

*AASHTOWare BrDR 6.8.2*

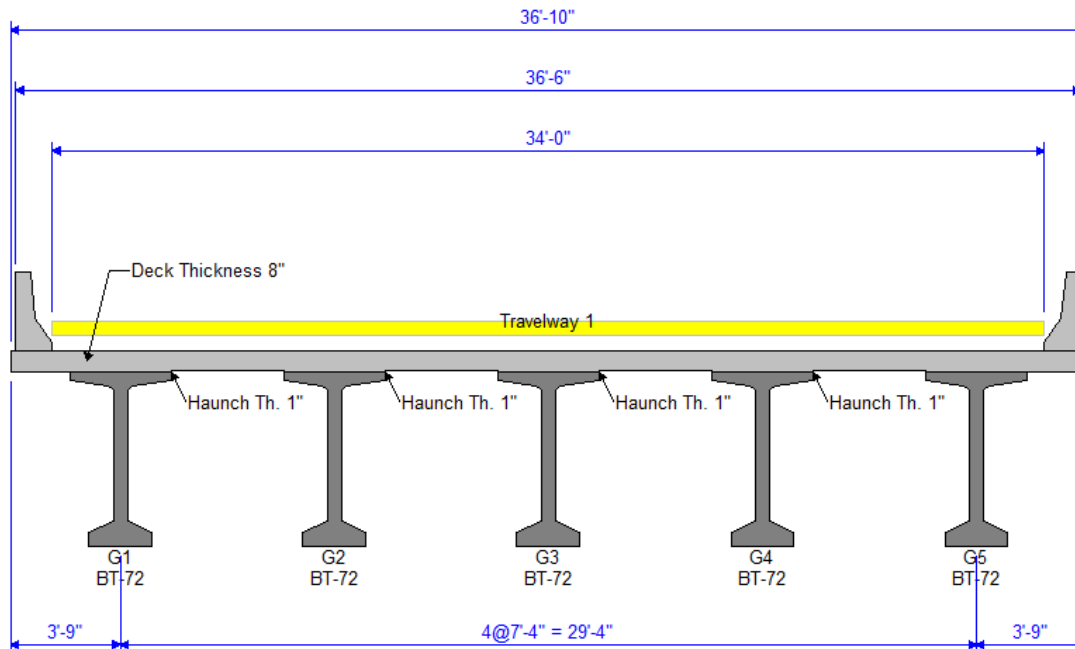
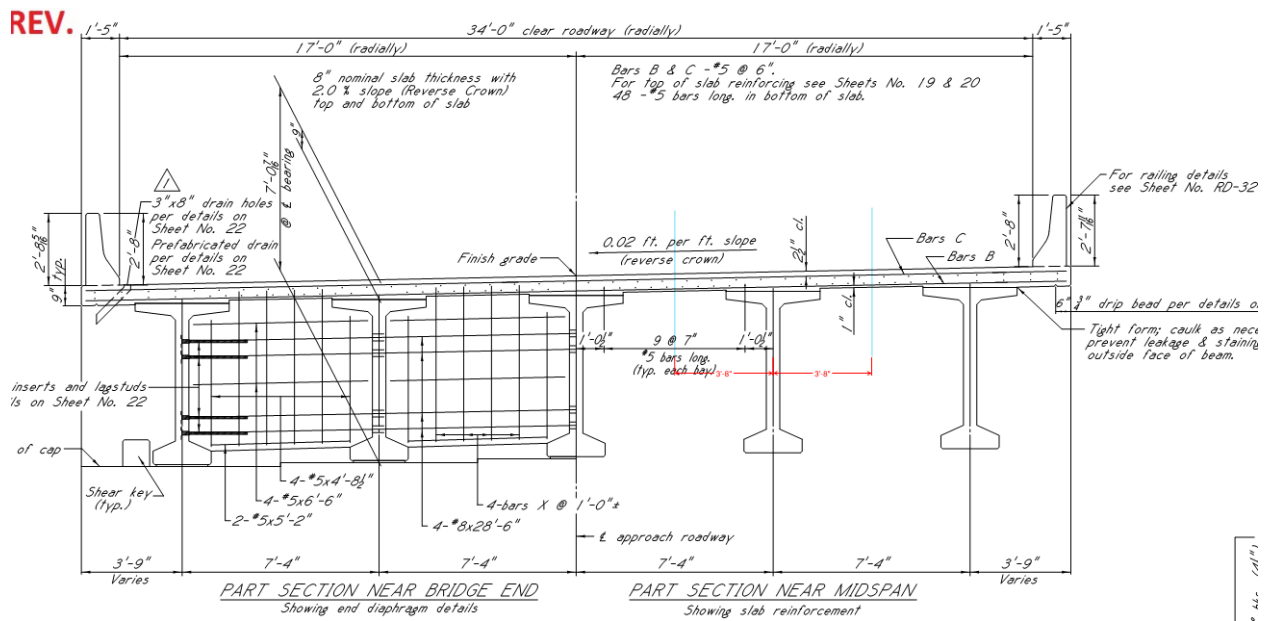
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*Prestress Superstructure Tutorial*

*PS14 – Prestressed Concrete I Beam Example*

## PS14 - Prestressed Concrete I Beam Example

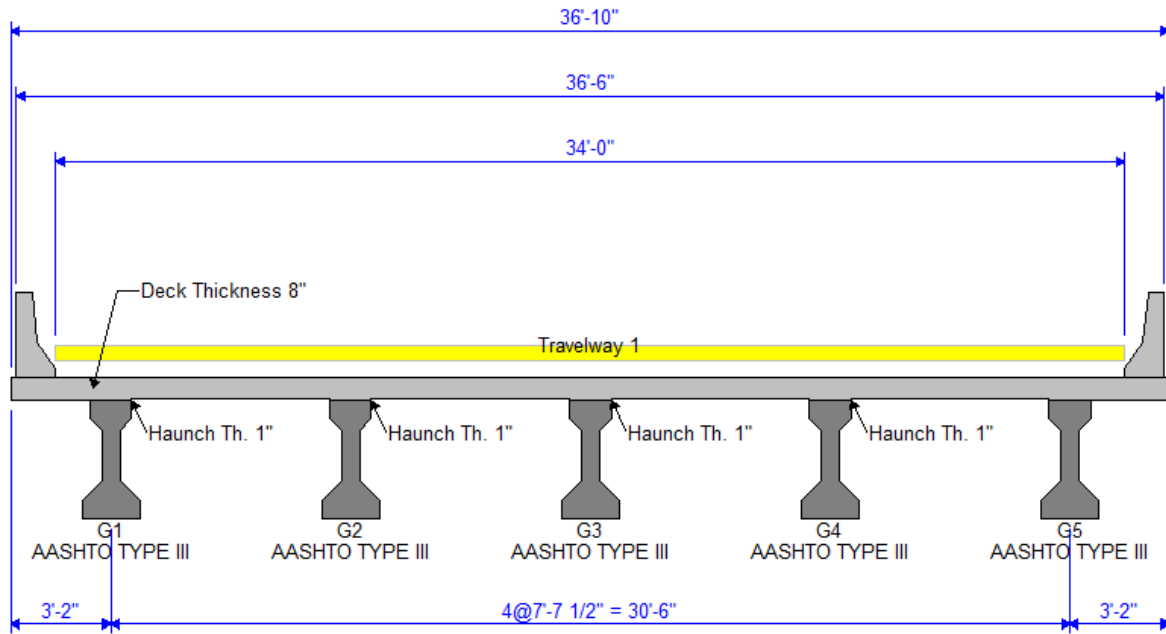
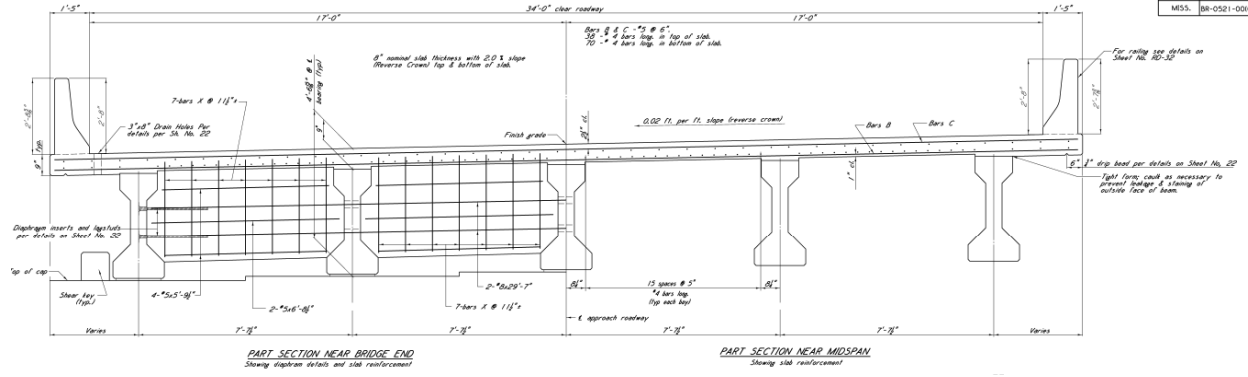
This example details the data input of a prestressed concrete I beam bridge and performing an analysis. This example is a bridge from the Mississippi DOT inventory which includes two units of SR 429, a three-span (138 ft each) continuous unit and a single 80 ft span unit.



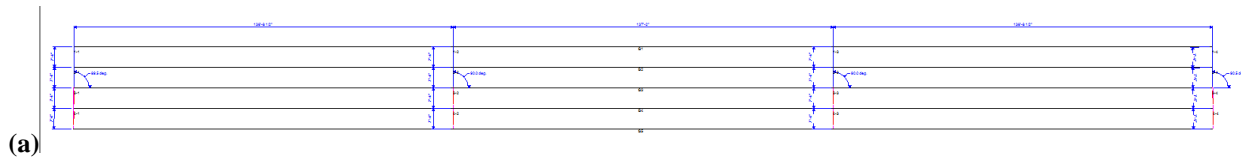
Structure Typical Section - Unit 1

PS14 - Prestressed Concrete I Beam

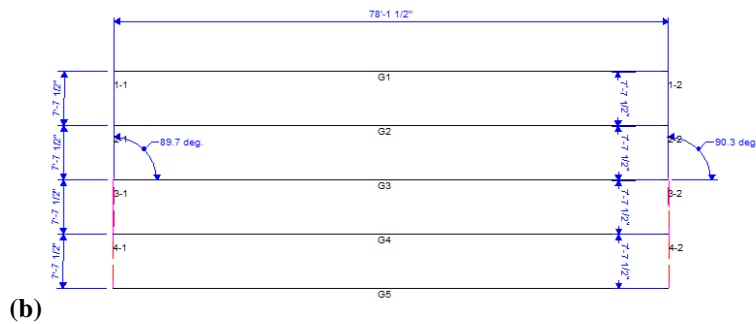
STATE PROJECT NO.  
MSS. BR-0521-00004



Structure Typical Section – Unit 2



(a)



(b)

Structure Framing Plan (a) Unit 1 (b) Unit 2

## Topics Covered

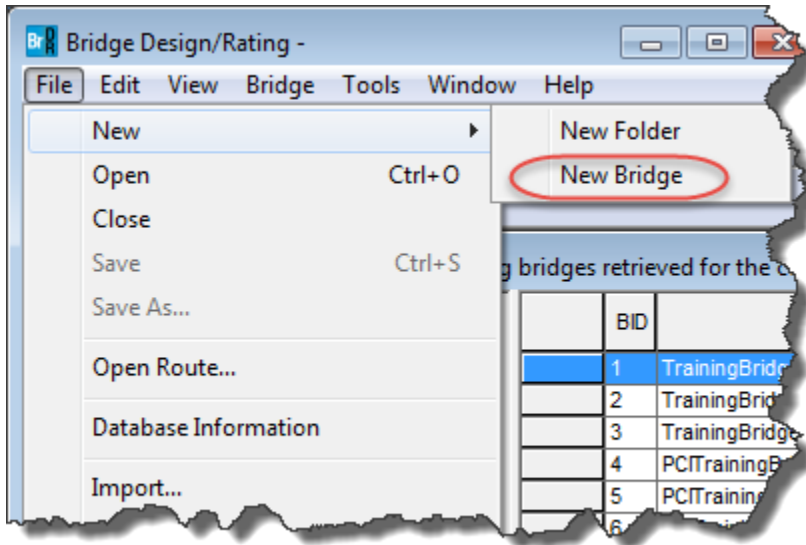
- Comments and Assumptions
- Data Entry of Prestressed concrete I beam with draped strands input as girder system.
- Prestressed multi-span modeling options
  - Multi-span continuous
  - Multi-span continuous and simple span
- Export of prestressed concrete beams to the BrDR LRFD analysis engine
- Analysis and Results

## Comments and Assumptions

- Assume 5000 psi for the 28-day compressive concrete strength of the Type III PS Beam for the 80-foot span.
- Due to rounding on the design plans, the BrR span lengths are slightly off from the design drawings. Lengths are within 1/16".
- The plans show a discrepancy for strand type for the 138 ft beam details. The notes indicate 1/2" diameter 270 K-LR strands where the table and section show 0.6" diameter 270 K-LR strands so 0.6" diameter 270 K-LR strands will be used in the model.
- With larger radius, assume the overhangs as equal.
- Due to the limitations in BrR, the skew angle at Support 2 & 3 of the three-span continuous unit will be 90 degrees.
- Traffic data and design speed for LRFR analysis
  - a. Assumed ADTT = 41 per NBI
- 1/4" Integral Wearing Surface
- HL93 will be the vehicle used for ratings
- District, County and Owner information is not populated
- For the exterior beams, a LRFD effective width = Overhang + S/2 is used, even though the overhang is greater than S/2 (C4.6.2.6.1).

## Data Entry

From the Bridge Explorer, select File | New | New Bridge from the menu to create a new bridge.




Enter the following bridge description data.

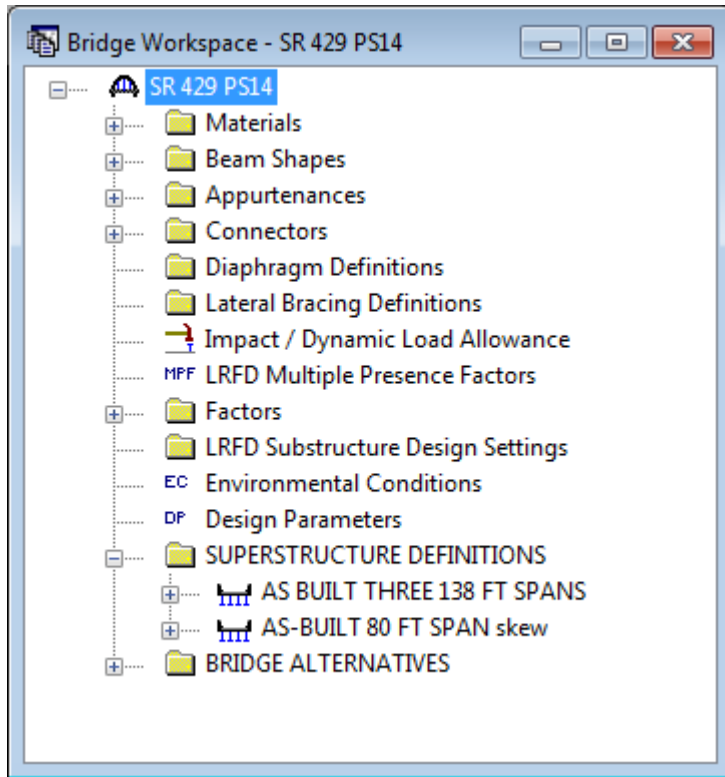
The screenshot shows the 'SR 429 PS14' data entry form. The fields are populated with the following information:

- Bridge ID: SR 429 PS14
- NBI Structure ID (8): 00000
- Template:
- Bridge Completely Defined:
- Superstructures:
- Culverts:
- Description: PS GIRDERS ON PILE BENTS  
LEAKE COUNTY  
MISSISSIPPI
- Name: SR 429 PS14
- Year Built: 2017
- Location: 1.3 MI S SR 43
- Length: 815.58 ft
- Facility Carried (7): SR 429
- Route Number: 429
- Feat. Intersected (6): YOCKANDOOKANY RIVER
- Mi. Post:
- Default Units: US Customary

At the bottom, there are checkboxes for 'B:R', 'B:D', and 'B:M', and buttons for 'OK', 'Apply', and 'Cancel'.

Close the window by clicking OK. This saves the data to memory and closes the window.

To enter the materials to be used by members of the bridge, click on the  to expand the Bridge Workspace tree for Materials. The tree with the expanded Materials branch is shown below.



To add a concrete material for the girder, click on Concrete in the tree and select File | New from the menu (or right mouse click on Concrete and select New). The window shown below will open.

Bridge Materials - Concrete

Name:  Description:

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

Initial compressive strength (f'ci) =  ksi

Coefficient of thermal expansion = 0.0000060000 1/F

Density (for dead loads) =  kcf

Density (for modulus of elasticity) =  kcf

Std Modulus of elasticity (Ec) =  ksi

LRFD Modulus of elasticity (Ec) =  ksi

Std Initial modulus of elasticity =  ksi

LRFD Initial modulus of elasticity =  ksi

Poisson's ratio = 0.200

Composition of concrete = Normal

Modulus of rupture =  ksi

Shear factor = 1.000

Splitting tensile strength (fct) =  ksi

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

Enter the following concrete material properties for the girder concrete. The  $f'_c$  and  $f'_{ci}$  is found on the drawings or assumed.

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

Std Modulus of elasticity ( $E_c$ ) =  ksi

LRFD Modulus of elasticity ( $E_c$ ) =  ksi

Std Initial modulus of elasticity =  ksi

LRFD Initial modulus of elasticity =  ksi

Poisson's ratio =

Composition of concrete =

Modulus of rupture =  ksi

Shear factor =

Splitting tensile strength ( $f_{ct}$ ) =

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

Std Modulus of elasticity ( $E_c$ ) =  ksi

LRFD Modulus of elasticity ( $E_c$ ) =  ksi

Std Initial modulus of elasticity =  ksi

LRFD Initial modulus of elasticity =  ksi

Poisson's ratio =

Composition of concrete =

Modulus of rupture =  ksi

Shear factor =

Splitting tensile strength ( $f_{ct}$ ) =

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



Enter the following concrete material properties for the deck concrete or use Class A from library and change name to Class AA.

Property	Value	Unit
Name	Class AA (US)	
Description	Class AA cement concrete	
Compressive strength at 28 days (f'c)	4.0000006	ksi
Initial compressive strength (f'ci)		ksi
Coefficient of thermal expansion	0.000006	1/F
Density (for dead loads)	0.15	kcf
Density (for modulus of elasticity)	0.145	kcf
Std Modulus of elasticity (Ec)	3644.149254	ksi
LRFD Modulus of elasticity (Ec)	3644.149254	ksi
Std Initial modulus of elasticity		ksi
LRFD Initial modulus of elasticity		ksi
Poisson's ratio	0.2	
Composition of concrete	Normal	
Modulus of rupture	0.4798574	ksi
Shear factor	1	
Splitting tensile strength (fct)		ksi

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

To add reinforcement material, click on Reinforcing Steel in the tree and select File | New from the menu (or right mouse click on Reinforcing Steel and select New). Click on the Copy from Library button to open the Reinforcing Steel Materials Library Data window.

Name	Description	Library	Units	Fy	Fu	Es
Grade 300	300 MPa rei	Standard	SI / Metric	300.00	500.00	199948.0
Grade 350	350 MPa rei	Standard	SI / Metric	350.00	550.00	199948.0
Grade 40	40 ksi reinfo	Standard	US Customary	40.000	70.000	29000.00
Grade 400	400 MPa rei	Standard	SI / Metric	400.00	600.00	199948.0
Grade 50	50 ksi reinfo	Standard	US Customary	50.000	80.000	29000.00
Grade 500	500 MPa rei	Standard	SI / Metric	500.00	700.00	199948.0
Grade 60	60 ksi reinfo	Standard	US Customary	60.000	90.000	29000.00
Grade 75	75 ksi reinfo	Standard	US Customary	75.000	100.000	29000.00
Structural or unknown grade prior 1954	Structural or	Standard	US Customary	33.000	60.000	29000.00

Select the Grade 60 material and click OK. The selected material properties are copied to the Bridge Materials - Reinforcing Steel window.

Name:  Description:

Material Properties

Specified yield strength (Fy) =  ksi

Modulus of elasticity (Es) =  ksi

*Ultimate strength (Fu)* =  ksi

Type

- Plain
- Epoxy
- Galvanized
- Other

Buttons: Copy To Library... Copy from Library... **OK** Apply Cancel

Close the window by clicking OK. This saves the data to memory and closes the window.

Add prestress strand using the same Copy from Library technique. The window will look like as shown below.

*LR indicates low-relaxation strands*

**PRESTRESS REQUIREMENTS**

*For deflection diagram, see Misc. Span Details per Sheet No. 22*

Strand type	Minimum breaking strength lbs/strand	Initial tension lbs/strand	Required number and location of strands						Centroid for total number of strands (in.)		Distance from $\epsilon$ span to hold-down point	Camber limits	Deflection diagram			Minimum concrete strength at time of release (psi)
			Total number strands	Straight strands		Draped strands		At $\epsilon$ span	At beam end	A			B	C		
				Number strands	Centroid (in.)	Number strands	Centroid (in.)									
0.6" #270 K-LR	45,000	43,940	36	26	4.19	10	6.50	65.00	4.83	21.08	14'-0"	0 to 31"	54"	51"	21"	6000

Bridge Materials - PS Strand

Name:  Description: Low relaxation 0.600"/Seven Wire/tpu = 27

Strand diameter =  in

Strand area =  in<sup>2</sup>

Strand type =

Ultimate tensile strength (Fu) =  ksi

Yield strength (Fy) =  ksi

Modulus of elasticity (E) =  ksi

Transfer length (Std) =  in

Transfer length (LRFD) =  in

Unit load per length =  lb/ft

Epoxy coated

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

*LR indicates low-relaxation strands*

**PRESTRESS REQUIREMENTS**

*For deflection diagram, see Misc. Span Details per Sheet No. 22*

Strand type	Minimum breaking strength lbs/strand	Initial tension lbs/strand	Required number and location of strands						Centroid for total number of strands (in.)		Distance from $\epsilon$ span to hold-down point	Camber limits	Deflection diagram			Minimum concrete strength at time of release (psi)
			Total number strands	Straight strands		Draped strands		At $\epsilon$ span	At beam end	A			B	C		
				Number strands	Centroid (in.)	Number strands	Centroid (in.)									
1/2" #270 K-LR	41,300	30,980	26	20	4.10	6	4.50	40.00	4.19	12.38	8'-0"	0 to 23"	17"	13"	8"	4200

Bridge Materials - PS Strand

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

Strand diameter =  in

Strand area =  in<sup>2</sup>

Strand type =

Ultimate tensile strength (Fu) =  ksi

Yield strength (Fy) =  ksi

Modulus of elasticity (E) =  ksi

Transfer length (Std) =  in

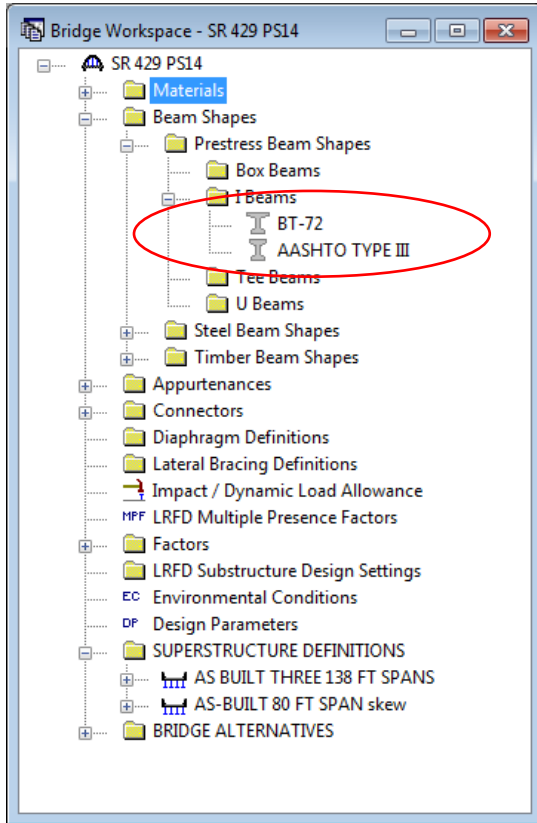
Transfer length (LRFD) =  in

Unit load per length =  lb/ft

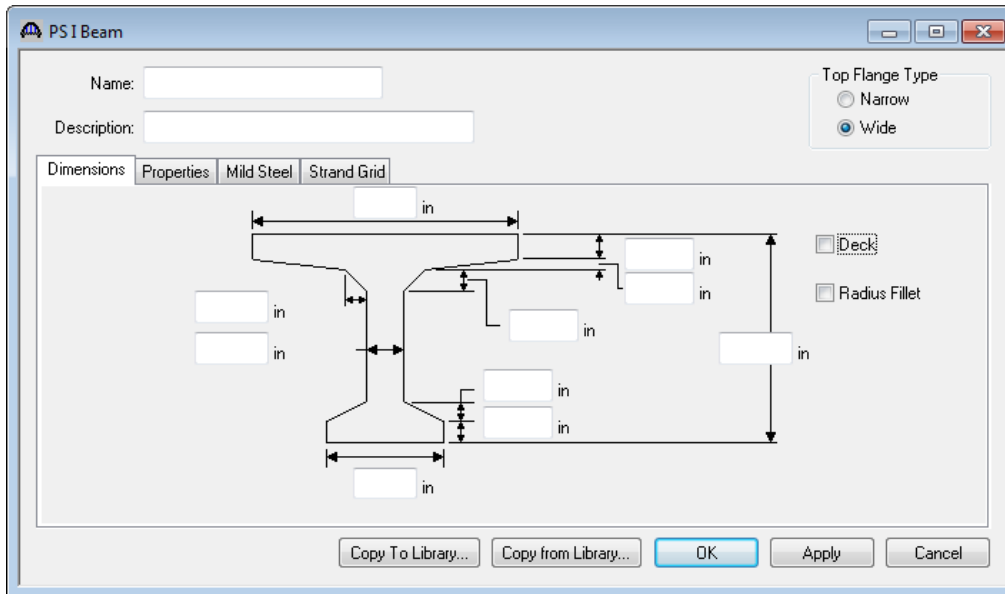
Epoxy coated

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

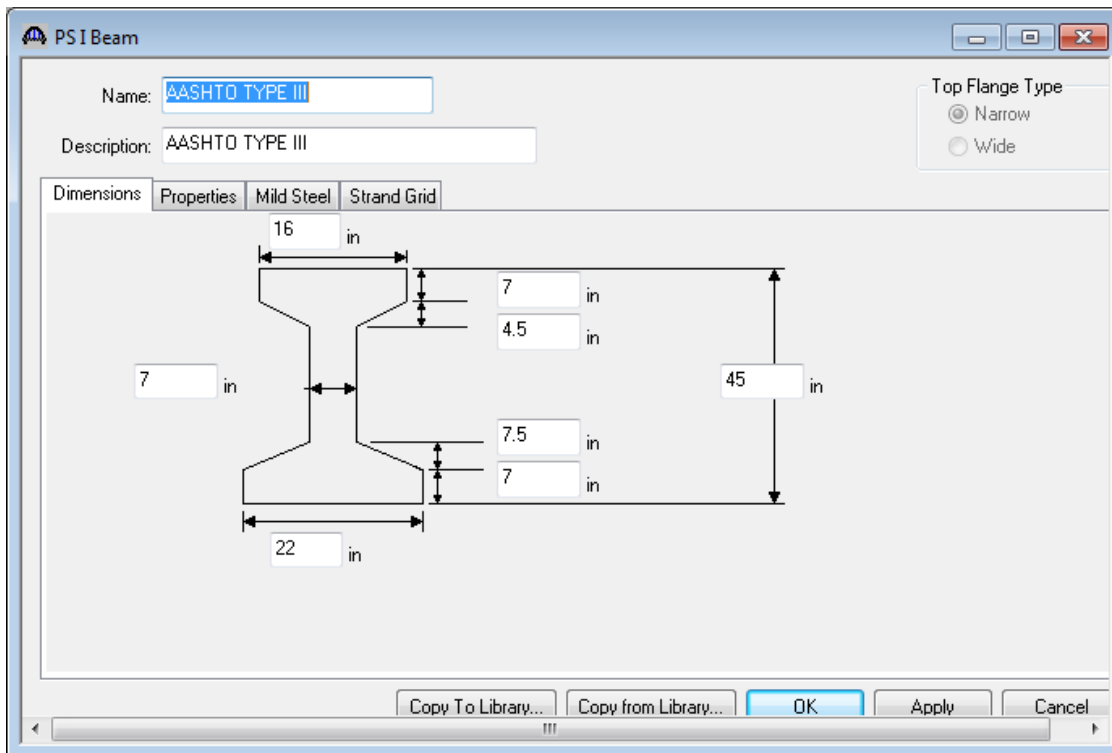
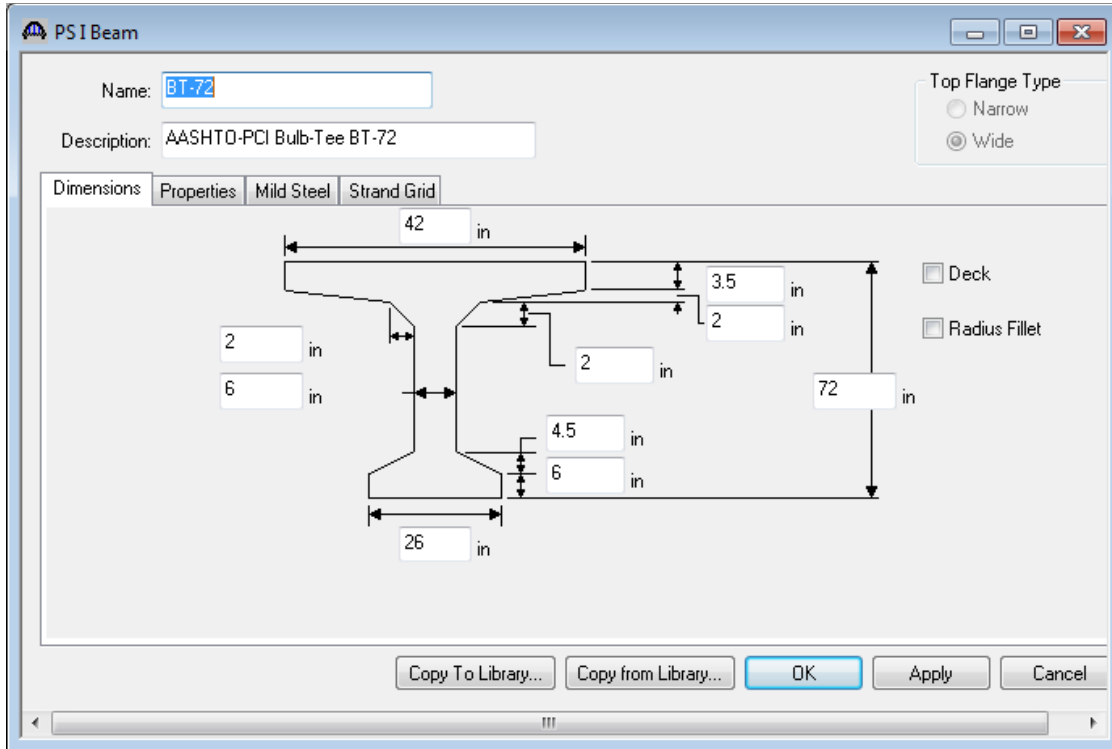
To enter a prestress beam shape to be used in this bridge, expand the tree labeled Beam Shapes as shown below.



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



Click on the Copy from Library button. Select BT-72 (AASHTO-PCI-Bulb-Tee BT-72) in the PS I Beam Shapes Library Data window and the AASHTO Type III beam or enter the data manually and click OK. The beam properties are copied to the PS I Beam window as shown below.



Click OK to save the data to memory and close the window. We will now edit the Strand Grid. Delete the existing grid and enter the following data.

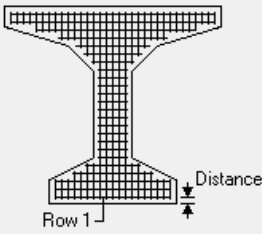
PSI Beam

Name: BT-72

Description: AASHTO-PCI Bulb-Tee BT-72

Top Flange Type  
 Narrow  
 Wide

Dimensions Properties Mild Steel Strand Grid



Row No.	No of Strands	Vertical Distance from bottom (in)	Horizontal Spacing (in)
1	12	2.5	2
2	12	4.5	2
3	8	6.5	2
4	4	8.5	2
5	2	10.5	2
6	2	61	2
7	2	63	2
8	2	65	2
9	2	67	2
10	2	69	2

New Duplicate Delete

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

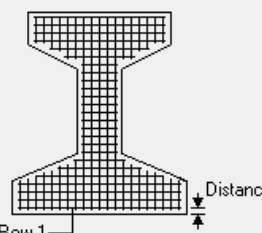
PSI Beam

Name: AASHTO TYPE III

Description: AASHTO TYPE III

Top Flange Type  
 Narrow  
 Wide

Dimensions Properties Mild Steel Strand Grid

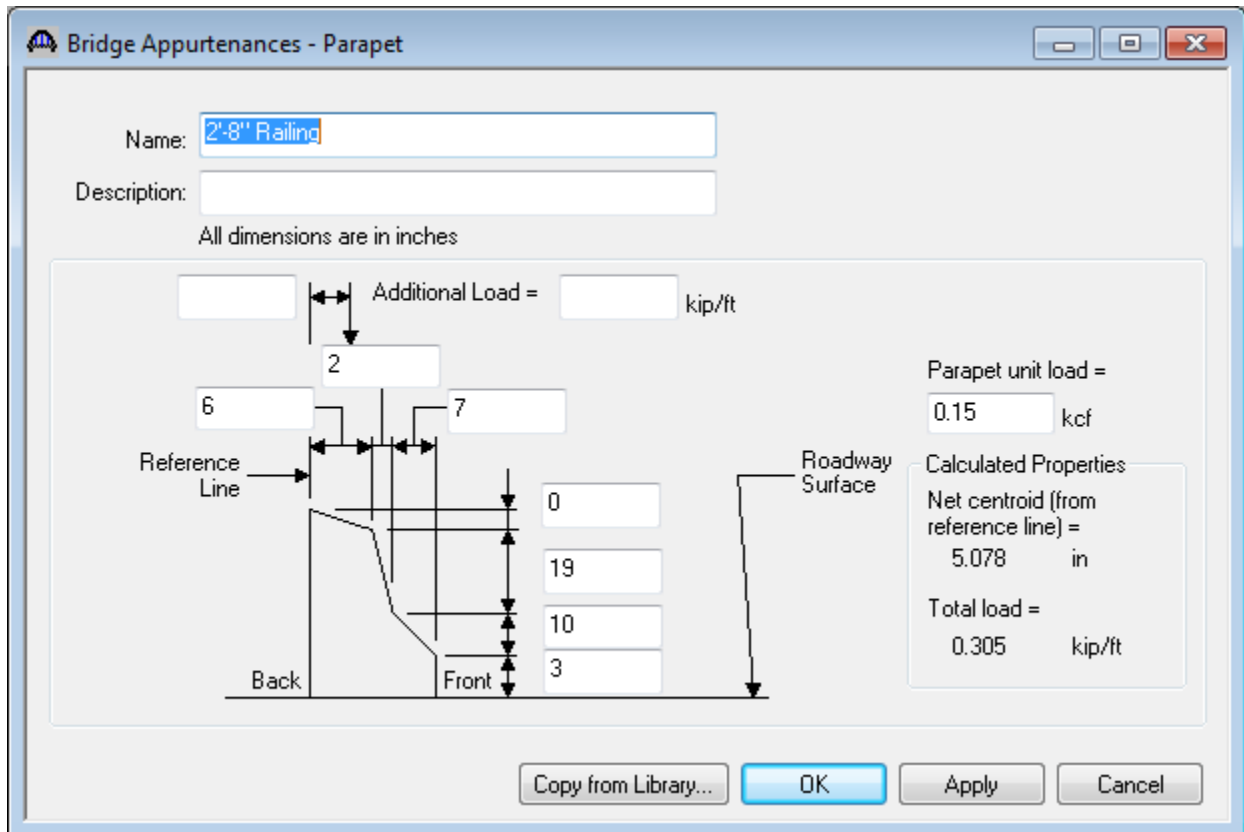
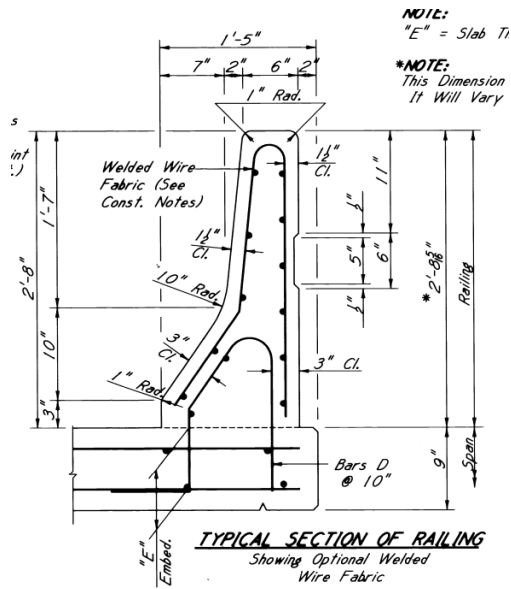


Row No.	No of Strands	Vertical Distance from bottom (in)	Horizontal Spacing (in)
1	10	2.5	2
2	10	4.5	2
3	10	6.5	2
4	2	38	2
5	2	40	2
6	2	42	2

New Duplicate Delete

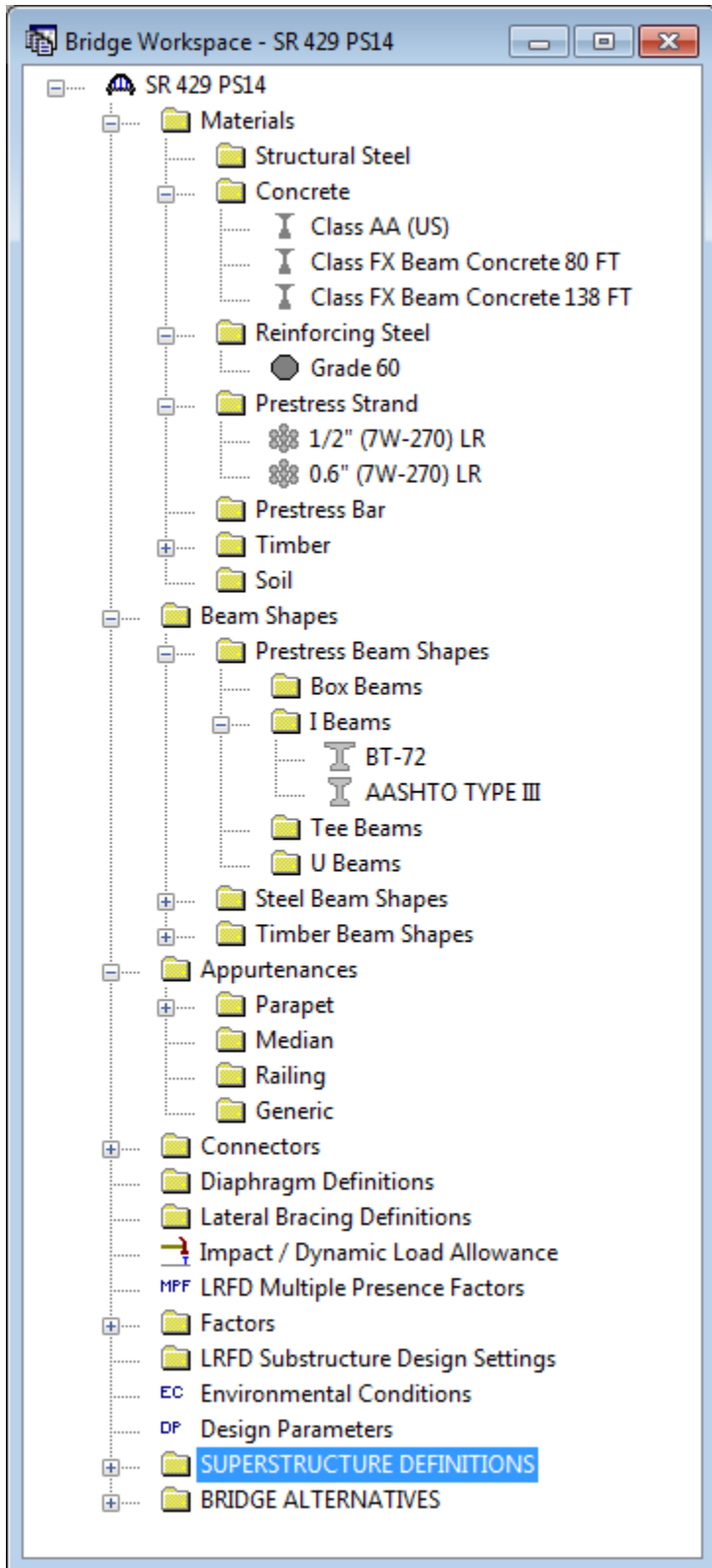
Copy To Library... Copy from Library... OK Apply Cancel

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 enter the parapet dimensions as shown below. Click OK to save the data to memory and close the window.



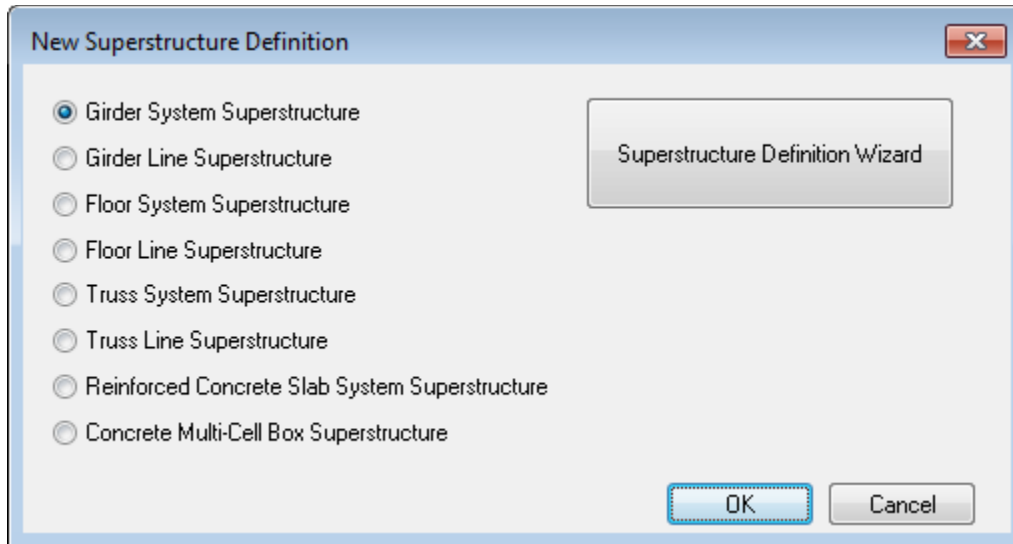
The default LRFD dynamic load allowance and default LRFD factors will be used so we will skip to Superstructure Definition.

Now the Bridge workspace is as shown below.





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 superstructure definition. The following dialog will open.



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: AS BUILT THREE 138 FT SPANS

Description: THREE CONTINUOUS SPANS

Default Units: US Customary

Number of spans: 3

Number of girders: 5

Enter Span Lengths Along the Reference Line:

Span	Length (ft)
1	136.708333
2	137.166666
3	136.708333

Frame Structure Simplified Definition:

Deck type: Concrete

For PS only

Average humidity: 70 %

Member Alt. Types

- Steel
- P/S
- R/C
- Timber

Horizontal Curvature Along Reference Line

Horizontal curvature

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

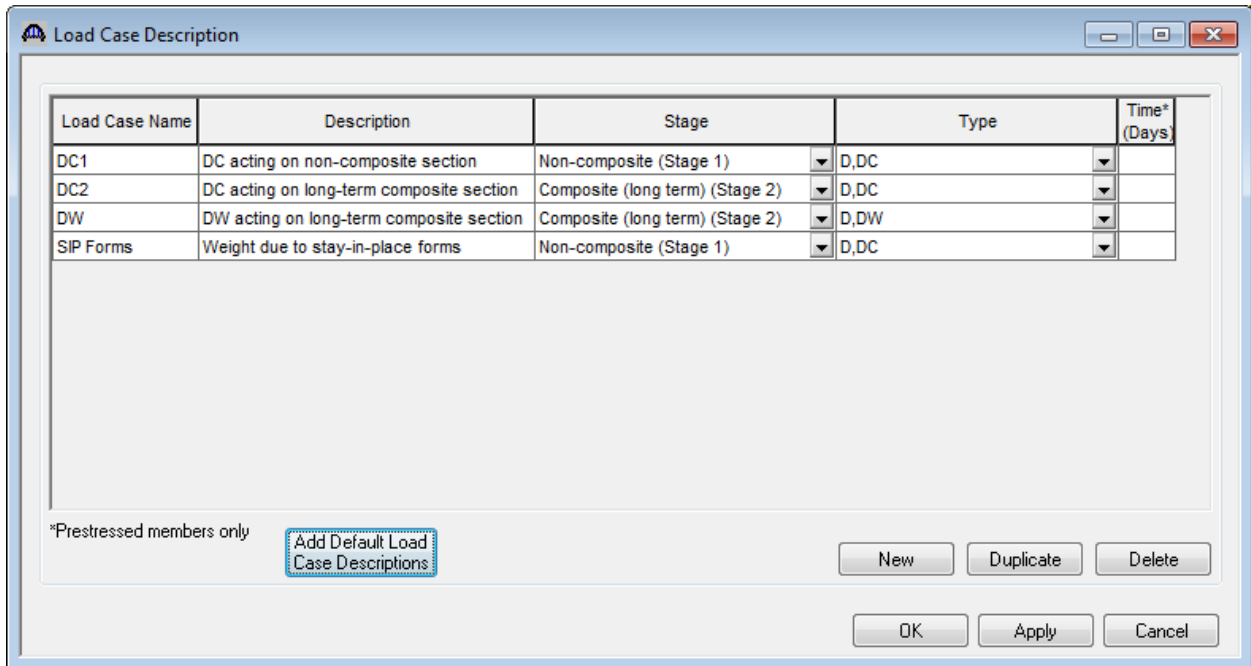
Superelevation:  %

Superstructure Alignment

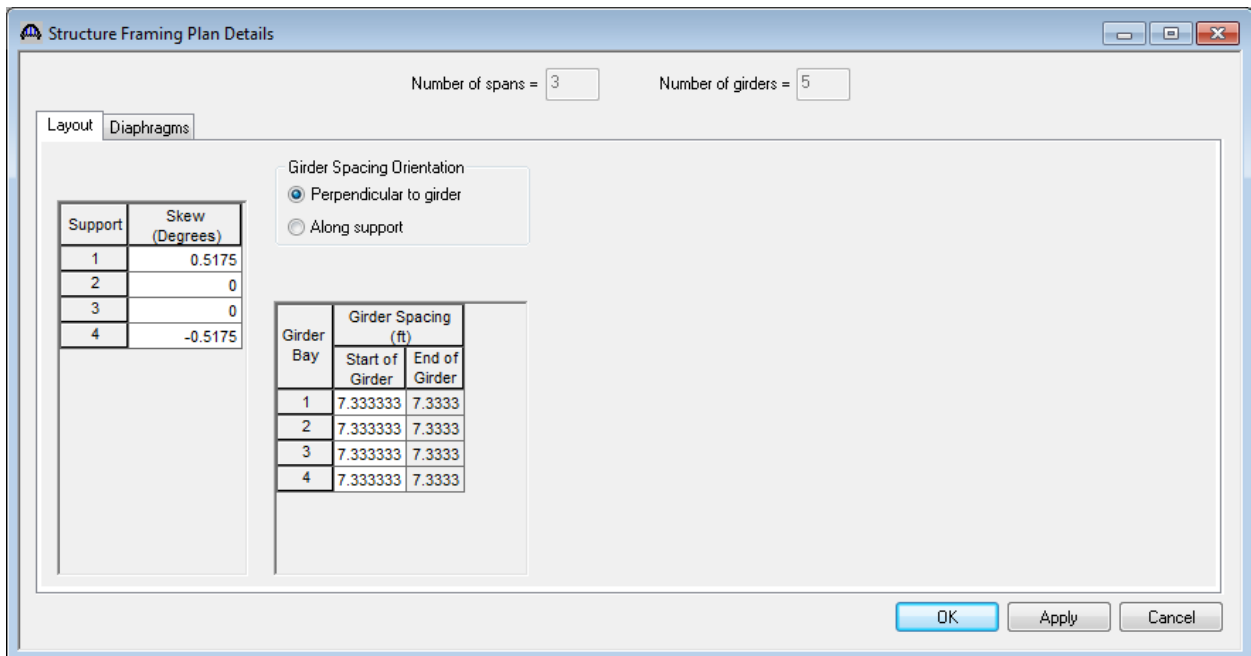
- Curved
- Tangent, curved, tangent
- Tangent, curved
- Curved, tangent

OK Apply Cancel

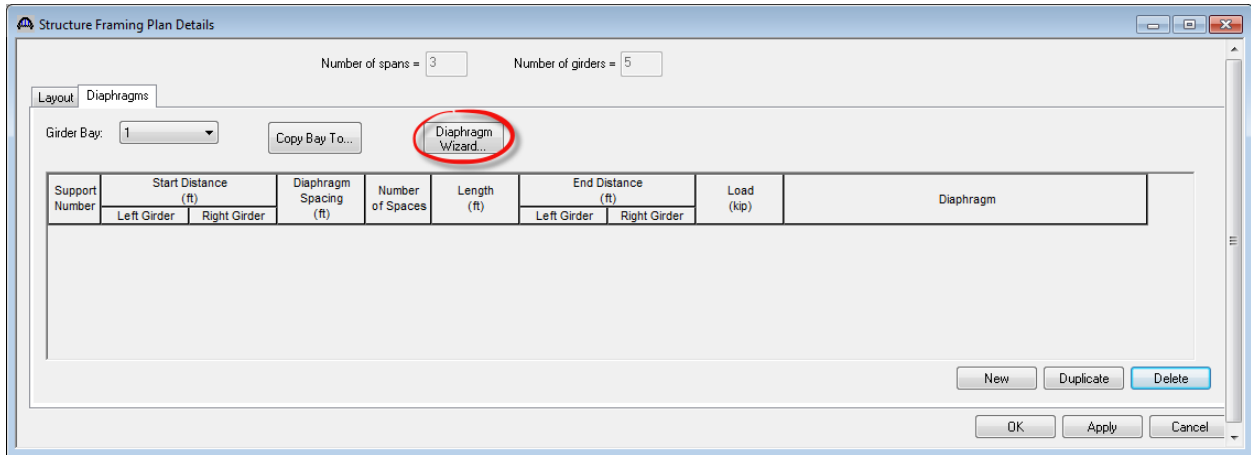
Click Load Case Description to define the dead load cases. Use the “Add Default...” button to create the following load cases.



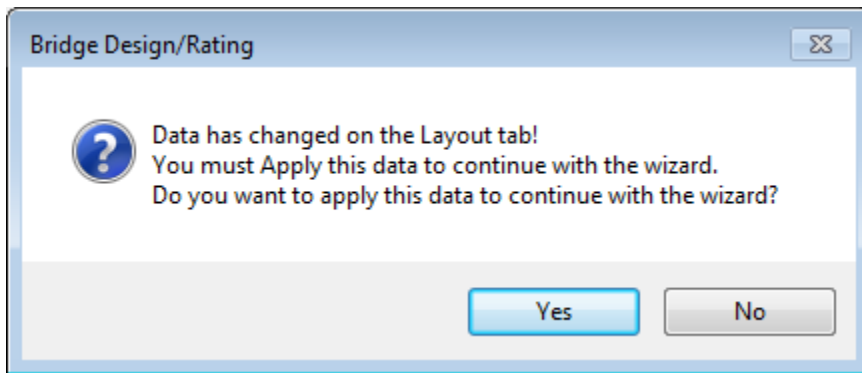
Double-click on Framing Plan Detail to describe the framing plan. Enter the appropriate data as shown below. In this example we are entering all data to 4 significant digits so enter the 7'-4" spacing as 7.3333.



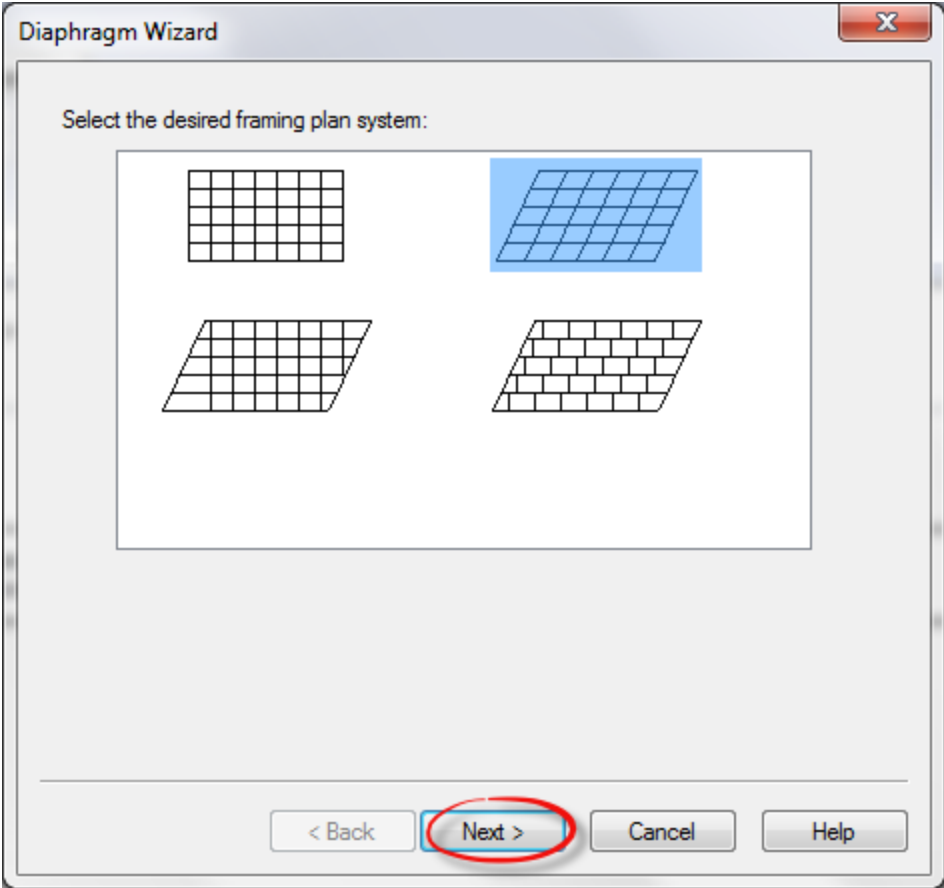
Switch to the Diaphragms tab and use the Wizard to enter diaphragm spacing.



Click on “Diaphragm Wizard” button; The following dialog will appear. Click ‘Yes’ to continue.



Click 'Next' to advance the Wizard.



Enter the following data in the wizard and click 'Finish'. Modifications will need made to update interior supports with different load.

Diaphragm Wizard

Diaphragm Spacing

Enter number of equal spaces per span

Enter equal spacing per span

Support diaphragm load: 5.440000 kip

Interior diaphragm load:  kip

Span	Length (ft)	Number of Equal Spaces
1	136.7083	1
2	137.1667	1
3	136.7083	1

< Back Finish Cancel Help

The following data appears in the Framing Plan Details window and the Framing Plan Schematic is shown below.

Structure Framing Plan Details

Number of spans = 3 Number of girders = 5

Layout Diaphragms

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)	
	Left Girder	Right Girder				Left Girder	Right Girder		
1	0	0	0	1	0	0	0	5.44	-- Not Assigned --
2	0	0	0	1	0	0	0	5.73	-- Not Assigned --
3	0	0	0	1	0	0	0	5.73	-- Not Assigned --
3	136.575859	136.642096	0	1	0	136.575859	136.642096	5.44	-- Not Assigned --

New Duplicate Delete

OK Apply Cancel

Structure Framing Plan Details

Number of spans = 3      Number of girders = 5

Layout Diaphragms

Girder Bay: 2      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	0	0	1	0	0	0	5.44	-- Not Assigned --
2	0	0	0	1	0	0	0	5.73	-- Not Assigned --
3	0	0	0	1	0	0	0	5.73	-- Not Assigned --
3	136.642096	136.708333	0	1	0	136.642096	136.708333	5.44	-- Not Assigned --

New Duplicate Delete

OK Apply Cancel

Structure Framing Plan Details

Number of spans = 3      Number of girders = 5

Layout Diaphragms

Girder Bay: 3      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	0	0	1	0	0	0	5.44	-- Not Assigned --
2	0	0	0	1	0	0	0	5.73	-- Not Assigned --
3	0	0	0	1	0	0	0	5.73	-- Not Assigned --
3	136.708333	136.77457	0	1	0	136.708333	136.77457	5.44	-- Not Assigned --

New Duplicate Delete

OK Apply Cancel

Structure Framing Plan Details

Number of spans = 3      Number of girders = 5

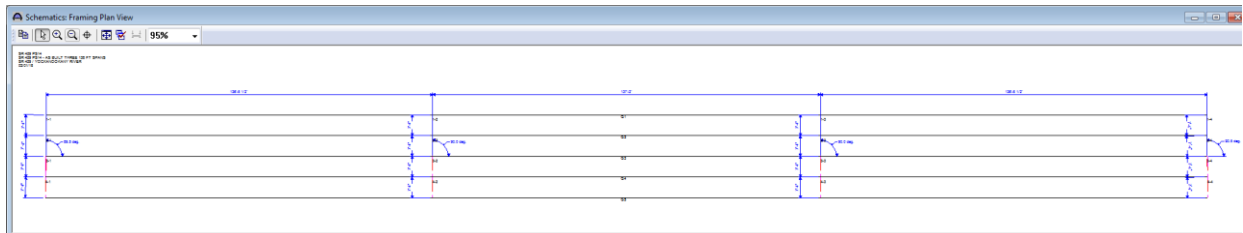
Layout Diaphragms

Girder Bay: 4      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	0	0	1	0	0	0	5.44	-- Not Assigned --
2	0	0	0	1	0	0	0	5.73	-- Not Assigned --
3	0	0	0	1	0	0	0	5.73	-- Not Assigned --
3	136.77457	136.840807	0	1	0	136.77457	136.840807	5.44	-- Not Assigned --

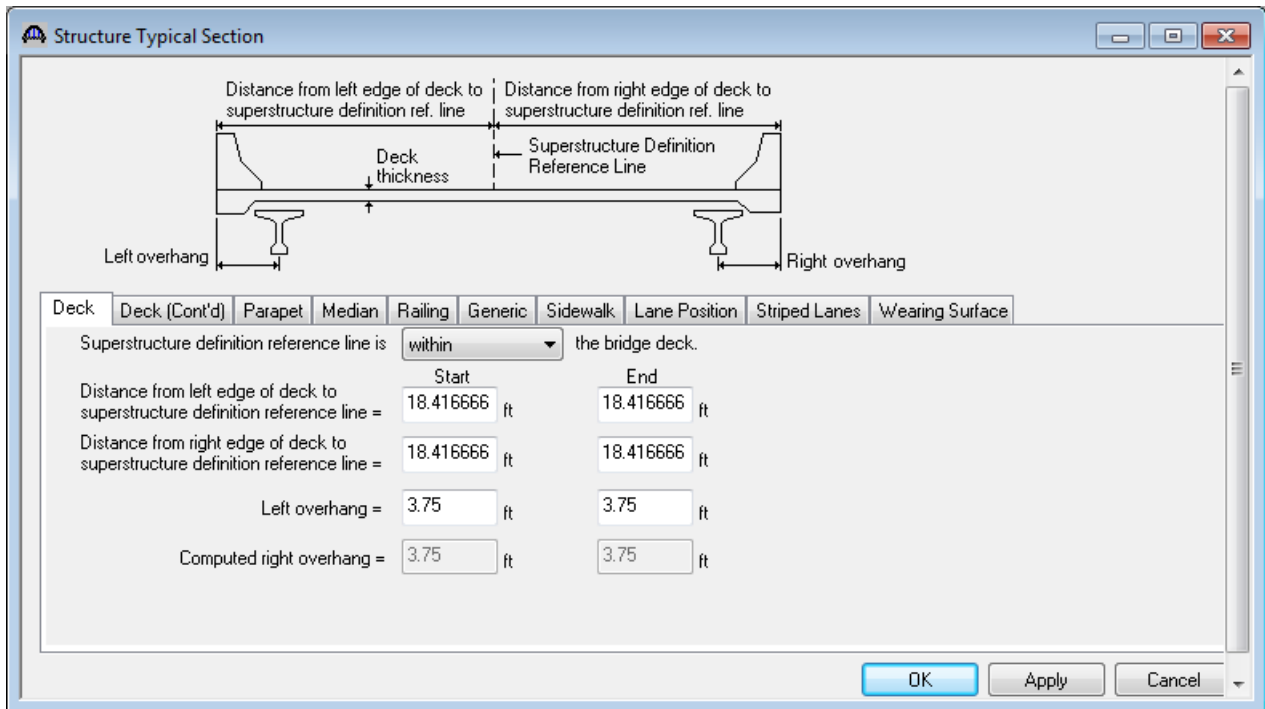
New Duplicate Delete

OK Apply Cancel



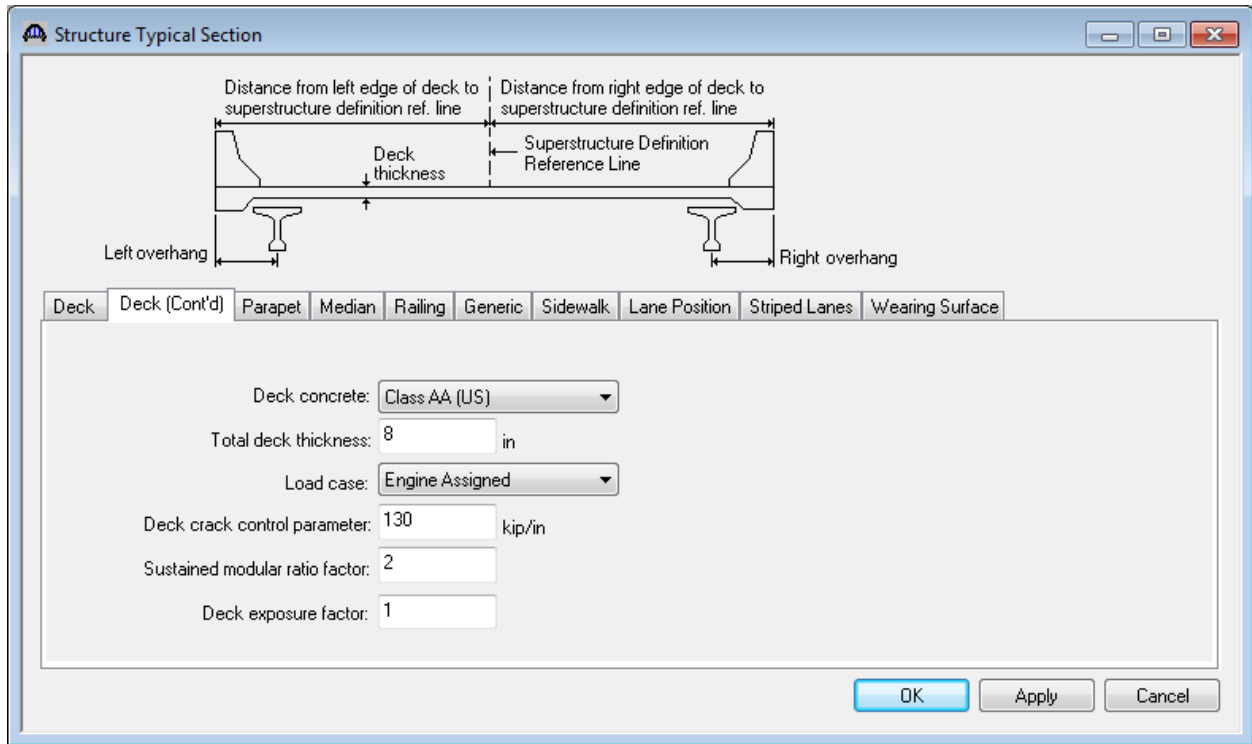
Next define the structure typical section by double-clicking on Structure Typical Section in the Bridge Workspace tree. Input the data describing the typical section as shown below. This screen initially shows steel girders as the default girder type until the member alternatives are defined.

Basic deck geometry:

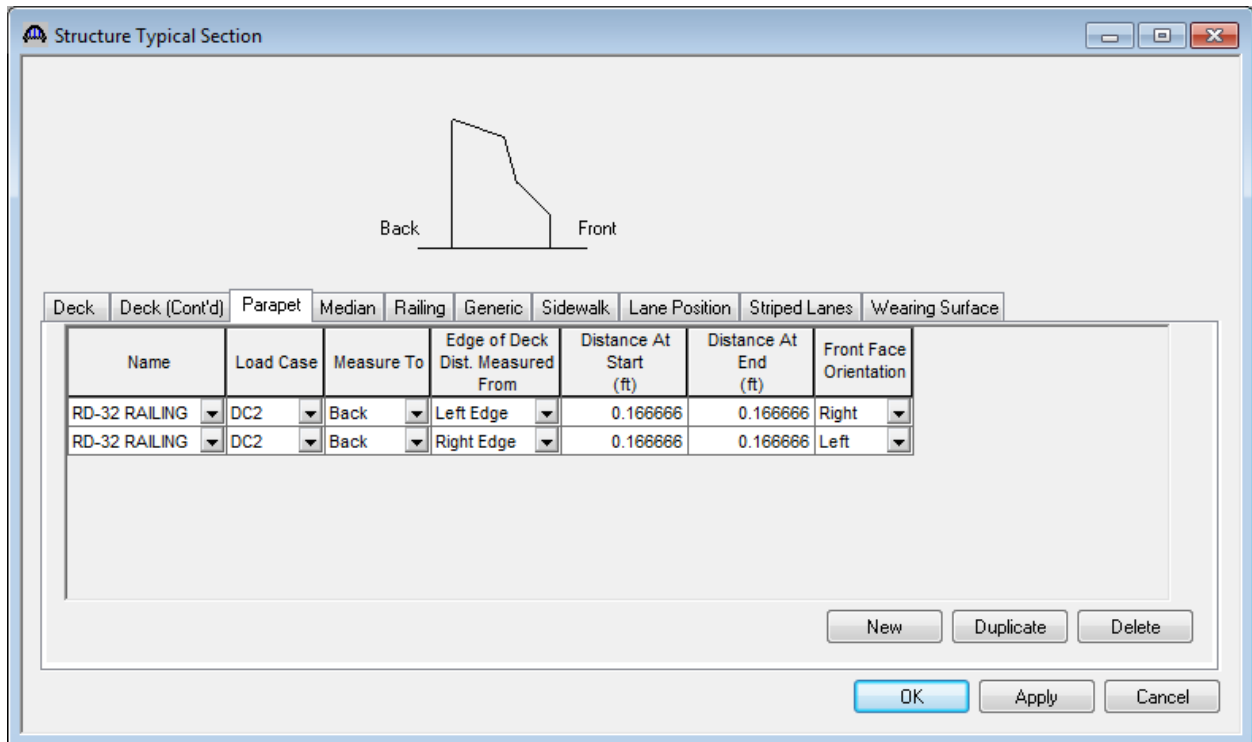




The Deck (cont'd) tab is used to enter information about the deck concrete and thickness.

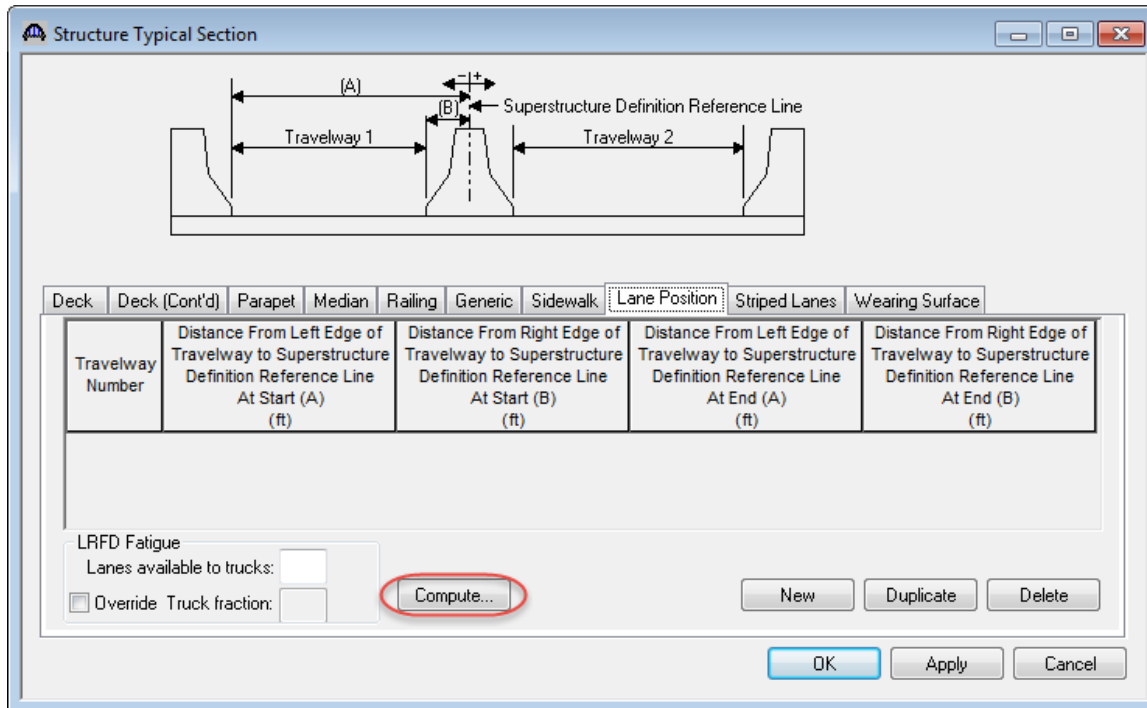


Enter the following parapets:

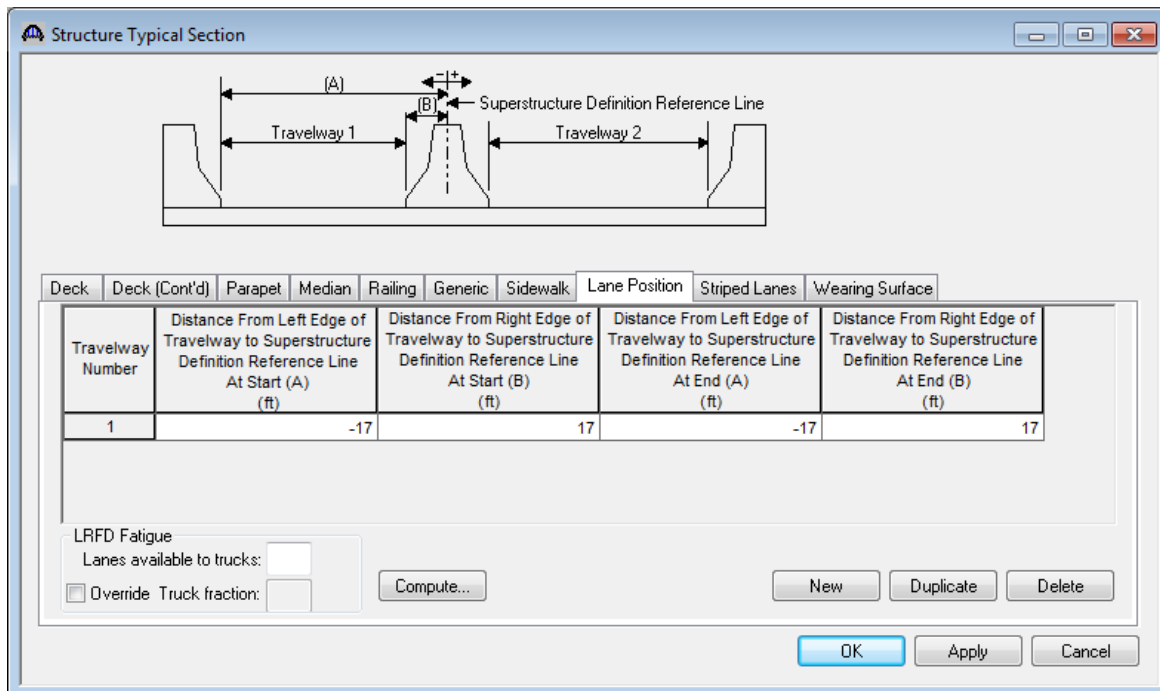


Lane Positions:

Use the 'Compute' button to have BrD compute the lane positions for you. These lane positions are used by BrD to compute the LRFD live load distribution factors.

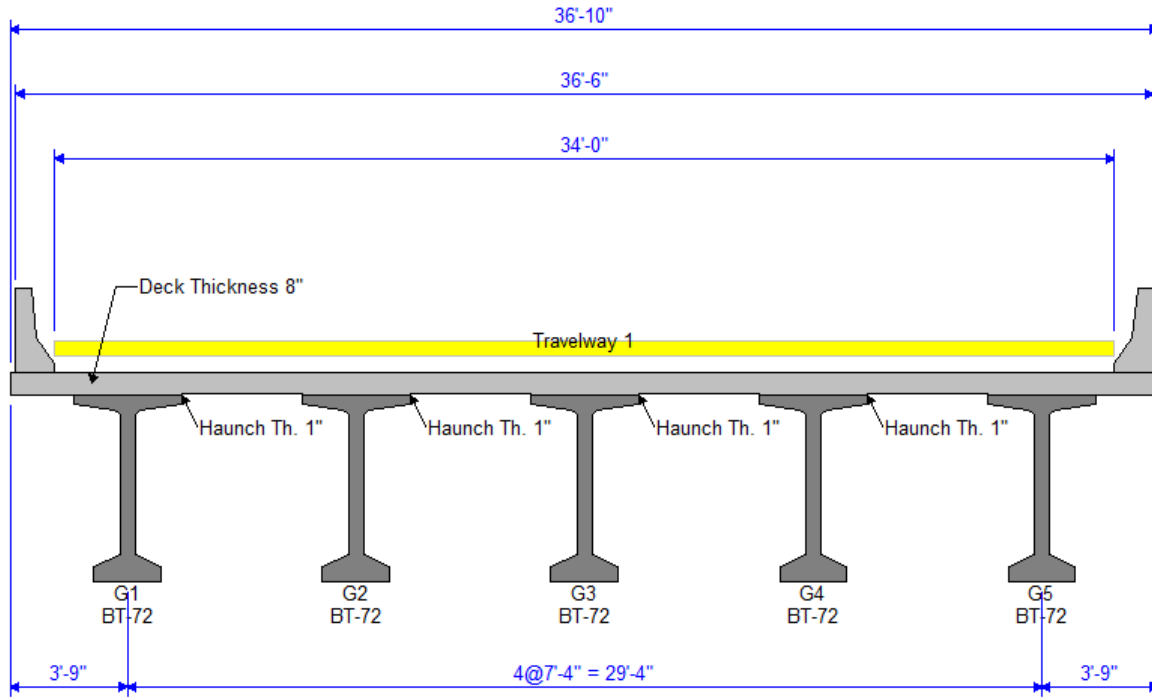


The computed values are shown below.

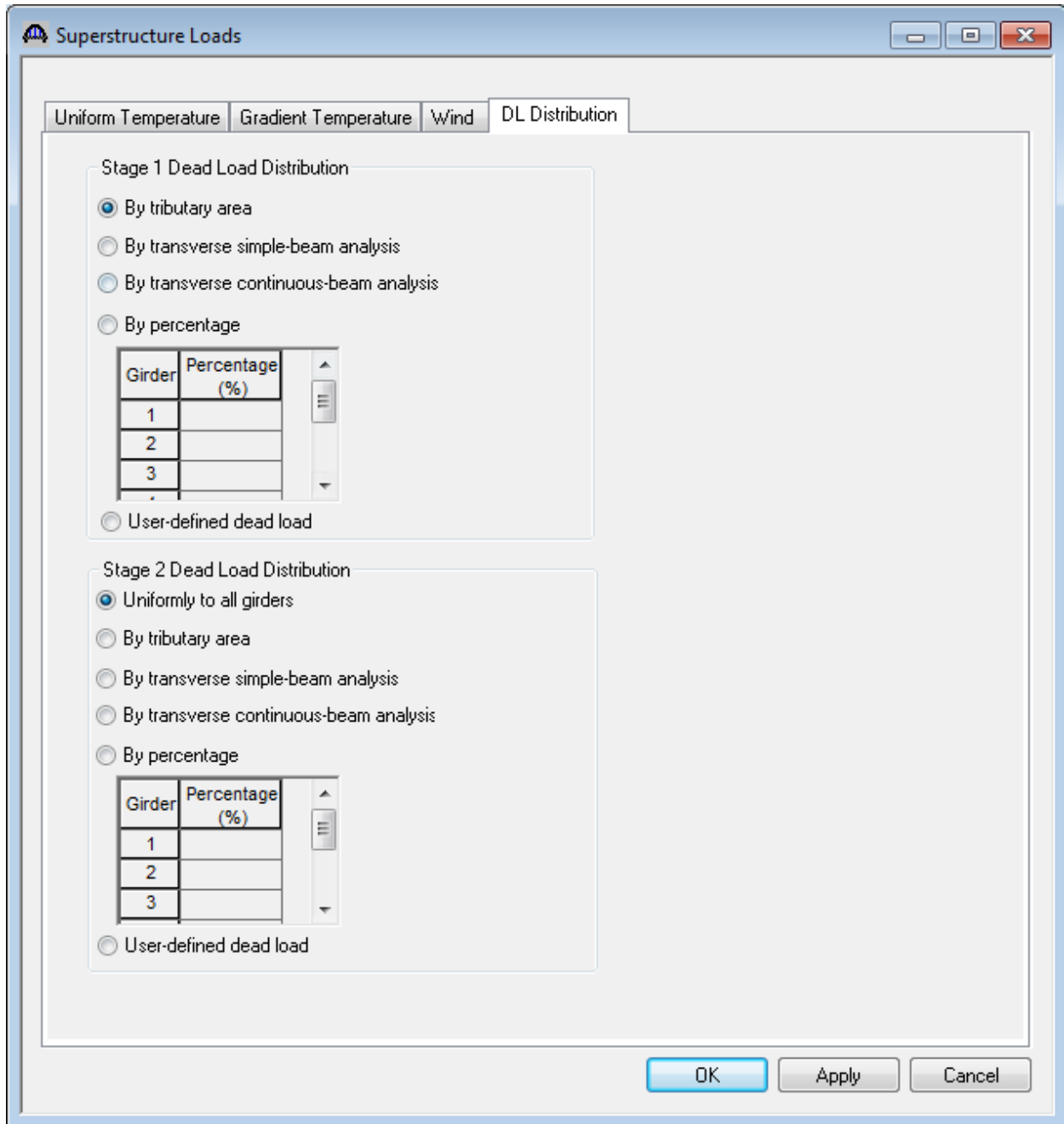


The schematic of the Structure Typical Section is shown below.

SR 429 PS14  
SR 429 PS14 - AS BUILT THREE 138 FT SPANS  
SR 429 / YOCKANOOKANY RIVER  
01/31/18



The DL Distribution tab of the Superstructure Loads window is shown below. The BrD LRFD engine does not support the transverse continuous beam analysis option.



Create the following stress limit.

	LFD	LRFD
Initial allowable compression:	3.6 ksi	3.9 ksi
Initial allowable tension:	0.2 ksi	0.2 ksi
Final allowable compression:	4.5 ksi	4.5 ksi
Final allowable tension:	1 ksi	ksi
Final allowable DL compression:	3 ksi	3.375 ksi
Final allowable slab compression:	ksi	ksi
Final allowable compression: (LL + 1/2(Pe + DL))	3 ksi	3 ksi

If you leave the allowable stresses blank in the stress limit the BrD LRFD engine will compute the allowable based on the AASHTO specification articles and the concrete material selected. The allowable slab compression is not computed for you since the deck is typically a different material than the girder.

Create the following Prestress Property. Select the loss method as ‘AASHTO Approximate’.

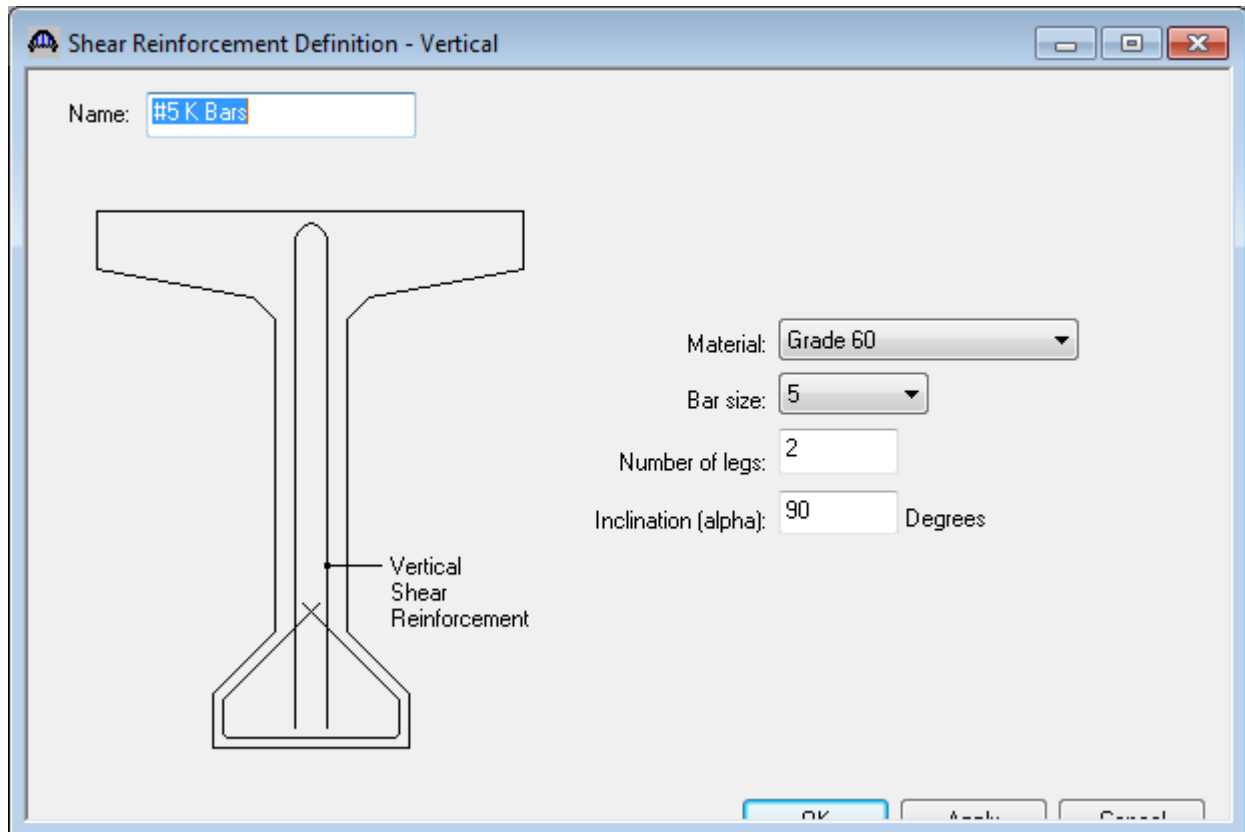
The screenshot shows a software dialog box titled "Prestress Properties". At the top, the "Name" field contains "0.6\" (7W-270) LR". Below this are three tabs: "General P/S Data", "Loss Data - Lump Sum", and "Loss Data - PCI". The "General P/S Data" tab is active. It contains several input fields: "P/S strand material" is set to "0.6\" (7W-270) LR"; "Loss method" is set to "AASHTO Approximate" and is circled in red; "Jacking stress ratio" is "0.75"; "P/S transfer stress ratio" is empty; "Transfer time" is "24" Hours; "Age at deck placement" is "60" Days; "Final age" is "27375" Days. Below these is a section for "Loss Data - AASHTO" with a "Percentage DL" field set to "0". At the bottom left, there is a checkbox labeled "Include elastic gains" which is also circled in red. At the bottom right are "OK", "Apply", and "Cancel" buttons.

The following loss methods are available in the BrD LRFD engine:

- AASHTO Approximate
- AASHTO Refined
- Lump Sum
- PCI
- Pre-2005 AASHTO Refined (AASHTO Refined, Third Edition, 2004 without interims)

Another feature for prestress loss calculations in the BrD LRFD engine is the ability to include elastic gains and losses due to dead load application.

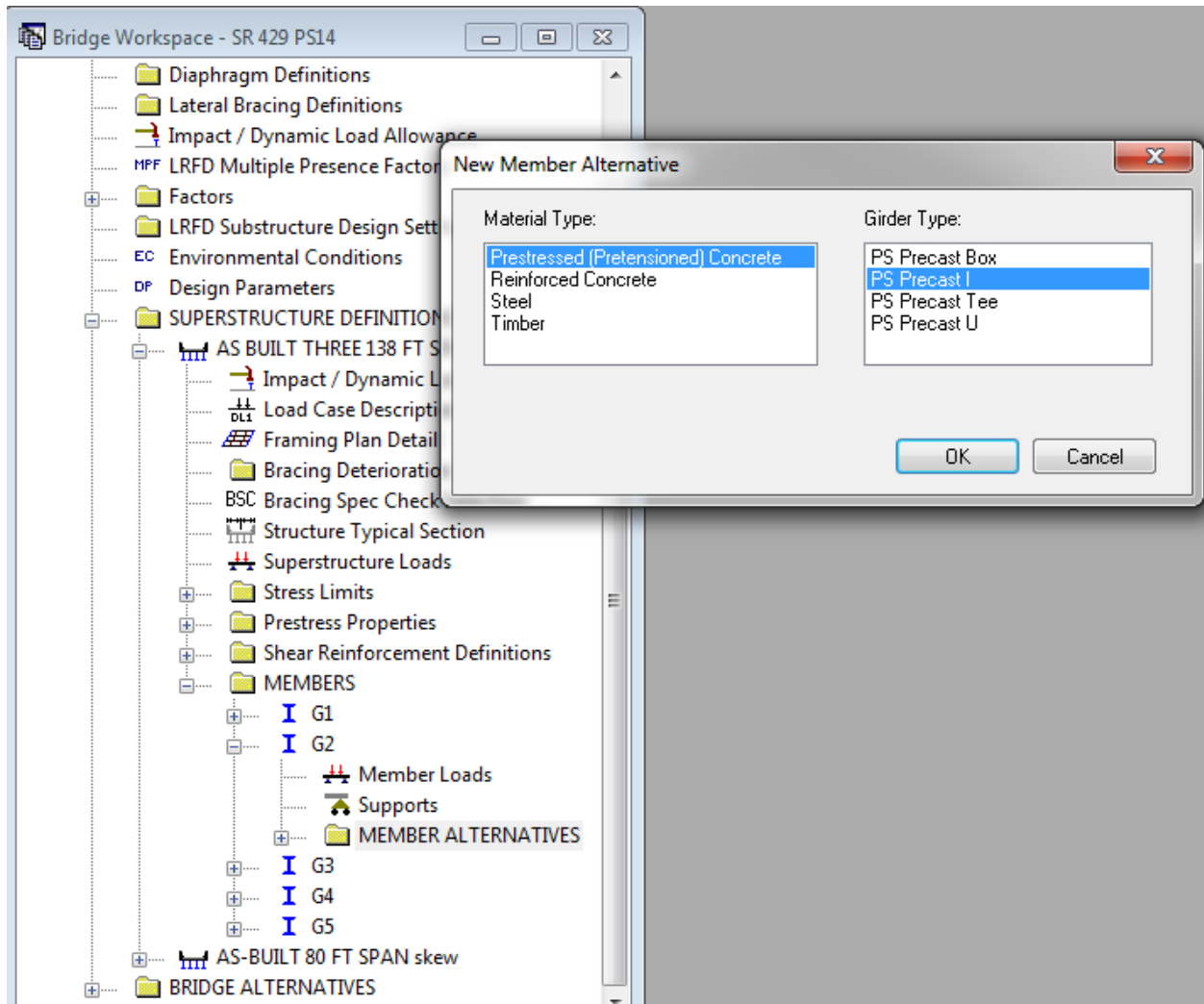
Define the Vertical Shear Reinforcement by double clicking on Vertical (under Shear Reinforcement Definitions in the tree). Note, #5 S Bars are the same definition as #5 K bars. Define the reinforcement as shown below. Click OK to save to memory and close the window.



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.

Now create a prestressed I beam alternative for member G2 by double-clicking on the 'MEMBER ALTERNATIVES' label.





Enter the following data in the Member Alternative window. The Schedule-based Girder property input method is the only input method available for a prestressed concrete beam.

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

Default rating method:

Self Load

Load case:

Additional self load =  kip/ft

Additional self load =  %

Crack control parameter (Z)

Top of beam:  kip/in

Bottom of beam:  kip/in

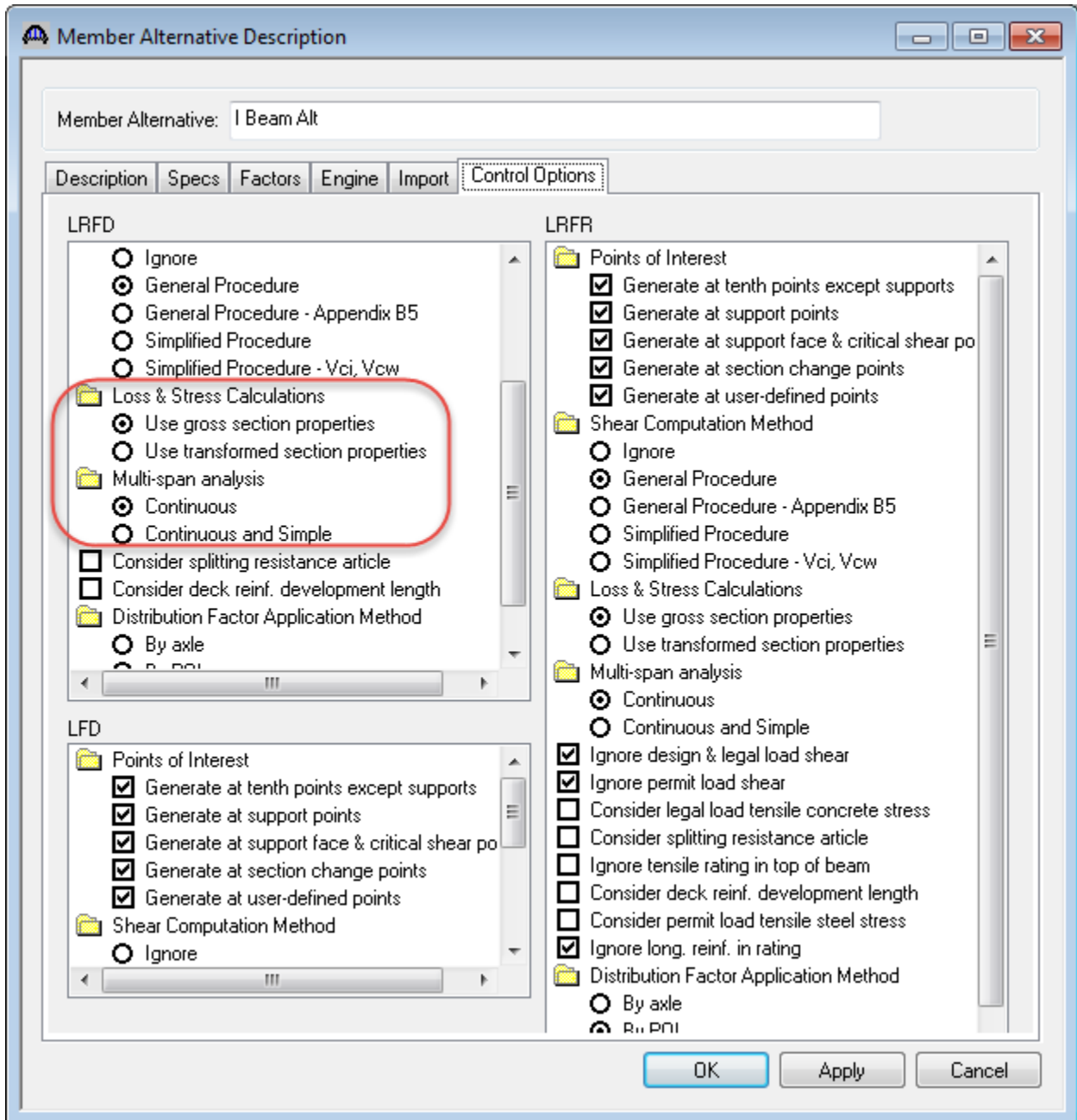
Exposure factor

Top of beam:

Bottom of beam:

OK Apply Cancel

The Control Options tab allows you to select the following control features.



The BrD LRFD engine allows you to select either gross or transformed section properties to be used in the loss and stress calculations. Note that the gross section properties are always used in the structural analysis.

The BrD LRFD engine also allows you to model prestress beams made continuous for live load in 2 ways:

- The Continuous analysis method considers multi-span structures to be simply supported for beam self-weight and uncured deck and continuously supported for composite dead and live loads. This method takes advantage of the continuity connection to reduce the maximum positive moment at mid-spans.
- The Continuous and Simple method analyzes the structure as simply supported for beam self-weight and uncured deck and both continuously and simply supported for composite dead and live loads. The maximum effects from the two analyses are then used in the specification checking. This method accounts for the condition where full continuity is not provided at interior supports and does not reduce the maximum positive moment at mid-spans.

We will let the BrD LRFD engine compute the live load distribution factors for us so we will not enter them.

Enter the following data on the Shrinkage/Time window.

Shrinkage/Time

Shrinkage Time

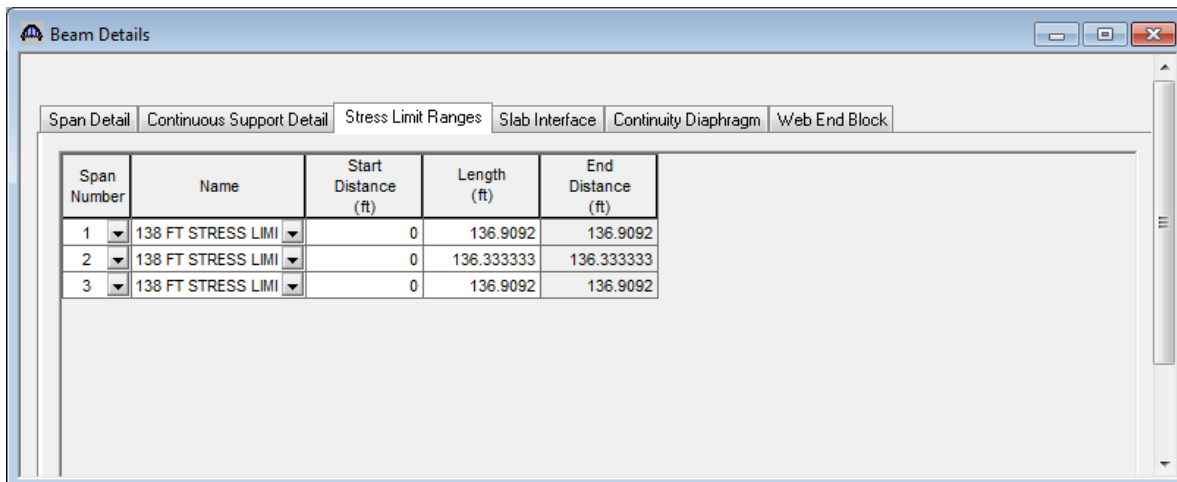
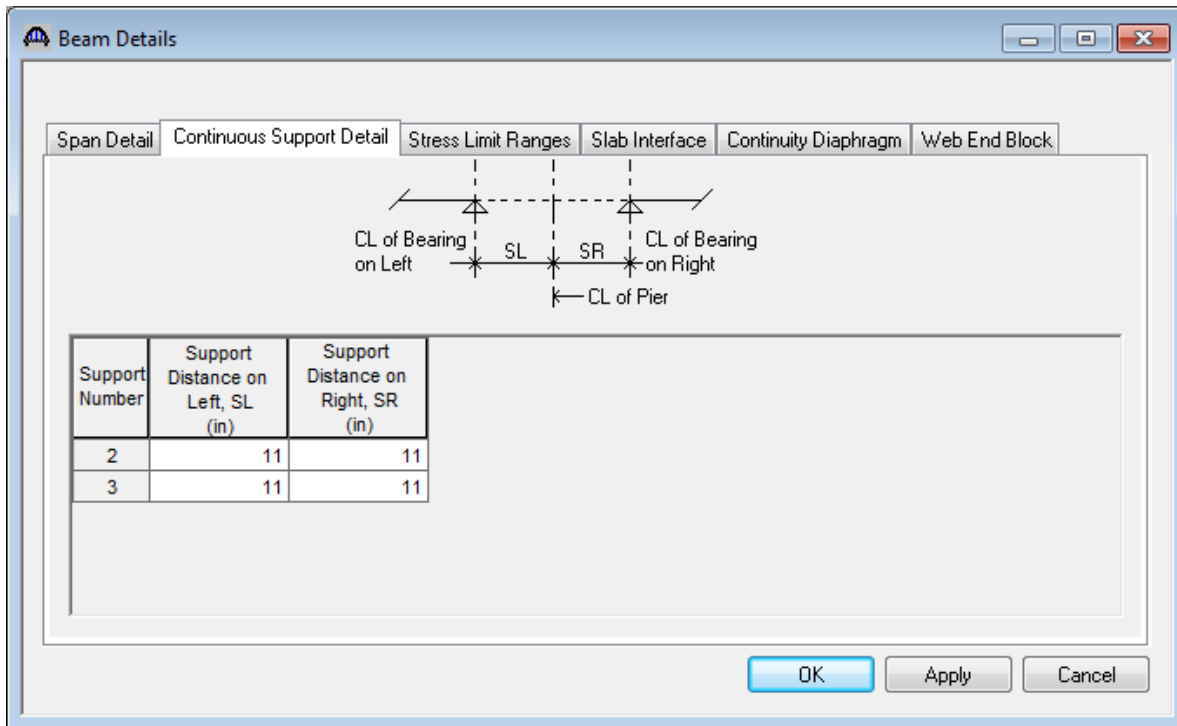
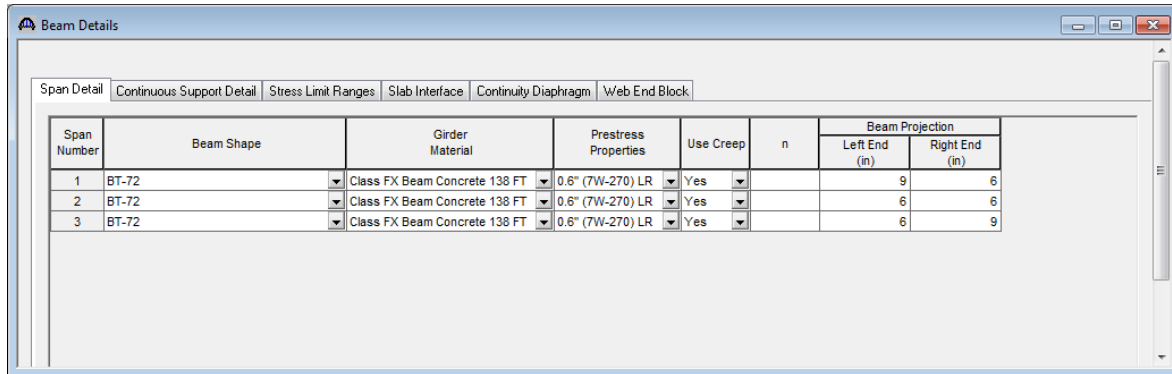
Beam  
Curing method: Steam-cured

Deck  
Curing method: Moist-cured  
Drying time: Days

Consider deck differential shrinkage loads

OK Apply Cancel

Enter the following data on the Beam Details window.



**Beam Details**

Span Detail | Continuous Support Detail | Stress Limit Ranges | **Slab Interface** | Continuity Diaphragm | Web End Block

Interface type: Intentionally Roughened

Default interface width to beam widths:

Interface width:  in

Cohesion factor:  ksi

Friction factor:

K1:

K2:  ksi

OK Apply Cancel

**Beam Details**

Span Detail | Continuous Support Detail | Stress Limit Ranges | **Slab Interface** | Continuity Diaphragm | Web End Block

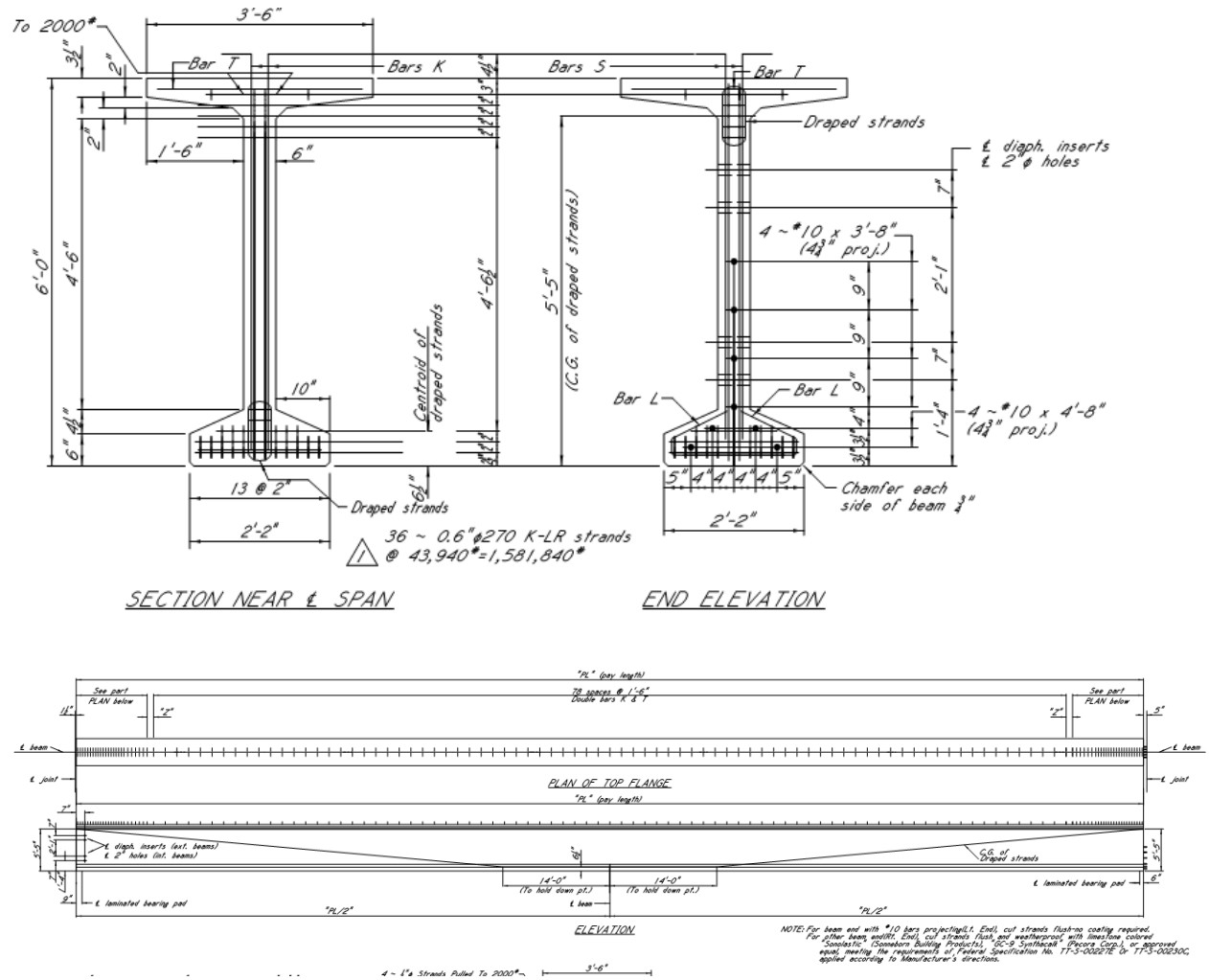
Span Number	Left Support				Right Support			
	Material	Distance (in)	Bar Count	Bar Size	Material	Distance (in)	Bar Count	Bar Size
1					Grade 60	3.5	2	10
1					Grade 60	7	2	10
1					Grade 60	11	1	10
1					Grade 60	20	1	10
1					Grade 60	29	1	10
1					Grade 60	38	1	10
2	Grade 60	3.5	2	10	Grade 60	3.5	2	10
2	Grade 60	7	2	10	Grade 60	7	2	10
2	Grade 60	11	1	10	Grade 60	11	1	10
2	Grade 60	20	1	10	Grade 60	20	1	10
2	Grade 60	29	1	10	Grade 60	29	1	10
2	Grade 60	38	1	10	Grade 60	38	1	10
3	Grade 60	3.5	2	10				
3	Grade 60	7	2	10				
3	Grade 60	11	1	10				
3	Grade 60	20	1	10				
3	Grade 60	29	1	10				
3	Grade 60	38	1	10				

Ignore positive moment at supports in ratings

New Duplicate Delete

OK Apply Cancel

Now define the following strand layout at midspan using the screen captures from the drawings (shown below).



Strand Layout - Span 1
145%

**Description Type**

P and CGS only     Strands in rows

**Strand Configuration Type**

Straight/Debonded     Symmetry

Harped

Harped and straight debonded

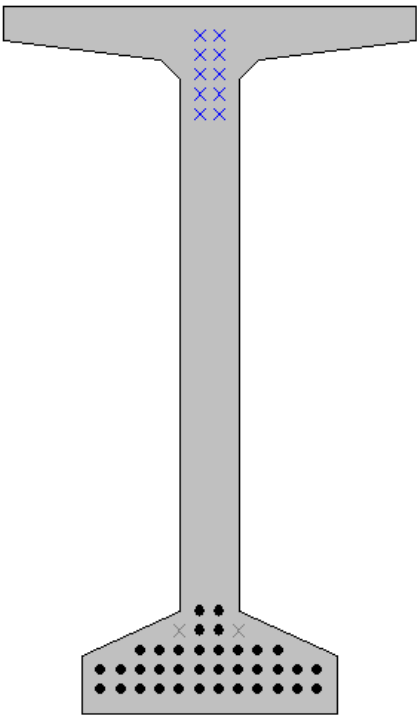
Mid span

Left end

Right end

Harped Point Locations		
Harped Point	Distance (ft)	Radius (in)
Left	54.45459	0
Right	54.45459	0

Notes:  
Strand positions generated by the PSI/SSD method.  
Please refer to help for a description of this method.



Number of strands = 36  
 Number of harped strands = 0  
 CG of strands (measured from bottom of section) = 4.83 in

**Legend:**

- X No strand at this position at the current section location.
- X No strand at this position at the current location but a strand is harped to this position.
- A strand occupies this position at the current section location.
- The strand is debonded from the end of the beam to the current section location.
- The strand is debonded from the mid-span to the current section location.
- The strand is debonded at other section location. Hover over the strand for more information.
- The harped position of a harped strand.
- The mid-span position of a harped strand.
- The mid-span position of one strand and the harped position of another strand.
- Mild steel.

OK
Apply
Cancel

Then define the following harped strands at this location.

Strand Layout - Span 1

145%

Description Type  
 P and CGS only  Strands in rows

Strand Configuration Type  
 Straight/Debonded  Symmetry  
 Harped  
 Harped and straight debonded

Mid span

Left end  
 Right end

Harp Point Locations		
Harp Point	Distance (ft)	Radius (in)
Left	54.45459	0
Right	54.45459	0

Notes:  
 Strand positions generated by the RSV/S&D method.  
 Please refer to Help for a description of this method.

Number of strands = 36  
 Number of harped strands = 10  
 CG of strands (measured from bottom of section) = 21.08 in

Legend:

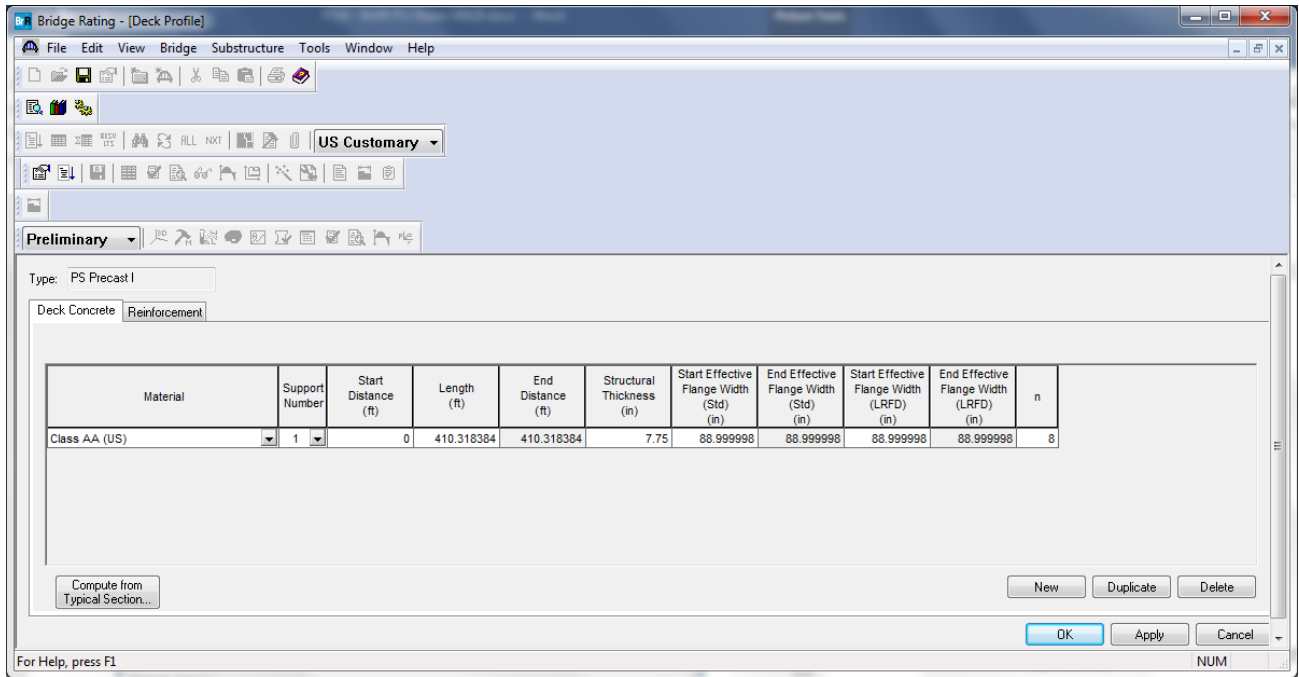
- ✕ No strand at this position at the current section location.
- ✕ No strand at this position at the current location but a strand is harped to this position.
- A strand occupies this position at the current section location.
- The strand is debonded from the end of the beam to the current section location.
- The strand is debonded from the mid-span to the current section location.
- The strand is debonded at other section location. Hover over the strand for more information.
- The harped position of a harped strand.
- The mid-span position of a harped strand.
- The mid-span position of one strand and the harped position of another strand.
- Mild steel.

OK Apply Cancel

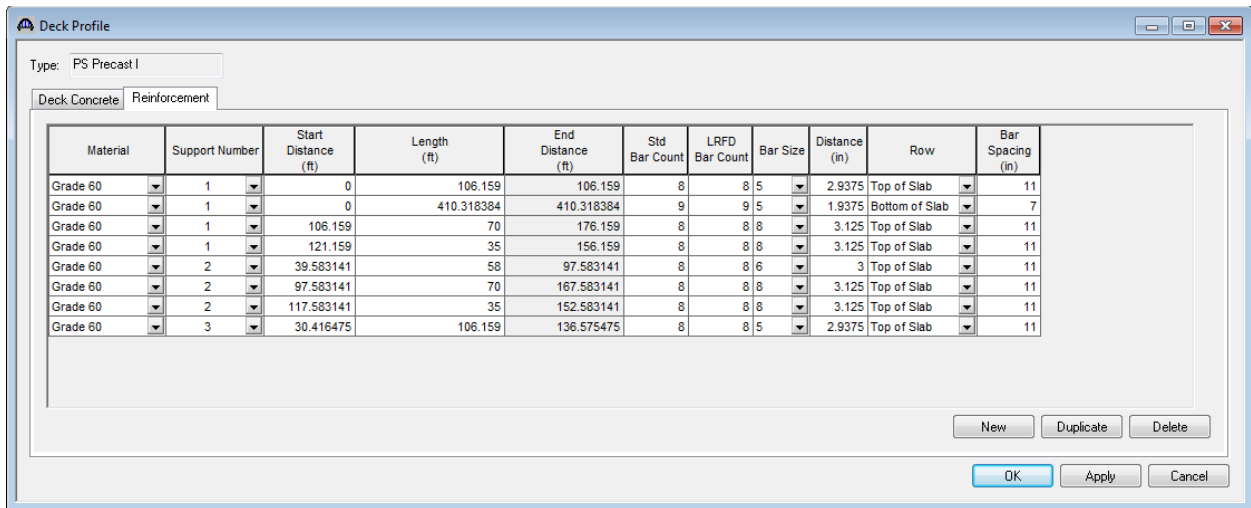
Repeat the process and describe the same strand layout for span 2 and Span 3. Span 2 Harp Point is located at 54.16666 ft and Span 3 Harp Point is located at 54.45460 ft.



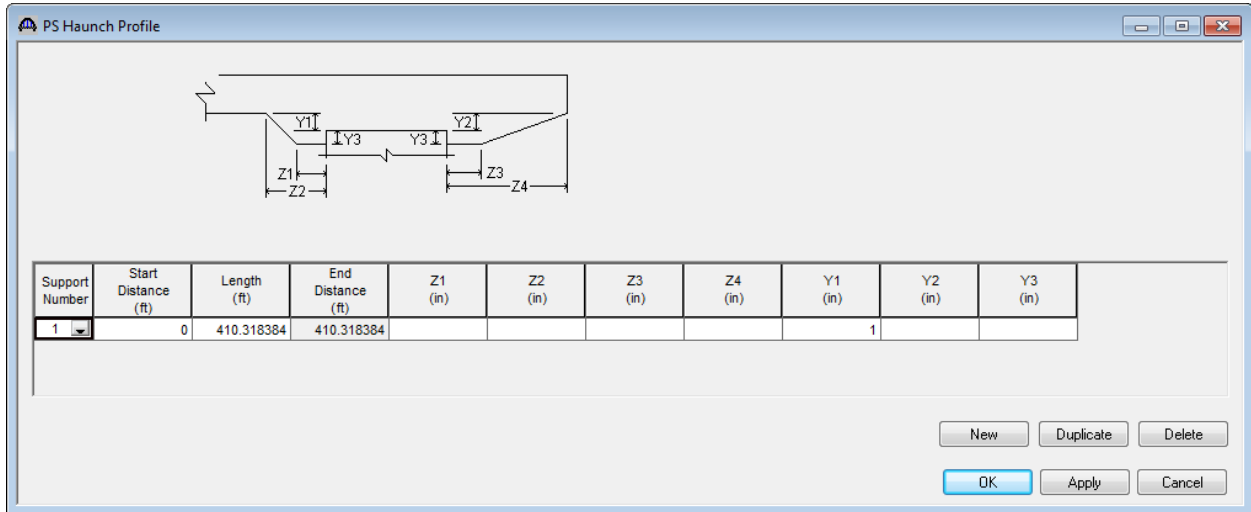
Describe the deck as follows:



Describe the deck reinforcement as follows:



The Haunch Profile is shown below.

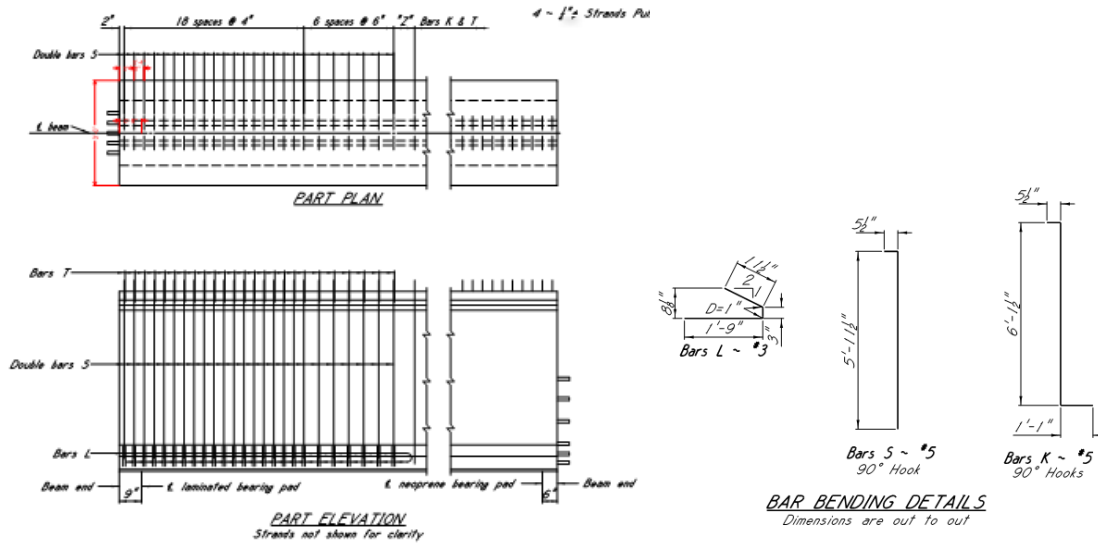


The diagram shows a haunch profile with dimensions Z1, Z2, Z3, Z4, Y1, Y2, and Y3. The table below provides the data for the profile.

Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Z1 (in)	Z2 (in)	Z3 (in)	Z4 (in)	Y1 (in)	Y2 (in)	Y3 (in)
1	0	410.318384	410.318384					1		

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

Use the Stirrup Wizard to create the following shear stirrups:



**Beam Elevation Showing Stirrups**

Vertical Stirrup Wizard

Span: 1

0.75 ft      135.65919 ft      0.5 ft

Distance from left end to first stirrup: 0.166666 ft      Distance from left end to last stirrup: 136.90919 ft

Distance from right end to last stirrup: -0.0000070 ft       All extended into deck

Reinf. Name	Number of Spaces	Spacing (in)
#5 S Bars	1	0
#5 S Bars	18	4
#5 S Bars	6	6
#5 K Bars	1	10.4552
#5 K Bars	78	18
#5 S Bars	1	10.4552
#5 S Bars	6	6
#5 S Bars	18	4

New   Duplicate   Delete

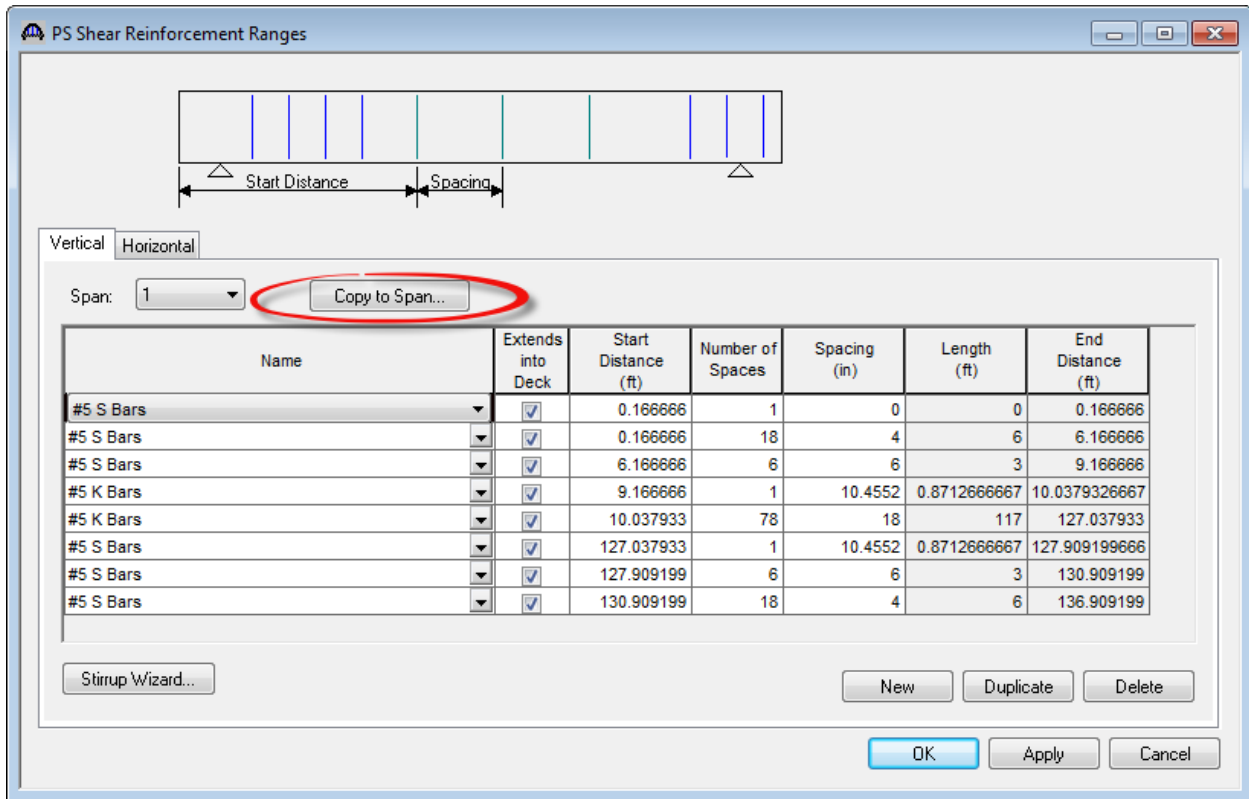
Symmetry

Finish by symmetry

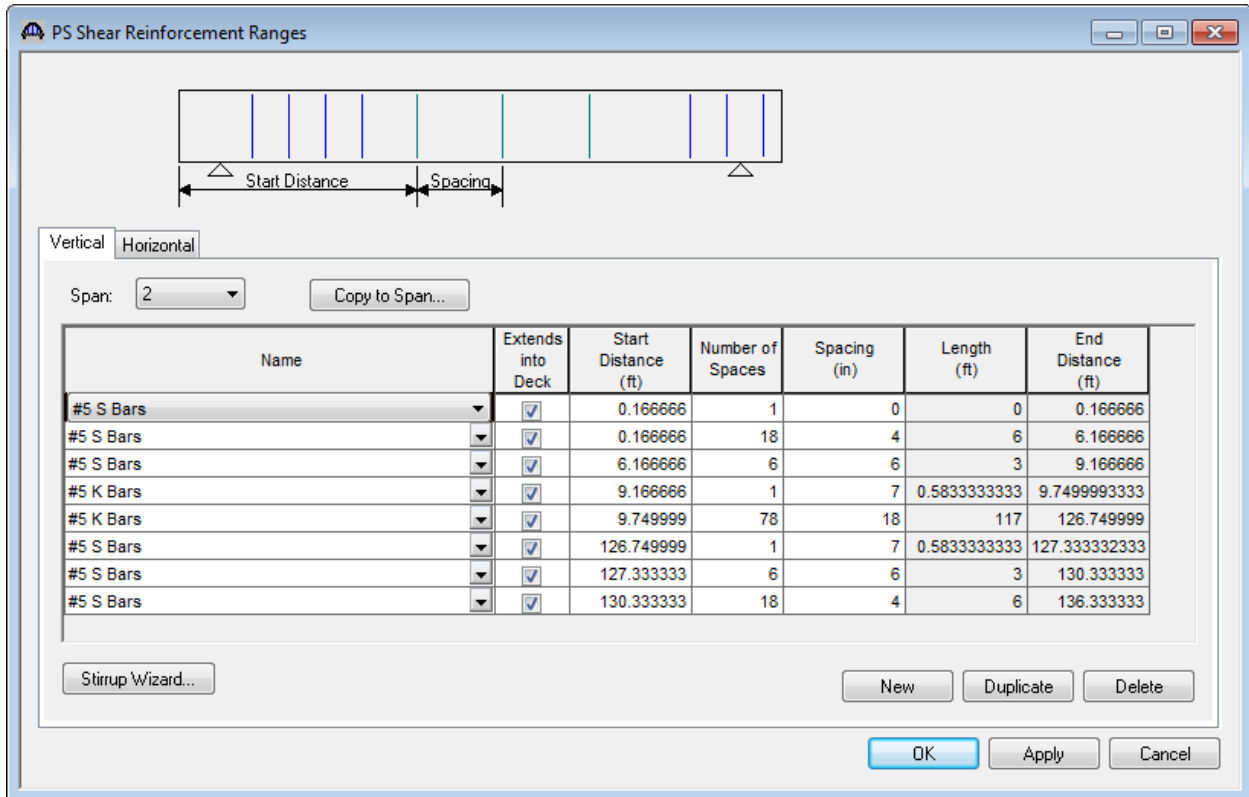
Even number spaces

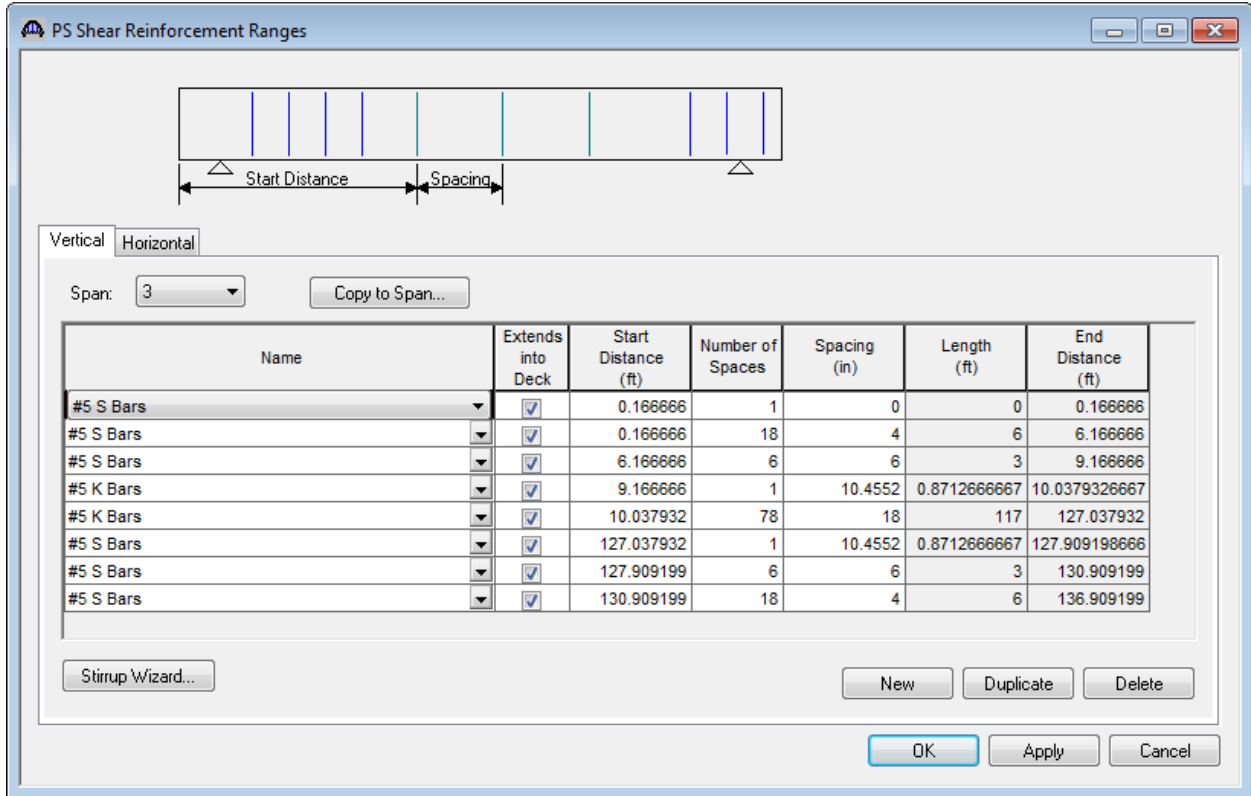
Odd number spaces

Apply All   Apply Span   Cancel   Help

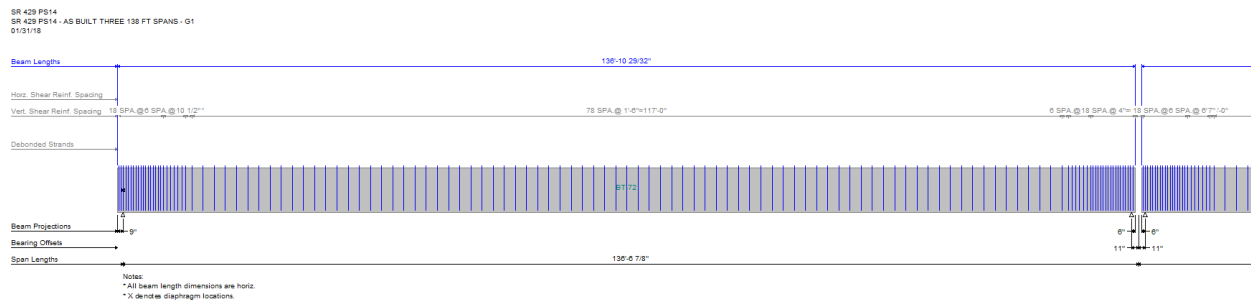


Then use the 'Copy to Span' button to copy the stirrups to Span 2 and Span 3. Update as needed.





The Member Alternative Schematic is shown below:



Girder 1 is complete. Girders G2-G5 are similar but the lengths are different.

Harp Locations			
Girder	Span 1	Span 2	Span 3
1	54.45460	54.16667	54.45460
2	54.48771	54.16667	54.48771
3	54.52083	54.16667	54.52083
4	54.55395	54.16667	54.55395
5	54.58707	54.16667	54.58707

**Beam Details**

Span Detail | Continuous Support Detail | **Stress Limit Ranges** | Slab Interface | Continuity Diaphragm | Web End Block

Span Number	Name	Start Distance (ft)	Length (ft)	End Distance (ft)
1	138 FT STRESS LIMIT	0	136.9754	136.9754
2	138 FT STRESS LIMIT	0	136.333333	136.333333
3	138 FT STRESS LIMIT	0	136.9754	136.9754

GIRDER 2

**Deck Profile**

Type: PS Precast I

GIRDER 2

Deck Concrete | **Reinforcement**

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 AA (US)	1	0	410.450858	410.450858	7.75	87.999996	87.999996	87.999996	87.999996	8

Compute from Typical Section... | New | Duplicate | Delete

OK | Apply | Cancel

**Deck Profile**

Type: PS Precast I

GIRDER 2

Deck Concrete | **Reinforcement**

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	0	410.450858	410.450858	10	10	5	1.9375	Bottom of Slab	7
Grade 60	1	0	106.225429	106.225429	8	8	5	2.9375	Top of Slab	11
Grade 60	1	106.225429	70	176.225429	8	8	8	3.125	Top of Slab	11
Grade 60	1	121.225429	35	156.225429	8	8	8	3.125	Top of Slab	11
Grade 60	2	39.583333	58	97.583333	8	8	6	3	Top of Slab	11
Grade 60	2	97.583333	70	167.583333	8	8	8	3.125	Top of Slab	11
Grade 60	3	15.416667	35	50.416667	8	8	8	3.125	Top of Slab	11
Grade 60	3	30.416667	106.225429	136.642096	8	8	5	2.9375	Top of Slab	11

New | Duplicate | Delete

OK | Apply | Cancel

PS Haunch Profile

Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Z1 (in)	Z2 (in)	Y1 (in)	Y3 (in)
1	0	410.450858	410.450858			1	

New Duplicate Delete

OK Apply Cancel

PS Shear Reinforcement Ranges

Vertical Horizontal

Span: 1 Copy to Span...

Name	Extends into Deck	Start Distance (ft)	Number of Spaces	Spacing (in)	Length (ft)	End Distance (ft)
#5 S Bars	<input checked="" type="checkbox"/>	0.166666	1	0	0	0.166666
#5 S Bars	<input checked="" type="checkbox"/>	0.166666	18	4	6	6.166666
#5 S Bars	<input checked="" type="checkbox"/>	6.166666	6	6	3	9.166666
#5 K Bars	<input checked="" type="checkbox"/>	9.166666	1	10.852	0.9043333333	10.0709993333
#5 K Bars	<input checked="" type="checkbox"/>	10.070999	78	18	117	127.070999
#5 S Bars	<input checked="" type="checkbox"/>	127.070999	1	10.852	0.9043333333	127.975332333
#5 S Bars	<input checked="" type="checkbox"/>	127.975333	6	6	3	130.975333
#5 S Bars	<input checked="" type="checkbox"/>	130.975333	18	4	6	136.975333

Stirrup Wizard...

New Duplicate Delete

OK Apply Cancel

**Beam Details** GIRDER 3

Span Detail | Continuous Support Detail | Stress Limit Ranges | Slab Interface | Continuity Diaphragm | Web End Block

Span Number	Name	Start Distance (ft)	Length (ft)	End Distance (ft)
1	138 FT STRESS LIM	0	137.0417	137.0417
2	138 FT STRESS LIM	0	136.333333	136.333333
3	138 FT STRESS LIM	0	137.0417	137.0417

**Deck Profile** GIRDER 3

Type: PS Precast I

Deck Concrete | Reinforcement

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 AA (US)	1	0	410.583332	410.583332	7.75	87.999996	87.999996	87.999996	87.999996	8

Compute from Typical Section... New Duplicate Delete

OK Apply Cancel

**Deck Profile** GIRDER 3

Type: PS Precast I

Deck Concrete | Reinforcement

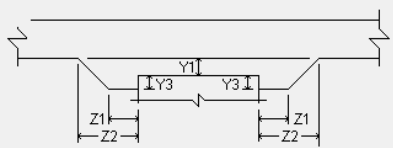
Material	Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Std Bar Count	LRFD Bar Count	Bar Size	Distance (in)	Row	Bar Spacing (in)
Grade 60	1	0	410.583332	410.583332	10	10	5	1.9375	Bottom of Slab	7
Grade 60	1	0	106.291666	106.291666	8	8	5	2.9375	Top of Slab	11
Grade 60	1	106.291666	70	176.291666	8	8	8	3.125	Top of Slab	11
Grade 60	1	121.291666	35	156.291666	8	8	8	3.125	Top of Slab	11
Grade 60	2	39.583333	58	97.583333	8	8	6	3	Top of Slab	11
Grade 60	2	97.583333	70	167.583333	8	8	8	3.125	Top of Slab	11
Grade 60	3	15.416667	35	50.416667	8	8	8	3.125	Top of Slab	11
Grade 60	3	30.416667	106.291666	136.708333	8	8	5	2.9375	Top of Slab	11

New Duplicate Delete

OK Apply Cancel



PS Haunch Profile




Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Z1 (in)	Z2 (in)	Y1 (in)	Y3 (in)
1	0	410.583332	410.583332			1	

New Duplicate Delete

OK Apply Cancel

PS Shear Reinforcement Ranges



Vertical Horizontal

Span: 1 Copy to Span...

Name	Extends into Deck	Start Distance (ft)	Number of Spaces	Spacing (in)	Length (ft)	End Distance (ft)
#5 S Bars	<input checked="" type="checkbox"/>	0.166666	1	0	0	0.166666
#5 S Bars	<input checked="" type="checkbox"/>	0.166666	18	4	6	6.166666
#5 S Bars	<input checked="" type="checkbox"/>	6.166666	6	6	3	9.166666
#5 K Bars	<input checked="" type="checkbox"/>	9.166666	1	11.25	0.9375	10.104166
#5 K Bars	<input checked="" type="checkbox"/>	10.104166	78	18	117	127.104166
#5 S Bars	<input checked="" type="checkbox"/>	127.104166	1	11.25	0.9375	128.041666
#5 S Bars	<input checked="" type="checkbox"/>	128.041666	6	6	3	131.041666
#5 S Bars	<input checked="" type="checkbox"/>	131.041666	18	4	6	137.041666

Stirrup Wizard...

New Duplicate Delete

OK Apply Cancel

**Beam Details** GIRDER 4

Span Detail | Continuous Support Detail | **Stress Limit Ranges** | Slab Interface | Continuity Diaphragm | Web End Block

Span Number	Name	Start Distance (ft)	Length (ft)	End Distance (ft)
1	138 FT STRESS LIM	0	137.1079	137.1079
2	138 FT STRESS LIM	0	136.333333	136.333333
3	138 FT STRESS LIM	0	137.1079	137.1079

**Deck Profile** GIRDER 4

Type: PS Precast I

Deck Concrete | **Reinforcement**

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 AA (US)	1	0	410.715806	410.715806	7.75	87.999996	87.999996	87.999996	87.999996	8

Compute from Typical Section... New Duplicate Delete

OK Apply Cancel

**Deck Profile** GIRDER 4

Type: PS Precast I

Deck Concrete | **Reinforcement**

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	0	410.715806	410.715806	10	10	5	1.9375	Bottom of Slab	7
Grade 60	1	0	106.357904	106.357904	8	8	5	2.9375	Top of Slab	11
Grade 60	1	106.357904	70	176.357904	8	8	8	3.125	Top of Slab	11
Grade 60	1	121.357904	35	156.357904	8	8	8	3.125	Top of Slab	11
Grade 60	2	39.583334	58	97.583334	8	8	6	3	Top of Slab	11
Grade 60	2	97.583334	70	167.583334	8	8	8	3.125	Top of Slab	11
Grade 60	3	15.416666	35	50.416666	8	8	8	3.125	Top of Slab	11
Grade 60	3	30.416668	106.357904	136.774572	8	8	5	2.9375	Top of Slab	11

New Duplicate Delete

OK Apply Cancel

PS Haunch Profile

Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Z1 (in)	Z2 (in)	Y1 (in)	Y3 (in)
1	0	410.715806	410.715806			1	

New Duplicate Delete

OK Apply Cancel

PS Shear Reinforcement Ranges

Vertical Horizontal

Span: 1 Copy to Span...

Name	Extends into Deck	Start Distance (ft)	Number of Spaces	Spacing (in)	Length (ft)	End Distance (ft)
#5 S Bars	<input checked="" type="checkbox"/>	0.166666	1	0	0	0.166666
#5 S Bars	<input checked="" type="checkbox"/>	0.166666	18	4	6	6.166666
#5 S Bars	<input checked="" type="checkbox"/>	6.166666	6	6	3	9.166666
#5 K Bars	<input checked="" type="checkbox"/>	9.166666	1	11.647	0.9705833333	10.1372493333
#5 K Bars	<input checked="" type="checkbox"/>	10.137249	78	18	117	127.137249
#5 S Bars	<input checked="" type="checkbox"/>	127.137249	1	11.647	0.9705833333	128.107832333
#5 S Bars	<input checked="" type="checkbox"/>	128.107833	6	6	3	131.107833
#5 S Bars	<input checked="" type="checkbox"/>	131.107833	18	4	6	137.107833

Stirrup Wizard...

New Duplicate Delete

OK Apply Cancel

**Beam Details** GIRDER 5

Span Detail | Continuous Support Detail | **Stress Limit Ranges** | Slab Interface | Continuity Diaphragm | Web End Block

Span Number	Name	Start Distance (ft)	Length (ft)	End Distance (ft)
1	138 FT STRESS LIM	0	137.1741	137.1741
2	138 FT STRESS LIM	0	136.333333	136.333333
3	138 FT STRESS LIM	0	137.1741	137.1741

**Deck Profile** GIRDER 5

Type: PS Precast I

Deck Concrete | **Reinforcement**

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 AA (US)	1	0	410.84828	410.84828	7.75	88.999998	88.999998	88.999998	88.999998	8

Compute from Typical Section... New Duplicate Delete

OK Apply Cancel

**Deck Profile** GIRDER 5

Type: PS Precast I

Deck Concrete | **Reinforcement**

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	0	410.848281	410.848281	9	9	5	1.9375	Bottom of Slab	7
Grade 60	1	0	106.424141	106.424141	8	8	5	2.9375	Top of Slab	11
Grade 60	1	106.424141	70	176.424141	8	8	8	3.125	Top of Slab	11
Grade 60	1	121.424141	35	156.424141	8	8	8	3.125	Top of Slab	11
Grade 60	2	39.583334	58	97.583334	8	8	6	3	Top of Slab	11
Grade 60	2	97.583334	70	167.583334	8	8	8	3.125	Top of Slab	11
Grade 60	3	15.416666	35	50.416666	8	8	8	3.125	Top of Slab	11
Grade 60	3	30.416668	106.424141	136.840809	8	8	5	2.9375	Top of Slab	11

New Duplicate Delete

OK Apply Cancel

PS Haunch Profile

Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Z1 (in)	Z2 (in)	Z3 (in)	Z4 (in)	Y1 (in)	Y2 (in)	Y3 (in)
1	0	410.84828	410.84828					1		

New Duplicate Delete

OK Apply Cancel

PS Shear Reinforcement Ranges

Vertical Horizontal

Span: 1 Copy to Span...

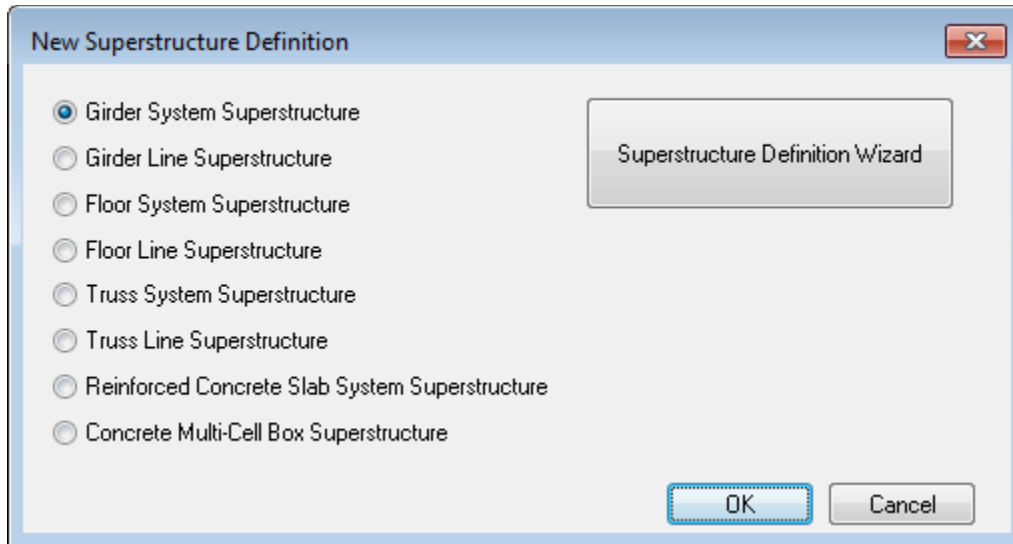
Name	Extends into Deck	Start Distance (ft)	Number of Spaces	Spacing (in)	Length (ft)	End Distance (ft)
#5 S Bars	<input checked="" type="checkbox"/>	0.166666	1	0	0	0.166666
#5 S Bars	<input checked="" type="checkbox"/>	0.166666	18	4	6	6.166666
#5 S Bars	<input checked="" type="checkbox"/>	6.166666	6	6	3	9.166666
#5 K Bars	<input checked="" type="checkbox"/>	9.166666	1	12.045	1.00375	10.170416
#5 K Bars	<input checked="" type="checkbox"/>	10.170416	78	18	117	127.170416
#5 S Bars	<input checked="" type="checkbox"/>	127.170416	1	12.045	1.00375	128.174166
#5 S Bars	<input checked="" type="checkbox"/>	128.174166	6	6	3	131.174166
#5 S Bars	<input checked="" type="checkbox"/>	131.174166	18	4	6	137.174166

Stirrup Wizard...

New Duplicate Delete

OK Apply Cancel

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 superstructure definition for the 80 ft span. The following dialog will open.



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: AS-BUILT 80 FT SPAN skew

Description: SIMPLE SPAN

Frame Structure Simplified Definition

Deck type: Concrete

Default Units: US Customary

Enter Span Lengths Along the Reference Line:

Span	Length (ft)
1	78.125

Number of spans: 1

Number of girders: 5

For PS only

Average humidity: 70 %

Member Alt. Types

- Steel
- P/S
- R/C
- Timber

Horizontal Curvature Along Reference Line

Horizontal curvature

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

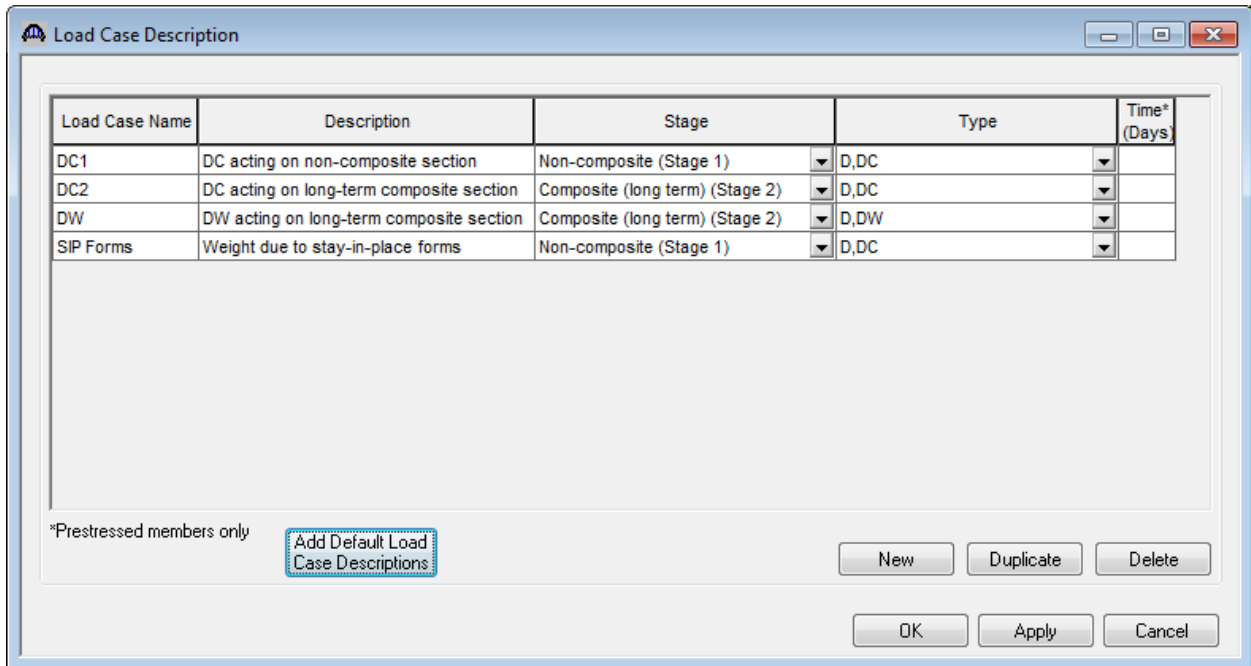
Superelevation:  %

Superstructure Alignment

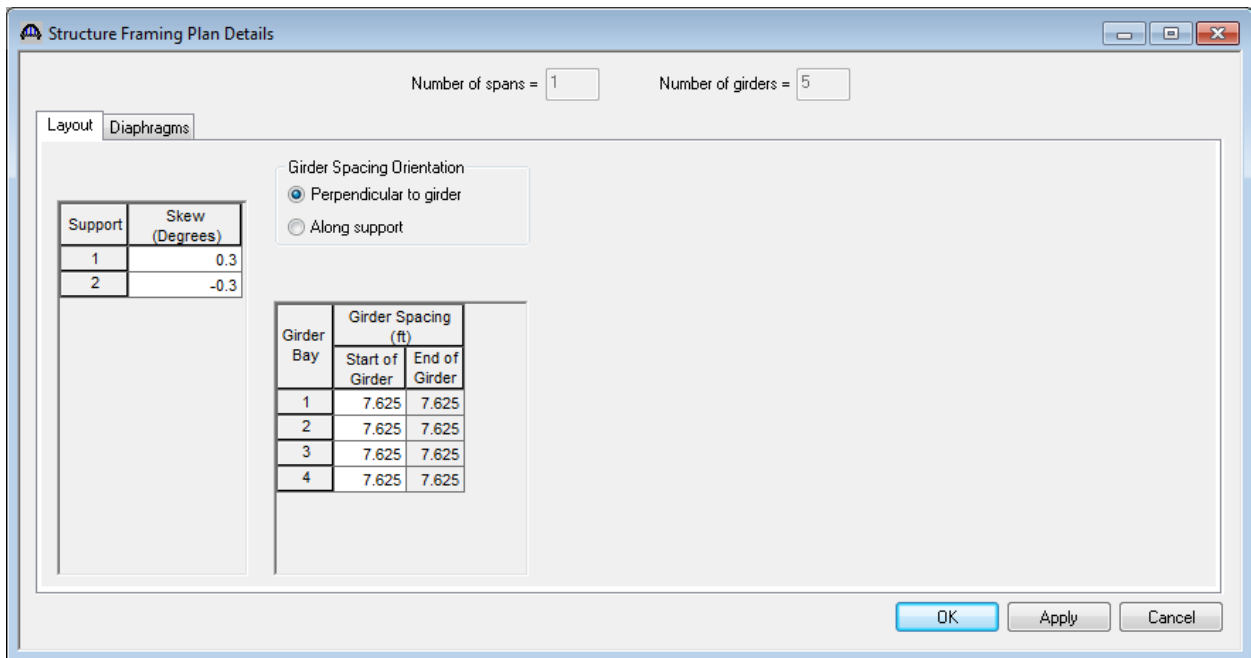
- Curved
- Tangent, curved, tangent
- Tangent, curved
- Curved, tangent

OK Apply Cancel

Click Load Case Description to define the dead load cases. Use the “Add Default...” button to create the following load cases.



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



Switch to the Diaphragms tab and enter diaphragm spacing.



Structure Framing Plan Details

Number of spans = 1      Number of girders = 5

Layout Diaphragms

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	0	0	1	0	0	0	3.19	-- Not Assigned --
1	77.965301	78.04515	0	1	0	77.965301	78.04515	3.19	-- Not Assigned --

New Duplicate Delete

OK Apply Cancel

Structure Framing Plan Details

Number of spans = 1      Number of girders = 5

Layout Diaphragms

Girder Bay: 2      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	0	0	1	0	0	0	3.19	-- Not Assigned --
1	78.04515	78.125	0	1	0	78.04515	78.125	3.19	-- Not Assigned --

New Duplicate Delete

OK Apply Cancel

Structure Framing Plan Details

Number of spans = 1      Number of girders = 5

Layout Diaphragms

Girder Bay: 3      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	0	0	1	0	0	0	3.19	-- Not Assigned --
1	78.125	78.20485	0	1	0	78.125	78.20485	3.19	-- Not Assigned --

New Duplicate Delete

OK Apply Cancel

Structure Framing Plan Details

Number of spans = 1      Number of girders = 5

Layout Diaphragms

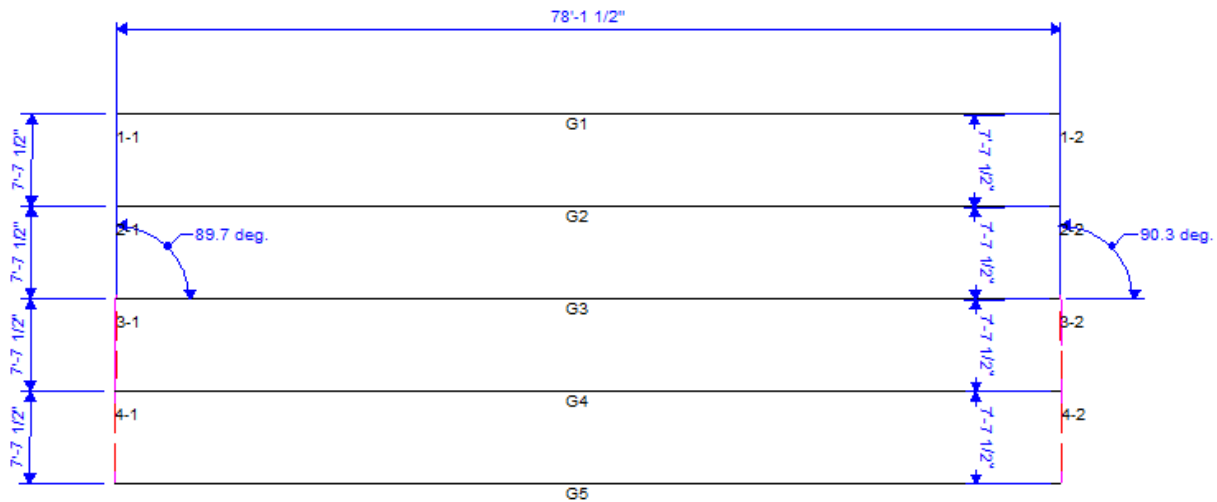
Girder Bay: 4      Copy Bay To...      Diaphragm Wizard...

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	0	0	1	0	0	0	3.19	-- Not Assigned --
1	78.20485	78.284699	0	1	0	78.20485	78.284699	3.19	-- Not Assigned --

New Duplicate Delete

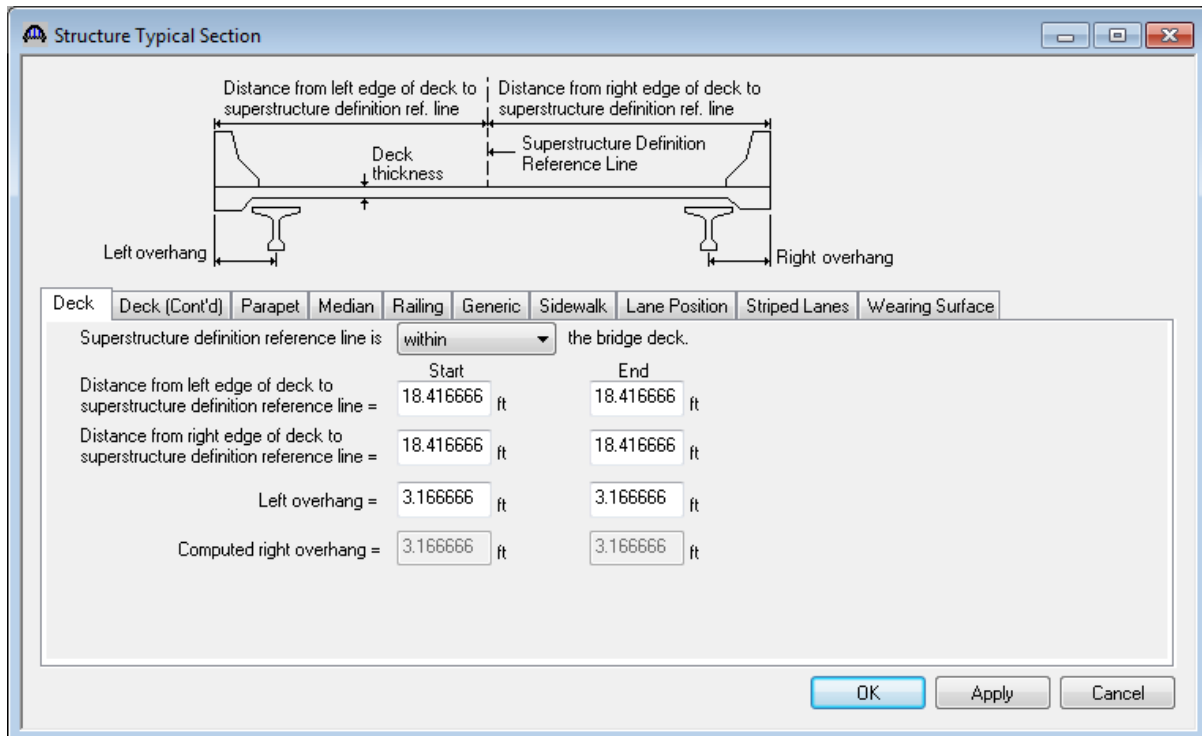
OK Apply Cancel

The following data appears in the Framing Plan Details window and the Framing Plan Schematic is shown below.

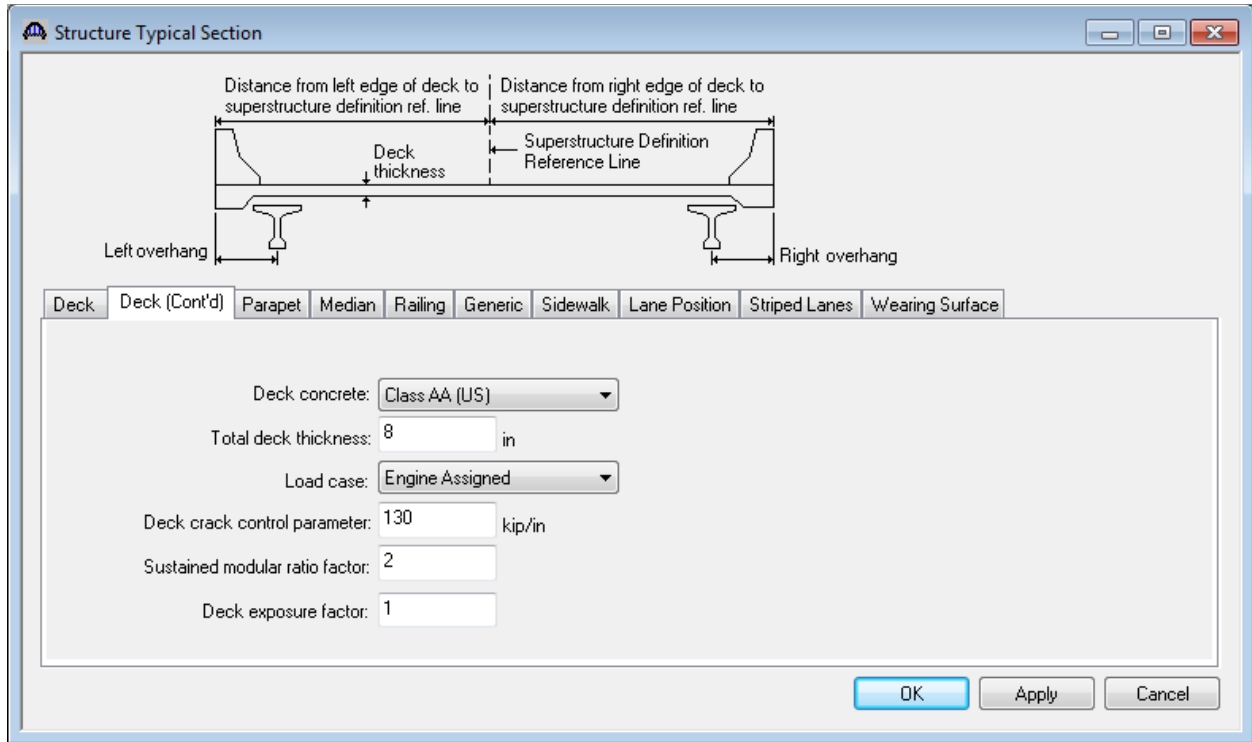


Next define the structure typical section by double-clicking on Structure Typical Section in the Bridge Workspace tree. Input the data describing the typical section as shown below. This screen initially shows steel girders as the default girder type until the member alternatives are defined.

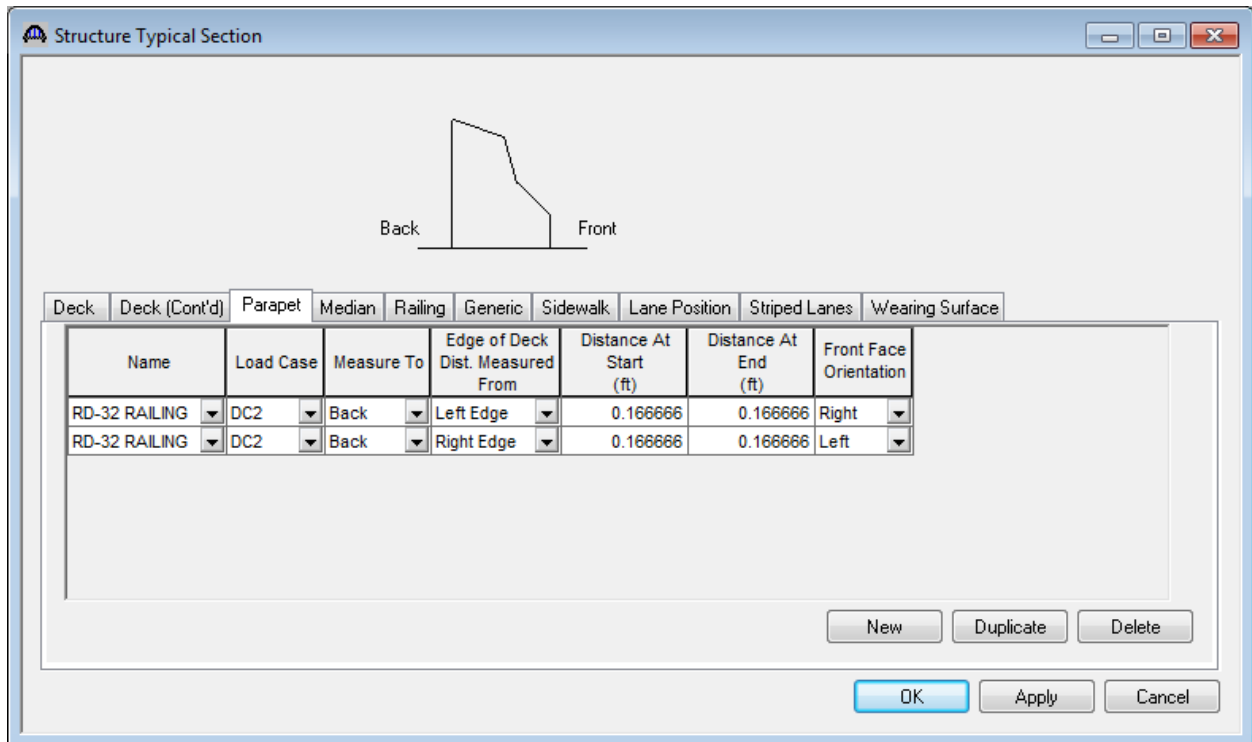
Basic deck geometry:



The Deck (cont'd) tab is used to enter information about the deck concrete and thickness.

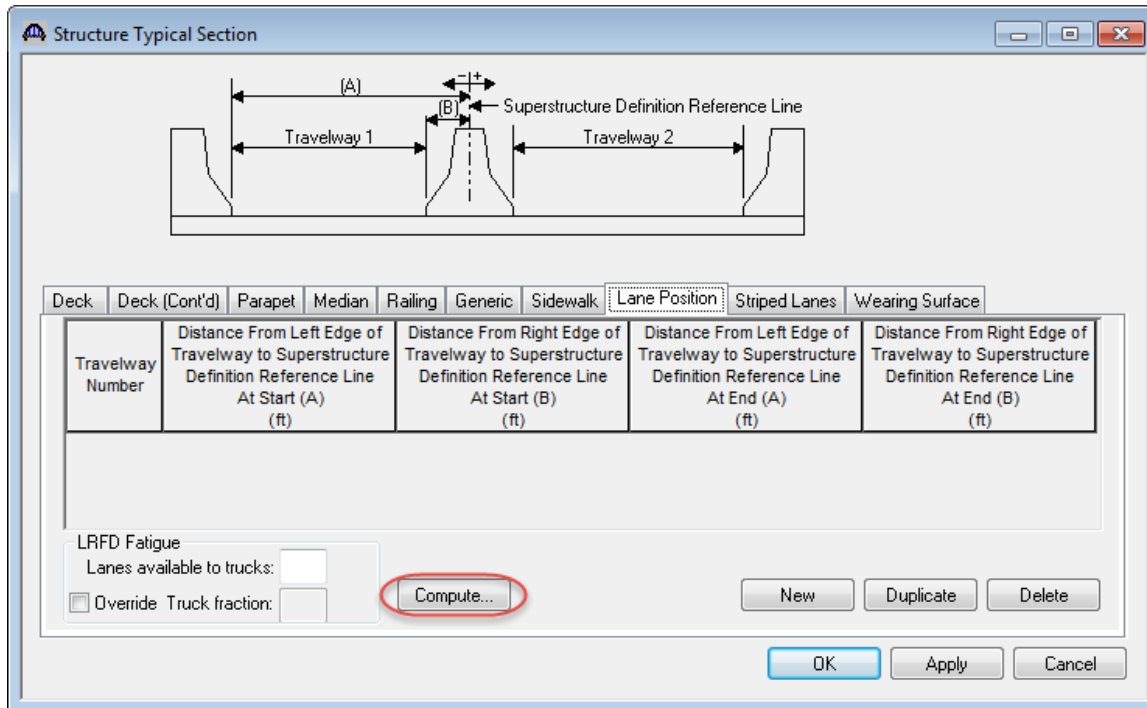


Enter the following parapets:

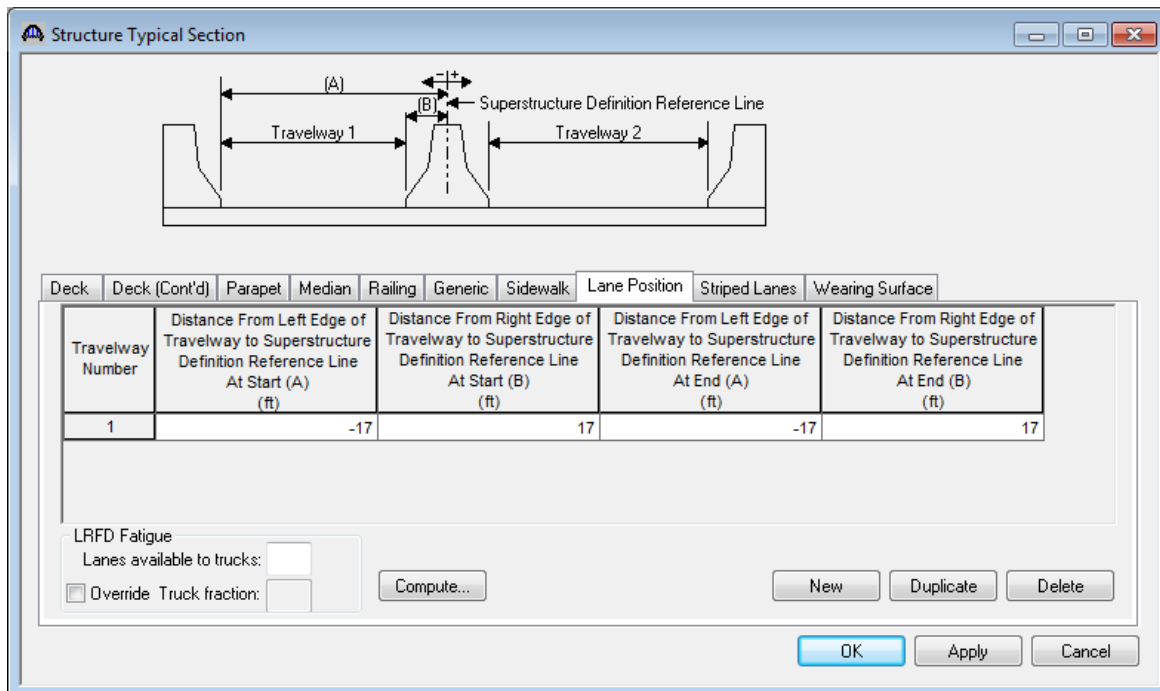


Lane Positions:

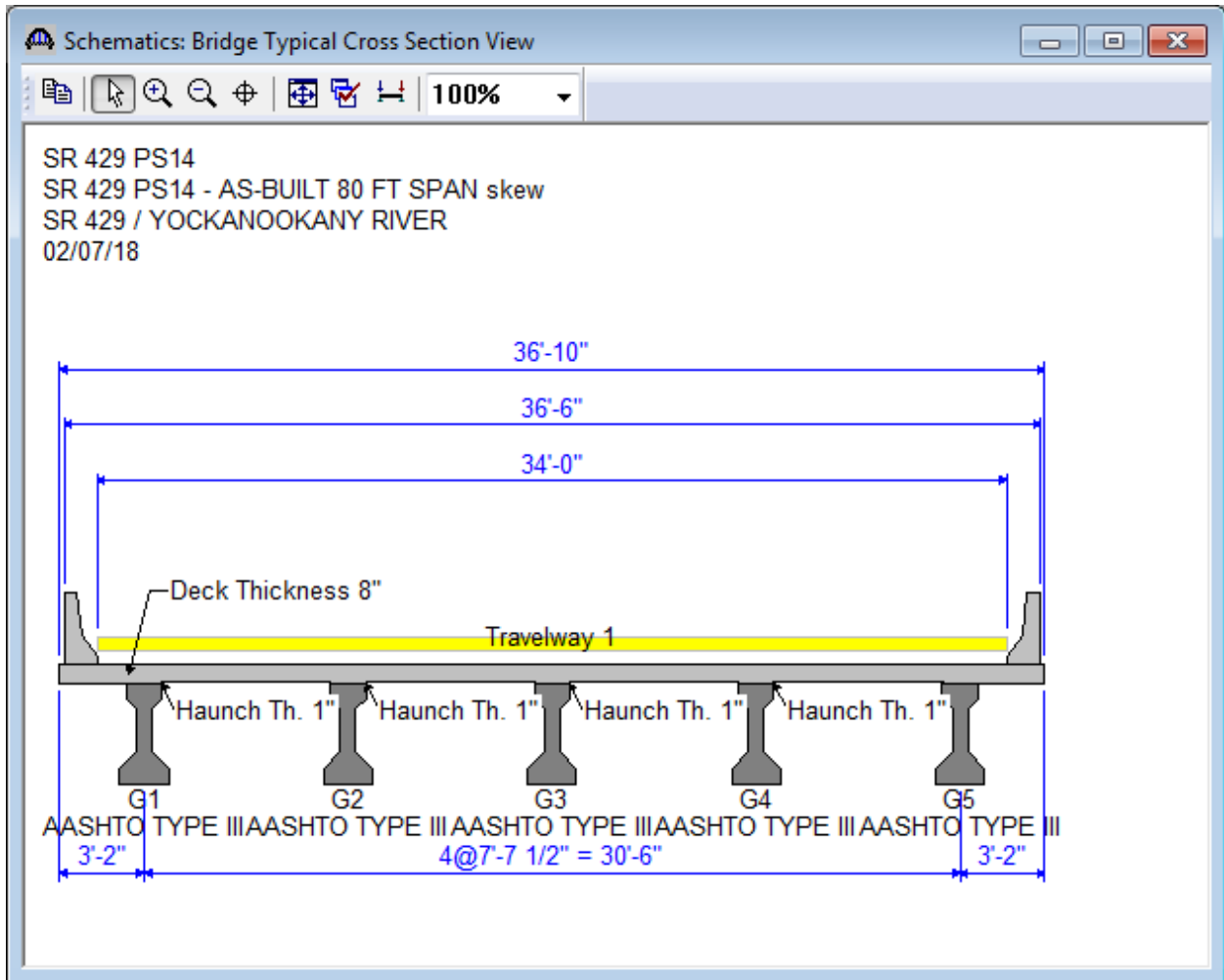
Use the 'Compute' button to have BrD compute the lane positions for you. These lane positions are used by BrD to compute the LRFD live load distribution factors.



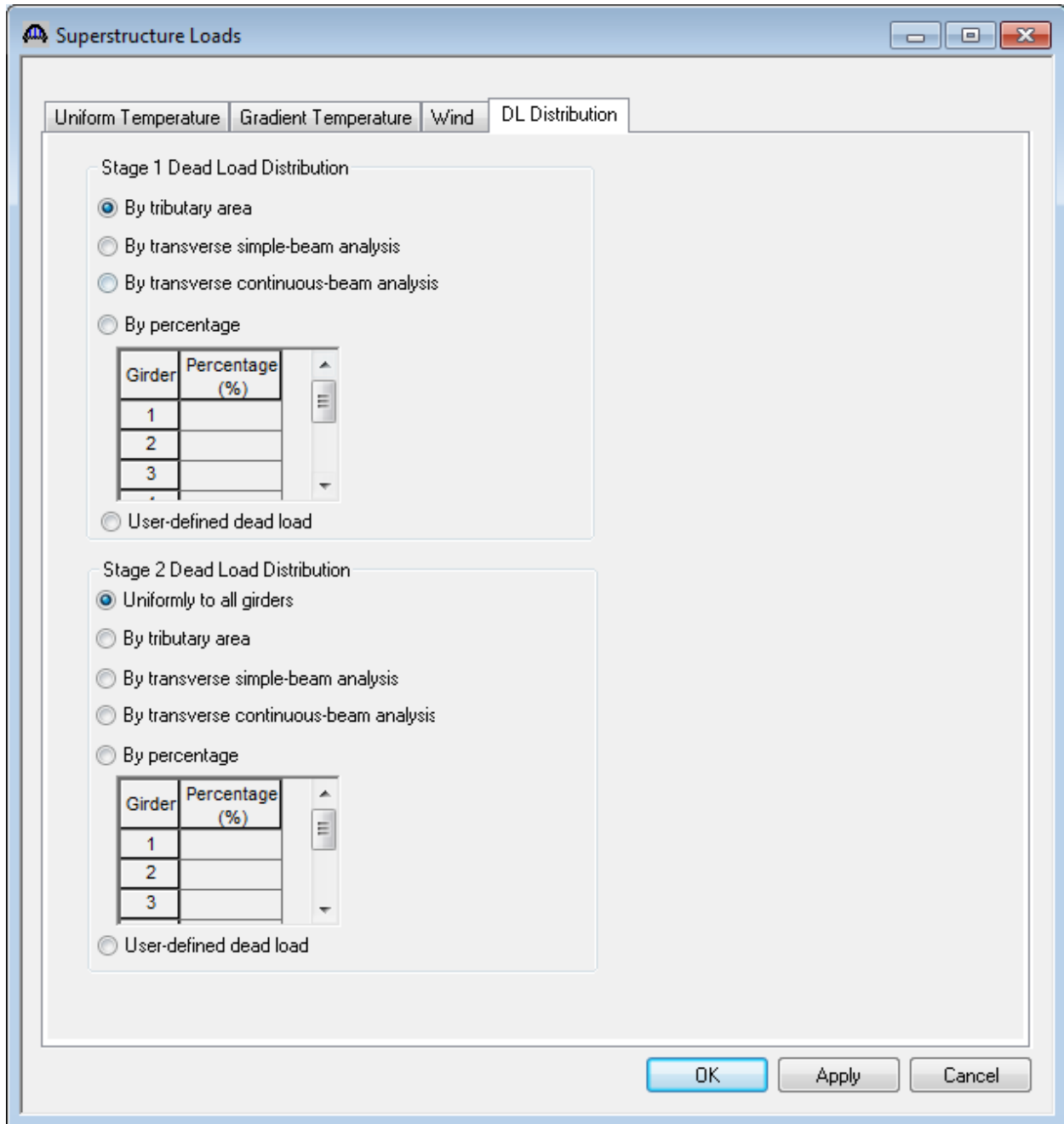
The computed values are shown below.



The schematic of the Structure Typical Section is shown below.



The DL Distribution tab of the Superstructure Loads window is shown below. The BrD LRFD engine does not support the transverse continuous beam analysis option.



Create the following stress limit.

	LFD	LRFD
Initial allowable compression:	2.52 ksi	2.73 ksi
Initial allowable tension:	0.1944222 ksi	0.1942822 ksi
Final allowable compression:	3 ksi	3 ksi
Final allowable tension:	ksi	ksi
Final allowable DL compression:	2 ksi	2.25 ksi
Final allowable slab compression:	ksi	ksi
Final allowable compression: (LL + 1/2(Pe + DL))	2 ksi	2 ksi

If you leave the allowable stresses blank in the stress limit the BrD LRFD engine will compute the allowable based on the AASHTO specification articles and the concrete material selected. The allowable slab compression is not computed for you since the deck is typically a different material than the girder.

Create the following Prestress Property. Select the loss method as 'AASHTO Approximate'.

The image shows a software dialog box titled "Prestress Properties". It has three tabs: "General P/S Data", "Loss Data - Lump Sum", and "Loss Data - PCI". The "General P/S Data" tab is active. The "Name" field at the top contains "1/2\" (7W-270) LR". Below the tabs, there are several input fields and a checkbox. The "P/S strand material" dropdown is set to "1/2\" (7W-270) LR". The "Loss method" dropdown is set to "AASHTO Approximate" and is circled in red. The "Jacking stress ratio" is 0.75. The "P/S transfer stress ratio" is empty. The "Transfer time" is 24 Hours. The "Age at deck placement" is 60 Days. The "Final age" is 27375 Days. The "Loss Data - AASHTO" section has a "Percentage DL" of 0%. The "Include elastic gains" checkbox is unchecked and also circled in red. At the bottom right, there are "OK", "Apply", and "Cancel" buttons.

Field	Value
Name	1/2" (7W-270) LR
P/S strand material	1/2" (7W-270) LR
Loss method	AASHTO Approximate
Jacking stress ratio	0.75
P/S transfer stress ratio	
Transfer time	24 Hours
Age at deck placement	60 Days
Final age	27375 Days
Loss Data - AASHTO Percentage DL	0 %
Include elastic gains	<input type="checkbox"/>

The vertical shear reinforcement bars are the same as the 138 foot unit.



Now create a prestressed I beam alternative for member G1-G5 by double-clicking on the 'MEMBER ALTERNATIVES' label.

Enter the following data on the Shrinkage/Time window.

The image shows a software dialog box titled "Shrinkage/Time". It has two tabs: "Shrinkage" (selected) and "Time".

- Beam section:** Curing method: Steam-cured (dropdown menu).
- Deck section:** Curing method: Moist-cured (dropdown menu); Drying time: [ ] Days (text input).
- Options:**  Consider deck differential shrinkage loads.
- Buttons:** OK, Apply, Cancel.

Enter the following data on the Beam Details window.

Beam Details

Span Detail | Stress Limit Ranges | Slab Interface | Web End Block

Span Number	Beam Shape	Girder Material	Prestress Properties	Use Creep	n	Beam Projection	
						Left End (in)	Right End (in)
1	AASHTO TYPE III	Class FX Beam Concrete 80 FT	1/2" (7W-270) LR	No		9	10.5

Beam Details

Span Detail | Stress Limit Ranges | Slab Interface | Web End Block

Span Number	Name	Start Distance (ft)	Length (ft)	End Distance (ft)
1	80 FT STRESS LIMIT	0	79.590301	79.590301

Beam Details

Span Detail | Stress Limit Ranges | Slab Interface | Web End Block

Interface type: Intentionally Roughened

Default interface width to beam widths:

Interface width:  in

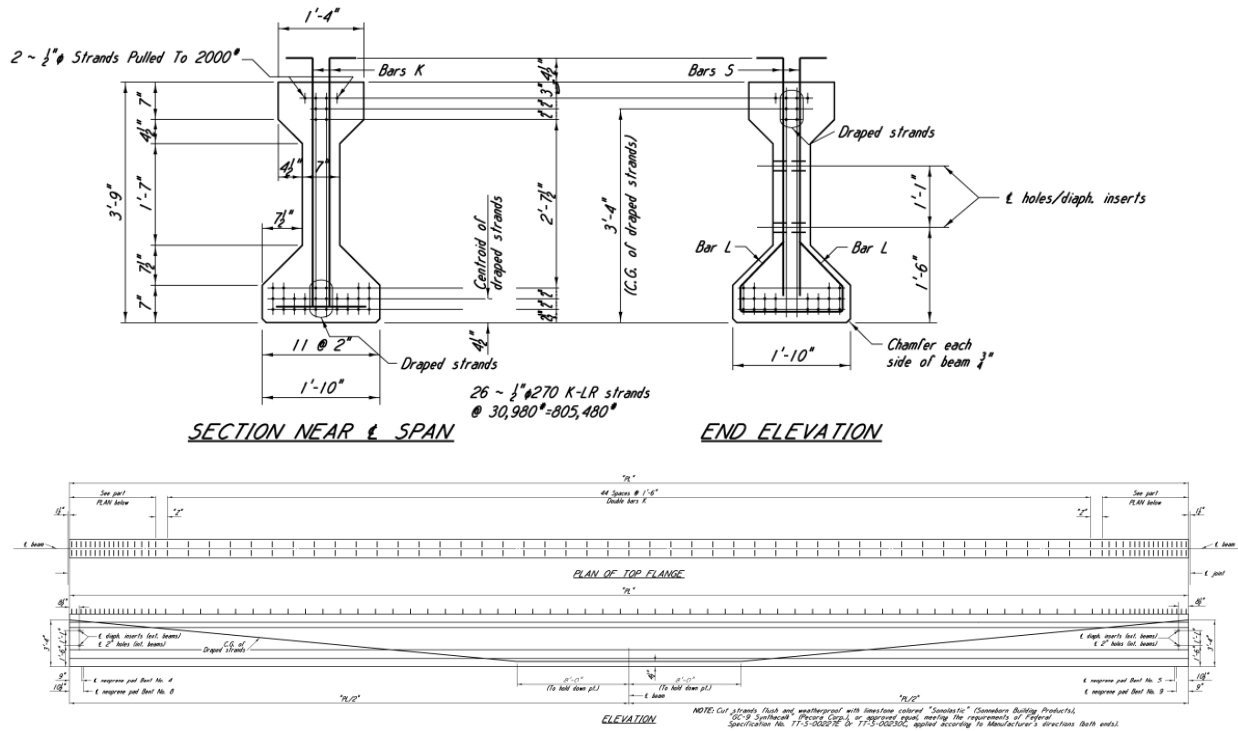
Cohesion factor: 0.28 ksi

Friction factor: 1

K1: 0.3

K2: 1.8 ksi

Now define the following strand layout at midspan using the screen captures from the drawings (shown below).



Strand Layout - Span 1

200%

Description Type  
 P and CGS only  
 Strands in rows

Strand Configuration Type  
 Straight/Debonded  
 Harped  
 Harped and straight debonded

Symmetry

Mid span  
 Left end  
 Right end

Harp Point Locations		
Harp Point	Distance (ft)	Radius (in)
Left	31.79687	0
Right	31.79687	0

Notes:  
 Strand positions generated by the REVISED method.  
 Please refer to Help for a description of this method.

Number of strands = 26  
 Number of harped strands = 0  
 CG of strands (measured from bottom of section) = 4.19 in

Legend:  
 X No strand at this position at the current section location.  
 X No strand at this position at the current location but a strand is harped to this position.  
 ● A strand occupies this position at the current section location.  
 ● The strand is debonded from the end of the beam to the current section location.  
 ● The strand is debonded from the mid-span to the current section location.  
 ○ The strand is debonded at other section location. Hover over the strand for more information.  
 ● The harped position of a harped strand.  
 ● The mid-span position of a harped strand.  
 ● The mid-span position of one strand and the harped position of another strand.  
 ● Mild steel.

OK Apply Cancel

Then define the following harped strands at this location.

Strand Layout - Span 1

200%

Description Type  
 P and CGS only  Strands in rows

Strand Configuration Type  
 Straight/Debonded  Symmetry  
 Harped  
 Harped and straight debonded

Mid span  
 Left end  
 Right end

Harped Point Locations		
Harped Point	Distance (ft)	Radius (in)
Left	31.79687	0
Right	31.79687	0

Notes:  
 Strand positions generated by the REVISED method.  
 Please refer to Help for a description of this method.

Number of strands = 26  
 Number of harped strands = 6  
 CG of strands (measured from bottom of section) = 12.38 in

Legend:

- × No strand at this position at the current section location.
- × No strand at this position at the current location but a strand is harped to this position.
- A strand occupies this position at the current section location.
- The strand is debonded from the end of the beam to the current section location.
- The strand is debonded from the mid-span to the current section location.
- The strand is debonded at other section location. Hover over the strand for more information.
- The harped position of a harped strand.
- The mid-span position of a harped strand.
- The mid-span position of one strand and the harped position of another strand.
- Mild steel.

OK Apply Cancel

Describe the deck as follows:

Deck Profile

Type: PS Precast I

Deck Concrete Reinforcement

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 AA (US)	1	0	77.965301	77.965301	7.75	83.749992	83.749992	83.749992	83.749992	8

Compute from Typical Section...

New Duplicate Delete

OK Apply Cancel

The Haunch Profile is shown below.

PS Haunch Profile

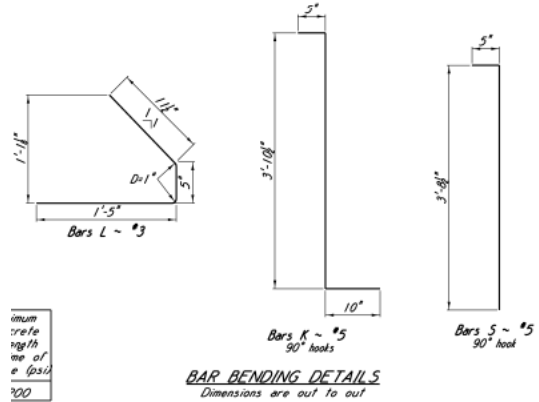
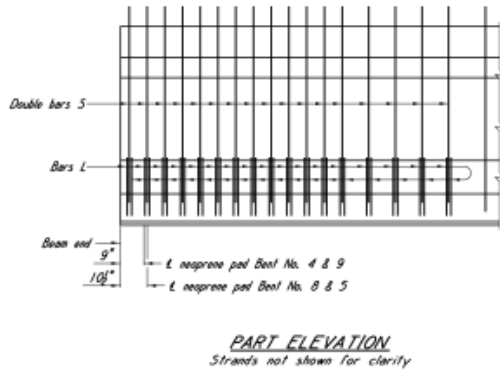
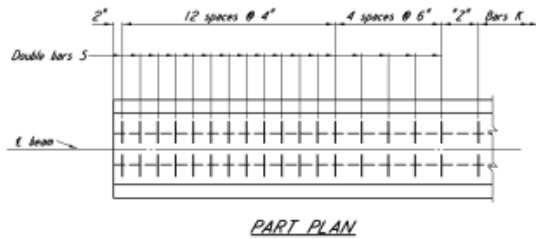
The diagram shows a cross-section of a haunch profile. It features a central horizontal section with a width of Z3 and a height of Y3. This central section is flanked by two sloped sections. The left sloped section has a vertical height of Y1 and a horizontal width of Z1. The right sloped section has a vertical height of Y2 and a horizontal width of Z2. The total width of the haunch at its base is Z4. The total height of the haunch at its base is Y3.

Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Z1 (in)	Z2 (in)	Z3 (in)	Z4 (in)	Y1 (in)	Y2 (in)	Y3 (in)
1	0	77.965301	77.965301					1		

New Duplicate Delete

OK Apply Cancel

Create the following shear stirrups:



PS Shear Reinforcement Ranges

Vertical  Horizontal

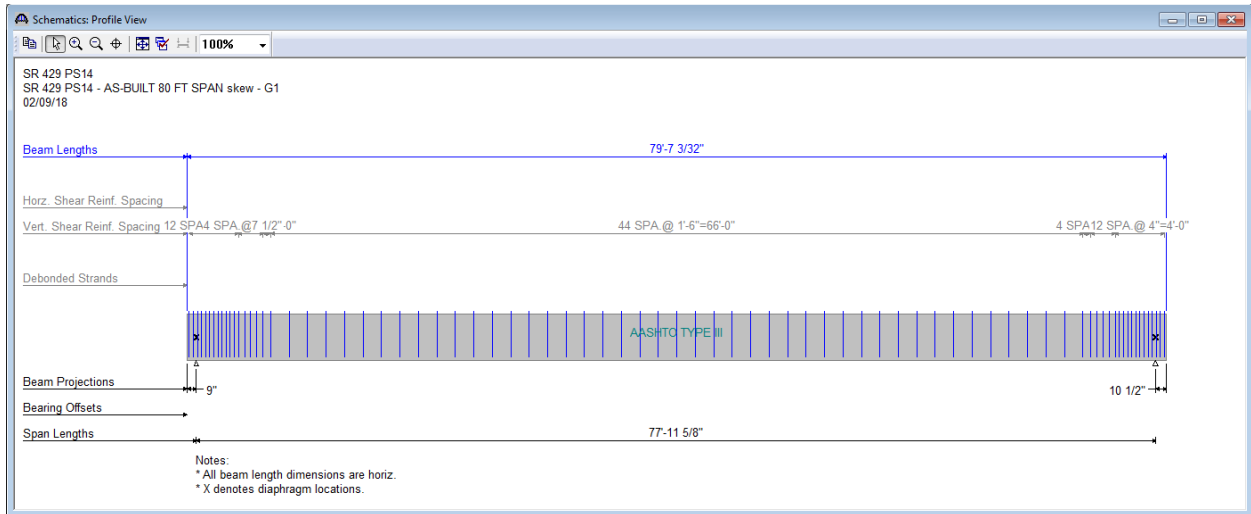
Span: 1

Name	Extends into Deck	Start Distance (ft)	Number of Spaces	Spacing (in)	Length (ft)	End Distance (ft)
#5 S Bars	<input checked="" type="checkbox"/>	0.166666	1	0	0	0.166666
#5 S Bars	<input checked="" type="checkbox"/>	0.166666	12	4	4	4.166666
#5 S Bars	<input checked="" type="checkbox"/>	4.166666	4	6	2	6.166666
#5 K Bars	<input checked="" type="checkbox"/>	6.166666	1	7.544	0.6286666667	6.7953326667
#5 K Bars	<input checked="" type="checkbox"/>	6.795333	44	18	66	72.795333
#5 S Bars	<input checked="" type="checkbox"/>	72.795333	1	7.54	0.6283333333	73.4236663333
#5 S Bars	<input checked="" type="checkbox"/>	73.423666	4	6	2	75.423666
#5 S Bars	<input checked="" type="checkbox"/>	75.423666	12	4	4	79.423666

Stirrup Wizard... New Duplicate Delete

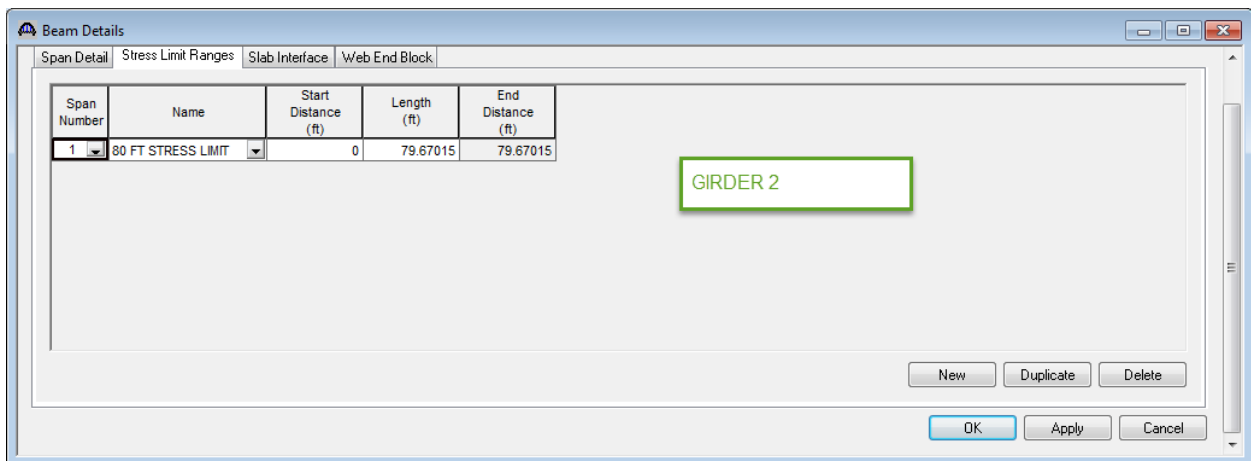
OK Apply Cancel

The Member Alternative Schematic is shown below:



Girder 1 is complete. Girders G2-G5 are similar but the lengths are different.

Harp Locations	
Girder	DRAPE
1	31.79688
2	31.83333
3	31.875
4	31.91667
5	31.95833



Deck Profile

Type: PS Precast I

Deck Concrete | Reinforcement

GIRDER 2

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 AA (US)	1	0	78.04515	78.04515	7.75	91.5	91.5	91.5	91.5	8

Compute from Typical Section...

New Duplicate Delete

OK Apply Cancel

PS Haunch Profile

GIRDER 2

Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Z1 (in)	Z2 (in)	Y1 (in)	Y3 (in)
1	0	78.04515	78.04515			1	

New Duplicate Delete

OK Apply Cancel

PS Shear Reinforcement Ranges

GIRDER 2

Vertical | Horizontal

Span: 1

Name	Extends into Deck	Start Distance (ft)	Number of Spaces	Spacing (in)	Length (ft)	End Distance (ft)
#5 S Bars	<input checked="" type="checkbox"/>	0.166666	1		0	0.166666
#5 S Bars	<input checked="" type="checkbox"/>	0.166666	12	4	4	4.166666
#5 S Bars	<input checked="" type="checkbox"/>	4.166666	4	6	2	6.166666
#5 K Bars	<input checked="" type="checkbox"/>	6.166666	1	8	0.666666667	6.833332667
#5 K Bars	<input checked="" type="checkbox"/>	6.833333	44	18	66	72.833333
#5 S Bars	<input checked="" type="checkbox"/>	72.833333	1	8	0.666666667	73.499996667
#5 S Bars	<input checked="" type="checkbox"/>	73.499999	4	6	2	75.499999
#5 S Bars	<input checked="" type="checkbox"/>	75.499999	12	4	4	79.499999

Stirrup Wizard...

New Duplicate Delete

OK Apply Cancel



Beam Details

**GIRDER 3**

Span Detail | Stress Limit Ranges | Slab Interface | Web End Block

Span Number	Name	Start Distance (ft)	Length (ft)	End Distance (ft)
1	80 FT STRESS LIMIT	0	79.75	79.75

New Duplicate Delete

OK Apply Cancel

Deck Profile

Type: PS Precast I

**GIRDER 3**

Deck Concrete | Reinforcement

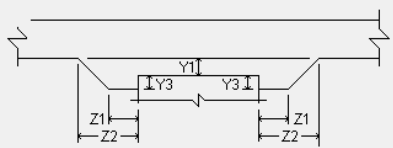
Material	Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Structural Thickness (in)	Start Effective Flange Width (Std) (in)	End Effective Flange Width (Std) (in)	Start Effective Flange Width (LRFD) (in)	End Effective Flange Width (LRFD) (in)	n
Class AA (US)	1	0	78.125	78.125	7.75	91.5	91.5	91.5	91.5	8

Compute from Typical Section...

New Duplicate Delete

OK Apply Cancel

PS Haunch Profile




Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Z1 (in)	Z2 (in)	Y1 (in)	Y3 (in)
1	0	78.125	78.125			1	

New Duplicate Delete

OK Apply Cancel

PS Shear Reinforcement Ranges



Vertical Horizontal

Span: 1

Name	Extends into Deck	Start Distance (ft)	Number of Spaces	Spacing (in)	Length (ft)	End Distance (ft)
#5 S Bars	<input checked="" type="checkbox"/>	0.166666	1	0	0	0.166666
#5 S Bars	<input checked="" type="checkbox"/>	0.166666	12	4	4	4.166666
#5 S Bars	<input checked="" type="checkbox"/>	4.166666	4	6	2	6.166666
#5 K Bars	<input checked="" type="checkbox"/>	6.166666	1	8.5	0.7083333333	6.8749993333
#5 K Bars	<input checked="" type="checkbox"/>	6.874999	44	18	66	72.874999
#5 S Bars	<input checked="" type="checkbox"/>	72.874999	1	8.5	0.7083333333	73.5833323333
#5 S Bars	<input checked="" type="checkbox"/>	73.583333	4	6	2	75.583333
#5 S Bars	<input checked="" type="checkbox"/>	75.583333	12	4	4	79.583333

Stirrup Wizard...

New Duplicate Delete

OK Apply Cancel

Beam Details

**GIRDER 4**

Span Detail | Stress Limit Ranges | Slab Interface | Web End Block

Span Number	Name	Start Distance (ft)	Length (ft)	End Distance (ft)
1	80 FT STRESS LIMIT	0	79.82985	79.82985

New Duplicate Delete

OK Apply Cancel

Deck Profile

Type: PS Precast I

**GIRDER 4**

Deck Concrete | Reinforcement

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 AA (US)	1	0	78.20485	78.20485	7.75	91.5	91.5	91.5	91.5	8

Compute from Typical Section...

New Duplicate Delete

OK Apply Cancel

PS Haunch Profile

Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Z1 (in)	Z2 (in)	Y1 (in)	Y3 (in)
1	0	78.20485	78.20485			1	

New Duplicate Delete

OK Apply Cancel

PS Shear Reinforcement Ranges

Vertical Horizontal

Span: 1

Name	Extends into Deck	Start Distance (ft)	Number of Spaces	Spacing (in)	Length (ft)	End Distance (ft)
#5 S Bars	<input checked="" type="checkbox"/>	0.166666	1	0	0	0.166666
#5 S Bars	<input checked="" type="checkbox"/>	0.166666	12	4	4	4.166666
#5 S Bars	<input checked="" type="checkbox"/>	4.166666	4	6	2	6.166666
#5 K Bars	<input checked="" type="checkbox"/>	6.166666	1	9	0.75	6.916666
#5 K Bars	<input checked="" type="checkbox"/>	6.916666	44	18	66	72.916666
#5 S Bars	<input checked="" type="checkbox"/>	72.916666	1	9	0.75	73.666666
#5 S Bars	<input checked="" type="checkbox"/>	73.666666	4	6	2	75.666666
#5 S Bars	<input checked="" type="checkbox"/>	75.666666	12	4	4	79.666666

Stirrup Wizard...

New Duplicate Delete

OK Apply Cancel

**Beam Details** GIRDER 5

Span Detail | Stress Limit Ranges | Slab Interface | Web End Block

Span Number	Name	Start Distance (ft)	Length (ft)	End Distance (ft)
1	80 FT STRESS LIMIT	0	79.909699	79.909699

**Deck Profile** GIRDER 5

Type: PS Precast I

Deck Concrete | Reinforcement

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 AA (US)	1	0	78.284699	78.284699	7.75	83.749992	83.749992	83.749992	83.749992	8

PS Haunch Profile

Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Z1 (in)	Z2 (in)	Z3 (in)	Z4 (in)	Y1 (in)	Y2 (in)	Y3 (in)
1	0	78.284699	78.284699					1		

New Duplicate Delete

OK Apply Cancel

PS Shear Reinforcement Ranges

Vertical Horizontal

Span: 1

Name	Extends into Deck	Start Distance (ft)	Number of Spaces	Spacing (in)	Length (ft)	End Distance (ft)
#5 S Bars	<input checked="" type="checkbox"/>	0.166666	1	0	0	0.166666
#5 S Bars	<input checked="" type="checkbox"/>	0.166666	12	4	4	4.166666
#5 S Bars	<input checked="" type="checkbox"/>	4.166666	4	6	2	6.166666
#5 K Bars	<input checked="" type="checkbox"/>	6.166666	1	9.5	0.7916666667	6.9583326667
#5 K Bars	<input checked="" type="checkbox"/>	6.958333	44	18	66	72.958333
#5 S Bars	<input checked="" type="checkbox"/>	72.958333	1	9.5	0.7916666667	73.749996667
#5 S Bars	<input checked="" type="checkbox"/>	73.749999	4	6	2	75.749999
#5 S Bars	<input checked="" type="checkbox"/>	75.749999	12	4	4	79.749999

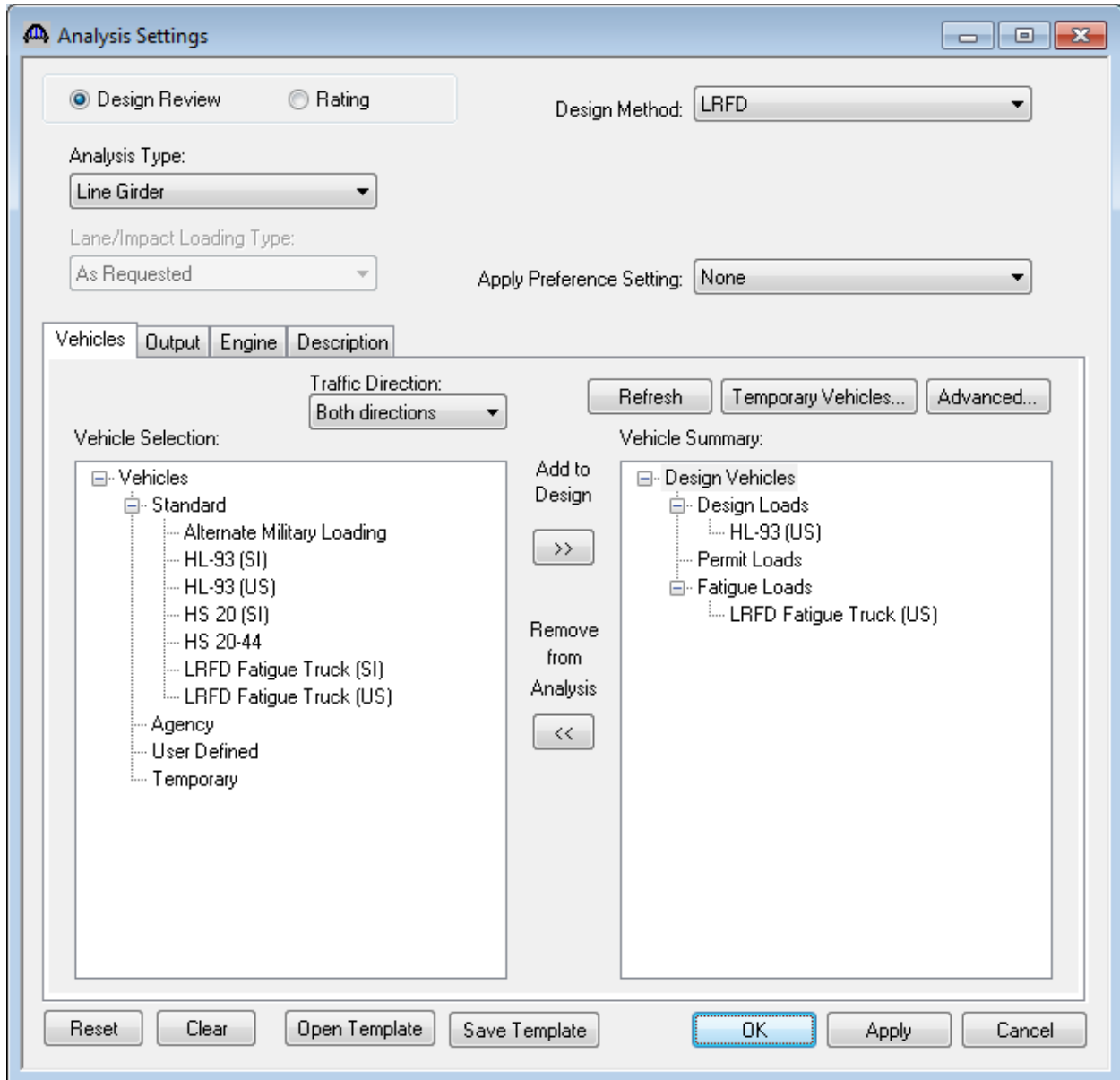
Stirrup Wizard...

New Duplicate Delete

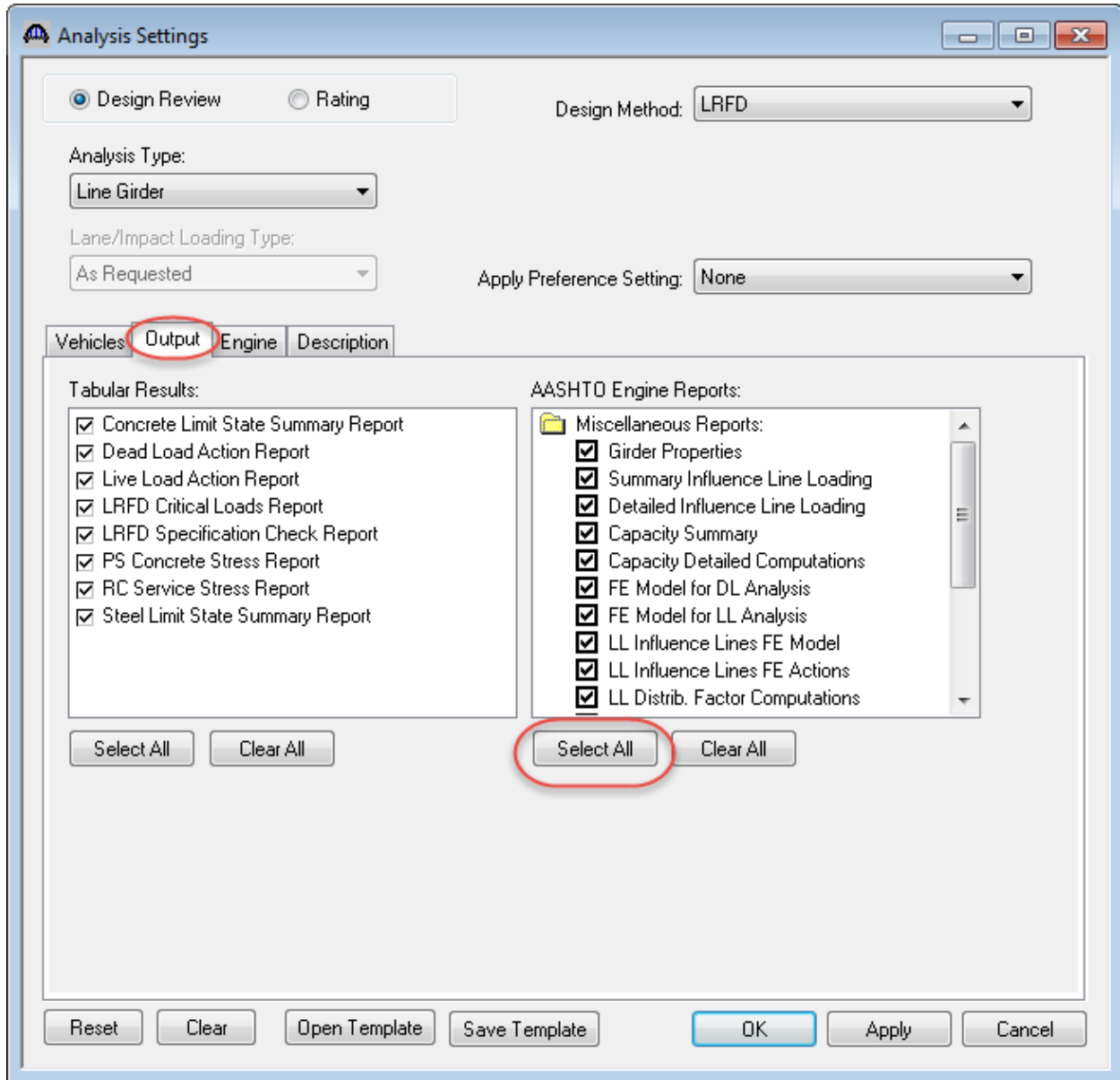
OK Apply Cancel

## Analysis and Results

To perform a design review, select the View Analysis Settings button on the toolbar to open the window shown below. Use the “HL-93 Design Review” template to select the vehicles to be used. This is done inside the file.

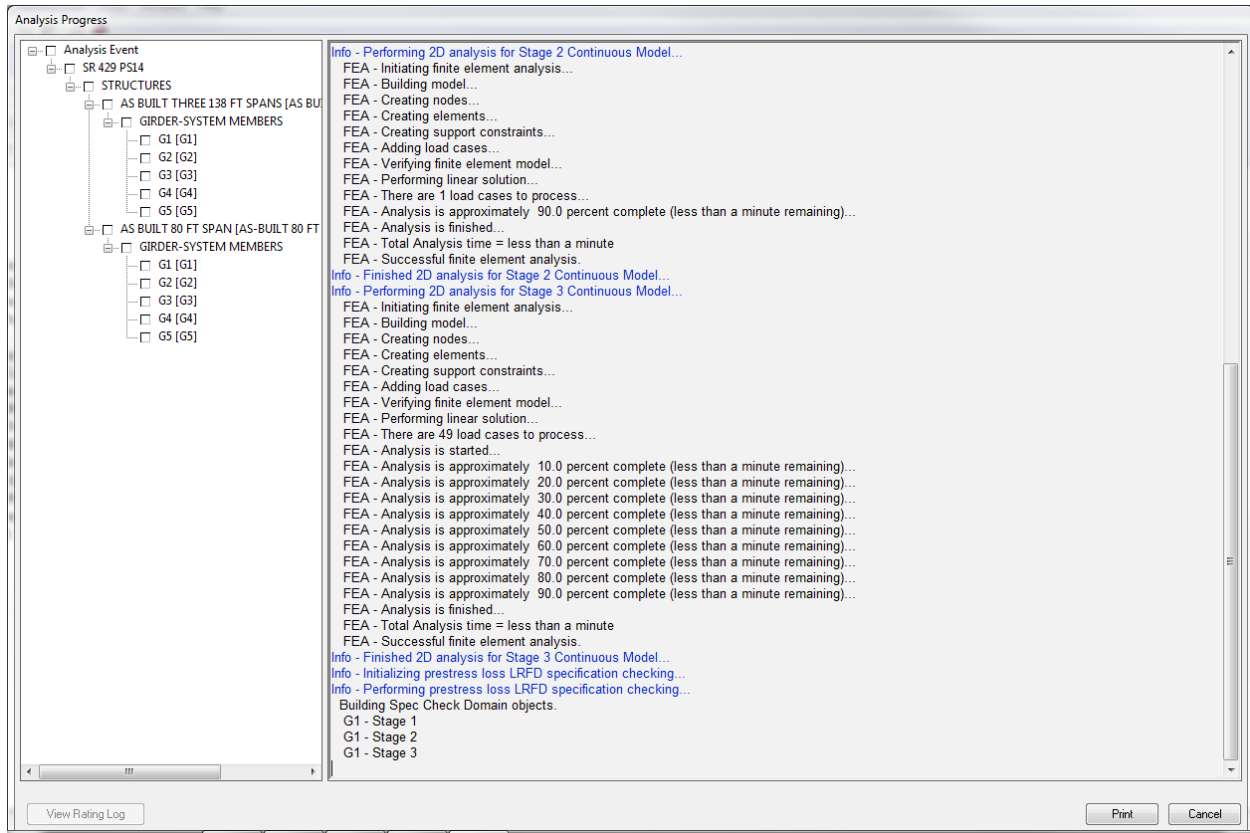


Next go to “Output” tab and click on “Select All” under AASHTO Engine Reports and then click Ok.



Next click the Analyze button on the toolbar to perform the design review. The Analysis Progress dialog will appear and should be reviewed for any warning messages.





The following steps are performed when doing a design review of a multi-span prestressed beam using the BrD LRFD analysis engine:

1. Finite element models are generated for the dead load and live load analyses. A Stage 1 FE model is generated for the dead loads on the non-composite simple span prestressed concrete beam.

For Continuous method of analysis:

A Stage 2 FE model is generated for the continuous final span condition for composite dead load analysis.

A Stage 3 FE model is generated for the continuous final span condition for the live load analysis.

For Continuous and Simple method of analysis:

Two Stage 2 FE models are generated:

Continuous final span condition

Simple span condition

Two Stage3 FE models are generated:

Continuous final span condition

Simple span condition

Stage 2 models contain section properties corresponding to the sustained modular ratio factor entered in BrD (eg,  $2n$ ). Stage 3 models contain section properties corresponding to the modular ratio ( $n$ ).

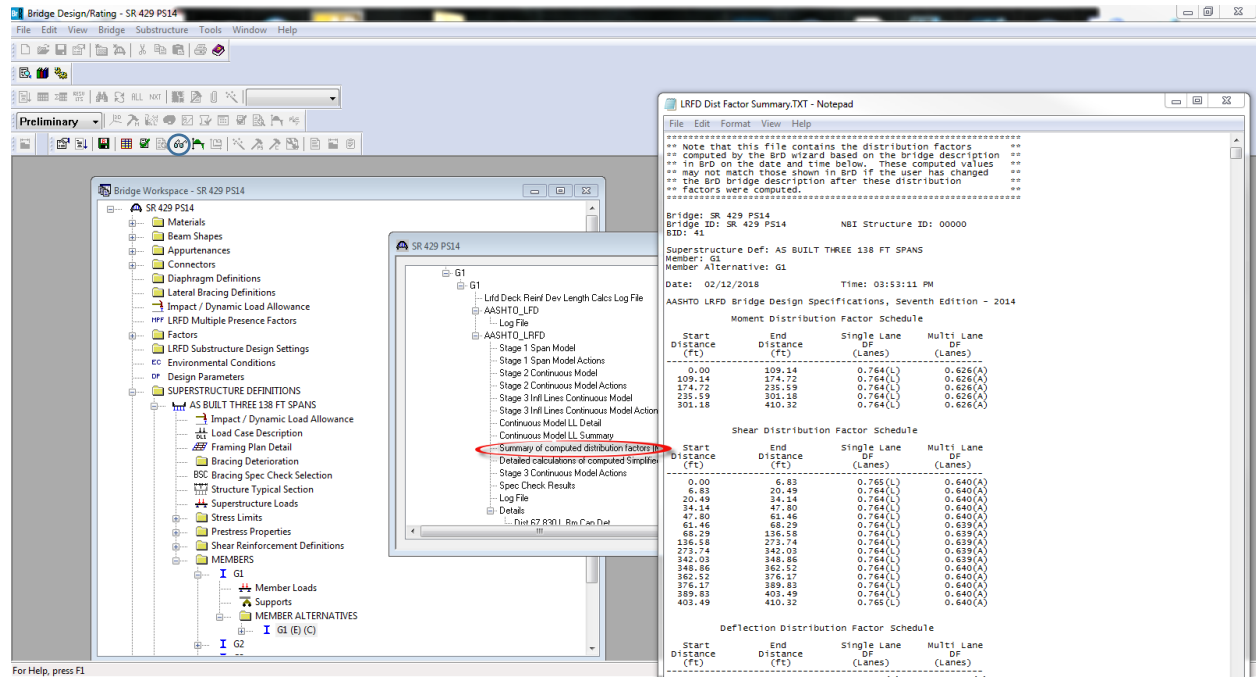
The model generated by the export to the BrD LRFD analysis engine will always contain node points at the middle of each simple span, at simple support locations, at harp points, at debond locations and at prestress strand transfer length locations so that the prestress force distribution can be computed.

2. The Stage 1 and 2 FE models are analyzed for the dead load. The prestress loss calculations are then performed along with determining the prestress forces at transfer and the restraint effects for the creep and shrinkage analysis for multi-span structures.
3. The final analysis then takes place. The prestress forces at transfer are applied to the Stage 1 FE model solely to determine the prestress camber in the beam. They are not included in the load combination generation. Creep and shrinkage forces are applied to the Stage 2 FE model.

The Stage 1 and 2 FE models are analyzed for the dead load. The Stage 3 FE model is loaded with unit loads at each node to generate influence lines for the beam. The influence loads are then loaded with the selected vehicles to find the maximum live load effects.

4. Load combinations are generated for the loadings and specification checks are performed at each of the nodes in finite element model. For the Continuous and Simple method of analysis the maximum force effects between the 2 sets of models are used to generate the load combinations.

A summary and a detailed report of the computed live load distribution factors are available.



A summary report of the specification check results is also available. This summary report lists the design ratios for each spec article at each spec check location point. The design ratio is the ratio of capacity to demand. A design ratio less than one indicates the demand is greater than the capacity and the spec article fails. A design ratio equal to 99.0 indicates the section is subject to zero demand.

The screenshot shows the Bridge Design/Rating software interface. The left pane displays a project tree for 'SR 429 PS14', including sections for Materials, Beam Shapes, and Design Parameters. The right pane shows project metadata and a 'Specification Check Summary' table. A red circle highlights the 'Spec Check Results (Monday Feb 12, 2018)' entry in the tree.

**Project Metadata:**

- Bridge ID : 41
- Bridge : SR 429 PS14
- Superstructure Def : AS BUILT THREE 138 FT SPANS
- Member : G1
- Analysis Preference Setting : None
- NBI Structure ID : 00000
- Bridge Alt : AS-BUILT
- Member Alt : G1

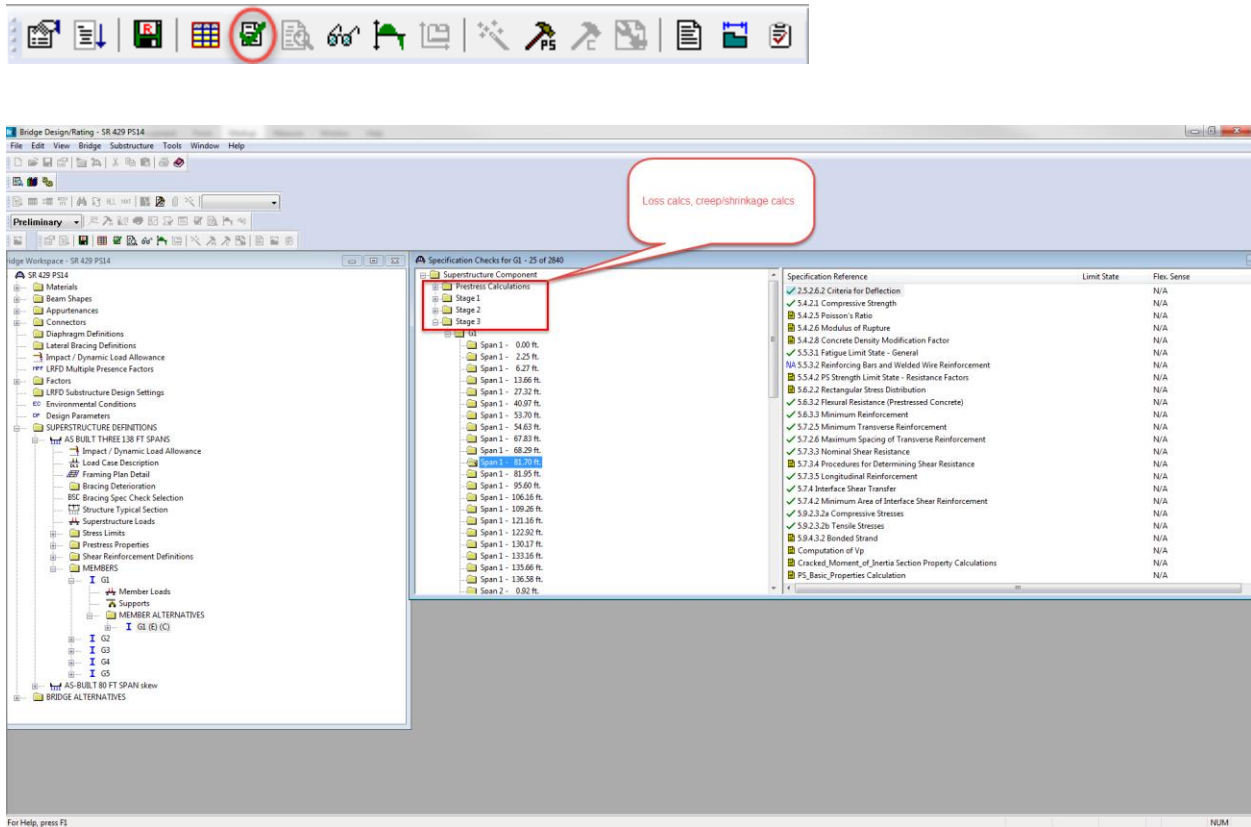
**Specification Check Summary**

Article	Status
Initial Stress at Transfer (5.9.2.3.1a, 5.9.2.3.1b)	Pass
Final Stress due to Permanent and Transient Loads (5.9.2.3.2a, 5.9.2.3.2b)	Pass
Flexure (5.6.3.2, 5.6.3.3)	Pass
Shear (5.7.3.3, 5.7.2.5, 5.7.2.6, 5.7.3.5)	Pass
Deflection (5.6.3.5.2)	Pass

**Initial Compression Stress At Transfer of Prestress**

Location (ft)	Allowable Stress (ksi)	Actual Stress Top of Beam (ksi)	Actual Stress Bot of Beam (ksi)	Ratio	Code
0.000	-3.90	-0.10	-0.84	6.64	Pass
2.250	-3.90	-0.43	-3.33	1.17	Pass
6.267	-3.90	-0.47	-3.29	1.19	Pass
13.658	-3.90	-0.54	-3.22	1.21	Pass
27.315	-3.90	-0.57	-3.19	1.22	Pass
40.973	-3.90	-0.48	-3.28	1.19	Pass

The specification checks can be viewed by selecting the “View Spec Check” button.



Open the spec check detail window for the flexural resistance at the middle of the simple span. The following is noted for this window, other spec articles are similar:

1. For each spec check location, both the left and right sides of the point are evaluated. The Deflection article is an exception to this since deflection must be the same between the left and right sides of a point.
2. The design ratio is printed out for the article. The design ratio is the ratio of capacity to demand. A design ratio less than one indicates the demand is greater than the capacity and the spec article fails. A design ratio equal to 99.0 indicates the section is subject to zero demand.
3. The Strength-I, Service-I, Service III and Fatigue limit states are the only limit states investigated. For each limit state, the max and min force effect is checked. Thus each limit state shows two rows of data.
4. The LL load combination is shown in this column. If the location is not at a node in the FE model (eg, the node is at a point where the rebar is fully developed), this column will list two load combinations separated by a comma. The first load combination is the combination considered at the left end and the second load combination is the combination considered at the right end of the FE element that contains this location. The resulting load displayed is a linear interpolation between the two displayed load cases.

Spec Check Detail for 5.6.3.2 Flexural Resistance (Prestressed Concrete)

5.6 Design for Flexural and Axial Effects - B Regions  
 5.6.3 Flexural Members  
 5.6.3.2 Flexural Resistance  
 (AASHTO LRFD Bridge Design Specifications, Eighth Edition)

PS I Narrow - At Location = 38.9827 (ft) - Left Stage 3

Cross Section Properties

Name: AASHTO TYPE III  
 Girder f'c = 5.00(ksi) Girder f'ci = 4.20(ksi)  
 Slab f'c = 4.00(ksi)


Effective Slab Width = 83.75(in)  
 Effective Slab Thickness = 7.75(in)  
 Haunch Width = 16.00(in)  
 Haunch Thickness = 0.50(in)  
 Beam Height = 45.00(in)

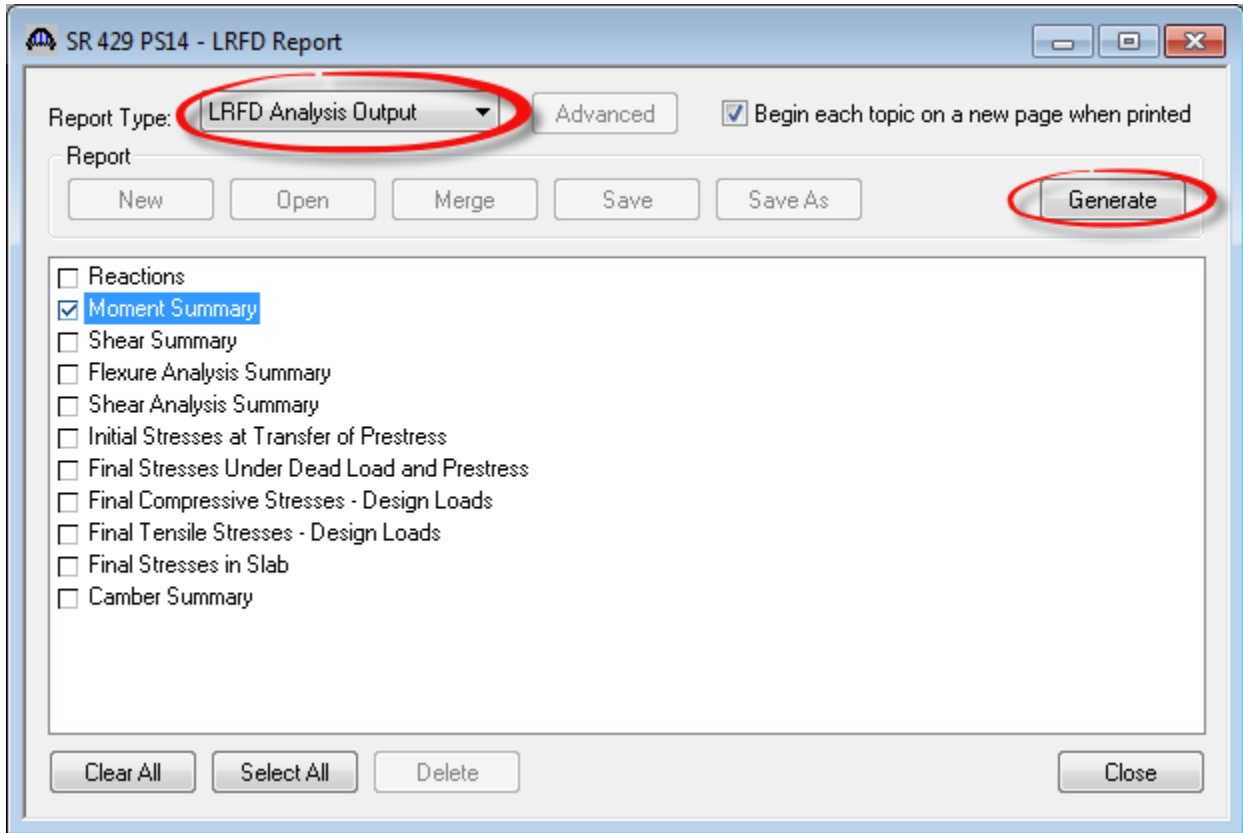
Total Aps = 3.98(in<sup>2</sup>)  
 Total Ccs = 4.19(in<sup>2</sup>)  
 Eff Aps = 3.98(in<sup>2</sup>)  
 Eff Ccs = 4.19(in<sup>2</sup>)

Note: If the capacity has been overridden, the Resistance is computed as override phi\*override capacity. Otherwise the Resistance is computed as per the Specification.

Limit State	Load Combination	Mu kip-ft	Phi	Mn kip-ft	Phi * Mn	Mr/Mu	NA Depth in	Ac in <sup>2</sup>	Max Conc Stress ksi	Max Rebar Stress ksi	Tensile Capacity kip	Fps ksi	dv in	dv=MAX(dv,0.9de,0.72h) I kip	0.9de in	0.72h in
STR-I	1	3788.56	1.000	4115.90	---	4115.90	1.09	4.59	347.63	0.00	0.00	262.92	47.22	1045.90	44.15	38.34
STR-I	2	1099.71	1.000	4115.90	---	4115.90	4.08	4.59	347.63	0.00	0.00	262.92	47.22	1045.90	44.15	38.34
STR-I	2	3469.96	1.000	4115.90	---	4115.90	1.19	4.59	347.63	0.00	0.00	262.92	47.22	1045.90	44.15	38.34
STR-I	2	1099.71	1.000	4115.90	---	4115.90	4.08	4.59	347.63	0.00	0.00	262.92	47.22	1045.90	44.15	38.34
SER-I	1	2485.43	1.000	4115.90	---	4115.90	1.46	4.59	347.63	0.00	0.00	262.92	47.22	1045.90	44.15	38.34
SER-I	1	1121.90	1.000	4115.90	---	4115.90	3.67	4.59	347.63	0.00	0.00	262.92	47.22	1045.90	44.15	38.34
SER-I	2	2303.28	1.000	4115.90	---	4115.90	1.79	4.59	347.63	0.00	0.00	262.92	47.22	1045.90	44.15	38.34
SER-I	2	1121.90	1.000	4115.90	---	4115.90	3.67	4.59	347.63	0.00	0.00	262.92	47.22	1045.90	44.15	38.34
SER-III	1	2212.73	1.000	4115.90	---	4115.90	1.86	4.59	347.63	0.00	0.00	262.92	47.22	1045.90	44.15	38.34
SER-III	1	1121.90	1.000	4115.90	---	4115.90	3.67	4.59	347.63	0.00	0.00	262.92	47.22	1045.90	44.15	38.34
SER-III	2	2067.08	1.000	4115.90	---	4115.90	1.99	4.59	347.63	0.00	0.00	262.92	47.22	1045.90	44.15	38.34
SER-III	2	1121.90	1.000	4115.90	---	4115.90	3.67	4.59	347.63	0.00	0.00	262.92	47.22	1045.90	44.15	38.34
FAT-I	3	1001.87	1.000	4115.90	---	4115.90	4.13	4.59	347.63	0.00	0.00	262.92	47.22	1045.90	44.15	38.34
FAT-II	3	0.00	1.000	4115.90	---	4115.90	99.00	4.59	347.63	0.00	0.00	262.92	47.22	1045.90	44.15	38.34
FAT-III	3	487.86	1.000	4115.90	---	4115.90	8.99	4.59	347.63	0.00	0.00	262.92	47.22	1045.90	44.15	38.34
FAT-IV	3	0.00	1.000	4115.90	---	4115.90	99.00	4.59	347.63	0.00	0.00	262.92	47.22	1045.90	44.15	38.34

The loads making up the Mu = 3788.56 k-ft for the maximum Strength-I limit state can be tracked down in Moment Summary report.

The Moment Summary report can be viewed by selecting the “Report Tool” button  on the toolbar to open the window shown below. Select “LRFD Analysis Output” in “Report Type”.



Select Moment Summary check box and click on “Generate” button will populate the moment summary report as shown below.

Bridge Name: SR 429 PS14  
 NBI Structure ID: 00000  
 Bridge ID: SR 429 PS14

Analyzed By: Bridge  
 Analyze Date: Monday, February 12, 2018 15:52:43  
 Analysis Engine: AASHTO LRFD Engine Version 6.8.2.3003  
 Analysis Preference Setting: None

Report By: bridge  
 Report Date: Monday, February 12, 2018 16:23:24

Structure Definition Name: AS-BUILT 80 FT SPAN skew  
 Member Name: G1  
 Member Alternative Name: G1

**Moment Summary**  
 Live Load HL-93 (US)  
 Impact = \*\* %

Span 1

Location (ft)	Percent	DC Load (kip-ft)	DW Load (kip-ft)	+(LL+I) (kip-ft)	Controlling Live Load	-(LL+I) (kip-ft)	Controlling Live Load
0.00(R)	0.0	0.00	N/A	0.00	Tandem + Lane	0.00	Tandem + Lane
1.75(B)	2.2	98.47	N/A	128.37	Truck + Lane	0.00	Tandem + Lane
7.80(B)	10.0	403.88	N/A	521.64	Truck + Lane	0.00	Tandem + Lane
15.59(B)	20.0	718.01	N/A	913.69	Truck + Lane	0.00	Tandem + Lane
23.39(B)	30.0	942.39	N/A	1176.14	Truck + Lane	0.00	Tandem + Lane
31.05(B)	39.8	1075.40	N/A	1327.72	Truck + Lane	0.00	Tandem + Lane
31.19(B)	40.0	1077.02	N/A	1329.51	Truck + Lane	0.00	Tandem + Lane
38.98(B)	50.0	1121.90	N/A	1363.54	Truck + Lane	0.00	Tandem + Lane
46.78(B)	60.0	1077.02	N/A	1329.51	Truck + Lane	0.00	Tandem + Lane
47.04(B)	60.3	1073.93	N/A	1326.08	Truck + Lane	0.00	Tandem + Lane
54.58(B)	70.0	942.39	N/A	1176.14	Truck + Lane	0.00	Tandem + Lane
62.37(B)	80.0	718.01	N/A	913.69	Truck + Lane	0.00	Tandem + Lane
70.17(B)	90.0	403.88	N/A	521.64	Truck + Lane	0.00	Tandem + Lane
76.34(B)	97.9	91.58	N/A	119.41	Truck + Lane	0.00	Tandem + Lane
77.97(L)	100.0	-0.00	N/A	0.00	Tandem + Lane	0.00	Tandem + Lane

The resulting maximum moment for Strength-I at the midspan is equal to  $(1.25 * 1121.90) + (1.75 * 1363.54) = 3788.56$  kft.



Tabular dead load and live load analysis results are available in the Analysis Results window.

The screenshot shows the 'Analysis Results - G1' window in the Bridge Design/Rating software. The window title is 'Analysis Results - G1'. It features three dropdown menus at the top: 'Report Type' set to 'Dead Load Actions', 'Stage' set to 'Non-composite (Stage 1)', and 'Dead Load Case' set to 'Self Load (Stage 1:D,DC)'. Below these is a table with the following columns: Span, Location (ft), % Span, Side, Moment (kip-ft), Shear (kip), Axial (kip), Reaction (kip), X Deflection (in), and Y Deflection (in). The table contains 15 rows of data for different span locations. At the bottom of the window, it displays 'AASHTO LRFD Engine Version 6.8.2.3003' and 'Analysis Preference Setting: None'. A 'Close' button is located at the bottom right of the window.

Span	Location (ft)	% Span	Side	Moment (kip-ft)	Shear (kip)	Axial (kip)	Reaction (kip)	X Deflection (in)	Y Deflection (in)
1	0.00	0.0	Right	0.00	22.72	0.00	22.72	0.0000	-0.0000
1	1.75	2.2	Both	38.87	21.70	0.00		0.0000	-0.0646
1	7.80	10.0	Both	159.42	18.18	0.00		0.0000	-0.2827
1	15.59	20.0	Both	283.41	13.63	0.00		0.0000	-0.5348
1	23.39	30.0	Both	371.98	9.09	0.00		0.0000	-0.7322
1	31.05	39.8	Both	424.48	4.63	0.00		0.0000	-0.8560
1	31.19	40.0	Both	425.12	4.54	0.00		0.0000	-0.8575
1	38.98	50.0	Both	442.83	0.00	0.00		0.0000	-0.9005
1	46.78	60.0	Both	425.12	-4.54	0.00		0.0000	-0.8575
1	47.04	60.3	Both	423.90	-4.70	0.00		0.0000	-0.8546
1	54.58	70.0	Both	371.98	-9.09	0.00		0.0000	-0.7322
1	62.37	80.0	Both	283.41	-13.63	0.00		0.0000	-0.5348
1	70.17	90.0	Both	159.42	-18.18	0.00		0.0000	-0.2827
1	76.34	97.9	Both	36.15	-21.77	0.00		0.0000	-0.0600
1	77.97	100.0	Left	-0.00	-22.72	0.00	22.72	0.0000	-0.0000

PS14 - Prestressed Concrete I Beam

Analysis Results - G1

Report Type: Live Load Actions | Stage: Composite (short term) (Stage 3) | Live Load: HL-93 (US) | Live Load Type: Axle Load

Span	Location (ft)	% Span	Positive Moment (kip-ft)	Negative Moment (kip-ft)	Positive Shear (kip)	Negative Shear (kip)	Positive Axial (kip)	Negative Axial (kip)	Positive Reaction (kip)	Negative Reaction (kip)	Positive X Deflection (in)	Negative X Deflection (in)	Positive Y Deflection (in)	Negative Y Deflection (in)	% Impact Pos Reaction	% Impact Neg Reaction
1	0.00	0.0	0.00	0.00	58.09	0.00	0.00	0.00	58.09	0.00	0.0000	0.0000	0.0000	0.0000	33.000	0.000
1	1.75	2.2	98.98	0.00	56.61	-0.66	0.00	0.00			0.0000	0.0000	0.0000	-0.0268		
1	7.80	10.0	401.11	0.00	51.48	-2.93	0.00	0.00			0.0000	0.0000	0.0000	-0.1177		
1	15.59	20.0	699.40	0.00	44.88	-6.46	0.00	0.00			0.0000	0.0000	0.0000	-0.2246		
1	23.39	30.0	894.89	0.00	38.27	-12.32	0.00	0.00			0.0000	0.0000	0.0000	-0.3100		
1	31.05	39.8	1006.78	0.00	31.79	-18.37	0.00	0.00			0.0000	0.0000	0.0000	-0.3631		
1	31.19	40.0	1008.08	0.00	31.67	-18.48	0.00	0.00			0.0000	0.0000	0.0000	-0.3638		
1	38.98	50.0	1028.72	0.00	25.07	-25.07	0.00	0.00			0.0000	0.0000	0.0000	-0.3838		
1	46.76	60.0	1008.08	0.00	18.48	-31.67	0.00	0.00			0.0000	0.0000	0.0000	-0.3640		
1	47.04	60.3	1005.58	0.00	18.26	-31.90	0.00	0.00			0.0000	0.0000	0.0000	-0.3626		
1	54.58	70.0	894.89	0.00	12.32	-38.27	0.00	0.00			0.0000	0.0000	0.0000	-0.3100		
1	62.37	80.0	699.40	0.00	6.46	-44.88	0.00	0.00			0.0000	0.0000	0.0000	0.2246		
1	70.17	90.0	401.11	0.00	2.93	-51.48	0.00	0.00			0.0000	0.0000	0.0000	0.1177		
1	76.34	97.9	92.08	0.00	0.61	-56.72	0.00	0.00			0.0000	0.0000	0.0000	0.0249		
1	77.97	100.0	0.00	0.00	-0.00	-58.09	0.00	0.00	58.09	0.00	0.0000	0.0000	0.0000	0.0000	33.000	0.000

AASHTO LRFD Engine Version 6.8.2.3003  
Analysis Preference Setting: None

Close

Note these values include dynamic load allowance, distribution factors and any live load scale factor entered on the Analysis Settings window.