

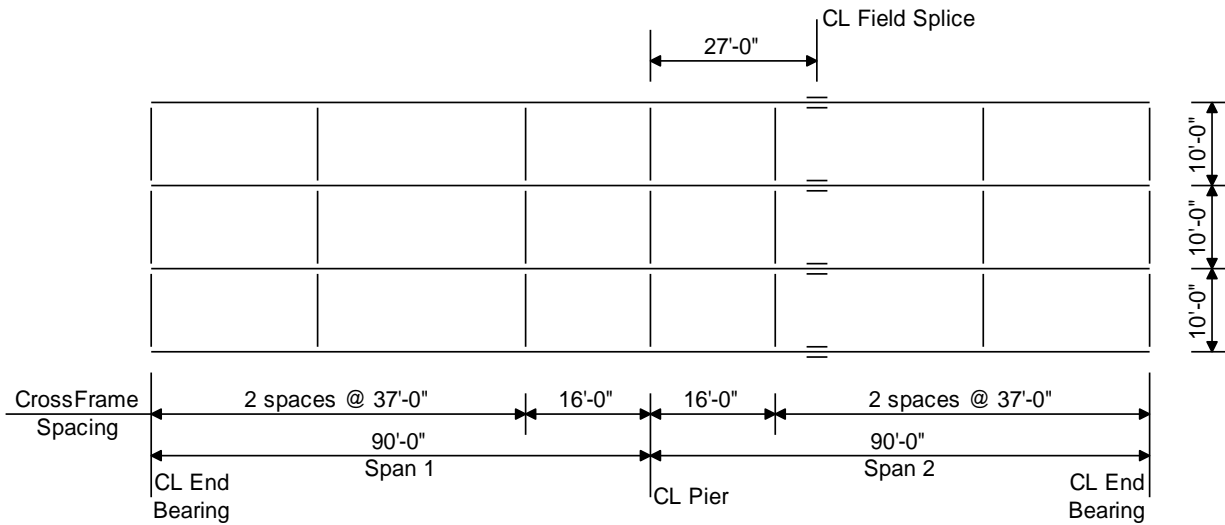
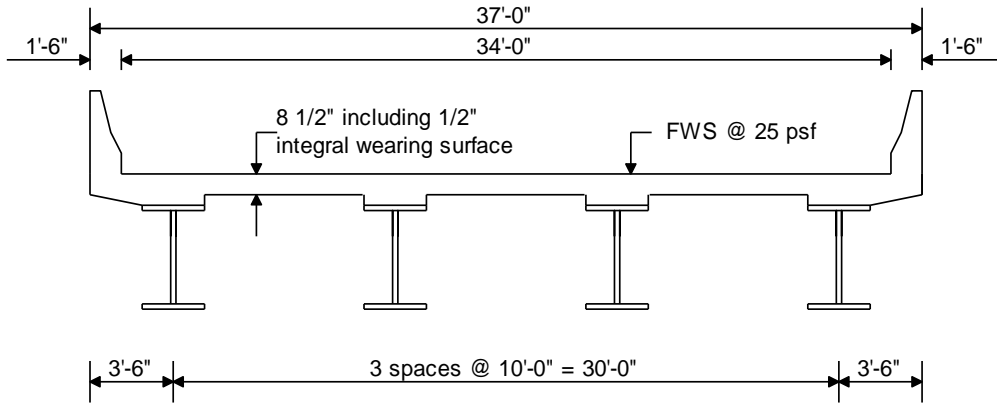
*AASHTOWare BrD/BrR 6.8*

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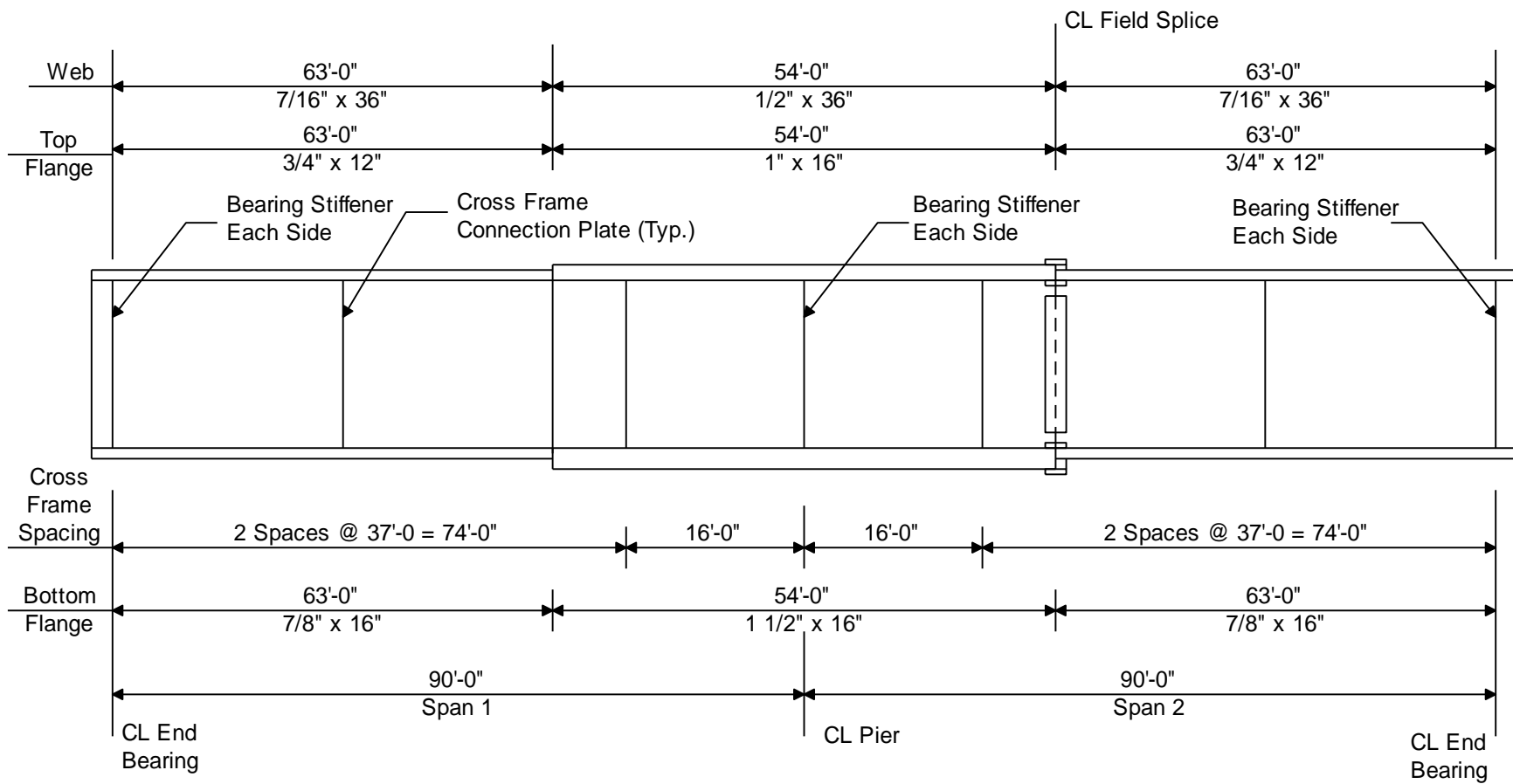
*Steel Structure Tutorial*

*STL2 - Two Span Plate Girder Example*

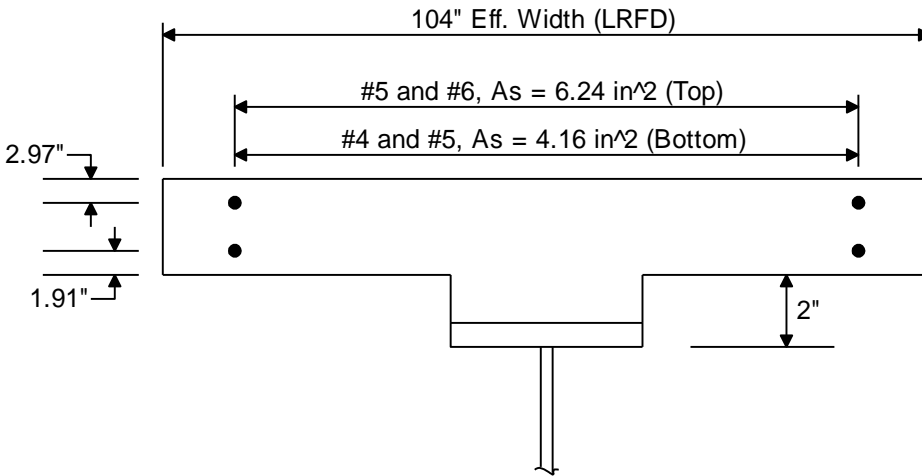
## STL2 - Two Span Plate Girder Example



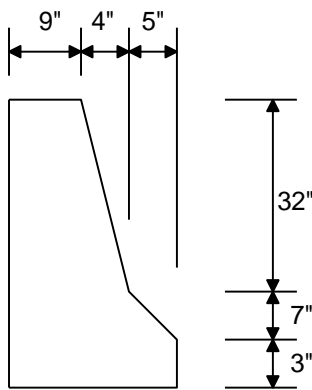
**Framing Plan**



**Elevation of Interior Girder**

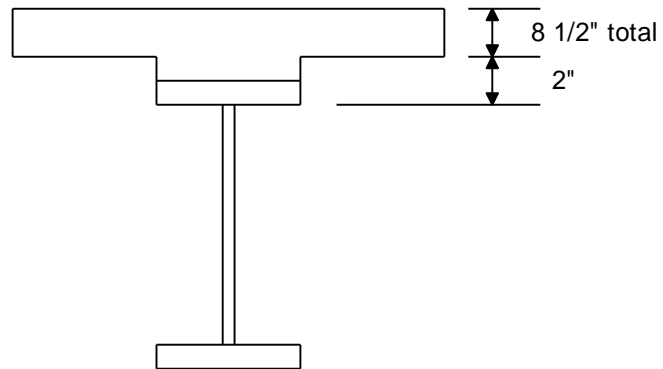


**Composite Section at Pier**



Weight = 536 plf

**Parapet Detail**



**Haunch Detail**

**Material Properties**

Structural Steel: AASHTO M270, Grade 50W uncoated weathering steel with  $F_y = 50 \text{ ksi}$

Deck Concrete:  $f'_c = 4.0 \text{ ksi}$ , modular ratio  $n = 8$

Slab Reinforcing Steel: AASHTO M31, Grade 60 with  $F_y = 60 \text{ ksi}$

Cross Frame Connection Plates:  $3/4" \times 6"$

Bearing Stiffener Plates:  $7/8" \times 9"$

## AASHTOWare Bridge Design and Rating Training

### STL2 - Two Span Plate Girder Example

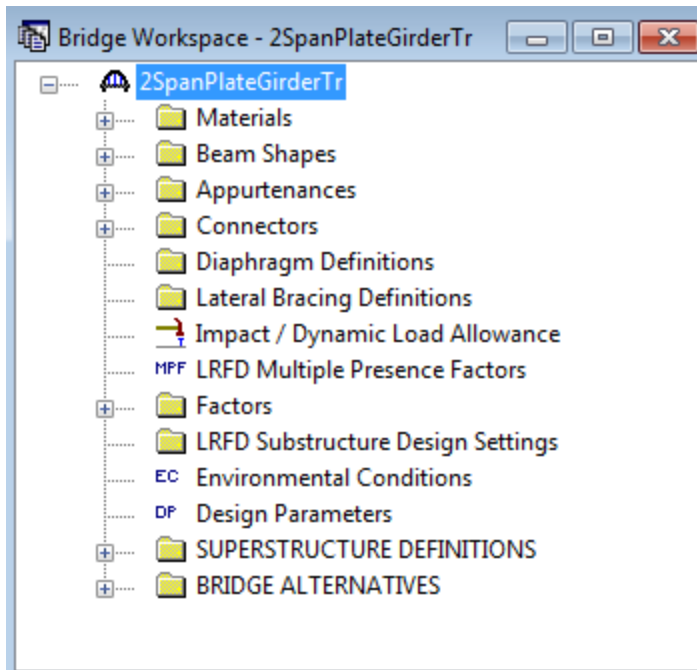
From the Bridge Explorer, select File/New/New Bridge from the menu to create a new bridge. Enter the following description data:

The screenshot shows the 'New Bridge' dialog box in AASHTOWare Bridge Explorer. The window title is '2SpanPlateGirderTr'. The 'Description' tab is selected. The 'Bridge ID' is '2SpanPlateGirderTr' and the 'NBI Structure ID (8)' is 'PLGirderTrBri'. There are checkboxes for 'Template', 'Bridge Completely Defined', 'Superstructures', and 'Culverts'. The 'Name' field contains '2SpanPlateGirderTraining' and the 'Year Built' field is empty. The 'Description' text box contains '2 span continuous composite steel plate girder uses LRFD'. The 'Location' field is empty. The 'Length' is '180.00' ft. The 'Facility Carried (7)' field is empty. The 'Route Number' is '-1'. The 'Feat. Intersected (6)' field is empty. The 'Mi. Post' field is empty. The 'Default Units' are set to 'US Customary'. At the bottom, there is a button for 'AASHTOWare Association...' and checkboxes for 'BrR', 'BrD', and 'BrM'. The 'OK', 'Apply', and 'Cancel' buttons are also present.


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

## STL2 - Two Span Plate Girder Example

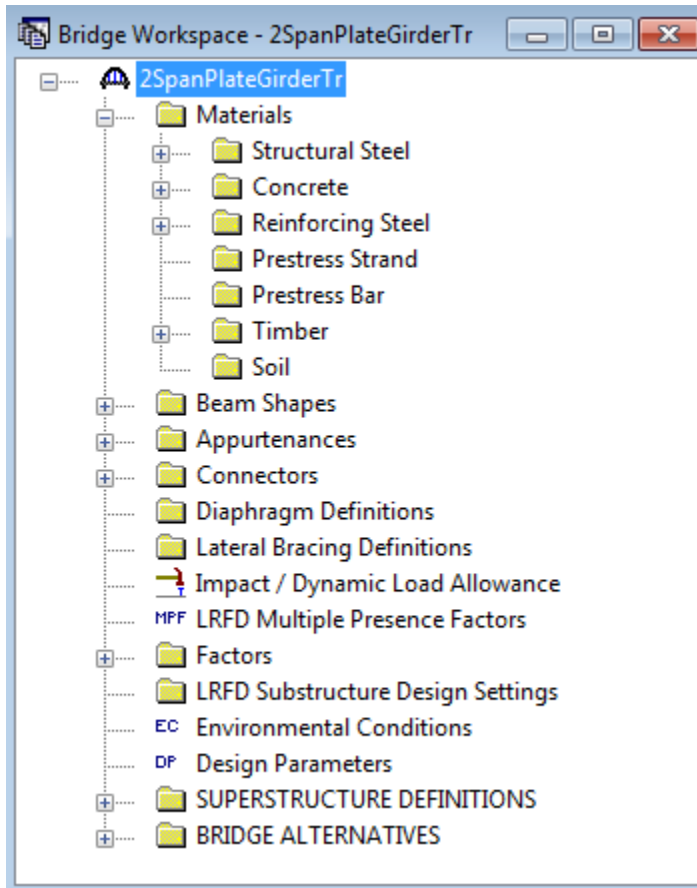
The Bridge Workspace tree after the bridge is created is shown below:



## STL2 - Two Span Plate Girder Example

To enter the materials to be used by members of the bridge, click on the  to expand the tree for Materials.

The tree with the expanded Materials branch is shown below:



## STL2 - Two Span Plate Girder Example

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.

Bridge Materials - Structural Steel

Name:  Description:

Material Properties

Specified minimum yield strength (Fy) =  ksi

Specified minimum tensile strength (Fu) =  ksi

Coefficient of thermal expansion =  1/F

Density =  kcf

Modulus of elasticity (E) =  ksi

Copy To Library... Copy from Library... OK Apply Cancel

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

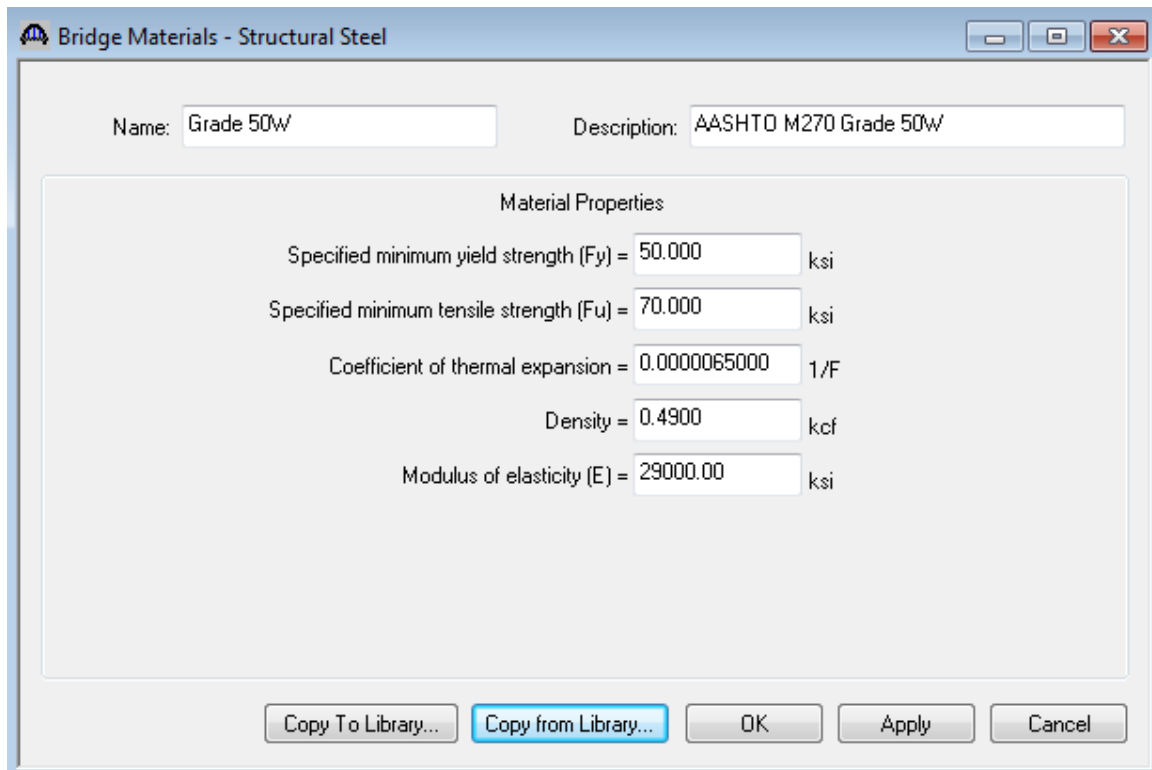


STL2 - Two Span Plate Girder Example

Name	Description	Library	Units	Fy	Fu	alpha	Density/ Unit Load	Modulus of Elasticity
ASTM A242 - > 1 1/2" to 4" i	ASTM A 24	Standar	US Cu	2.000	3.000	65000	0.4900	29000.00
ASTM A242 - > 3/4" to 1 1/2"	ASTM A 24	Standar	US Cu	6.000	7.000	65000	0.4900	29000.00
ASTM A36	ASTM A 36	Standar	US Cu	6.000	8.000	65000	0.4900	29000.00
ASTM A440 - <= 3/4"	ASTM A 44	Standar	US Cu	0.000	0.000	65000	0.4900	29000.00
ASTM A440 - > 1 1/2" to 4" i	ASTM A 44	Standar	US Cu	2.000	3.000	65000	0.4900	29000.00
ASTM A440 - > 3/4" to 1 1/2"	ASTM A 44	Standar	US Cu	6.000	7.000	65000	0.4900	29000.00
ASTM A441 - > 3/4" to 1 1/2"	ASTM A 44	Standar	US Cu	6.000	7.000	65000	0.4900	29000.00
ASTM A441 - <= 3/4"	ASTM A 44	Standar	US Cu	0.000	0.000	65000	0.4900	29000.00
ASTM A441 - > 1 1/2" to 4" i	ASTM A 44	Standar	US Cu	2.000	3.000	65000	0.4900	29000.00
ASTM A441 - > 4" to 8" incl.	ASTM A 44	Standar	US Cu	0.000	0.000	65000	0.4900	29000.00
ASTM A514 - over 2 1/2" to	ASTM A 51	Standar	US Cu	0.000	5.000	65000	0.4900	29000.00
ASTM A514 - to 2 1/2" incl.	ASTM A 51	Standar	US Cu	0.000	5.000	65000	0.4900	29000.00
ASTM A517	ASTM A 51	Standar	US Cu	0.000	5.000	65000	0.4900	29000.00
ASTM A572 - <= 3/4", Fy = 5	ASTM A572	Standar	US Cu	0.000	0.000	65000	0.4900	29000.00
ASTM A572 - > 1 1/2" to 4" i	ASTM A 57	Standar	US Cu	2.000	3.000	65000	0.4900	29000.00
ASTM A572 - 1 1/2" max, Fy	ASTM A 57	Standar	US Cu	5.000	0.000	65000	0.4900	29000.00
ASTM A572 - 1 1/2" max., Fy	ASTM A 57	Standar	US Cu	5.000	0.000	65000	0.4900	29000.00
ASTM A572 - 1" max, Fy = 6	ASTM A 57	Standar	US Cu	0.000	5.000	65000	0.4900	29000.00
ASTM A572 - 1/2" max, Fy =	ASTM A 57	Standar	US Cu	5.000	0.000	65000	0.4900	29000.00
ASTM A588 - <= 4", Fy = 50	ASTM A588	Standar	US Cu	0.000	0.000	65000	0.4900	29000.00
ASTM A588 - > 4" to 5" incl.	ASTM A 58	Standar	US Cu	6.000	7.000	65000	0.4900	29000.00
ASTM A588 - > 5" to 8" incl.	ASTM A 58	Standar	US Cu	2.000	3.000	65000	0.4900	29000.00
ASTM A94 - <= 1 1/8"	ASTM A 94	Standar	US Cu	0.000	5.000	65000	0.4900	29000.00
ASTM A94 - over 1 1/8" to 2"	ASTM A 94	Standar	US Cu	7.000	2.000	65000	0.4900	29000.00
Grade 100 - > 2.5" to 4" incl.	AASHTO M	Standar	US Cu	0.000	0.000	65000	0.4900	29000.00
Grade 100 <= 2.5"	AASHTO M	Standar	US Cu	0.000	0.000	65000	0.4900	29000.00
Grade 100W - > 2.5" to 4" in	AASHTO M	Standar	US Cu	0.000	0.000	65000	0.4900	29000.00
Grade 100W <= 2.5"	AASHTO M	Standar	US Cu	0.000	0.000	65000	0.4900	29000.00
Grade 250	AASHTO M	Standar	SI / Me	50.00	00.00	17000	849.0000	199948.00
Grade 345	AASHTO M	Standar	SI / Me	45.00	50.00	17000	849.0000	199948.00
Grade 345W	AASHTO M	Standar	SI / Me	45.00	85.00	17000	849.0000	199948.00
Grade 36	AASHTO M	Standar	US Cu	6.000	8.000	65000	0.4900	29000.00

## STL2 - Two Span Plate Girder Example

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



The screenshot shows a software dialog box titled "Bridge Materials - Structural Steel". It contains the following fields and values:

Field	Value	Unit
Name	Grade 50W	
Description	AASHTO M270 Grade 50W	
Material Properties		
Specified minimum yield strength (F <sub>y</sub> )	50.000	ksi
Specified minimum tensile strength (F <sub>u</sub> )	70.000	ksi
Coefficient of thermal expansion	0.0000065000	1/F
Density	0.4900	kcf
Modulus of elasticity (E)	29000.00	ksi

At the bottom of the dialog box, there are five buttons: "Copy To Library...", "Copy from Library..." (highlighted in blue), "OK", "Apply", and "Cancel".

## STL2 - Two Span Plate Girder Example

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

The 'Bridge Materials - Concrete' dialog box is shown. It has a title bar with a bridge icon, a minimize button, a maximize button, and a close button. The 'Name' field contains 'Class A (US)' and the 'Description' field contains 'Class A cement concrete'. The main area contains several input fields for material properties:

Compressive strength at 28 days ( $f'_c$ ) =	4.000	ksi
Initial compressive strength ( $f'_{ci}$ ) =		ksi
Coefficient of thermal expansion =	0.0000060000	1/F
Density (for dead loads) =	0.150	kcf
Density (for modulus of elasticity) =	0.145	kcf
Modulus of elasticity ( $E_c$ ) =	3644.15	ksi
Initial modulus of elasticity =		ksi
Poisson's ratio =	0.200	
Composition of concrete =	Normal	
Modulus of rupture =	0.480	ksi
Shear factor =	1.000	

At the bottom, there are four buttons: 'Copy To Library...', 'Copy from Library...' (highlighted with a blue border), 'OK', 'Apply', and 'Cancel'.

The 'Bridge Materials - Reinforcing Steel' dialog box is shown. It has a title bar with a bridge icon, a minimize button, a maximize button, and a close button. The 'Name' field contains 'Grade 60' and the 'Description' field contains '60 ksi reinforcing steel'. The main area contains several input fields for material properties:

Material Properties

Specified yield strength ( $F_y$ ) =	60.000	ksi
Modulus of elasticity ( $E_s$ ) =	29000.00	ksi
<i>Ultimate strength (<math>F_u</math>) =</i>	90.000	ksi

Type

- Plain
- Epoxy
- Galvanized
- Other

At the bottom, there are four buttons: 'Copy To Library...', 'Copy from Library...' (highlighted with a blue border), 'OK', 'Apply', and 'Cancel'.

## STL2 - Two Span Plate Girder Example

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. Enter the parapet as shown below. Click Ok to save the data to memory and close the window.

Name:

Description:

All dimensions are in inches

Additional Load =  kip/ft

9.0000 4.0000 5.0000

Reference Line

Back Front

Roadway Surface

Parapet unit load =  kcf

Calculated Properties

Net centroid (from reference line) =  in

Total load =  kip/ft

## STL2 - Two Span Plate Girder Example

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. Enter the appropriate values as shown and click Ok to save the data to memory and close the window. The values shown below are default values.

Bridge Impact / Dynamic Load ...

Standard Impact Factor

For structural components where impact is to be included per AASHTO 3.8.1, choose the impact factor to be used:

Standard AASHTO impact  $I = \frac{50}{L + 125}$

Modified impact =  times AASHTO impact

Constant impact override =  %

LRFD Dynamic Load Allowance

Fatigue and fracture limit states:  %

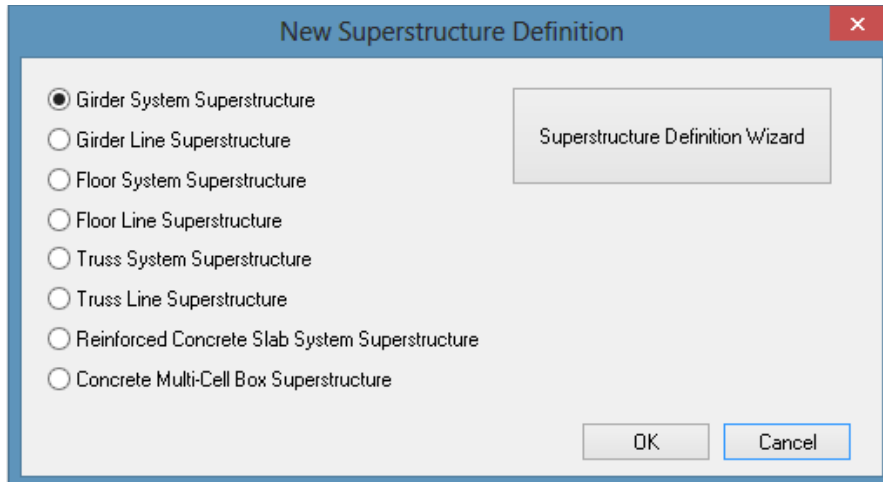
All other limit states:  %

OK Apply Cancel

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.

## STL2 - Two Span Plate Girder Example

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 pop up menu) to create a new structure definition. The dialog shown below will appear.



## STL2 - Two Span Plate Girder Example

Select Girder System and the Structure Definition window will open. Enter the appropriate data as shown below:

**Girder System Superstructure Definition**

Definition Analysis Specs Engine

Name: 2 Span 4 Girder System

Description:

Default Units: US Customary

Number of spans: 2

Number of girders: 4

Enter Span Lengths Along the Reference Line:

Span	Length (ft)
1	90.00
2	90.00

Frame Structure Simplified Definition

Deck type: Concrete

For PS only

Average humidity: %

Member Alt. Types

Steel

P/S

R/C

Timber

Horizontal Curvature Along Reference Line

Horizontal curvature

Superstructure Alignment

Curved

Tangent, curved, tangent

Tangent, curved

Curved, tangent

Distance from PC to first support line: ft

Start tangent length: ft

Radius: ft

Direction: Left

End tangent length: ft

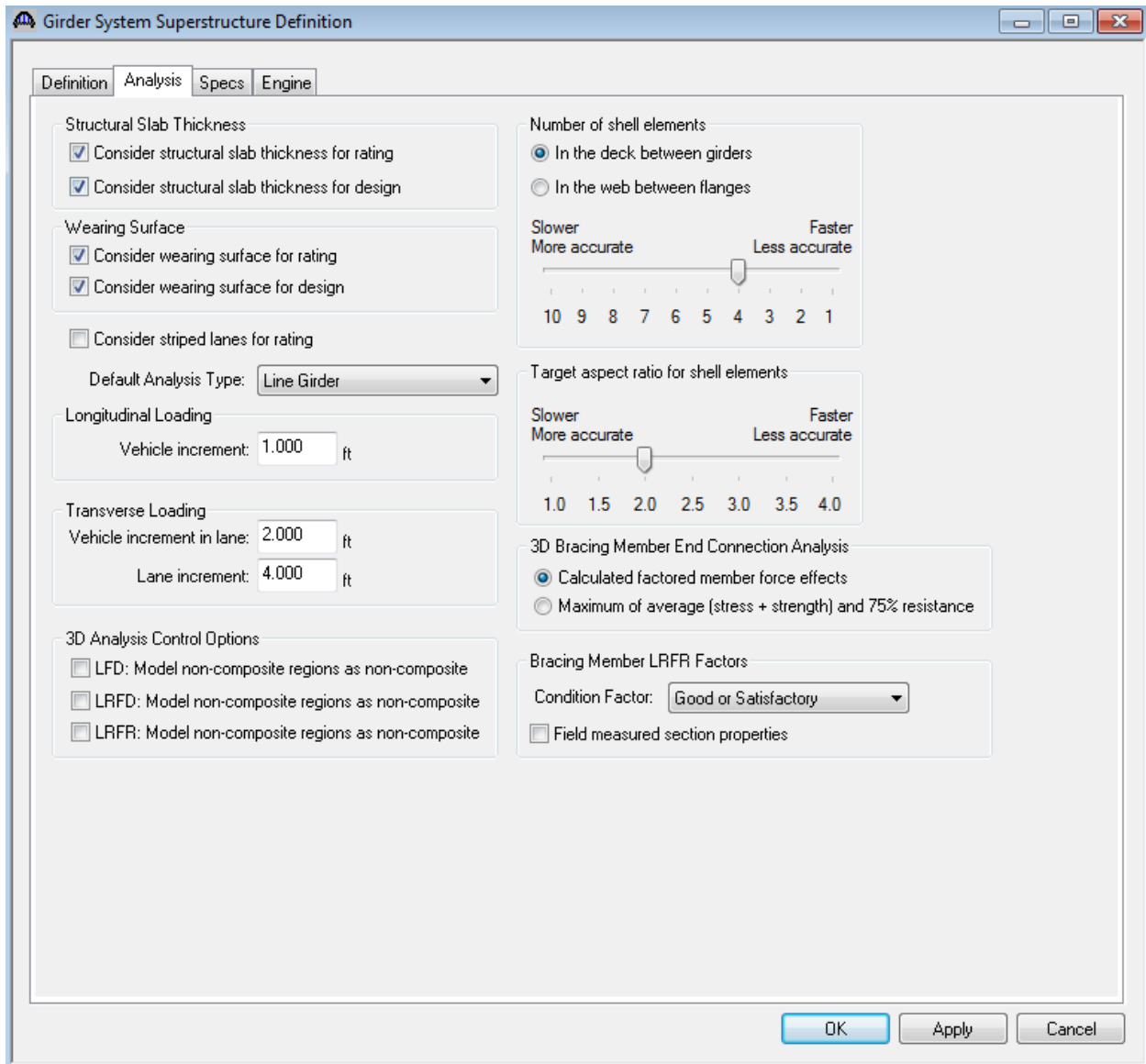
Distance from last support line to PT: ft

Design speed: mph

Superelevation: %

OK Apply Cancel

## STL2 - Two Span Plate Girder Example



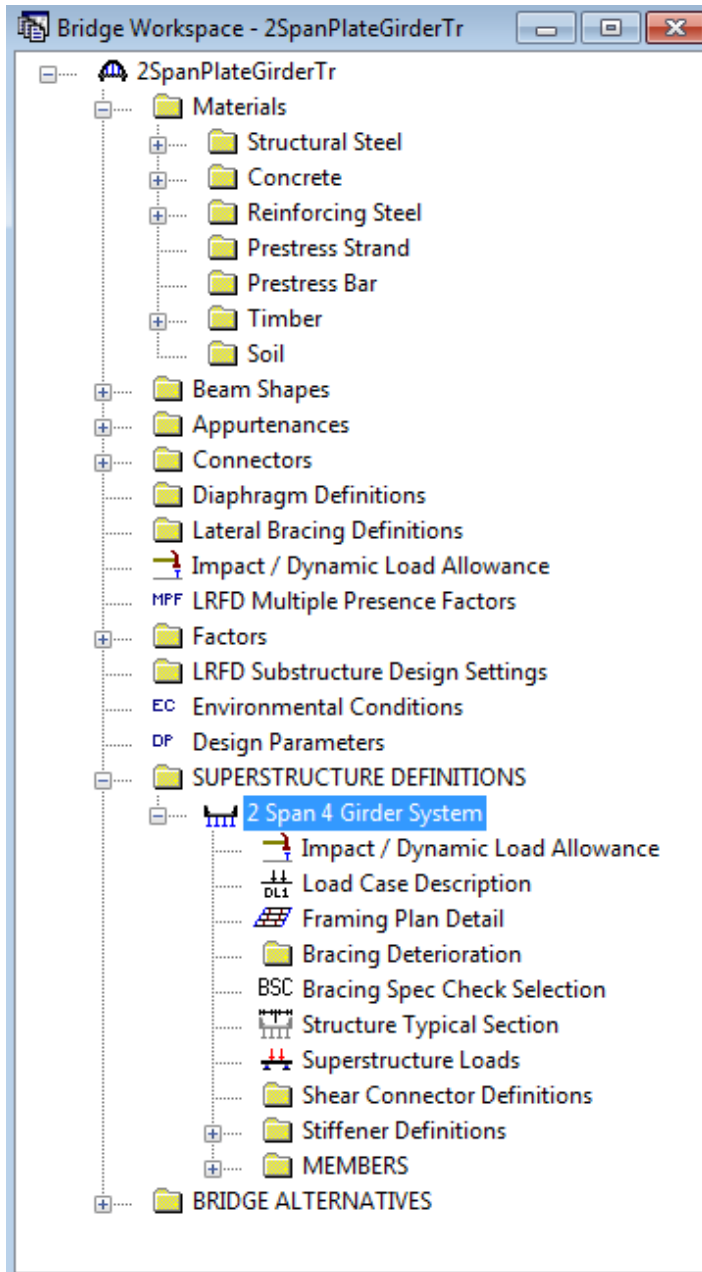
The Analysis tab is shown above with the default selections. Since we are not overriding default selections for this exercise, no changes are required.

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



## STL2 - Two Span Plate Girder Example

The partially expanded Bridge Workspace tree is shown below:



## STL2 - Two Span Plate Girder Example

We now go back to the Bridge Alternatives and create a new Bridge Alternative by double-clicking on Bridge Alternatives in the tree. Enter the following data:

Bridge Alternative

Alternative Name: Bridge Alternative 1

Description Substructures

Description:

Horizontal curvature

Reference Line Length = [ ] ft

Start bearing  End bearing

Starting Station = [ ] ft

Bearing = N 90<sup>0</sup>' 0' 0.00" E

Global Positioning

Distance = 0.000 ft

Offset = 0.000 ft

Elevation = [ ] ft

Bridge Alignment

Curved

Tangent, curved, tangent

Tangent, curved

Curved, tangent

Start tangent length: [ ] ft

Curve length: [ ] ft

Radius: [ ] ft

Direction: Left

End tangent length: [ ] ft

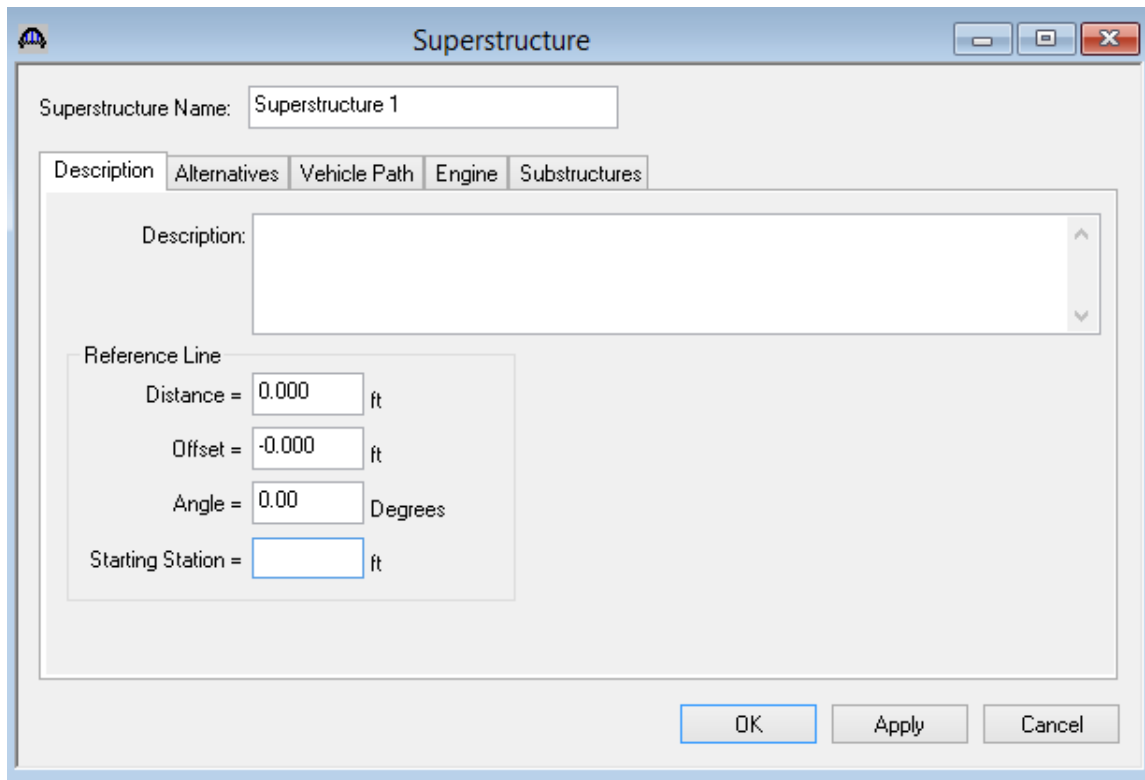
Superstructure Wizard... Culvert Wizard...

OK Apply Cancel

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

## STL2 - Two Span Plate Girder Example

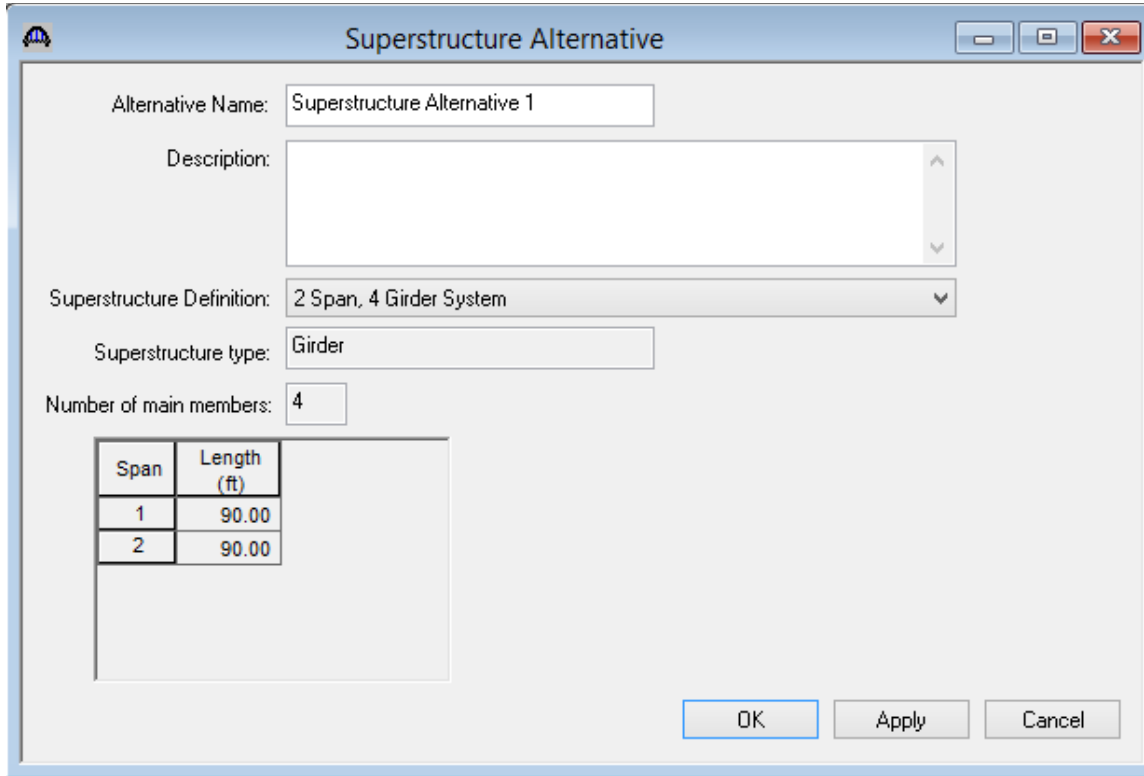
Double-click on Superstructures in the tree and enter the following new superstructure:



The image shows a software dialog box titled "Superstructure". At the top, there is a "Superstructure Name:" label followed by a text input field containing "Superstructure 1". Below this is a tabbed interface with five tabs: "Description", "Alternatives", "Vehicle Path", "Engine", and "Substructures". The "Description" tab is currently selected. Inside this tab, there is a large text area labeled "Description:" which is empty. Below the text area is a "Reference Line" section containing four input fields: "Distance = 0.000 ft", "Offset = -0.000 ft", "Angle = 0.00 Degrees", and "Starting Station = [ ] ft". At the bottom right of the dialog box are three buttons: "OK", "Apply", and "Cancel".

## STL2 - Two Span Plate Girder Example

Double-click on Superstructure Alternatives and enter the following new Superstructure Alternative. Select the superstructure definition 2 Span, 4 Girder System as the current superstructure definition for this Superstructure Alternative.



Superstructure Alternative

Alternative Name: Superstructure Alternative 1

Description:

Superstructure Definition: 2 Span, 4 Girder System

Superstructure type: Girder

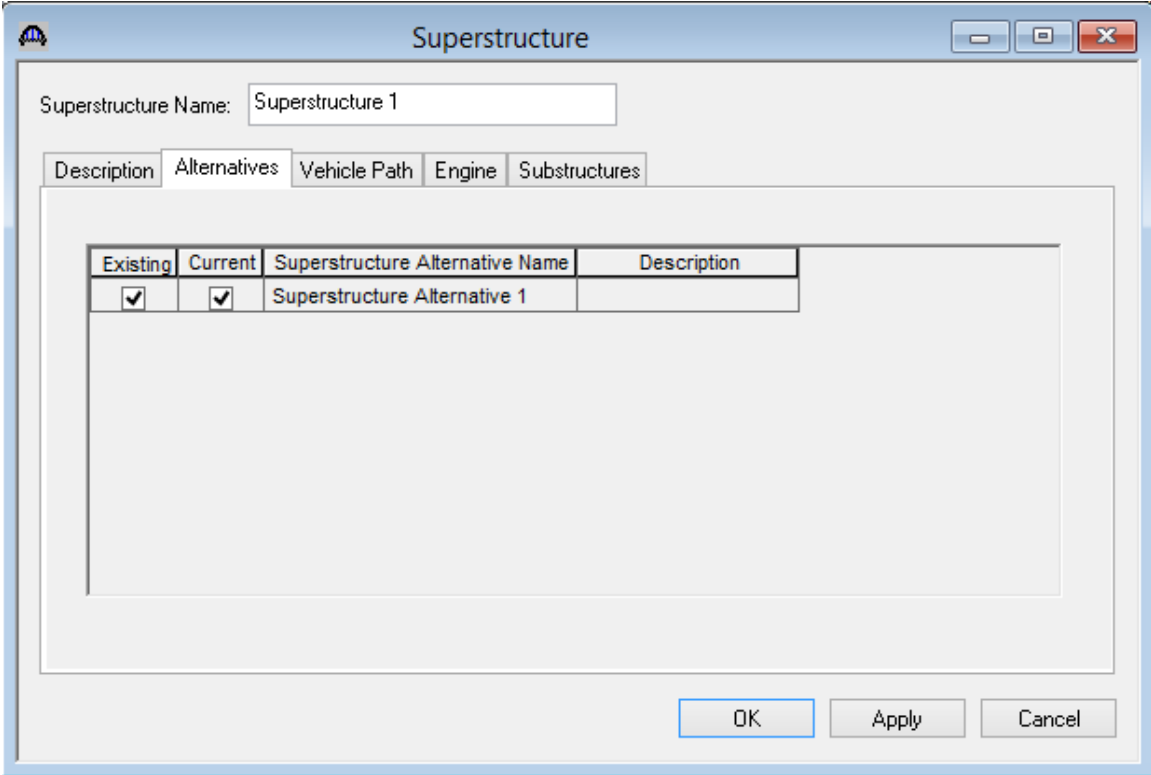
Number of main members: 4

Span	Length (ft)
1	90.00
2	90.00

OK Apply Cancel

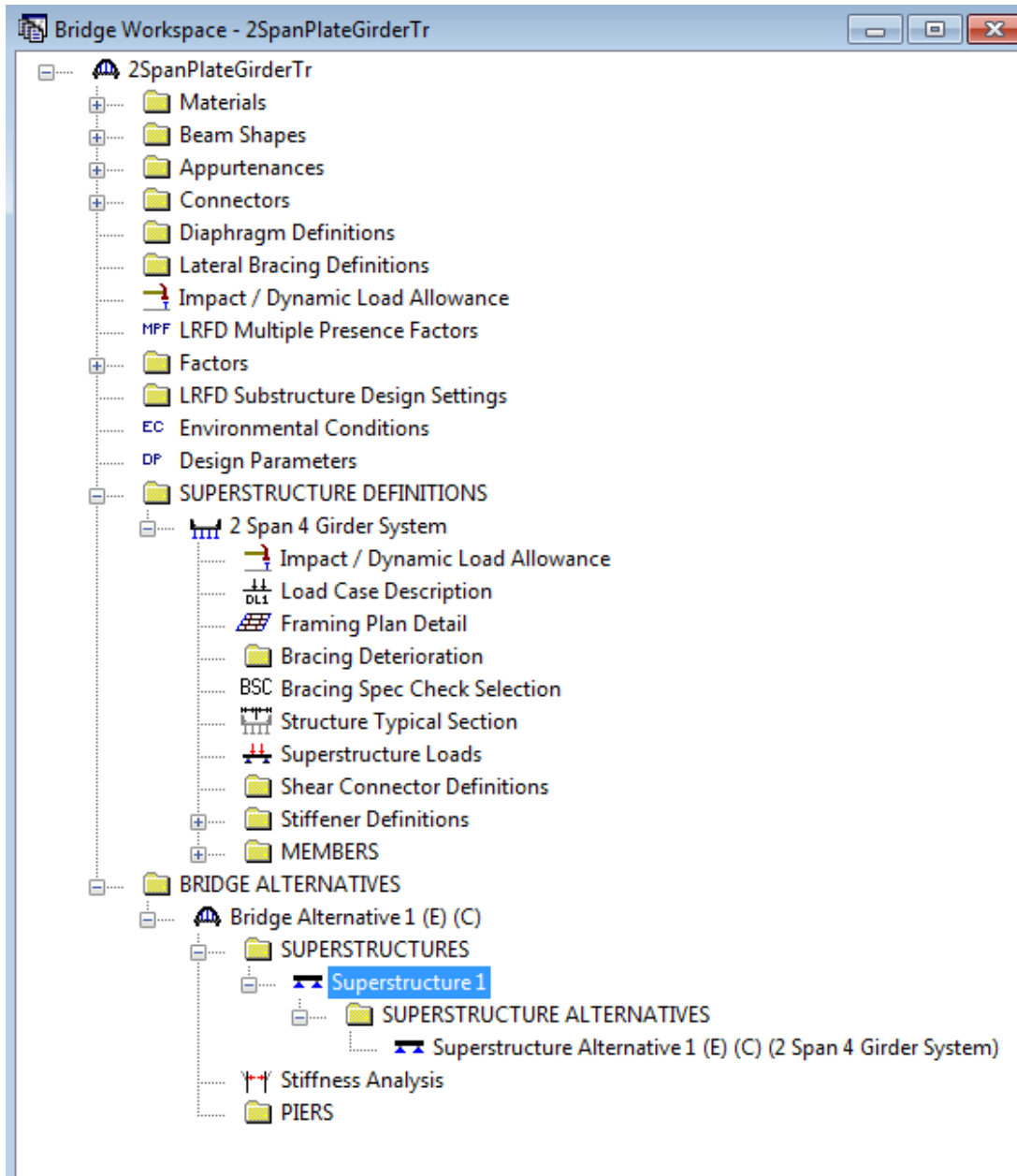
STL2 - Two Span Plate Girder Example

Re-open the Superstructure 1 window and select the Alternatives tab. The Superstructure Alternative 1 will be shown as the existing and current alternative for Superstructure 1.



## STL2 - Two Span Plate Girder Example

The partially expanded Bridge Workspace tree is shown below:



## STL2 - Two Span Plate Girder Example

Click Load Case Description to define the dead load cases. The completed Load Case Description window is shown below. Click the “Add Default Load Case Descriptions” generate the table below.

Load Case Name	Description	Stage	Type	Time* (Days)
DC1	DC acting o	Non-composite (Stage 1)	D,DC	
DC2	DC acting o	Composite (long term) (Stage 2)	D,DC	
DW	DW acting	Composite (long term) (Stage 2)	D,DW	
SIP Forms	Weight due	Non-composite (Stage 1)	D,DC	

\*Prestressed members only

Add Default Load Case Descriptions

New Duplicate Delete

OK Apply Cancel

## STL2 - Two Span Plate Girder Example

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

Structure Framing Plan Details

Number of spans = 2      Number of girders = 4

Layout   Diaphragms   Lateral Bracing Ranges

Girder Spacing Orientation

Perpendicular to girder

Along support

Support	Skew (Degrees)
1	0.0000
2	0.0000
3	0.0000

Girder Bay	Girder Spacing (ft)	
	Start of Girder	End of Girder
1	10.00	10.00
2	10.00	10.00
3	10.00	10.00

OK   Apply   Cancel



## STL2 - Two Span Plate Girder Example

Switch to the Diaphragms tab to enter diaphragm spacing. Enter the following diaphragms for Girder Bay 1 as shown below:

Structure Framing Plan Details

Number of spans = 2      Number of girders = 4

Layout   Diaphragms   Lateral Bracing Ranges

Girder Bay: 1      Copy Bay To...      Diaphragm Wizard...

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	-- Not Assigned --	
1	0.00	0.00	37.00	2	74.00	74.00	74.00	-- Not Assigned --	
2	0.00	0.00	0.00	1	0.00	0.00	0.00	-- Not Assigned --	
2	0.00	0.00	16.00	1	16.00	16.00	16.00	-- Not Assigned --	
2	16.00	16.00	37.00	2	74.00	90.00	90.00	-- Not Assigned --	

New   Duplicate   Delete

OK   Apply   Cancel

Click the Copy Bay To button to copy the diaphragms entered for Bay 1 to the other bays. The following dialog will appear. Click Apply to copy the diaphragms to girder bay 2.

Copy Diaphragm Bay

Select the new bay (s):


- Bay 2
- Bay 3

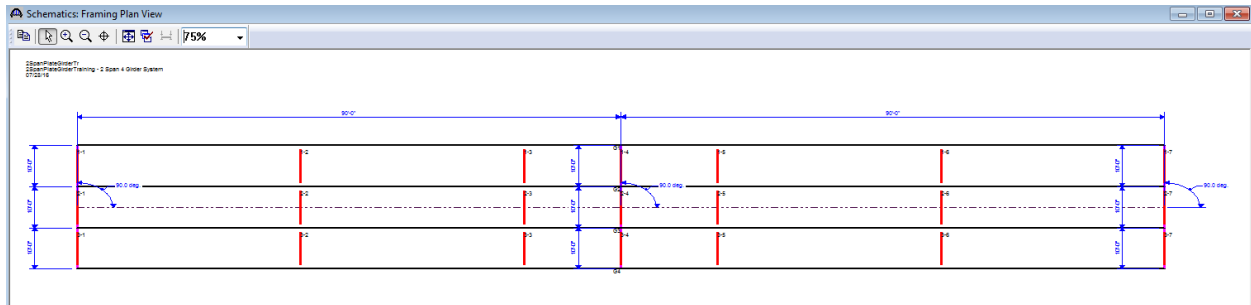
Apply   Cancel

Click the Copy Bay To button again, this time selecting 3 as the new bay. Click Apply to copy the diaphragms to girder bay 3.

Select Ok to close Structure Framing Plan Details window.

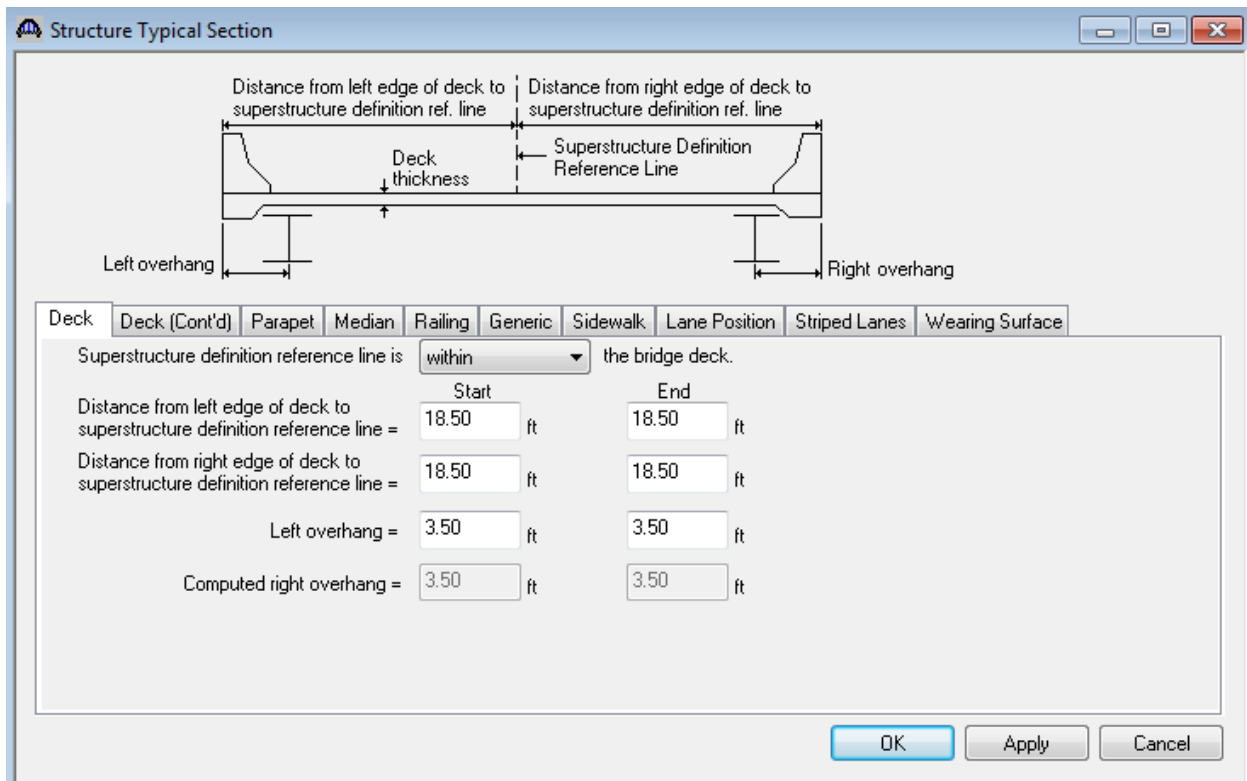
## STL2 - Two Span Plate Girder Example

While Framing Plan Detail is selected in the BWS tree, open the schematic for the framing plan by selecting the View Schematic toolbar button  or Bridge/Schematic from the menu. 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 Structure Typical Section dialog box displays the following parameters for the deck geometry:

Parameter	Start (ft)	End (ft)
Distance from left edge of deck to superstructure definition reference line	18.50	18.50
Distance from right edge of deck to superstructure definition reference line	18.50	18.50
Left overhang	3.50	3.50
Computed right overhang	3.50	3.50

The dialog box also includes a dropdown menu for the superstructure definition reference line, set to "within", and a tabbed interface with the "Deck" tab selected. The "Deck" tab includes sub-tabs for Deck (Cont'd), Parapet, Median, Railing, Generic, Sidewalk, Lane Position, Striped Lanes, and Wearing Surface.

## STL2 - Two Span Plate Girder Example

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.

Structure Typical Section

Distance from left edge of deck to superstructure definition ref. line

Distance from right edge of deck to superstructure definition ref. line

Deck thickness

Superstructure Definition Reference Line

Left overhang

Right overhang

Deck Deck (Cont'd) Parapet Median Railing Generic Sidewalk Lane Position Striped Lanes Wearing Surface

Deck concrete: Class A (US)

Total deck thickness: 8.5000 in

Load case: Engine Assigned

Deck crack control parameter: kip/in

Sustained modular ratio factor: 3.000

Deck exposure factor:

OK Apply Cancel

## STL2 - Two Span Plate Girder Example

### 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 “DC2” 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.

Name	Load Case	Measure To	Edge of Deck Dist. Measured From	Distance At Start (ft)	Distance At End (ft)	Front Face Orientation
Standard Parapet	DC2	Back	Left Edge	0.00	0.00	Right
Standard Parapet	DC2	Back	Right Edge	0.00	0.00	Left

## STL2 - Two Span Plate Girder Example

Lane Positions:

Select the Lane Position tab.

The diagram shows a cross-section of a two-span plate girder. A central vertical dashed line represents the 'Superstructure Definition Reference Line'. To its left is 'Travelway 1' and to its right is 'Travelway 2'. Dimension (A) is the distance from the left edge of the travelway to the reference line at the start. Dimension (B) is the distance from the right edge of the travelway to the reference line at the start. The end dimensions are also defined relative to the reference line.

Travelway Number	Distance From Left Edge of Travelway to Superstructure Definition Reference Line At Start (A) (ft)	Distance From Right Edge of Travelway to Superstructure Definition Reference Line At Start (B) (ft)	Distance From Left Edge of Travelway to Superstructure Definition Reference Line At End (A) (ft)	Distance From Right Edge of Travelway to Superstructure Definition Reference Line At End (B) (ft)

LRFD Fatigue  
Lanes available to trucks:

Override Truck fraction:

Compute...    New    Duplicate    Delete

OK    Apply    Cancel

## STL2 - Two Span Plate Girder Example

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.

Travelway Number	Distance From Left Edge of Travelway to Superstructure Definition Reference Line At Start (A) (ft)	Distance From Right Edge of Travelway to Superstructure Definition Reference Line At Start (B) (ft)	Distance From Left Edge of Travelway to Superstructure Definition Reference Line At End (A) (ft)	Distance From Right Edge of Travelway to Superstructure Definition Reference Line At End (B) (ft)
1	-17.00	17.00	-17.00	17.00

LRFD Fatigue  
 Lanes available to trucks:   
 Override Truck fraction:

Compute...    New    Duplicate    Delete

OK    Apply    Cancel

## STL2 - Two Span Plate Girder Example

Wearing Surface:

Enter the data shown below.

The screenshot shows a software dialog box titled "Structure Typical Section" with a "Wearing Surface" tab selected. At the top, a diagram illustrates a cross-section of a deck with a central "Superstructure Definition Reference Line". Dimensions include "Distance from left edge of deck to superstructure definition ref. line", "Distance from right edge of deck to superstructure definition ref. line", "Deck thickness", "Left overhang", and "Right overhang". Below the diagram is a tabbed interface with "Wearing Surface" active. The input fields are: "Wearing surface material" (Asphalt), "Description" (Asphalt - 25 psf), "Wearing surface thickness" (2.7800 in) with an unchecked checkbox for "Thickness field measured (D/W = 1.25 if checked)", "Wearing surface density" (108.000 pcf), and "Load case" (DW). A "Copy from Library..." button is also present. At the bottom are "OK", "Apply", and "Cancel" buttons.

Deck	Deck (Cont'd)	Parapet	Median	Railing	Generic	Sidewalk	Lane Position	Wearing Surface
------	---------------	---------	--------	---------	---------	----------	---------------	-----------------

Wearing surface material:

Description:


Wearing surface thickness =  in  Thickness field measured (D/W = 1.25 if checked)

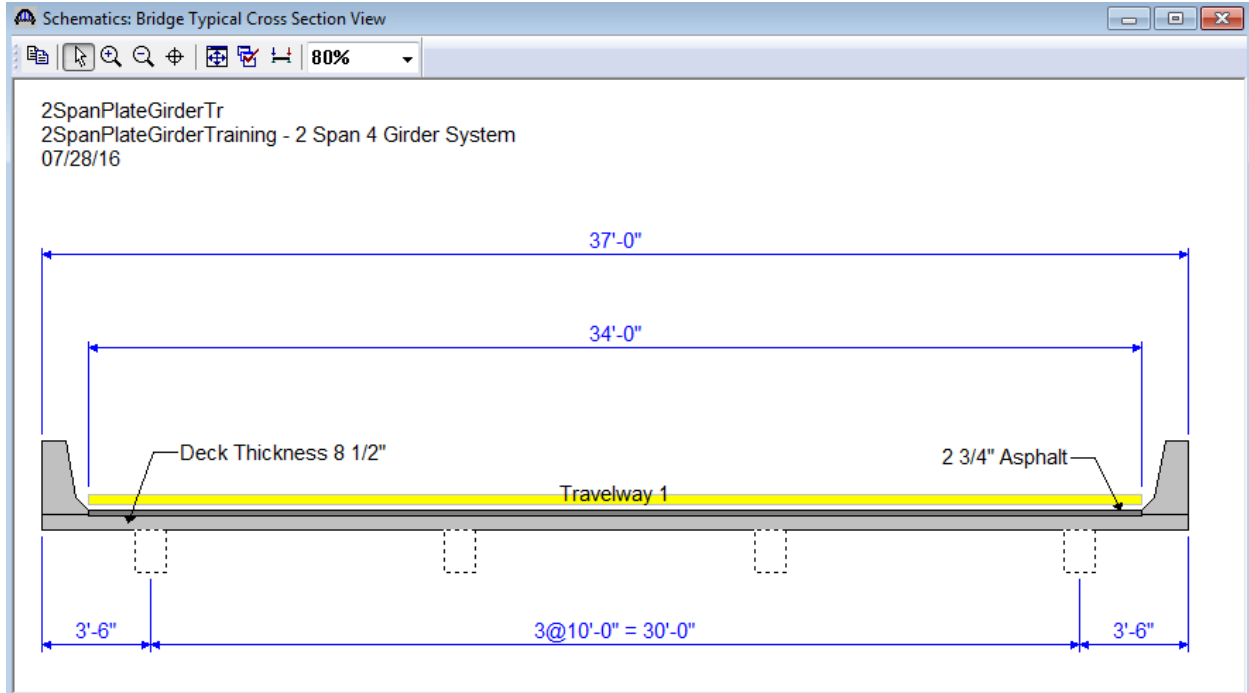
Wearing surface density =  pcf

Load case:

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

## STL2 - Two Span Plate Girder Example

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.





## STL2 - Two Span Plate Girder Example

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

Transverse Stiffener Definition

Name: 2 Sided Dia Conn PL

Stiffener Type

Single

Pair

Plate

Thickness: 0.7500 in

Material: Grade 50W

Welds

Top: -- None --

Web: -- None --

Bottom: -- None --

Top Gap: in

6.0000 in

Bottom Gap: in

OK Apply Cancel



## STL2 - Two Span Plate Girder Example

Describing a member:

Expand MEMBERS in the tree. The G2 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.

Member name: G2      Link with: None

Description:

Existing	Current	Member Alternative Name	Description
----------	---------	-------------------------	-------------

Number of spans: 2

Span No.	Span Length (ft)
1	90.00
2	90.00

OK      Apply      Cancel

## STL2 - Two Span Plate Girder Example

Next double click on the Member loads in the tree and select SIP Forms from the combobox. Enter the load due to stay-in-place forms as shown below.

Pedestrian load:  lb/ft

Uniform Distributed Concentrated Settlement

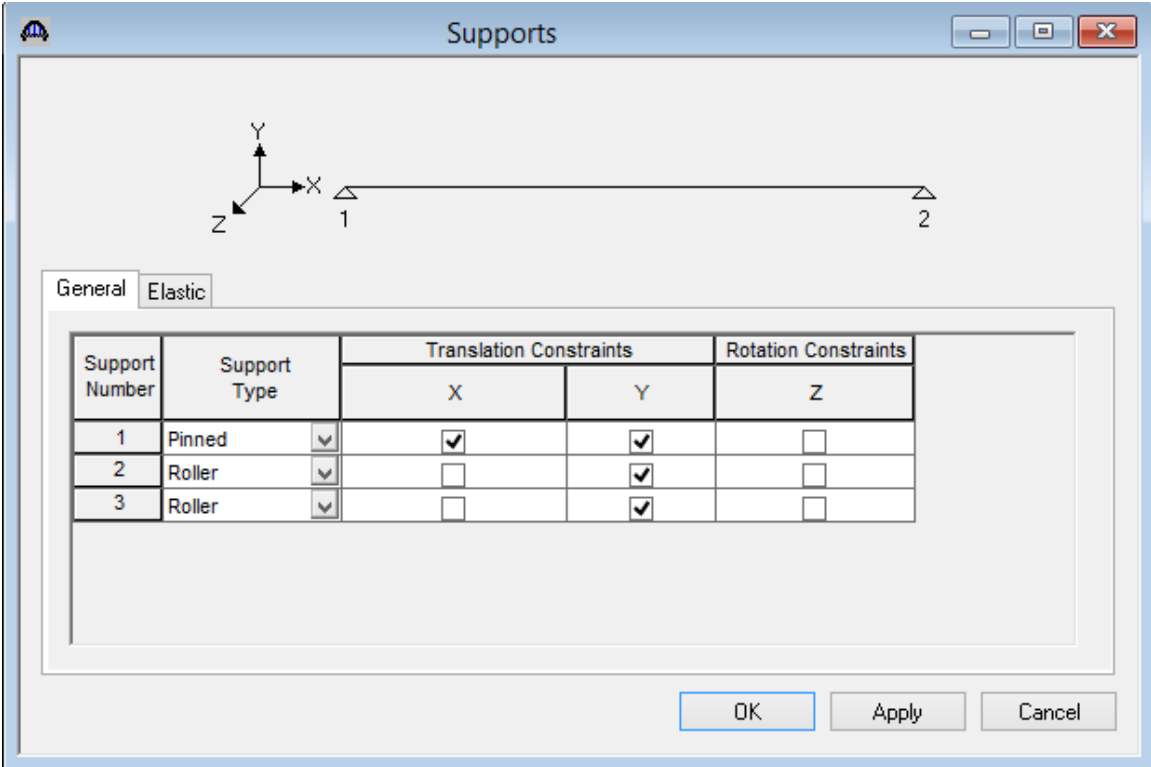
Load Case Name	Span	Uniform Load (kip/ft)
SIP Forms	All Spans	0.135

New Duplicate Delete

OK Apply Cancel

STL2 - Two Span Plate Girder Example

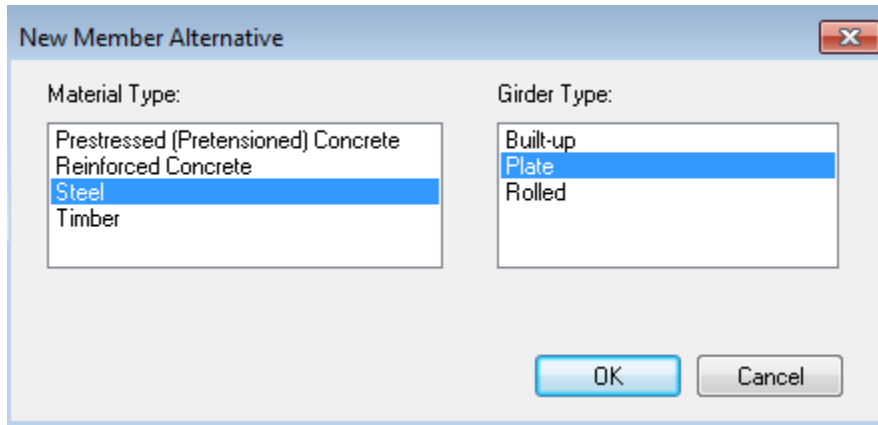
Support constraints were generated when the structure definition was created and are shown below.



## STL2 - Two Span Plate Girder Example

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 Plate for the Girder Type.



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

## STL2 - Two Span Plate Girder Example

The Member Alternative Description window will open. Enter the appropriate data as shown below. Select Schedule-based Girder property input method. The additional self-weight of 0.170 kip/ft is estimated for the weight of the diaphragms and stiffeners.

Member Alternative:

Description | Specs | Factors | Engine | Import | Control Options

Description:

Material Type:

Girder Type:

Default Units:

Girder property input method:  
 Schedule based  
 Cross-section based

End bearing locations:  
Left:  in  
Right:  in

Simple DL, continuous LL

Default rating method:

Self Load:  
Load case:

Additional self load =  kip/ft  
Additional self load =  %

OK Apply Cancel

## STL2 - Two Span Plate Girder Example

If we now re-open the Member G2 window, we will see this Member Alternative designated as the existing and current member alternative for this Member.

Member name:  Link with:

Description:

Existing	Current	Member Alternative Name	Description
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Plate Girder	

Number of spans:

Span No.	Span Length (ft)
1	90.00
2	90.00

OK Apply Cancel



## STL2 - Two Span Plate Girder Example

Distribution Factors (Standard):

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

Standard **LRFD**

Distribution Factor Input Method

Use Simplified Method    Use Advanced Method    Use Advanced Method with 1994 Guide Specs

Allow distribution factors to be used to compute effects of permit loads with routine traffic

Lanes Loaded	Distribution Factor (Wheels)			
	Shear	Shear at Supports	Moment	Deflection
1 Lane	1.429	1.400	1.429	0.500
Multi-Lane	1.818	2.000	1.818	1.000

Compute from Typical Section...   View Calcs

OK   Apply   Cancel

We do not need to enter any LRFD distribution factors since AASHTO LRFD will compute them for us since we have a girder system structure definition.

Interior (LFD wheels)

Lanes Loaded	Shear	Shear at Support	Moment	Deflection
1 lane	1.43	1.4	1.43	0.5
Multi-lane	1.81	2.0	1.81	1.0

STL2 - Two Span Plate Girder Example

Interior (LRFD lanes)

Lanes Loaded	Shear	Shear at Support	Pos. Moment	Neg. Moment	Deflection
1 lane	0.76	0.76	0.484	0.503	0.3*
Multi-lane	0.952	0.952	0.698	0.726	0.5

\* includes 1.20 multiple presence factor

Live load 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 web.

The screenshot shows a software window titled "Girder Profile". At the top, there are standard window controls (minimize, maximize, close). Below the title bar, the "Type" is set to "Plate Girder". There are three tabs: "Web", "Top Flange", and "Bottom Flange", with "Web" currently selected. The main area contains a table with the following data:

Begin Depth (in)	Depth Vary	End Depth (in)	Thickness (in)	Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Material	Weld at Right
36.0000	None	36.0000	0.4375	1	0.00	63.00	63.00	Grade 50W	-- Non
36.0000	None	36.0000	0.5000	1	63.00	54.00	117.00	Grade 50W	-- Non
36.0000	None	36.0000	0.4375	2	27.00	63.00	90.00	Grade 50W	-- Non

Below the table, there are three buttons: "New", "Duplicate", and "Delete". At the bottom of the dialog, there are three more buttons: "OK", "Apply", and "Cancel".

STL2 - Two Span Plate Girder Example

Describe the flanges as shown below.

**Girder Profile**

Type:

Web  Top Flange  Bottom Flange

Begin Width (in)	End Width (in)	Thickness (in)	Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Material	Weld	Weld at Right
12.0000	12.0000	0.7500	1	0.00	63.00	63.00	Grade 50W	-- None	-- None
16.0000	16.0000	1.0000	1	63.00	54.00	117.00	Grade 50W	-- None	-- None
12.0000	12.0000	0.7500	2	27.00	63.00	90.00	Grade 50W	-- None	-- None

Copy to Bottom Flange

New Duplicate Delete

OK Apply Cancel

**Girder Profile**

Type:

Web  Top Flange  Bottom Flange

Begin Width (in)	End Width (in)	Thickness (in)	Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Material	Weld	Weld at Right
16.0000	16.0000	0.8750	1	0.00	63.00	63.00	Grade 50W	-- None	-- None
16.0000	16.0000	1.5000	1	63.00	54.00	117.00	Grade 50W	-- None	-- None
16.0000	16.0000	0.8750	2	27.00	63.00	90.00	Grade 50W	-- None	-- None

Copy to Top Flange

New Duplicate Delete

OK Apply Cancel

## STL2 - Two Span Plate Girder Example

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.

Deck Profile

Type:

Deck Concrete **Reinforcement** Shear Connectors

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
Class A (US) ▾	1 ▾	0.00	180.00	180.00	8.0000	96.0000	96.0000	120.0000	120.0000	8.000

Deck Profile

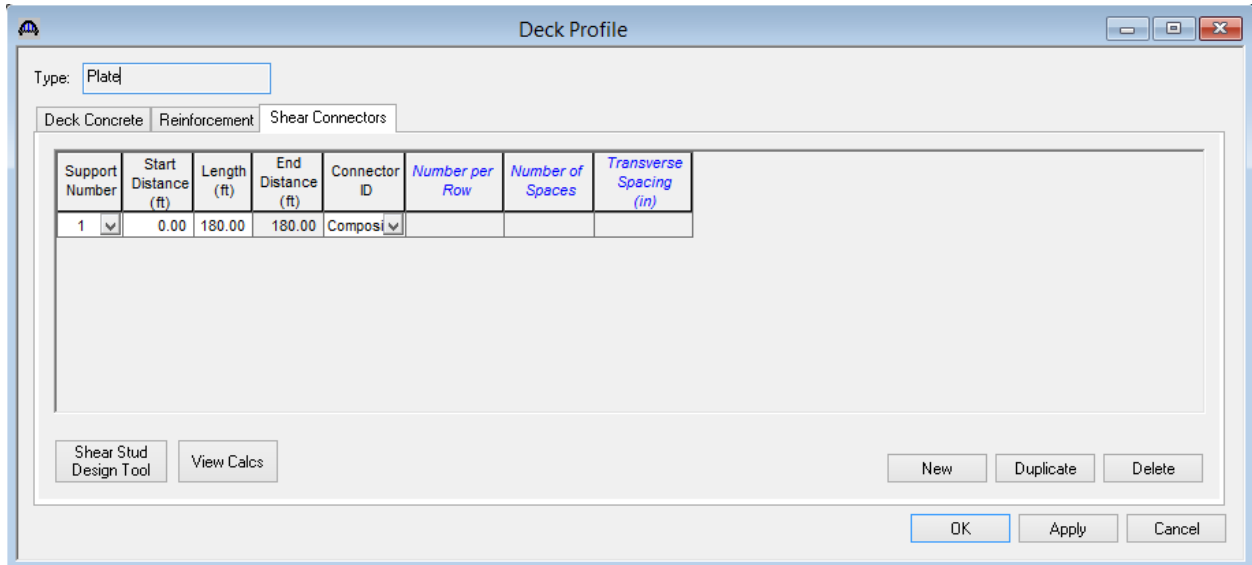
Type:

Deck Concrete Reinforcement **Shear Connectors**

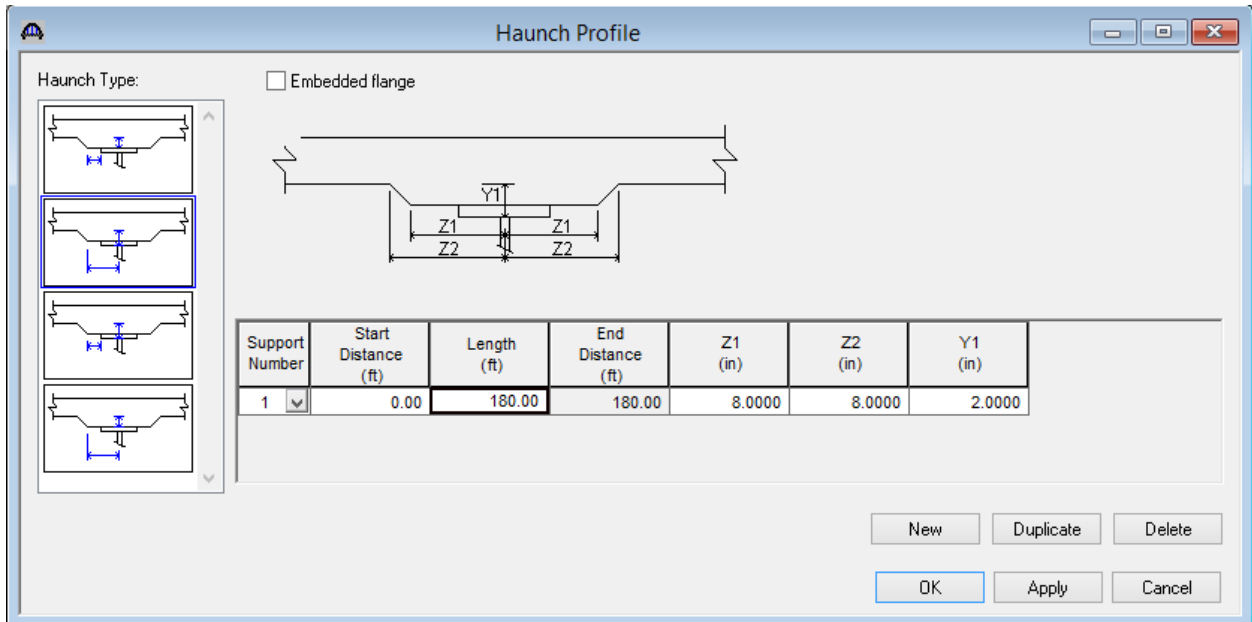
Material	Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Std Bar Count	LRFD Bar Count	Bar Size	Distance (in)	Row	Bar Spacing (in)
Grade 60 ▾	1 ▾	63.00	54.00	117.00	6.24	6.24	9 ▾	2.9700	Top of Slab ▾	
Grade 60 ▾	1 ▾	63.00	54.00	117.00	4.16	4.16	9 ▾	1.9100	Bottom of Slab ▾	

## STL2 - Two Span Plate Girder Example

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

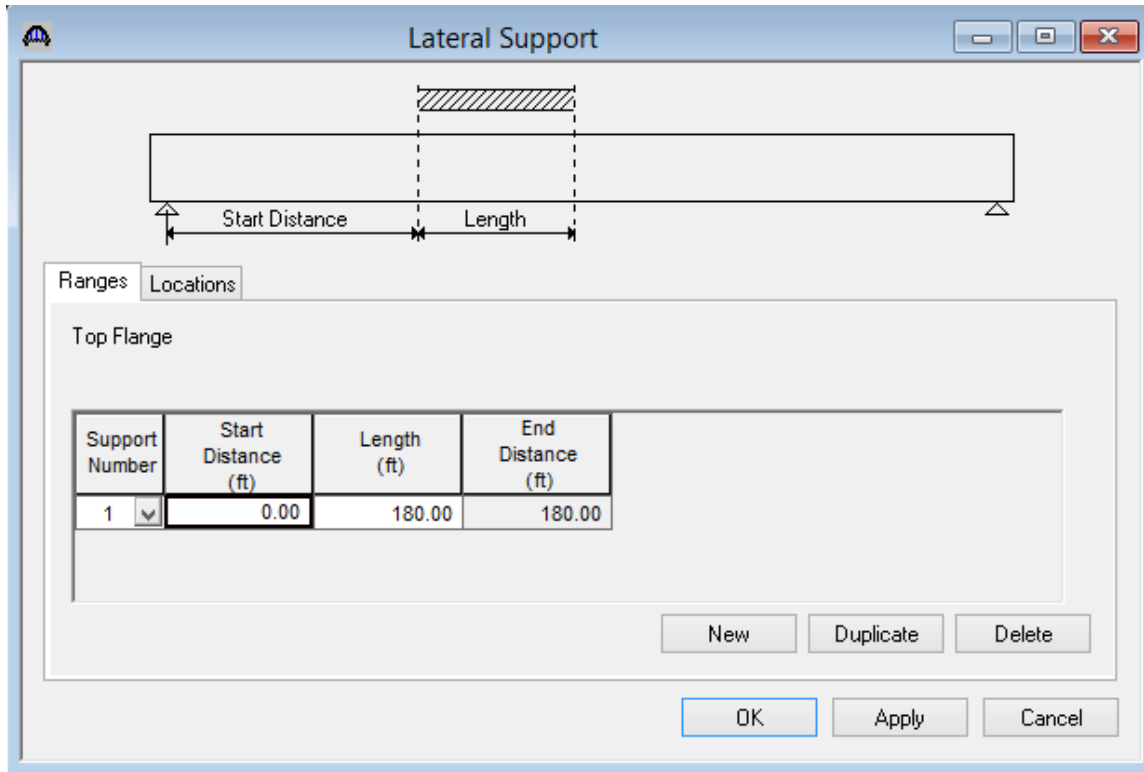


The haunch profile is defined by double clicking on Haunch Profile in the tree. The window is shown below.



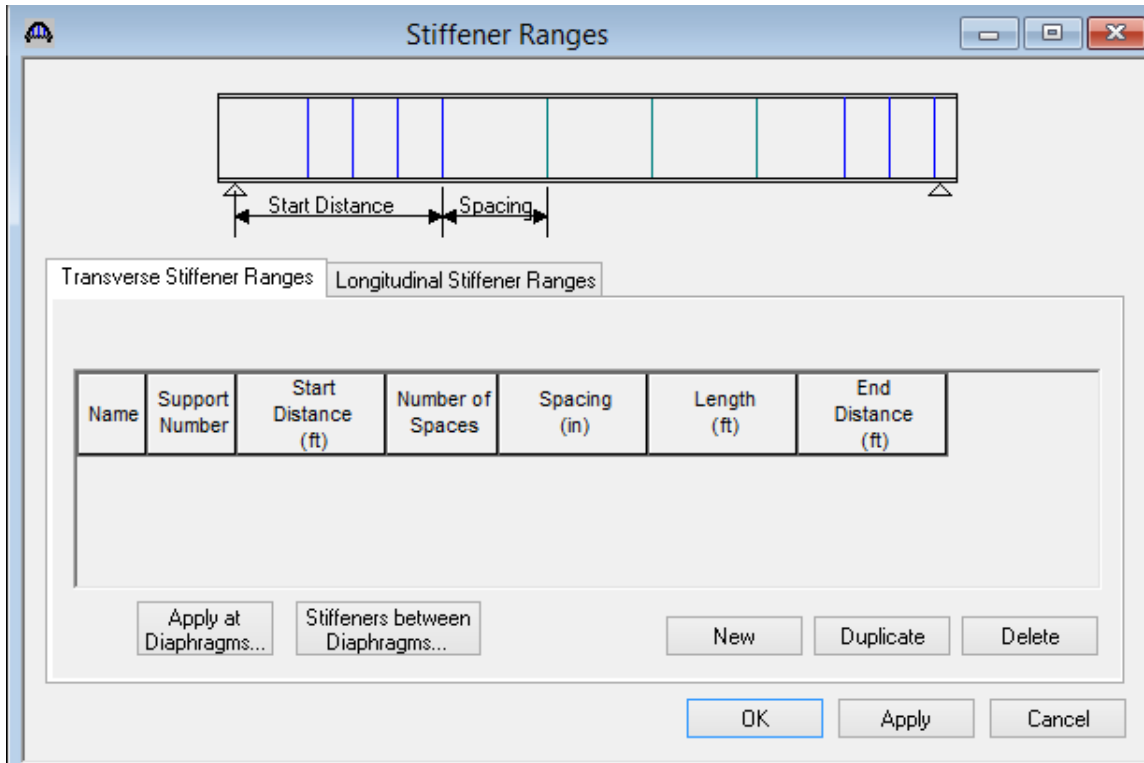
## STL2 - Two Span Plate Girder Example

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.

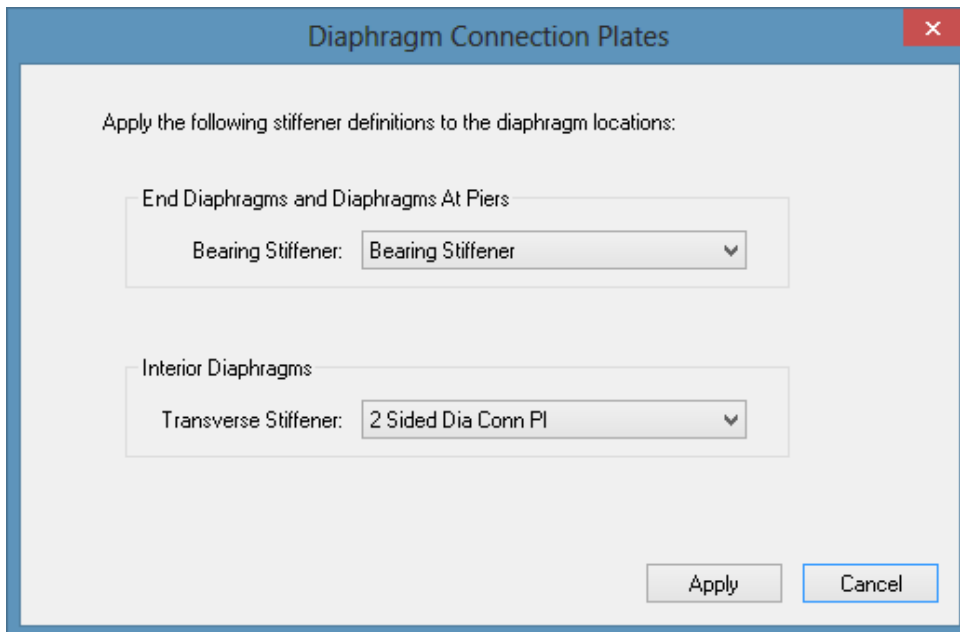


## STL2 - Two Span Plate Girder Example

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

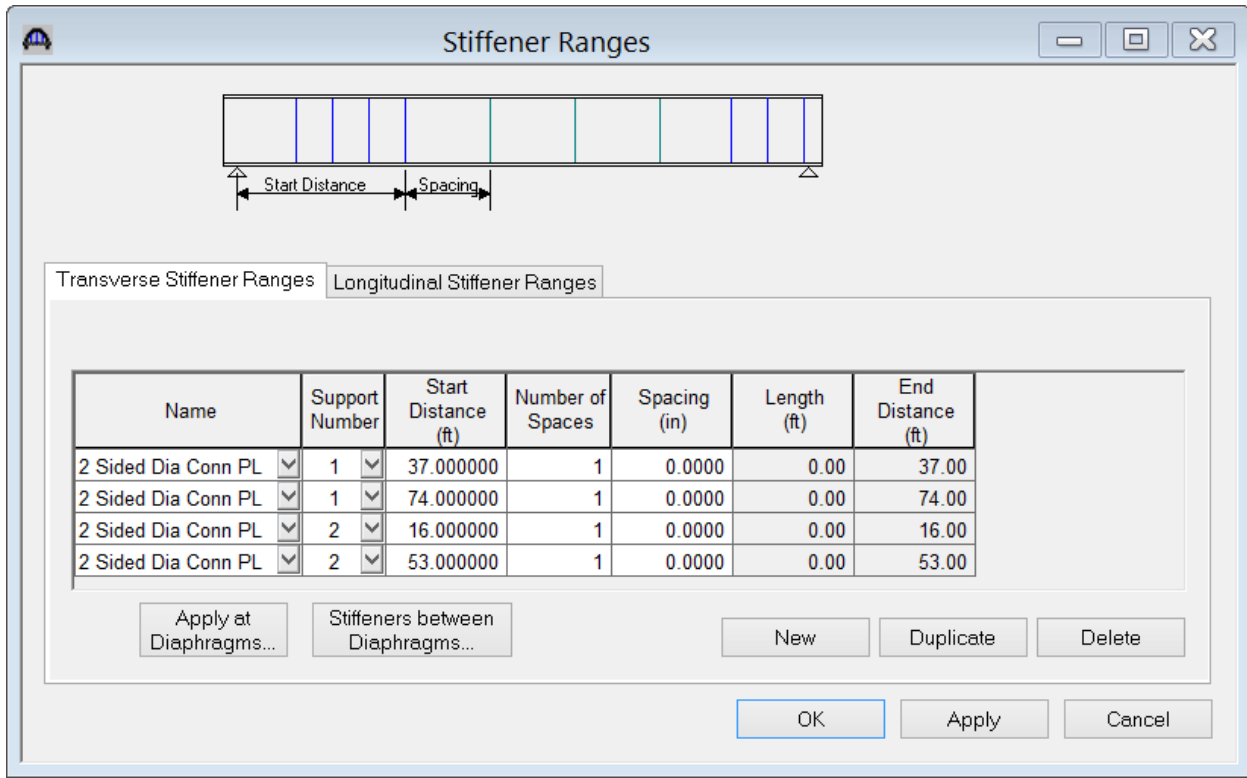


Click on the Apply at Diaphragms... button to open the following dialog. Select the 2 Sided Conn PL as the stiffener to apply at the interior diaphragms.



## STL2 - Two Span Plate Girder Example

Selecting Apply will create the following transverse stiffener locations.

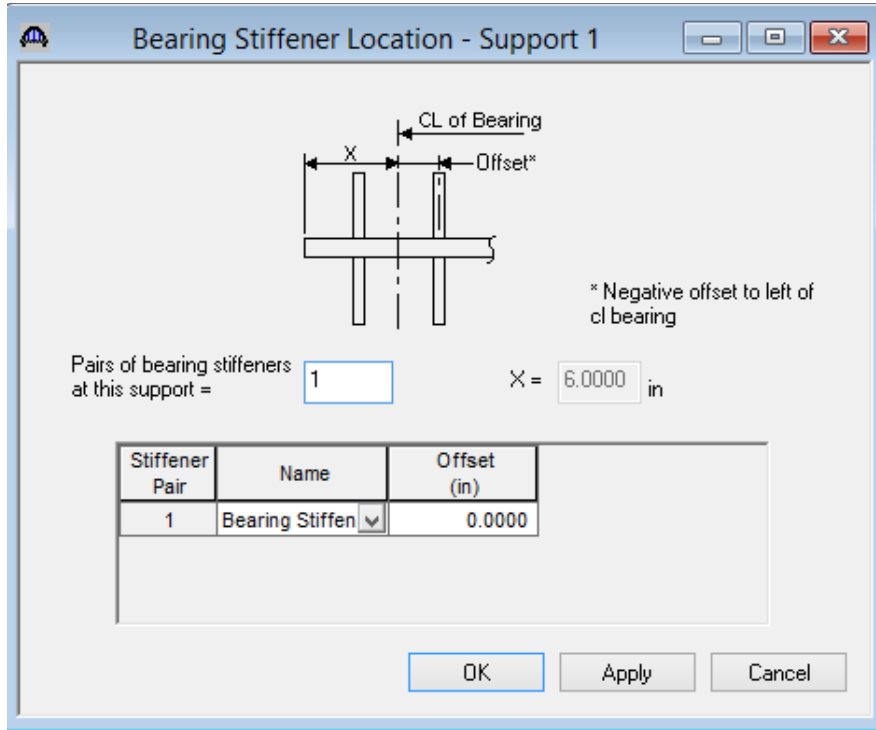


This example does not have any intermediate transverse stiffeners so we can click Ok to close this window



## STL2 - Two Span Plate Girder Example

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.



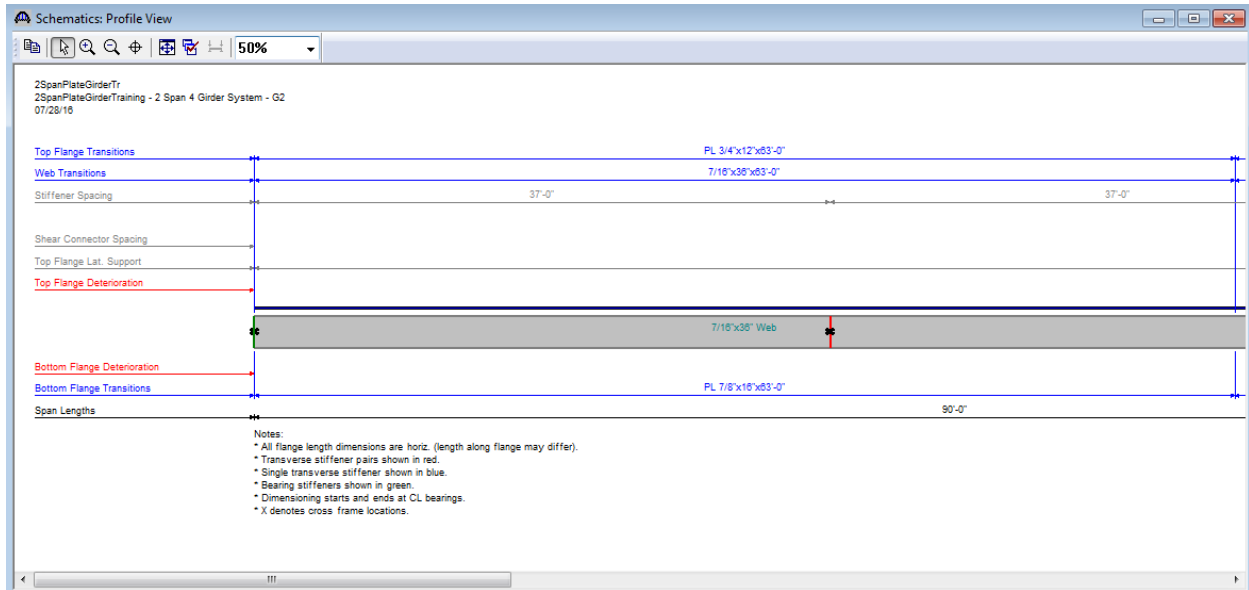
## STL2 - Two Span Plate Girder Example

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

While “Plate Girder” is selected in the BWS tree, open the schematic for the girder profile by selecting the View

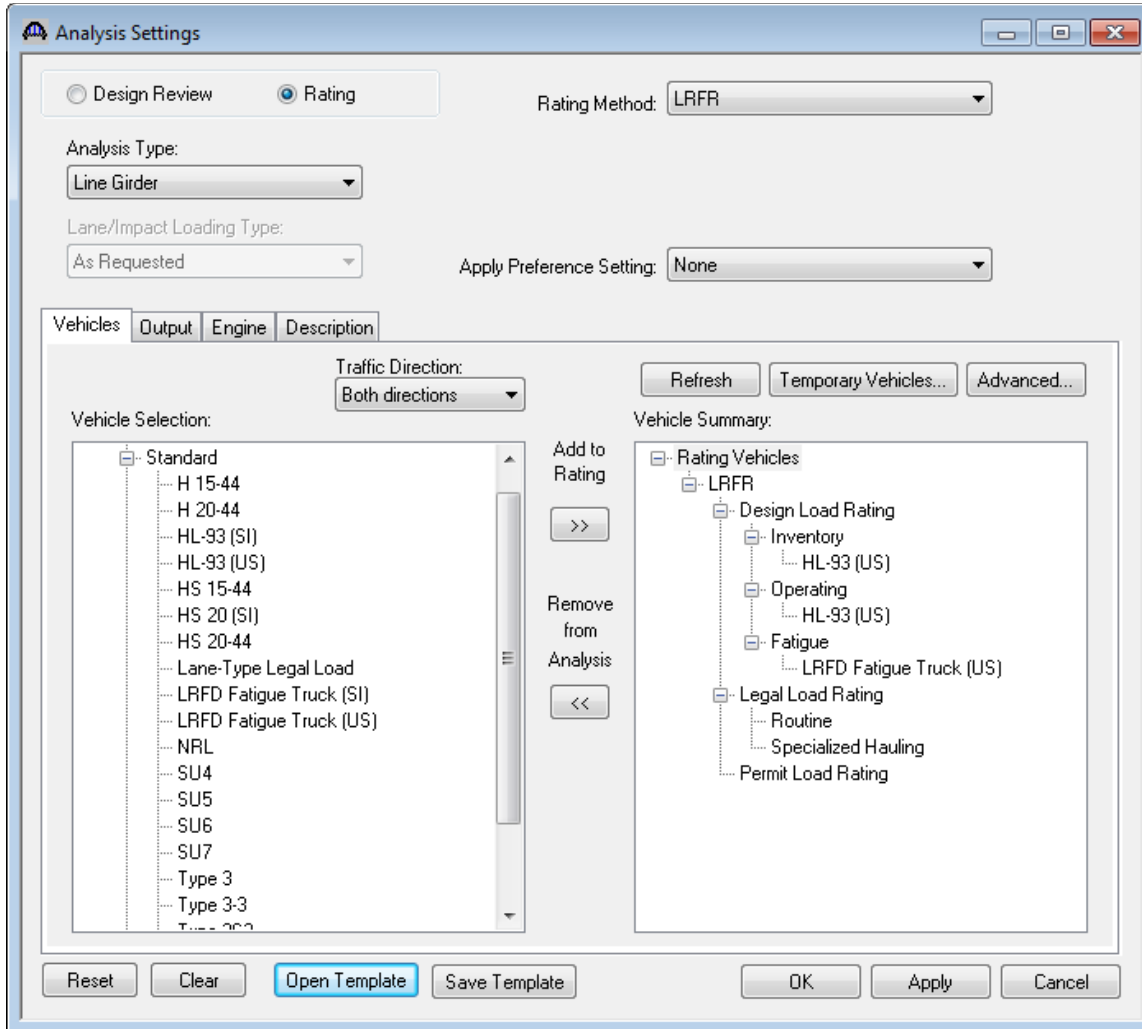


Schematic toolbar button or Bridge/Schematic from the menu. The following schematic will be displayed.



## STL2 - Two Span Plate Girder Example

The member alternative can now be analyzed. To perform LRFR rating, select the View Analysis Settings button on the toolbar to open the window shown below. Click Open Template button and select the LRFR Design Load Rating to be used in the rating and click Ok.



## STL2 - Two Span Plate Girder Example

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 on the toolbar. The window shown below will open.

Analysis Results - Plate Girder

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
HL-93 (US)	Truck + L	LRFR	Inventory	8.48	0.236	90.00	1 - (100.0)	STRENGTH-I Steel FI	As Requested	As Requested
HL-93 (US)	Truck + L	LRFR	Operating	11.00	0.305	90.00	1 - (100.0)	STRENGTH-I Steel FI	As Requested	As Requested
HL-93 (US)	Tandem +	LRFR	Inventory	9.98	0.277	90.00	1 - (100.0)	STRENGTH-I Steel FI	As Requested	As Requested
HL-93 (US)	Tandem +	LRFR	Operating	12.93	0.359	90.00	1 - (100.0)	STRENGTH-I Steel FI	As Requested	As Requested
HL-93 (US)	90%(Truc	LRFR	Inventory	6.09	0.169	90.00	1 - (100.0)	STRENGTH-I Steel FI	As Requested	As Requested
HL-93 (US)	90%(Truc	LRFR	Operating	7.90	0.219	90.00	1 - (100.0)	STRENGTH-I Steel FI	As Requested	As Requested
LRFD Fatigue Truck (US)	Axle Load	LRFR	Inventory	43.64	1.455	45.00	1 - (50.0)	FATIGUE Steel Flexu	As Requested	As Requested

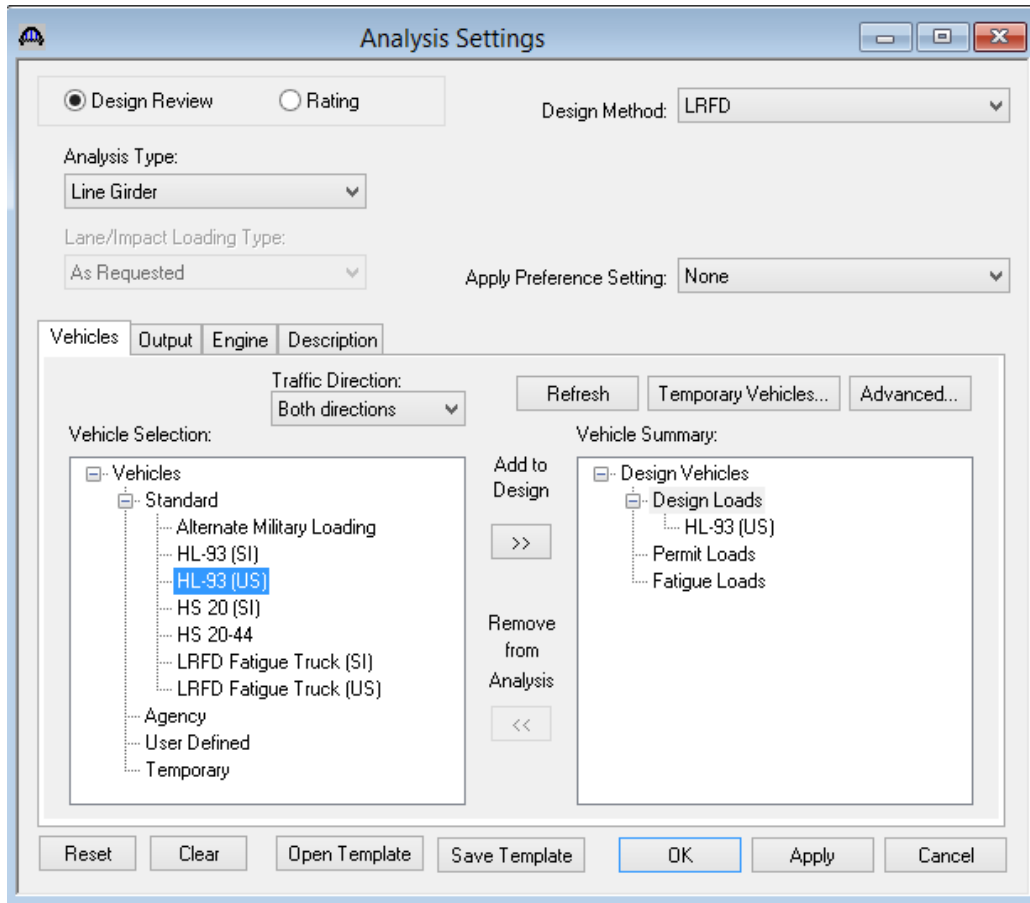
AASHTO LRFR Engine Version 6.8.0.3001

Analysis Preference Setting: None


Close

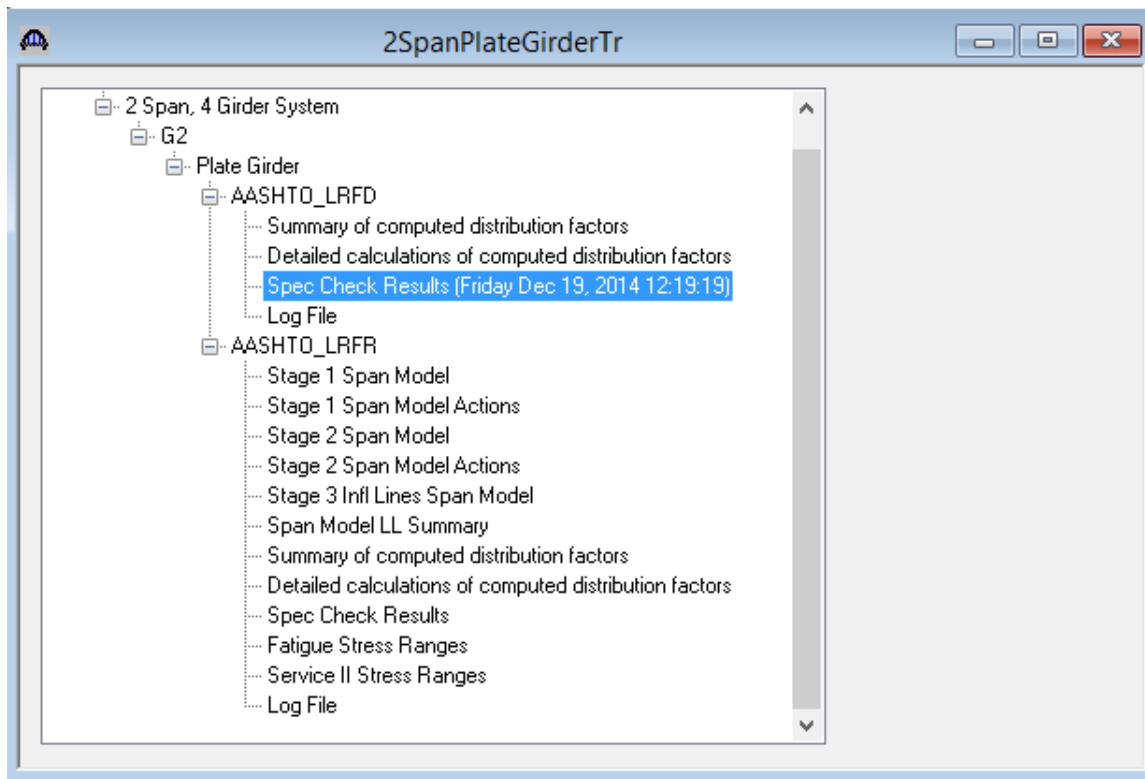
## STL2 - Two Span Plate Girder Example

An LRFD design review of this girder for HL-93 loading can be performed by AASHTO LRFD. To do LRFD design review, enter the Analysis Settings window as shown below:



## STL2 - Two Span Plate Girder Example

AASHTO LRFD analysis will generate a spec check results file. Click  on tool bar to open the following window.



To view the spec check results, double click the Spec Check Results in this window.