AASHTOWare BrD/BrR 6.8

Steel Structure Tutorial

STL5 - Two Span Rolled Beam Example

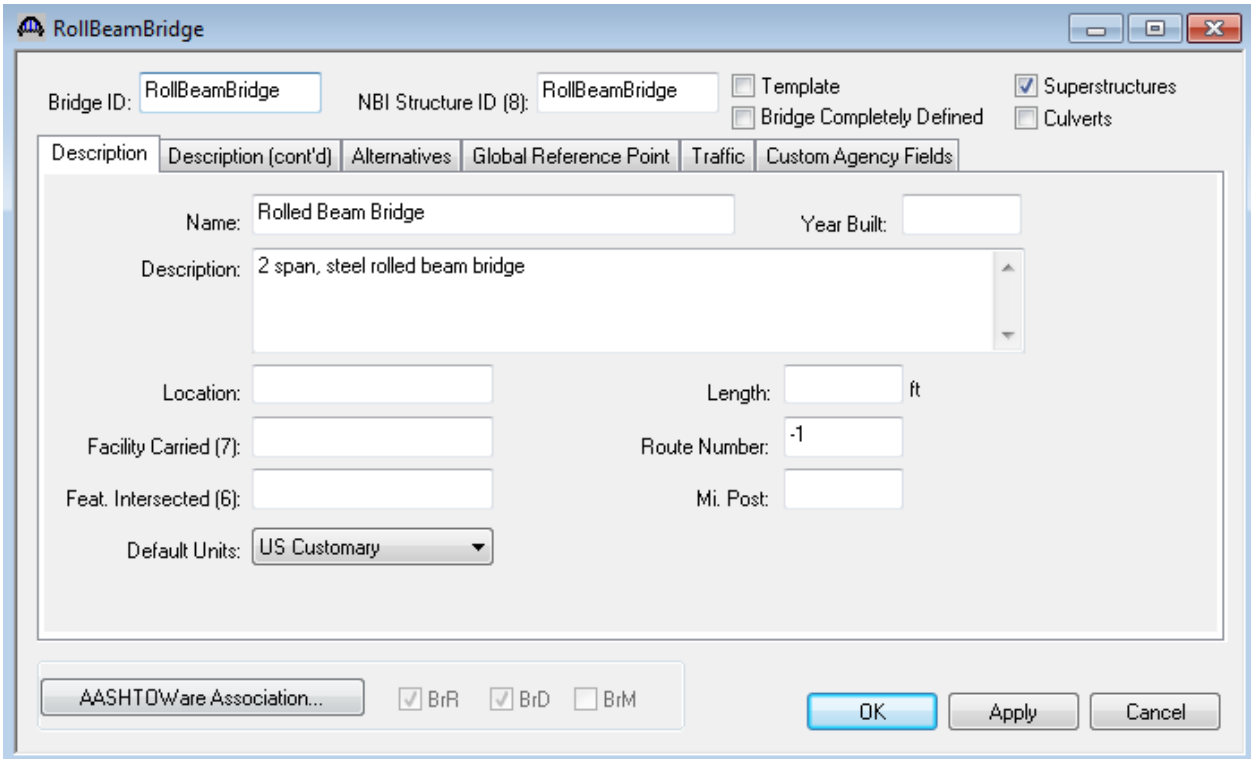
BrD and BrR Training

STL5 - Two Span Rolled Beam Example

Topics Covered

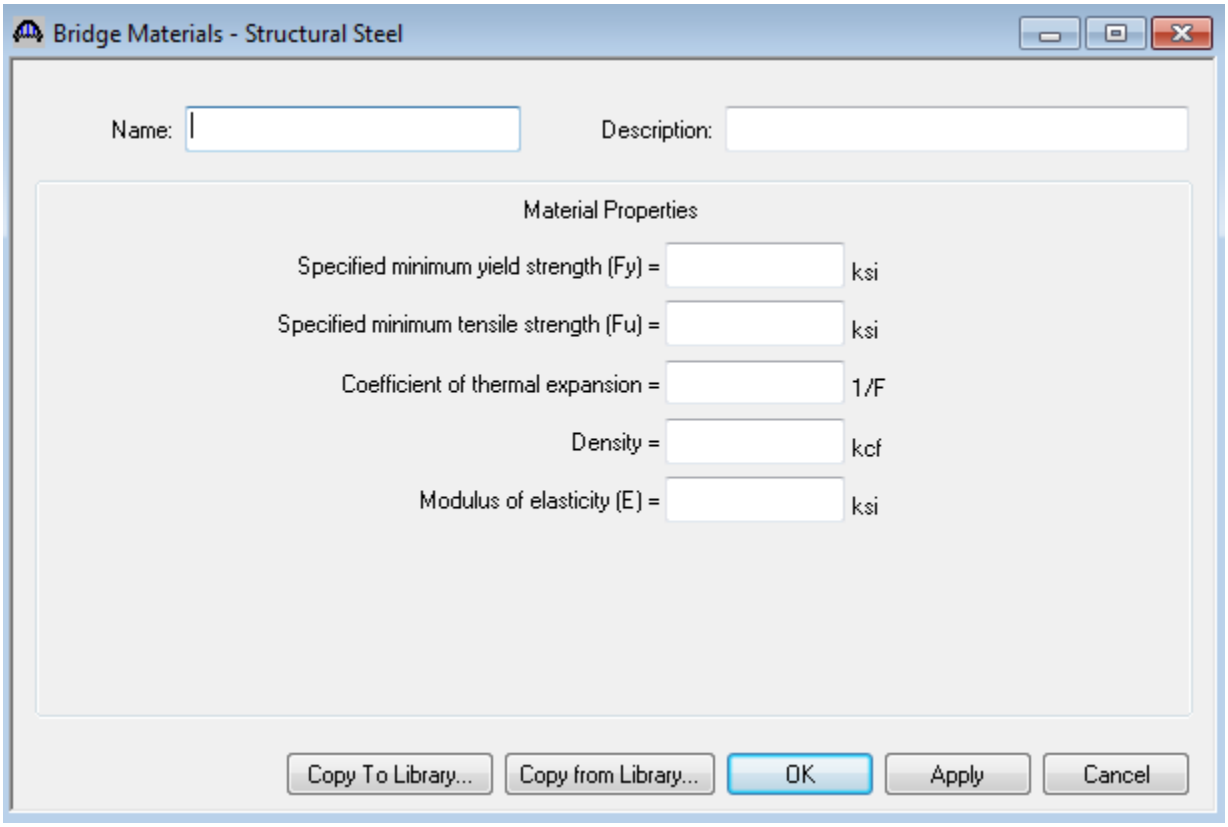
- Steel rolled beam with cover plates input as girder system.
- Schedule based input.
- Skewed framing plan.

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

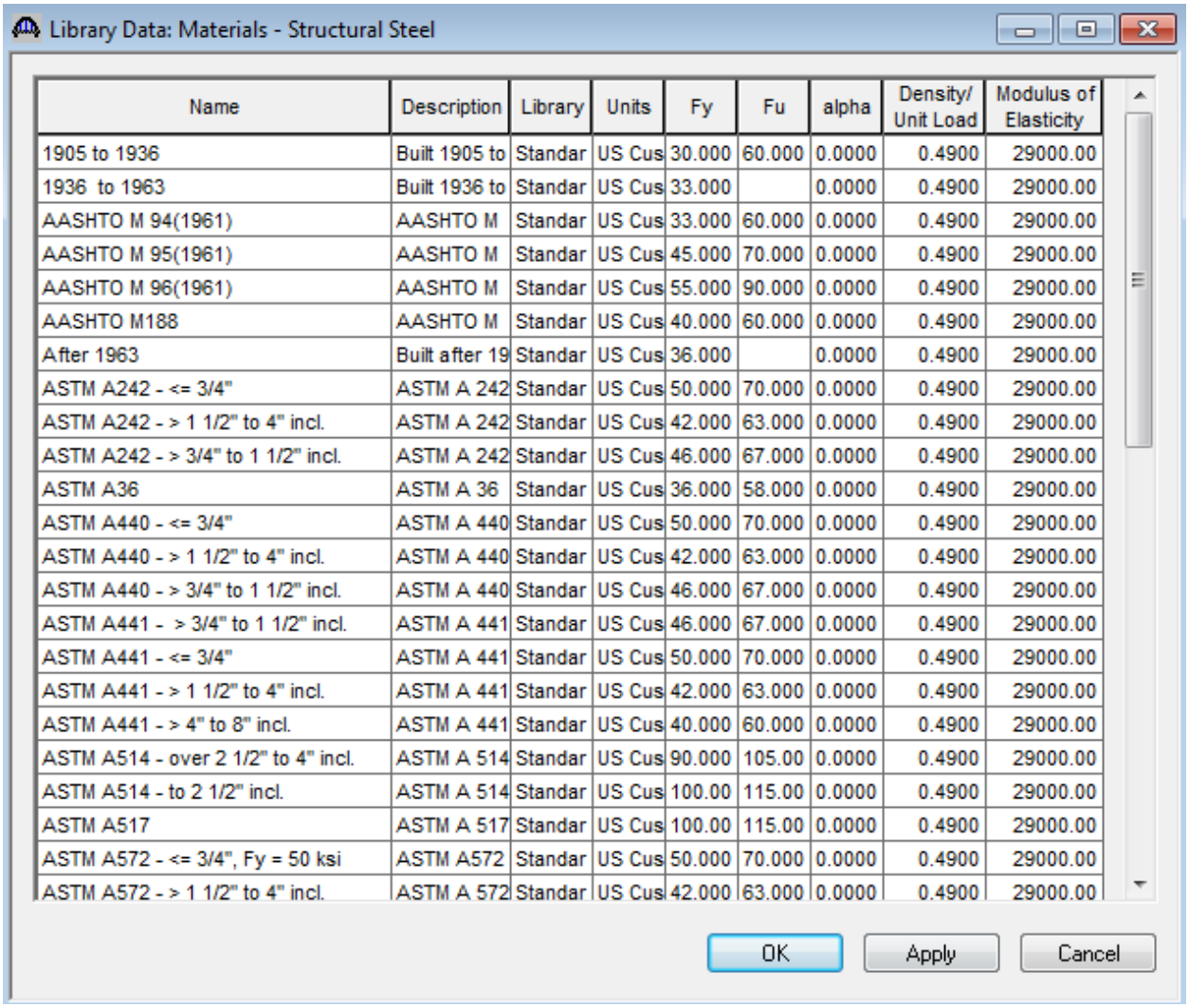


Close the window by clicking Ok. This saves the data to memory and closed the window.

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.

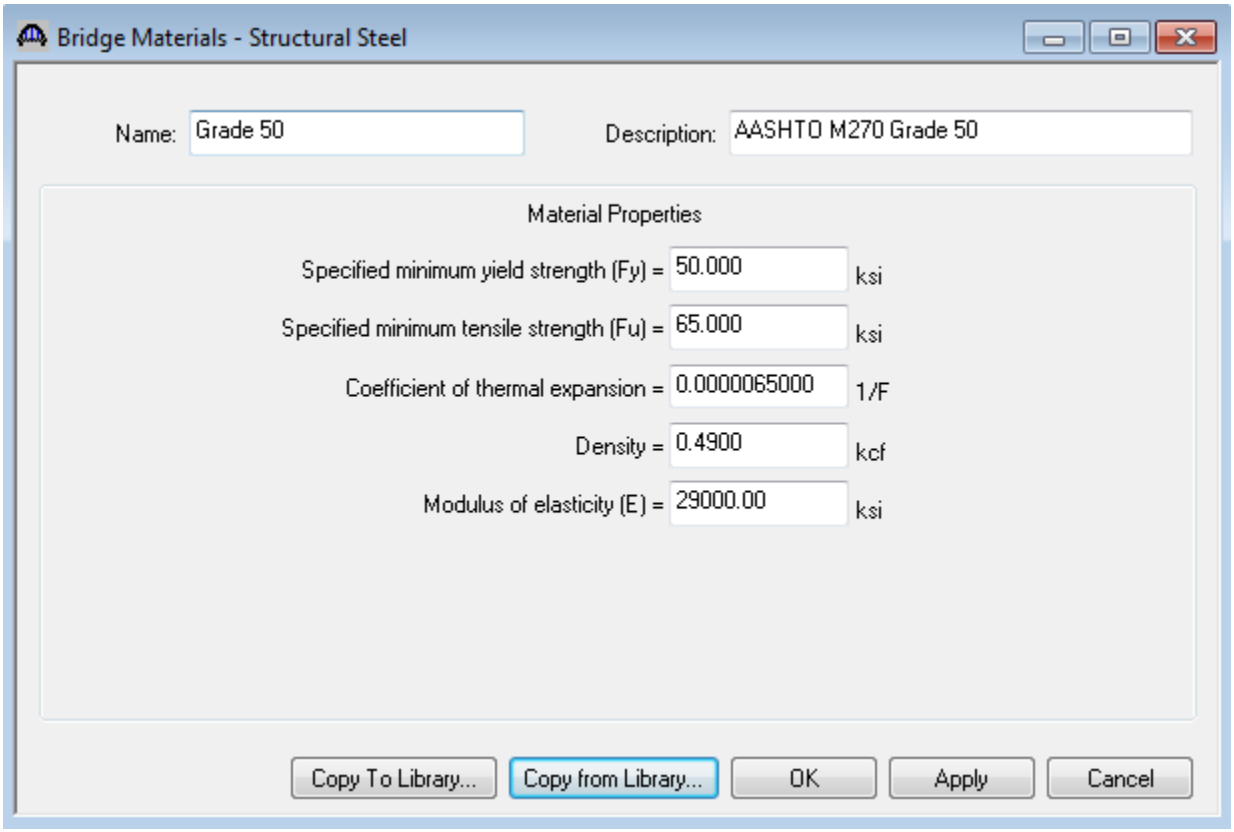


Add a structural steel material by selecting from the Structural Steel Materials Library by clicking the Copy from Library button.

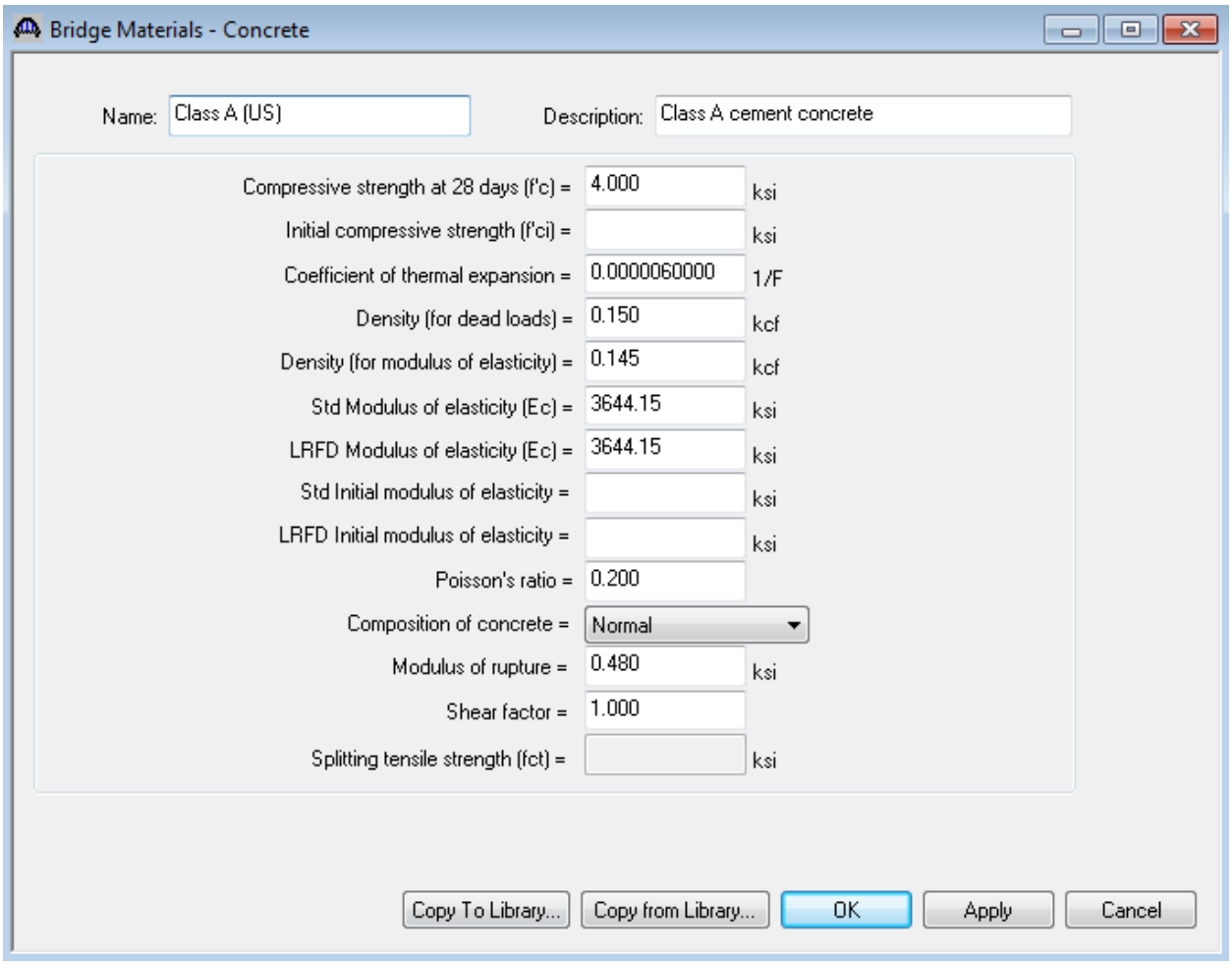


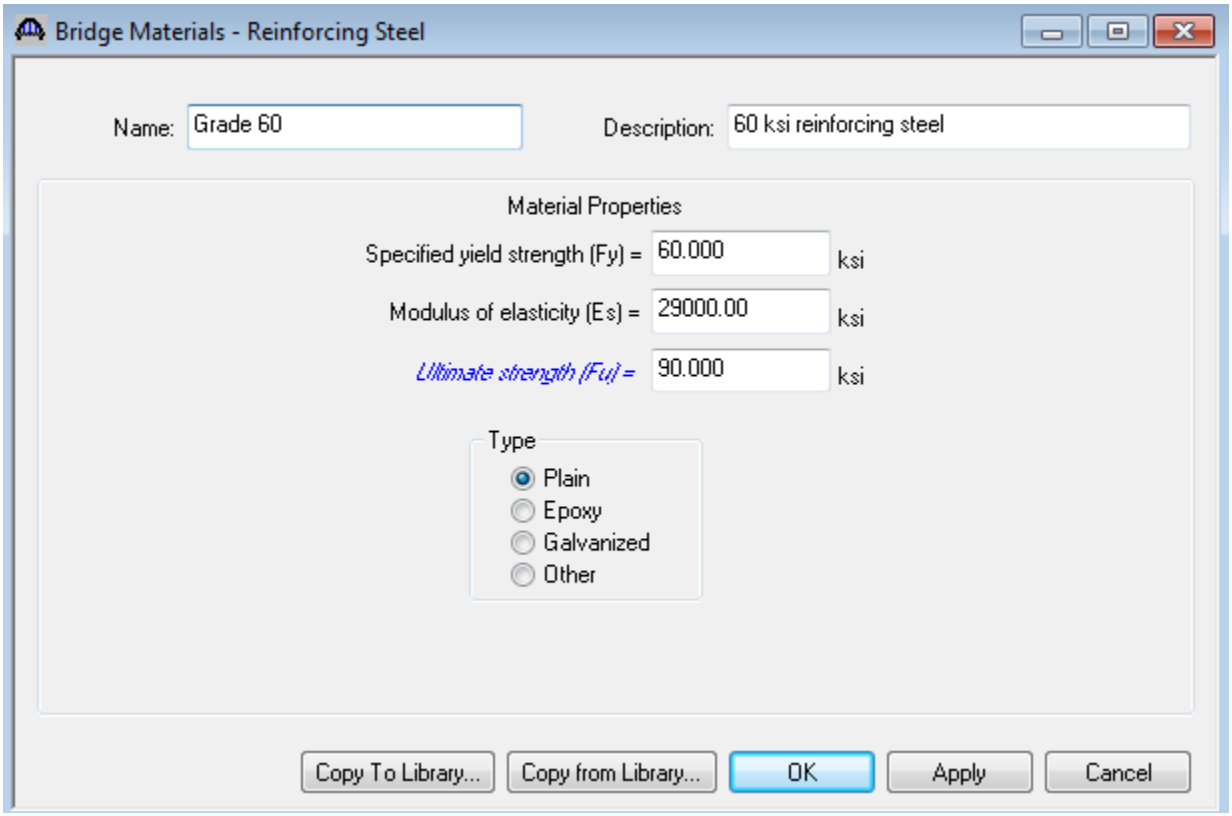
Name	Description	Library	Units	Fy	Fu	alpha	Density/ Unit Load	Modulus of Elasticity
1905 to 1936	Built 1905 to	Standar	US Cus	30.000	60.000	0.0000	0.4900	29000.00
1936 to 1963	Built 1936 to	Standar	US Cus	33.000		0.0000	0.4900	29000.00
AASHTO M 94(1961)	AASHTO M	Standar	US Cus	33.000	60.000	0.0000	0.4900	29000.00
AASHTO M 95(1961)	AASHTO M	Standar	US Cus	45.000	70.000	0.0000	0.4900	29000.00
AASHTO M 96(1961)	AASHTO M	Standar	US Cus	55.000	90.000	0.0000	0.4900	29000.00
AASHTO M188	AASHTO M	Standar	US Cus	40.000	60.000	0.0000	0.4900	29000.00
After 1963	Built after 19	Standar	US Cus	36.000		0.0000	0.4900	29000.00
ASTM A242 - <= 3/4"	ASTM A 242	Standar	US Cus	50.000	70.000	0.0000	0.4900	29000.00
ASTM A242 - > 1 1/2" to 4" incl.	ASTM A 242	Standar	US Cus	42.000	63.000	0.0000	0.4900	29000.00
ASTM A242 - > 3/4" to 1 1/2" incl.	ASTM A 242	Standar	US Cus	46.000	67.000	0.0000	0.4900	29000.00
ASTM A36	ASTM A 36	Standar	US Cus	36.000	58.000	0.0000	0.4900	29000.00
ASTM A440 - <= 3/4"	ASTM A 440	Standar	US Cus	50.000	70.000	0.0000	0.4900	29000.00
ASTM A440 - > 1 1/2" to 4" incl.	ASTM A 440	Standar	US Cus	42.000	63.000	0.0000	0.4900	29000.00
ASTM A440 - > 3/4" to 1 1/2" incl.	ASTM A 440	Standar	US Cus	46.000	67.000	0.0000	0.4900	29000.00
ASTM A441 - > 3/4" to 1 1/2" incl.	ASTM A 441	Standar	US Cus	46.000	67.000	0.0000	0.4900	29000.00
ASTM A441 - <= 3/4"	ASTM A 441	Standar	US Cus	50.000	70.000	0.0000	0.4900	29000.00
ASTM A441 - > 1 1/2" to 4" incl.	ASTM A 441	Standar	US Cus	42.000	63.000	0.0000	0.4900	29000.00
ASTM A441 - > 4" to 8" incl.	ASTM A 441	Standar	US Cus	40.000	60.000	0.0000	0.4900	29000.00
ASTM A514 - over 2 1/2" to 4" incl.	ASTM A 514	Standar	US Cus	90.000	105.00	0.0000	0.4900	29000.00
ASTM A514 - to 2 1/2" incl.	ASTM A 514	Standar	US Cus	100.00	115.00	0.0000	0.4900	29000.00
ASTM A517	ASTM A 517	Standar	US Cus	100.00	115.00	0.0000	0.4900	29000.00
ASTM A572 - <= 3/4", Fy = 50 ksi	ASTM A572	Standar	US Cus	50.000	70.000	0.0000	0.4900	29000.00
ASTM A572 - > 1 1/2" to 4" incl.	ASTM A 572	Standar	US Cus	42.000	63.000	0.0000	0.4900	29000.00

Select the AASHTO M270 Grade 50 material and click Ok. The selected material properties are copied to the Bridge Materials – Structural Steel window as shown below.

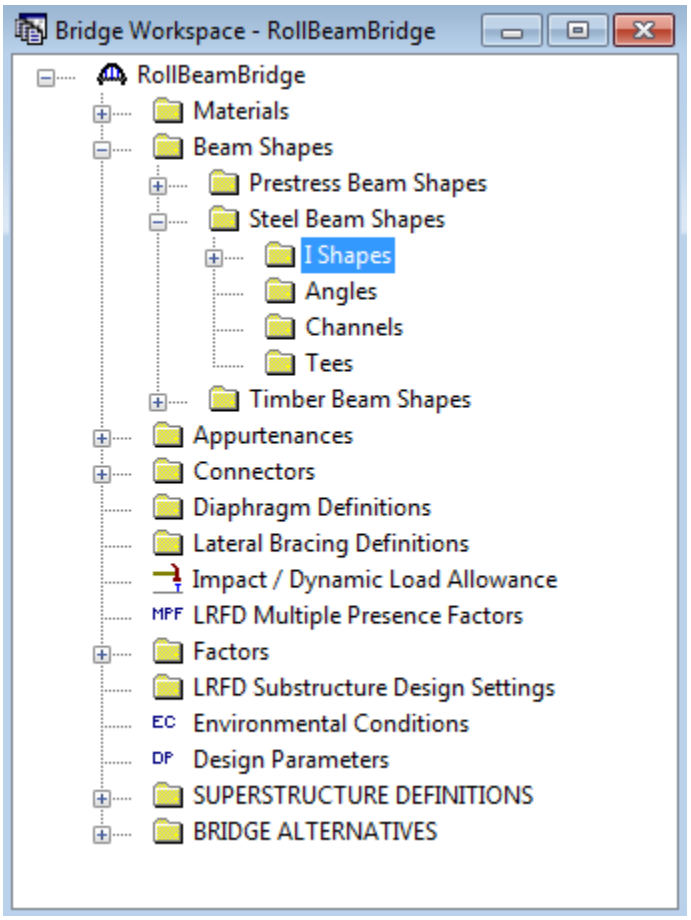


Add concrete and reinforcement materials using the same techniques. The windows will look like these:

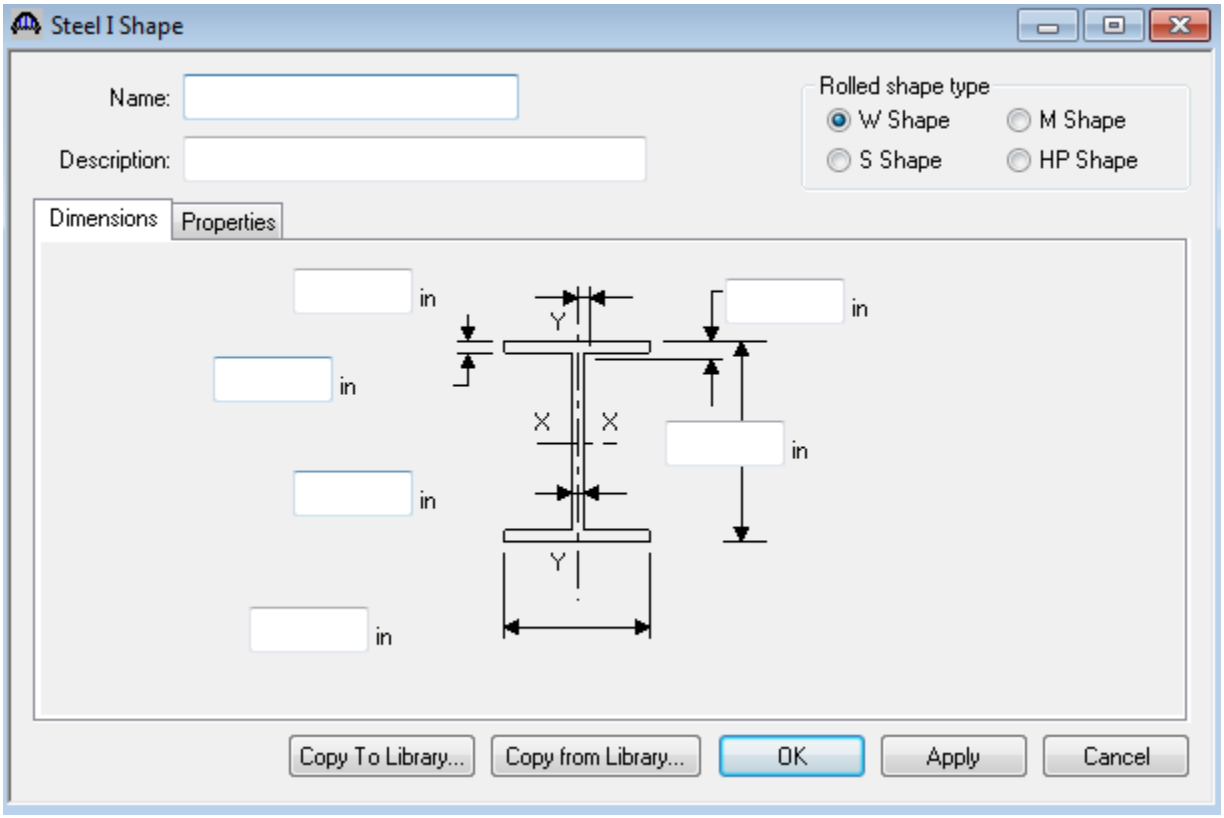



Bridge Materials - Reinforcing Steel
Name: Grade 60
Description: 60 ksi reinforcing steel
Material Properties
Specified yield strength (Fy) = 60.000 ksi
Modulus of elasticity (Es) = 29000.00 ksi
Ultimate strength (Fu) = 90.000 ksi
Type
Plain
Epoxy
Galvanized
Other
Copy To Library...
Copy from Library...
OK
Apply
Cancel

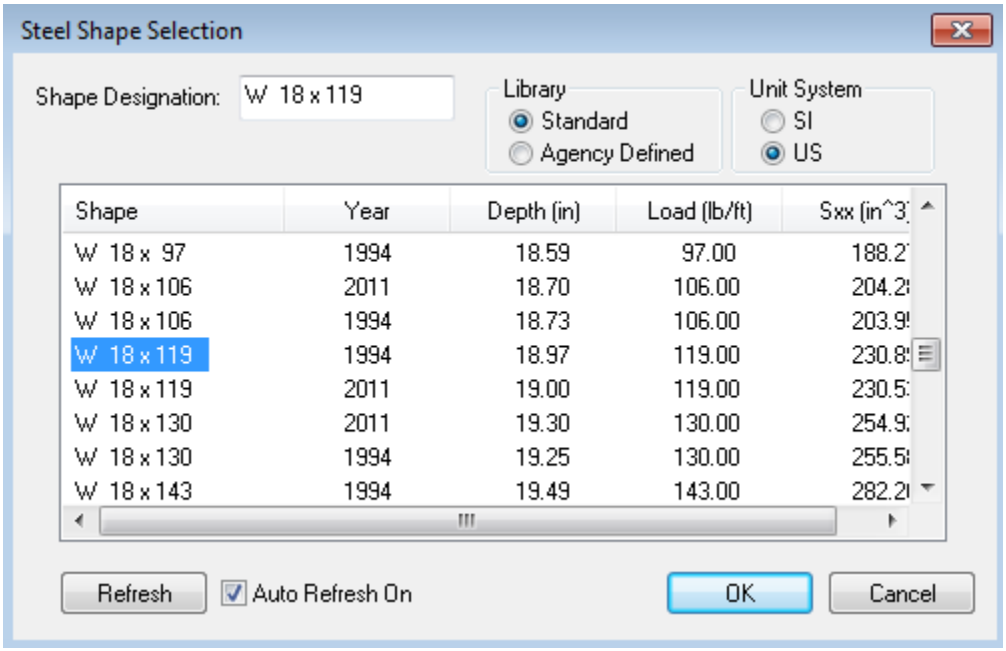
To enter a steel rolled beam shape to be used in this bridge expand the tree labeled Beam Shapes as shown below:



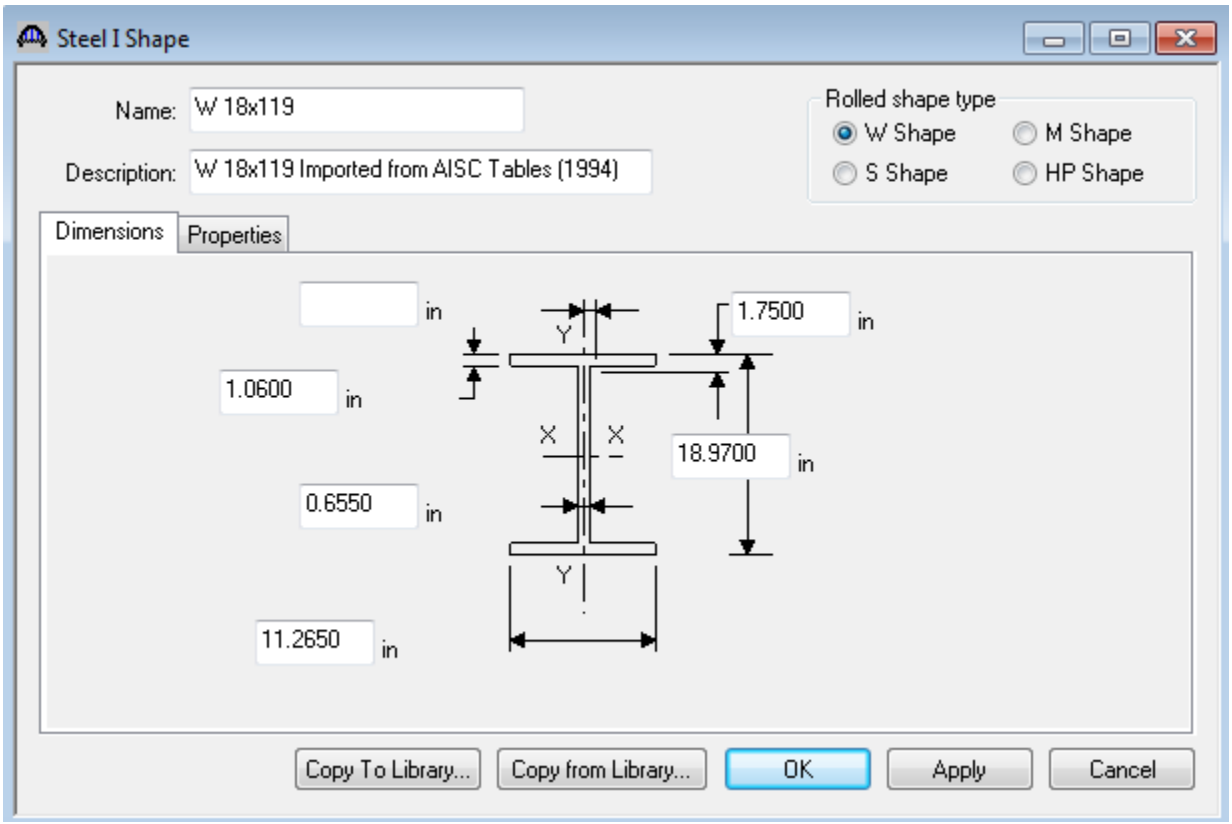
Click on I Shapes in the tree and select File/New from the menu (or double click on I Shapes in the tree). The window shown below will open.



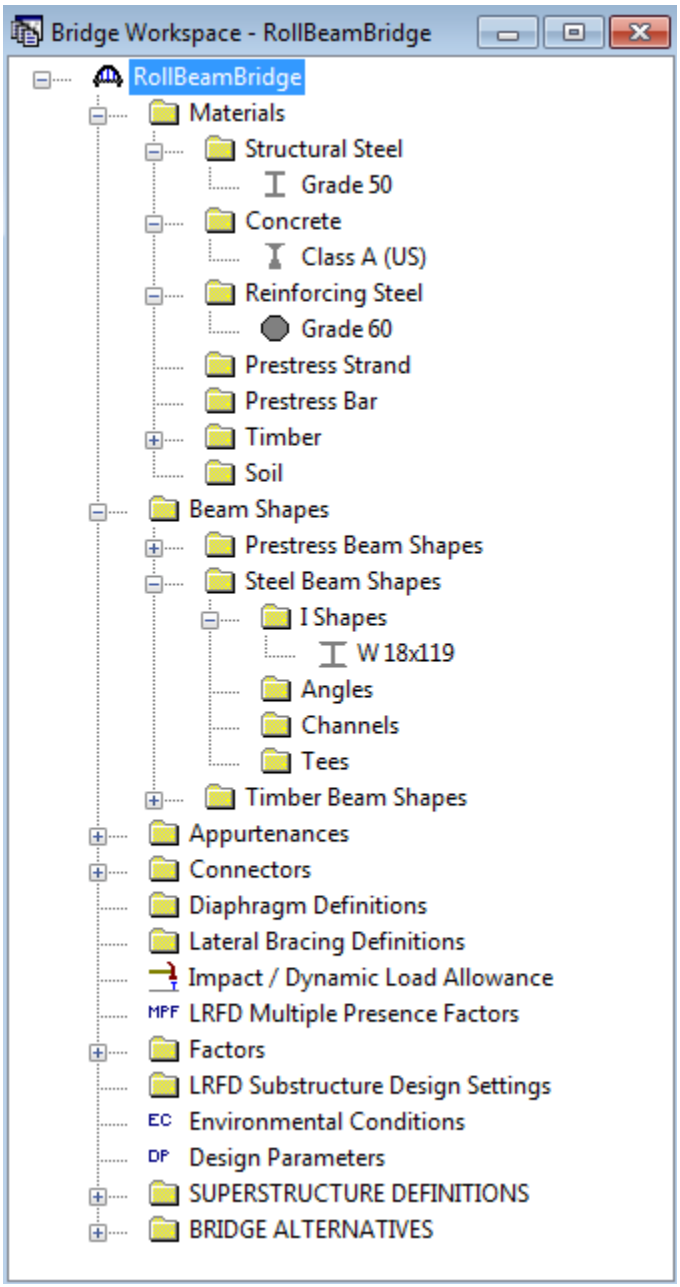
Select the Rolled Shape Type as W Shape and click on the copy from Library button. The Steel Shape Selection window will appear. This window displays all of the steel shapes available in the library. The list can be sorted by clicking on the Depth, Weight or Sxx column headers. Enter "W18" in the Shape Designation field and the list of steel shapes shown in the window will filter to show the W18 shapes. Select W18x119 and click Ok.



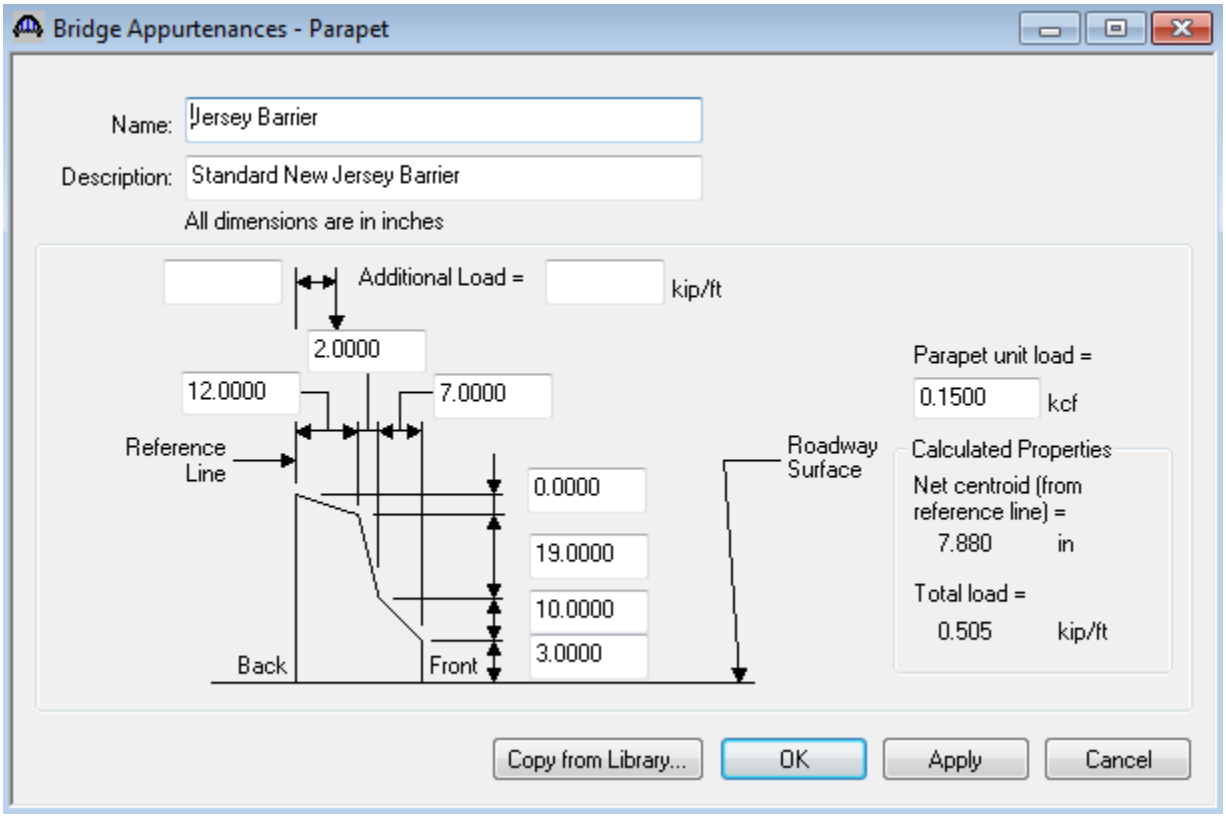
The beam properties are copied to the Steel I Shape window as shown below.



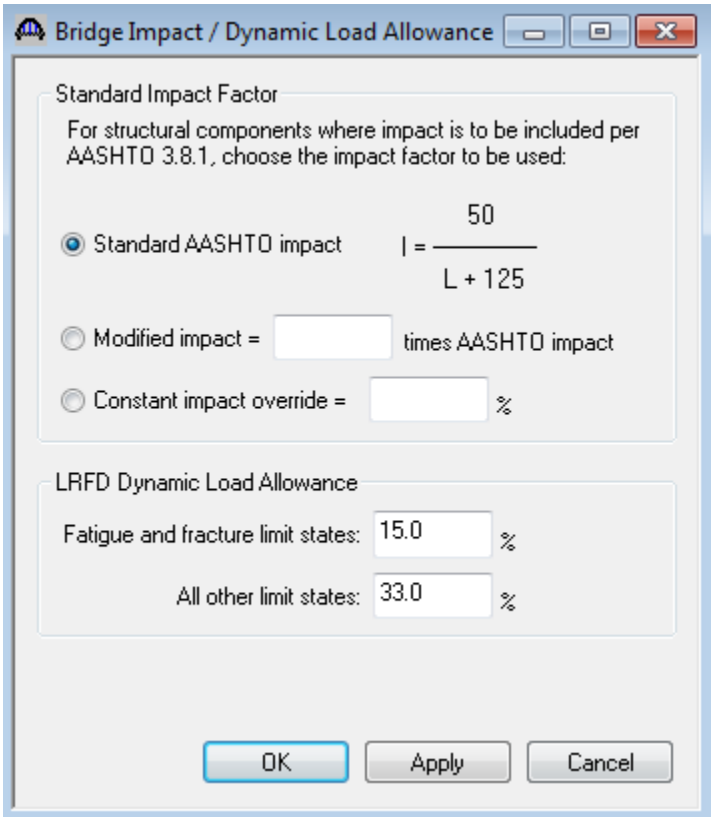
A partially expanded Bridge Workspace is shown below.



To enter the appurtenances to be used within the bridge expand the tree branch labeled Appurtenances. To define a parapet, double click on Parapet in the tree. Click the Copy from Library button and select the New Jersey barrier from the library. Click the Ok button and the parapet details are copied to the Parapet window as shown below. Click Ok to save the data to memory and close the window.

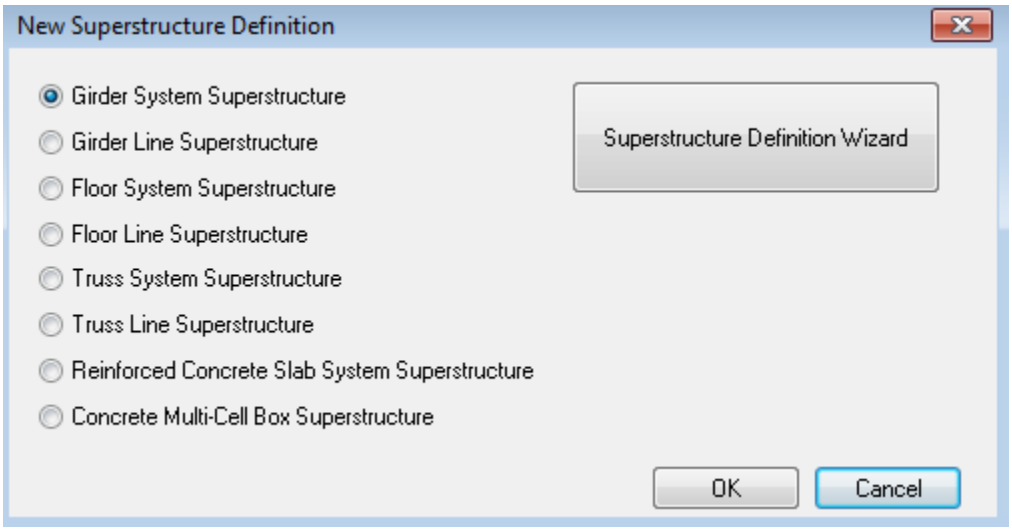


Enter the impact to be used for the entire bridge by clicking on Impact in the tree and selecting File/Open from the menu. The Bridge Impact window shown below will open. The values shown below are default values. Click Ok to save the data to memory and close the window.



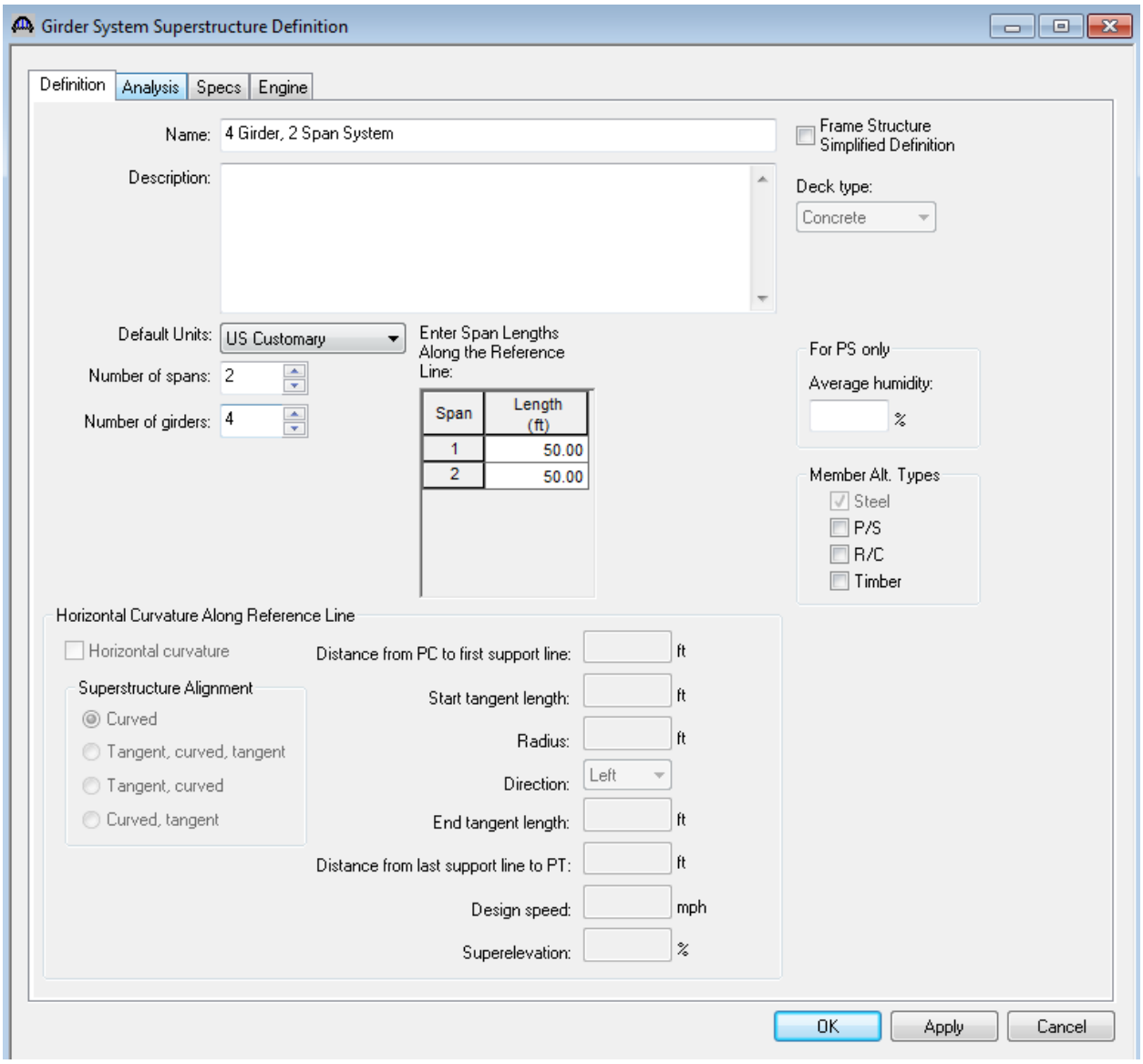
For this example problem we are not going to override the standard LRFD or LRFR factors so we skip to Structure Definition. We will come back to Bridge Alternatives after entering a Structure Definition.

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 Structure Definition window will open.

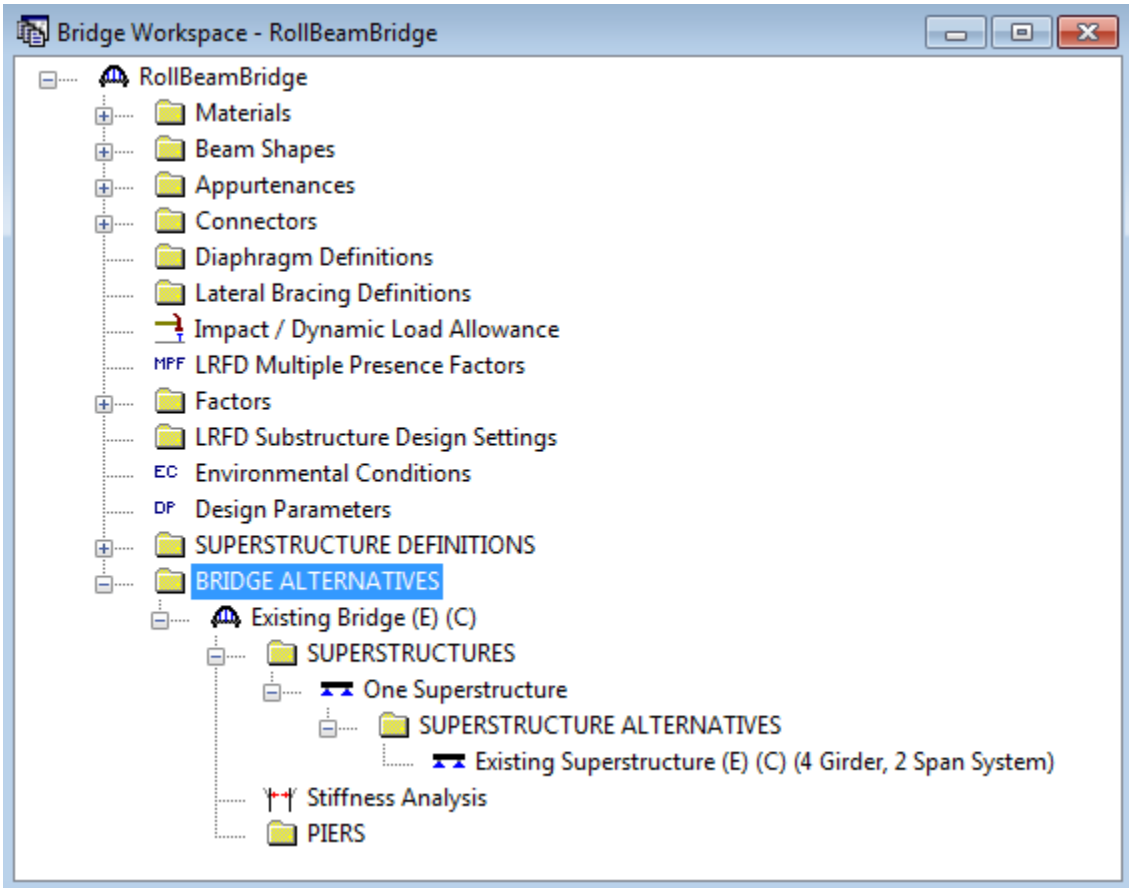
Enter the appropriate data as shown below:



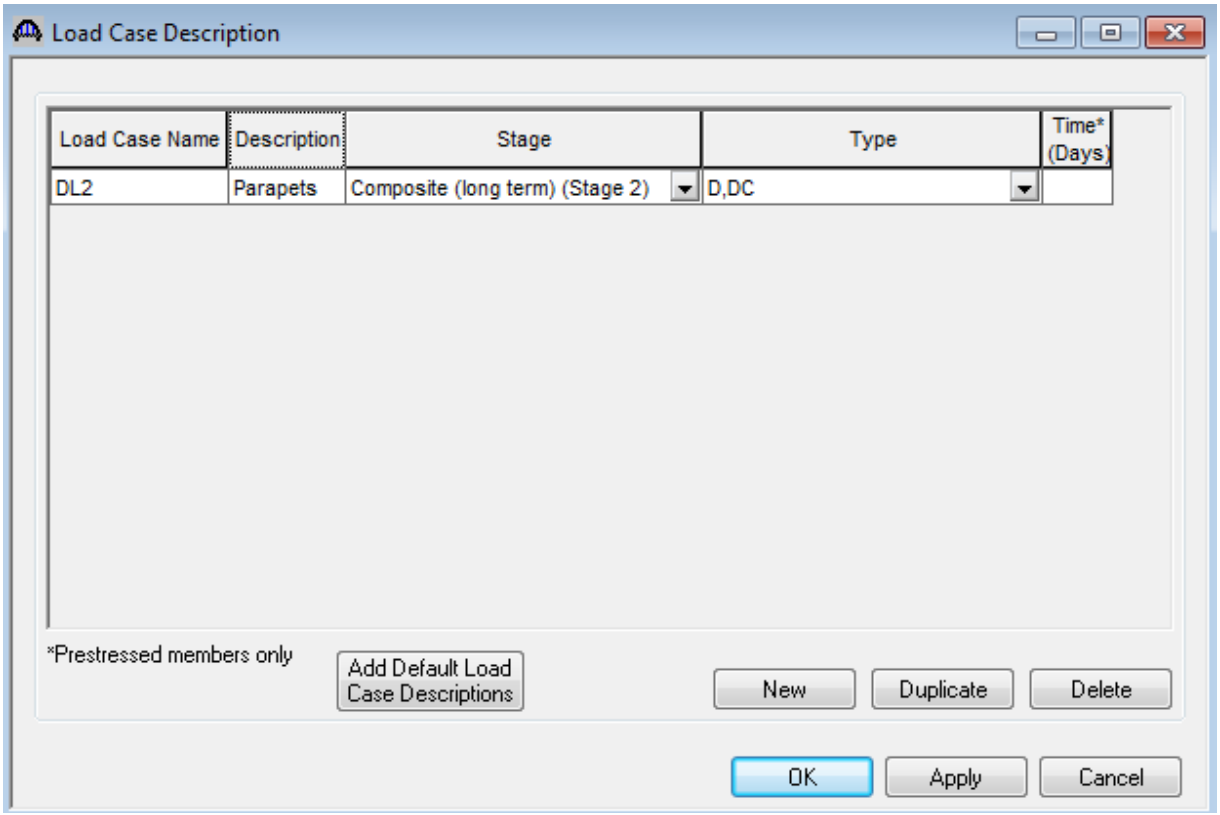
Click on Ok to save the data to memory and close the window.

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

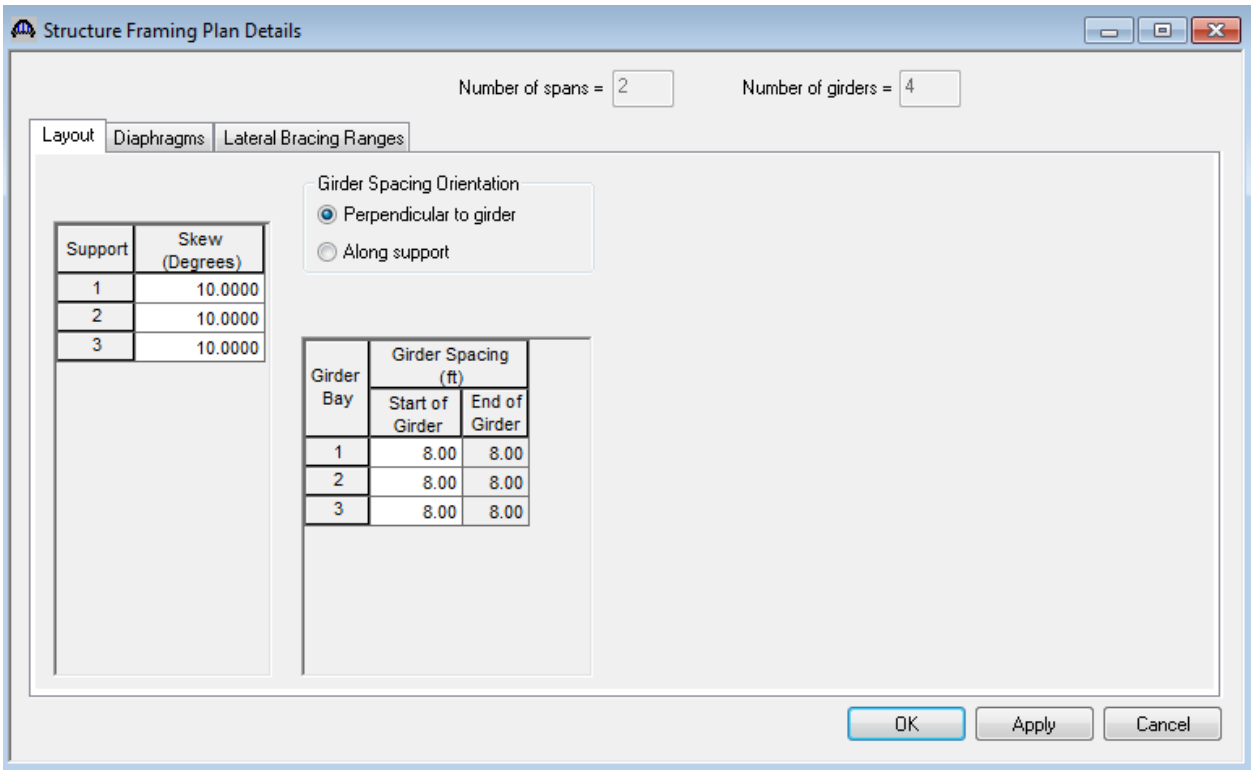
The partially expanded Bridge Workspace tree showing these alternatives is shown below:



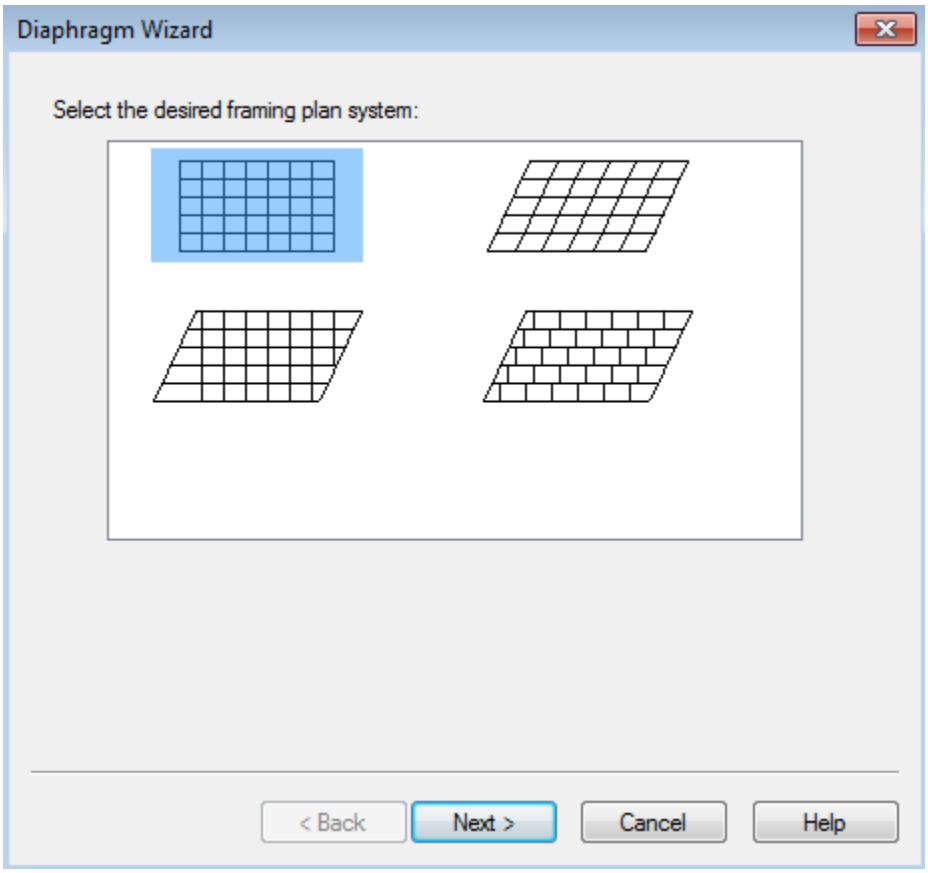
Click Load Case Description to define the dead load cases. The completed Load Case Description window is shown below.



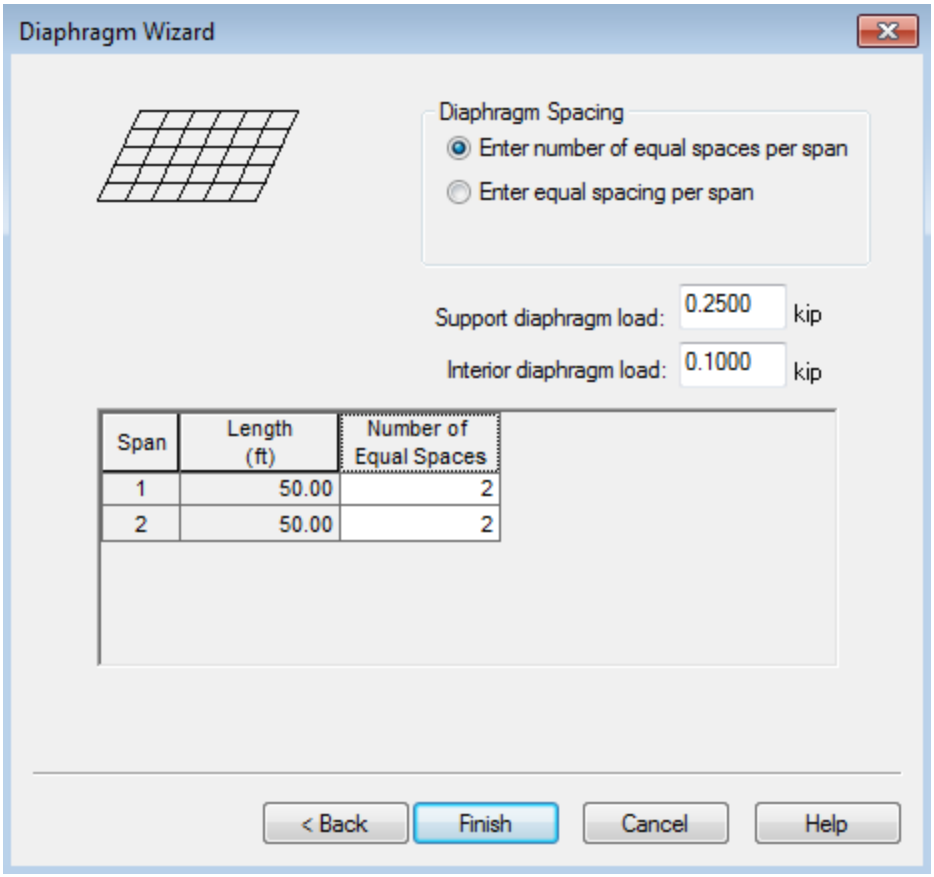
Double-click on Framing Plan Detail to describe the framing plan. Enter the appropriate data as shown below.



Click the Apply button to save this data to memory and switch to the Diaphragms tab to enter diaphragm spacing. Click the Diaphragm Wizard button to add diaphragms for the entire structure. Select the following Framing Plan System and Click the Next button.

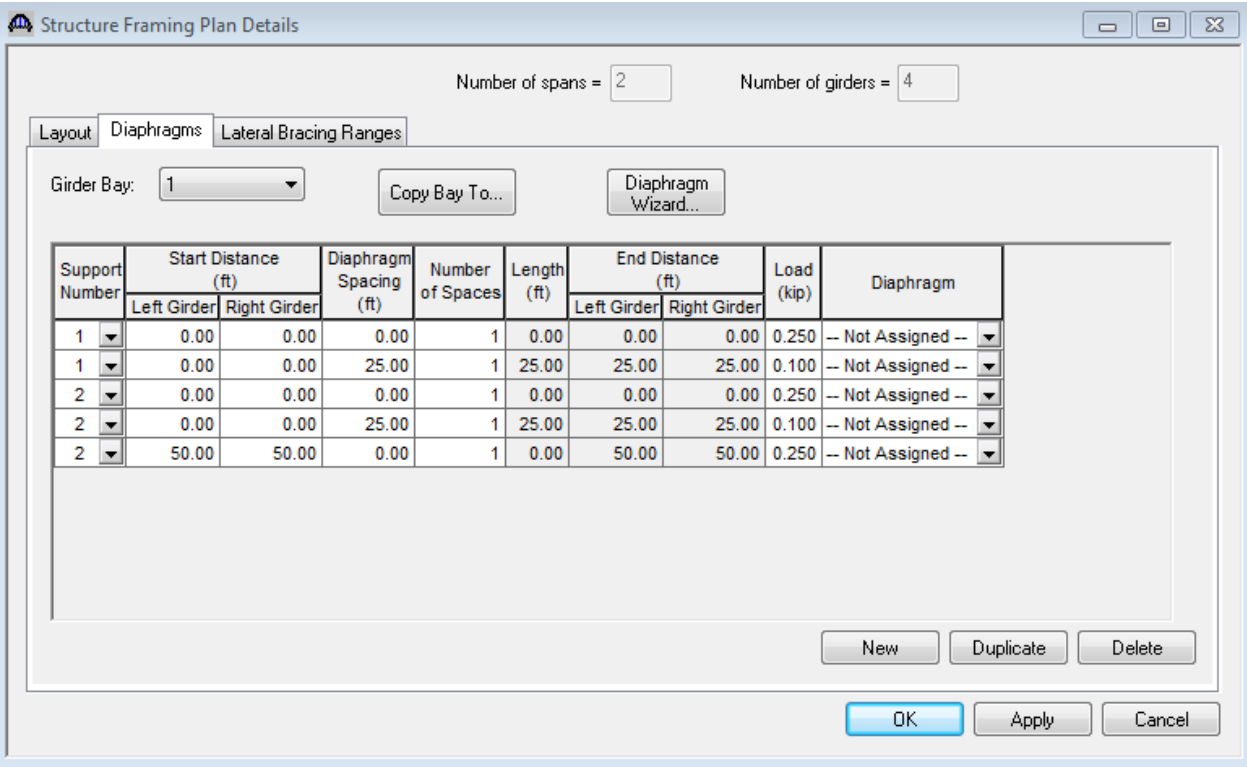


Enter the following data on the dialog shown below.



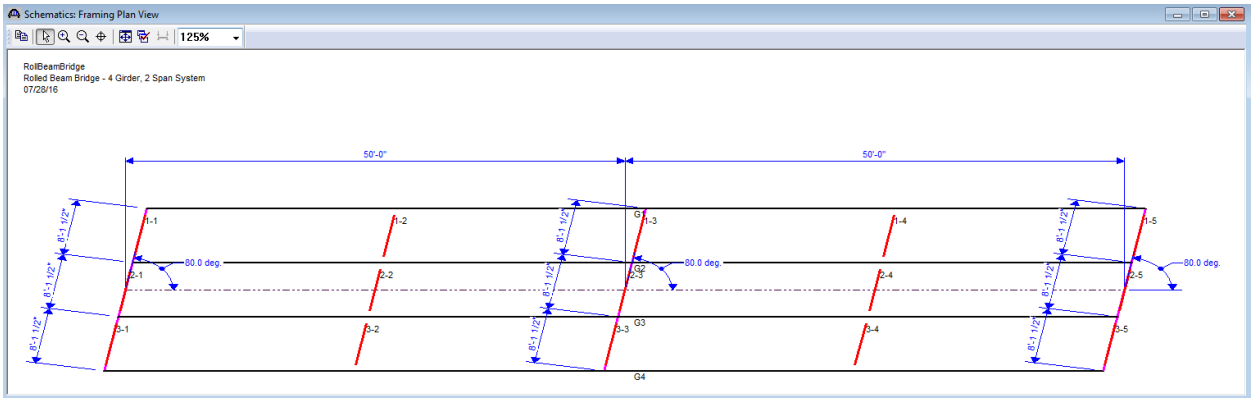
Click the Finish button to add the diaphragms and loads. The Diaphragm Wizard will create diaphragms and loads for all of the girder bays in the structure.

The diaphragms and loads created for Girder Bay 1 are shown below.



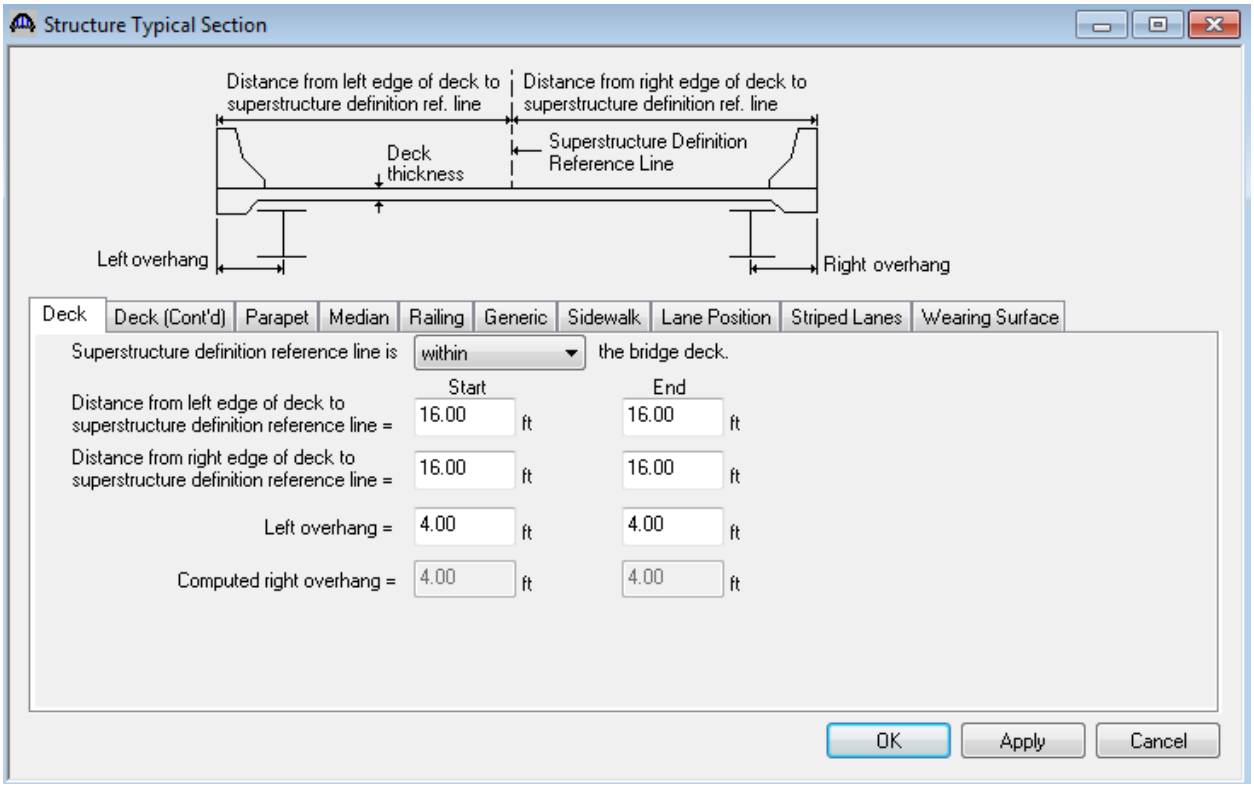
Click Ok to save this data to memory and close the window.

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

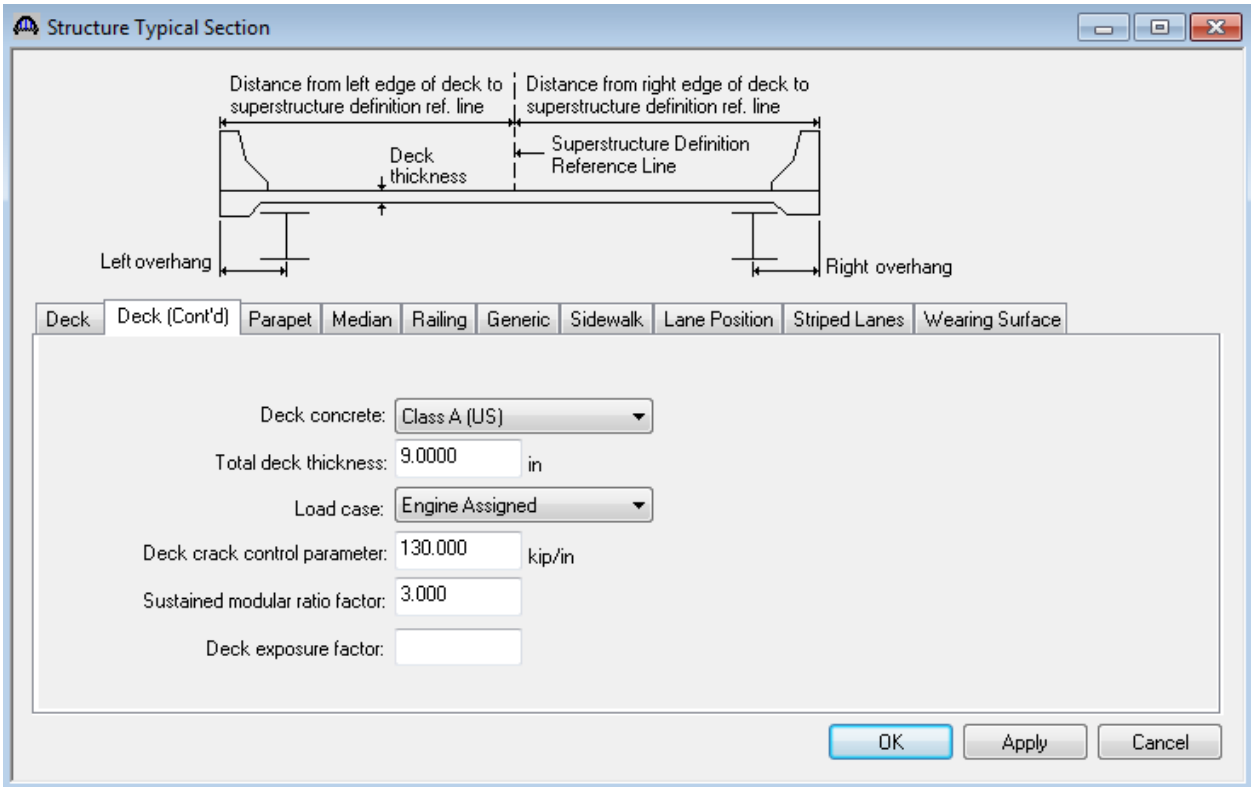


Next define the structure typical section by double-clicking on Structure Typical Section in the Bridge Workspace tree. Input the data describing the typical section as shown below.

Basic deck geometry:

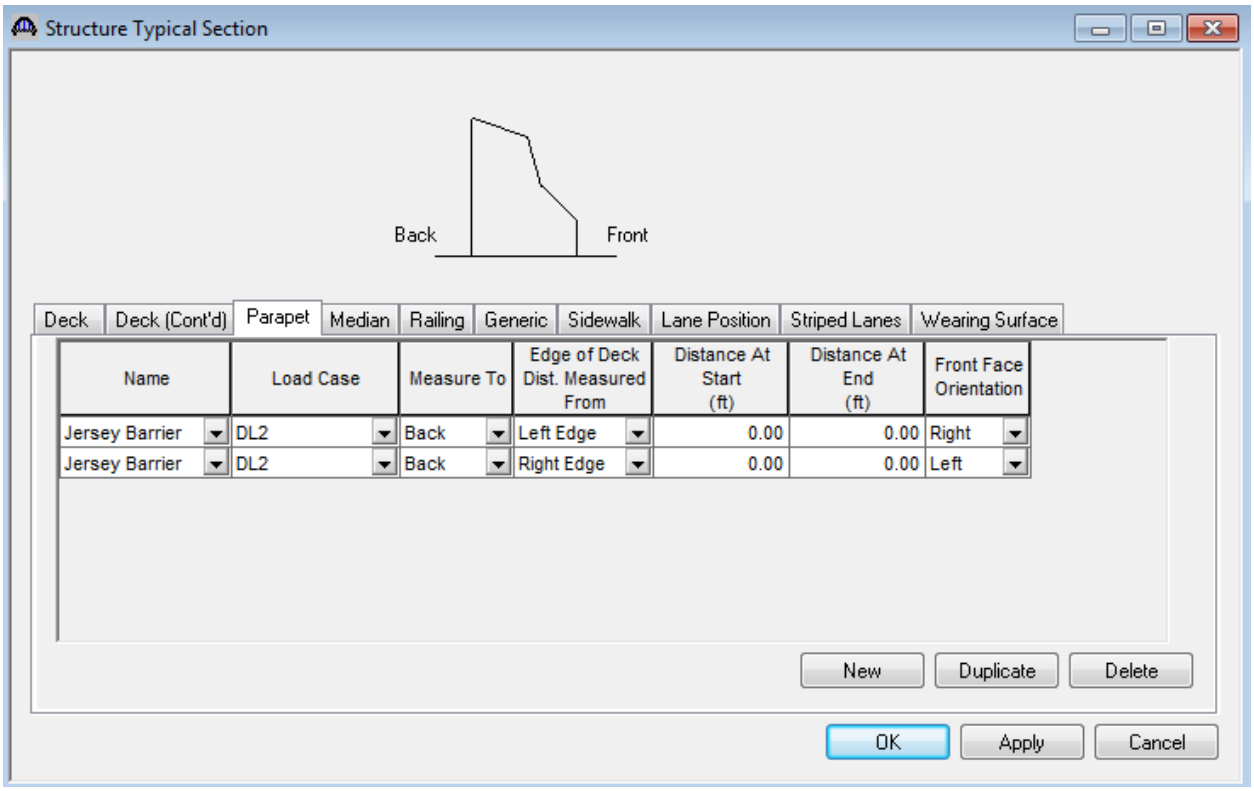


The Deck (cont'd) tab is used to enter information about the deck concrete and thickness. The material to be used for the deck concrete is selected from the list of bridge materials described above.



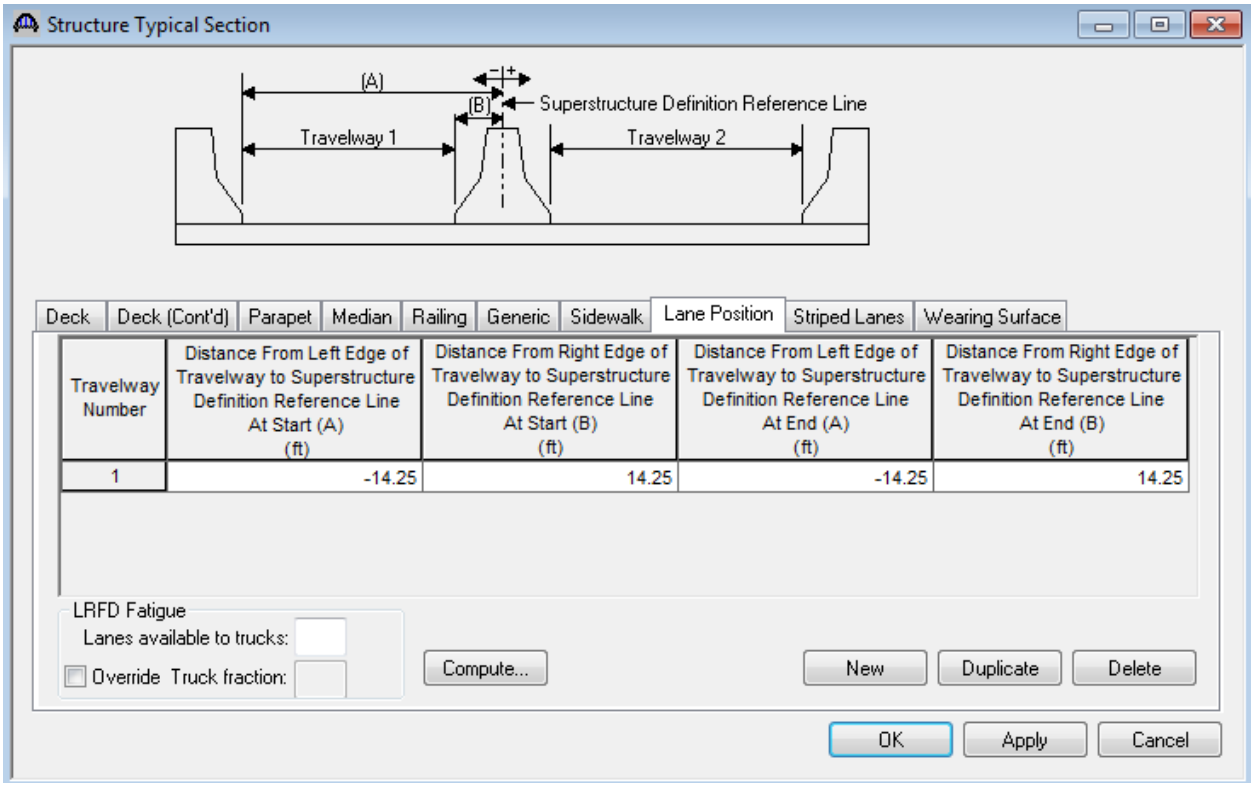
Parapets:

The two parapets are described using the Parapet tab. Click New to add a row to the table. The name of the parapet defaults to the only barrier described for the bridge. Change the "Load Case" to "DL2" and "Measure To" to "Back" (we are locating the parapet on the deck by referencing the back of the parapet to the left edge of the deck). Enter 0.0 for the "Distance at Start" and "Distance at End". Change the "Front Face Orientation" to "Right". The completed tab is shown below.



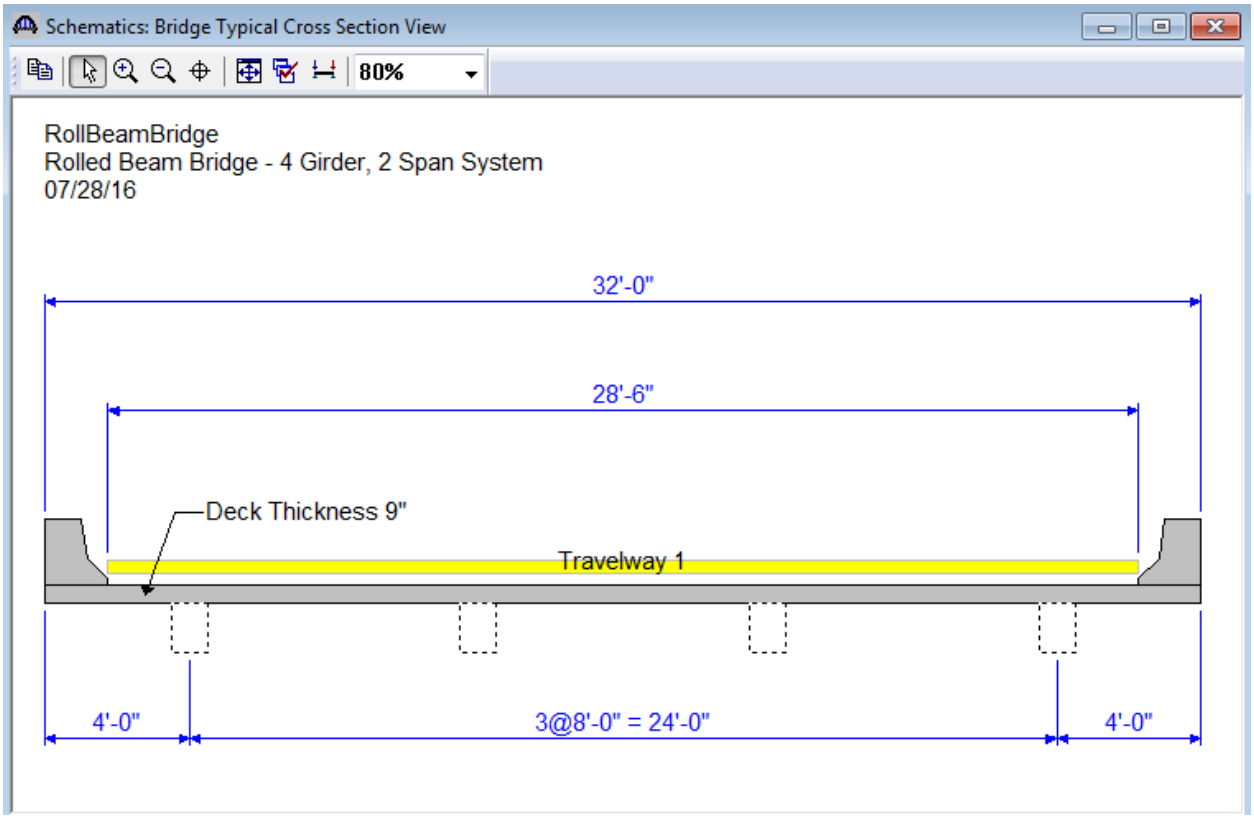
Lane Positions:

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.

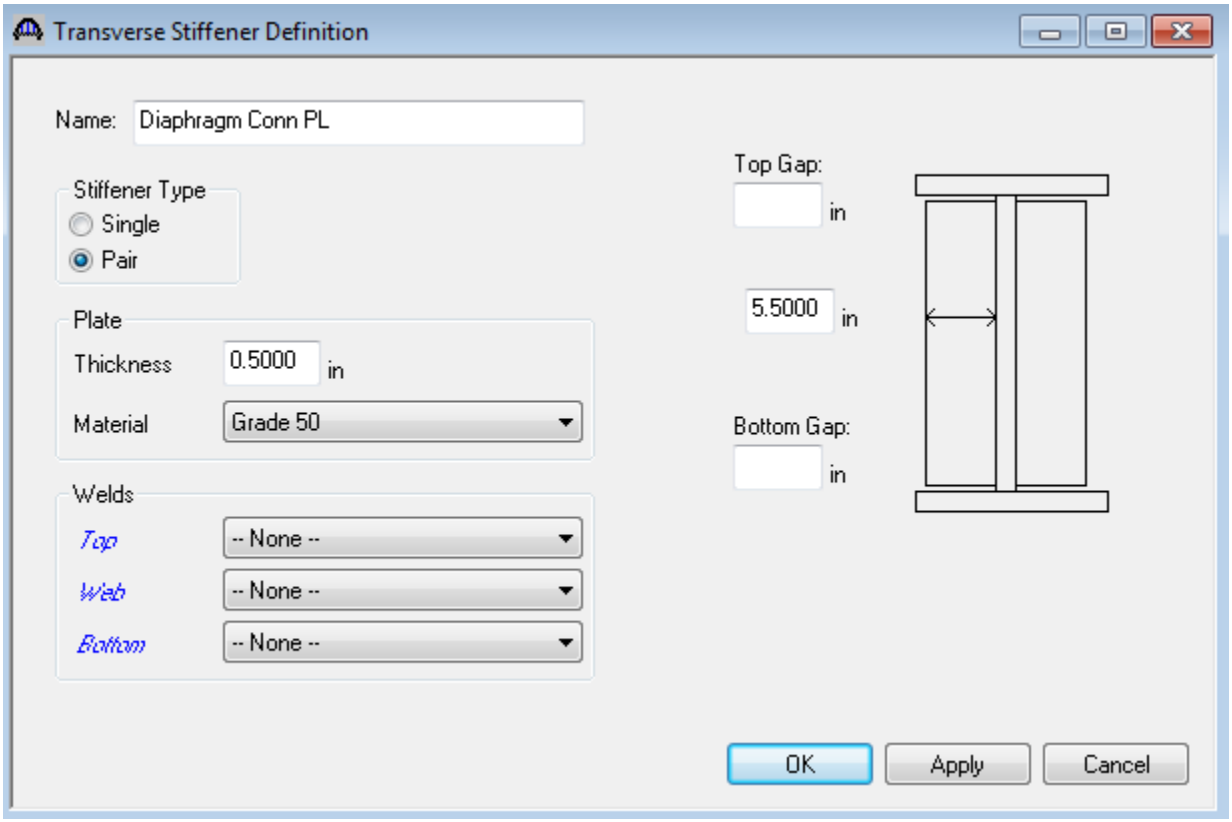


Click Ok to save the data to memory and close the window.

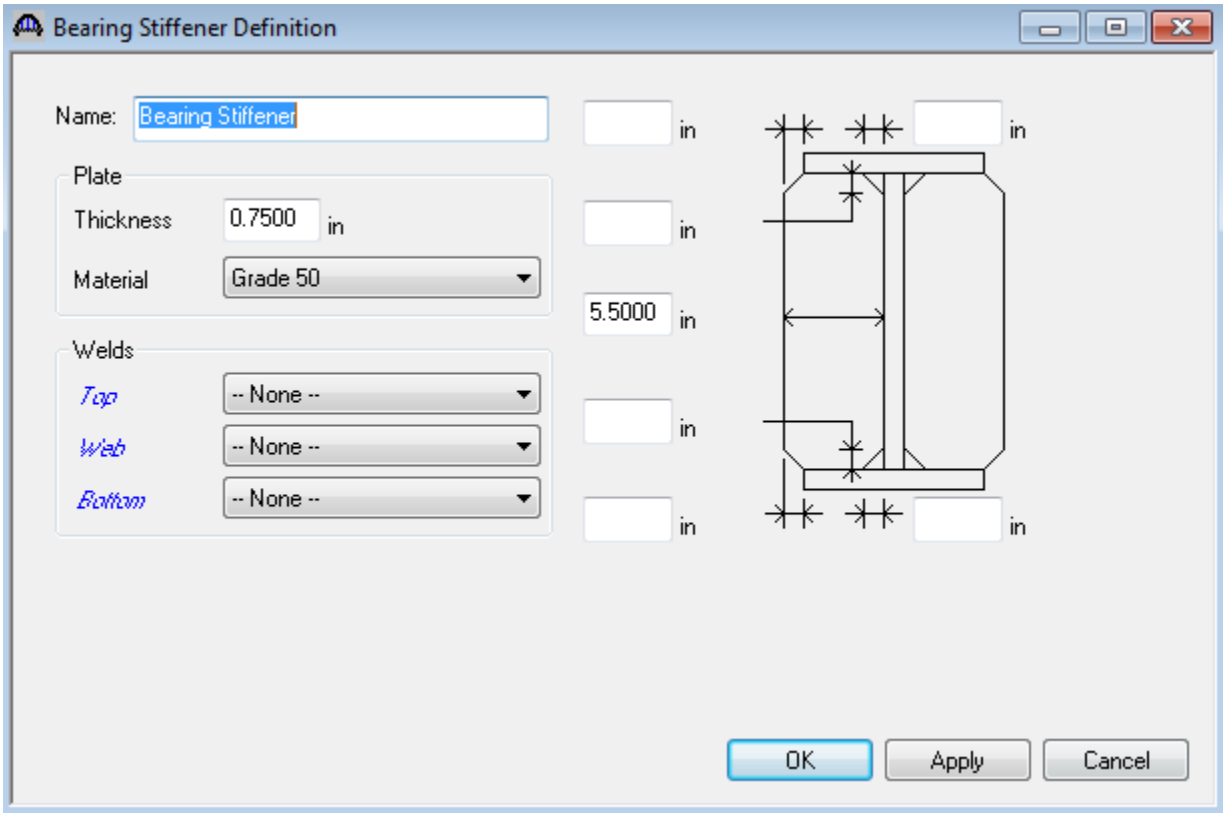
While Structure Typical Section is selected in the BWS tree, open the schematic for the typical section by selecting the View Schematic toolbar button  or Bridge/Schematic from the menu. The following schematic will be displayed. The girders are displayed as dashed boxes since we have not yet defined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



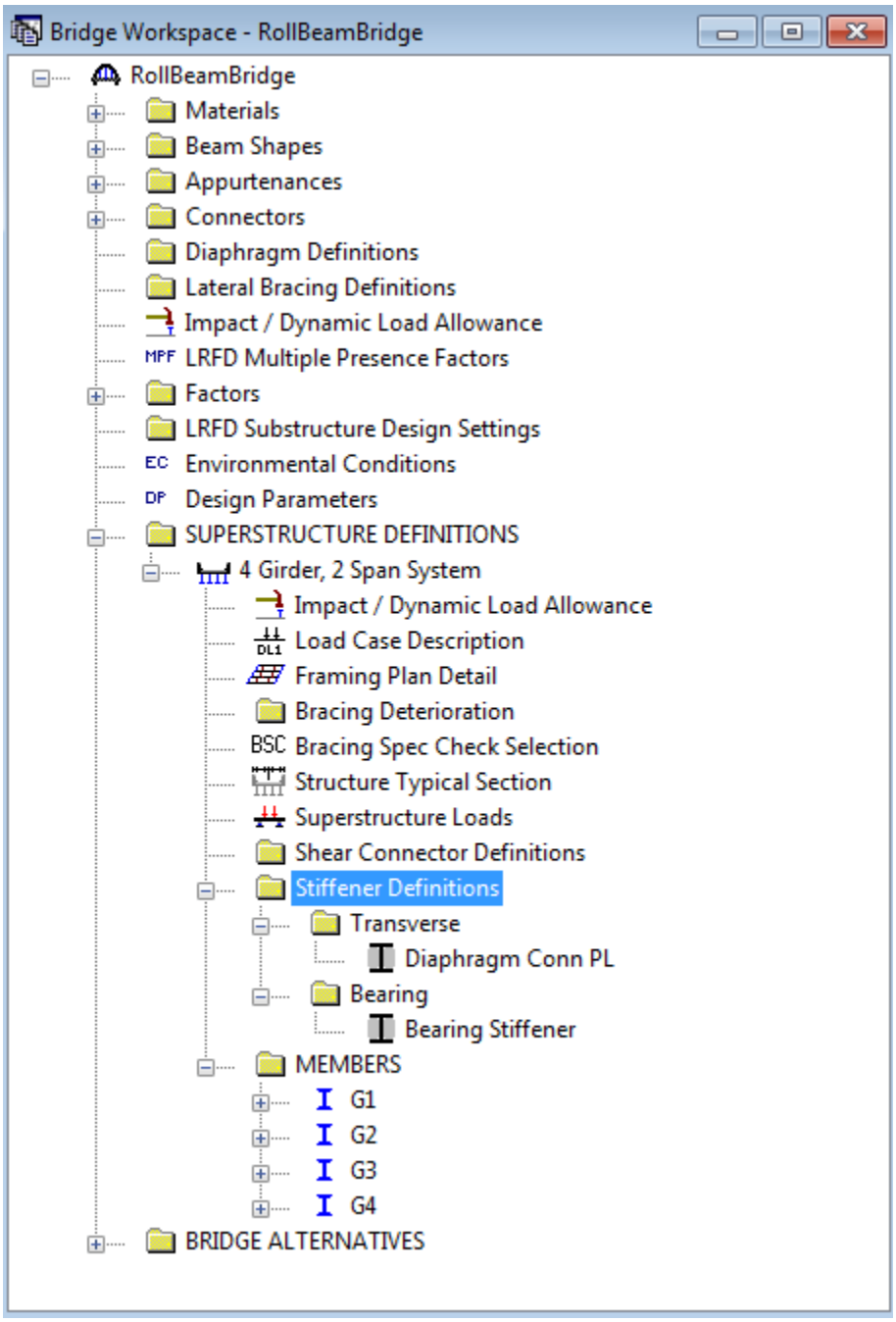
Define stiffeners to be used by the girders. Expand the Stiffener Definitions tree item and double click on Transverse. Select the stiffener type as Plate and click Ok. Define the stiffener as shown below. Click Ok to save to memory and close the window.



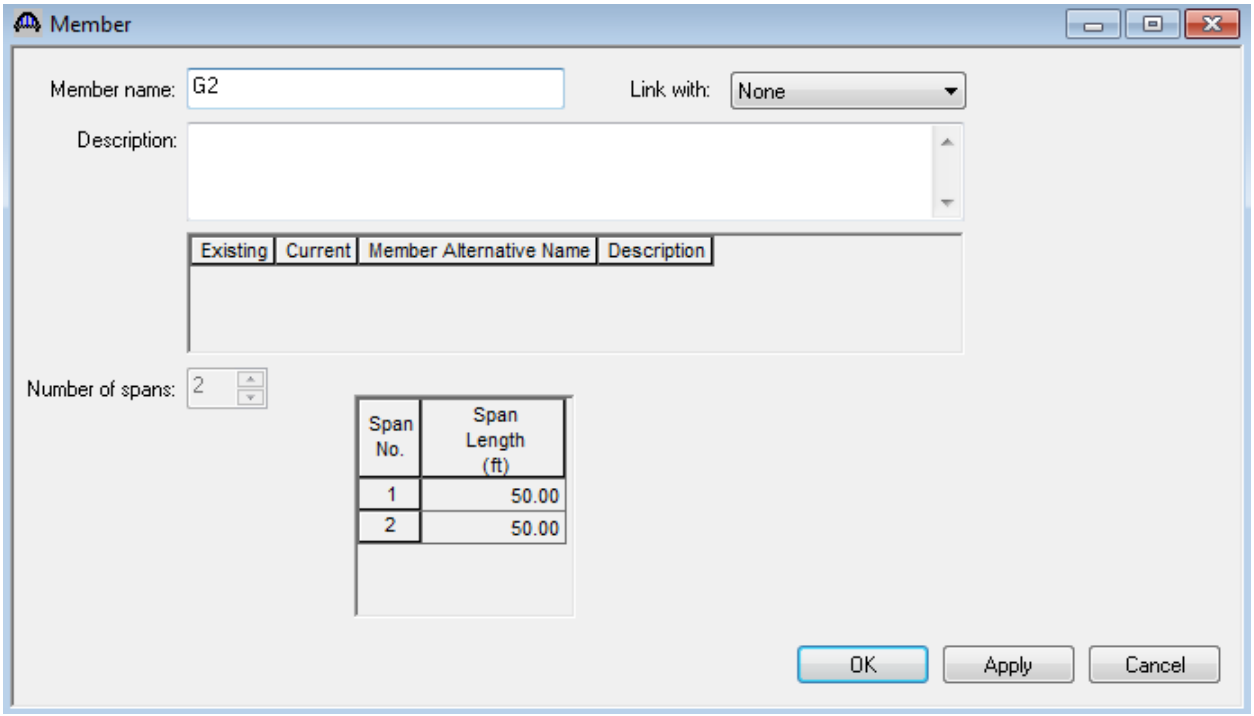
Now define the bearing stiffeners by double clicking on Bearing (under Stiffener Definitions in the tree). Select the type of stiffener as plate and click Ok. Define the stiffener as shown below. Click Ok to save to memory and close the window.



The partially expanded BWS tree is shown below:

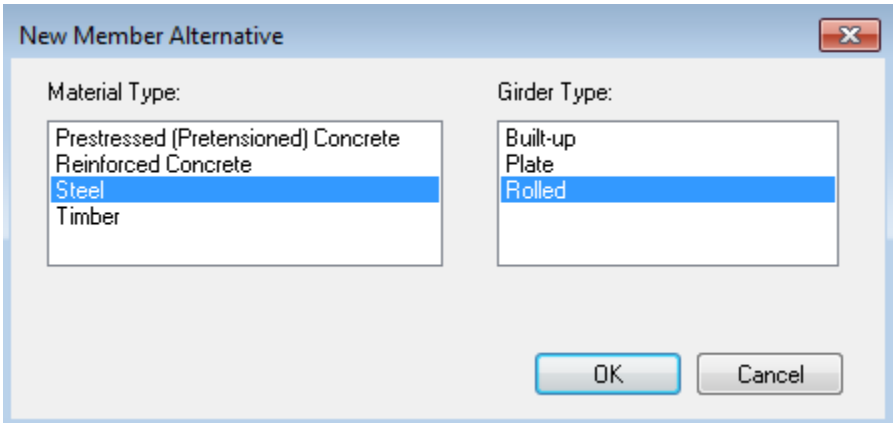


Open the window for member G2 by double clicking on “G2” in the BWS tree. The member window shows the data that was generated when the structure definition was created. No changes are required at this time. The first Member Alternative that we create will automatically be assigned as the Existing and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



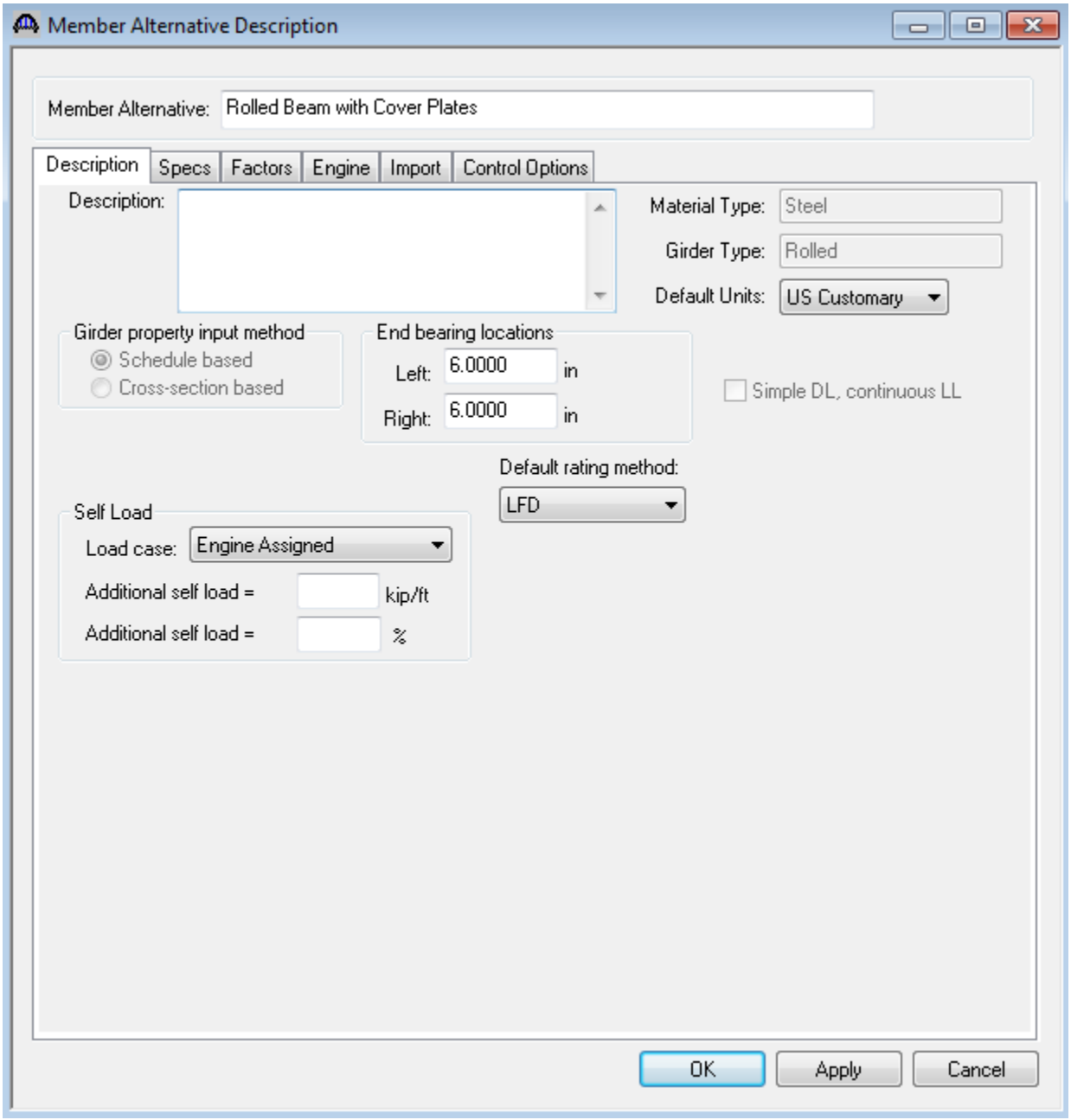
Defining a Member Alternative:

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.

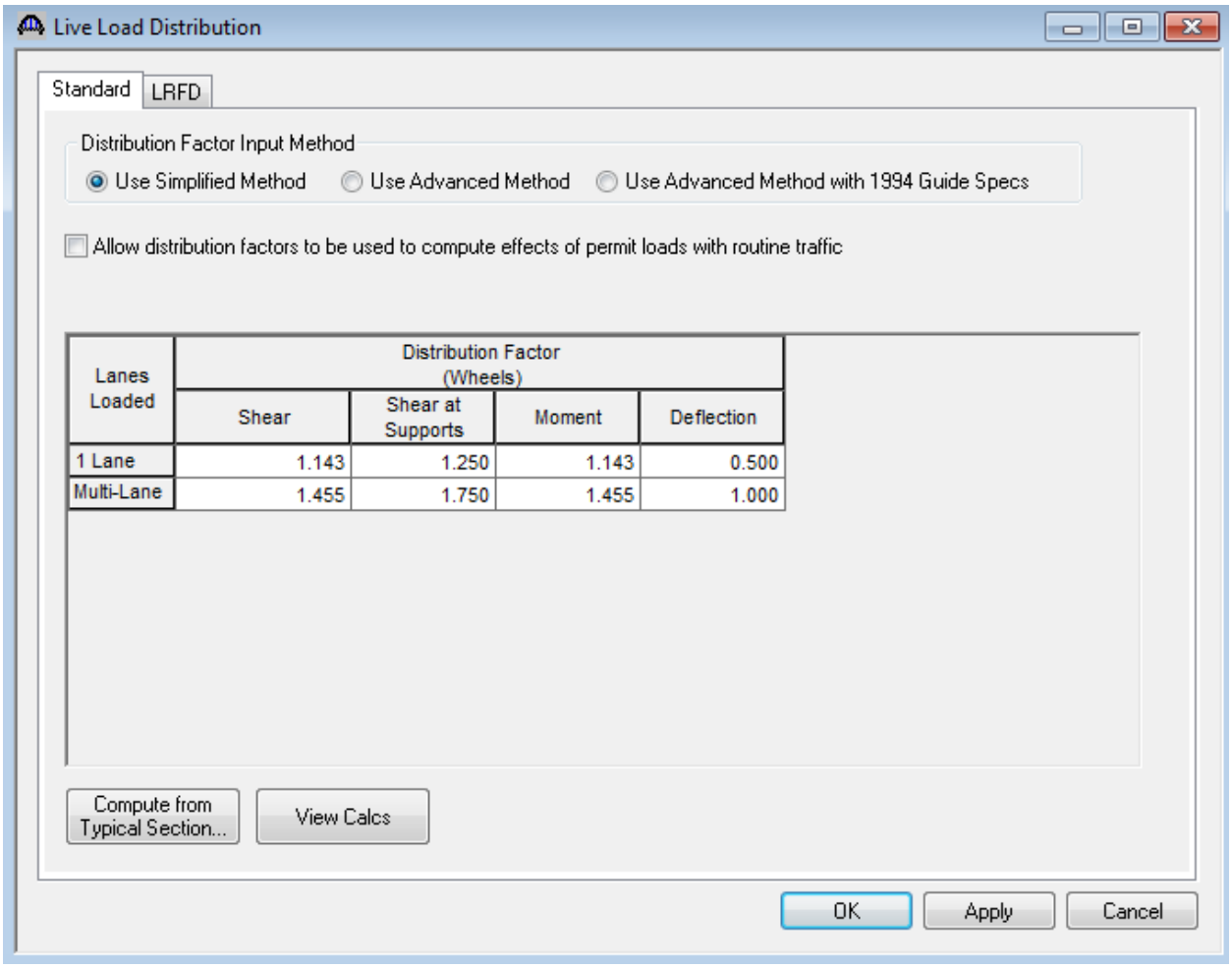
The Member Alternative Description window will open. Enter the appropriate data as shown below. Select Schedule-based Girder property input method.



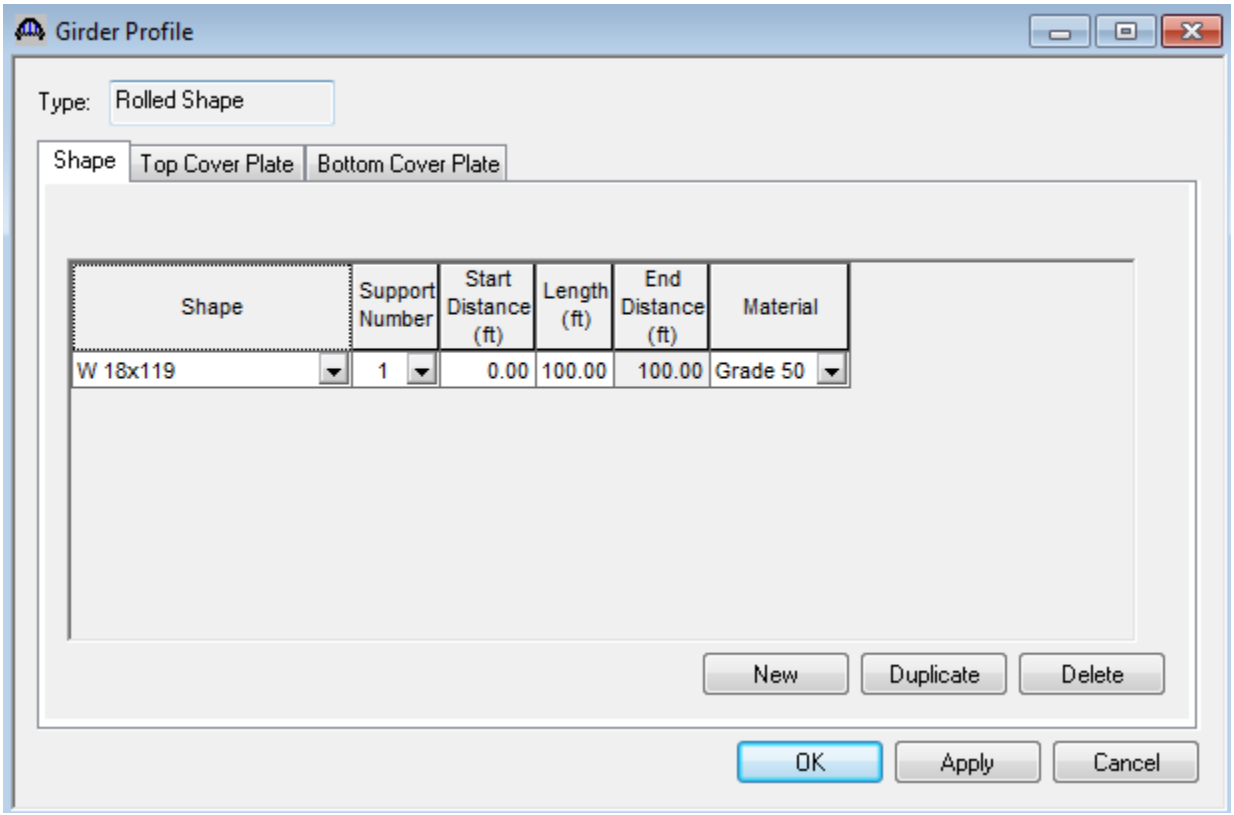
Distribution Factors (Standard):

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

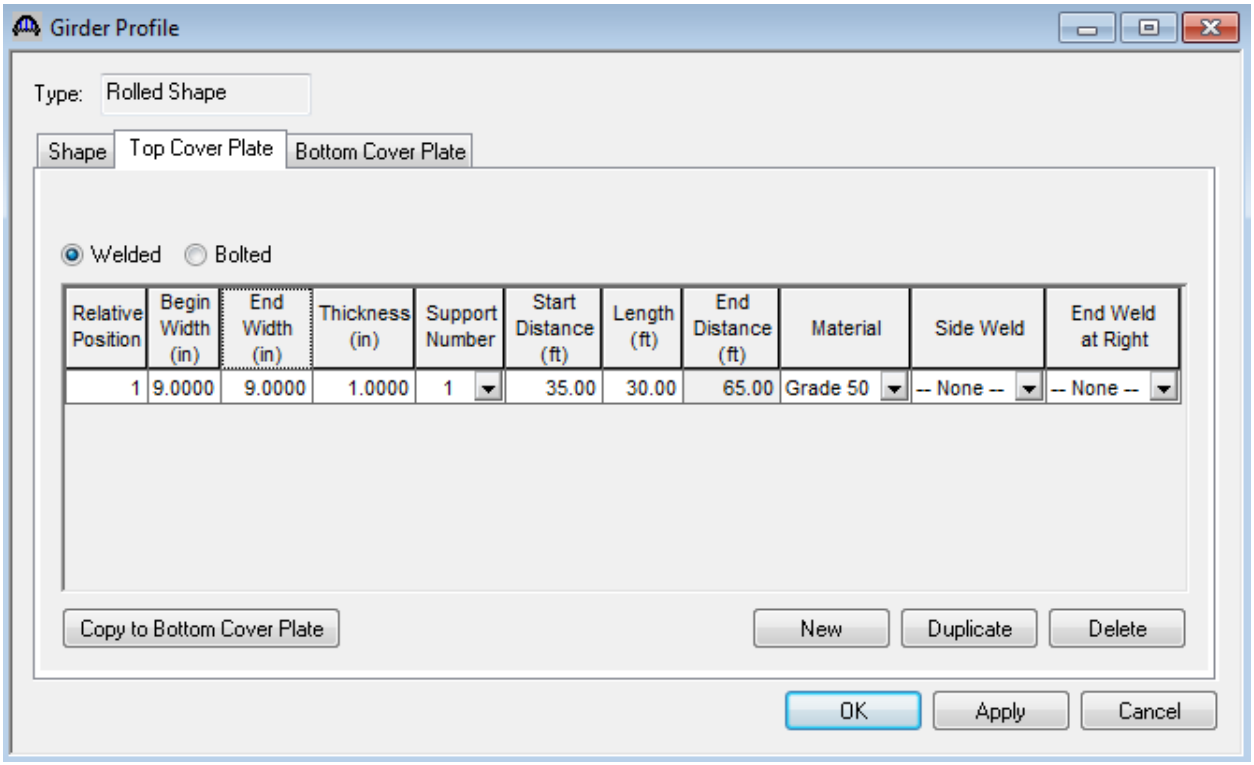
Distribution factor calculation details can be viewed by clicking View Calcs button.



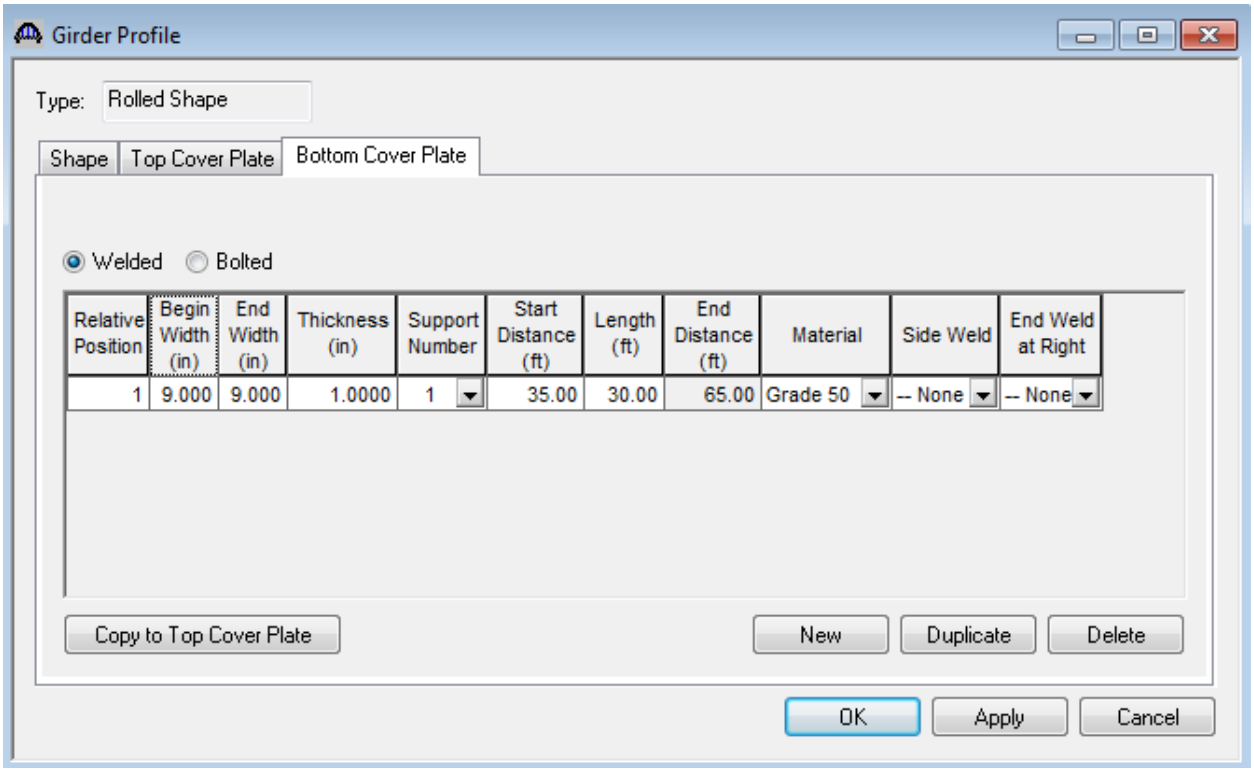
Next describe the girder profile by double clicking on Girder Profile in the tree. The window is shown below with the data describing the rolled shape.



Describe the cover plates as shown below.

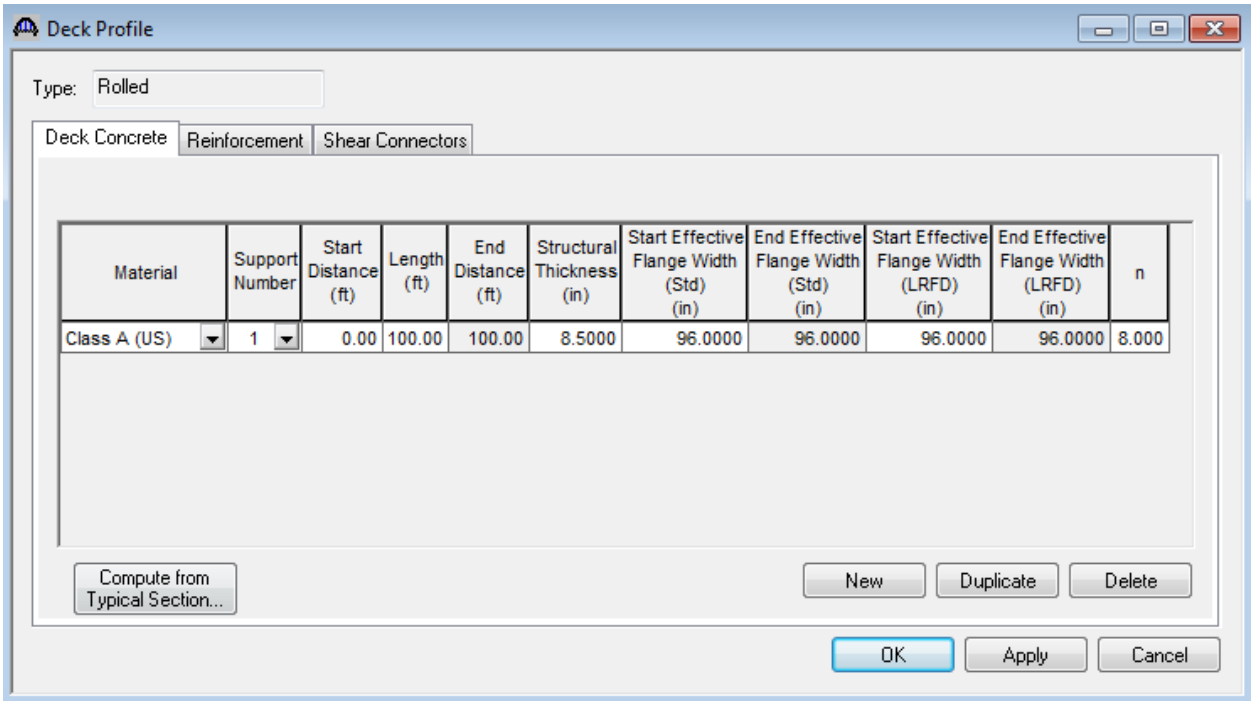


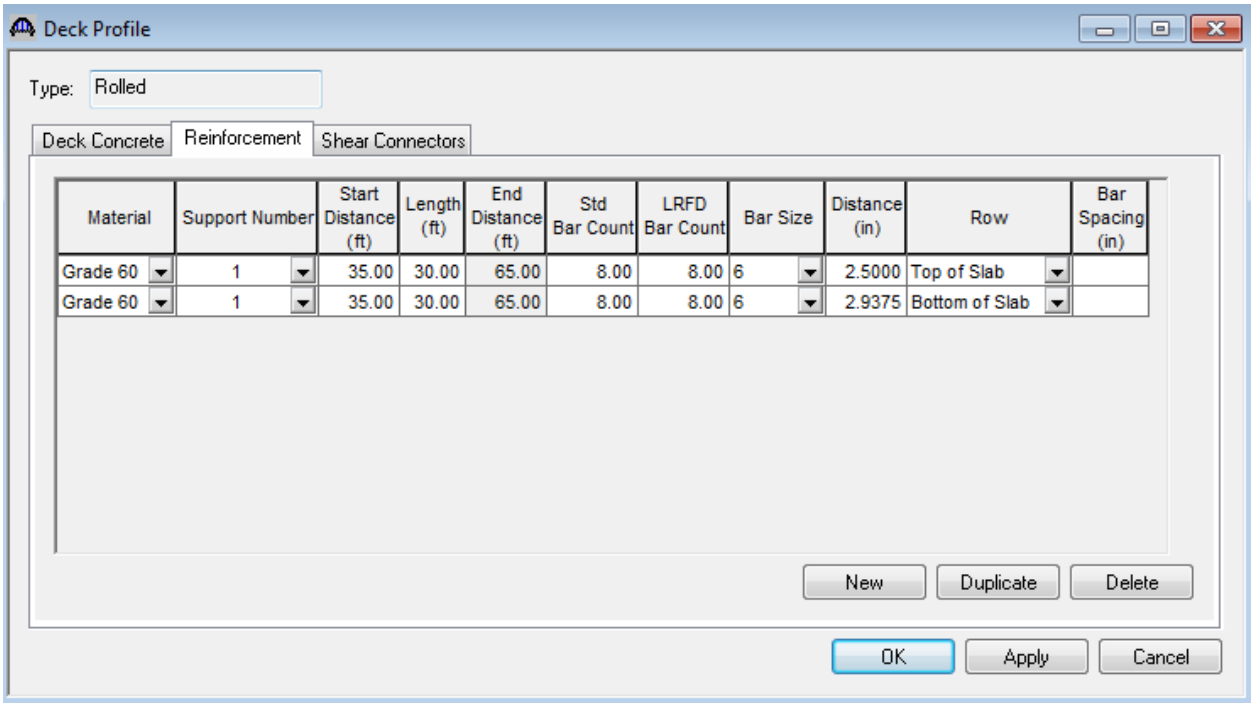
Click Copy to Bottom Cover Plate button, Bottom Cover Plate tab will look as below.



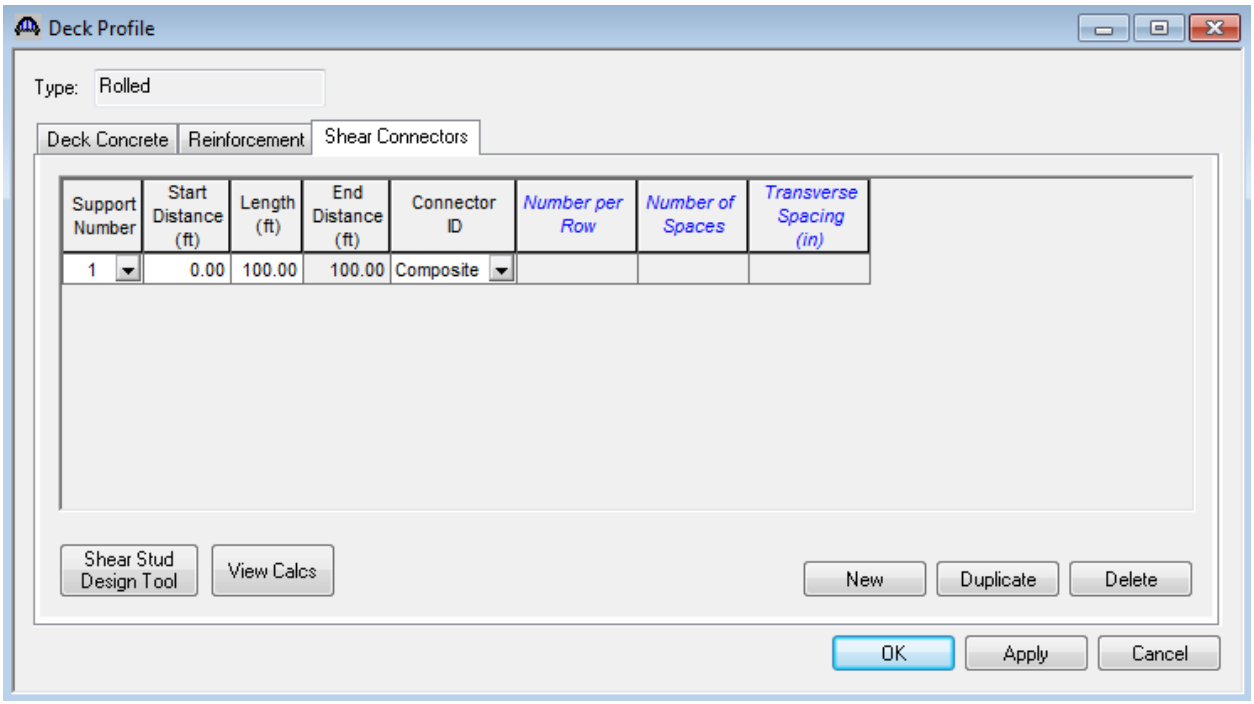
Click Ok to save to the memory and close the window.

Next open the Deck Profile and enter the data describing the structural properties of the deck. The deck concrete and reinforcement windows are shown below.

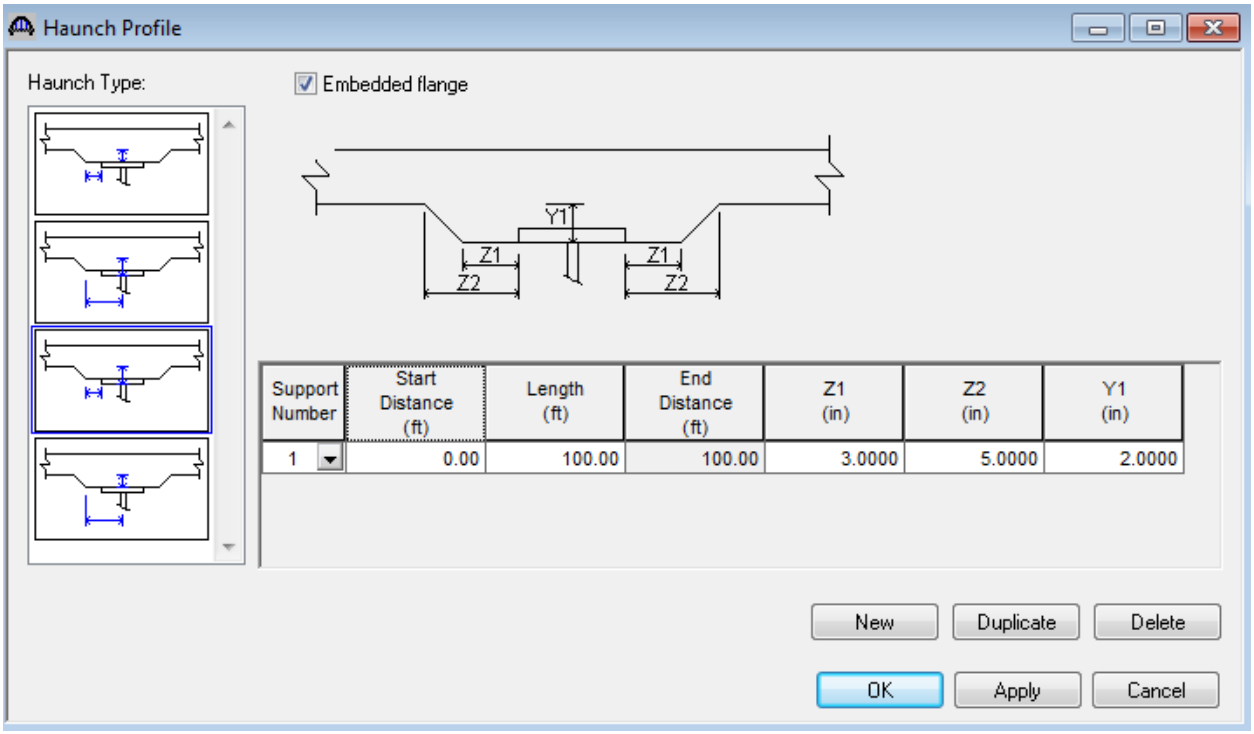




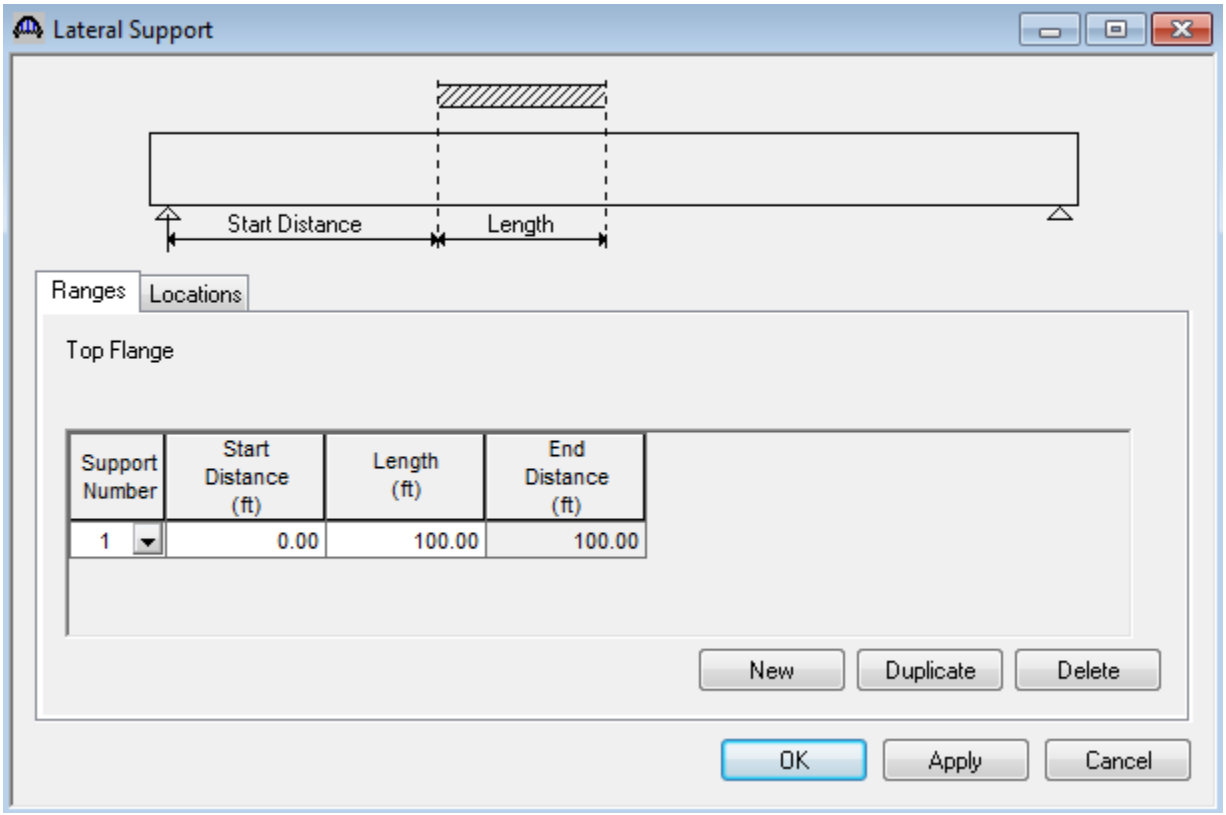
Composite regions are described using the Shear Connectors tab as shown below.



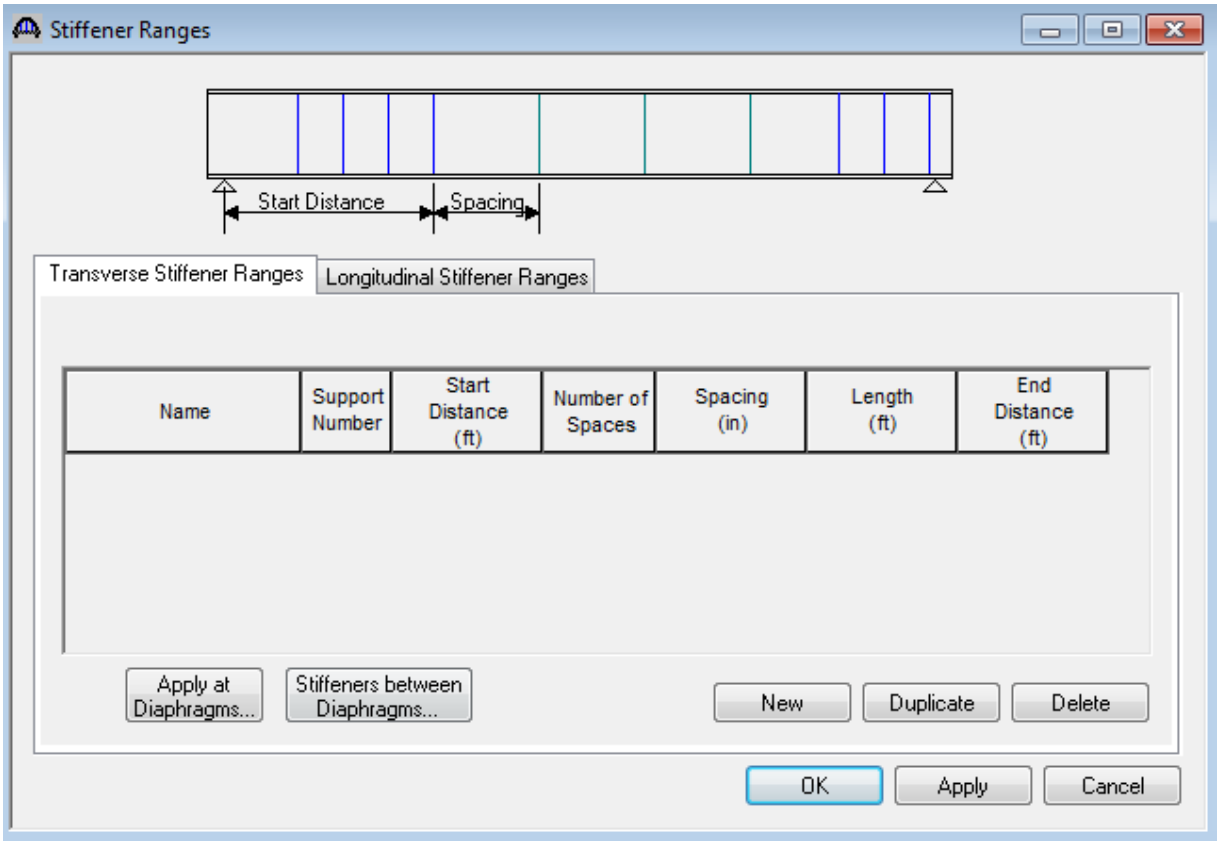
The haunch profile is defined by double clicking on Haunch Profile in the tree. The window is shown below.



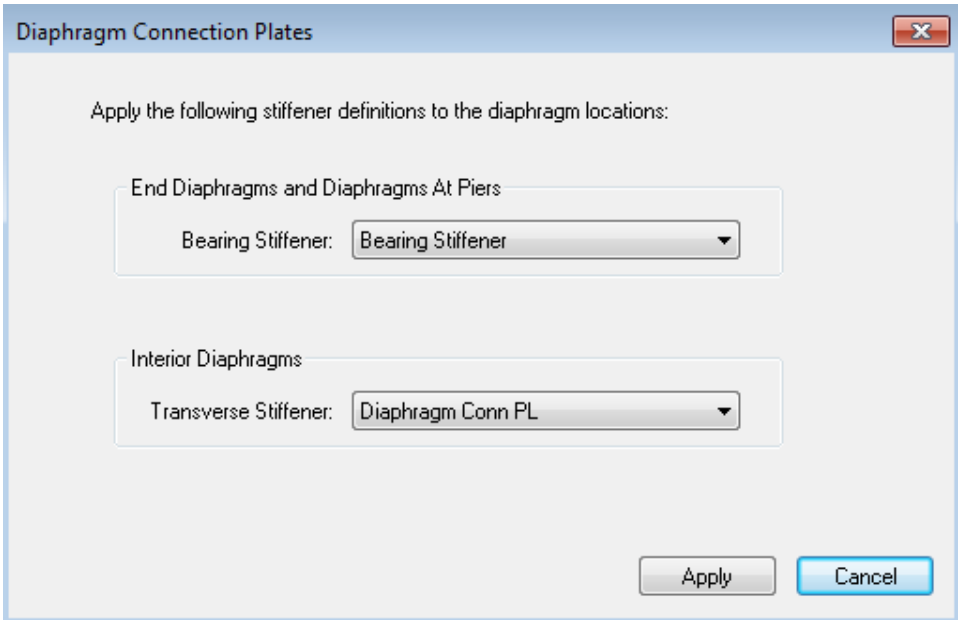
Regions where the slab is considered to provide lateral support for the top flange are defined using the Lateral Support window shown below. It can be opened by double clicking on Lateral Support in the tree.



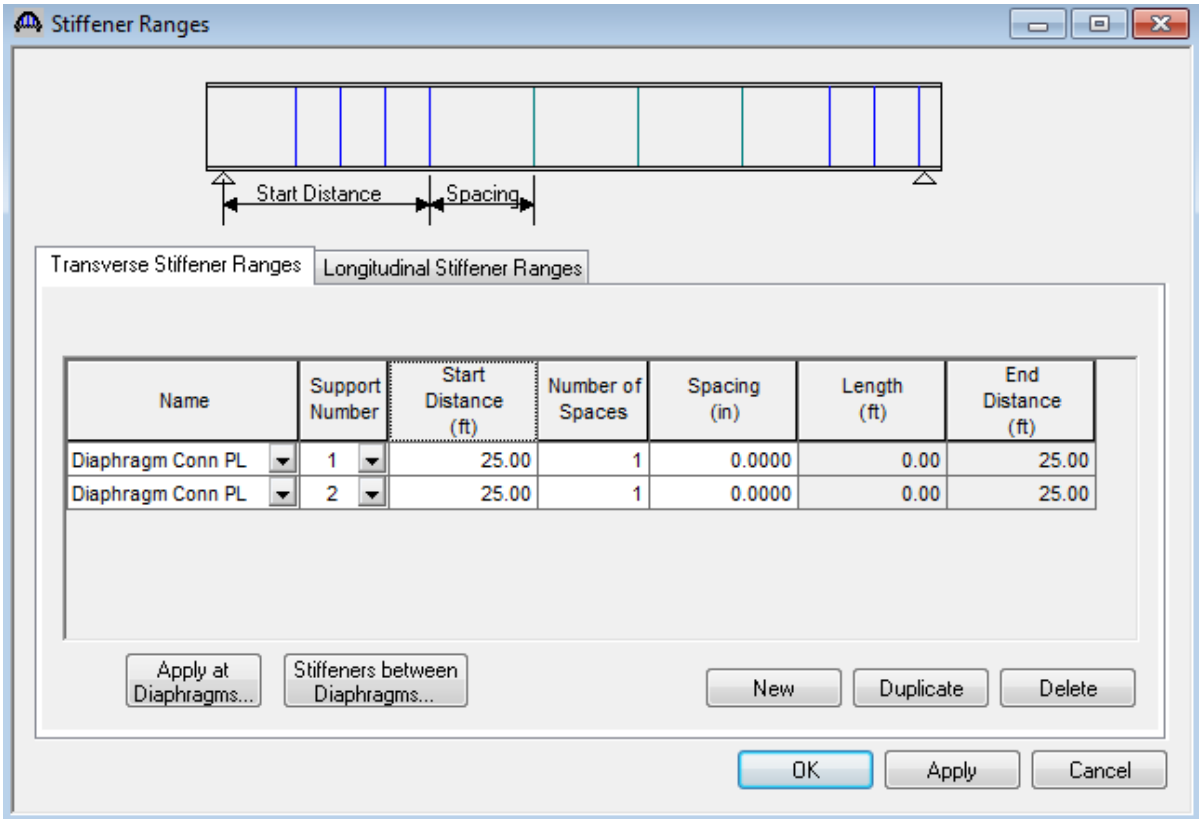
Stiffener locations are described using the Stiffener Ranges window shown below.



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

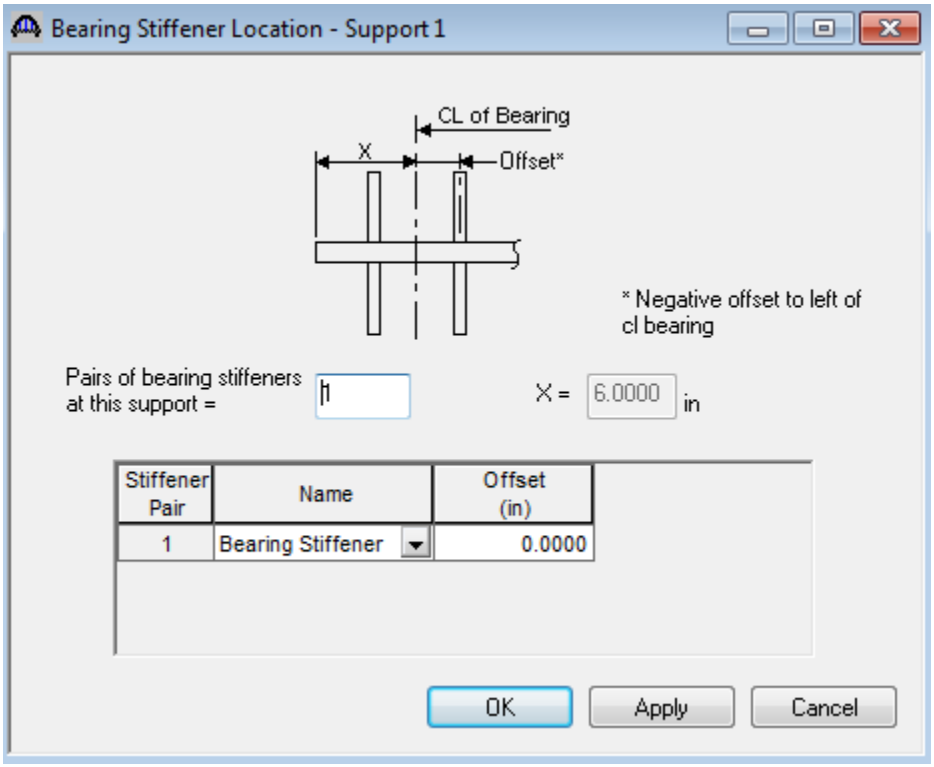


Selecting Apply will create the following transverse stiffener locations.



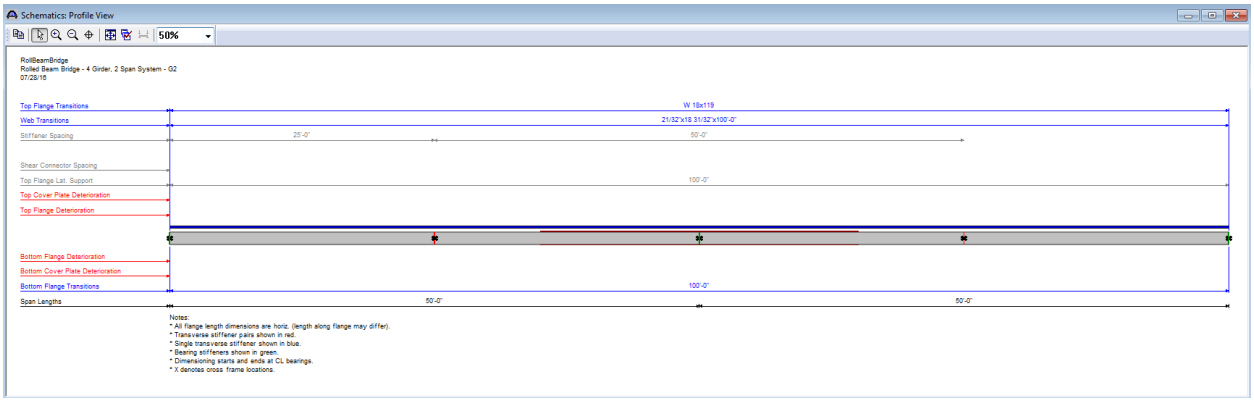
This example does not have any intermediate transverse stiffeners so we can click Ok to close this window

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.

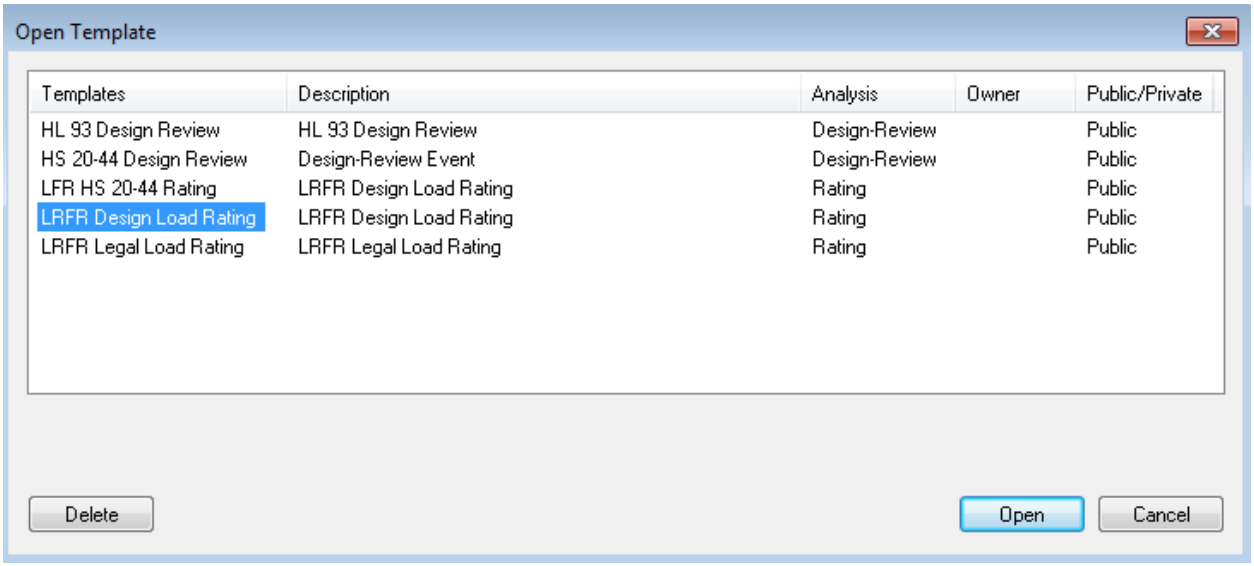


The description of an interior beam for a structure definition is complete.

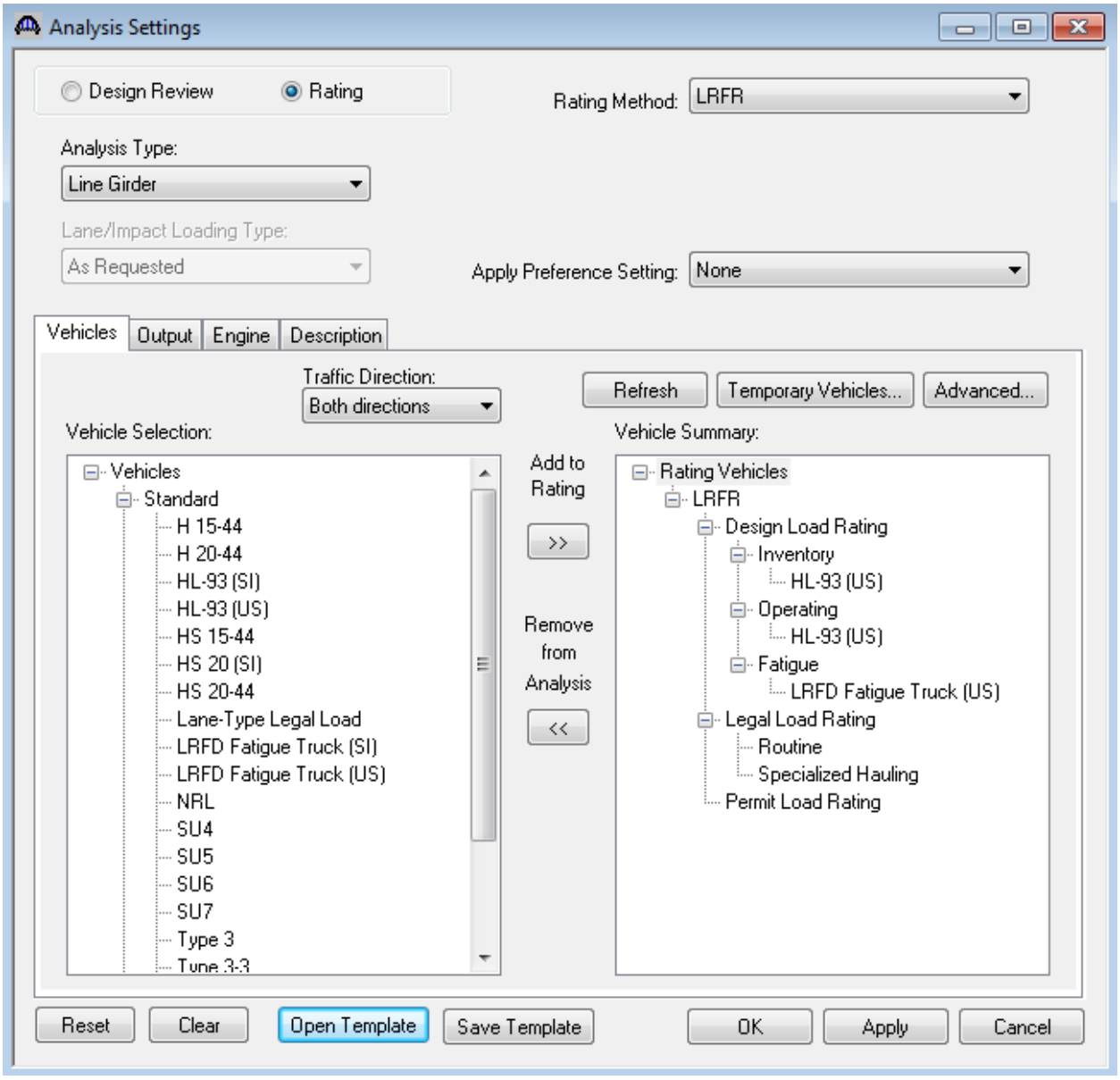
While “Rolled Beam with Cover Plates” is selected in the BWS tree, open the schematic for the girder profile by selecting the View Schematic toolbar button  or Bridge/Schematic from the menu. The following schematic will be displayed.



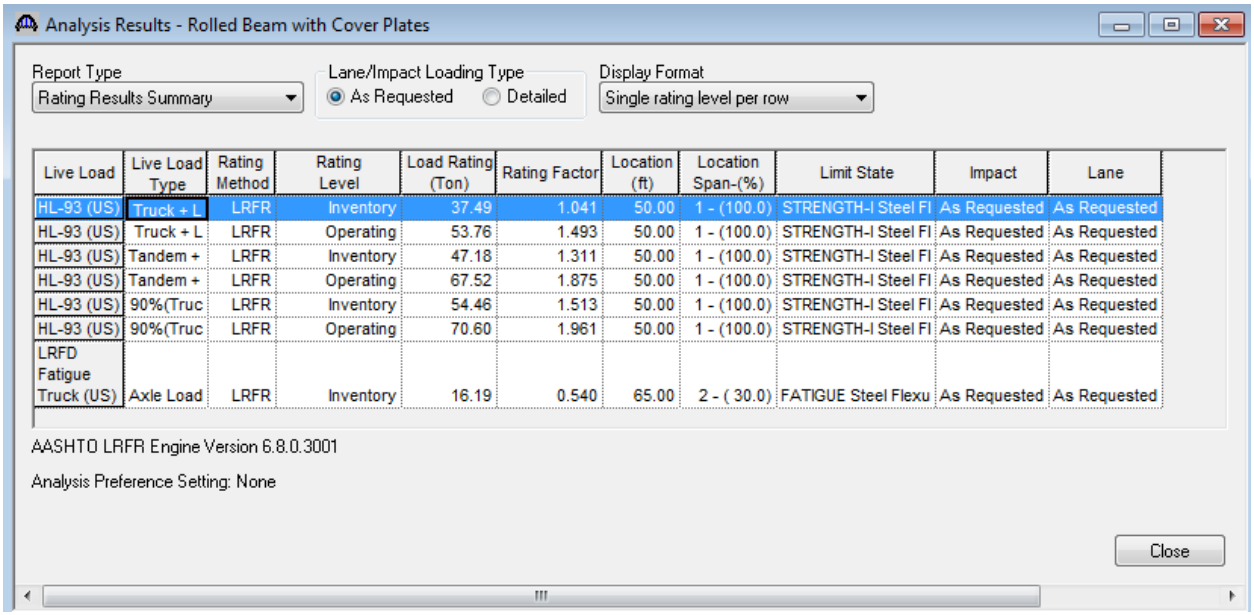
To perform AASHTO LRFR rating, select the name of the “Rolled Beam with Cover Plates” member alternative in the tree. Click the View Analysis Settings button on the toolbar. The Analysis Settings window will open. Select the “Open Template” button to open the following window. Select the LRFR Design Load rating template and click the Open button.



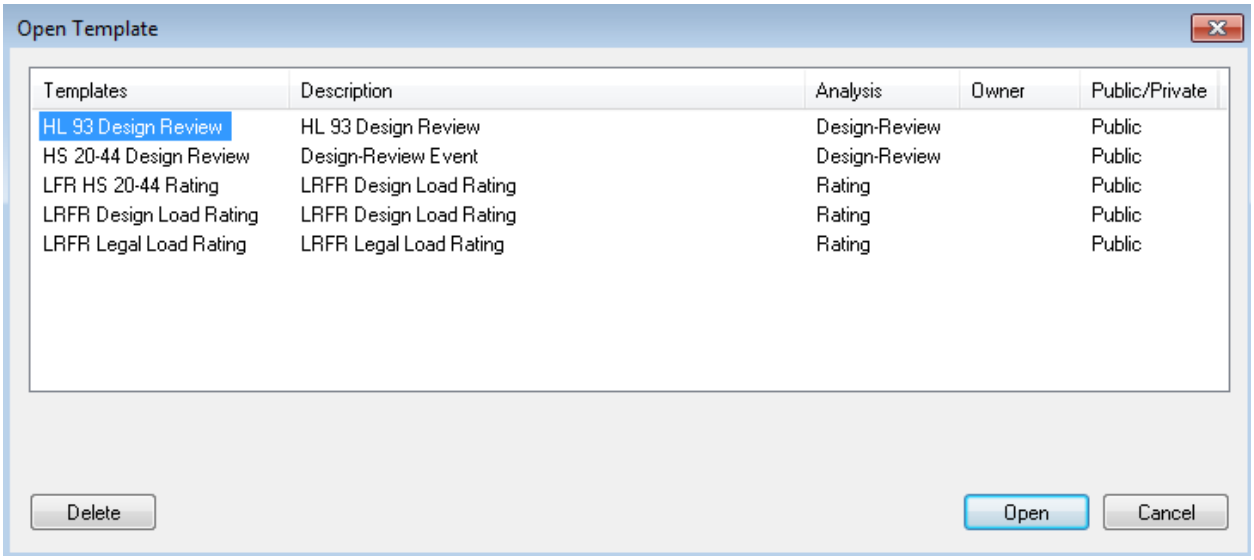
The Analysis Settings window with the selected vehicles is shown below. Click Ok to close the window.



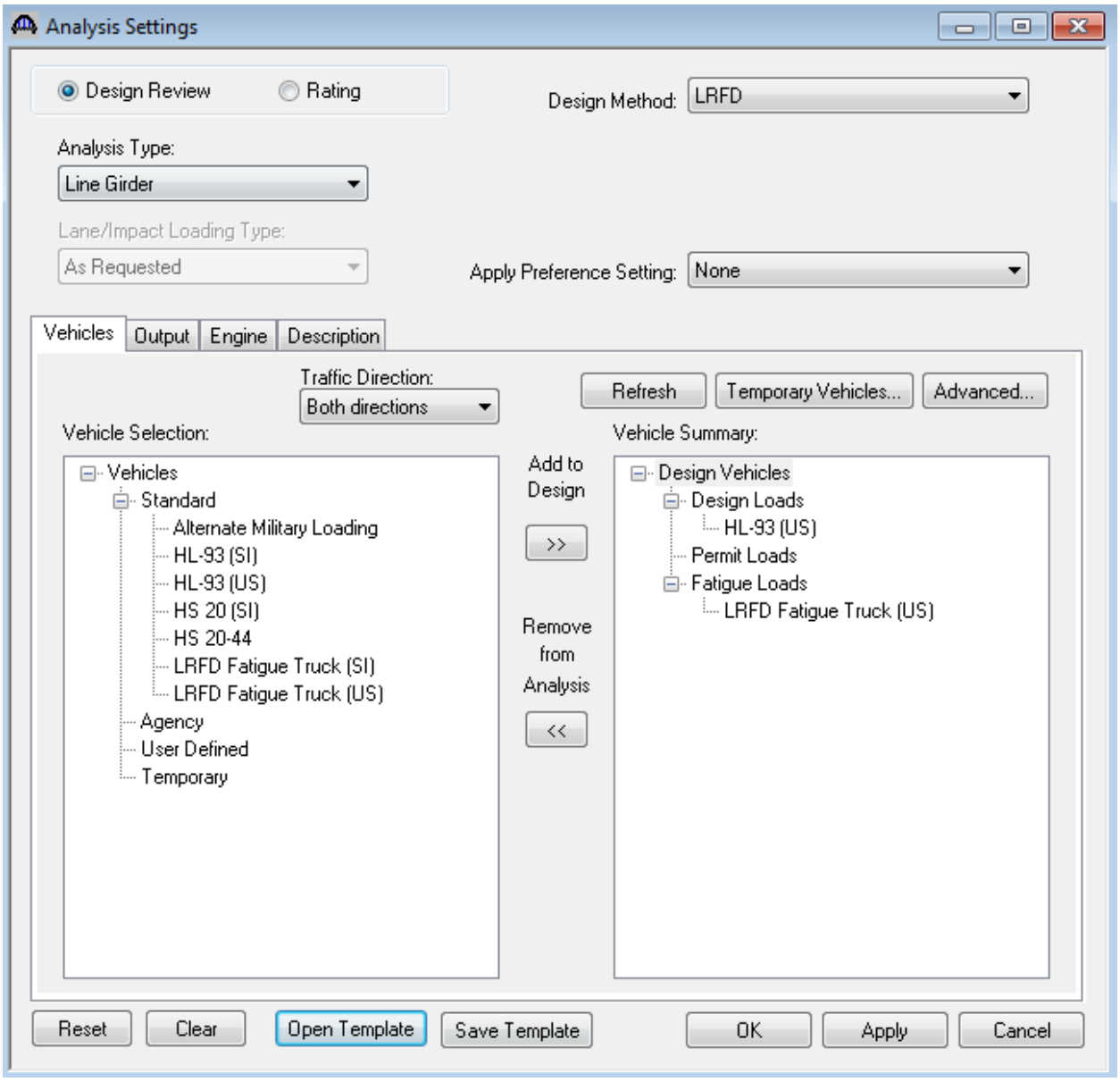
Next click the Analyze button on the toolbar to perform the rating. When the rating is finished you can review the results by clicking the View Analysis Report button on the toolbar. The window shown below will open.



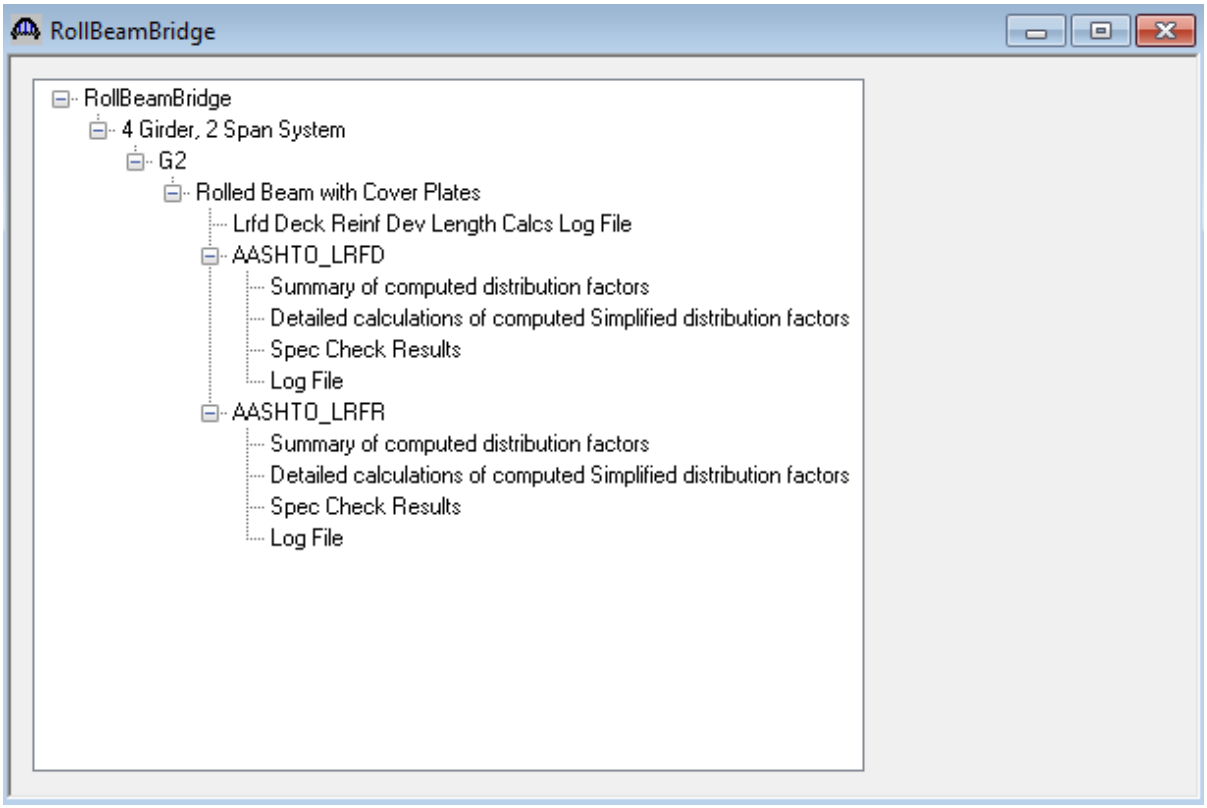
To perform AASHTO LRFD analysis, select the name of the “Rolled Beam with Cover Plates” member alternative in the tree. Click the View Analysis Settings button on the toolbar. The Analysis Settings window will open. Select the “Open Template” button to open the following window. Select the HL 93 Design Reveiw 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 analysis is finished you can review the results by clicking the  button on the toolbar. The window shown below will open.



You can view spec check results by double clicking spec check results. Spec check results window will open as below.