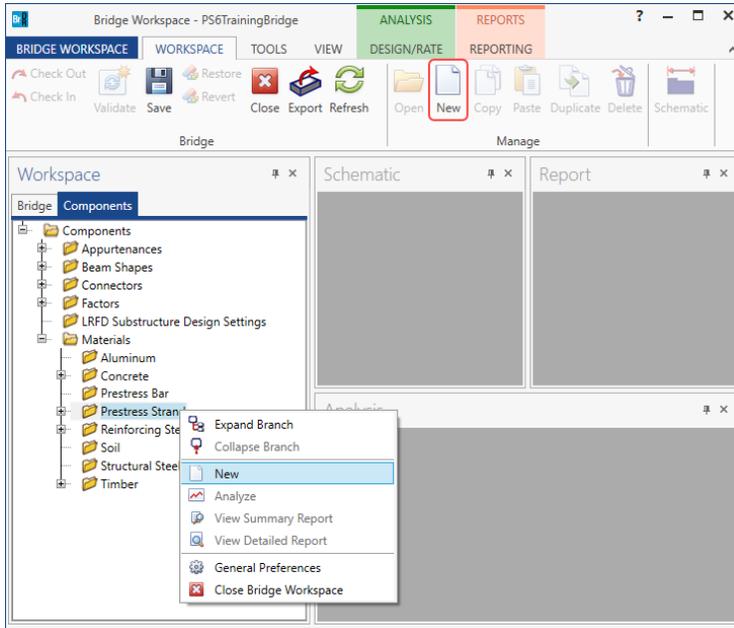


Click **OK** to apply the data and close the window.

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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**).

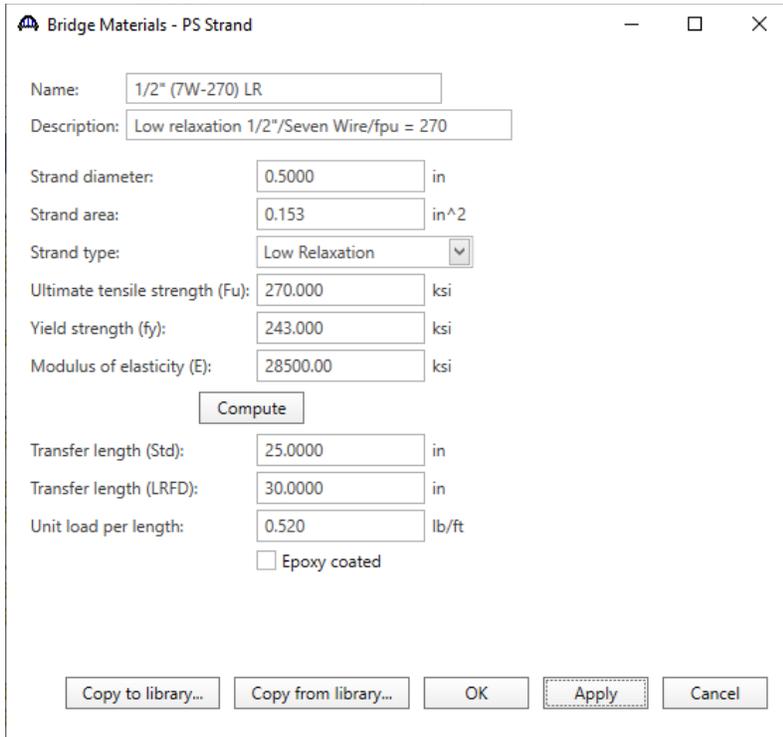


Click on the **Copy from library...** button in this window and select **½” (7W-270) LR** from the library and click **OK**.

Name	Description	Library	Units	Fy	Fu	Modulus of elasticity	Load per unit length	Diameter	Area	Transfer length (Std)	Transfer length (LRFD)	Strand type	Epoxy coated
1/2" (7W-250) LR	Low relaxation 1/2"/Seven Wire/fpu = 250	Standard	US Customary	225.000	250.000	28500.00	0.490	0.5000	0.144	25.0000	30.0000	Low Relaxation	False
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

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



Bridge Materials - PS Strand

Name: 1/2" (7W-270) LR

Description: Low relaxation 1/2"/Seven Wire/fpu = 270

Strand diameter: 0.5000 in

Strand area: 0.153 in²

Strand type: Low Relaxation

Ultimate tensile strength (Fu): 270.000 ksi

Yield strength (fy): 243.000 ksi

Modulus of elasticity (E): 28500.00 ksi

Compute

Transfer length (Std): 25.0000 in

Transfer length (LRFD): 30.0000 in

Unit load per length: 0.520 lb/ft

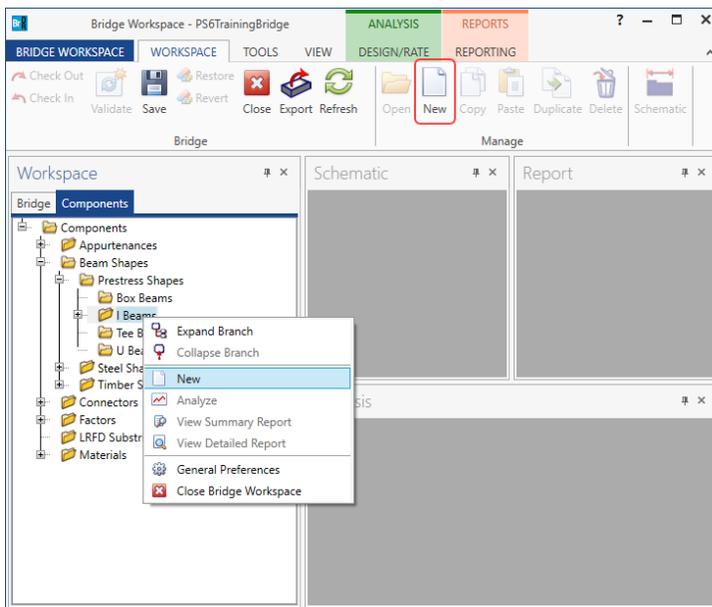
Epoxy coated

Copy to library... Copy from library... OK Apply Cancel

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

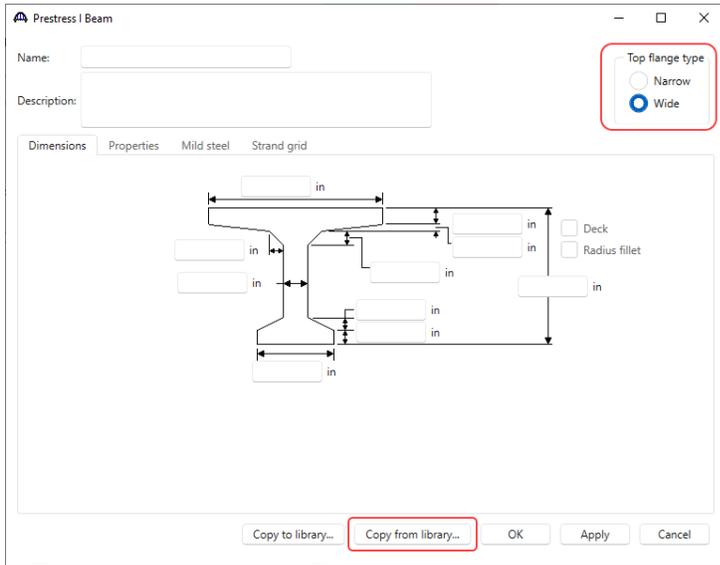
Beam Shapes

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).



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The **Prestress I Beam** window shown below will open.

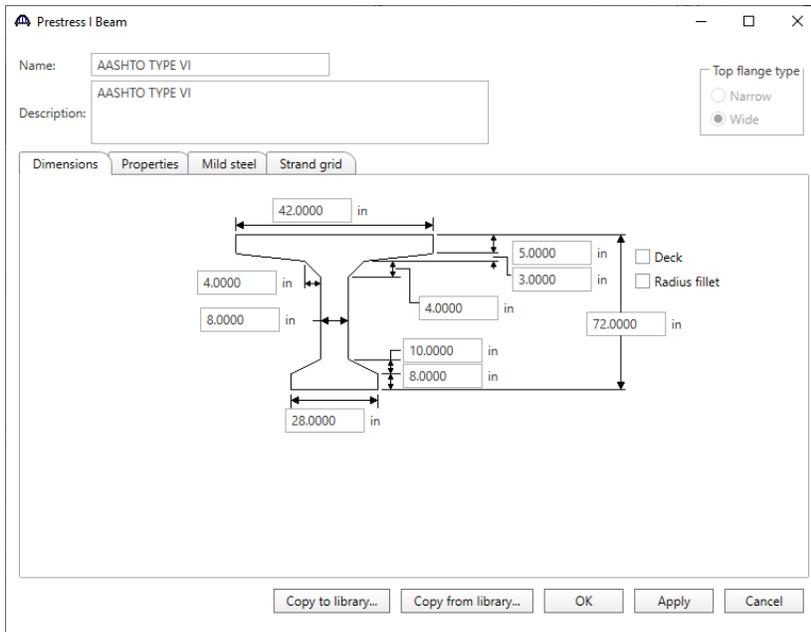


Select the **Top flange type** as **Wide** and click the **Copy from library...** button. Select **AASHTO TYPE VI** and click **OK**.

Library Data: Prestress I 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 web radius fillet
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				
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				
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				
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				

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



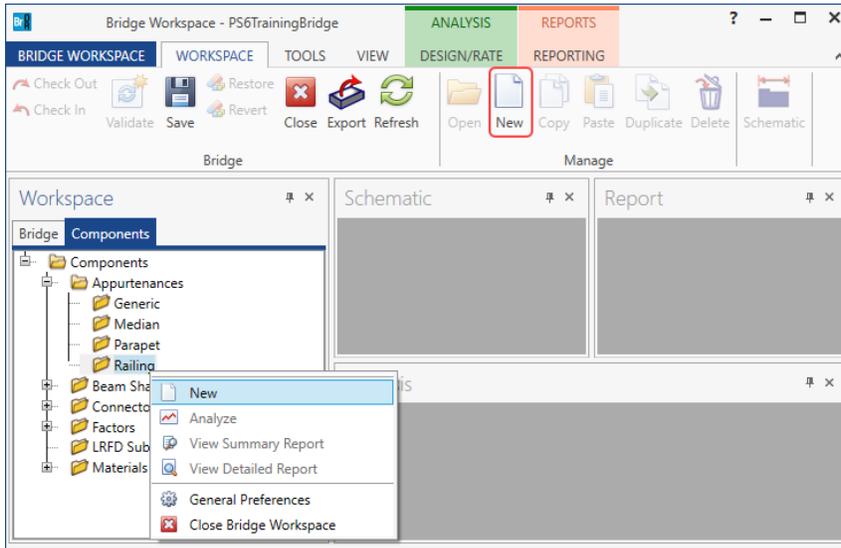
Click **OK** to apply the data and close the window.

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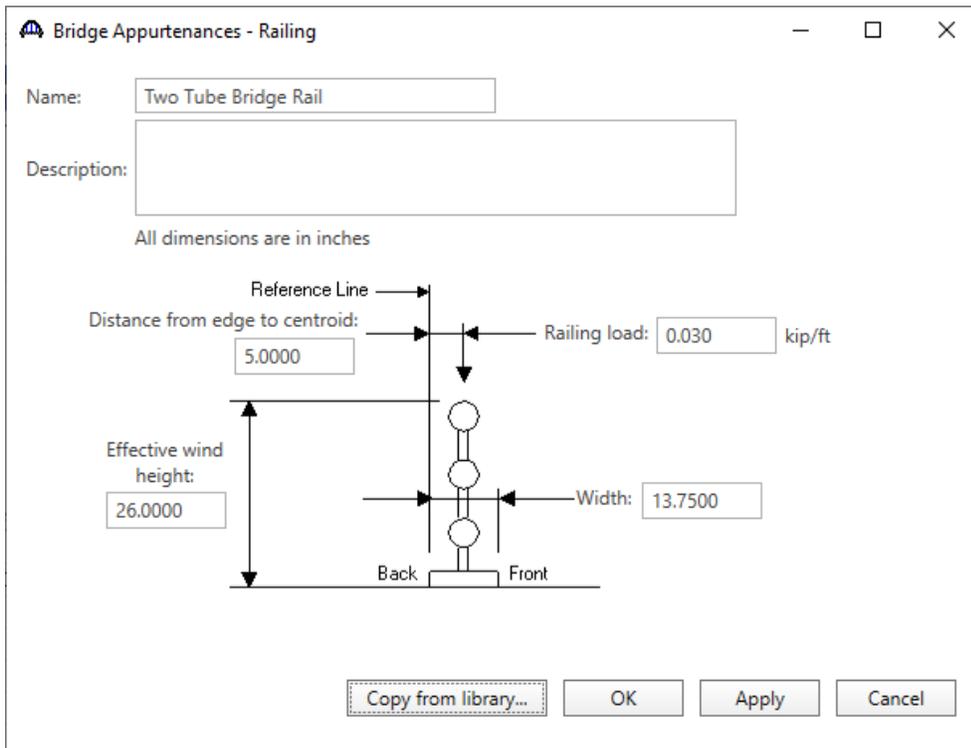
Bridge – Appurtenances

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.

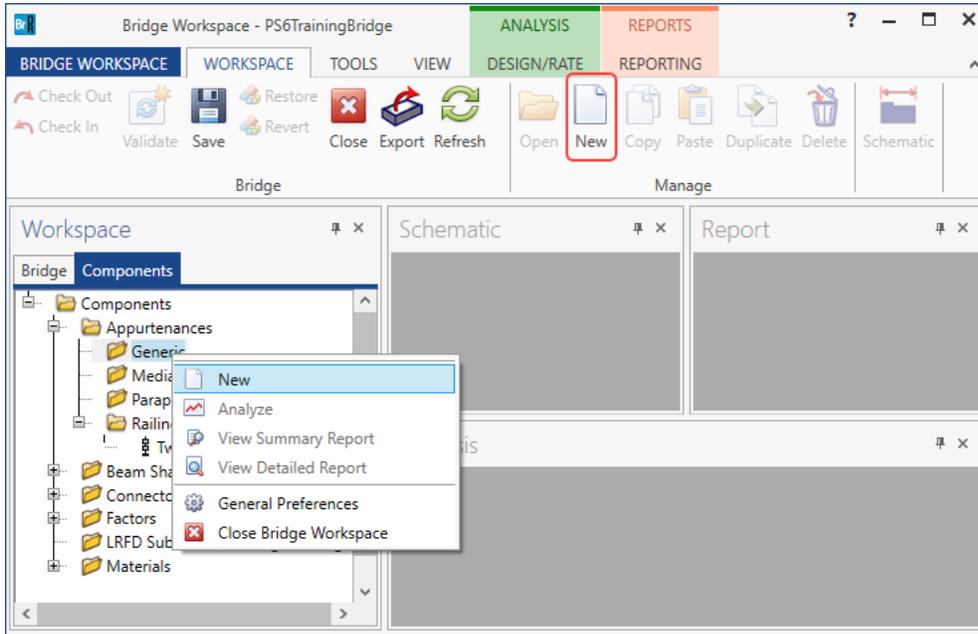


Click **OK** to apply the data and close the window.

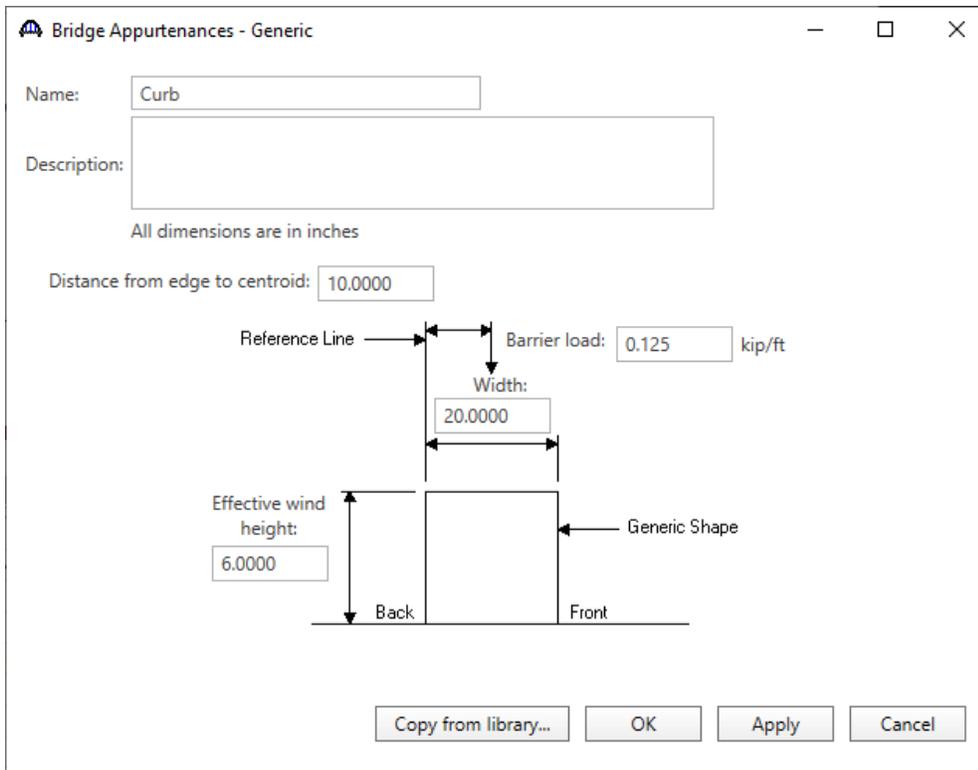
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Concrete curb

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**).



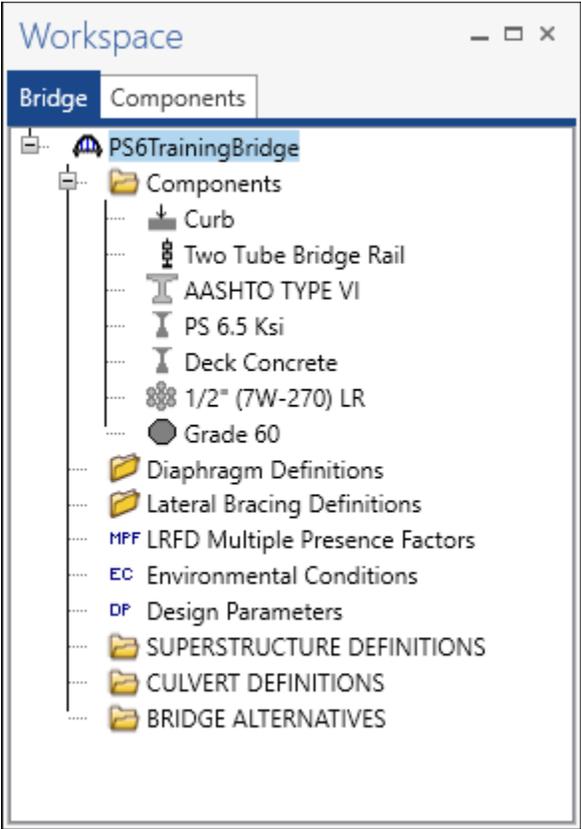
Enter the concrete curb details as shown below.

The image shows the 'Bridge Appurtenances - Generic' dialog box. The 'Name' field is 'Curb'. The 'Description' field is empty. The 'Distance from edge to centroid' is 10.0000. The 'Barrier load' is 0.125 kip/ft. The 'Width' is 20.0000. The 'Effective wind height' is 6.0000. The diagram shows a cross-section of the curb with 'Back' and 'Front' labels.

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

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

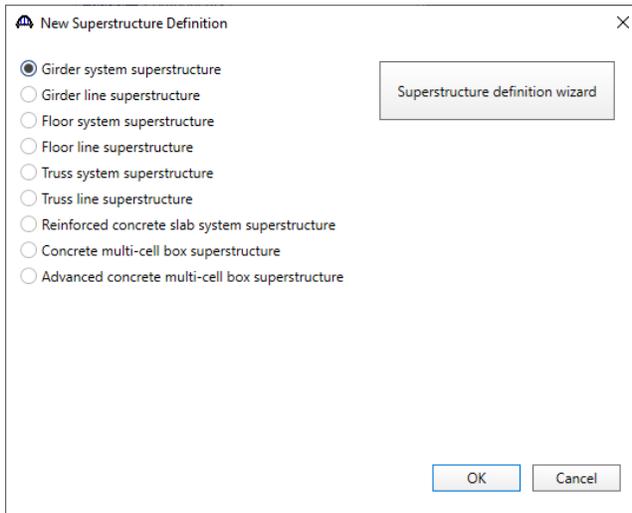


The default impact factors, standard LRFD and LFR factors will be used. Bridge Alternatives will be added after entering the Structure Definition.

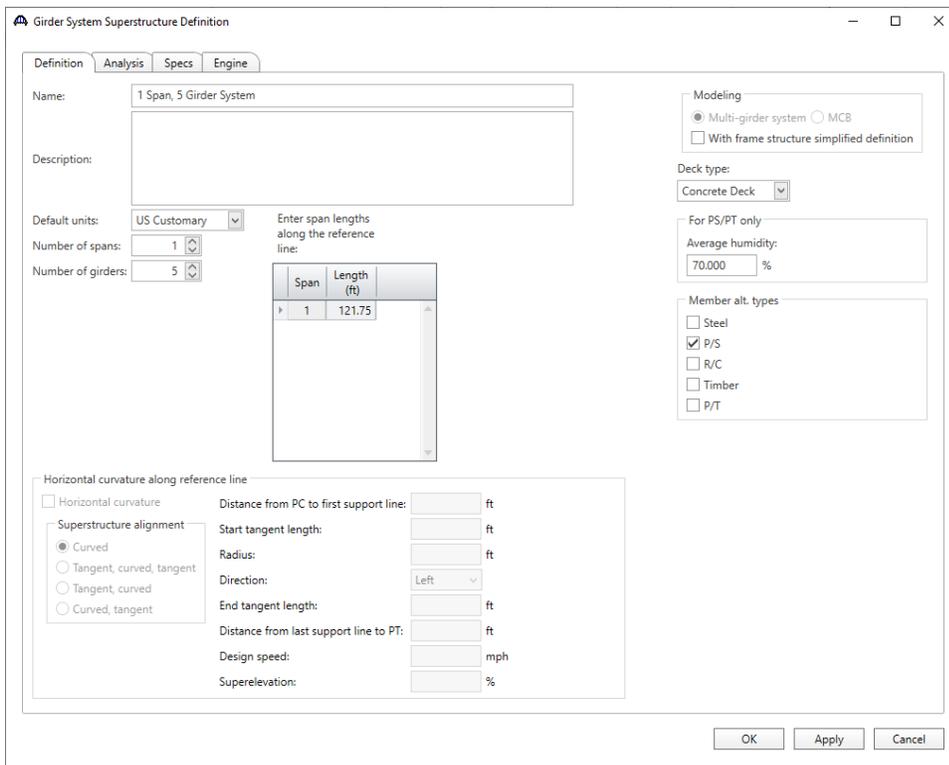
PS6 – Skewed, Simple Span Prestressed I Beam Example

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.



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

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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.

Bridge Alternative

Alternative name: Bridge Alternative #1

Description Substructures

Description:

Horizontal curvature

Reference line length: 0 ft

Start bearing End bearing

Starting station: ft

Bearing: N 90° 0' 0.00" E

Global positioning

Distance: 0 ft

Offset: 0 ft

Elevation: ft

Bridge alignment

Curved

Tangent, curved, tangent

Tangent, curved

Curved, tangent

Start tangent length: ft

Curve length: ft

Radius: ft

Direction: ▾

End tangent length: ft

Superstructure wizard...

Culvert wizard...

OK Apply Cancel

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

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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.

Superstructure

Superstructure name:

Description Alternatives Vehicle path Engine Substructures

Description:

Reference line

Distance: ft

Offset: ft

Angle: Degrees

Starting station: ft

OK Apply Cancel

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

PS6 – Skewed, Simple Span Prestressed I Beam Example

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.

Superstructure Alternative

Alternative name: Superstructure Alternative #1

Description:

Superstructure definition: 1 Span, 5 Girder System

Superstructure type: Girder

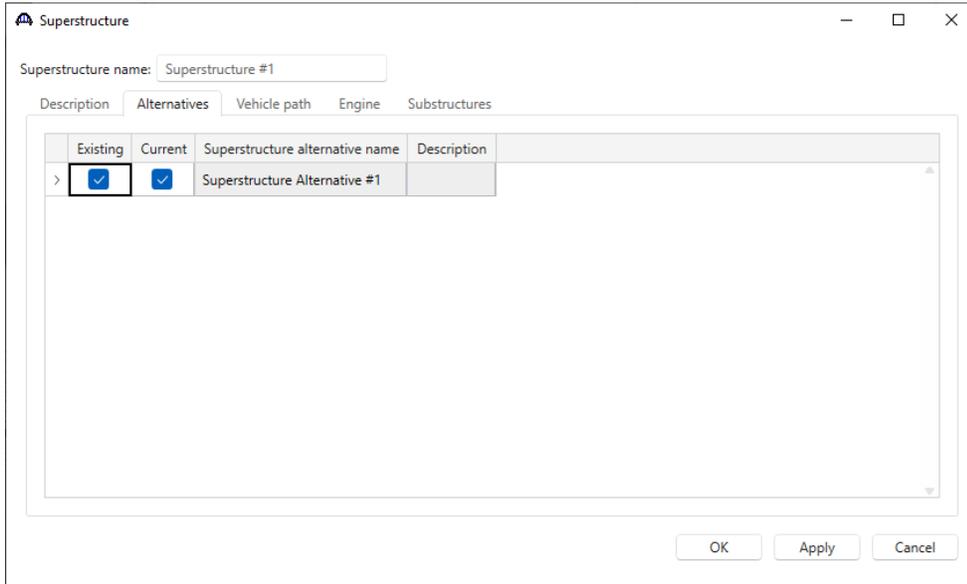
Number of main members: 5

	Span	Length (ft)
>	1	121.75

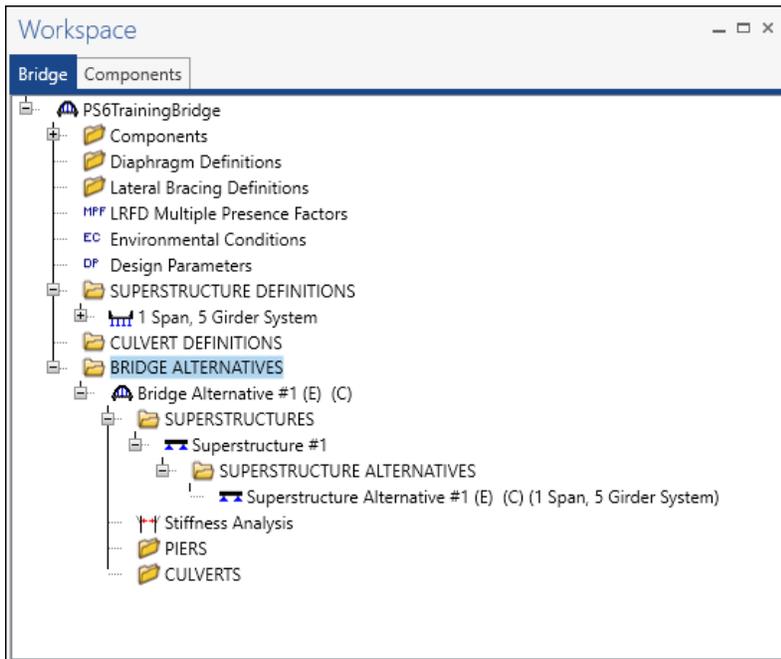
OK Apply Cancel

PS6 – Skewed, Simple Span Prestressed I Beam Example

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**.



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



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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	Type	Time* (days)
DC DL2	Parapets	Composite (long term) (Stage 2)	D,DC	
DW DL2	Future wearing surface	Composite (long term) (Stage 2)	D,DW	

*Prestressed members only

Add default load case descriptions

New Duplicate Delete

OK Apply Cancel

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.

Number of spans: 1 Number of girders: 5

Layout Diaphragms

Girder spacing orientation

Perpendicular to girder
 Along support

Support	Skew (degrees)
1	15
2	15

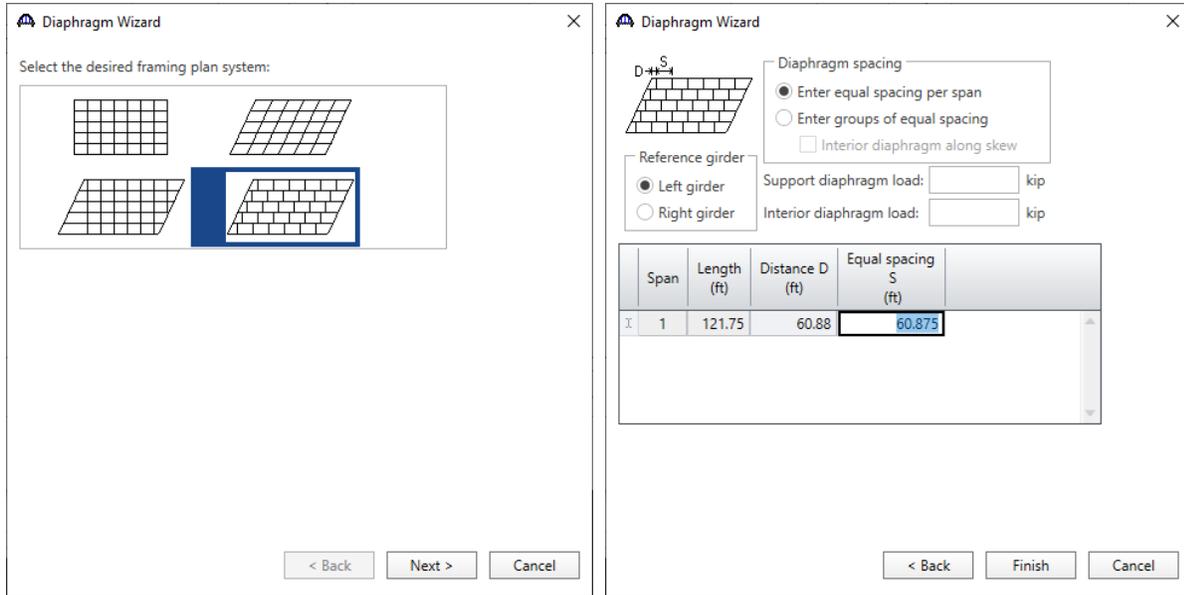
Girder bay	Girder spacing (ft)	
	Start of girder	End of girder
1	9.0833	9.0833
2	9.0833	9.0833
3	9.0833	9.0833
4	9.0833	9.0833

OK Apply Cancel

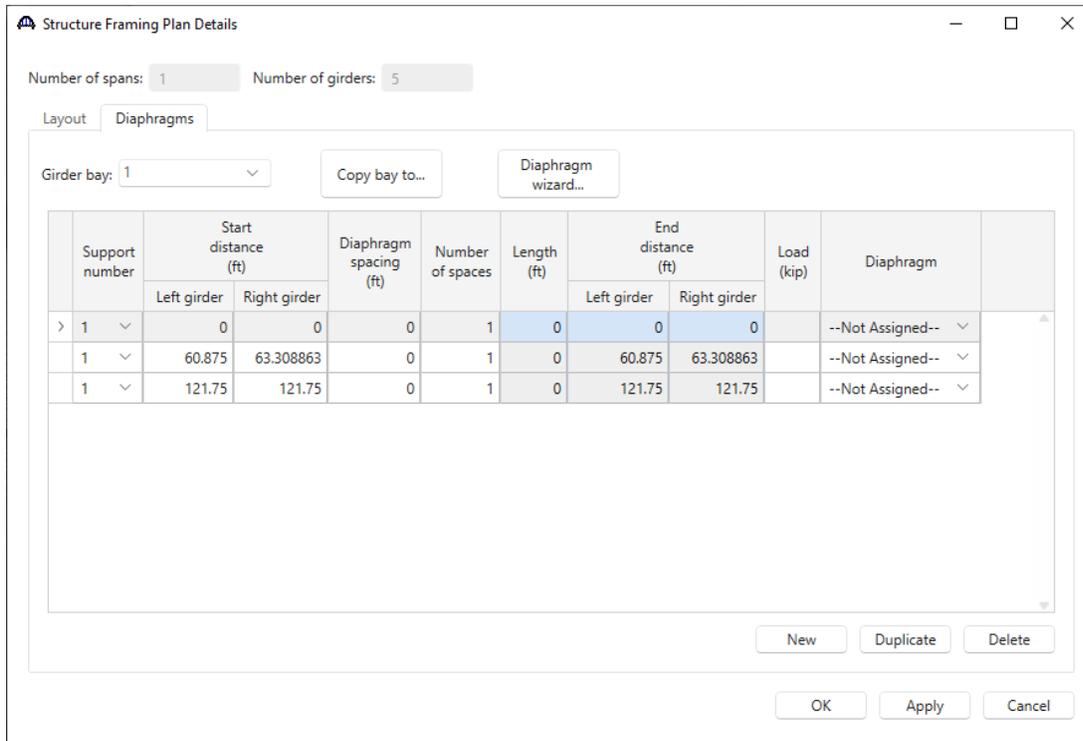
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Structure Framing Plan Detail – Diaphragms

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.



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.

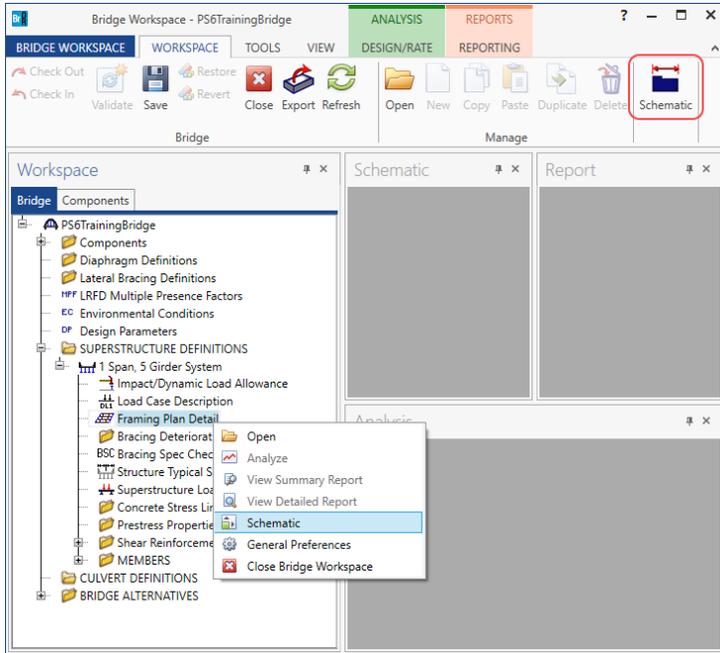


Click **OK** to apply the data and close the window.

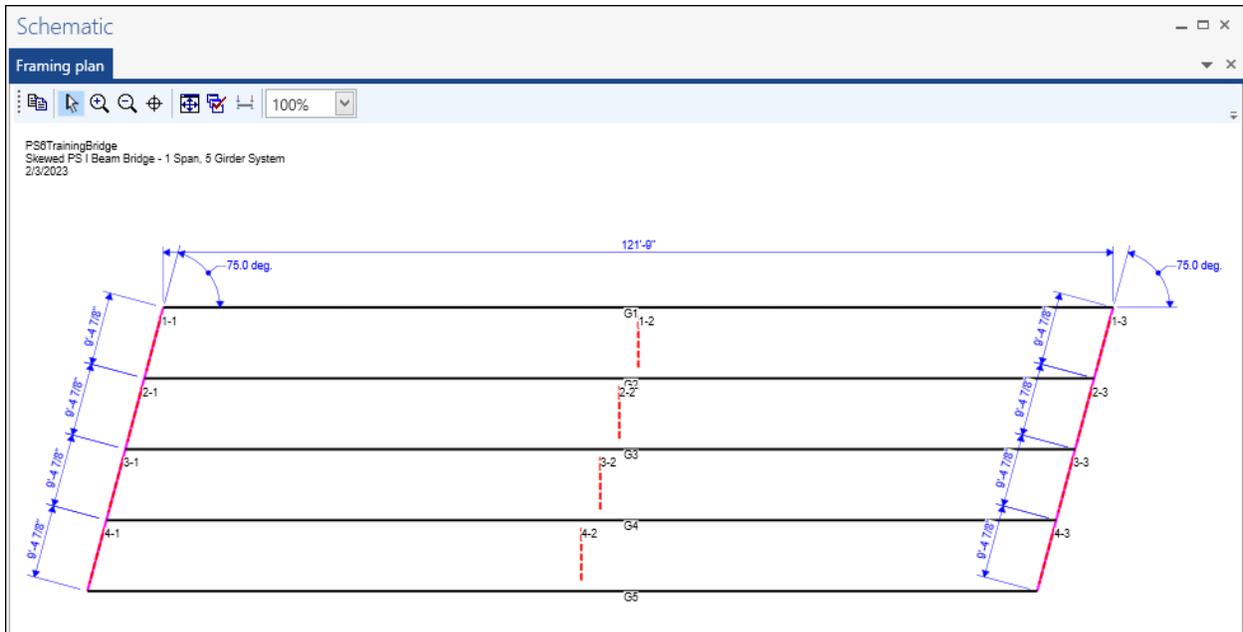
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Schematic – Framing Plan Detail

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.



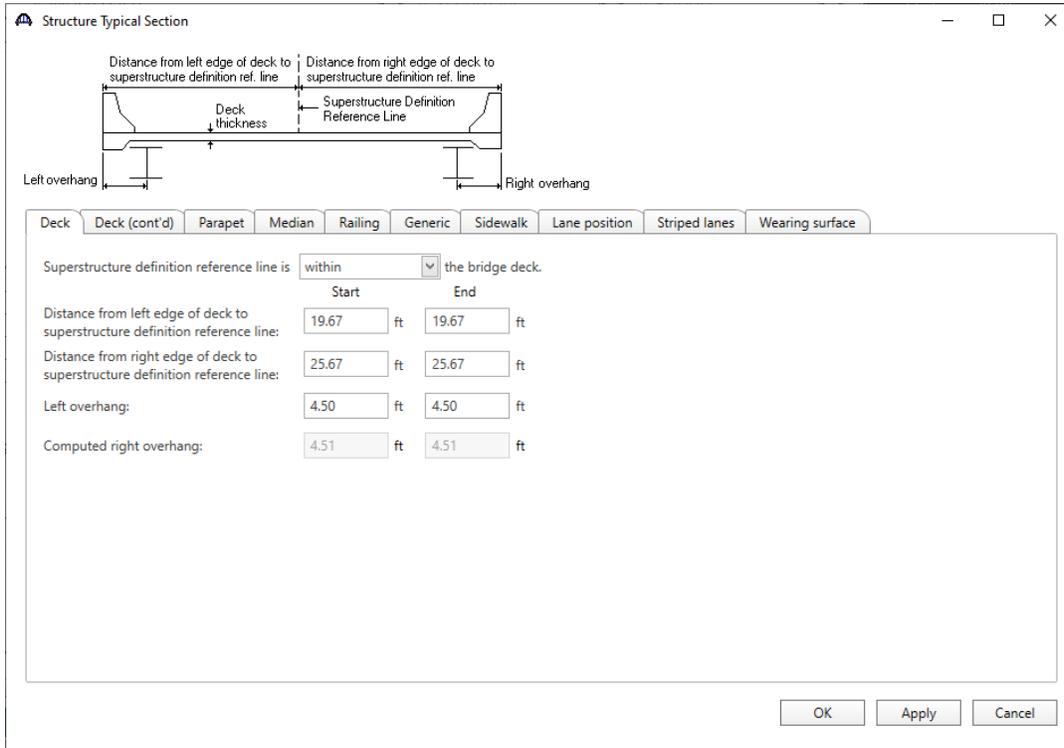
Notice that the span length is displayed along the first girder in the plan. Until the **Structure Typical Section** window is visited, the **Superstructure Definition Reference** line that was entered as span length in the **Girder System Superstructure Definition** window is located under the first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



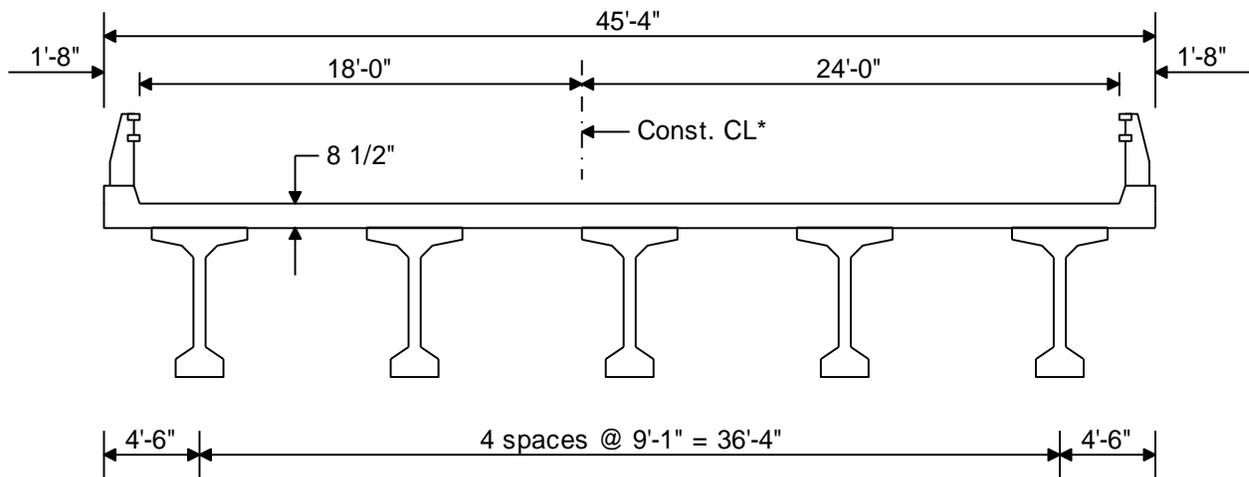
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Structure Typical Section - Deck

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.



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

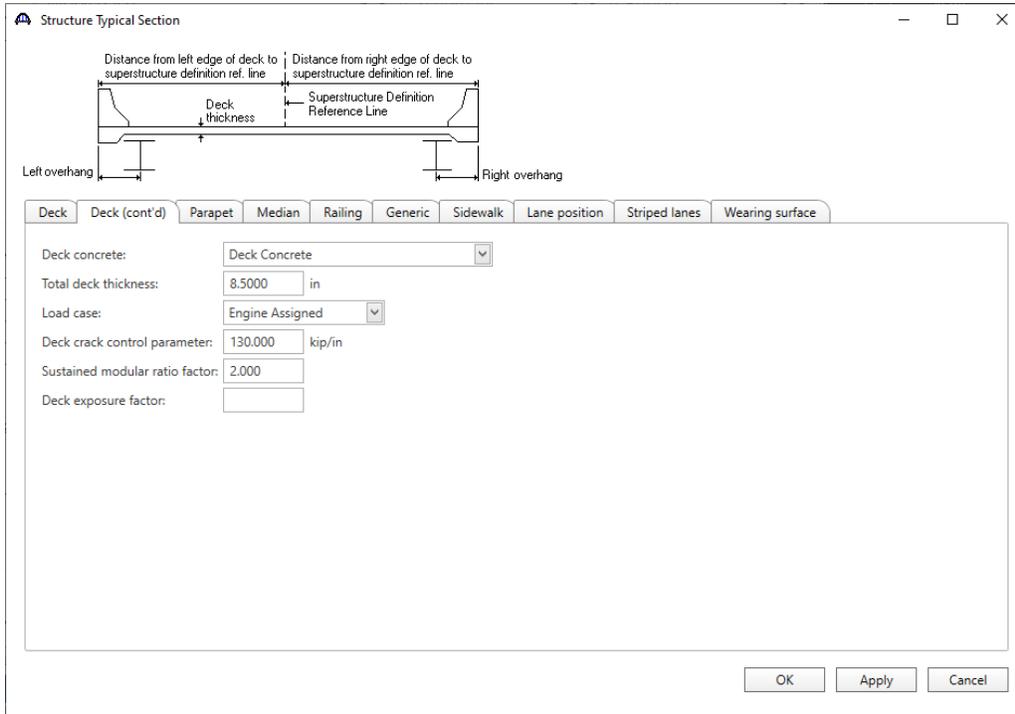


*The construction CL is used as the Structure Definition Reference line in this example

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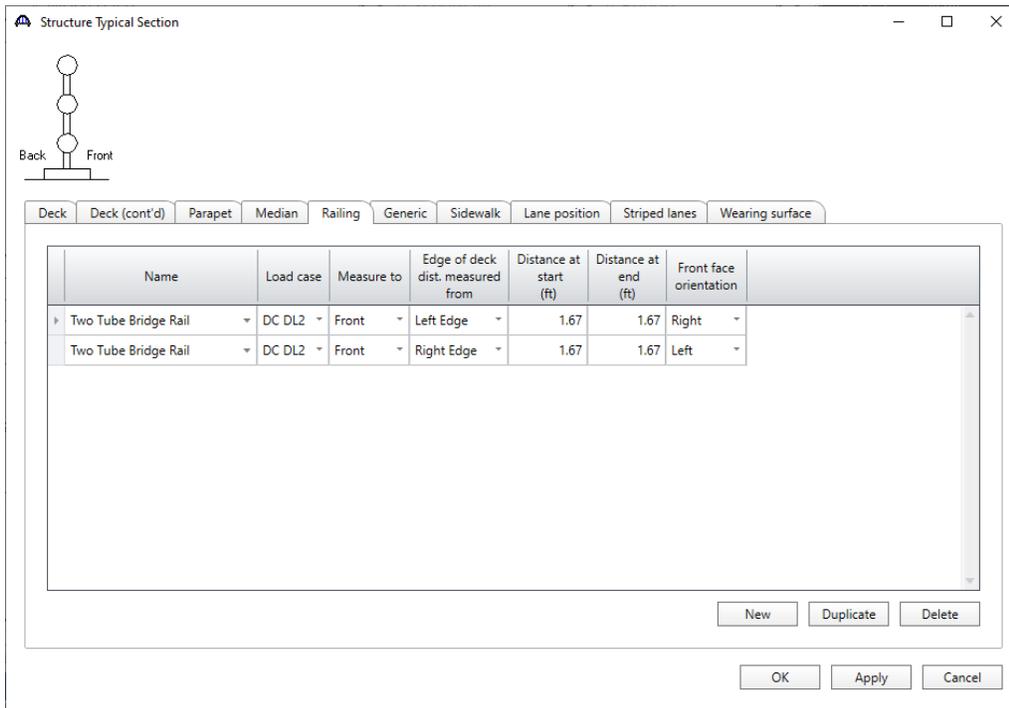
Structure Typical Section – Deck (cont'd)

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.



Structure Typical Section – Railing

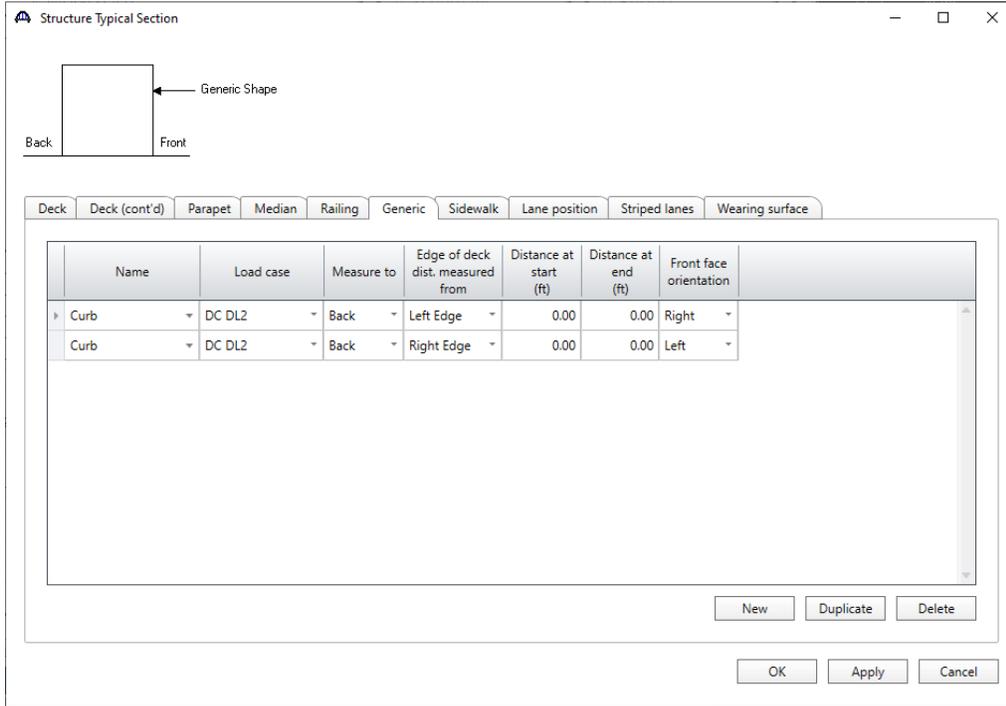
Add two steel railings as shown below.



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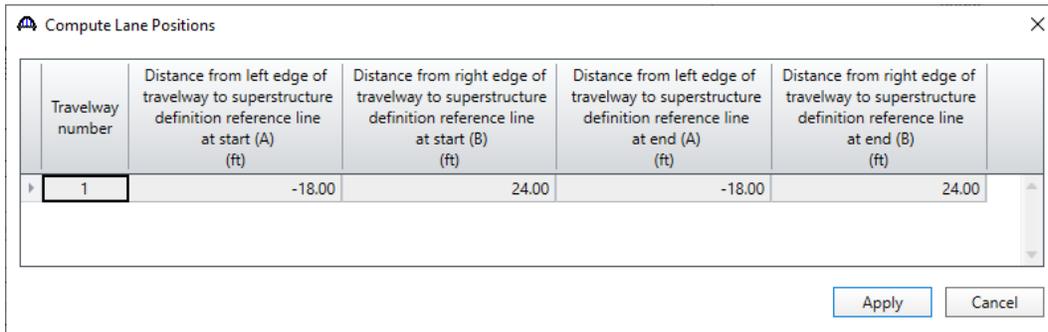
Structure Typical Section – Generic

Add two generic curbs as shown below.



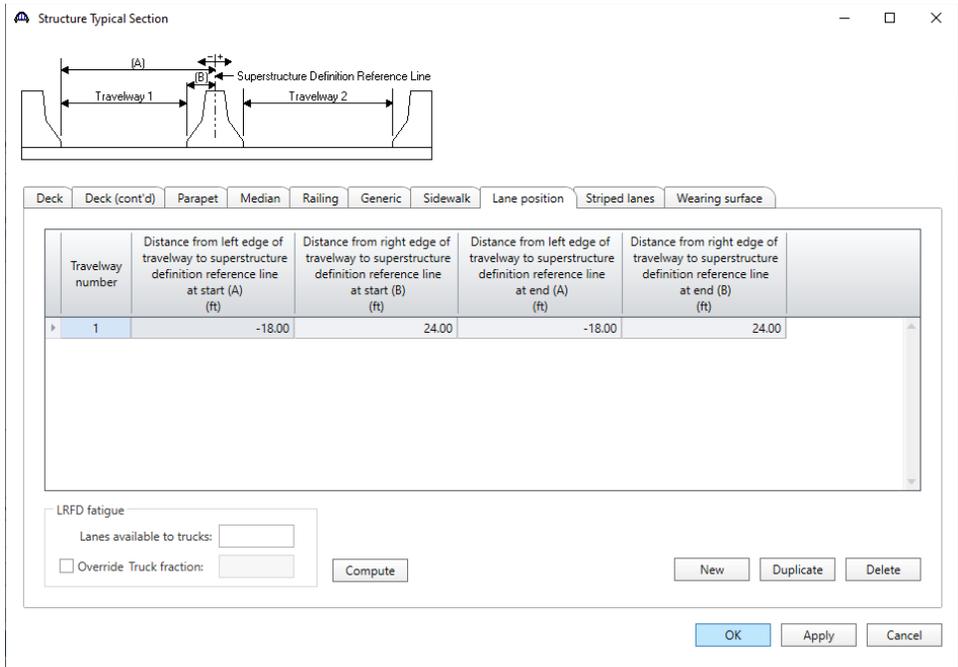
Structure Typical Section – Lane Positions

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.



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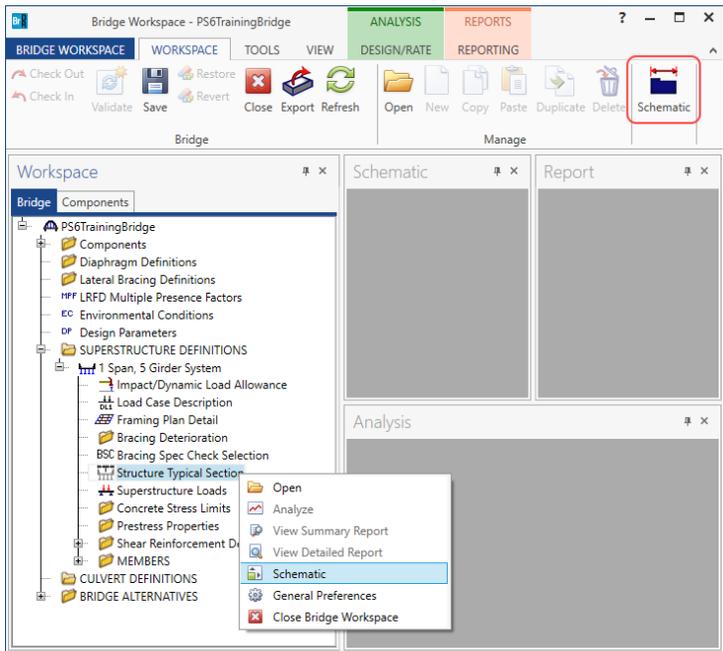
The **Lane Position** tab is populated as shown below.



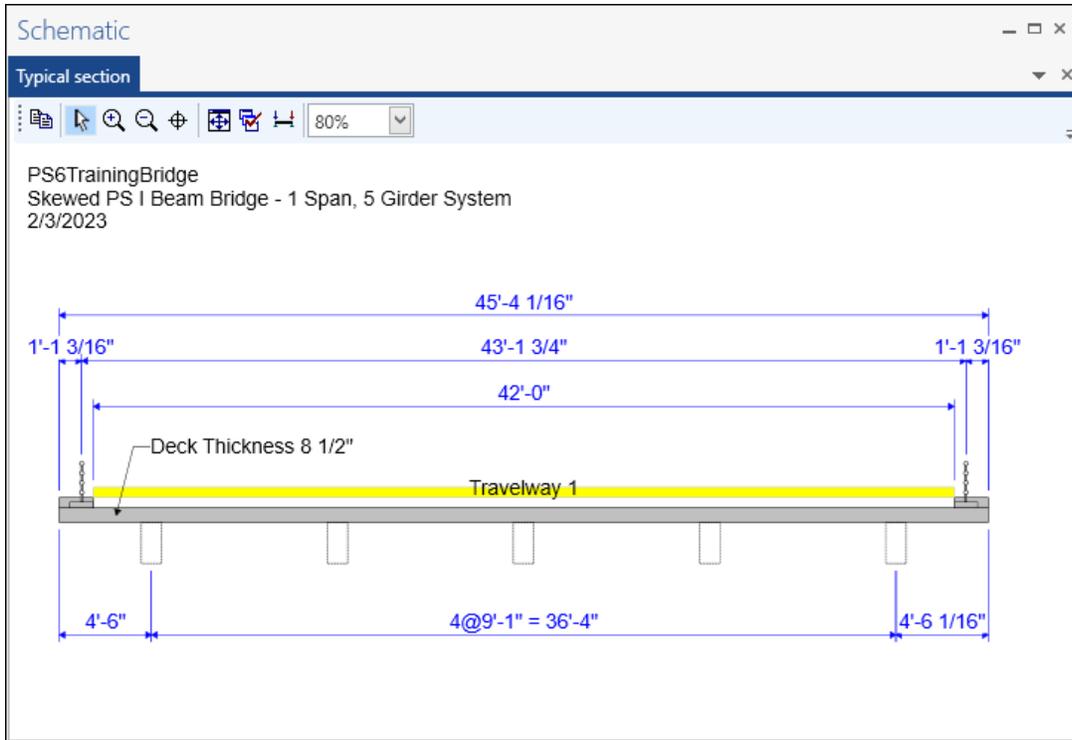
Click **OK** to apply the data and close the window.

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.

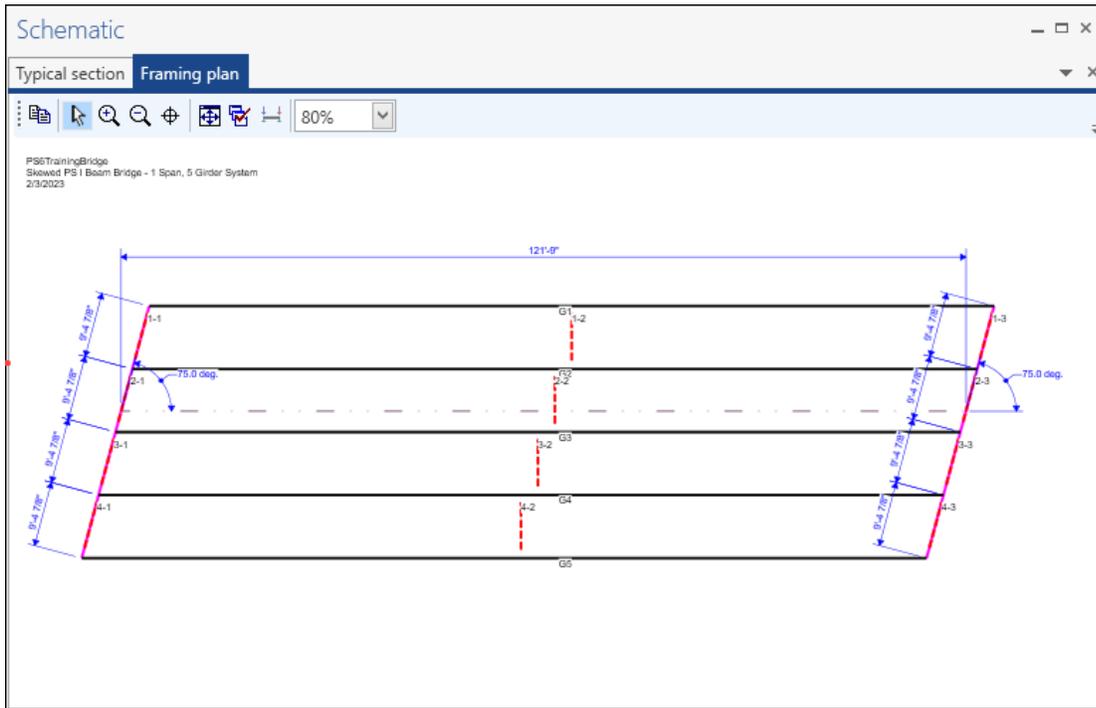


PS6 – Skewed, Simple Span Prestressed I Beam Example



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.



PS6 – Skewed, Simple Span Prestressed I Beam Example

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.

	LFD	LRFD
Initial allowable compression:	3.315 ksi	3.59125 ksi
Initial allowable tension:	0.2 ksi	0.2 ksi
Final allowable compression:	3.9 ksi	3.9 ksi
Final allowable tension:	0.4844069 ksi	0.4844069 ksi
Final allowable DL compression:	2.6 ksi	2.925 ksi
Final allowable slab compression:	2.7 ksi	2.7 ksi
Final allowable compression: (LL+1/2(Pe+DL))	2.6 ksi	2.6 ksi

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

PS6 – Skewed, Simple Span Prestressed I Beam Example

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.

Prestress Properties

Name: 1/2" Starand AASHTO Loss

General P/S data | Loss data - lump sum | Loss data - PCI

P/S strand material: 1/2" (7W-270) LR

Loss method: AASHTO Approximate

Jacking stress ratio: 0.750

P/S transfer stress ratio:

Transfer time: 24.0 Hours

Age at deck placement: 30.00 Days

Final age: 18250.00 Days

Loss data - AASHTO

Percentage DL: 0.0 %

Include elastic gains

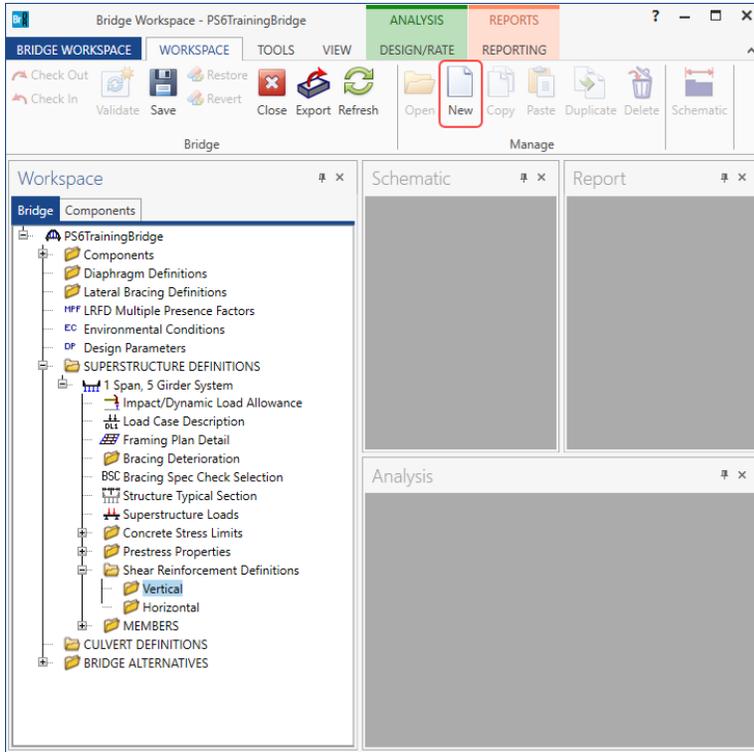
OK Apply Cancel

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

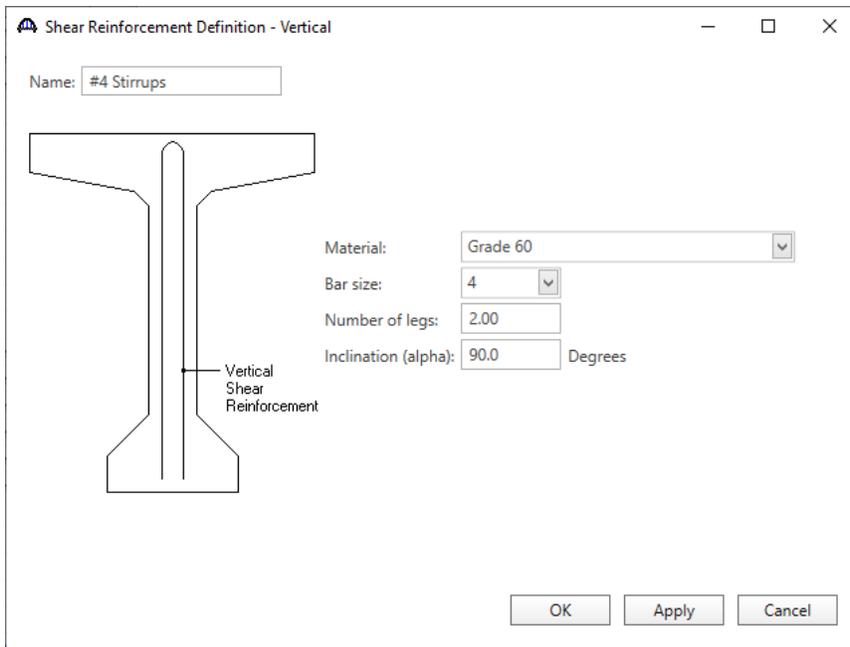
PS6 – Skewed, Simple Span Prestressed I Beam Example

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**).

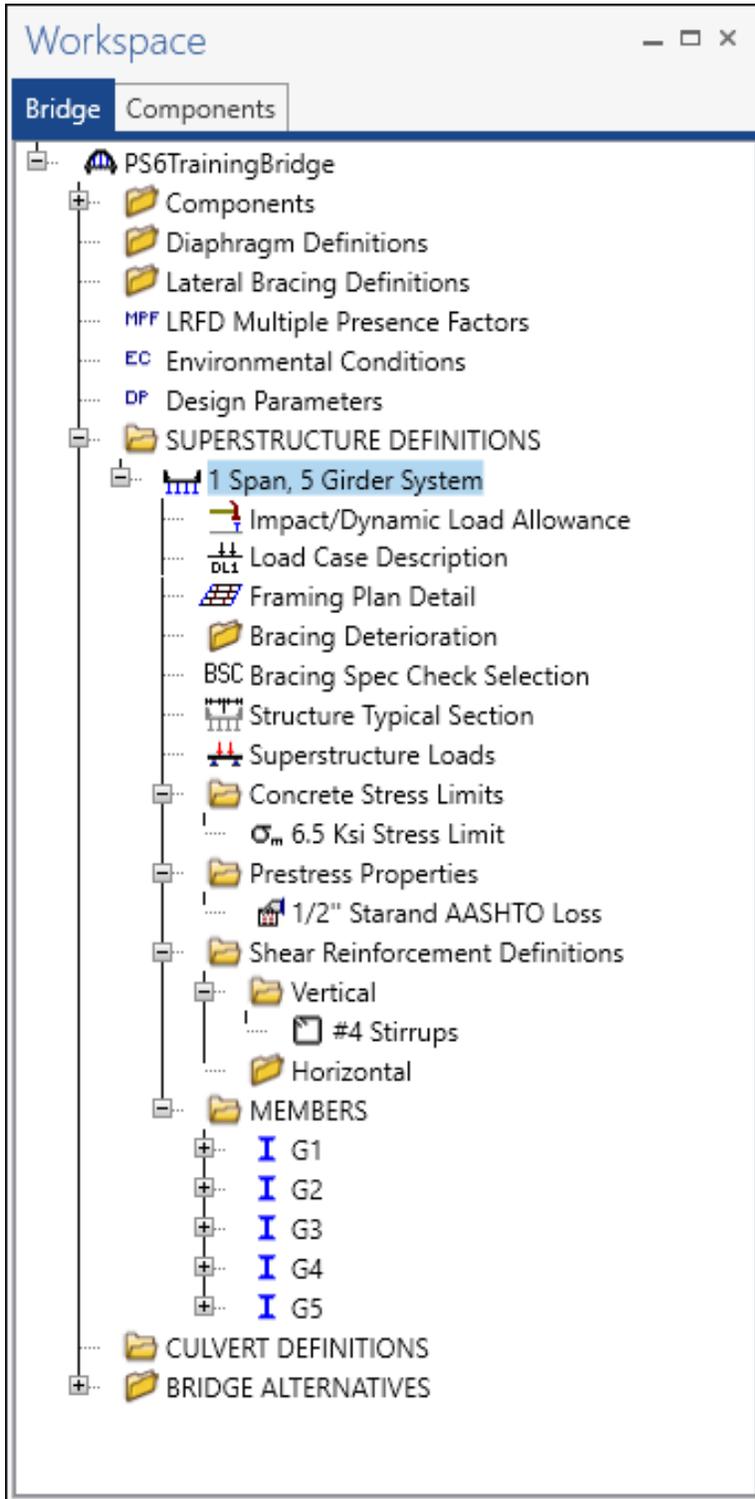


Define the stirrup as shown below. Click **OK** to save and close the window.



PS6 – Skewed, Simple Span Prestressed I Beam Example

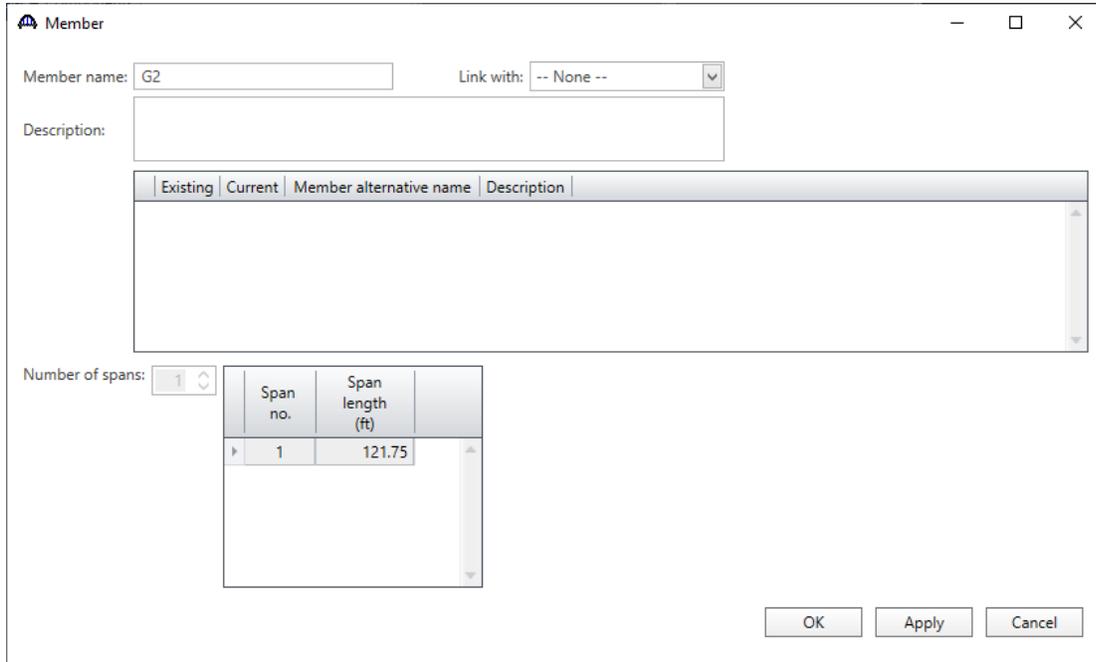
A partially expanded **Bridge Workspace** is shown below.



PS6 – Skewed, Simple Span Prestressed I Beam Example

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.



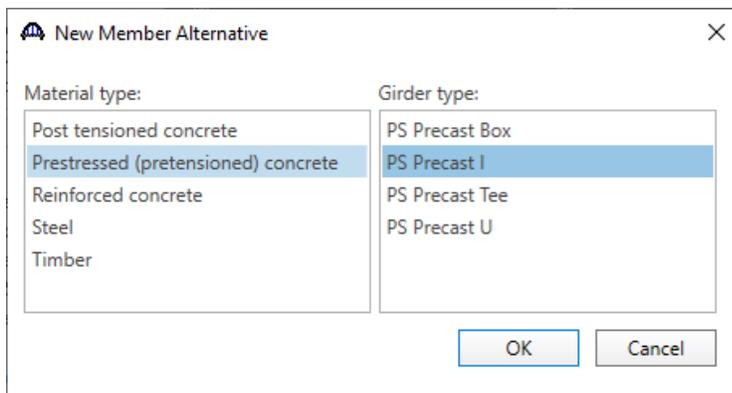
The screenshot shows the 'Member' dialog box. The 'Member name' is 'G2' and 'Link with' is '-- None --'. The 'Description' field is empty. Below is a table with columns 'Existing', 'Current', 'Member alternative name', and 'Description'. The 'Number of spans' is 1. A table below shows the span details:

Span no.	Span length (ft)
1	121.75

Buttons for 'OK', 'Apply', and 'Cancel' are at the bottom right.

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**.



The screenshot shows the 'New Member Alternative' dialog box. The 'Material type' list includes 'Post tensioned concrete', 'Prestressed (pretensioned) concrete', 'Reinforced concrete', 'Steel', and 'Timber'. The 'Girder type' list includes 'PS Precast Box', 'PS Precast I', 'PS Precast Tee', and 'PS Precast U'. Buttons for 'OK' and 'Cancel' are at the bottom.

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

PS6 – Skewed, Simple Span Prestressed I Beam Example

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.

Member alternative: Type VI Beam

Description Specs Factors Engine Import Control options

Description:

Material type: Prestressed (Pretensioned)
Girder type: PS Precast I
Modeling type: Multi Girder System
Default units: US Customary

Girder property input method
 Schedule based
 Cross-section based

Self load
Load case: Engine Assigned
Additional self load: 0 kip/ft
Additional self load: 0 %

Default rating method: LFR

Crack control parameter (Z)
Top of beam: 0 kip/in
Bottom of beam: 0 kip/in

Exposure factor
Top of beam: 0
Bottom of beam: 0

Use creep

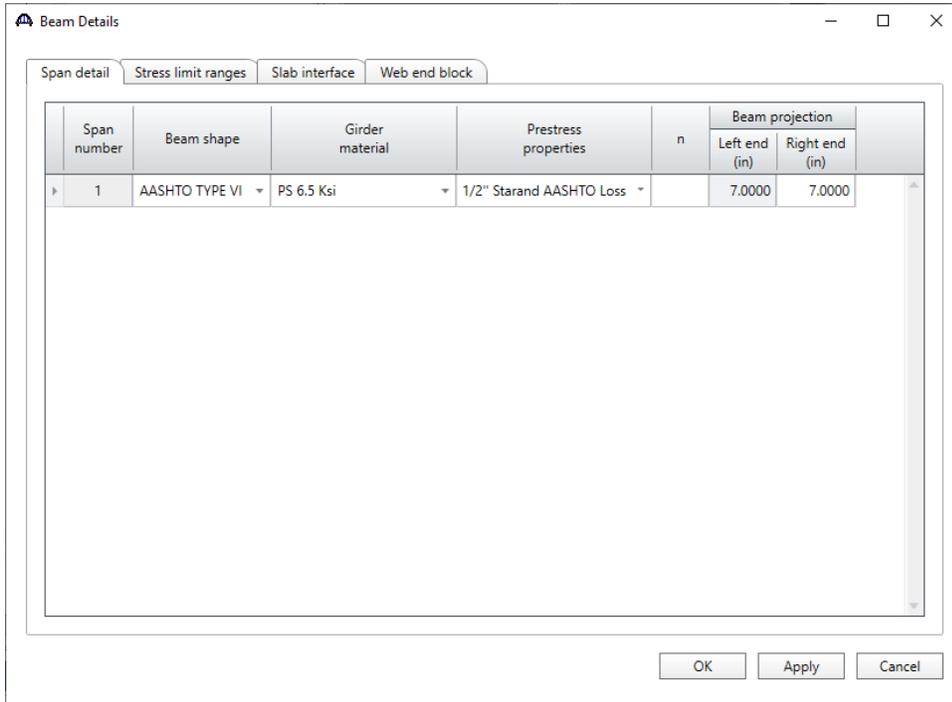
OK Apply Cancel

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

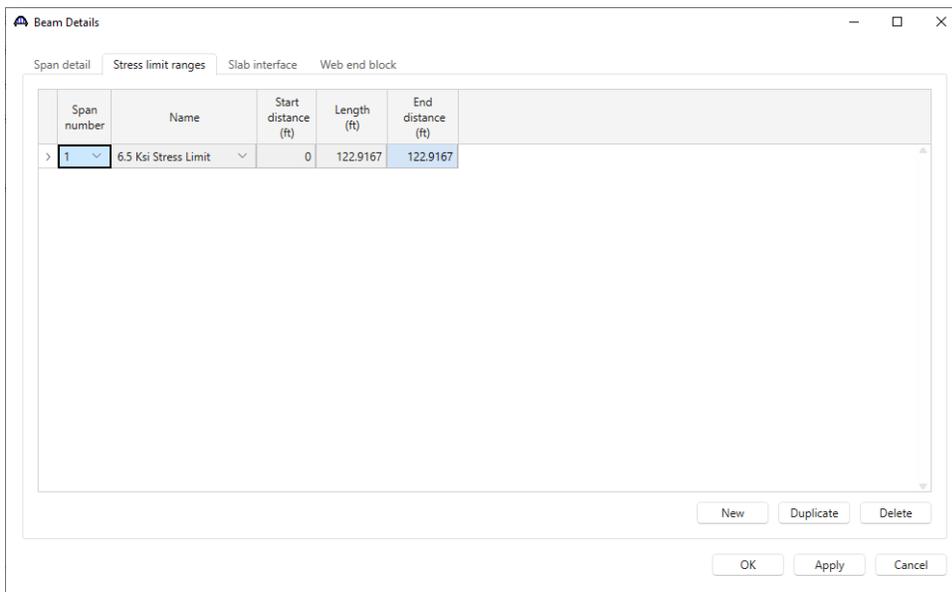
PS6 – Skewed, Simple Span Prestressed I Beam Example

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.

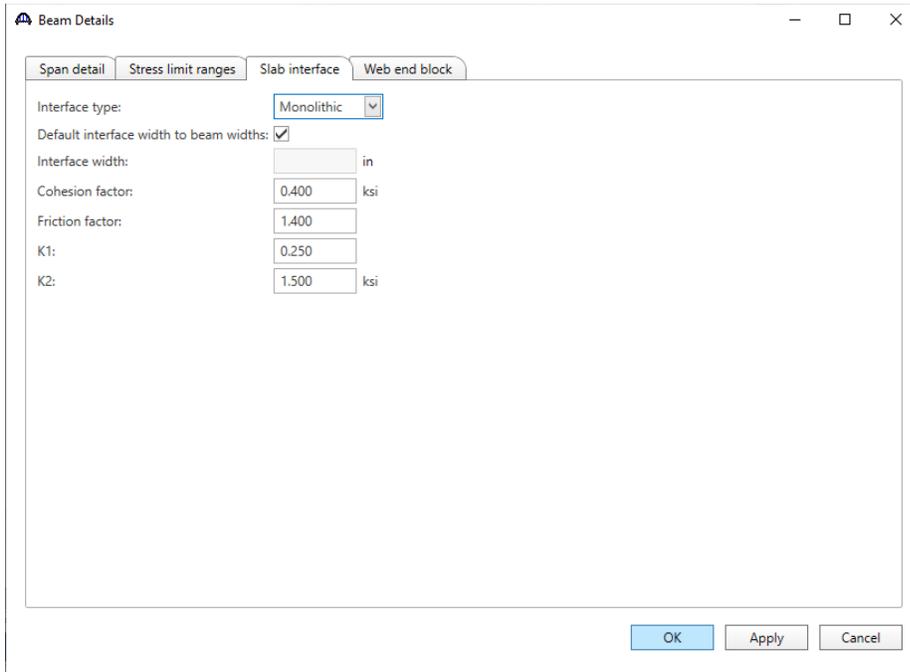


Note that the **Stress limit ranges** are defined over the entire length of the precast beam, including the projections of the beam past the centerline of bearing which were entered on the **Span detail** tab of this window.



PS6 – Skewed, Simple Span Prestressed I Beam Example

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

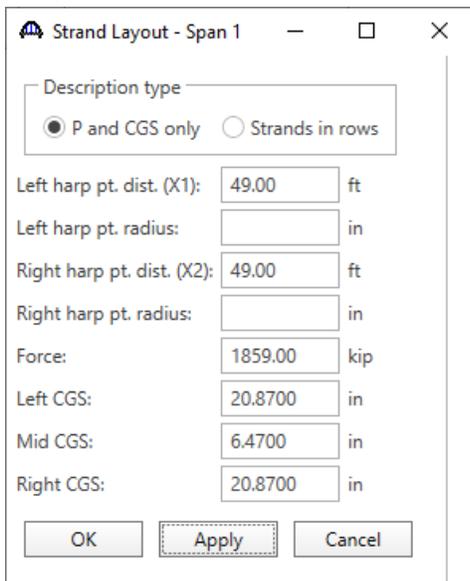


The screenshot shows the 'Beam Details' dialog box with the 'Slab interface' tab selected. The 'Interface type' is set to 'Monolithic'. The 'Default interface width to beam widths' checkbox is checked. The 'Interface width' is set to an empty field with 'in' as the unit. The 'Cohesion factor' is 0.400 ksi, 'Friction factor' is 1.400, 'K1' is 0.250, and 'K2' is 1.500 ksi. At the bottom, there are 'OK', 'Apply', and 'Cancel' buttons.

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.



The screenshot shows the 'Strand Layout - Span 1' dialog box. The 'Description type' is set to 'P and CGS only'. The 'Left harp pt. dist. (X1)' is 49.00 ft, 'Left harp pt. radius' is an empty field in inches, 'Right harp pt. dist. (X2)' is 49.00 ft, 'Right harp pt. radius' is an empty field in inches, 'Force' is 1859.00 kip, 'Left CGS' is 20.8700 in, 'Mid CGS' is 6.4700 in, and 'Right CGS' is 20.8700 in. At the bottom, there are 'OK', 'Apply', and 'Cancel' buttons.

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

PS6 – Skewed, Simple Span Prestressed I Beam Example

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.

The Deck Profile window is titled "Deck Profile" and has a "Type" field set to "PS Precast I". It features two tabs: "Deck concrete" (selected) and "Reinforcement". Below the tabs is a table with the following data:

Material	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 Concrete	1	0.00	121.75	121.75	8.5000	102.0000	102.0000	109.0000	109.0000	

At the bottom of the window, there is a "Compute from typical section..." button, and a set of control buttons: "New", "Duplicate", "Delete", "OK", "Apply", and "Cancel".

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.

The PS Haunch Profile window is titled "PS Haunch Profile" and displays a cross-sectional diagram of a haunched beam. The diagram shows a central section with a width of Y3 and a height of Y1. The haunches on either side have a width of Z1 and a height of Z2. Below the diagram is a table with the following data:

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

At the bottom of the window, there is a set of control buttons: "New", "Duplicate", "Delete", "OK", "Apply", and "Cancel".

PS6 – Skewed, Simple Span Prestressed I Beam Example

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 Shear Reinforcement Ranges

Vertical Horizontal

Span: 1

Name	Extends into deck	Start distance (ft)	Number of spaces	Spacing (in)	Length (ft)	End distance (ft)
> #4 Stirrups	<input checked="" type="checkbox"/>	0.17	1	0	0	0.17
#4 Stirrups	<input checked="" type="checkbox"/>	0.17	4	3	1	1.17
#4 Stirrups	<input checked="" type="checkbox"/>	1.17	1	4	0.333333	1.503333
#4 Stirrups	<input checked="" type="checkbox"/>	1.503333	120	12	120	121.503333
#4 Stirrups	<input checked="" type="checkbox"/>	121.503333	1	4	0.333333	121.836666
#4 Stirrups	<input checked="" type="checkbox"/>	121.836666	4	3	1	122.836666

Stirrup wizard... Stirrup design tool... View calcs New Duplicate Delete

OK Apply Cancel

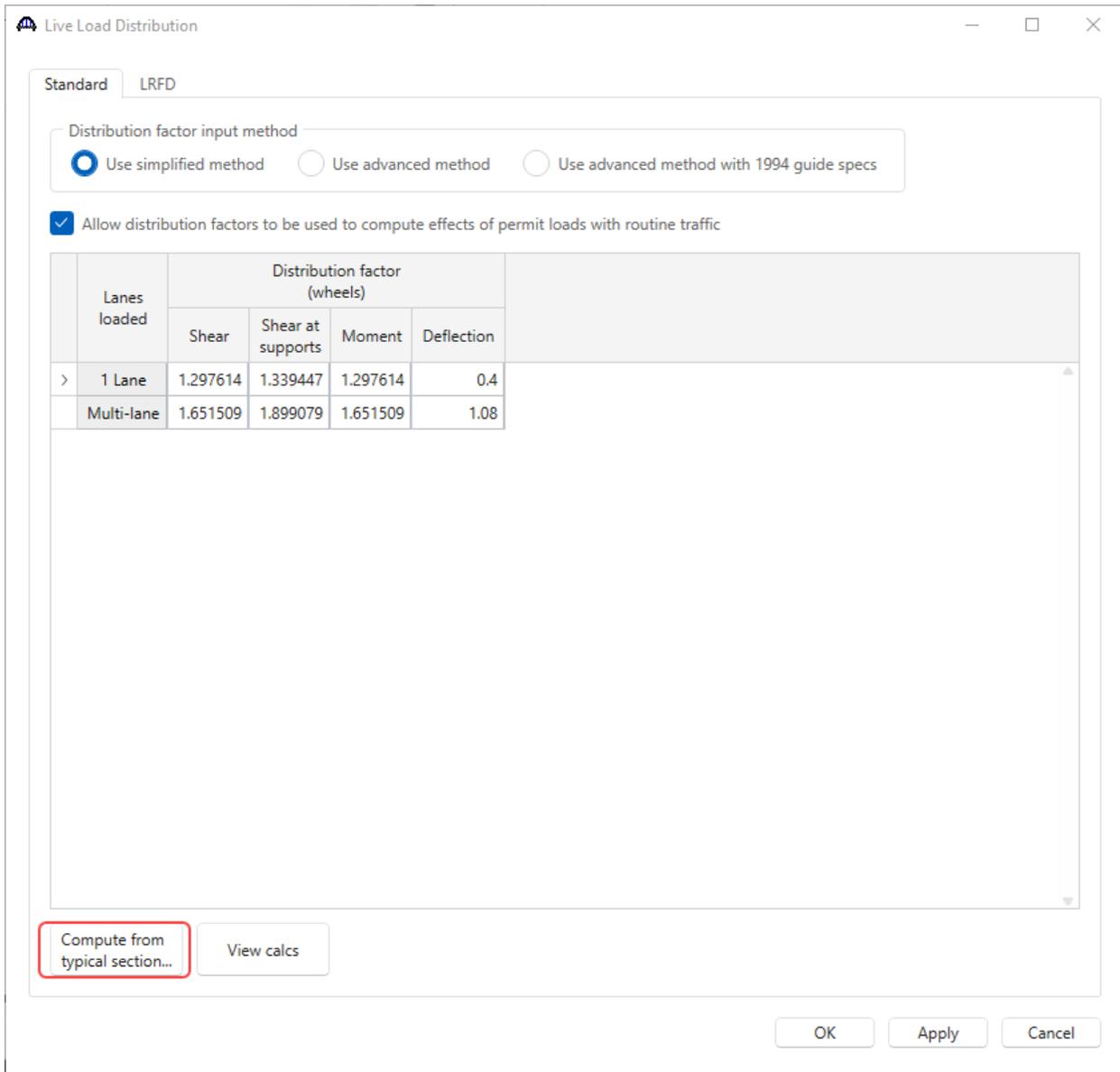
Click **OK** to apply the data and close the window.

PS6 – Skewed, Simple Span Prestressed I Beam Example

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.



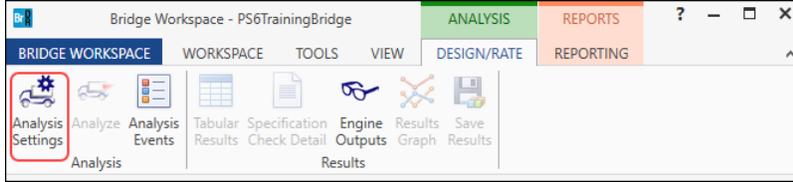
Click **OK** to apply the data and close the window.

The description of this structure definition is complete.

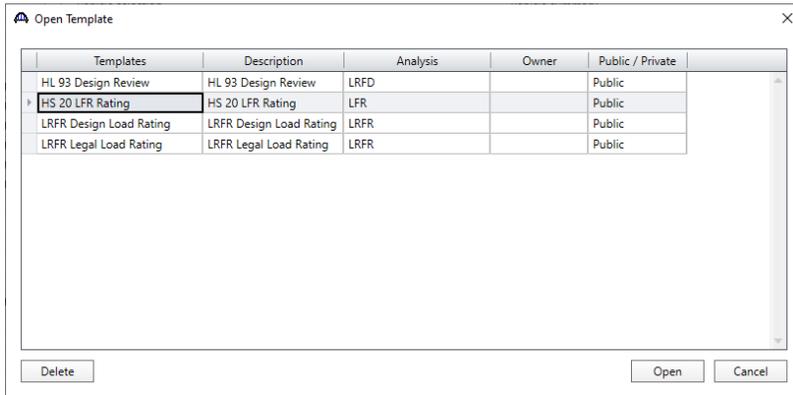
PS6 – Skewed, Simple Span Prestressed I Beam Example

LFR Analysis

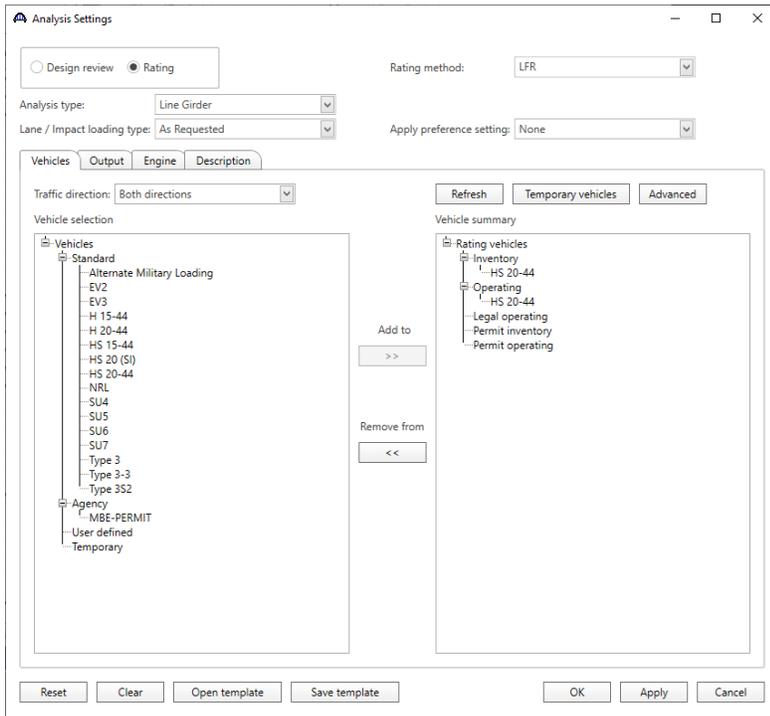
The member alternative can now be analyzed. To perform an **LFR** rating, select the **Analysis Settings** button on the **Analysis** group of the **DESIGN/RATE** ribbon. The window shown below opens.



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



The **Analysis Settings** window will be populated as shown below.

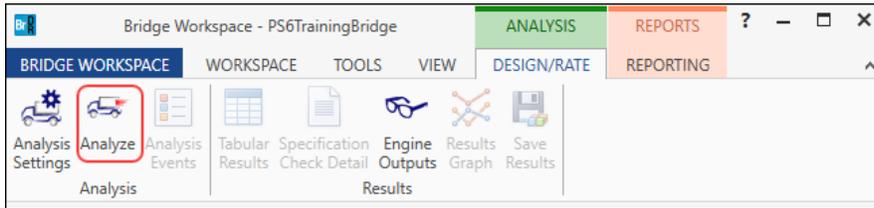


Click **OK** to apply the data and close the window.

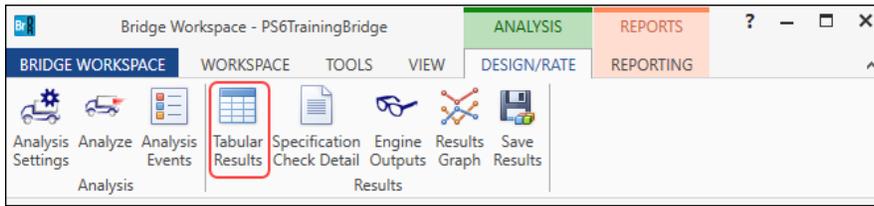
PS6 – Skewed, Simple Span Prestressed I Beam Example

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.



The window shown below will open.

Analysis Results - Type VI Beam

Print

Report type: Rating Results Summary

Lane/Impact loading type: As requested Detailed

Display Format: Single rating level per row

Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Limit State	Impact	Lane
HS 20-44	Axle Load	LFR	Inventory	62.41	1.734	118.31	1 - (97.2)	Design Shear - Concrete	As Requested	As Requested
HS 20-44	Axle Load	LFR	Operating	104.22	2.895	118.31	1 - (97.2)	Design Shear - Concrete	As Requested	As Requested
HS 20-44	Lane	LFR	Inventory	64.81	1.800	3.44	1 - (2.8)	Design Shear - Concrete	As Requested	As Requested
HS 20-44	Lane	LFR	Operating	108.24	3.007	3.44	1 - (2.8)	Design Shear - Concrete	As Requested	As Requested

AASHTO LFR Engine Version 7.5.0.3001
Analysis preference setting: None

Close