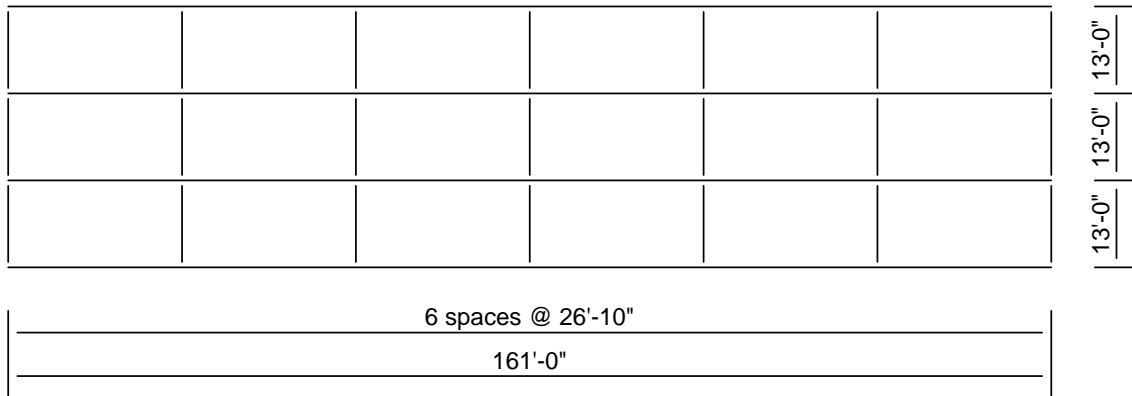
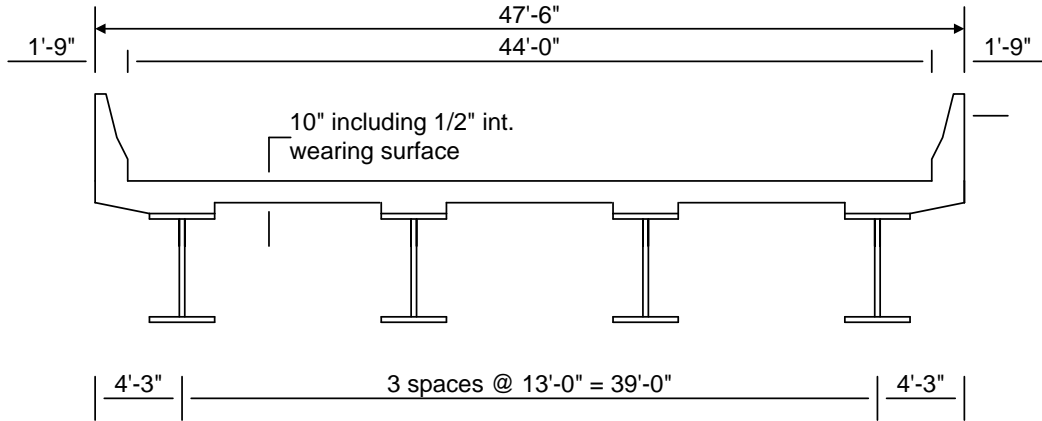
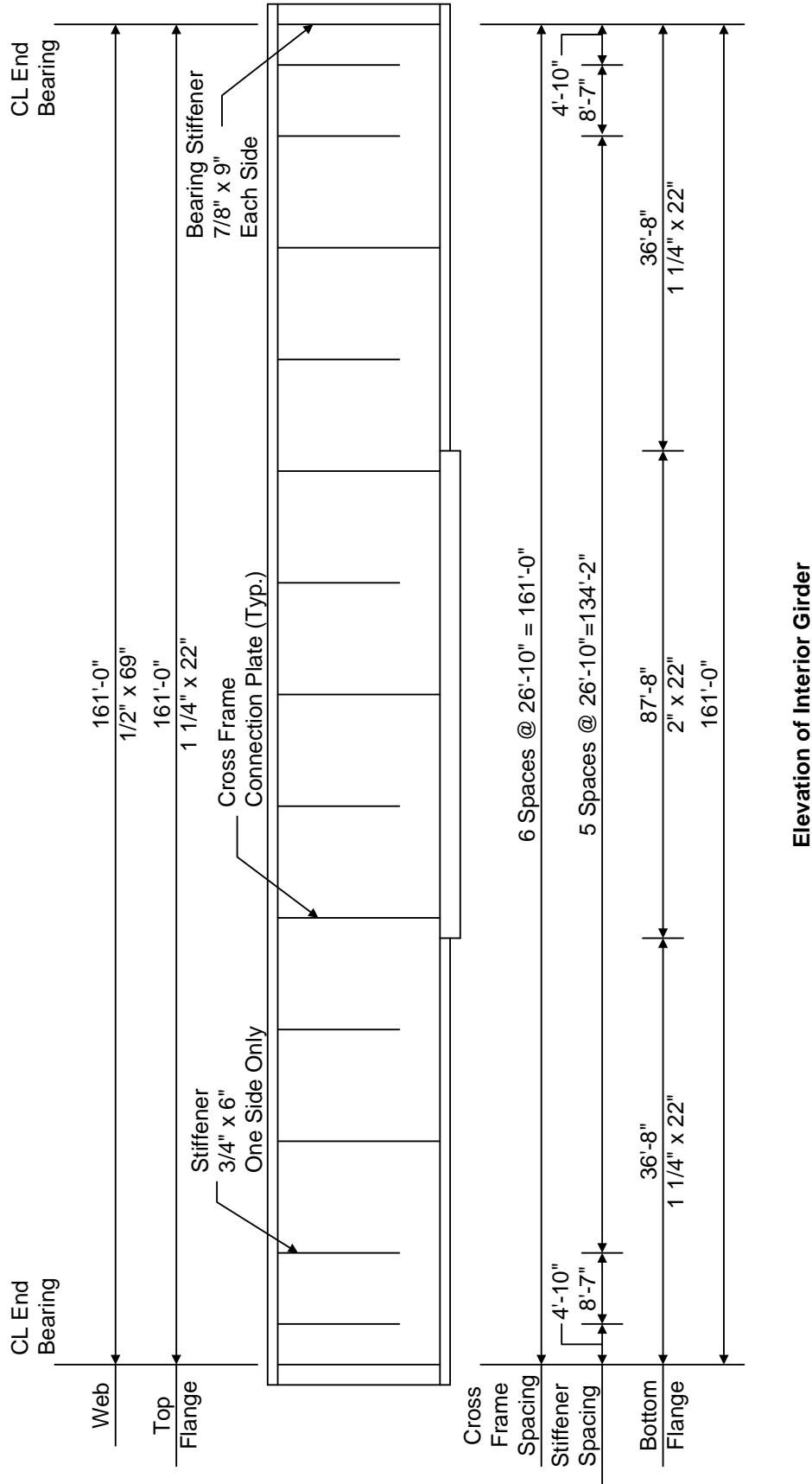


### STL1 - Simple Span Plate Girder Example



**Framing Plan**



Elevation of Interior Girder

**Material Properties**

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

Deck Concrete:  $f'_c = 4.5$  ksi, modular ratio  $n = 8$

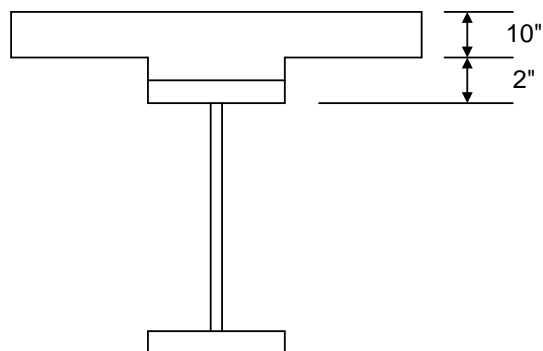
Slab Reinforcing Steel: AASHTO M31, Grade 60 with  $F_y = 60$  ksi

Transverse Stiffener Plates:  $3/4" \times 6"$

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

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

**Haunch Detail**



## AASHTOWare Bridge Rating and Design Training

### STL1– Simple Span Plate Girder Example (BrR/BrD 6.4)

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

Bridge ID:  NBI Structure ID (8):   Template  Superstructures  
 Bridge Completely Defined  Culverts

Description | Description (cont'd) | Alternatives | Global Reference Point | Traffic

Name:  Year Built:

Description:

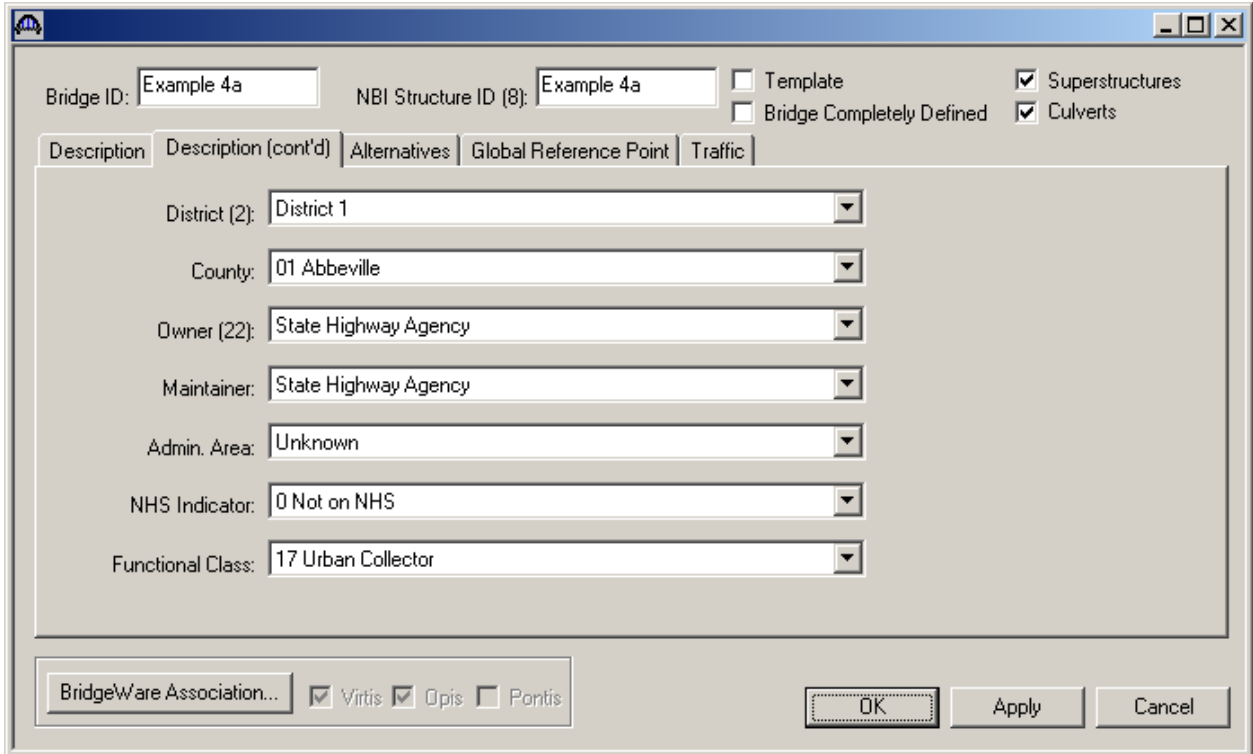
Location:  Length:  ft

Facility Carried (7):  Route Number:

Feat. Intersected (6):  Mi. Post:

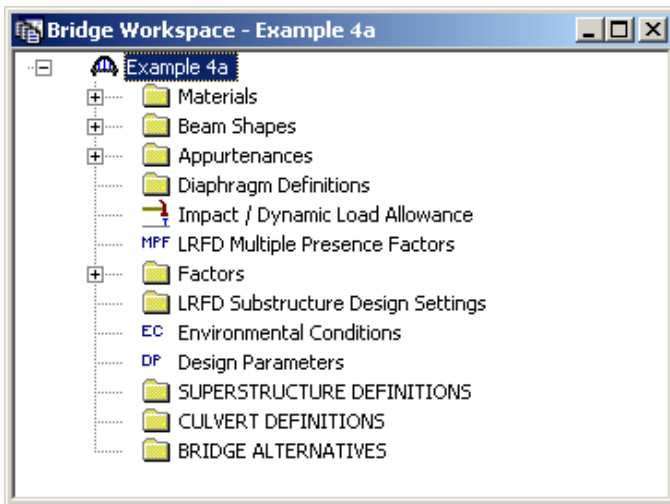
Default Units:

BridgeWare Association...  Virtis  Opis  Pontis




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

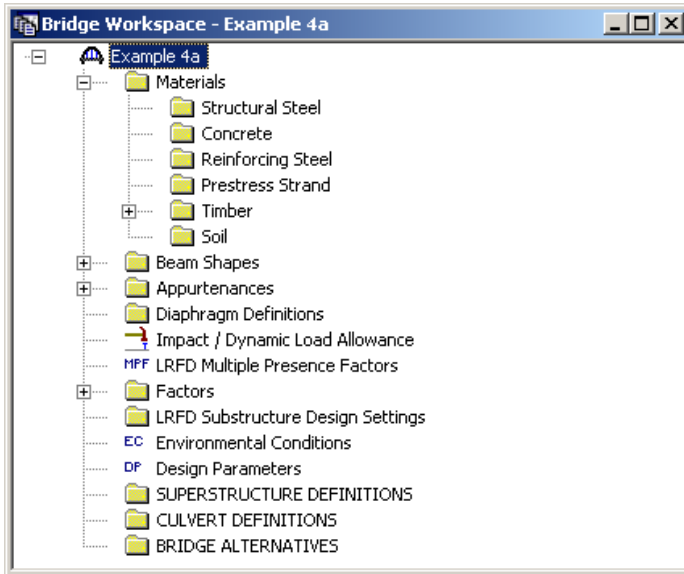
The Bridge Workspace tree after the bridge is created is shown below:



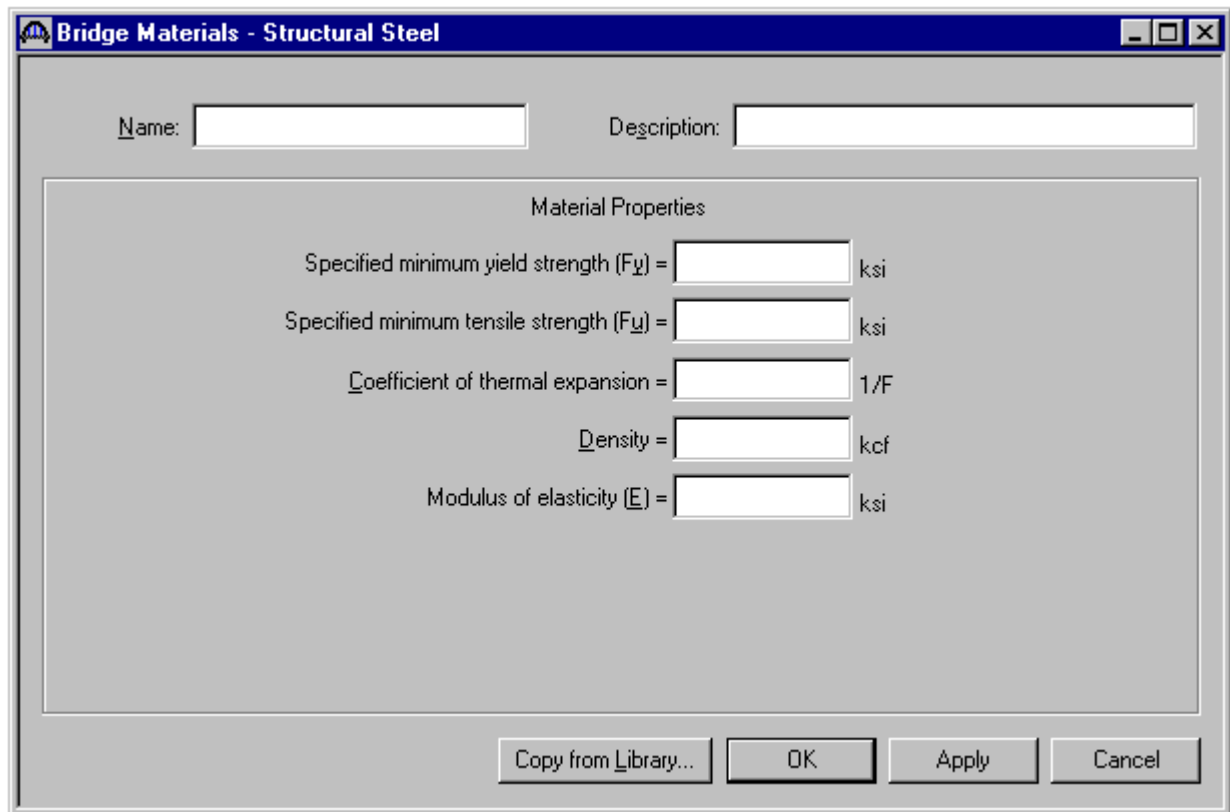
The tree is organized according to the definition of a bridge with data shared by many of the bridge components shown in the upper part of the tree. A bridge can be described by working from top to bottom within the tree.

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

The tree with the expanded Materials branch is shown below:



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 structural steel materials 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 - > 5" to 8" incl.	ASTM A 588 - over	Standa	US Cu	42.00	63.00	0.000	0.4900	29000.00
ASTM A94 - <= 1 1/8"	ASTM A 94 - 1 1/8" t	Standa	US Cu	50.00	75.00	0.000	0.4900	29000.00
ASTM A94 - over 1 1/8" to 2" incl.	ASTM A 94 - over 1	Standa	US Cu	47.00	72.00	0.000	0.4900	29000.00
Grade 100 - > 2.5" to 4" incl.	AASHTO M270 Grad	Standa	US Cu	90.00	100.0	0.000	0.4900	29000.00
Grade 100 <= 2.5"	AASHTO M270 Grad	Standa	US Cu	100.0	110.0	0.000	0.4900	29000.00
Grade 100W - > 2.5" to 4" incl.	AASHTO M270 Grad	Standa	US Cu	90.00	100.0	0.000	0.4900	29000.00
Grade 100W <= 2.5"	AASHTO M270 Grad	Standa	US Cu	100.0	110.0	0.000	0.4900	29000.00
Grade 250	AASHTO M270M Gr	Standa	SI / Me	250.0	400.0	0.000	7849.000	199948.00
Grade 345	AASHTO M270M Gr	Standa	SI / Me	345.0	450.0	0.000	7849.000	199948.00
Grade 345W	AASHTO M270M Gr	Standa	SI / Me	345.0	485.0	0.000	7849.000	199948.00
Grade 36	AASHTO M270 Grad	Standa	US Cu	36.00	58.00	0.000	0.4900	29000.00
Grade 485W	AASHTO M270M Gr	Standa	SI / Me	485.0	620.0	0.000	7849.000	199948.00
Grade 50	AASHTO M270 Grad	Standa	US Cu	50.00	65.00	0.000	0.4900	29000.00
Grade 50W	AASHTO M270 Grad	Standa	US Cu	50.00	70.00	0.000	0.4900	29000.00
Grade 690 - > 65 to 100 incl.	AASHTO M270M - o	Standa	SI / Me	620.0	690.0	0.000	7849.000	199947.95
Grade 690 <= 65 mm	AASHTO M270M Gr	Standa	SI / Me	690.0	760.0	0.000	7849.000	199948.00
Grade 690W - > 65 to 100 incl.	AASHTO M270M - o	Standa	SI / Me	620.0	690.0	0.000	7849.000	199947.95
Grade 690W <= 65 mm	AASHTO M270M Gr	Standa	SI / Me	690.0	760.0	0.000	7849.000	199948.00
Grade 70W	AASHTO M270 Grad	Standa	US Cu	70.00	90.00	0.000	0.4900	29000.00
Prior to 1905	Built prior to 1905 - s	Standa	US Cu	26.00	52.00	0.000	0.4900	29000.00

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 dialog box titled "Bridge Materials - Structural Steel". At the top, there are two text input fields: "Name:" with the value "Grade 50W" and "Description:" with the value "AASHTO M270 Grade 50W". Below these is a section titled "Material Properties" containing five rows of input fields with their respective units:

- Specified minimum yield strength ( $F_y$ ) = 50.000 ksi
- Specified minimum tensile strength ( $F_u$ ) = 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 four buttons: "Copy from Library...", "OK", "Apply", and "Cancel".



Add concrete materials and reinforcement materials using the same techniques. Enter the concrete material as shown below:

**Bridge Materials - Concrete**

Name:  Description:

Compressive strength at 28 days ( $f'c$ ) =  ksi

Initial compressive strength ( $f'ci$ ) =  ksi

Coefficient of thermal expansion =  1/F

Density (for dead loads) =  kcf

Density (for modulus of elasticity) =  kcf

Modulus of elasticity ( $E_c$ ) =  ksi

Initial modulus of elasticity =  ksi

Poisson's ratio =

Composition of concrete =

Modulus of rupture =  ksi

Shear factor =

**Bridge Materials - Reinforcing Steel**

Name:  Description:

**Material Properties**

Specified yield strength ( $F_y$ ) =  ksi

Modulus of elasticity ( $E_s$ ) =  ksi

*Ultimate strength ( $F_u$ )* =  ksi

**Type**

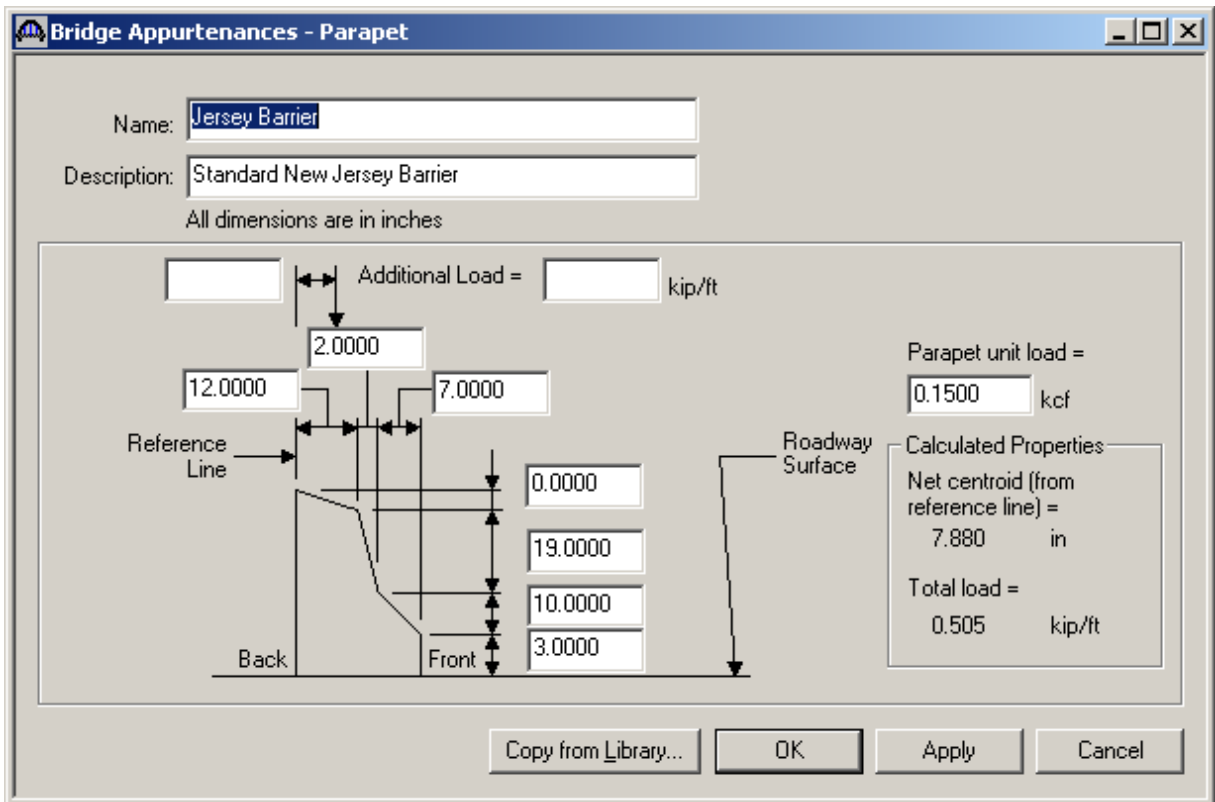
Plain

Epoxy

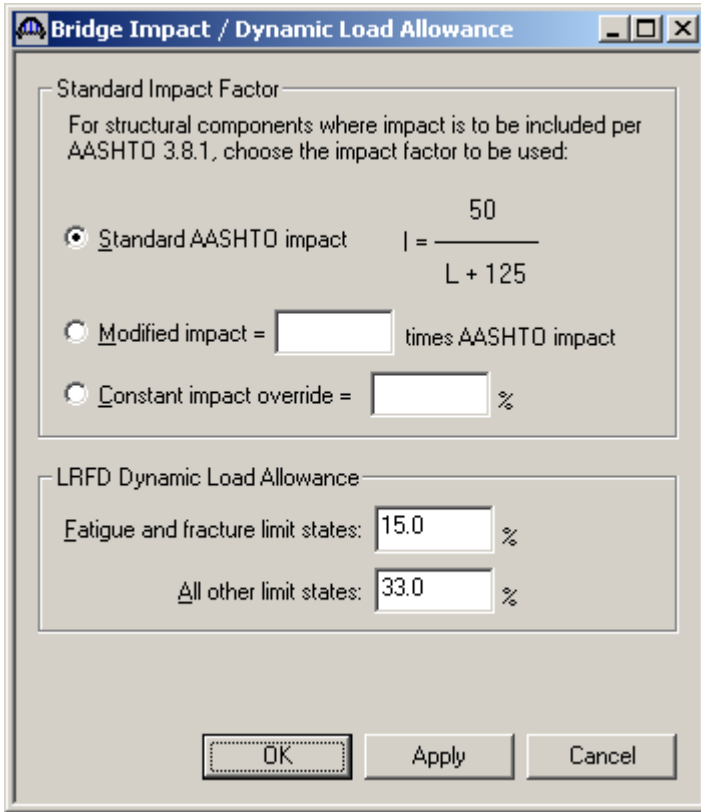
Galvanized

Other

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

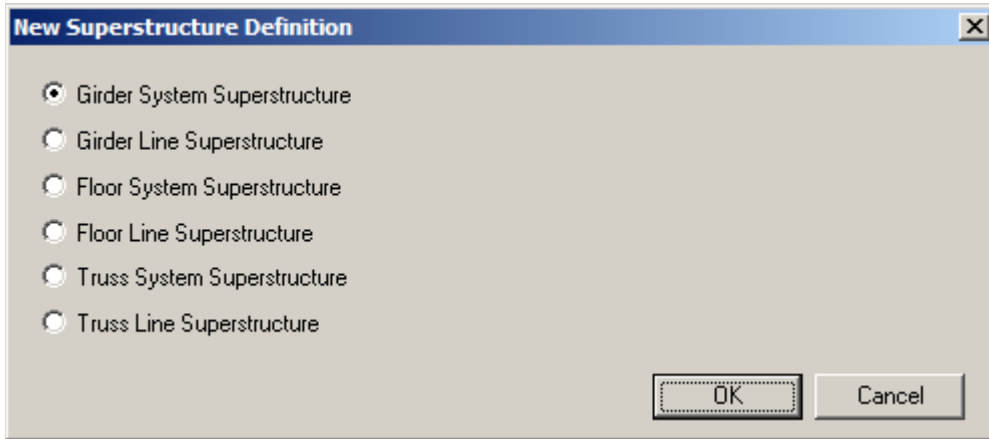


Enter the impact to be used for the entire bridge by clicking on Impact in the tree and selecting File/Open from the menu. The Bridge Impact window shown below will open. Enter the appropriate values as shown and click Ok to save the data to memory and close the window. The values shown below are default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

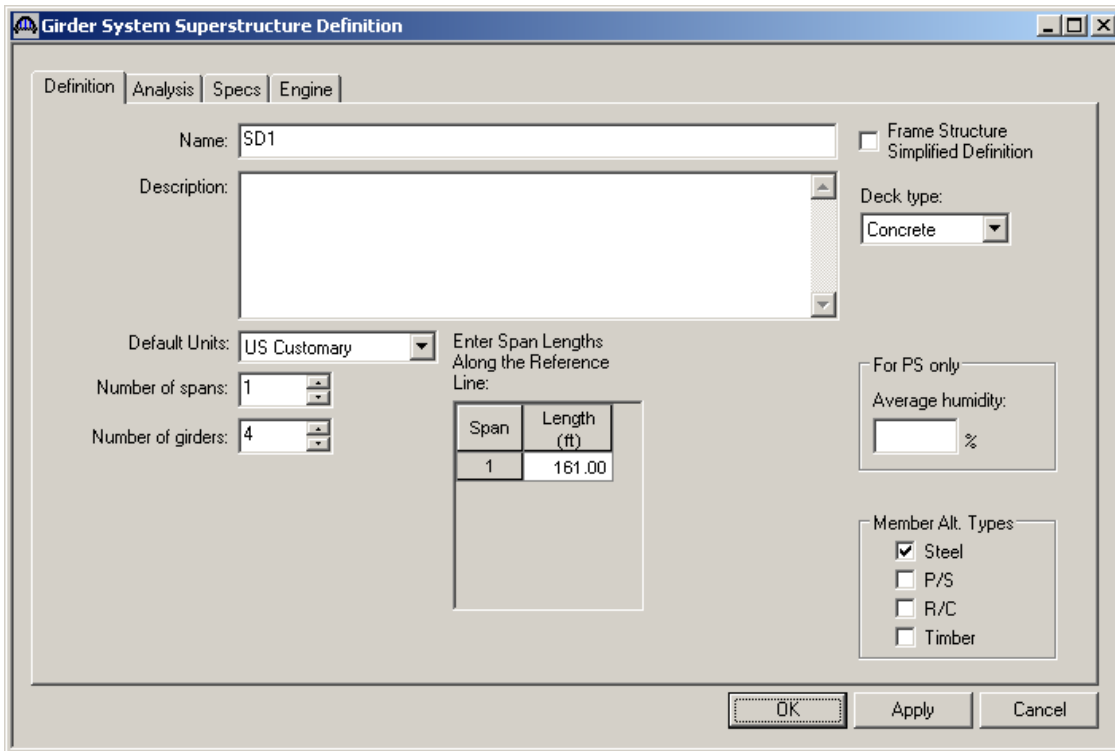


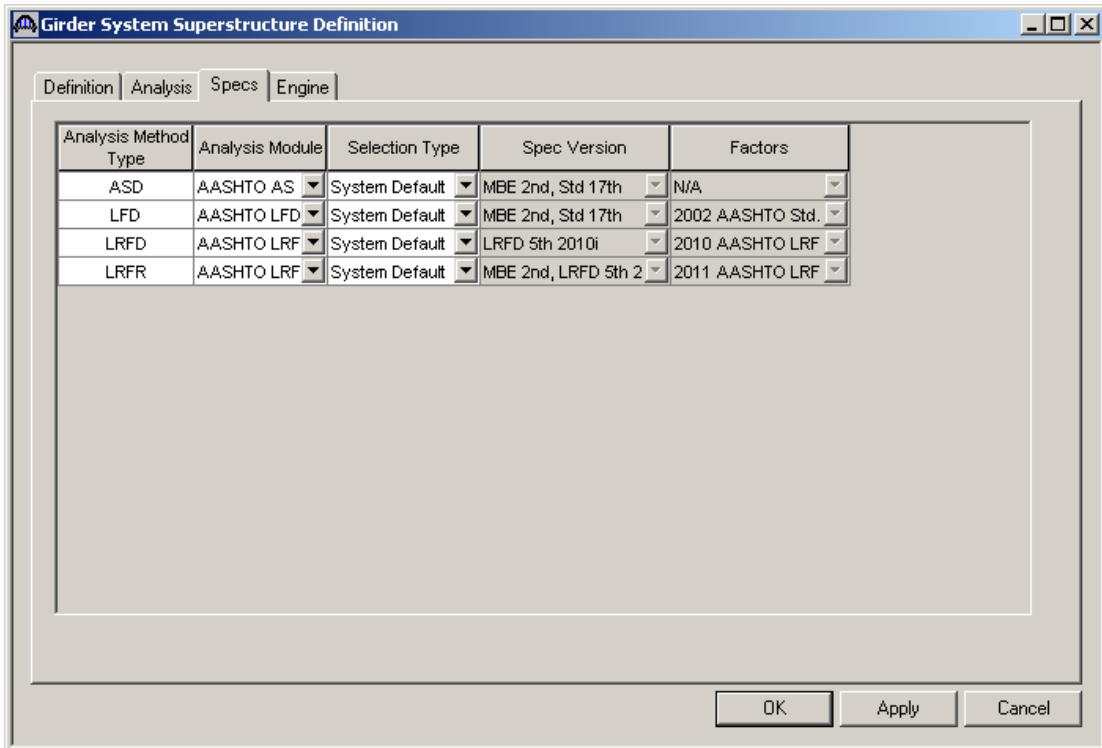
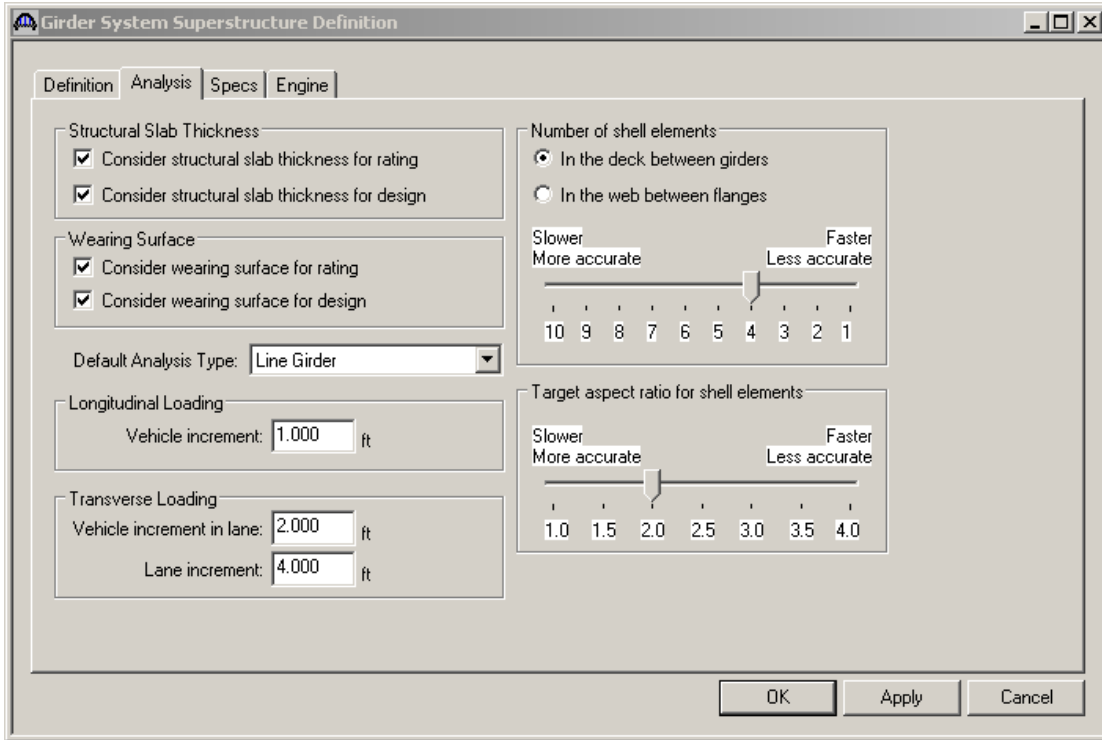
For this example problem we are not going to override the standard LRFD or LRFR factors so we skip to Structure Definition. We will come back to Bridge Alternatives after entering a Structure Definition.

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

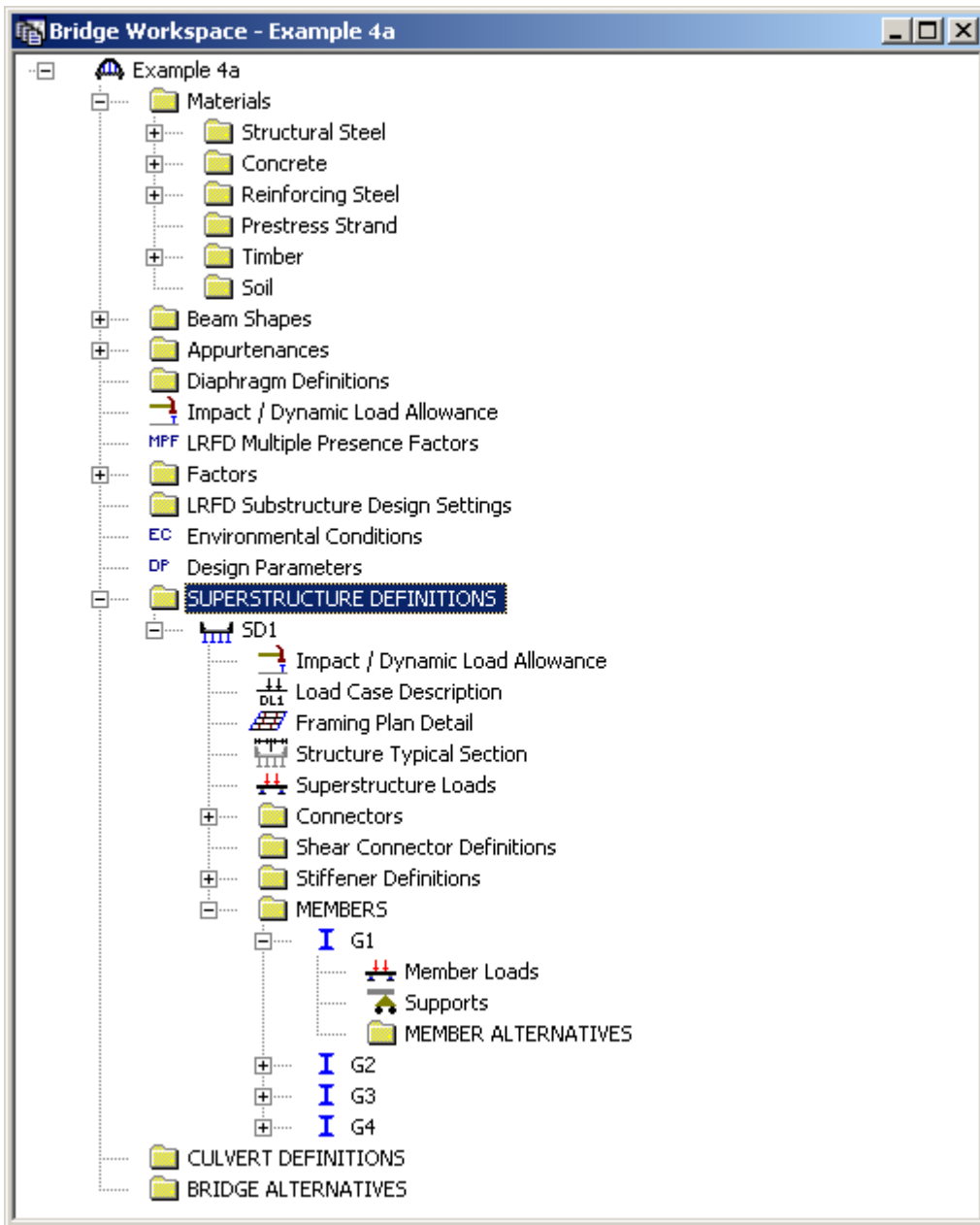




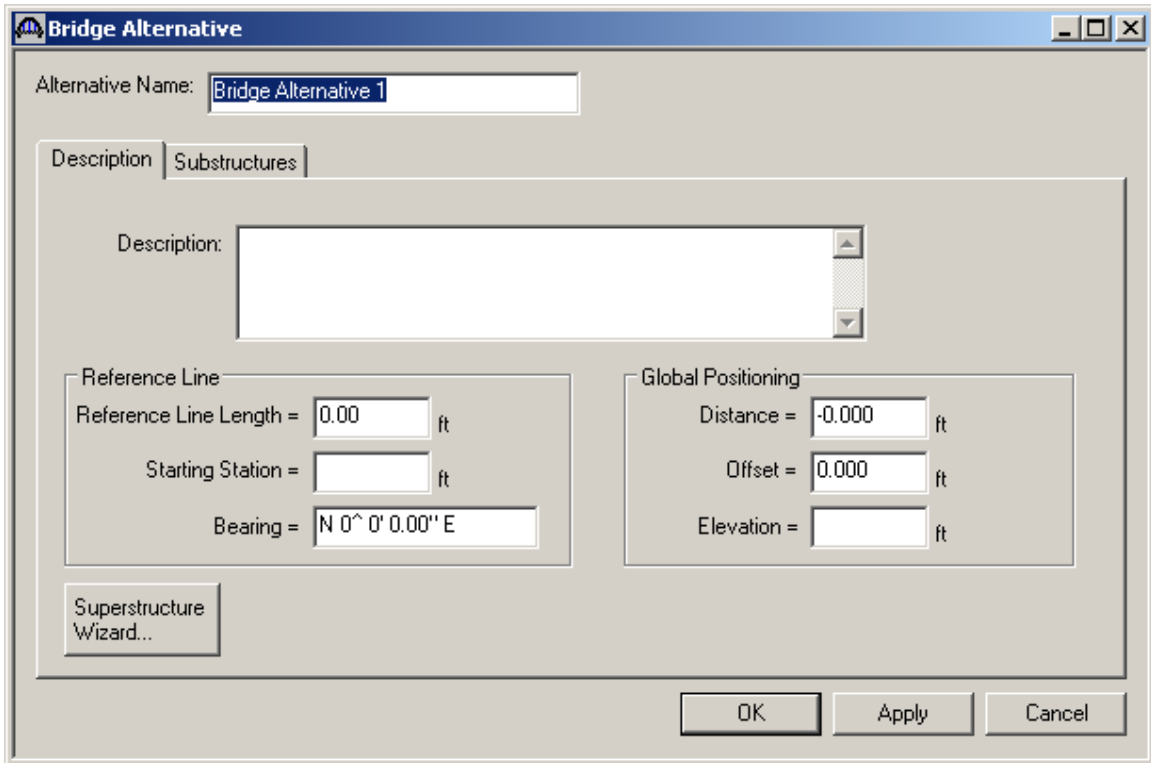
The Analysis tab and Specs tab are shown above with the default selections. Since we are not overriding default selections for this exercise, no changes are required.

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

The partially expanded Bridge Workspace tree is shown below:



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



Bridge Alternative

Alternative Name: Bridge Alternative 1

Description Substructures

Description:

Reference Line

Reference Line Length = 0.00 ft

Starting Station = [ ] ft

Bearing = N 0° 0' 0.00" E

Global Positioning

Distance = -0.000 ft

Offset = 0.000 ft

Elevation = [ ] ft

Superstructure Wizard...

OK Apply Cancel

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

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

Superstructure Name:

Description Alternatives Vehicle Path Engine Substructures

Description:

Reference Line

Distance =  ft

Offset =  ft

Angle =  Degrees

Starting Station =  ft

OK Apply Cancel



Double-click on Superstructure Alternatives and enter the following new Superstructure Alternative. Select the Superstructure definition SD1 as the current superstructure definition for this Superstructure Alternative.

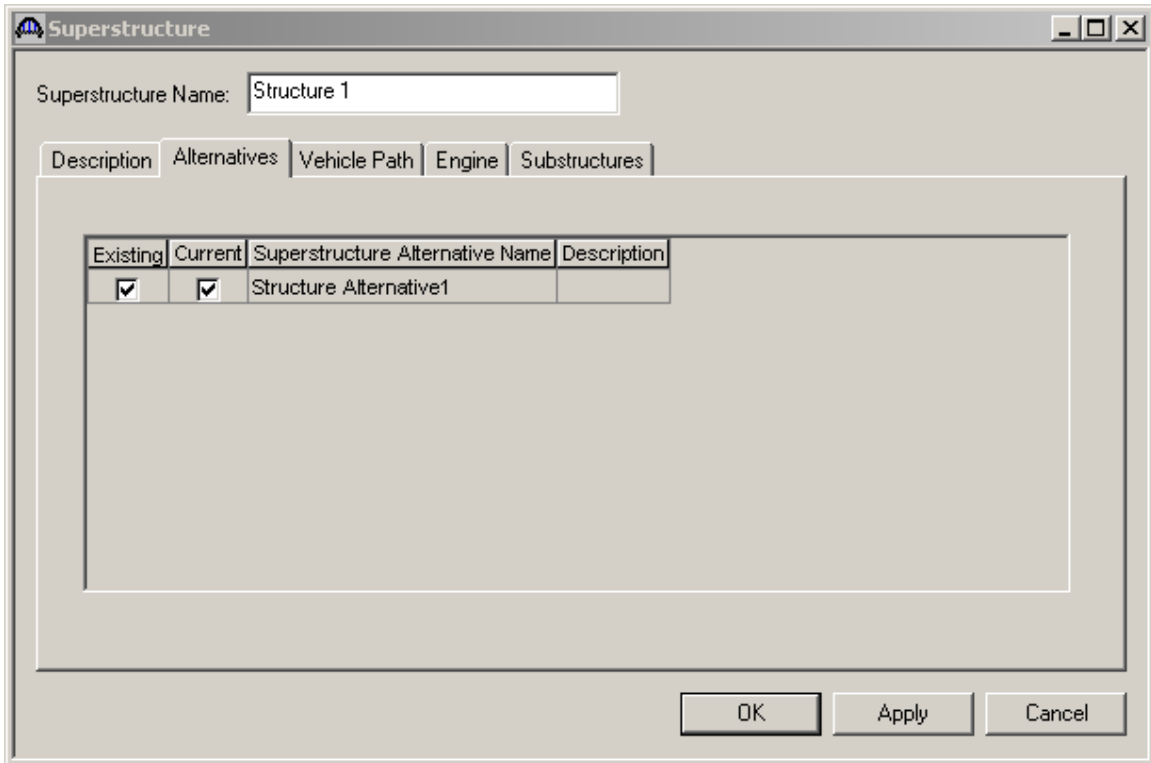
The screenshot shows a dialog box titled "Superstructure Alternative". It contains the following fields and controls:

- Alternative Name: Structure Alternative 1
- Description: (empty text box)
- Superstructure Definition: SD1 (selected in a dropdown menu)
- Superstructure type: Girder
- Number of main members: 4

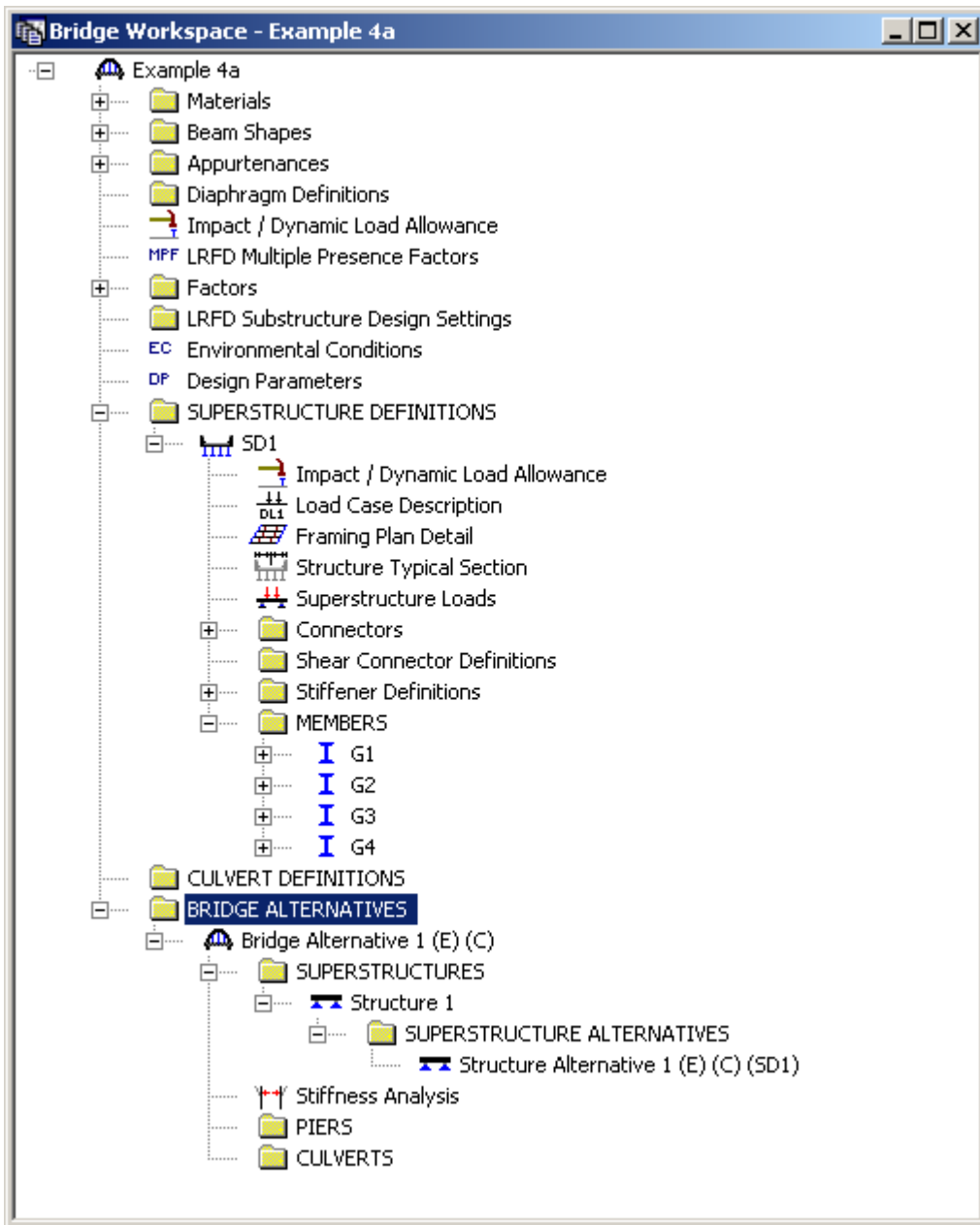
Span	Length (ft)
1	161.00

Buttons: OK, Apply, Cancel

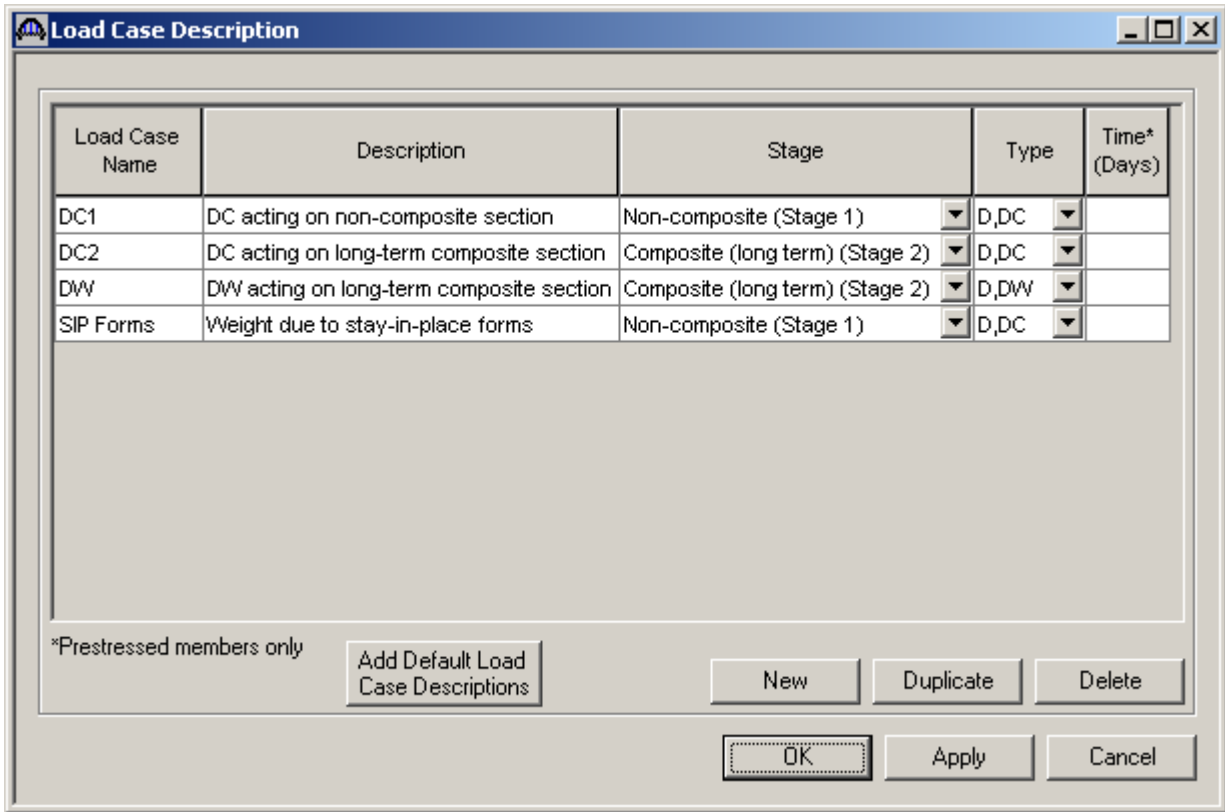
Re-open the Structure 1 window and select the Alternatives tab. The Structure Alternative 1 will be shown as the existing and current alternative for Structure 1.



The partially expanded Bridge Workspace tree 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.

Structure Framing Plan Details

Number of spans =       Number of girders =

Layout | Diaphragms

Support	Skew (Degrees)
1	0.0000
2	0.0000

Girder Spacing Orientation

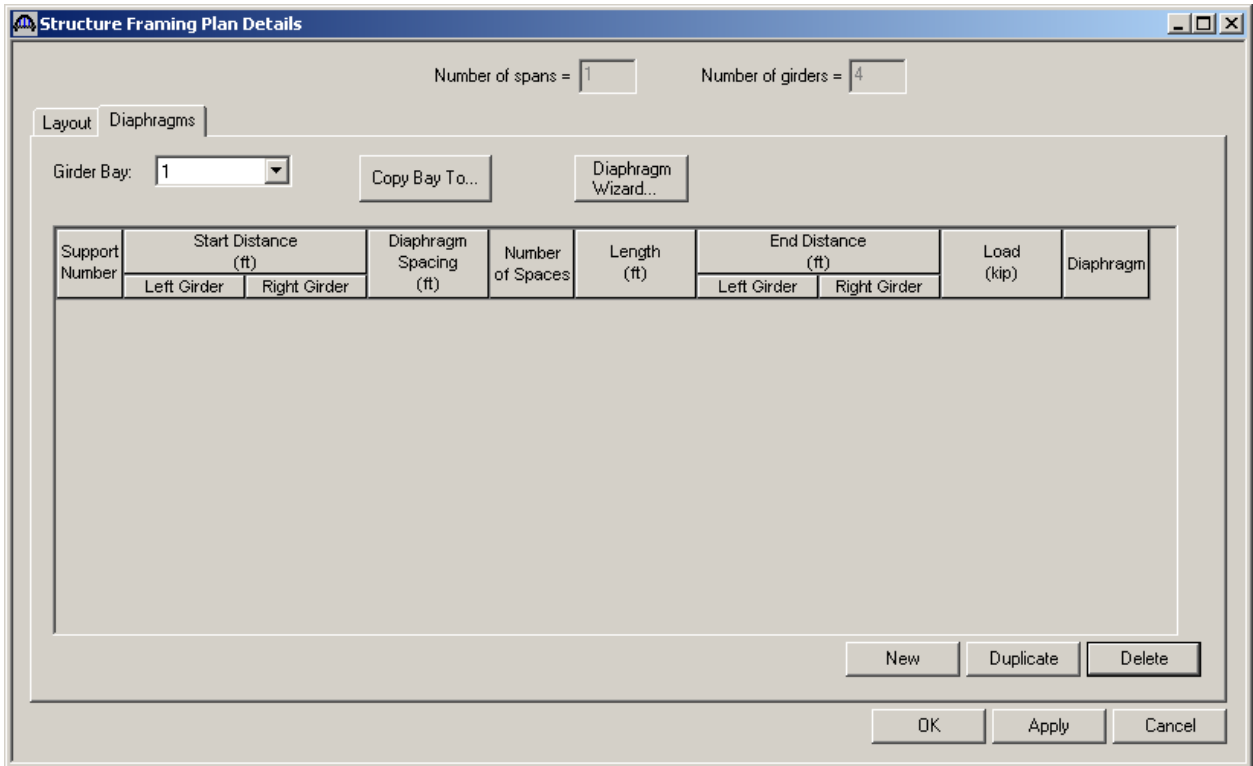
Perpendicular to girder

Along support

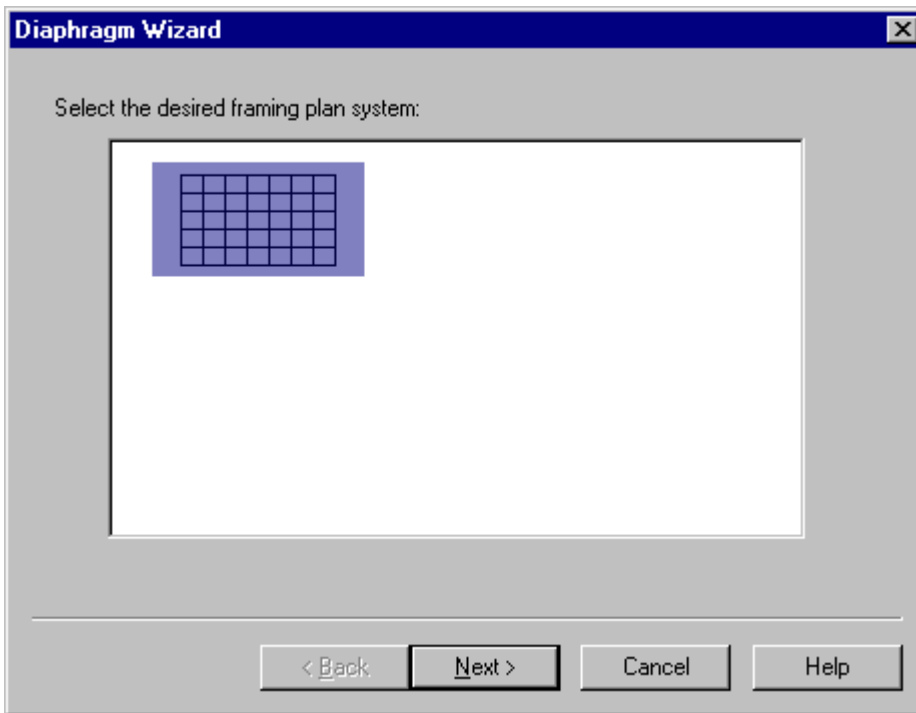
Girder Bay	Girder Spacing (ft)	
	Start of Girder	End of Girder
1	13.00	13.00
2	13.00	13.00
3	13.00	13.00

OK      Apply      Cancel

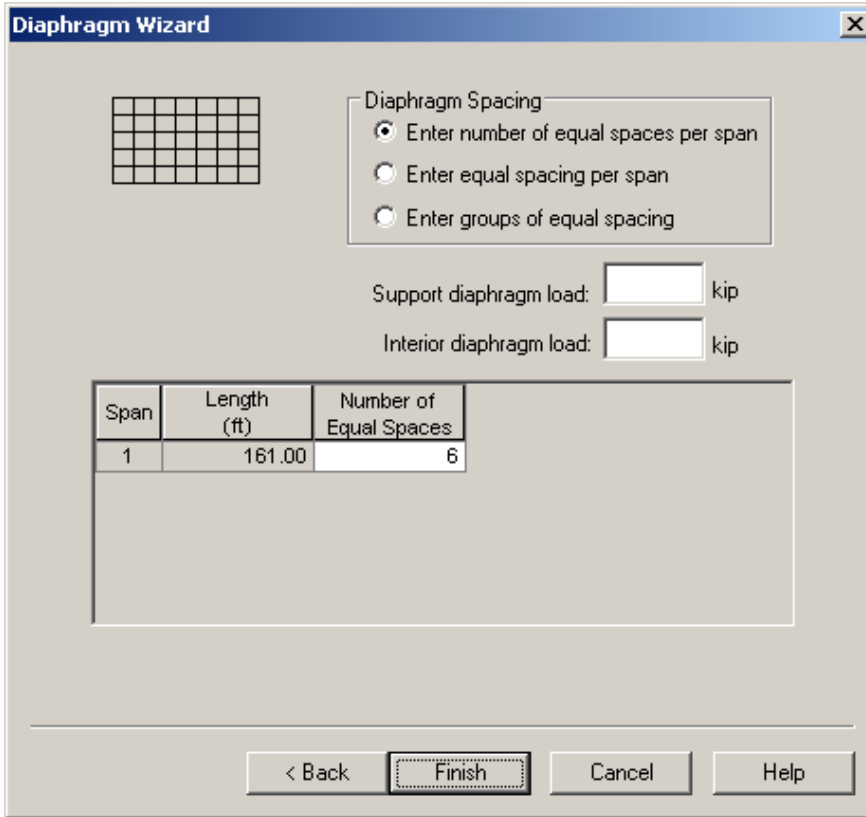
Switch to the Diaphragms tab to enter diaphragm spacing.



Click the Diaphragm Wizard button to add diaphragms for the entire structure. The Dialog shown below will appear.

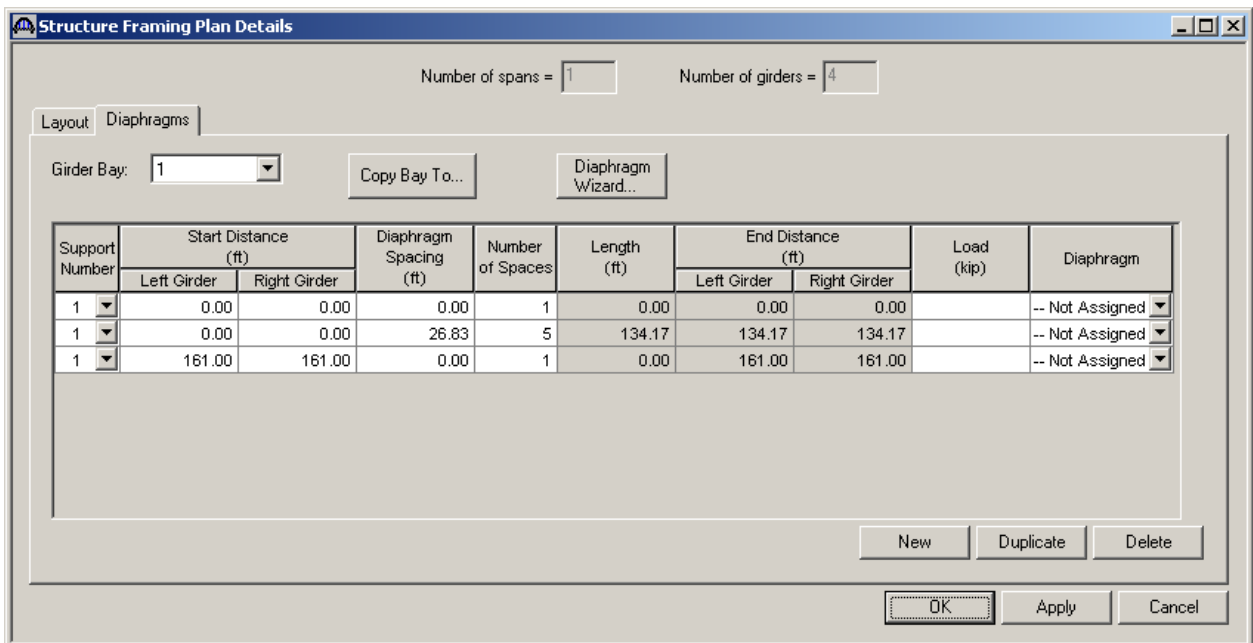


Click the Next button and enter the following spacing:



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

The diaphragms created for Girder Bay 1 are shown below:



Select Ok to close the window.

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:

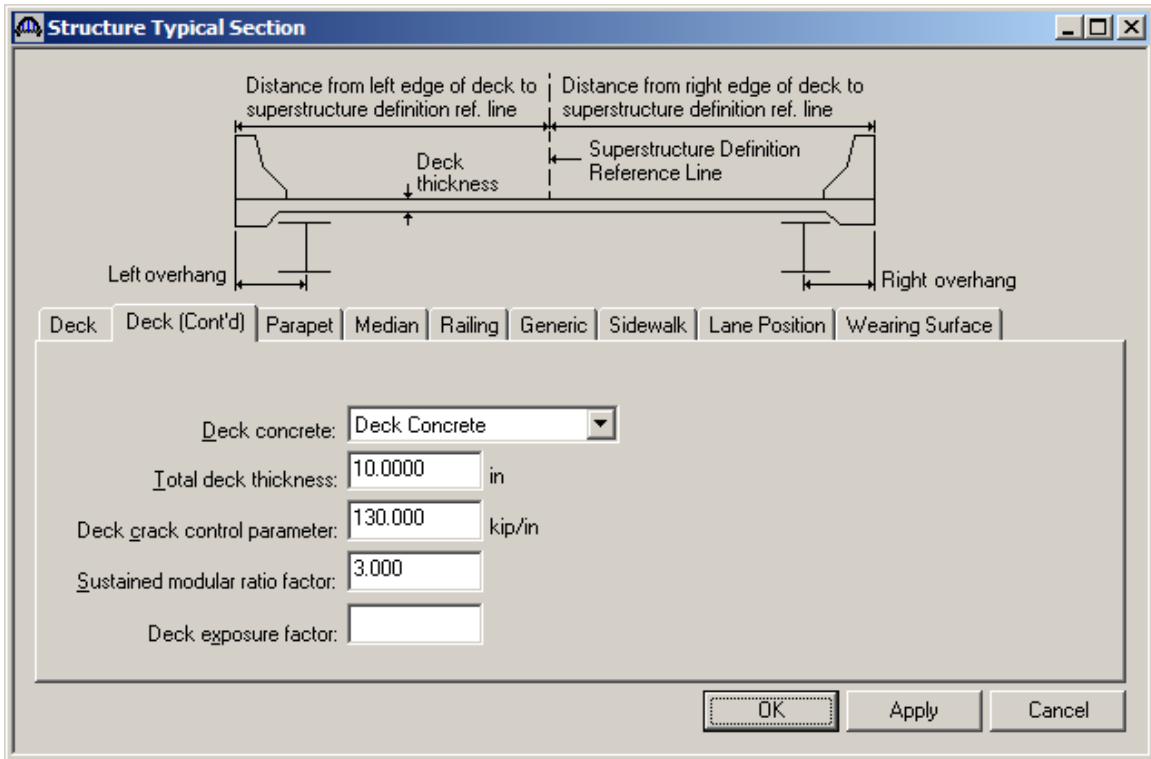
The screenshot shows the 'Structure Typical Section' dialog box with the 'Deck' tab selected. At the top, a diagram illustrates the deck geometry with labels: 'Distance from left edge of deck to superstructure definition ref. line', 'Distance from right edge of deck to superstructure definition ref. line', 'Deck thickness', 'Superstructure Definition Reference Line', 'Left overhang', and 'Right overhang'. Below the diagram, a series of tabs are visible: 'Deck', 'Deck (Cont'd)', 'Parapet', 'Median', 'Railing', 'Generic', 'Sidewalk', 'Lane Position', and 'Wearing Surface'. The 'Deck' tab is active, displaying the following settings:

- Superstructure definition reference line is  the bridge deck.
- Distance from left edge of deck to superstructure definition reference line =  ft
- Distance from right edge of deck to superstructure definition reference line =  ft
- Left overhang =  ft
- Computed right overhang =  ft

At the bottom of the dialog box, there are three buttons: 'OK', 'Apply', and 'Cancel'.

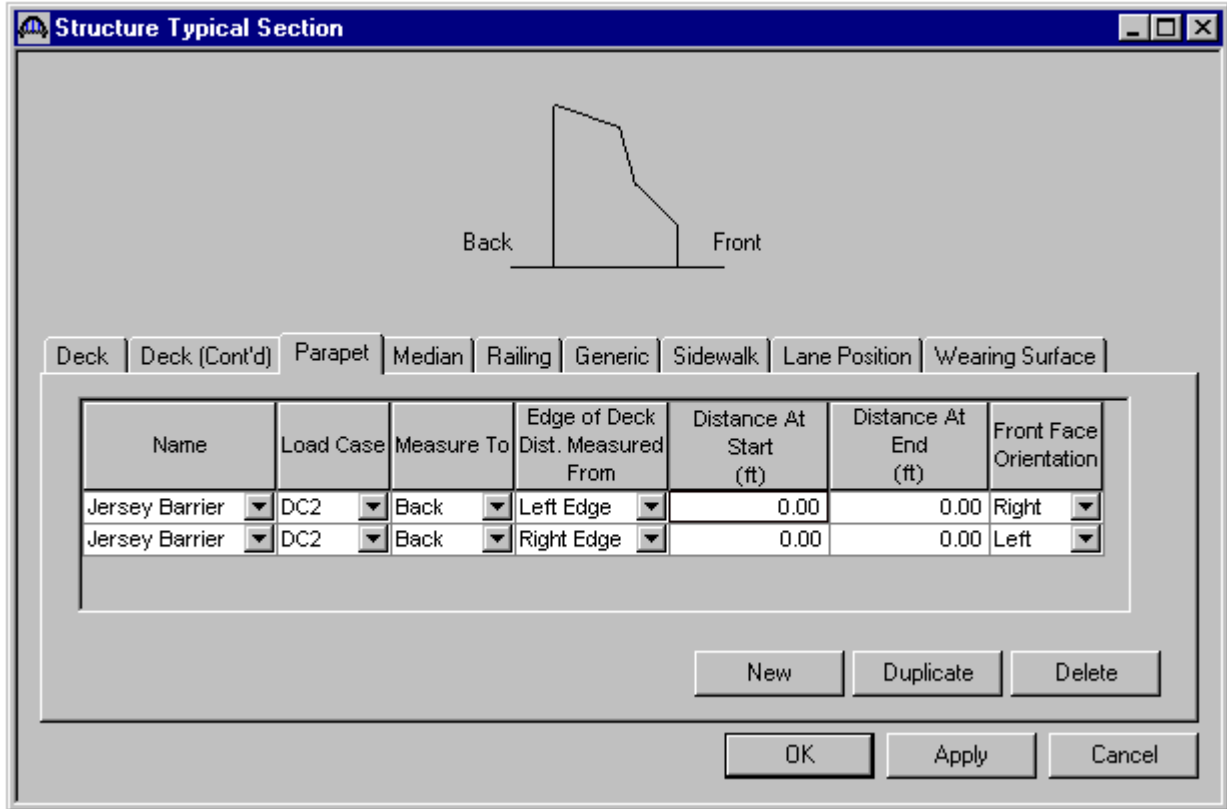


The Deck (cont'd) tab is used to enter information about the deck concrete and thickness. The material to be used for the deck concrete is selected from the list of bridge materials described above.



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 “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.



Lane Positions:

Select the Lane Position tab.

The screenshot shows the 'Structure Typical Section' dialog box with the 'Lane Position' tab selected. The diagram at the top illustrates a bridge cross-section with two travelways, 'Travelway 1' and 'Travelway 2', and a central 'Superstructure Definition Reference Line'. Dimension (A) is the distance from the left edge of Travelway 1 to the reference line, and dimension (B) is the distance from the right edge of Travelway 2 to the reference line. Below the diagram is a table for defining travelway positions.

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)

Below the table is the 'LRFD Fatigue' section with a checkbox for 'Override Truck fraction' and a text input for 'Lanes available to trucks:'. At the bottom are buttons for 'Compute...', 'New', 'Duplicate', 'Delete', 'OK', 'Apply', and 'Cancel'.

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.

The screenshot shows the 'Structure Typical Section' dialog box with the 'Lane Position' tab selected. The diagram at the top illustrates a bridge cross-section with two travelways, labeled 'Travelway 1' and 'Travelway 2'. A vertical dashed line represents the 'Superstructure Definition Reference Line'. Dimension lines indicate distances (A) and (B) from the travelway edges to the reference line at the start and end of the bridge.

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	-22.00	22.00	-22.00	22.00

LRFD Fatigue  
 Lanes available to trucks:   
 Override Truck fraction:

Buttons: Compute..., New, Duplicate, Delete, OK, Apply, Cancel

**Wearing Surface:**

Enter the data shown below.

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 | **Wearing Surface**

Wearing surface material: Asphalt

Description: Asphalt - 25 psf

Wearing surface thickness = 2.7800 in  Thickness field measured (DW = 1.25 if checked)

Wearing surface density = 108.000 pcf

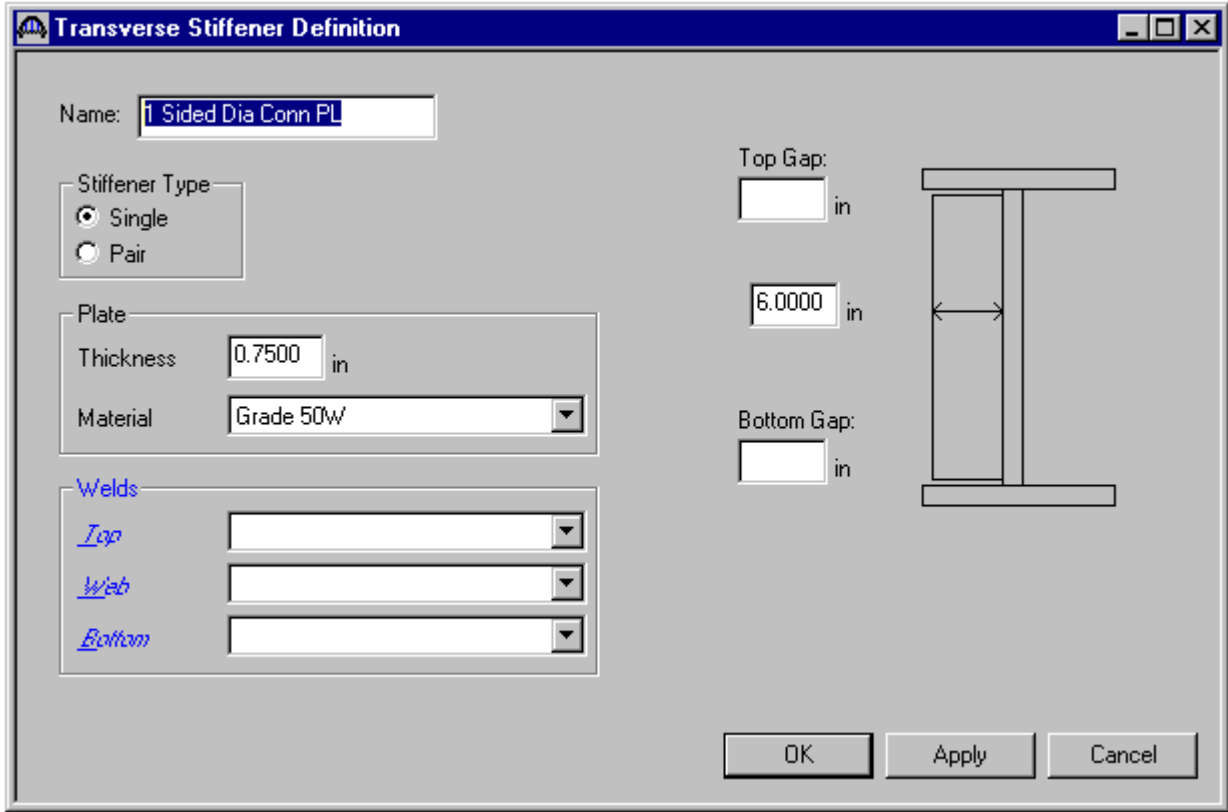
Load case: DW

Copy from Library...

OK Apply Cancel

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

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. Repeat this process to define the other two stiffeners. The windows are shown below.



**Transverse Stiffener Definition**

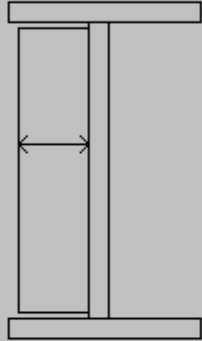
Name:

Stiffener Type  
 Single  
 Pair

Plate  
Thickness:  in  
Material:

Welds  
Top:   
Web:   
Bottom:

Top Gap:  in  
 in  
Bottom Gap:  in



OK Apply Cancel

**Transverse Stiffener Definition**

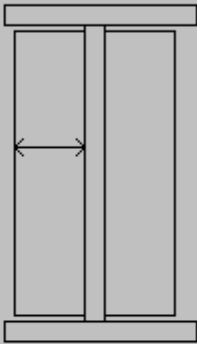
Name:

Stiffener Type  
 Single  
 Pair

Plate  
Thickness:  in  
Material:

Welds  
Top:   
Web:   
Bottom:

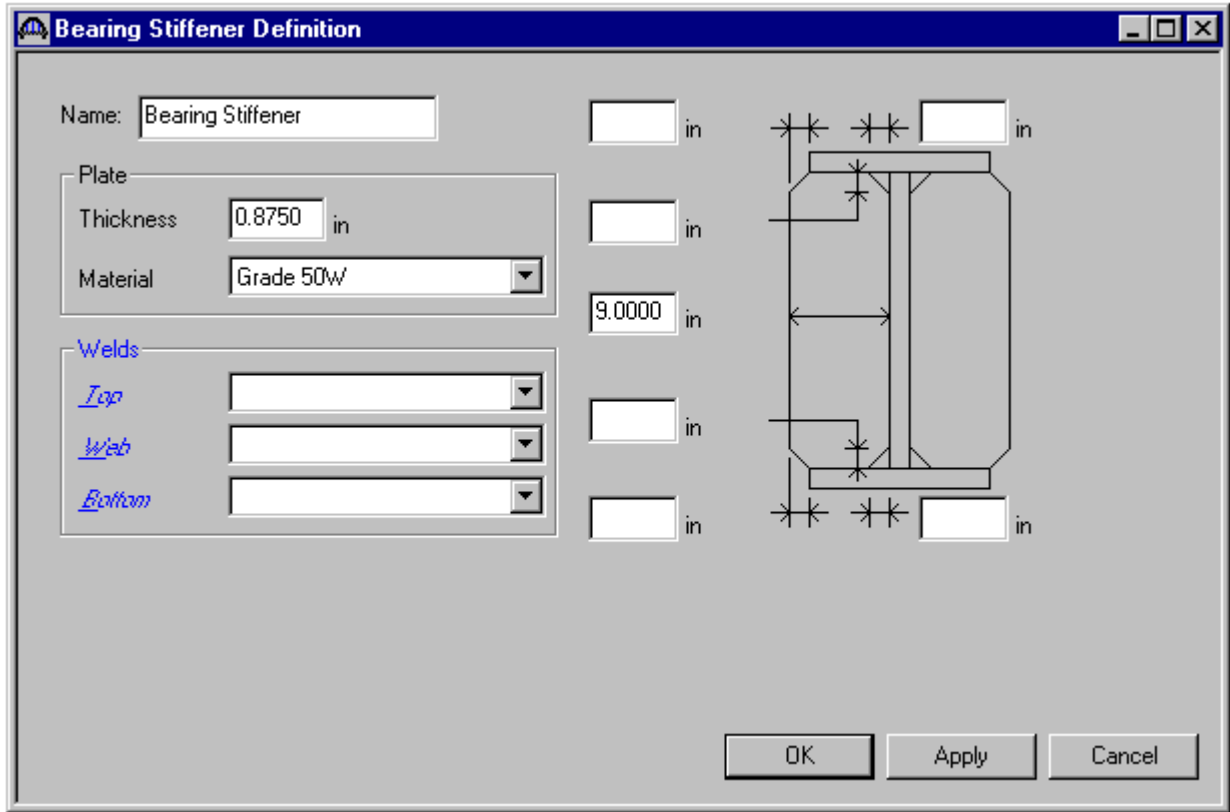
Top Gap:  in  
 in  
Bottom Gap:  in



OK Apply Cancel



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



Describing a member:

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.

Member name:  Link with:

Description:

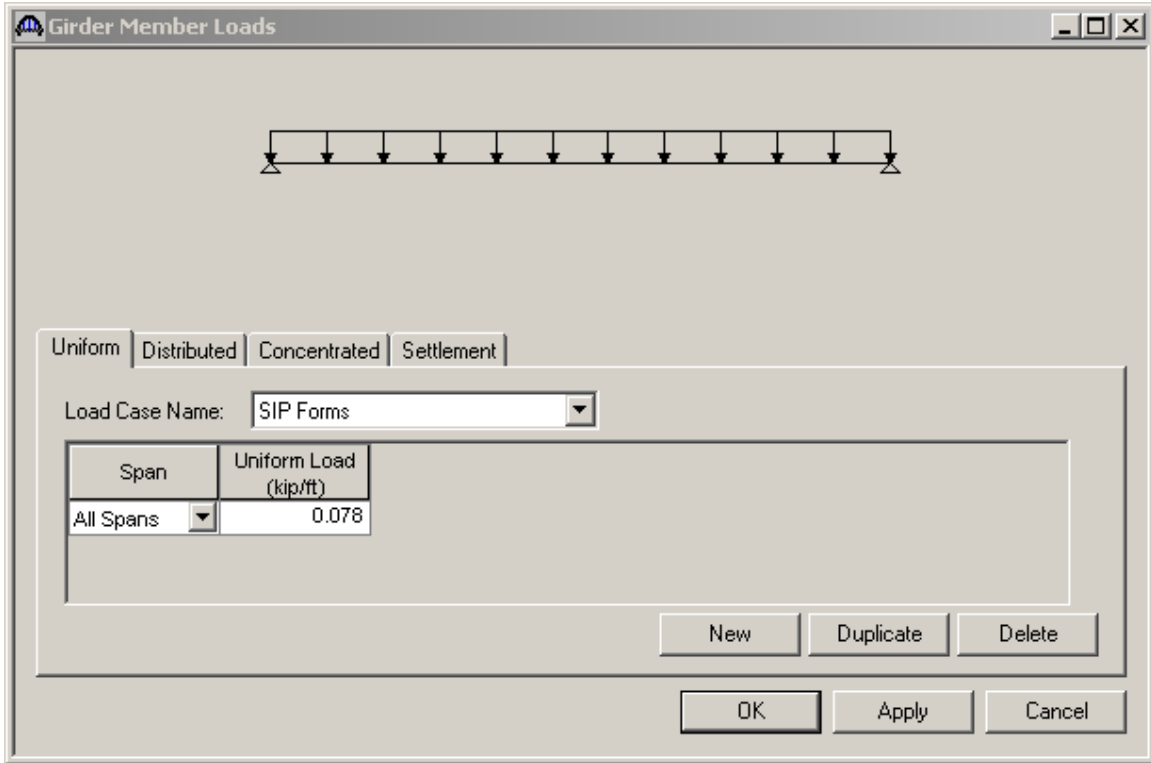
Existing	Current	Member Alternative Name	Description

Number of spans:  Pedestrian load:  lb/ft

Span No.	Span Length (ft)
1	161.00

OK Apply Cancel

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.

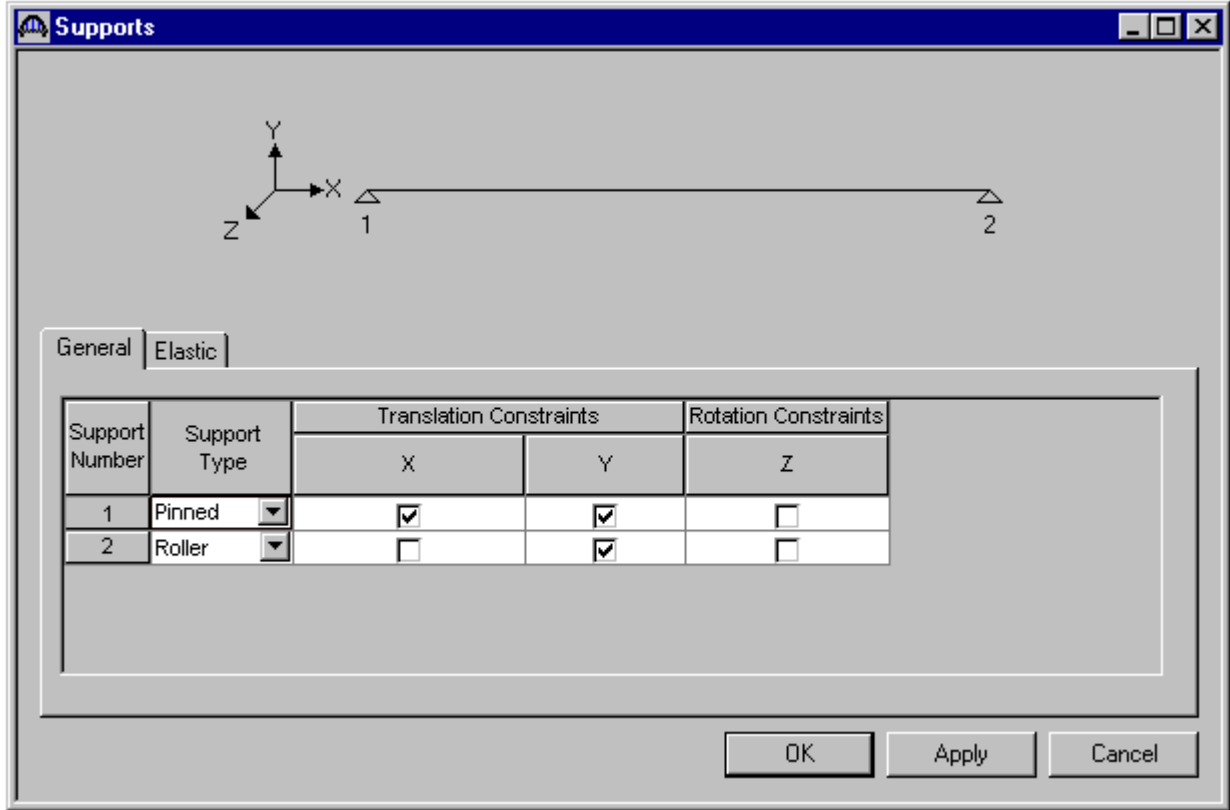


Member loads for Example 4

Example	Struct Def	Member Definition	Loads(Interior beam, Exterior beam)
a	GS	<b>Schedule-based</b>	<b>SIP (0.078, 0.039)</b>
b	GL	Schedule-based	SIP (0.078,0.039) Barrier (DC2) (0.253, 0.253) WS (DW) (0.275, 0.275)
c	GL	Cross-section based	SIP (0.078, 0.078) Barrier (DC2) (0.253, 0.253) WS (DW) (0.275, 0.275) Haunch (DC1) (0.017, 0.059)
d	GS	Cross-section based	SIP (0.078, 0.078) Haunch (DC1) (0.017, 0.059)

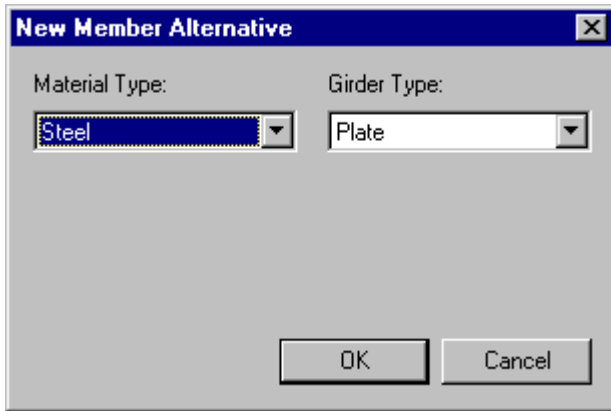
The Help topic “Dead Loads” summarizes for each type of structure definition and member modeling method which dead load components are computed automatically by the engine and which must be entered by the user.

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



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.

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

Member Alternative Description

Member Alternative: Plate Girder

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

Description: Add additional weight for steel details such as diaphragms and stiffeners

Material Type: Steel

Girder Type: Plate

Default Units: US Customary

Girder property input method

Schedule based

Cross-section based

End bearing locations

Left: 6.0000 in

Right: 6.0000 in

Default rating method:

LFD

Additional Self Load

Additional self load = 0.034 kip/ft

Additional self load = %

OK Apply Cancel

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:

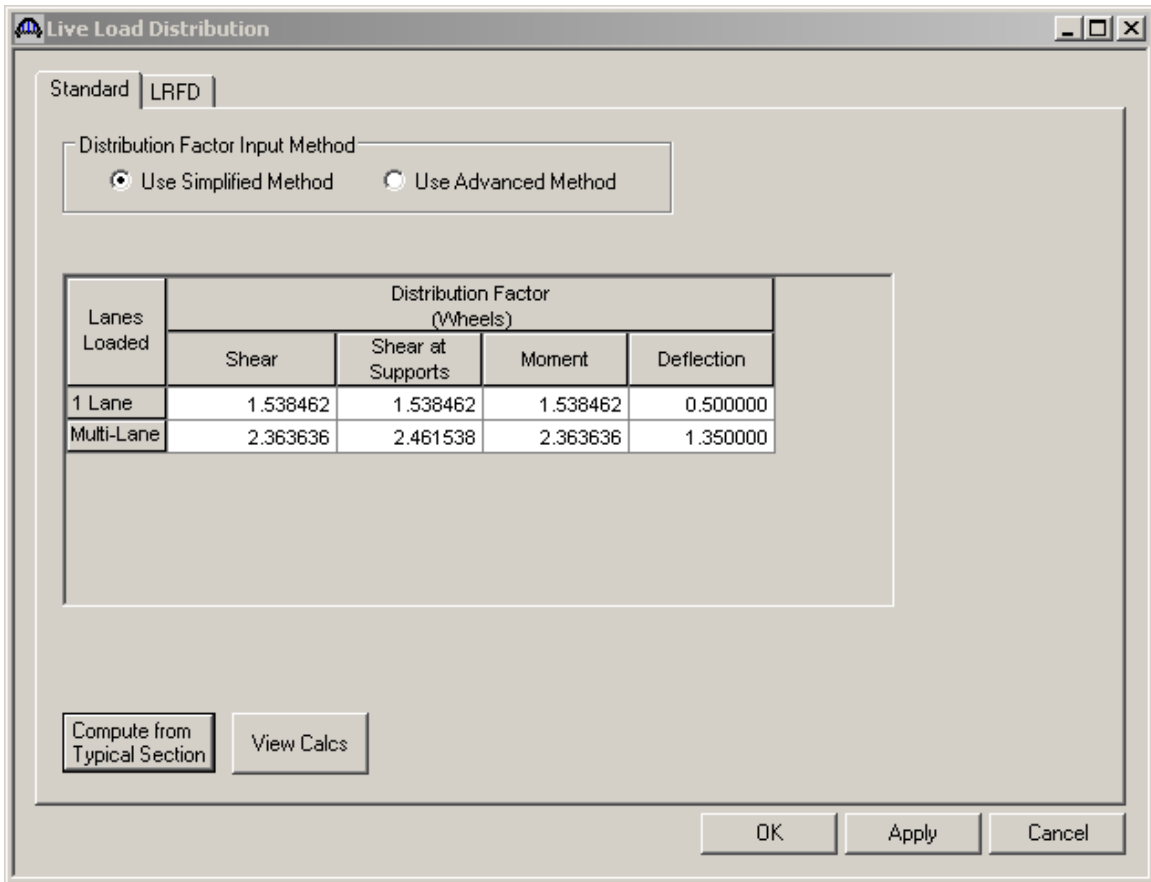
Existing	Current	Member Alternative Name	Description
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Plate Girder	Add additional self-weight for steel details

Number of spans:  Pedestrian load:  lb/ft

Span No.	Span Length (ft)
1	161.00

OK Apply Cancel

Use “Compute” button to generate distribution factors.



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 is a "Type:" field containing "Plate Girder". Below this 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
69.00	None	69.00	0.5000	1	0.00	161.00	161.00	Grade 50W	

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



Describe the flanges as shown below.

The screenshot shows the 'Girder Profile' window with the 'Top Flange' tab selected. The 'Type' is set to 'Plate Girder'. The table below shows the configuration for the top flange.

Begin Width (in)	End Width (in)	Thickness (in)	Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Material	Weld	Weld at Right
22.00	22.00	1.2500	1	0.00	161.00	161.00	Grade 50W		

Buttons at the bottom of the window include: Copy to Bottom Flange, New, Duplicate, Delete, OK, Apply, and Cancel.

Enter the following starting distance and length to the bottom flange tab.

starting distance	bottom flange
0	36.666
36.666	87.667
124.333	36.667

The screenshot shows the 'Girder Profile' window with the 'Bottom Flange' tab selected. The table below represents the data shown in the window:

Begin Width (in)	End Width (in)	Thickness (in)	Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Material	Weld	Weld at Right
22	22	1.25	1	0	36.67	36.67	Grade 50W		
22	22	2.0000	1	36.67	87.67	124.33	Grade 50W		
22	22	1.25	1	124.33	36.67	161.00	Grade 50W		

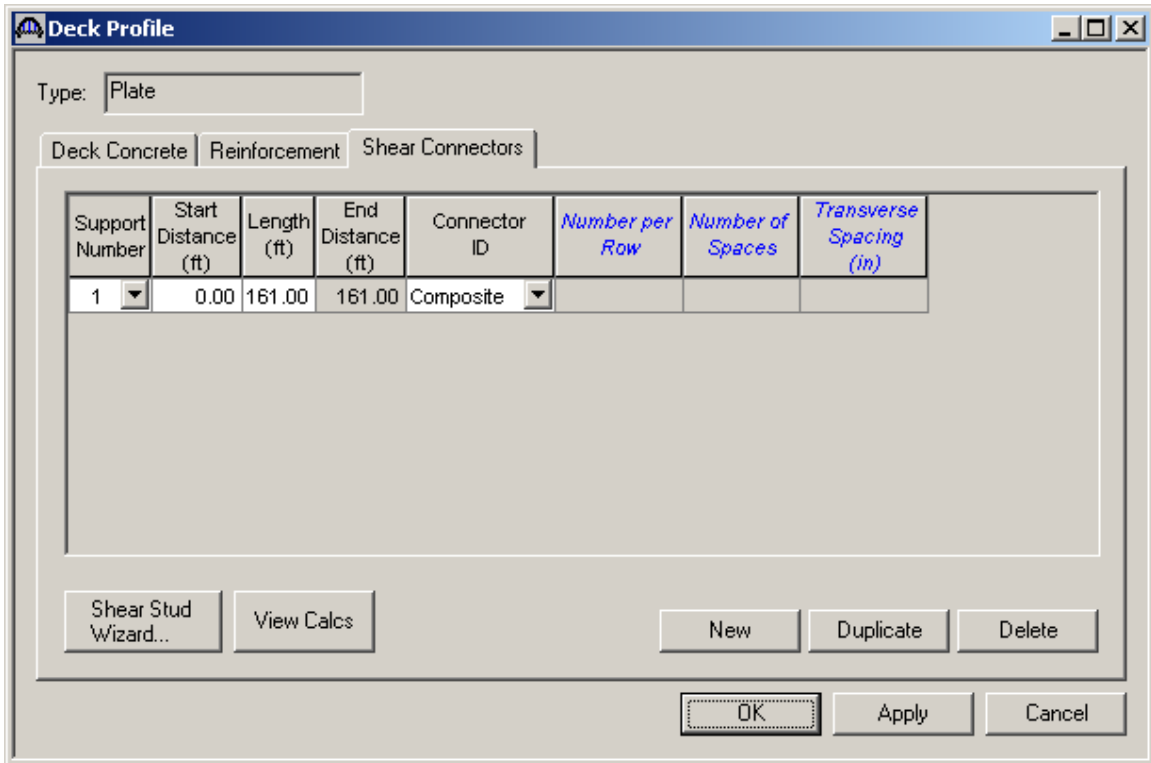
Next open the Deck Profile and enter the data describing the structural properties of the deck. The window is shown below.

The screenshot shows the 'Deck Profile' window with the following data in the table:

Material	Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Structural Thickness (in)	Start Effective Flange Width	End Effective Flange Width	Start Effective Flange Width	End Effective Flange Width	n
Deck Concrete	1	0.00	161.00	161.00	9.5000	114.0000	114.0000	125.0000	125.0000	8.00

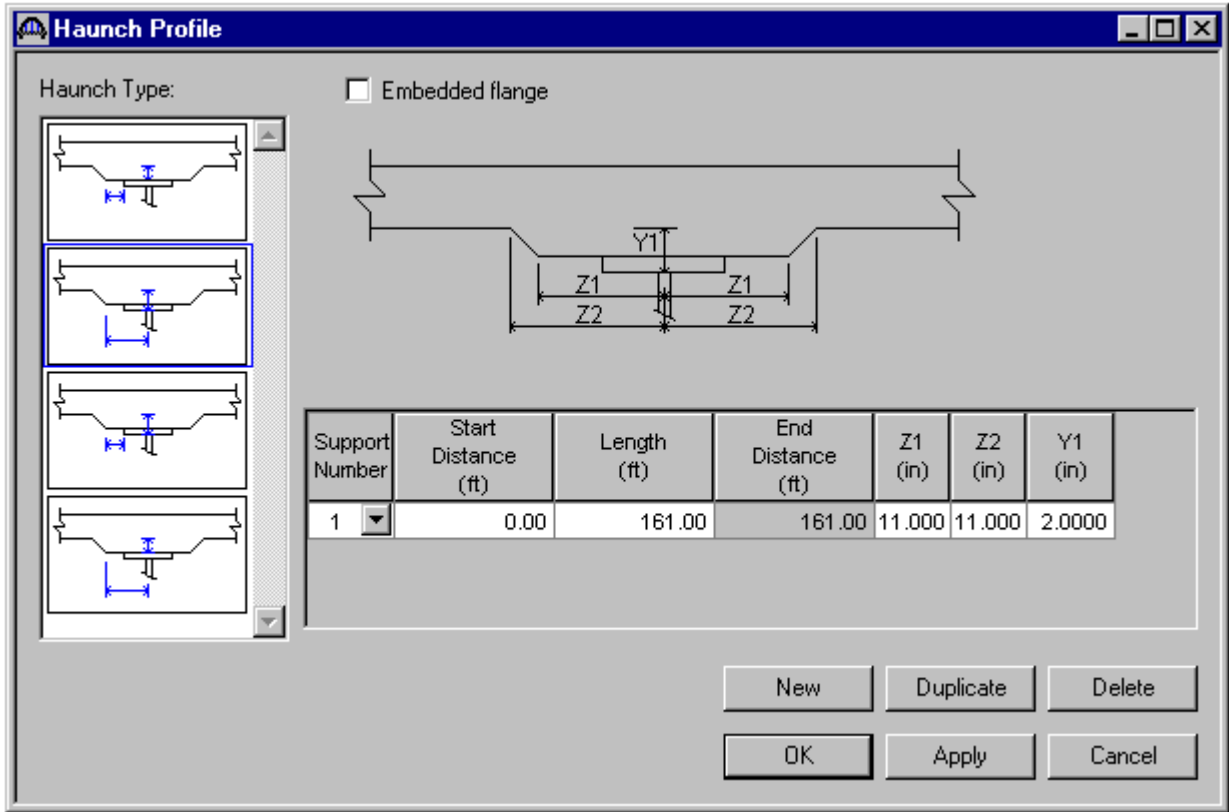
Buttons visible in the window include: Compute from Typical Section..., New, Duplicate, Delete, OK, Apply, and Cancel.

No reinforcement is described. 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.

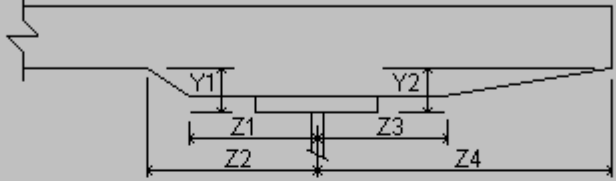
Interior Girder (G2):



Exterior Girder (G1):

**Haunch Profile**

Haunch Type:  Embedded flange



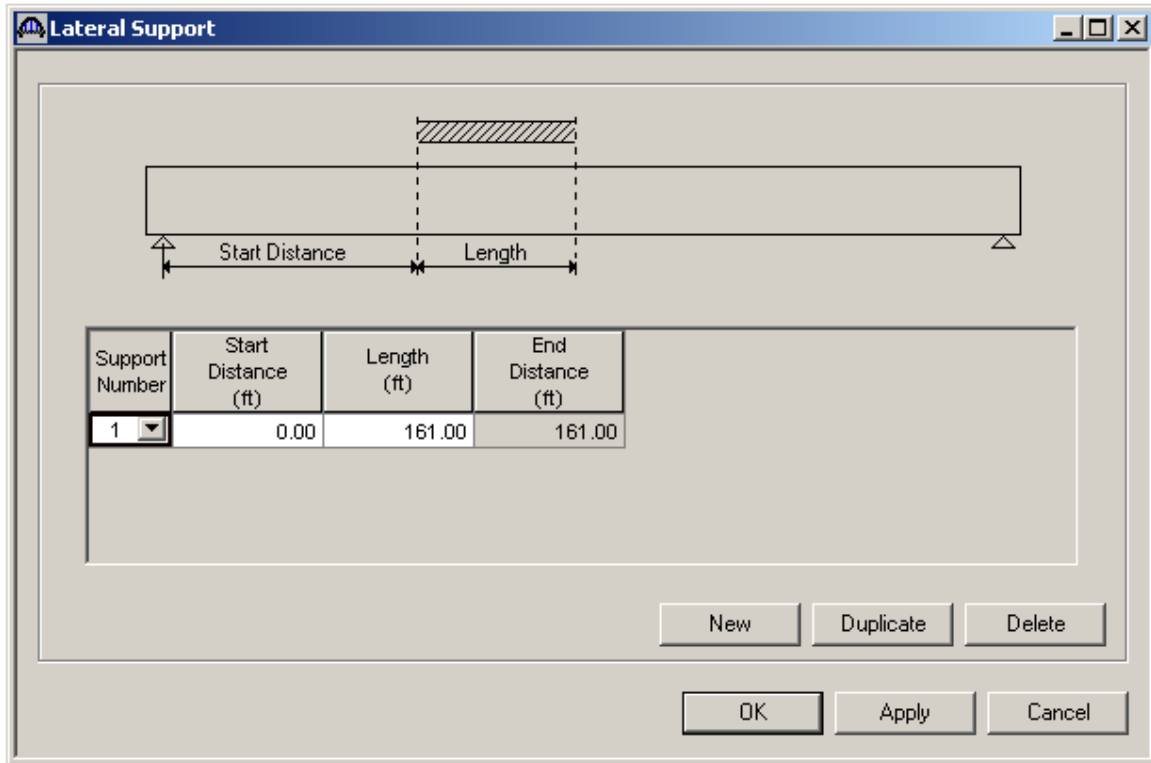
The diagram shows a cross-section of a haunch profile. It features a central horizontal section with a depth of 11.00 inches. This section is flanked by two sloped sections. The horizontal distance from the centerline to the start of the slope is Z1 (11.00 inches), and the horizontal distance from the centerline to the end of the slope is Z3 (11.00 inches). The total horizontal length of the haunch is Z2 (11.00 inches). The vertical height of the haunch at the ends is Y1 (2.00 inches) and Y2 (2.00 inches). The total length of the haunch is Z4 (51.00 inches).

Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Z1 (in)	Z2 (in)	Z3 (in)	Z4 (in)	Y1 (in)	Y2 (in)
1	0.00	161.00	161.00	11.00	11.00	11.00	51.00	2.00	2.00

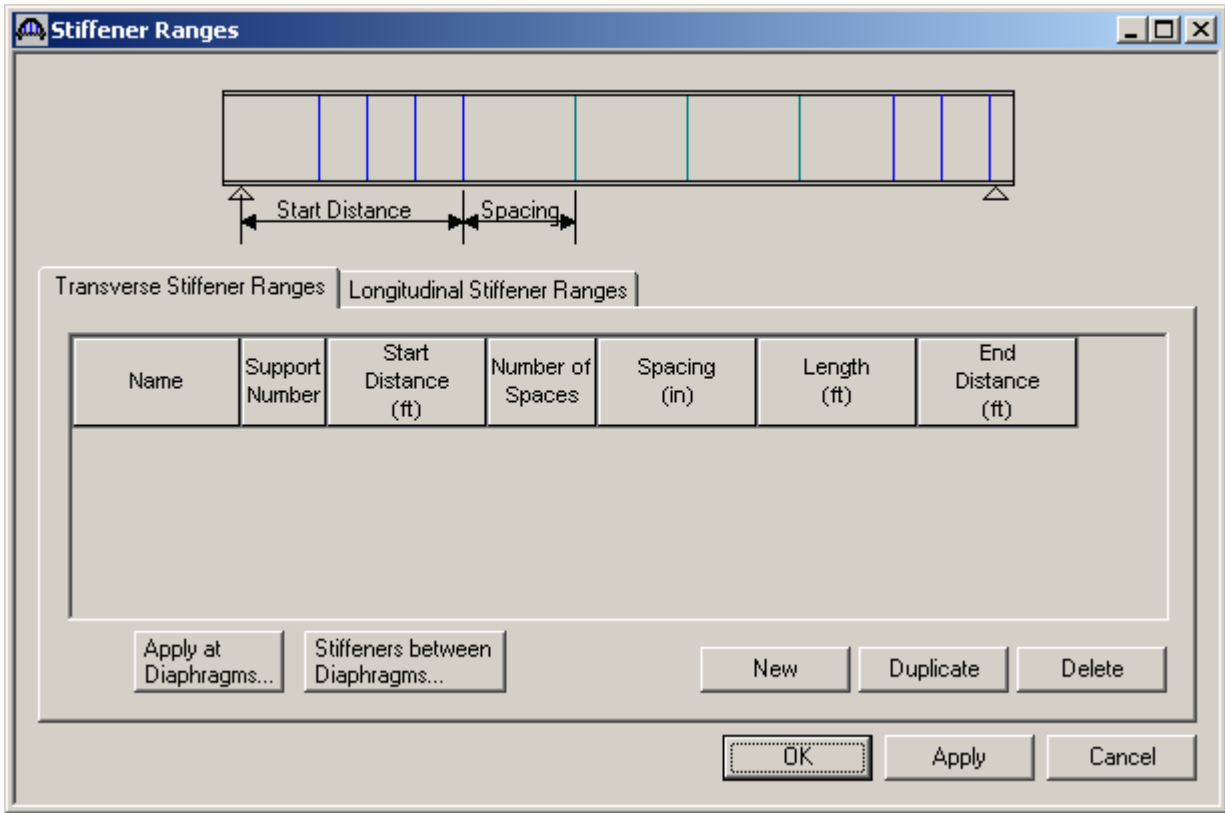
New Duplicate Delete

OK Apply Cancel

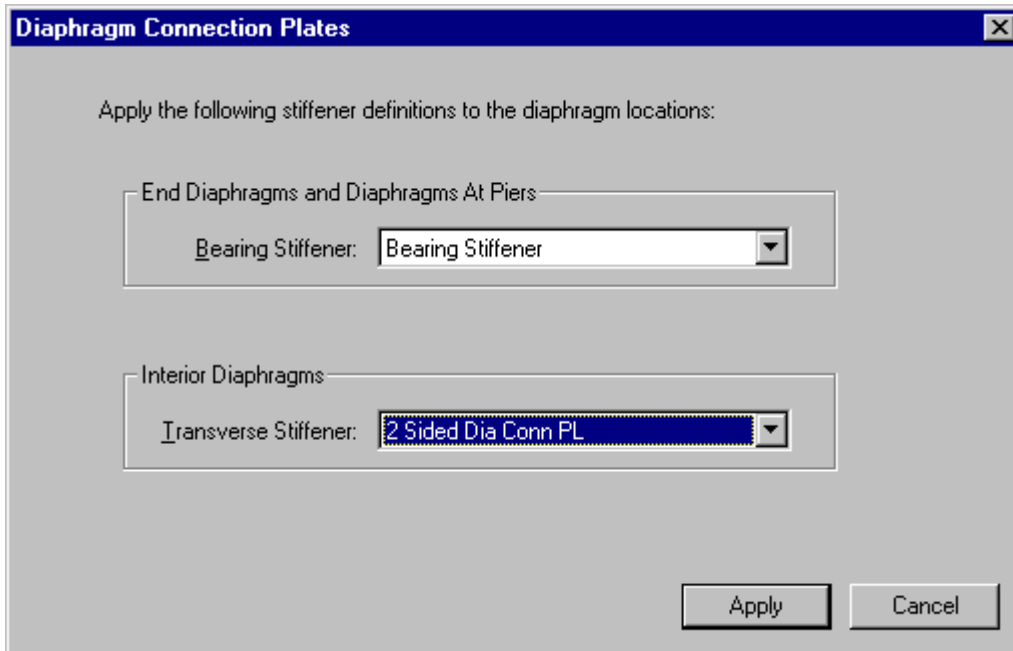
Regions where the slab is considered to provide lateral support for the top flange are defined using the Lateral Support window shown below. It can be opened by double clicking on Lateral Support in the tree.



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



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



Selecting Apply will create the following transverse stiffener locations.



The dialog box 'Stiffener Ranges' contains a diagram of a girder with vertical stiffeners. The first stiffener is at a 'Start Distance' from the left support, and the distance between adjacent stiffeners is labeled 'Spacing'. Below the diagram are two tabs: 'Transverse Stiffener Ranges' (selected) and 'Longitudinal Stiffener Ranges'. The table below lists the data for the transverse stiffeners.

Name	Support Number	Start Distance (ft)	Number of Spaces	Spacing (in)	Length (ft)	End Distance (ft)
2 Sided Dia Conn PL	1	26.833333	1	0.0000	0.00	26.83
2 Sided Dia Conn PL	1	26.833333	4	322.0000	107.33	134.17

Buttons at the bottom include: 'Apply at Diaphragms...', 'Stiffeners between Diaphragms...', 'New', 'Duplicate', 'Delete', 'OK', 'Apply', and 'Cancel'.

The intermediate transverse stiffeners are now located. Note that a range does not include a stiffener at the beginning of the range. The range that begins at the left end of the beam with one space and a spacing of 58 inches locates the first stiffener. The remaining intermediate stiffeners are located as follows.

Stiffener Ranges

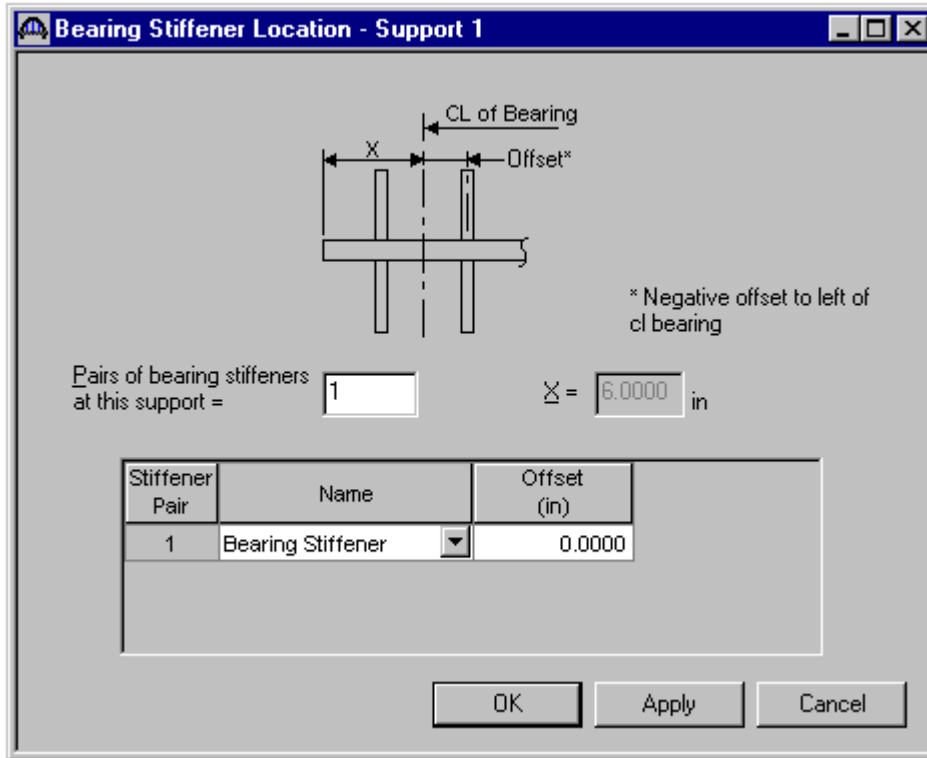
Transverse Stiffener Ranges | Longitudinal Stiffener Ranges

Name	Support Number	Start Distance (ft)	Number of Spaces	Spacing (in)	Length (ft)	End Distance (ft)
2 Sided Dia Conn PL	1	26.83	1	0.0000	0.00	26.83
2 Sided Dia Conn PL	1	26.83	4	322.0000	107.33	134.17
Stiffener	1	0.00	1	58.0000	4.83	4.83
Stiffener	1	0.00	1	161.0000	13.42	13.42
Stiffener	1	13.42	5	322.0000	134.17	147.59
Stiffener	1	147.58	1	103.0000	8.58	156.16

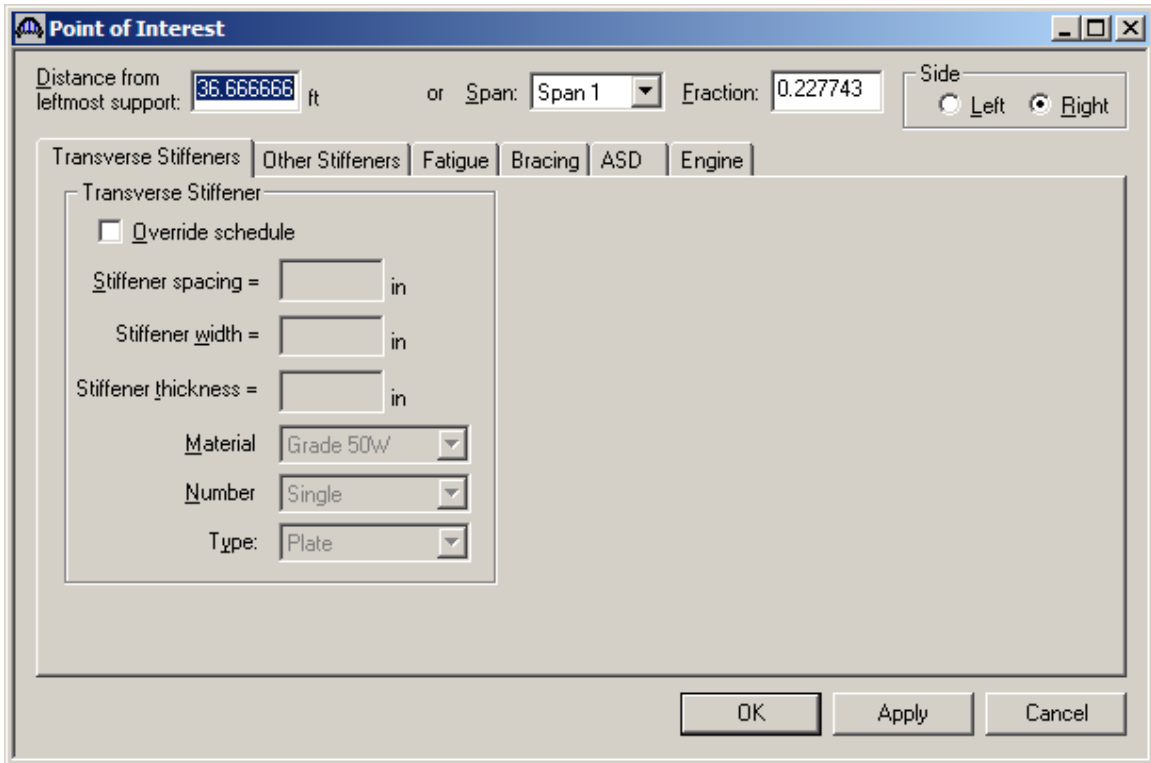
Apply at Diaphragms... Stiffeners between Diaphragms... New Duplicate Delete

OK Apply Cancel

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.



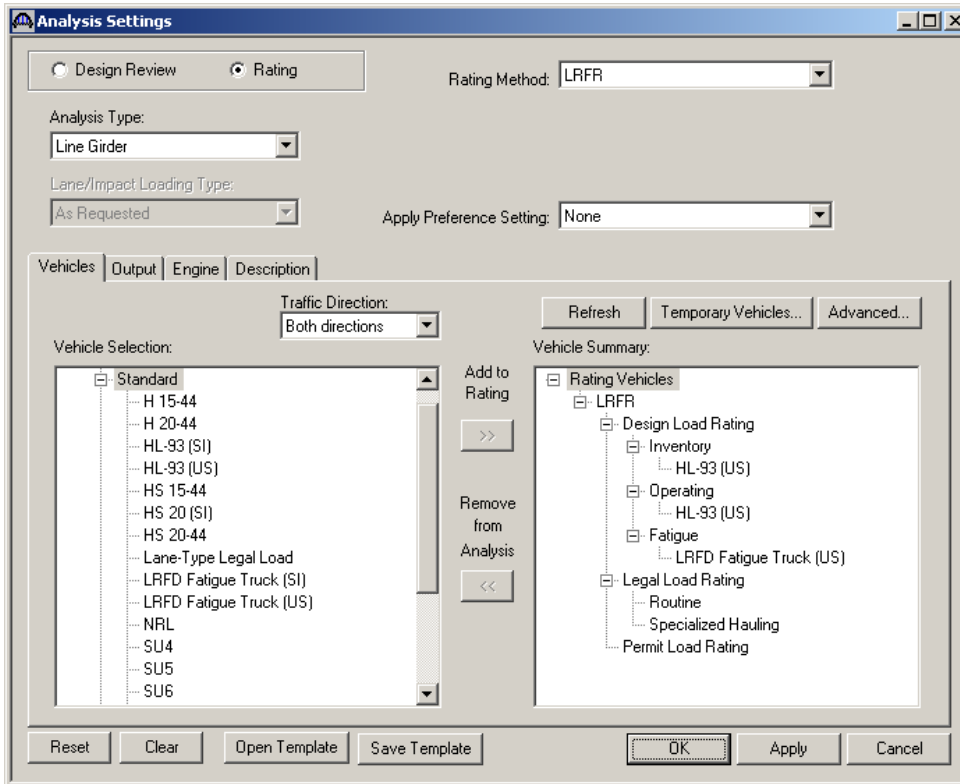
Define Points of Interest using the Points of Interest window shown below. A window for defining a Point of Interest is opened by double clicking on the Points of Interest tree item.



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

This example bridge is modeled after Example 1 from “Four LRFD Design Examples of Steel Highway Bridges”, Volume II, Chapter 1B of the Highway Structures Design Handbook produced by the American Iron and Steel Institute except this example bridge is not skewed like the one in the handbook.

To do LRFR Design Load Rating, enter the Analysis Settings window as shown below:

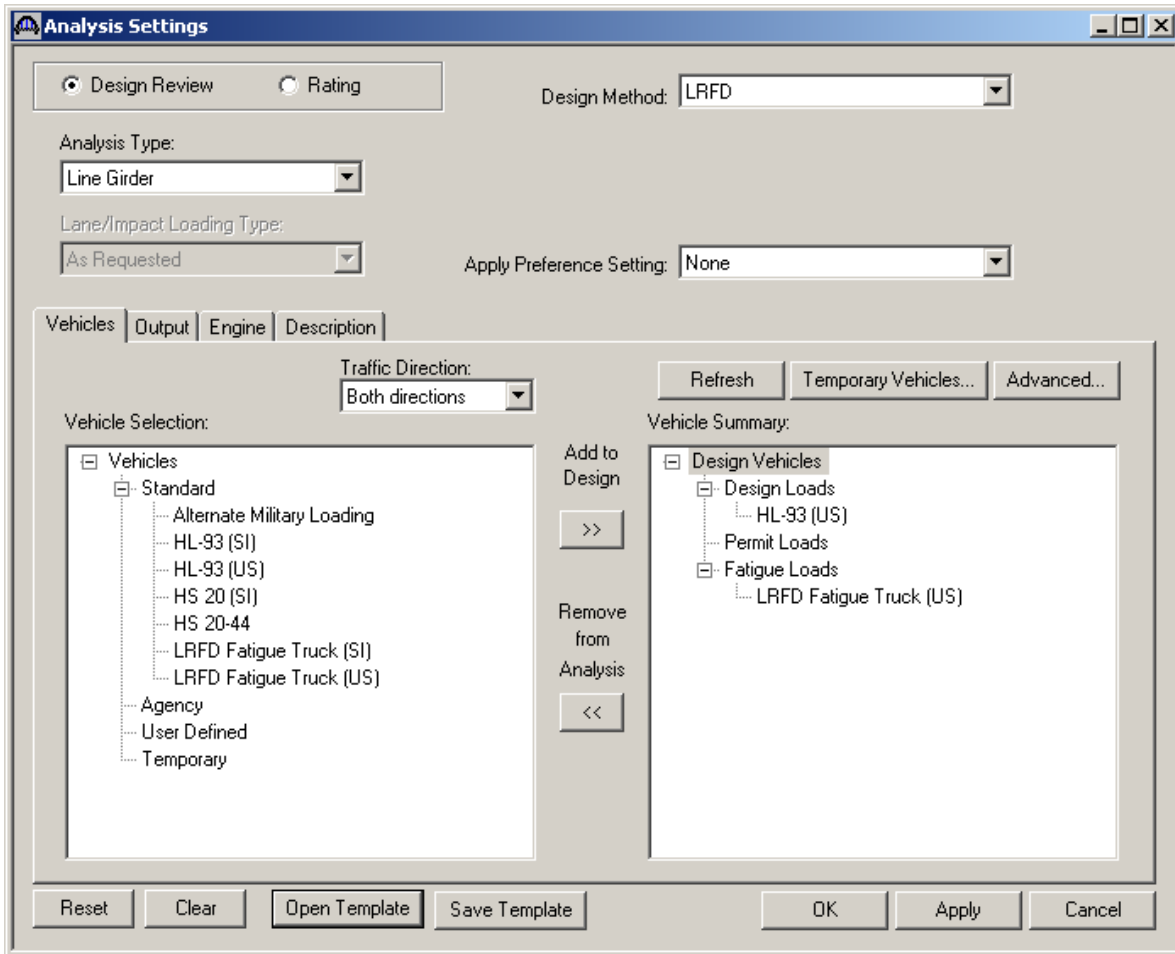



AASHTO LRFR results for HL93 loading for an interior girder are shown below:

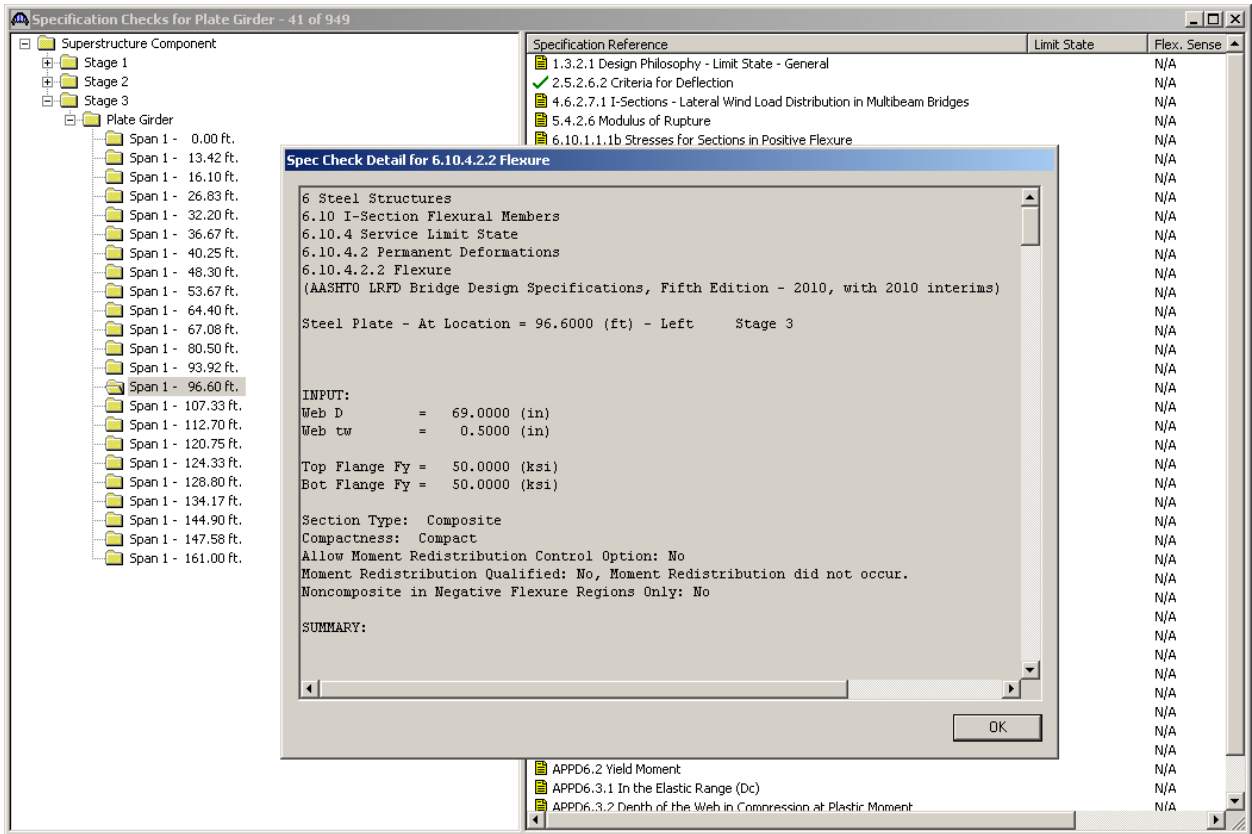
Live Load	Live Load Type	Rating Method	Inventory Load Rating (Ton)	Operating Load Rating (Ton)	Legal Load Rating (Ton)	Permit Load Rating (Ton)	Inventory Rating Factor	Operating Rating Factor	Legal Rating Factor	Permit Rating Factor	Inventory Location (ft)	Inventory Location Span-(%)	Operating Location (ft)	Operating Location Span-(%)
HL-93 (US)	Truck + Lane	LRFR	16.38	21.23			0.455	0.590			80.50	1 - (50.0)	80.50	1 - (50.0)
HL-93 (US)	Tandem + Lane	LRFR	19.43	25.19			0.540	0.700			80.50	1 - (50.0)	80.50	1 - (50.0)

AASHTO LRFR Engine Version 6.4.0.2003  
Analysis Preference Setting: None

An LRFD design review of this interior girder for HL93 loading can be performed by AASHTO LRFD. To do LRFD design review, enter the Analysis Settings window as shown below:



A summary of the specification checks is shown by selecting the View Spec Check button, , from the toolbar. The details for one of the spec checks is shown below.



**Spec Check Detail for 6.10.4.2.2 Flexure**

6 Steel Structures  
 6.10 I-Section Flexural Members  
 6.10.4 Service Limit State  
 6.10.4.2 Permanent Deformations  
 6.10.4.2.2 Flexure  
 (AASHTO LRFD Bridge Design Specifications, Fifth Edition - 2010, with 2010 interims)

Steel Plate - At Location = 96.6000 (ft) - Left Stage 3


INPUT:  
 Web D = 69.0000 (in)  
 Web tw = 0.5000 (in)  
 Top Flange Fy = 50.0000 (ksi)  
 Bot Flange Fy = 50.0000 (ksi)

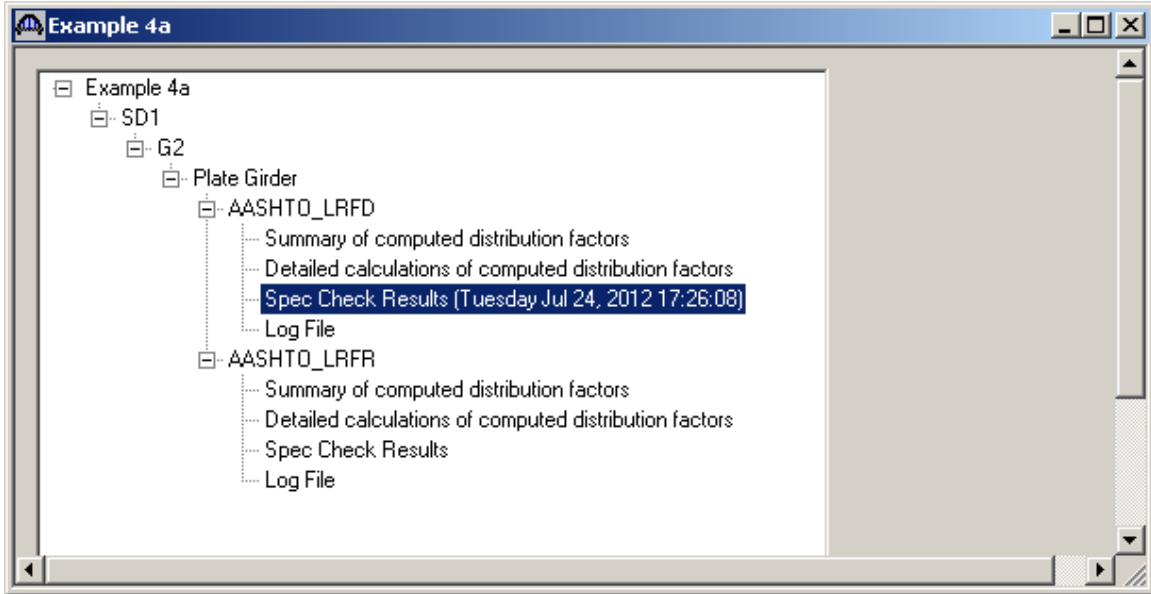
Section Type: Composite  
 Compactness: Compact  
 Allow Moment Redistribution Control Option: No  
 Moment Redistribution Qualified: No, Moment Redistribution did not occur.  
 Noncomposite in Negative Flexure Regions Only: No

SUMMARY:

OK

Specification Reference	Limit State	Flex. Sense
1.3.2.1 Design Philosophy - Limit State - General		N/A
2.5.2.6.2 Criteria for Deflection		N/A
4.6.2.7.1 I-Sections - Lateral Wind Load Distribution in Multibeam Bridges		N/A
5.4.2.6 Modulus of Rupture		N/A
6.10.1.1.1b Stresses for Sections in Positive Flexure		N/A
APPD6.2 Yield Moment		N/A
APPD6.3.1 In the Elastic Range (Dc)		N/A
APPD6.3.2 Depth of the Web in Compression at Plastic Moment		N/A

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.

Bridge ID : 26  
 Bridge : Example 4a  
 Superstructure Def: SD1  
 Member : G2  
 Analysis Preference Setting : None

NBI Structure ID : Example 4a  
 Bridge Alt :  
 Member Alt : Plate Girder

AASHTO LRFD Specification, Edition 5, Interim 2010

### Specification Check Summary

Article	Status
Flexure (6.10.7.1.1, 6.10.7.2.1, AppA6.1.1, AppA6.1.2, AppA6.1.3, AppA6.1.4)	Fail
Shear (6.10.9)	Pass
Fatigue (6.10.5.3)	Pass
Serviceability (6.10.4.2.2)	Fail
Constructability (6.10.3.2.1, 6.10.3.2.2, 6.10.3.2.3)	Pass
Transverse Stiffeners (6.10.11.1.2, 6.10.11.1.3)	Pass
Longitudinal Stiffeners (6.10.11.3.1, 6.10.11.3.2, 6.10.11.3.3)	NA
Bearing Stiffeners (6.10.11.2.2, 6.10.11.2.3, 6.10.11.2.4)	Pass
Shear Connector (6.10.10.1, 6.10.10.4)	NA

### Girder Member Proportions and Compactness (Stage 3)

Location (ft)	Composite	Proportion Code	Code Check	Compact	Code Check
0.000	Yes	Pass	---	Compact	E
16.100	Yes	Pass	---	Compact	E
32.200	Yes	Pass	---	Compact	E
36.666	Yes	Pass	---	Compact	E
48.300	Yes	Pass	---	Compact	E
64.400	Yes	Pass	---	Compact	E
80.500	Yes	Pass	---	Compact	E
96.600	Yes	Pass	---	Compact	E
112.700	Yes	Pass	---	Compact	E