AASHTOWare BrD/BrR 6.8

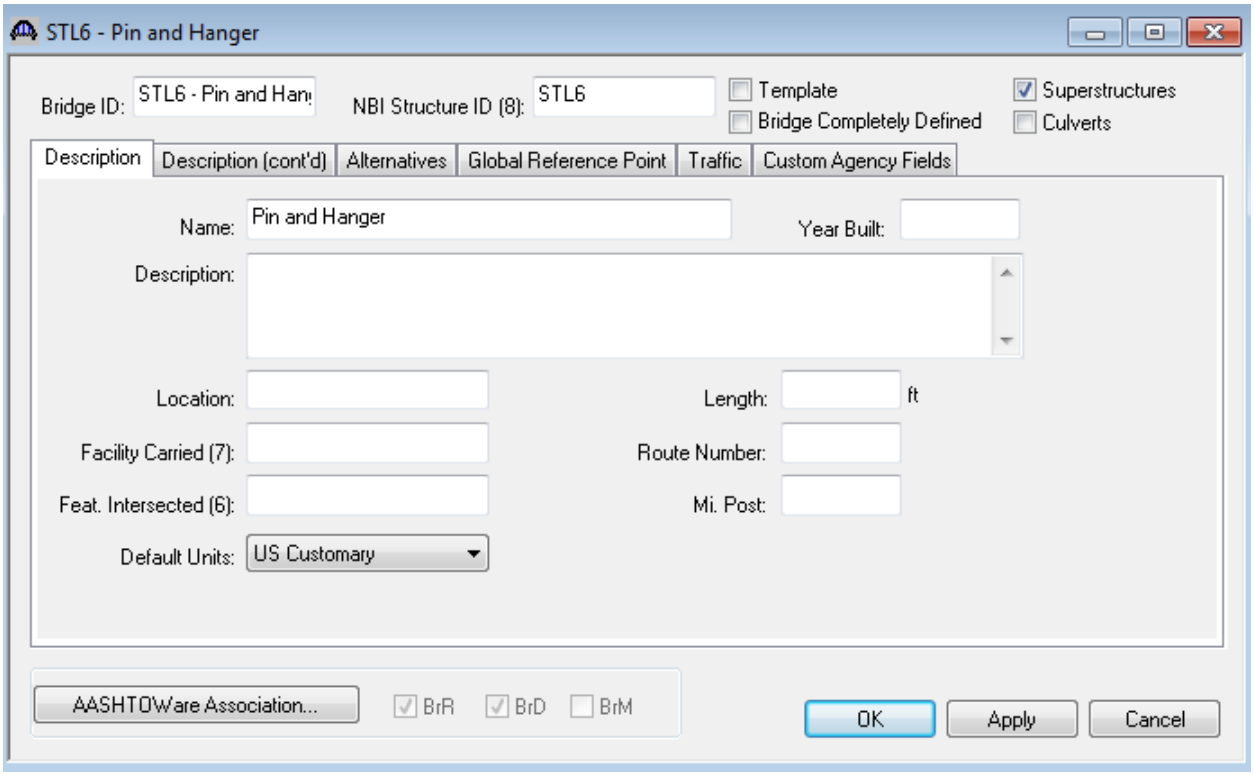
Steel Structures Tutorial

STL8 – Pin and Hanger Rolled Beam Example

Topics Covered

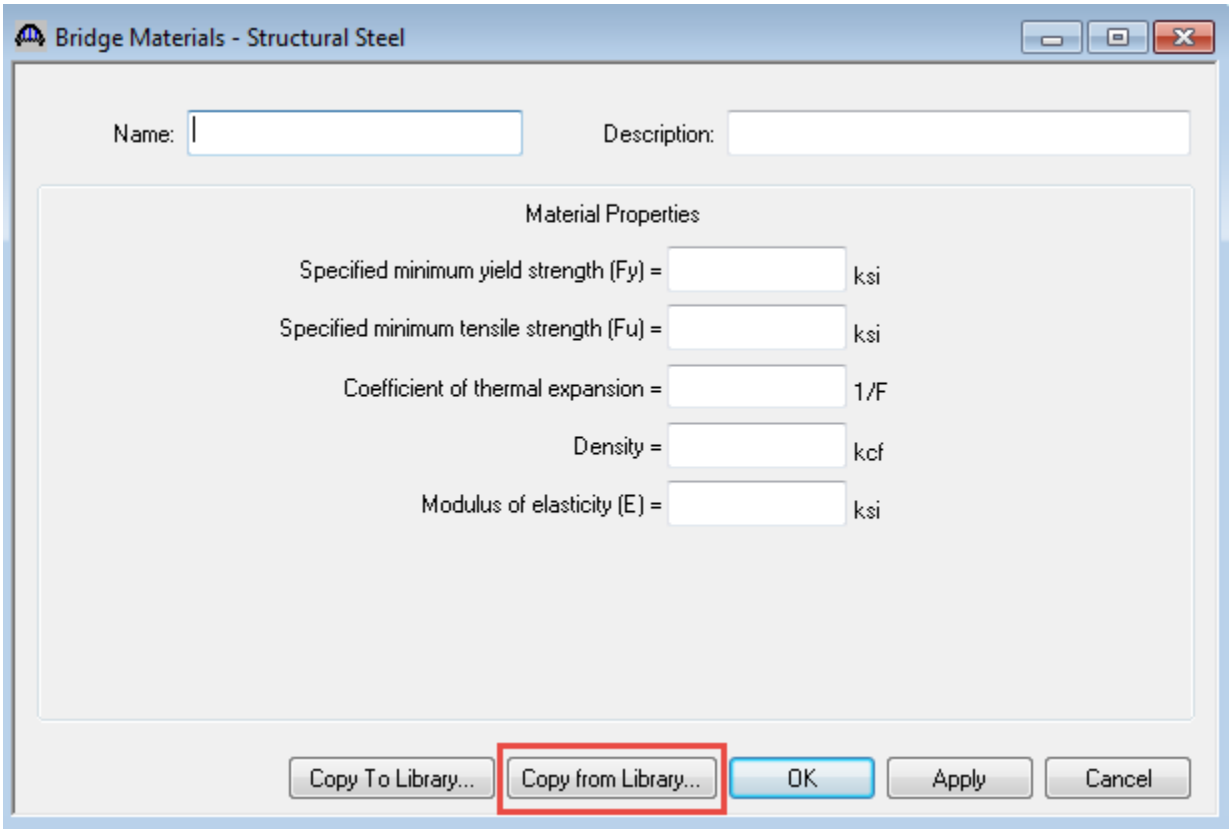
- Steel rolled beam with cover plates input as girder system.
- Schedule based input.
- Pin and hanger in center span

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

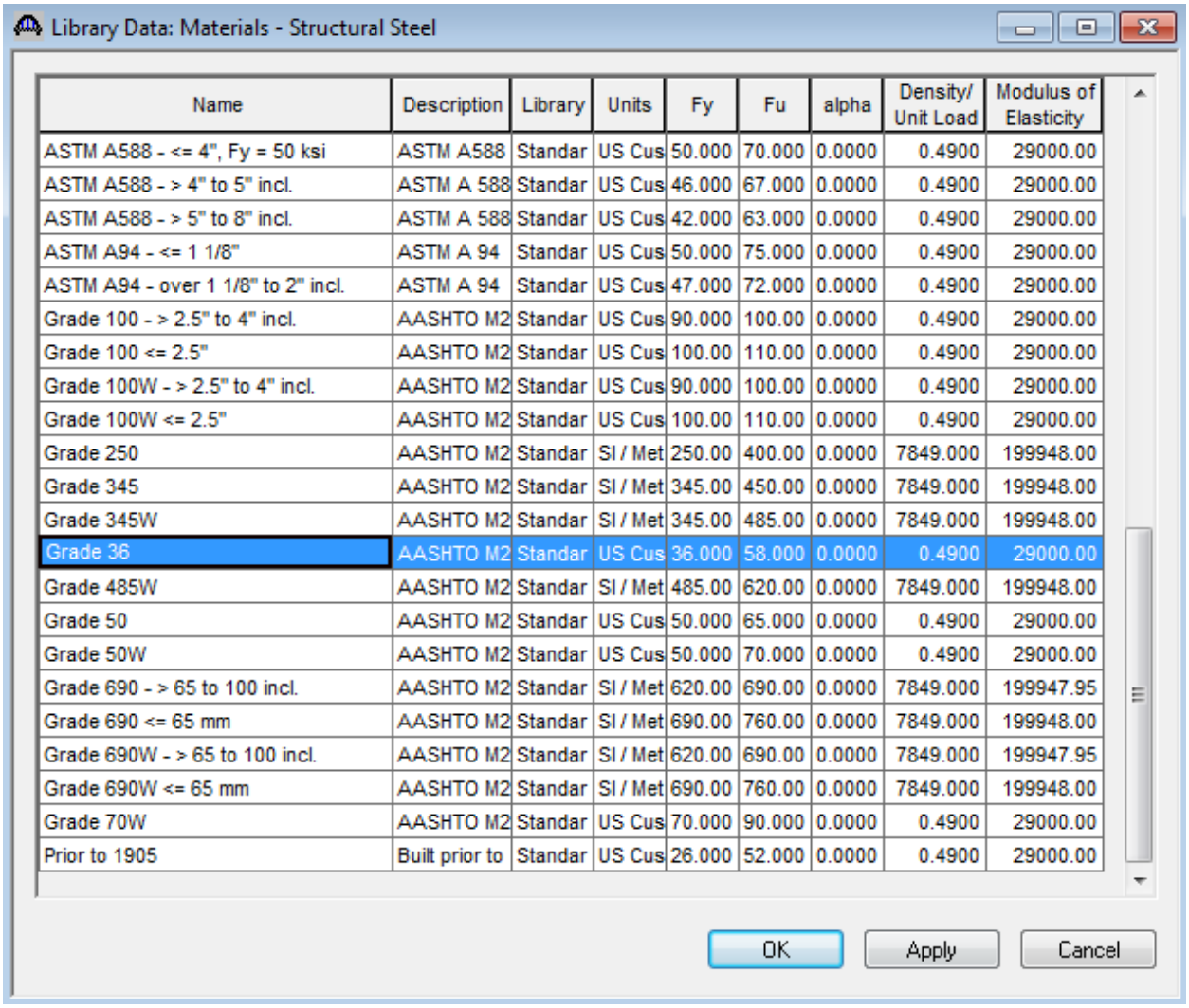


Close the window by clicking Ok. This saves the data to memory and closed the window.

To enter the materials to be used by members of the bridge, expand the tree for Materials. To add a new structural steel material, click on Structural Steel in the tree and select File/New from the menu (or right mouse click on Structural Steel and select New). The window shown below will open.



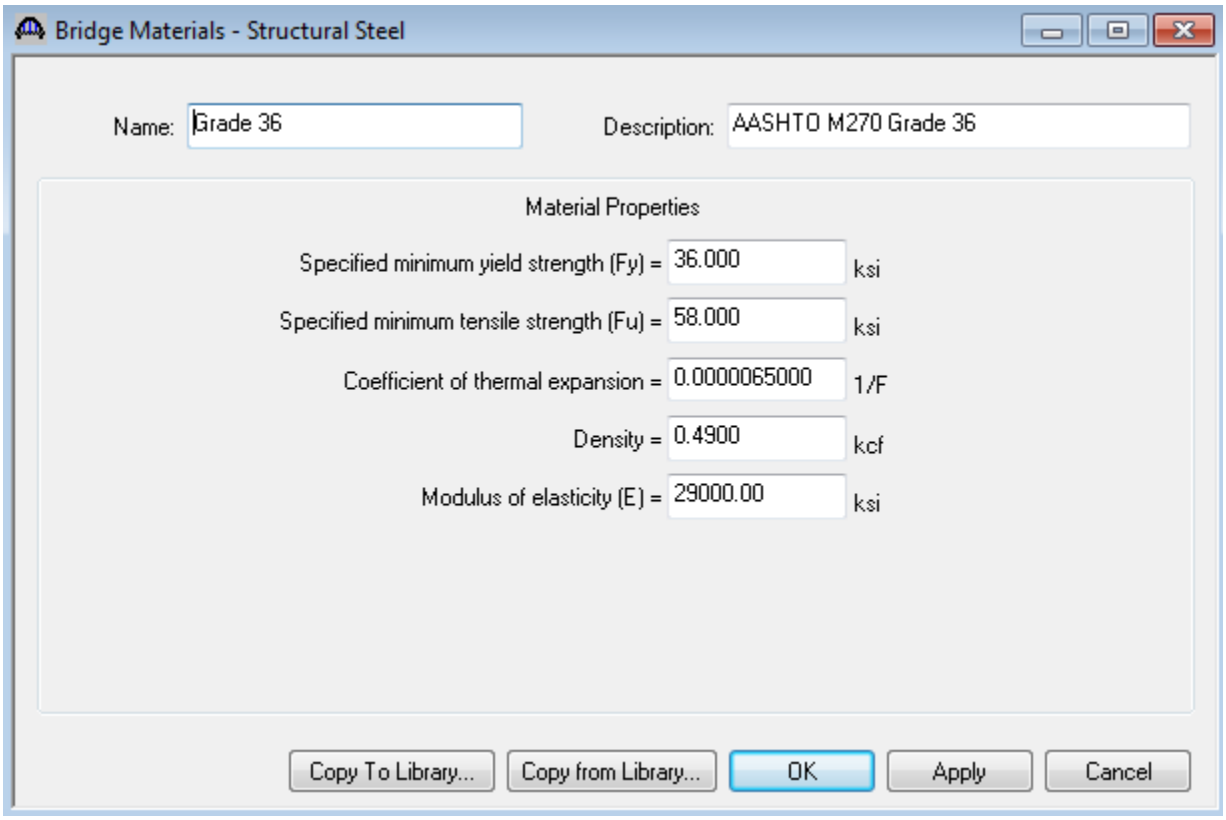
Add a structural steel material by selecting from the Structural Steel Materials Library by clicking the Copy from Library button.



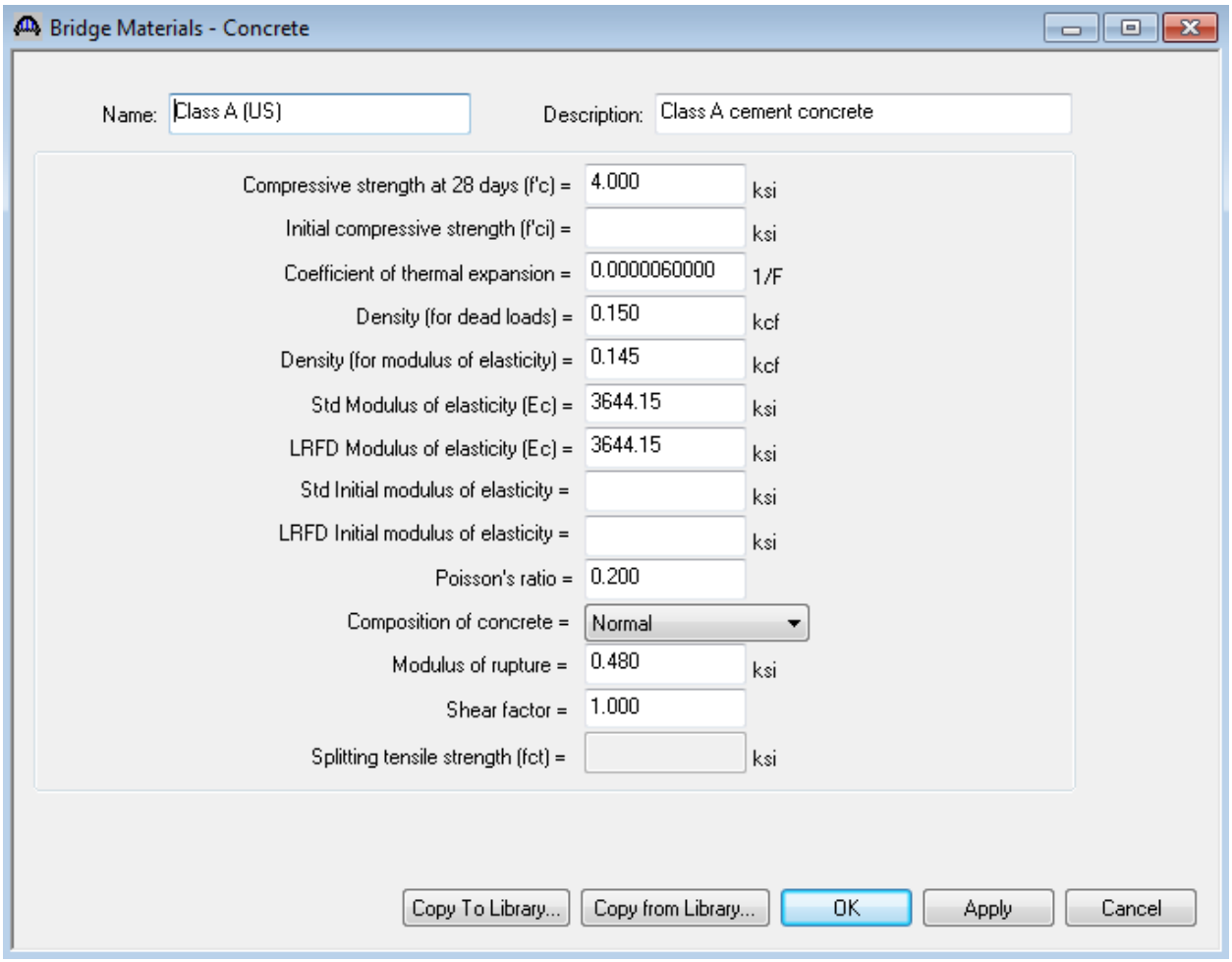
Name	Description	Library	Units	Fy	Fu	alpha	Density/ Unit Load	Modulus of Elasticity
ASTM A588 - <= 4", Fy = 50 ksi	ASTM A588	Standar	US Cus	50.000	70.000	0.0000	0.4900	29000.00
ASTM A588 - > 4" to 5" incl.	ASTM A 588	Standar	US Cus	46.000	67.000	0.0000	0.4900	29000.00
ASTM A588 - > 5" to 8" incl.	ASTM A 588	Standar	US Cus	42.000	63.000	0.0000	0.4900	29000.00
ASTM A94 - <= 1 1/8"	ASTM A 94	Standar	US Cus	50.000	75.000	0.0000	0.4900	29000.00
ASTM A94 - over 1 1/8" to 2" incl.	ASTM A 94	Standar	US Cus	47.000	72.000	0.0000	0.4900	29000.00
Grade 100 - > 2.5" to 4" incl.	AASHTO M2	Standar	US Cus	90.000	100.00	0.0000	0.4900	29000.00
Grade 100 <= 2.5"	AASHTO M2	Standar	US Cus	100.00	110.00	0.0000	0.4900	29000.00
Grade 100W - > 2.5" to 4" incl.	AASHTO M2	Standar	US Cus	90.000	100.00	0.0000	0.4900	29000.00
Grade 100W <= 2.5"	AASHTO M2	Standar	US Cus	100.00	110.00	0.0000	0.4900	29000.00
Grade 250	AASHTO M2	Standar	SI / Met	250.00	400.00	0.0000	7849.000	199948.00
Grade 345	AASHTO M2	Standar	SI / Met	345.00	450.00	0.0000	7849.000	199948.00
Grade 345W	AASHTO M2	Standar	SI / Met	345.00	485.00	0.0000	7849.000	199948.00
Grade 36	AASHTO M2	Standar	US Cus	36.000	58.000	0.0000	0.4900	29000.00
Grade 485W	AASHTO M2	Standar	SI / Met	485.00	620.00	0.0000	7849.000	199948.00
Grade 50	AASHTO M2	Standar	US Cus	50.000	65.000	0.0000	0.4900	29000.00
Grade 50W	AASHTO M2	Standar	US Cus	50.000	70.000	0.0000	0.4900	29000.00
Grade 690 - > 65 to 100 incl.	AASHTO M2	Standar	SI / Met	620.00	690.00	0.0000	7849.000	199947.95
Grade 690 <= 65 mm	AASHTO M2	Standar	SI / Met	690.00	760.00	0.0000	7849.000	199948.00
Grade 690W - > 65 to 100 incl.	AASHTO M2	Standar	SI / Met	620.00	690.00	0.0000	7849.000	199947.95
Grade 690W <= 65 mm	AASHTO M2	Standar	SI / Met	690.00	760.00	0.0000	7849.000	199948.00
Grade 70W	AASHTO M2	Standar	US Cus	70.000	90.000	0.0000	0.4900	29000.00
Prior to 1905	Built prior to	Standar	US Cus	26.000	52.000	0.0000	0.4900	29000.00

Select the Grade 36 material and click Ok.

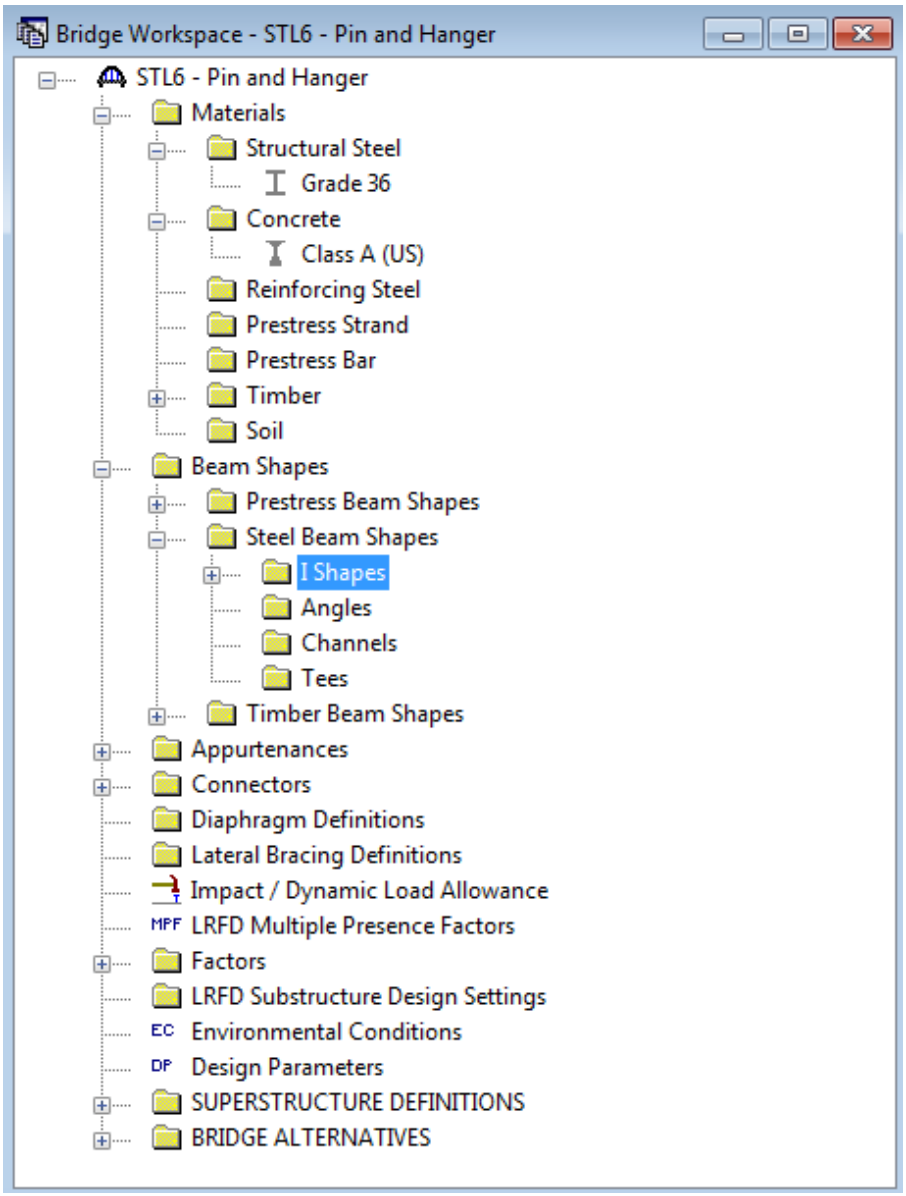
The selected material properties are copied to the Bridge Materials – Structural Steel window as shown below.



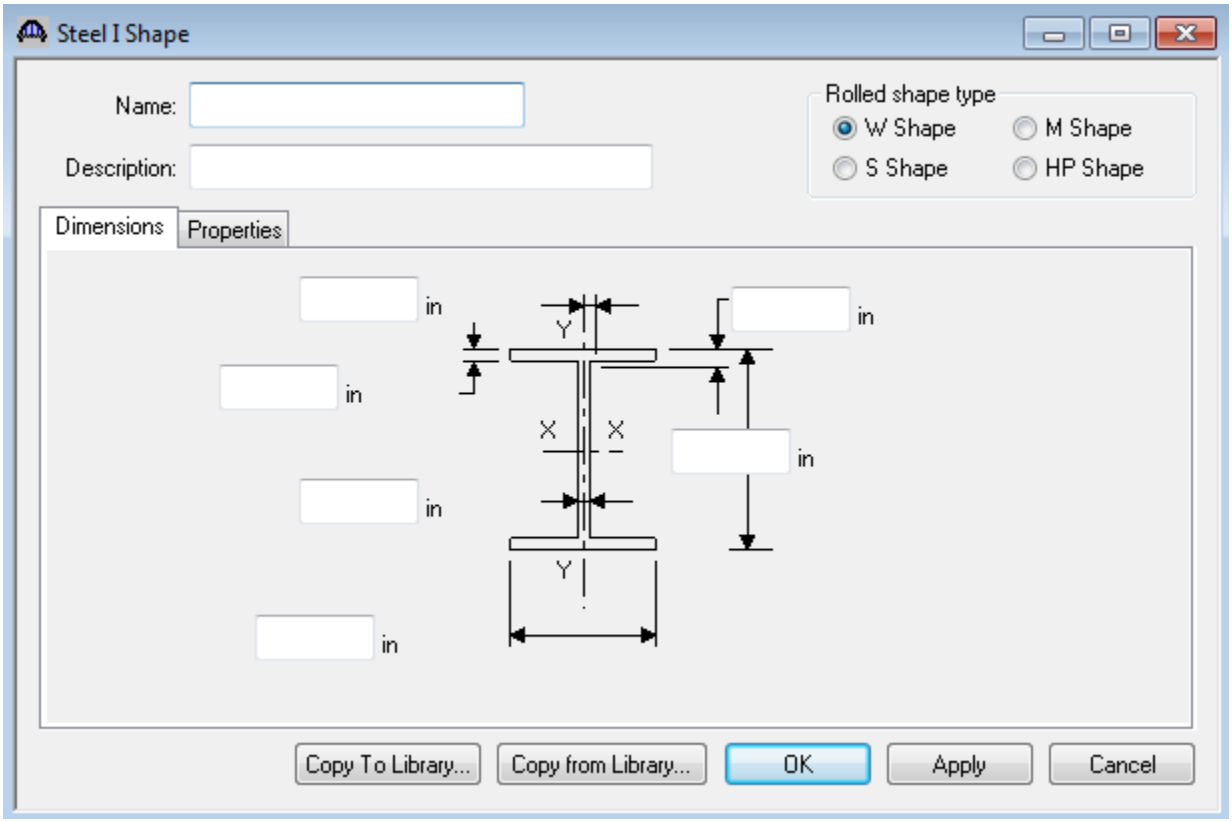
Add a concrete material using the same techniques. The window will look like this:



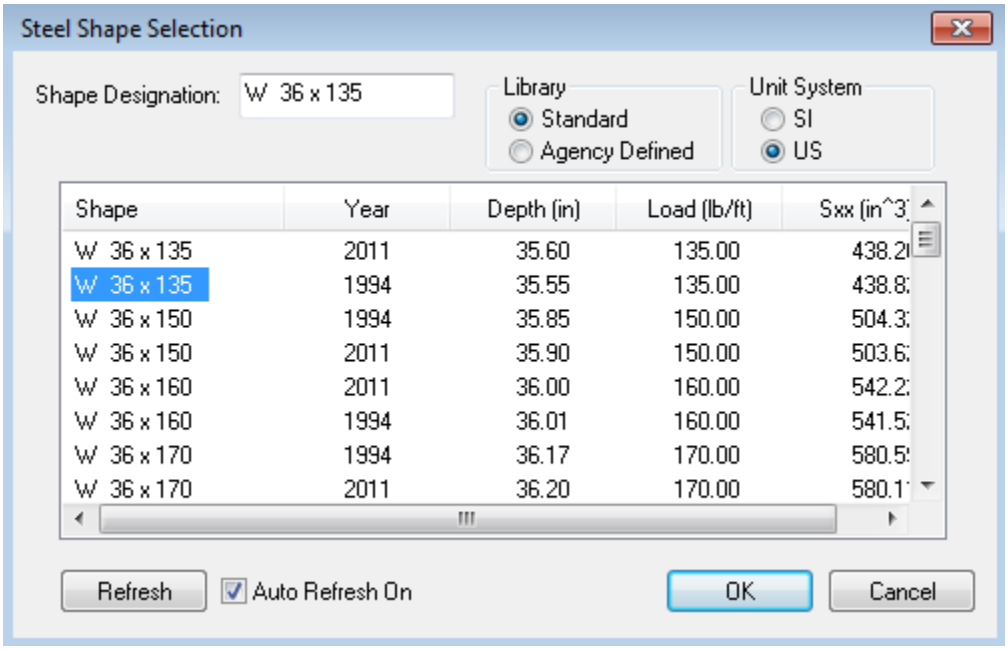
To enter a steel rolled beam shape to be used in this bridge expand the tree labeled Beam Shapes as shown below:



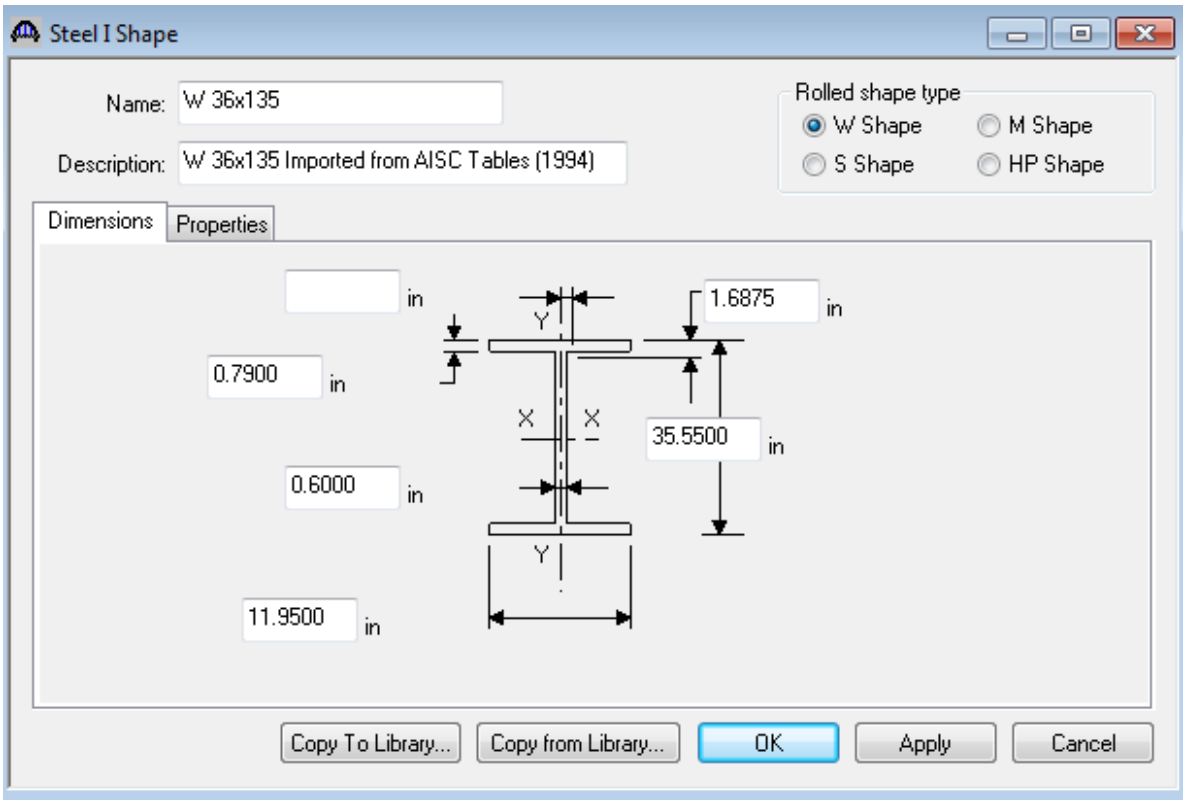
Click on I Shapes in the tree and select File/New from the menu (or double click on I Shapes in the tree). The window shown below will open.



Select the Rolled Shape Type as W Shape and click on the copy from Library button. The Steel Shape Selection window will appear. This window displays all of the steel shapes available in the library. The list can be sorted by clicking on the Depth, Weight or Sxx column headers. Enter "W36" in the Shape Designation field and the list of steel shapes shown in the window will filter to show the W36 shapes. Select W36x135 and click Ok.

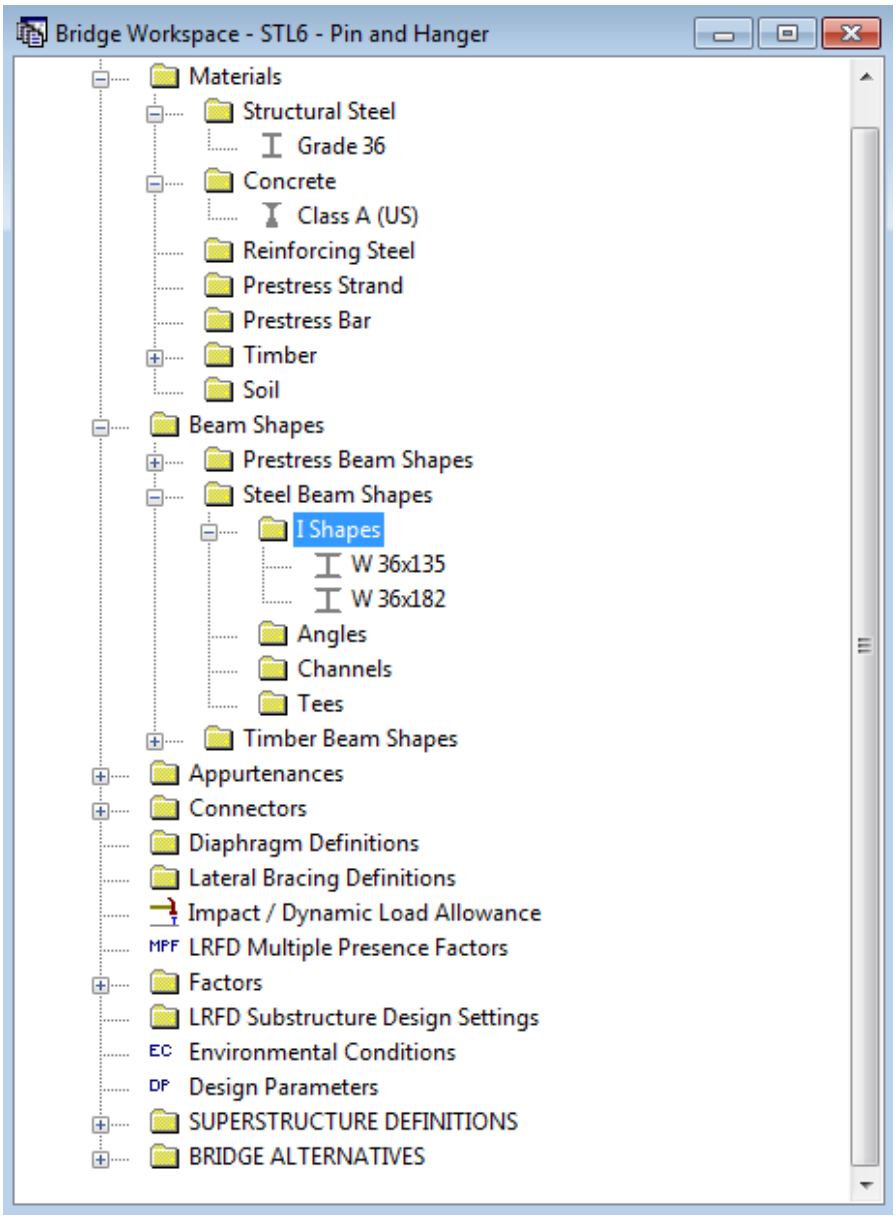


The beam properties are copied to the Steel I Shape window as shown below.

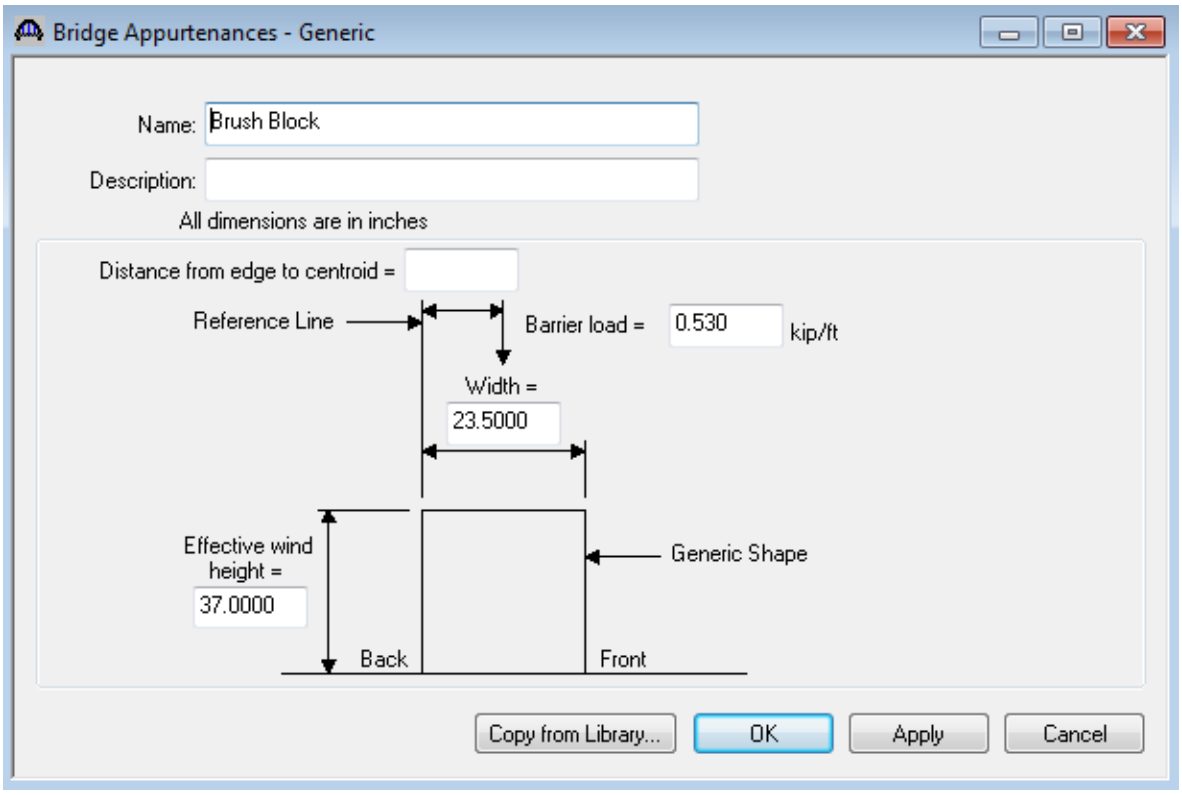


Follow the same procedure to copy a W36x182 shape from the library.

A partially expanded Bridge Workspace is shown below.

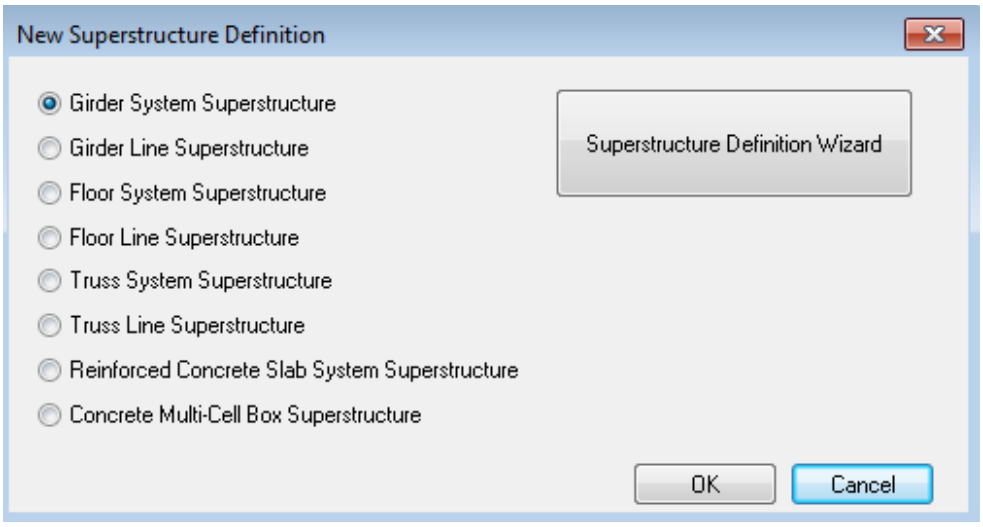


To enter the appurtenances to be used within the bridge expand the tree branch labeled Appurtenances. To define the brush block curb, double click on Generic in the tree. Enter the following details and click Ok to save the data to memory and close the window.

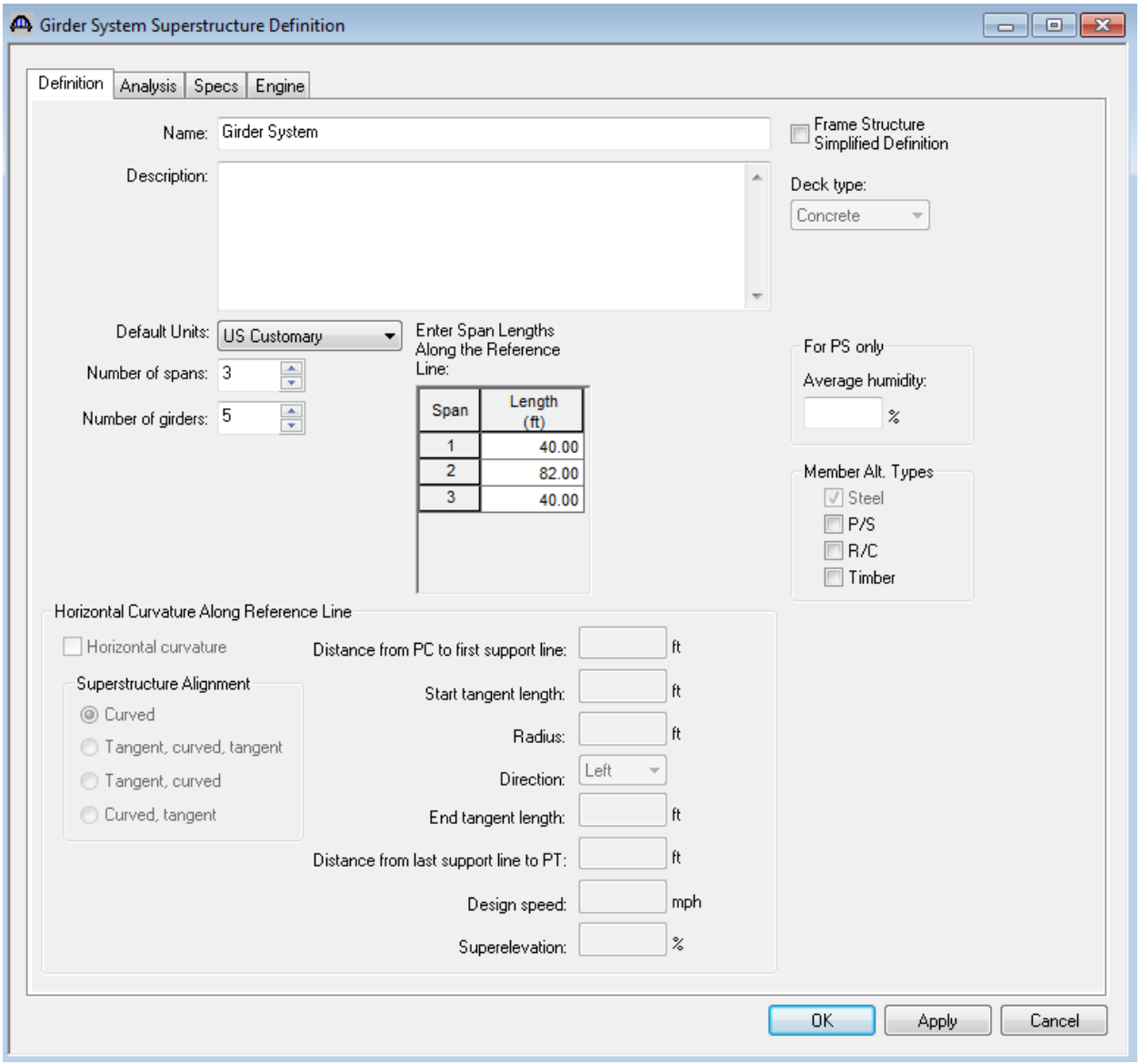


We will come back to Bridge Alternatives after entering a Structure Definition.

Double click on SUPERSTRUCTURE DEFINITIONS (or click on SUPERSTRUCTURE DEFINITIONS and select File/New from the menu or right mouse click on SUPERSTRUCTURE DEFINITIONS and select New from the popup menu) to create a new structure definition. The dialog shown below will appear.



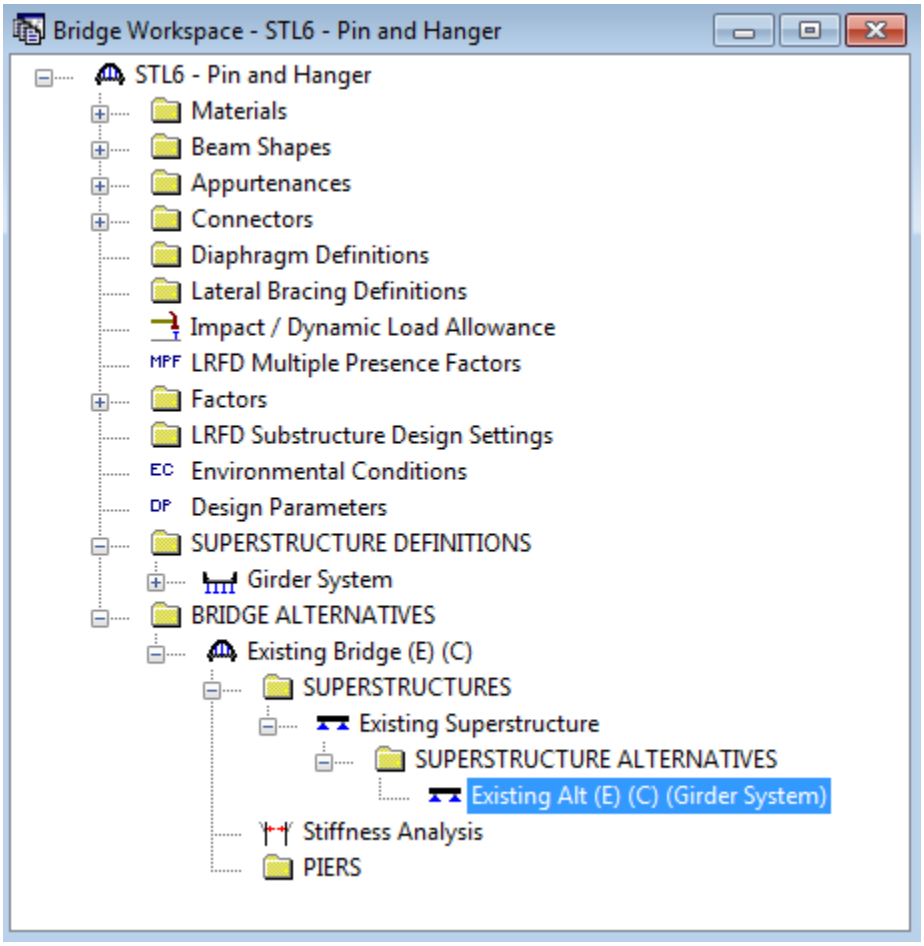
Select Girder System, click Ok and the Superstructure Definition window will open. Enter the appropriate data as shown below:



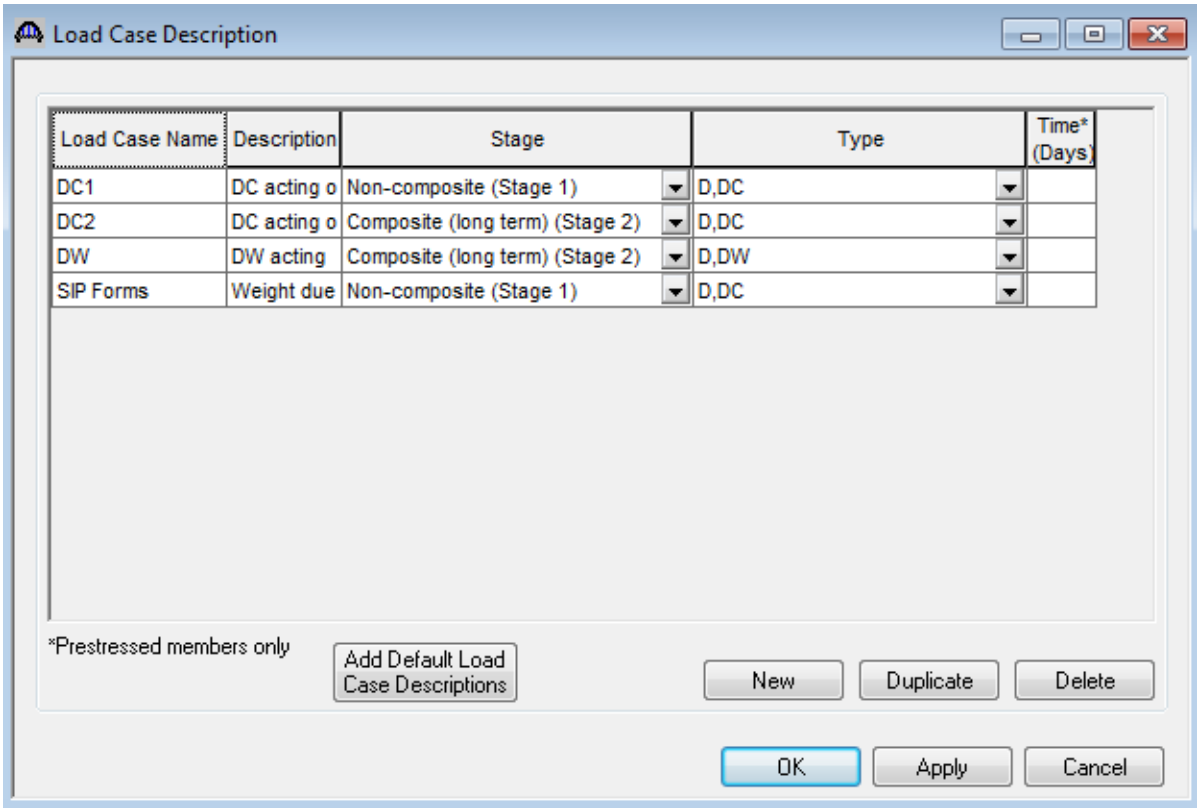
Click on Ok to save the data to memory and close the window.

We now go back to the Bridge Alternatives and create a new Bridge Alternative, a new Superstructure, and a new Superstructure Alternative as we did previously.

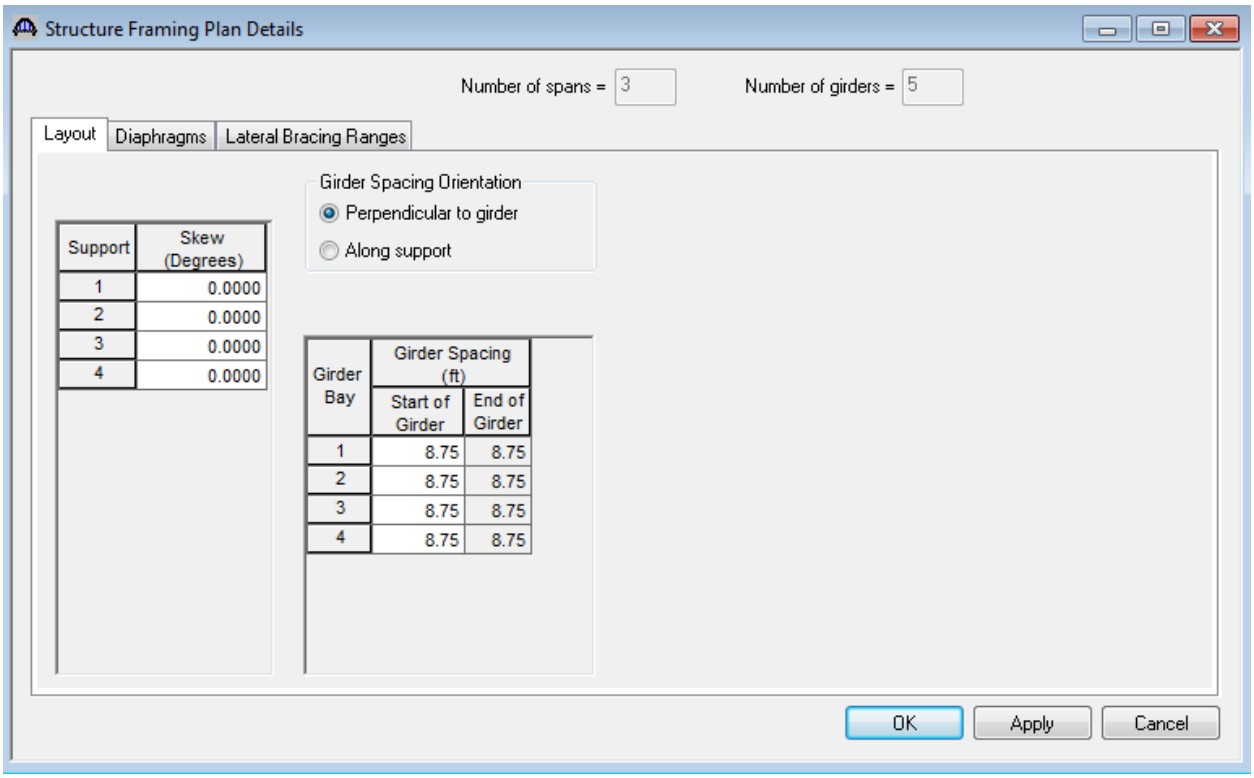
The partially expanded Bridge Workspace tree showing these alternatives is shown below:



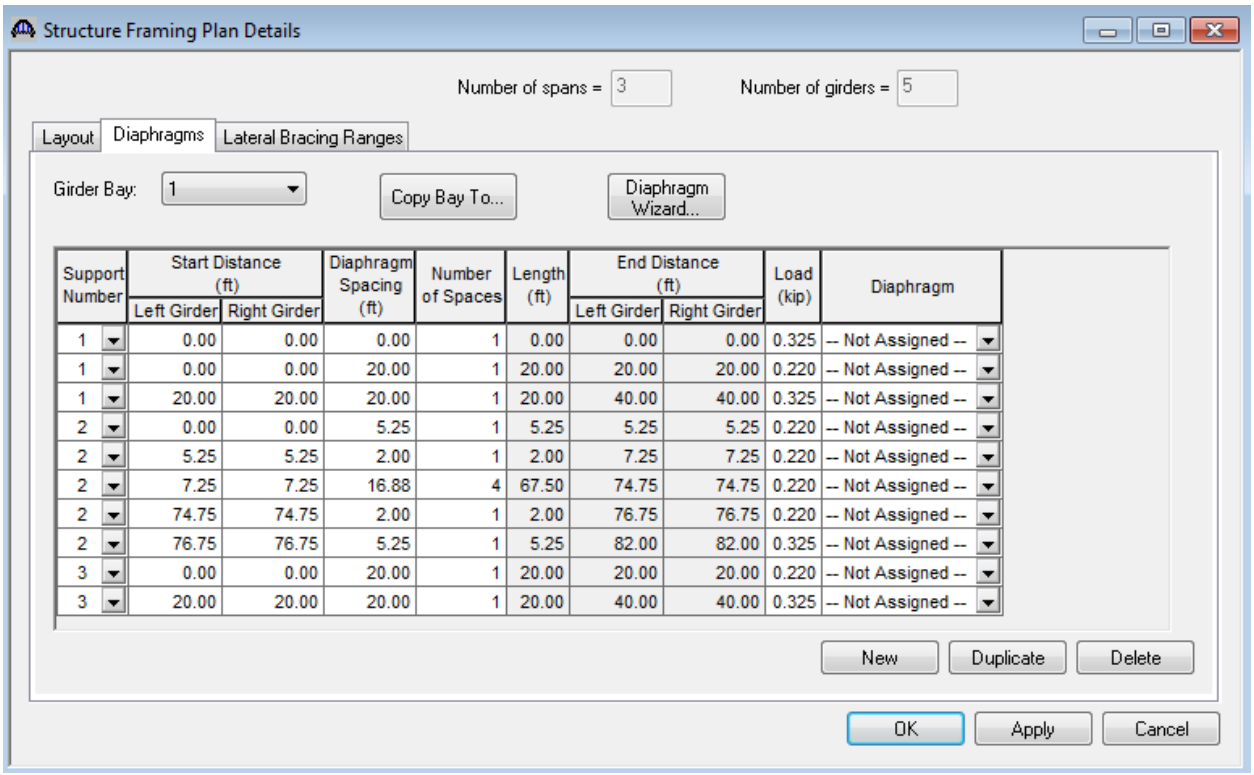
Click Load Case Description to define the dead load cases. Use the "Add Default Load Case Descriptions" button to populate the window as shown below.



Double-click on Framing Plan Detail to describe the framing plan. Enter the appropriate data as shown below.



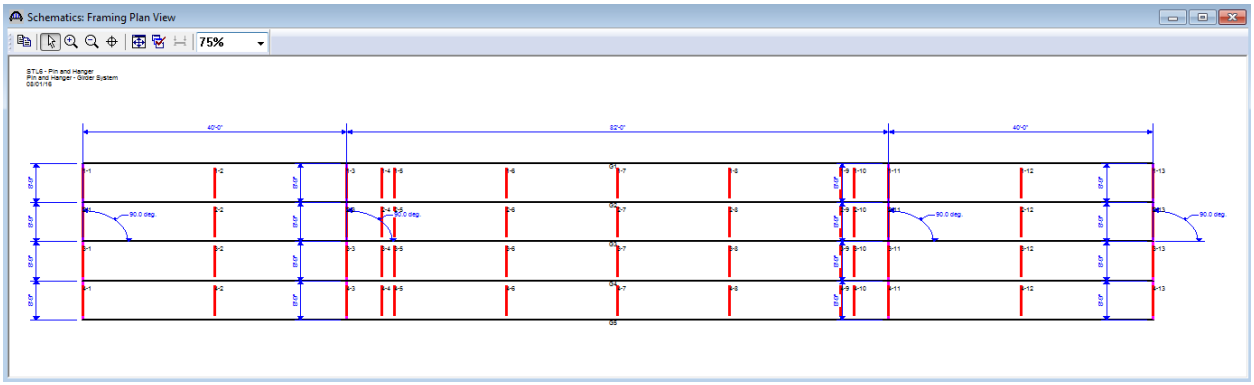
Click the Apply button to save this data to memory and switch to the Diaphragms tab to enter diaphragm spacing. Enter the following diaphragms for Girder Bay 1.



Support Number	Start Distance (ft)		Diaphragm Spacing (ft)	Number of Spaces	Length (ft)	End Distance (ft)		Load (kip)	Diaphragm
	Left Girder	Right Girder				Left Girder	Right Girder		
1	0.00	0.00	0.00	1	0.00	0.00	0.00	0.325	-- Not Assigned --
1	0.00	0.00	20.00	1	20.00	20.00	20.00	0.220	-- Not Assigned --
1	20.00	20.00	20.00	1	20.00	40.00	40.00	0.325	-- Not Assigned --
2	0.00	0.00	5.25	1	5.25	5.25	5.25	0.220	-- Not Assigned --
2	5.25	5.25	2.00	1	2.00	7.25	7.25	0.220	-- Not Assigned --
2	7.25	7.25	16.88	4	67.50	74.75	74.75	0.220	-- Not Assigned --
2	74.75	74.75	2.00	1	2.00	76.75	76.75	0.220	-- Not Assigned --
2	76.75	76.75	5.25	1	5.25	82.00	82.00	0.325	-- Not Assigned --
3	0.00	0.00	20.00	1	20.00	20.00	20.00	0.220	-- Not Assigned --
3	20.00	20.00	20.00	1	20.00	40.00	40.00	0.325	-- Not Assigned --

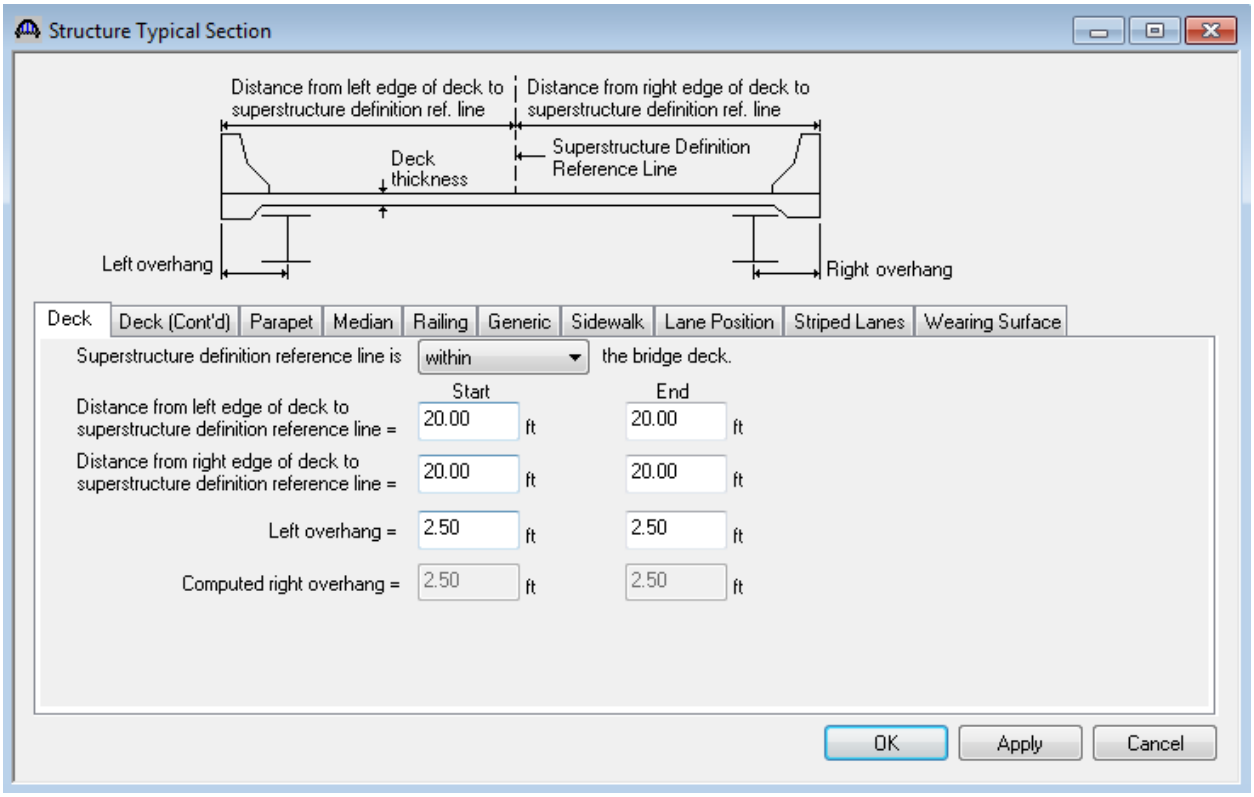
Click the Apply button to save this data to memory. Click the "Copy Bay To…" button, select bay 2 and click the Apply button. Click the Apply button to apply the data for bay2 to memory. Click the "Copy Bay To …" button again, select bay3 and click the Apply button. Click the Apply button to apply the data for bay 3 to memory. Follow this process to copy the diaphragm data to bay 4. Click Ok to save this data to memory and close the window.

While “Framing Plan Detail” is selected in the BWS tree, select the View Schematic toolbar button  . The following schematic will be displayed.

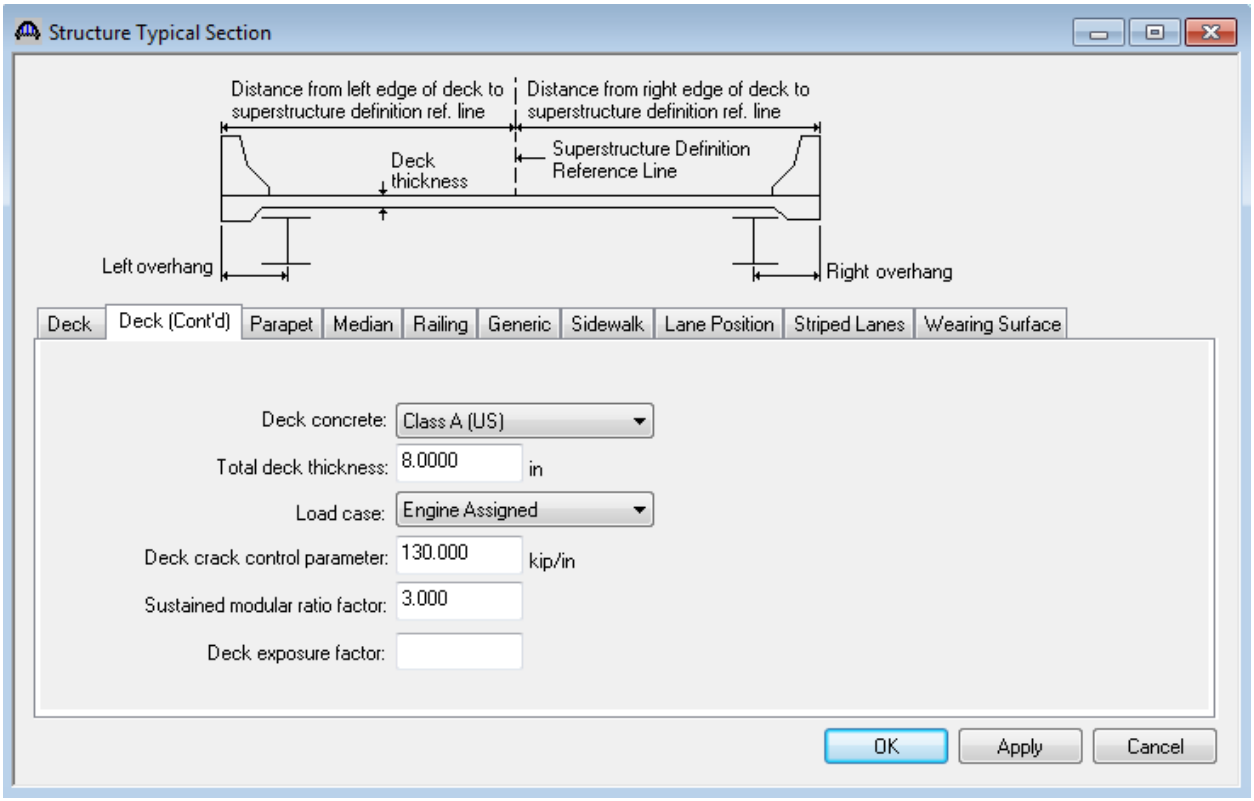


Next define the structure typical section by double-clicking on Structure Typical Section in the Bridge Workspace tree. Input the data describing the typical section as shown below.

Basic deck geometry:

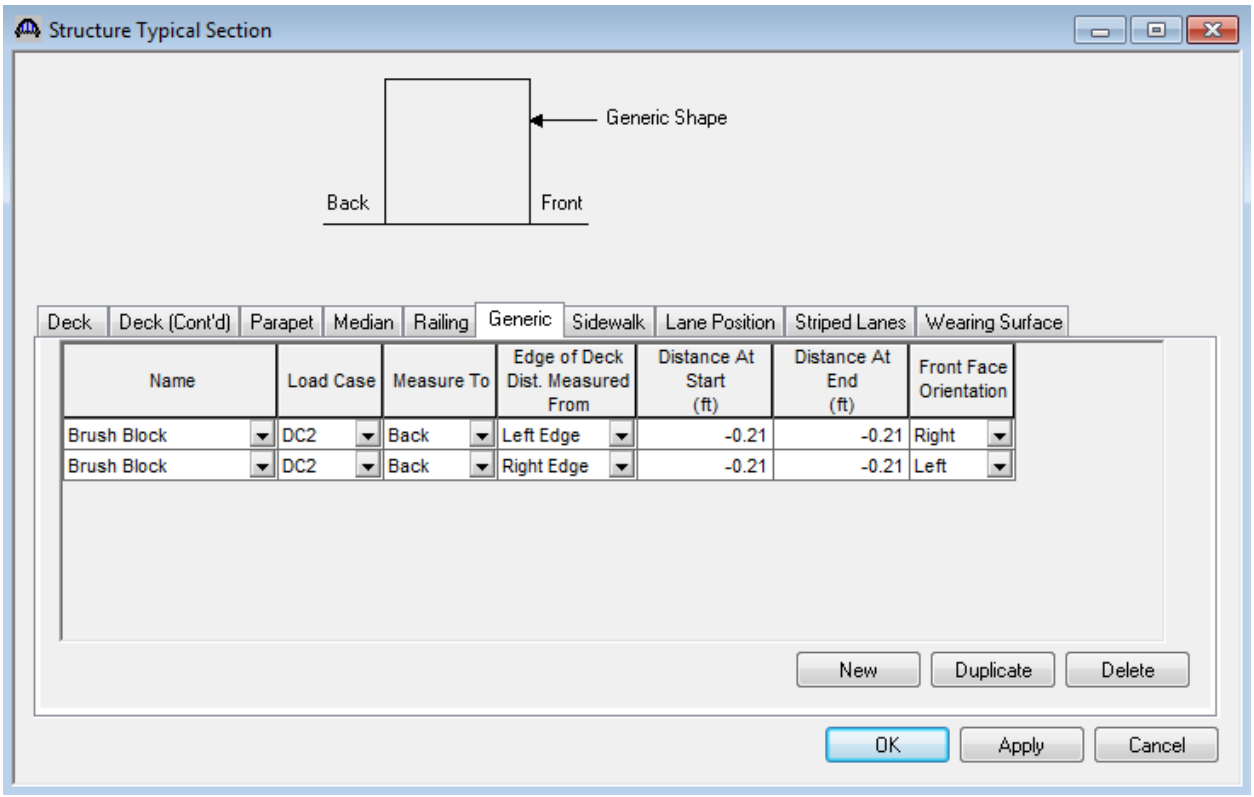


The Deck (cont'd) tab is used to enter information about the deck concrete and thickness. The material to be used for the deck concrete is selected from the list of bridge materials described above.



Curbs:

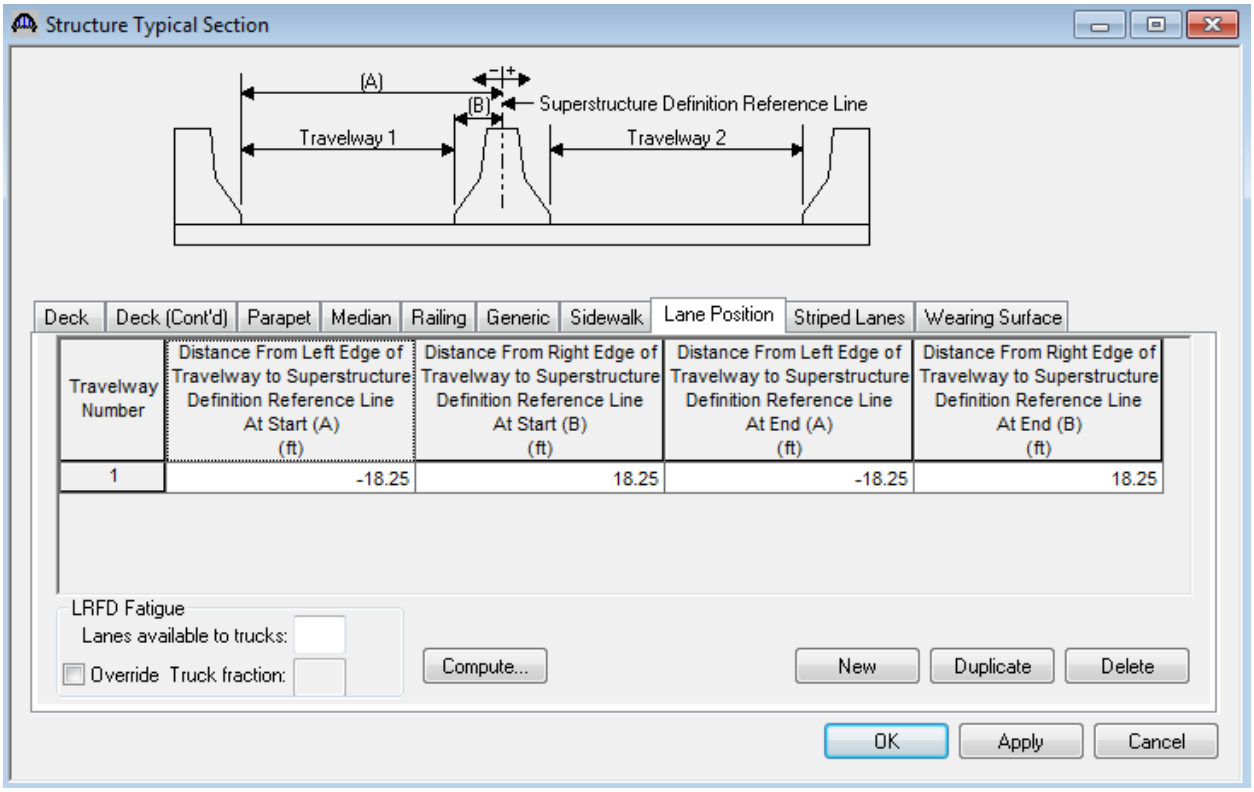
The two brush block curbs are described using the Generic tab. Click New to add a row to the table. The Name defaults to the only generic appurtenance described for the bridge. Change the "Load Case" to "DC2" and "Measure To" to "Back" (we are locating the curb on the deck by referencing the back of the curb to the left edge of the deck). Enter -0.2083'(=2.5") for the "Distance at Start" and "Distance at End". Change the "Front Face Orientation" to "Right". The completed tab is shown below.



Note: When you Validate or Save this bridge you will see an error message that the appurtenance is not located on the deck. You can ignore this error.

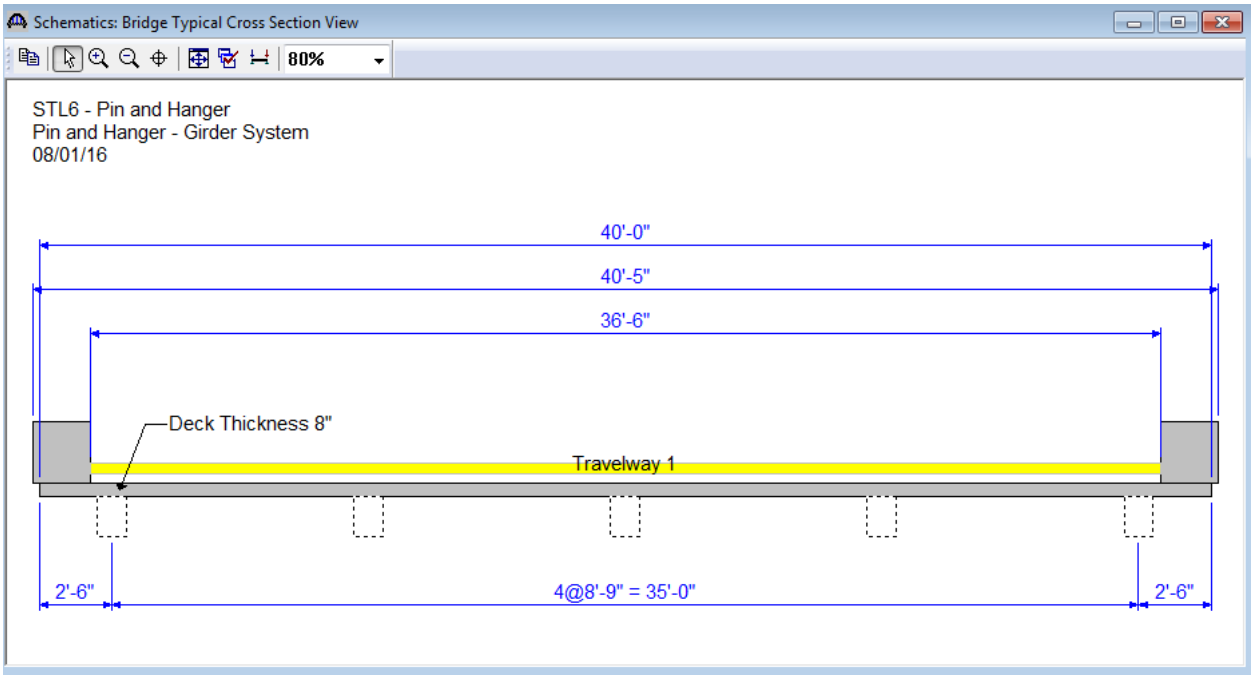
Lane Positions:

Select the Lane Position tab. Click the Compute… button to automatically compute the lane positions. A dialog showing the results of the computation opens. Click Apply to apply the computed values. The Lane Position tab is populated as shown below.

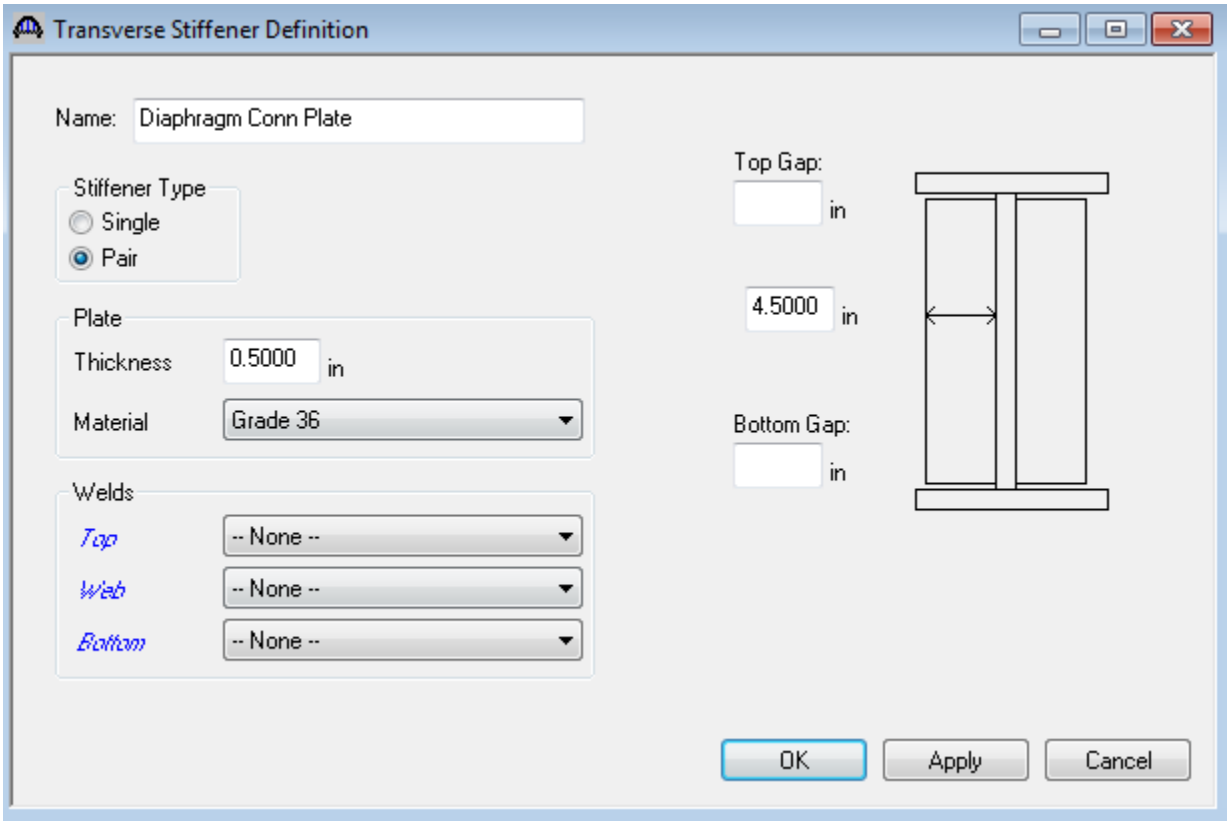


Click Ok to save the data to memory and close the window.

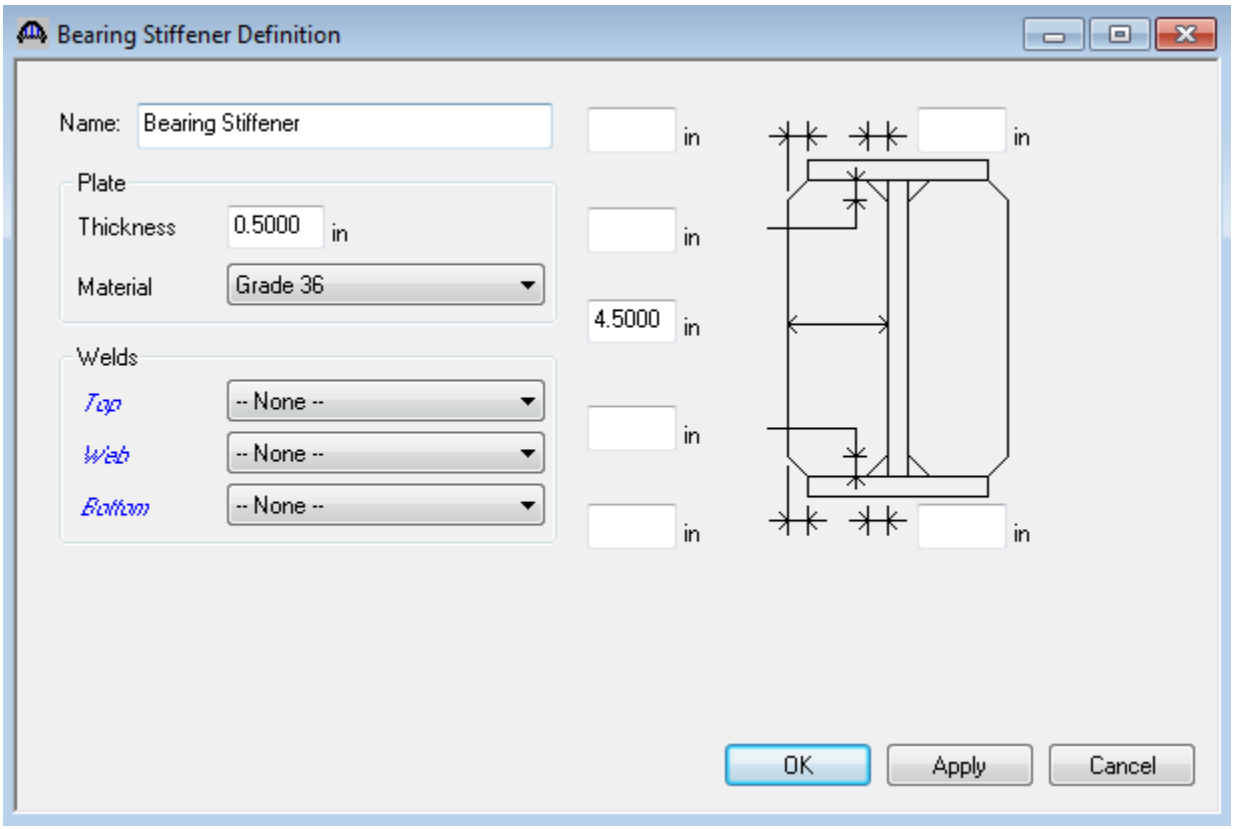
While Structure Typical Section is selected in the BWS tree, open the schematic for the typical section by selecting the View Schematic toolbar button  or Bridge/Schematic from the menu. The following schematic will be displayed. The girders are displayed as dashed boxes since we have not yet defined what type of girder we will have.



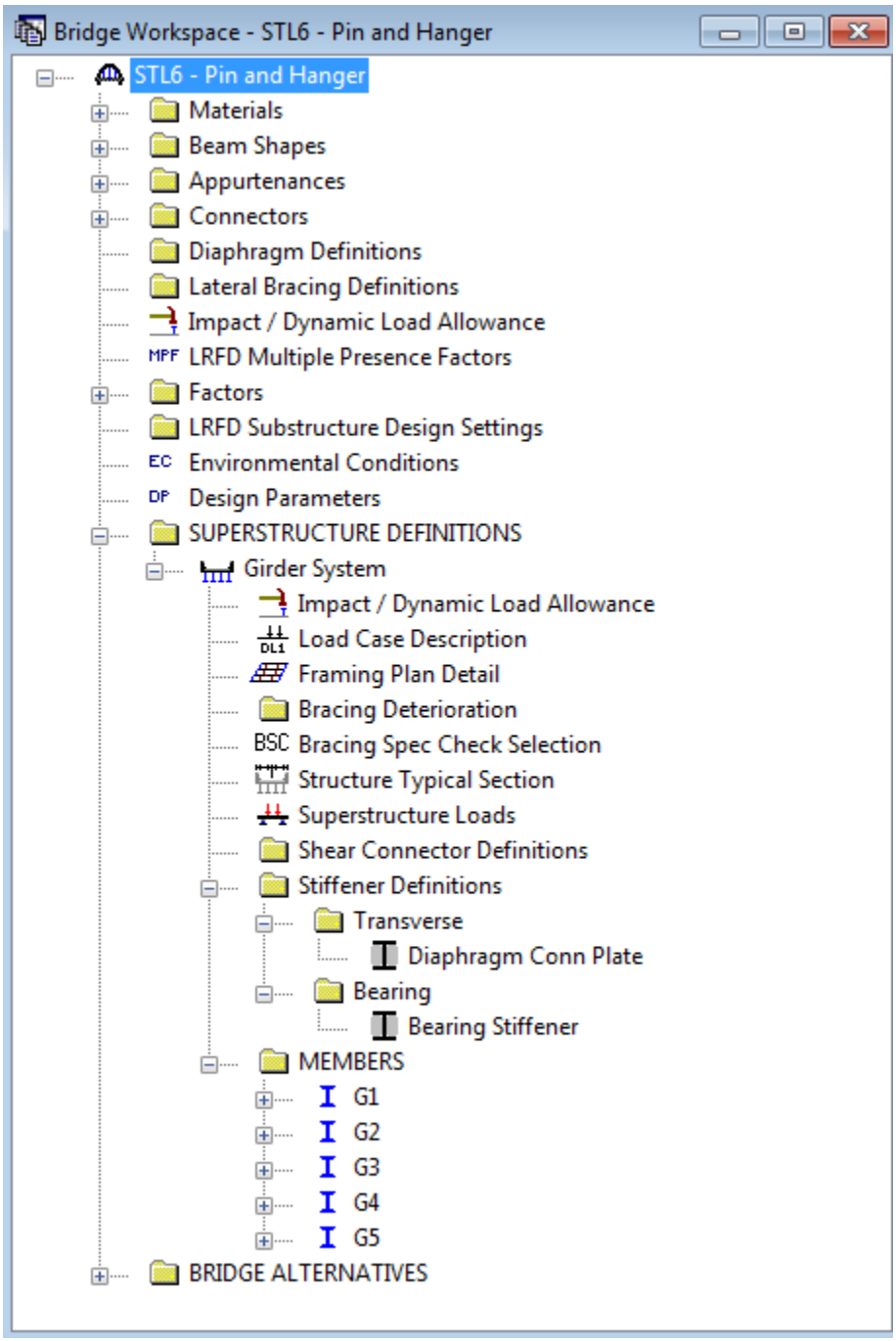
Define stiffeners to be used by the beams. Expand the Stiffener Definitions tree item and double click on Transverse. Select the stiffener type as Plate and click Ok. Define the stiffener as shown below. Click Ok to save to memory and close the window.



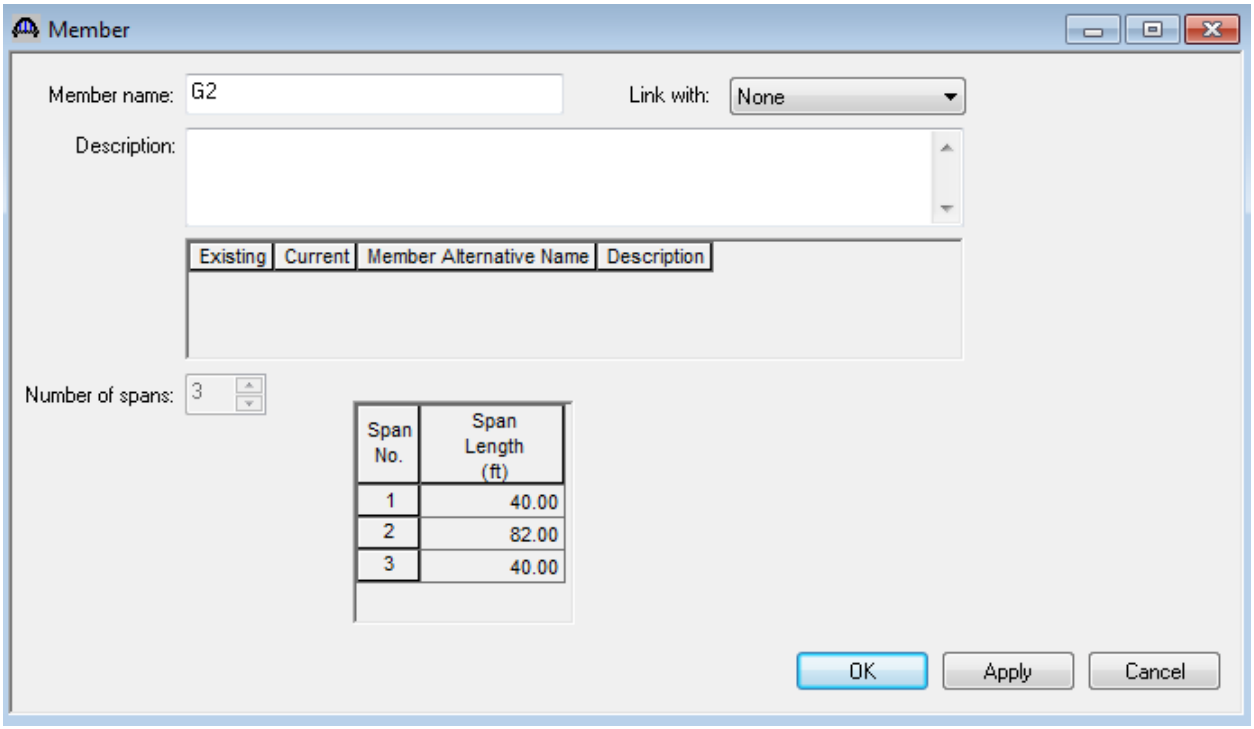
Define the following bearing stiffener.



The partially expanded BWS tree is shown below:

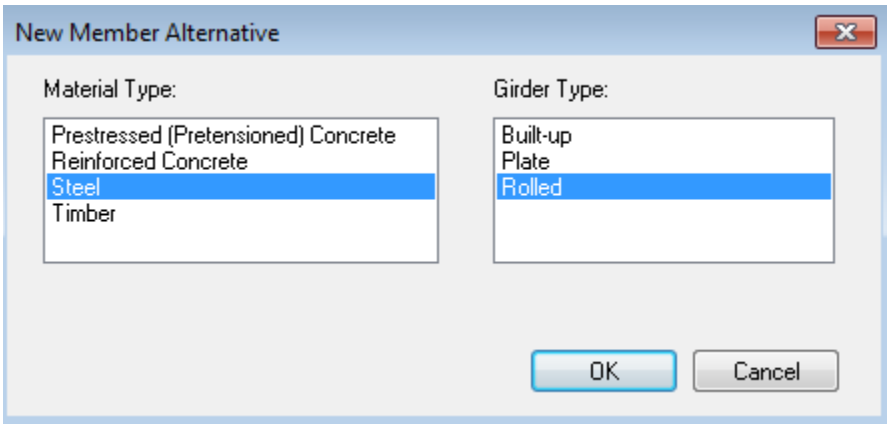


Open the window for member G2 by double clicking on “G2” in the BWS tree. The member window shows the data that was generated when the structure definition was created. No changes are required at this time. The first Member Alternative that we create will automatically be assigned as the Existing and Current Member alternative for this Member.



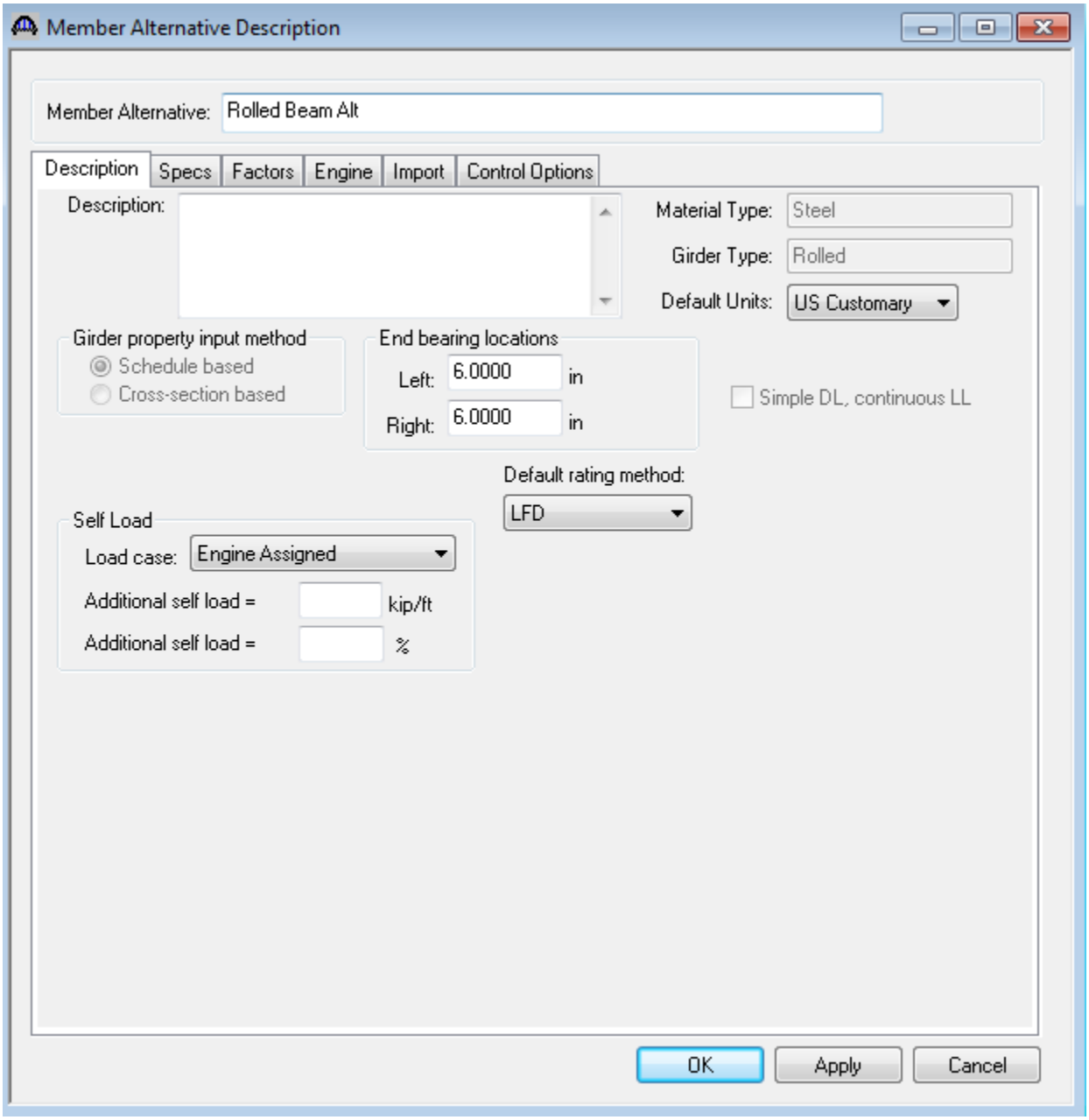
Defining a Member Alternative:

Double-click MEMBER ALTERNATIVES in the tree to create a new alternative. The New Member Alternative dialog shown below will open. Select Steel for the Material Type and Rolled for the Girder Type.

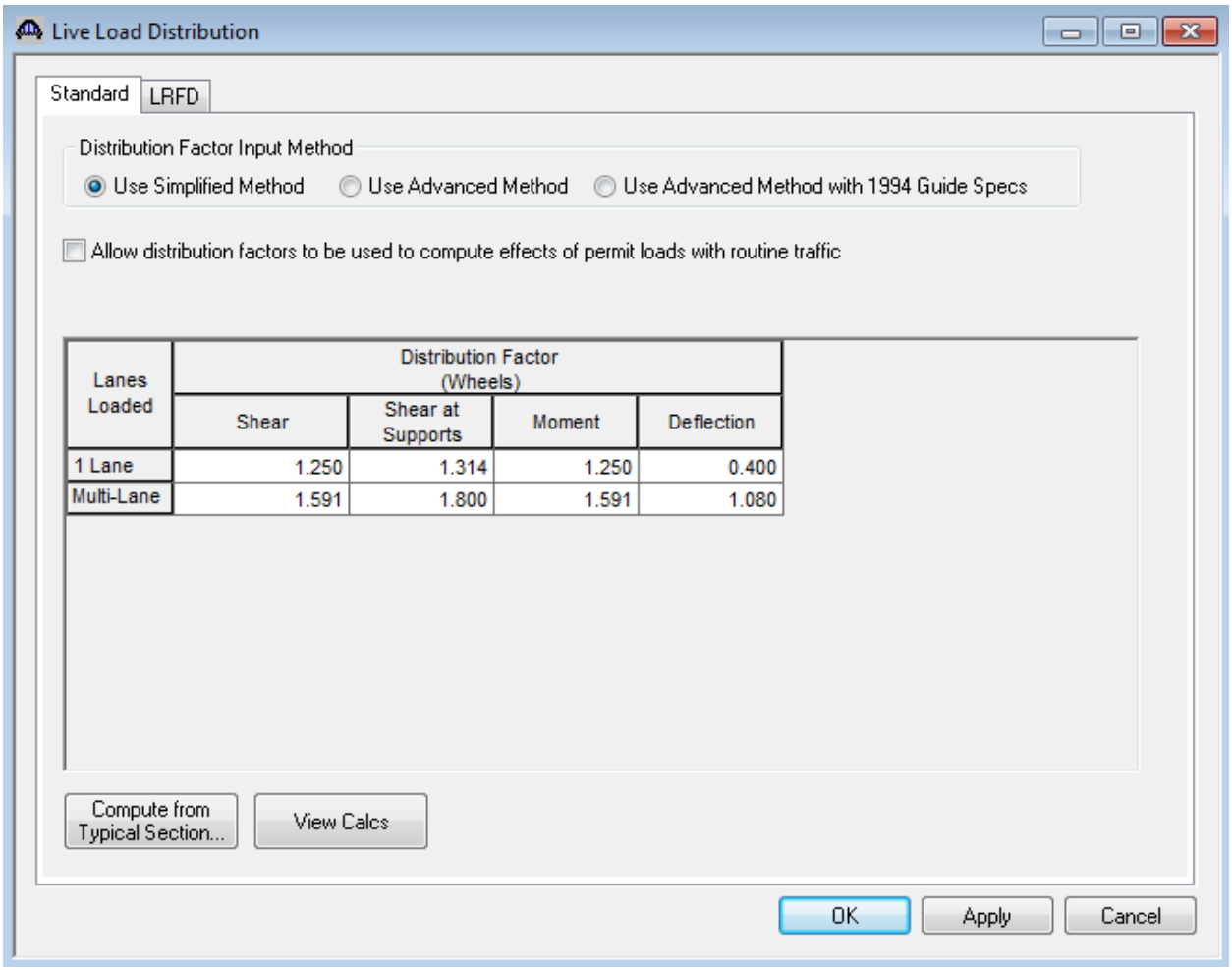


Click Ok to close the dialog and create a new member alternative.

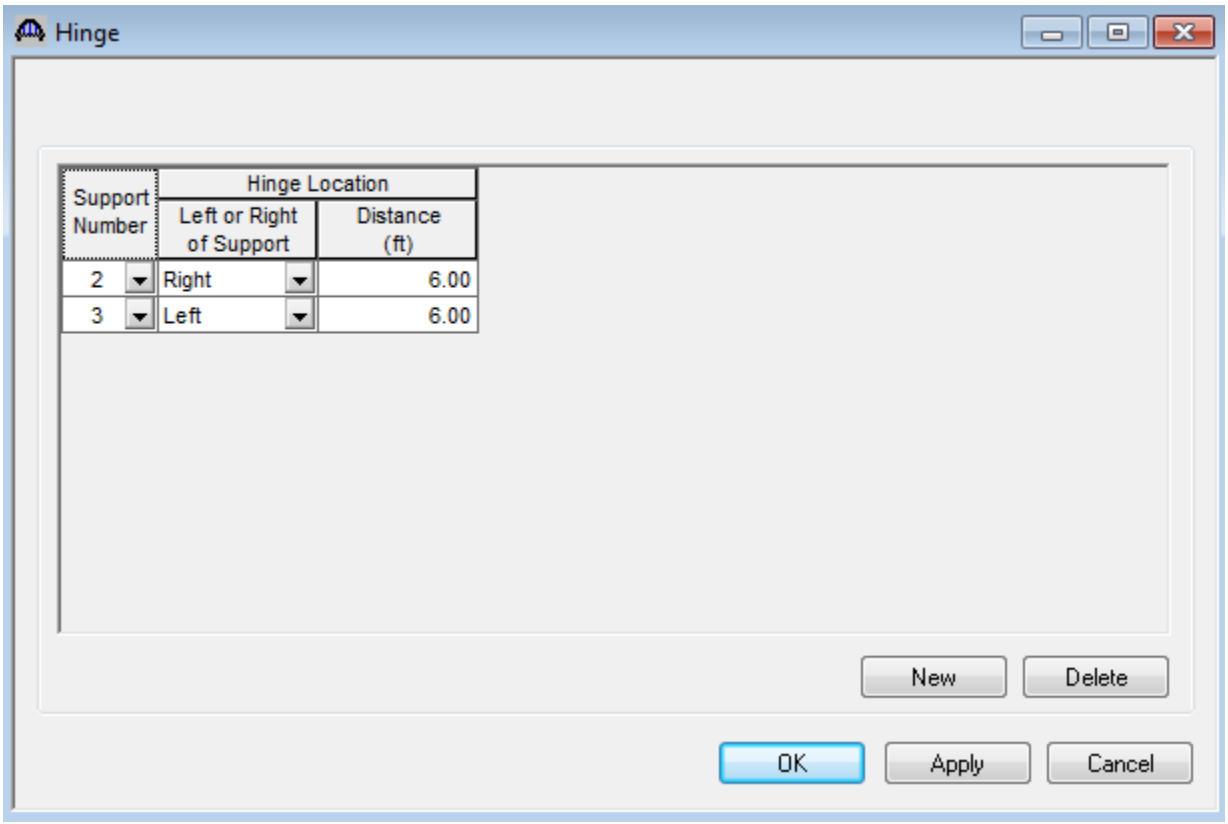
The Member Alternative Description window will open. Enter the appropriate data as shown below. Select Schedule-based Girder property input method.



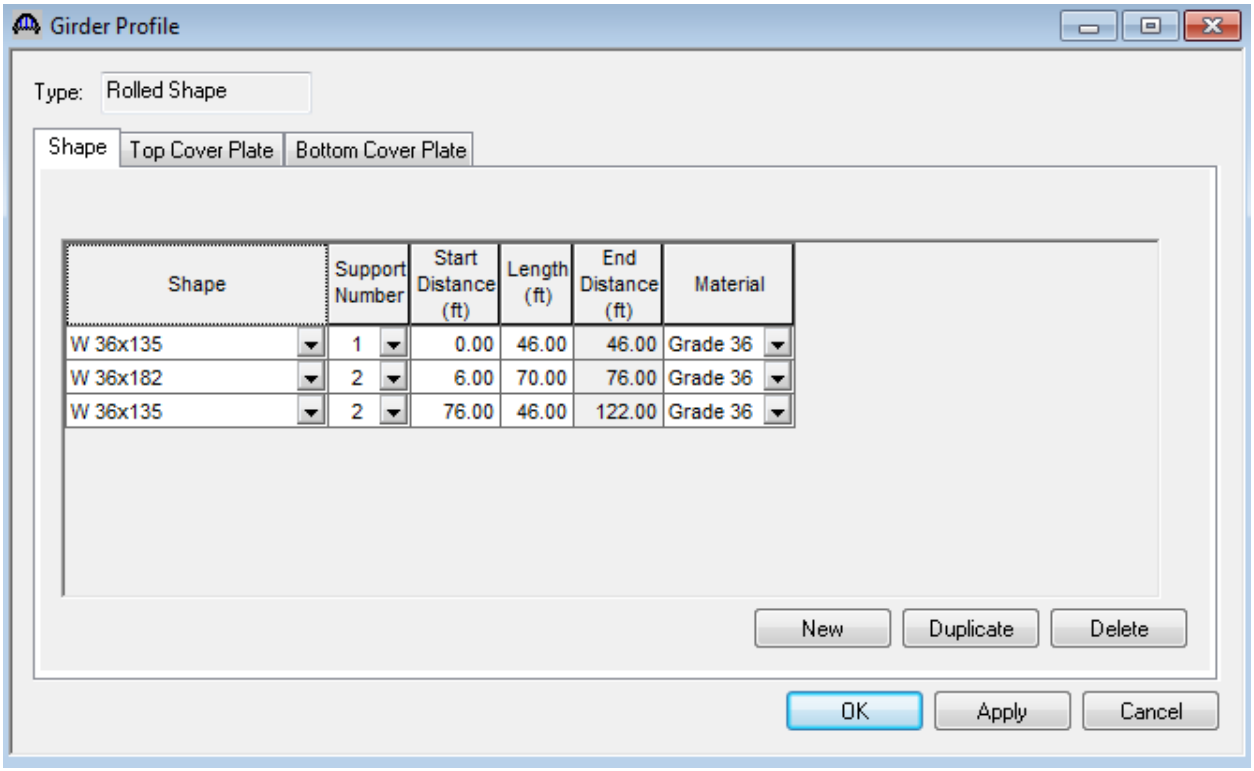
Use the Compute from Typical Section button to compute the following Standard (LFD) distribution factors.



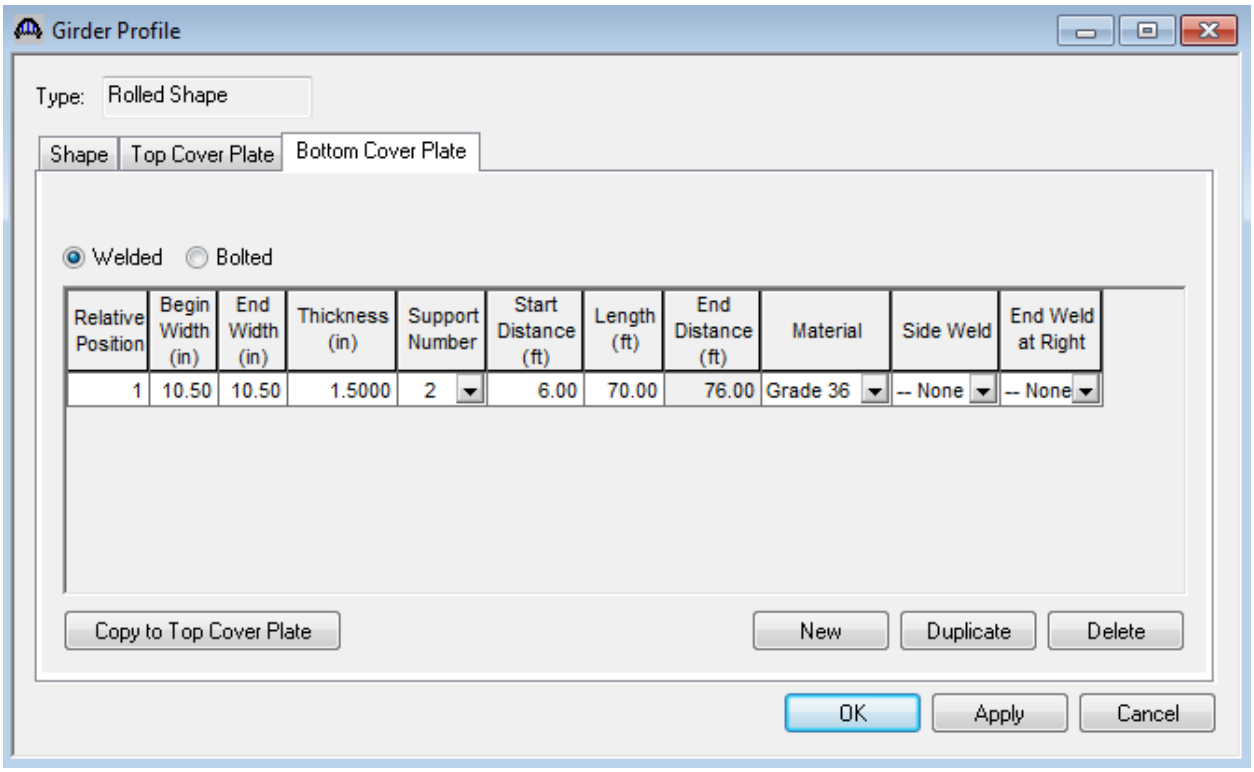
Next describe the pin locations on the Hinge window as shown below.



Next describe the girder profile by double clicking on Girder Profile in the tree. The window is shown below with the data describing the rolled shape.

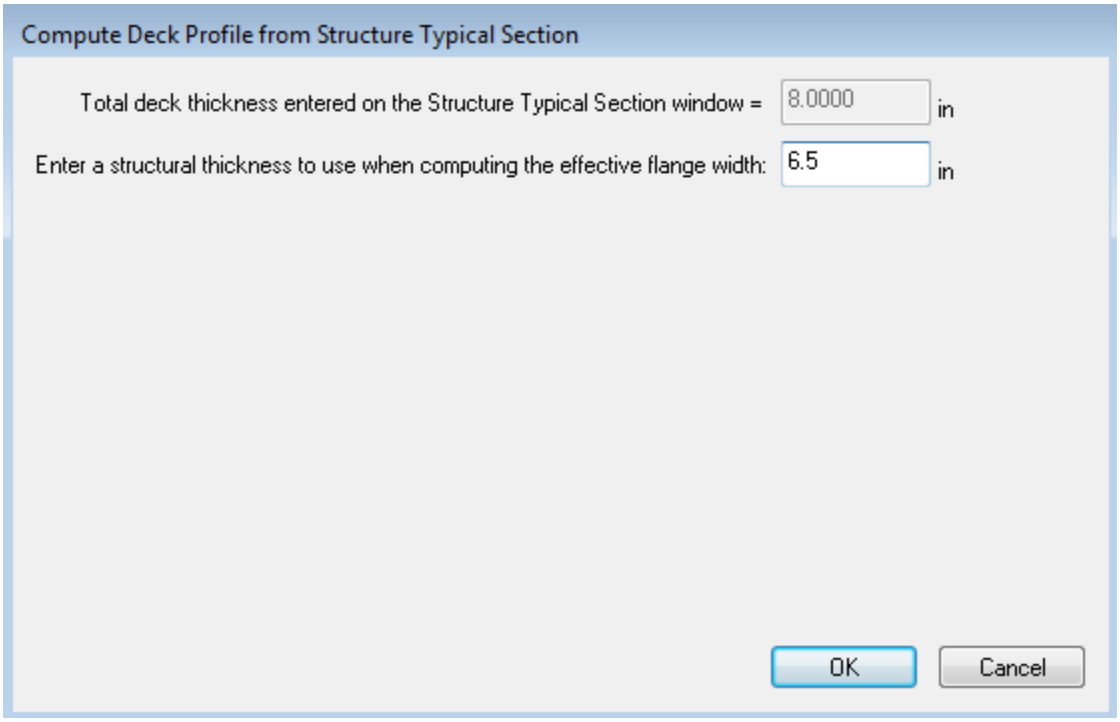


Describe the bottom cover plate as shown below.

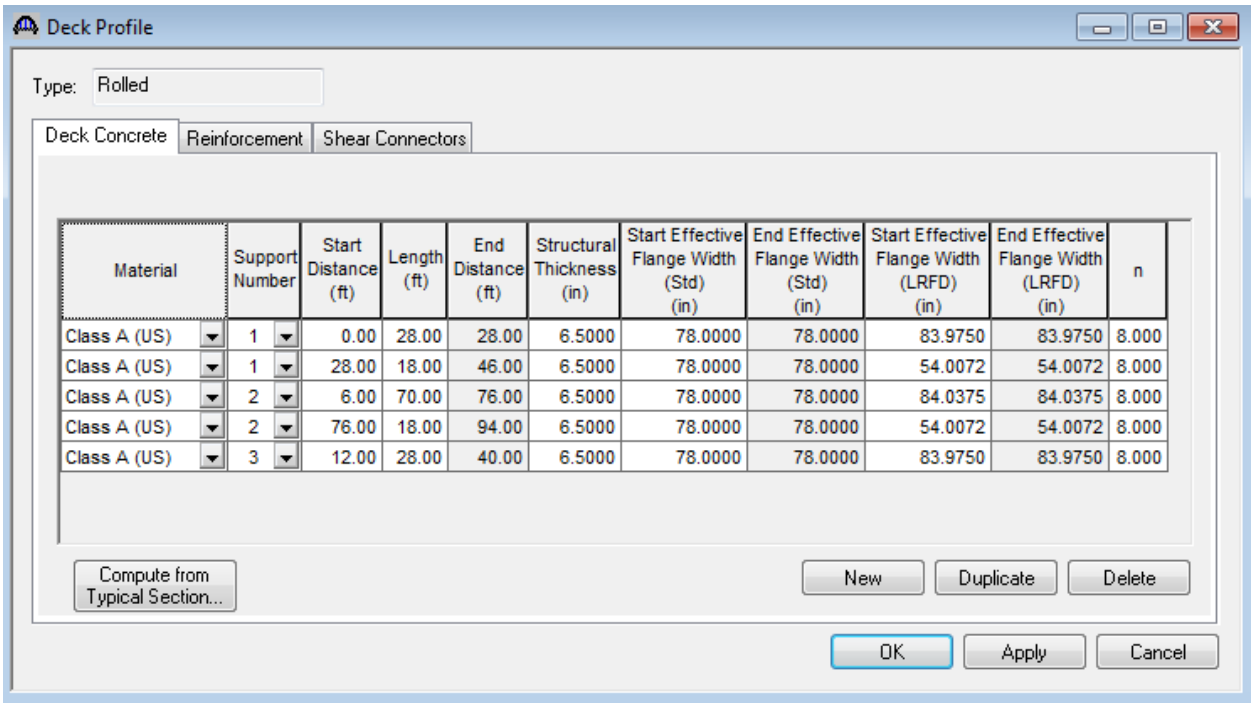


Next open the Deck Profile and click the “Compute from Typical Section…” button.

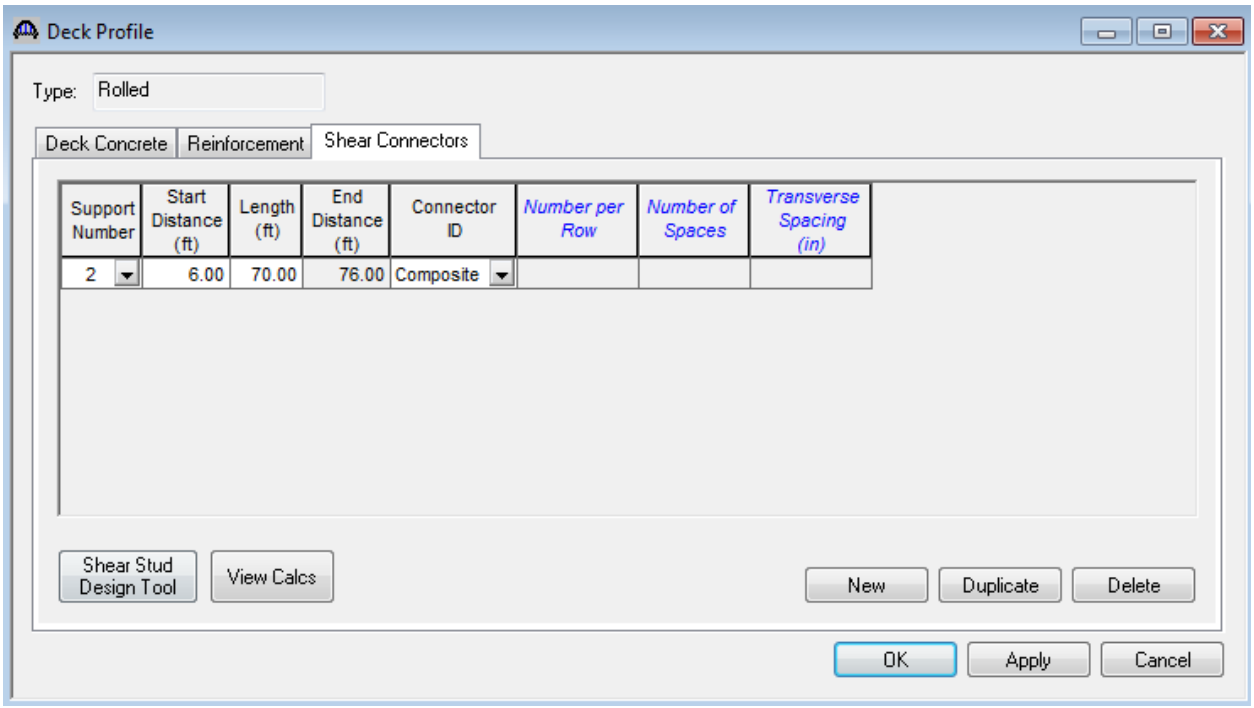
Enter the following data. The points of contraflexure are required for the computation of the LRFD effective flange width. Enter the hinge locations as the points of contraflexure in span 2 as shown below. Click OK.



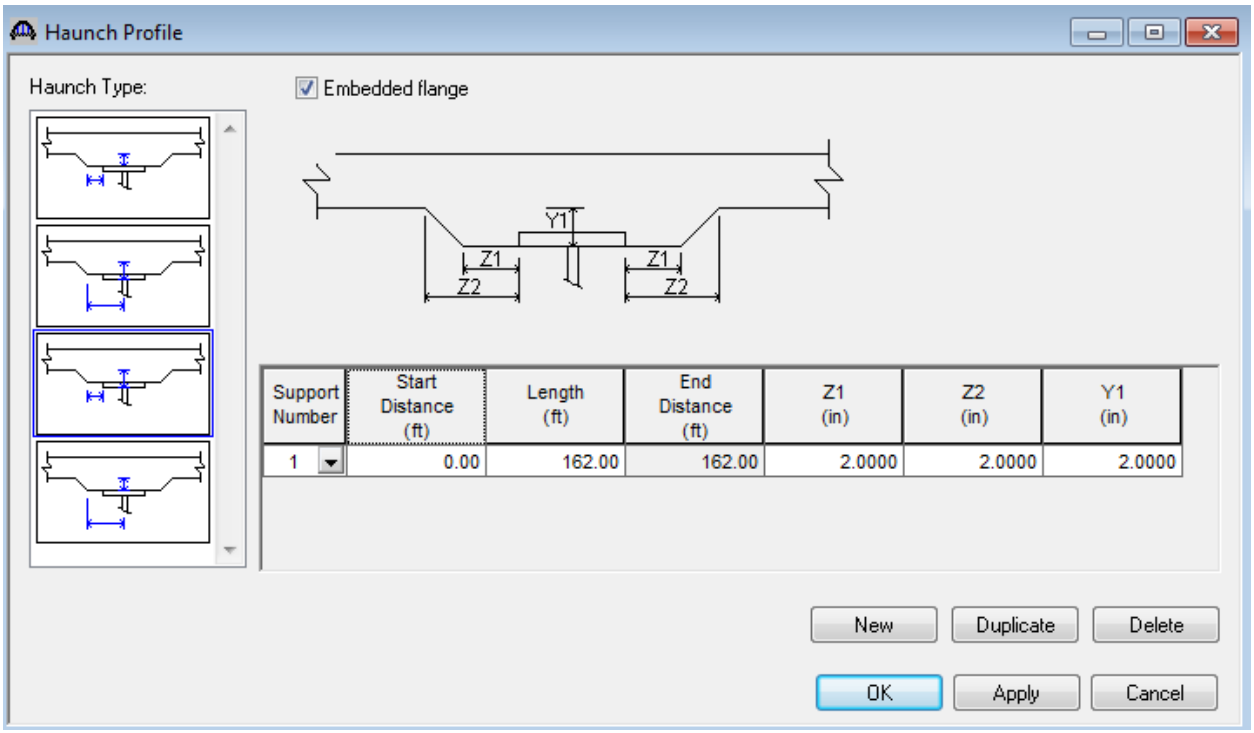
The completed deck concrete window is shown below. Note that the distance to the top row of steel is measured from the top of the effective deck slab thickness. Enter a value for the modular ratio of the concrete. The Compute from Typical Section button could not compute this for us since we have not defined a reinforcing steel material.



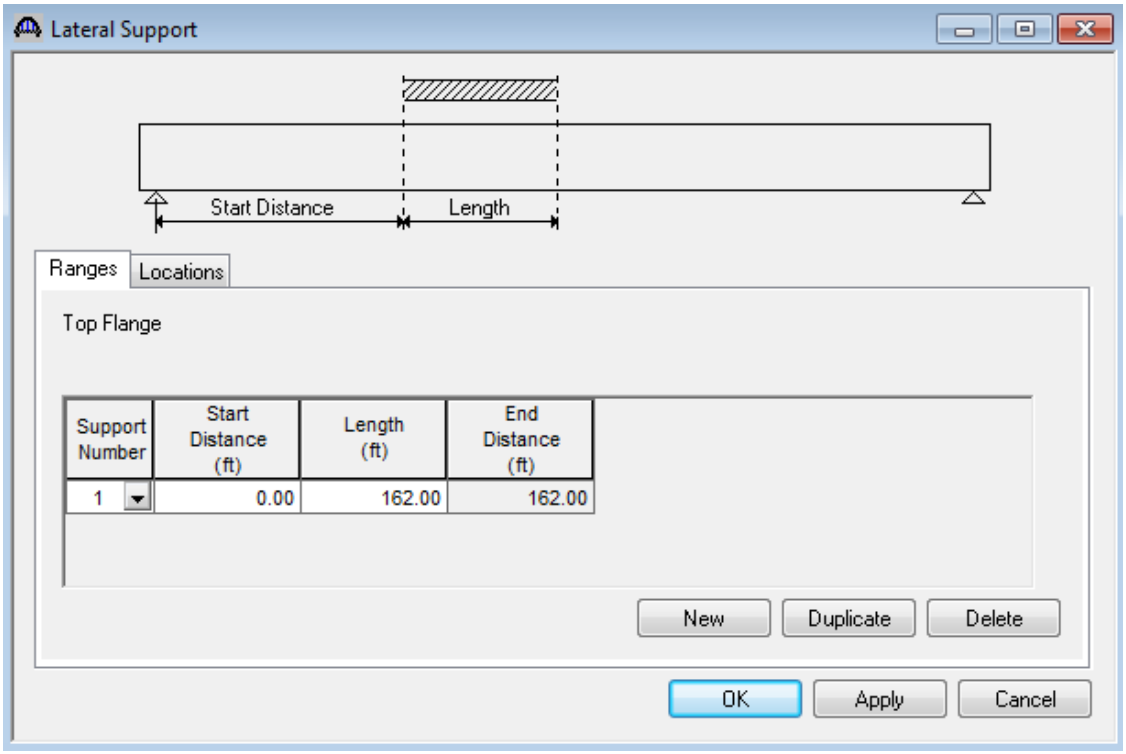
Composite regions are described using the Shear Connectors tab as shown below.



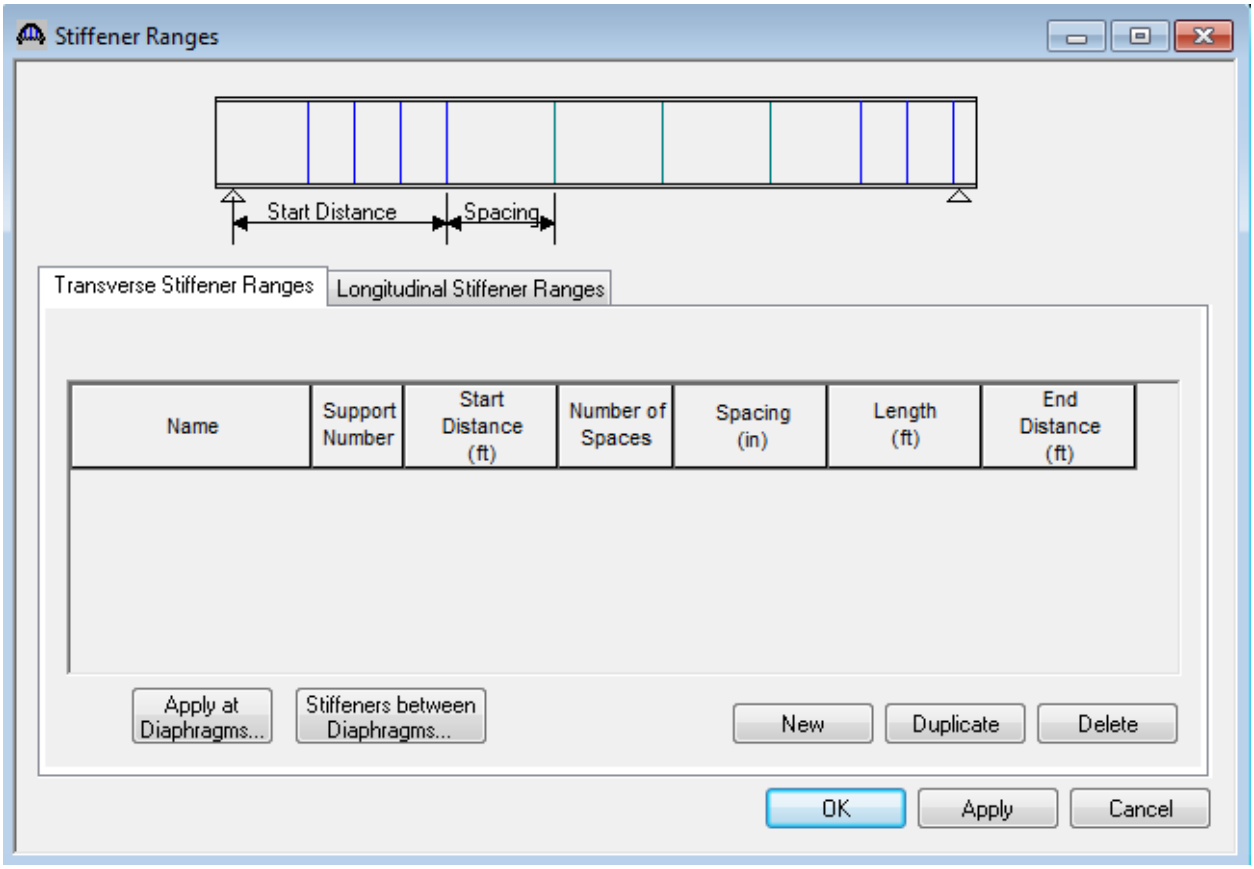
The haunch profile is defined by double clicking on Haunch Profile in the tree. The window is shown below.



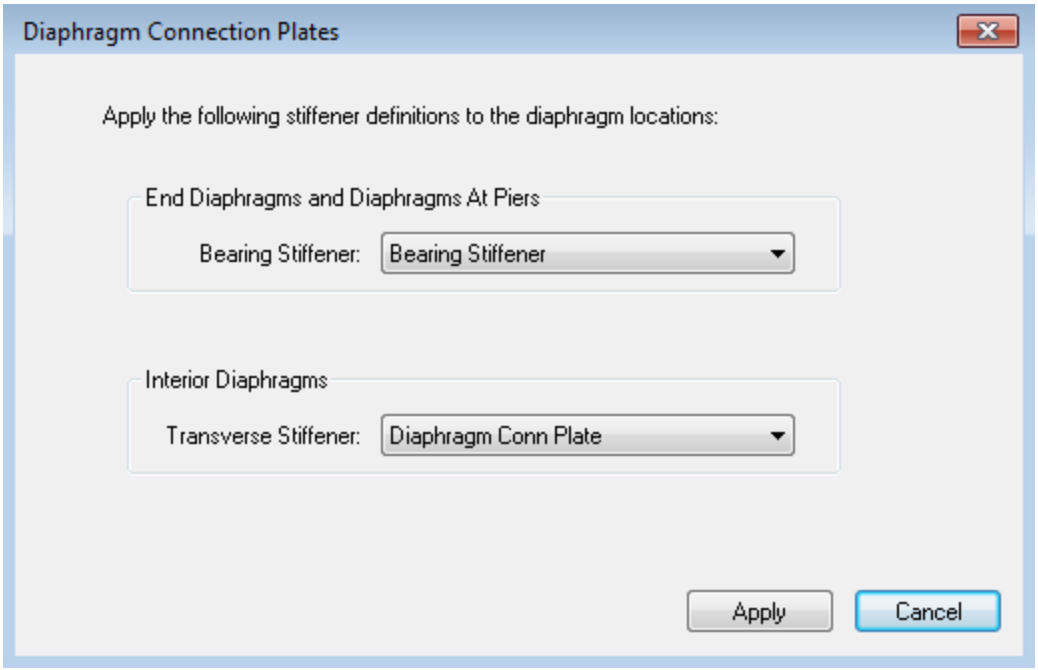
Regions where the slab is considered to provide lateral support for the top flange are defined using the Lateral Support window shown below. It can be opened by double clicking on Lateral Support in the tree.



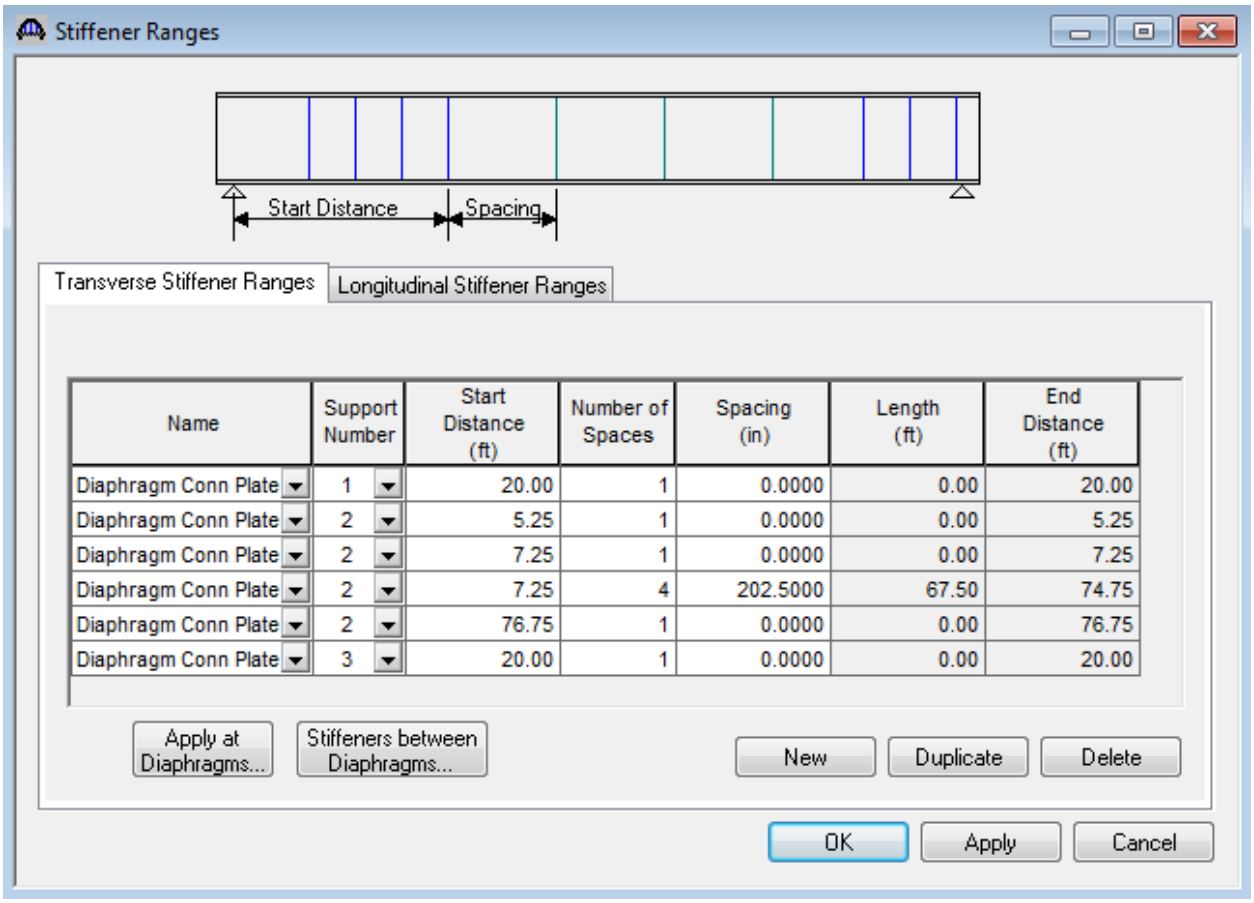
Stiffener locations are described using the Stiffener Ranges window shown below.



Click on the Apply at Diaphragms… button to open the following dialog.

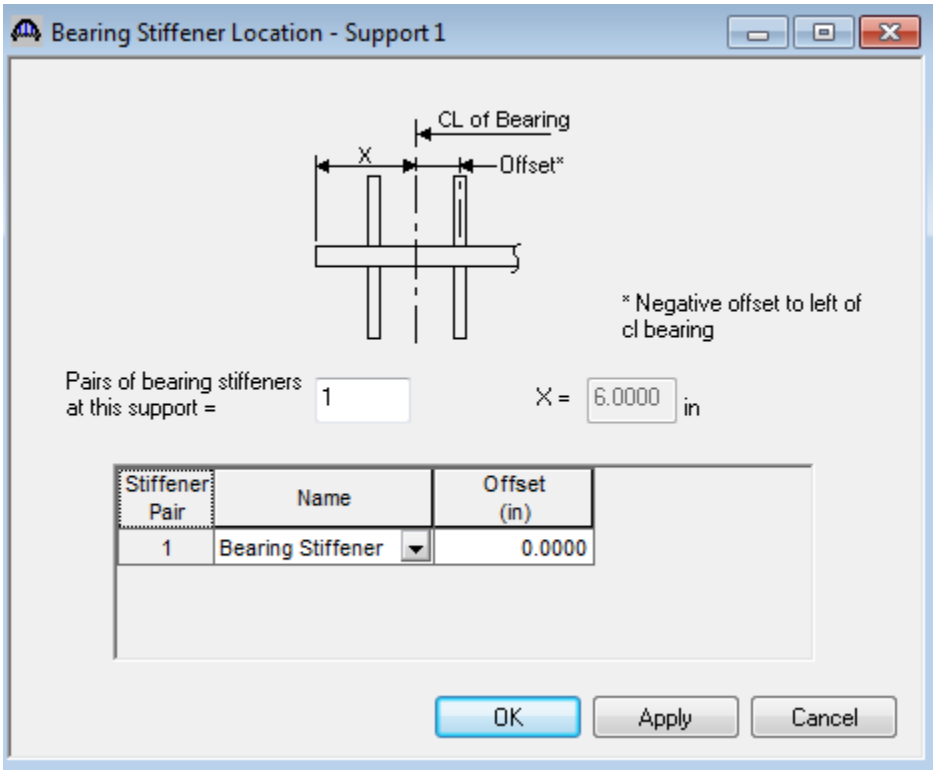


Selecting Apply will create the following transverse stiffener locations.



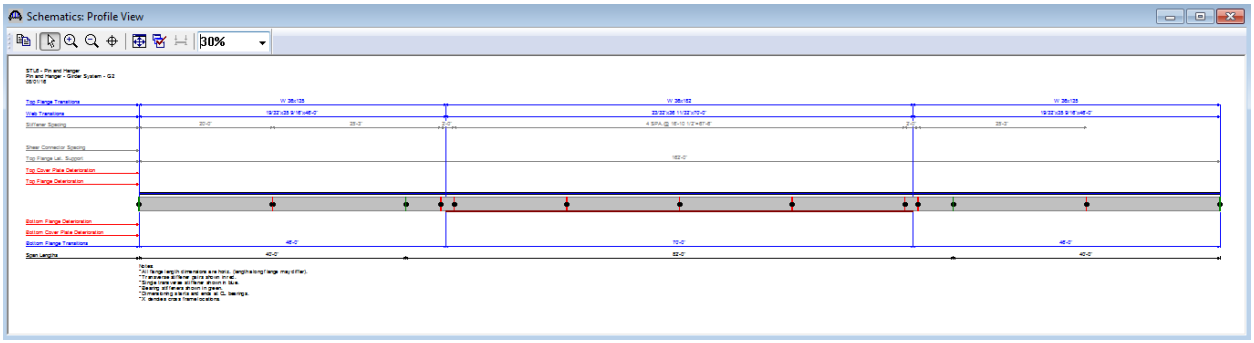
This example does not have any intermediate transverse stiffeners so we can click Ok to close this window

Bearing stiffener definitions were assigned to locations when we used the Apply at Diaphragms… button on the Transverse Stiffener Ranges window. The Bearing Stiffener Location window is opened by expanding the Bearing Stiffener Locations branch in the tree and double clicking on each support. The assignment for Support 1 is shown below.



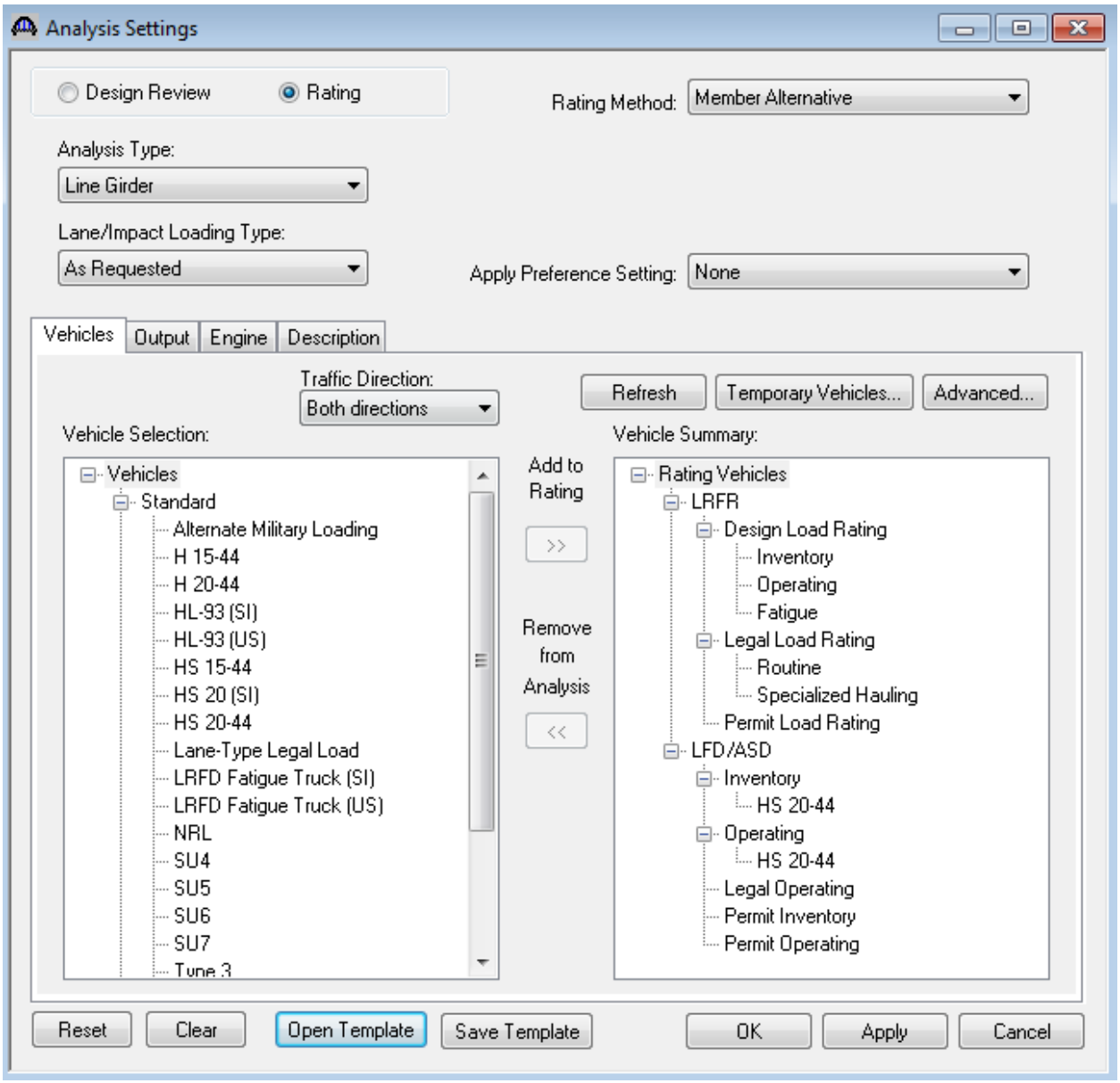
The description of an interior beam for a structure definition is complete.

While “Rolled Beam Alt” is selected in the BWS tree, open the schematic for the girder profile by selecting the View Schematic toolbar button  or Bridge/Schematic from the menu. The following schematic will be displayed.



To perform a rating, select the name of the “Rolled Beam Alt” member alternative in the tree. Click the View Analysis Settings button on the toolbar. The Analysis Settings window will open. Select the “Open Template” button to open the following window. Select the HS20 rating template and click the Open button.

The Analysis Settings window with the selected vehicles is shown below. Click Ok to close the window.



Next click the Analyze button on the toolbar to perform the rating. When the rating is finished you can review the results by clicking the View Analysis Report button on the toolbar. The window shown below will open.