

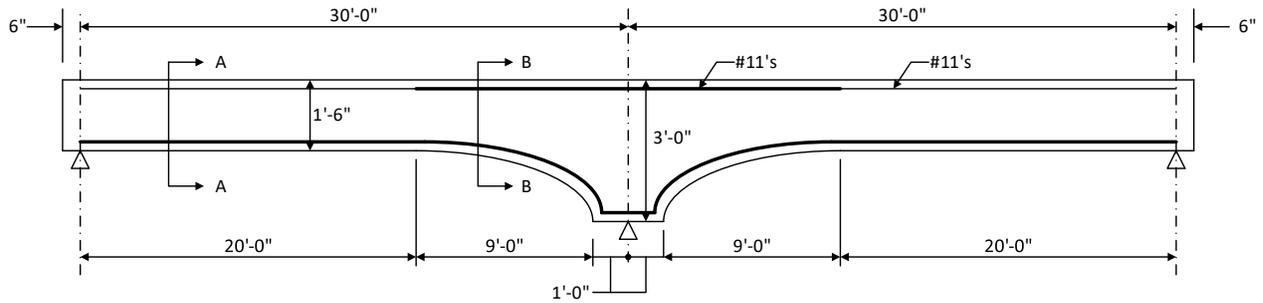
*AASHTOWare BrDR 7.5.0*

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*Reinforced Concrete Structure Tutorial*  
*RC6 – Two Span Reinforced Concrete Slab System Example*

# RC6 – Two Span RC Slab System

## Introduction – Elevation



Elevation

## Section and Material Properties

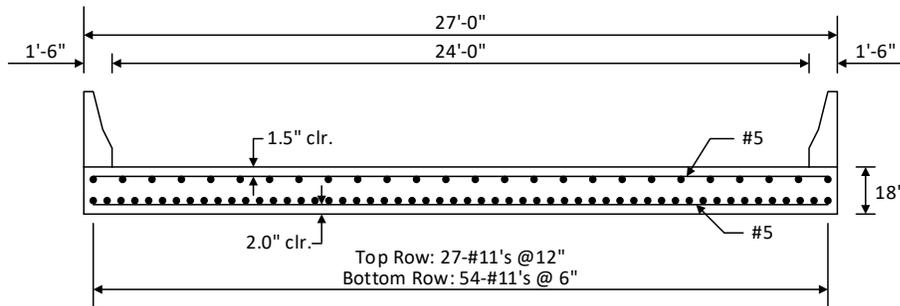
### Material Properties

Slab Concrete: Class A (US)  $f'_c = 4.0$  ksi, modular ratio  $n = 8$

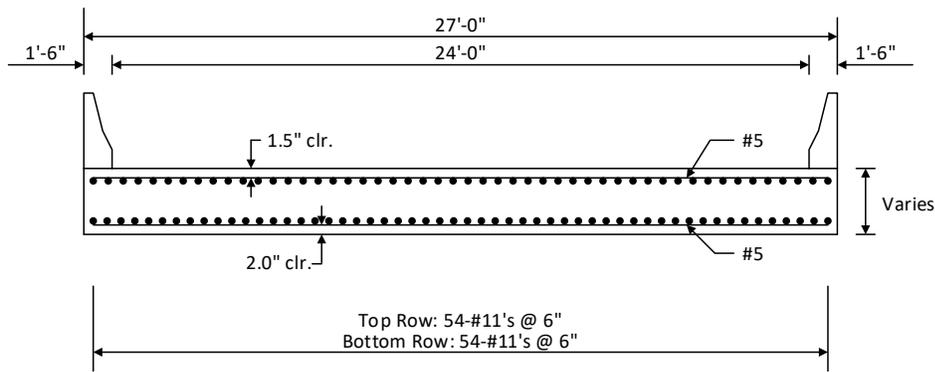
Slab Reinforcing Steel: AASHTO M31, Grade 60 with  $F_y = 60$  ksi

### Parapets

Weigh 300 lb/ft each.



Section A-A



Section B-B

## RC6 – Two Span RC Slab System

BrDR Training

RC6 – Two Span Reinforced Concrete Slab System Example

Topics Covered

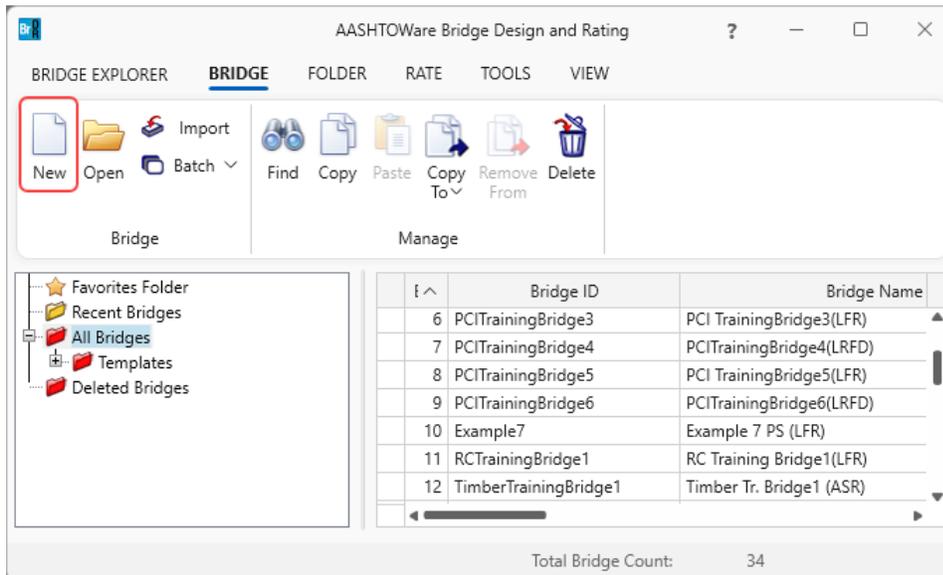
### Part 1: Reinforced concrete slab system input. Slab is not integral with pier.

- Schedule based input of slab strip.
- Slab depth varies parabolically over the pier.

### Part 2: Frame structure simplified definition slab structure type.

Reinforced concrete slab system input. Slab is not integral with pier

From the **Bridge Explorer** create a new bridge by selecting **New** from the **Bridge** ribbon and enter the following description data.



## RC6 – Two Span RC Slab System

Bridge ID: 2SpanRCslabSystem12    NBI structure ID (8): 2SpanRCslabSys5

Template  
 Bridge completely defined

Bridge Workspace View  
 Superstructures  
 Culverts  
 Substructures

Description    Description (cont'd)    Alternatives    Global reference point    Traffic    Custom agency fields

Name: 2SpanRCslab    Year built:   

Description:   

Location:    Length:    ft

Facility carried (7):    Route number: -1

Feat. intersected (6):    Mi. post:   

Default units: US Customary

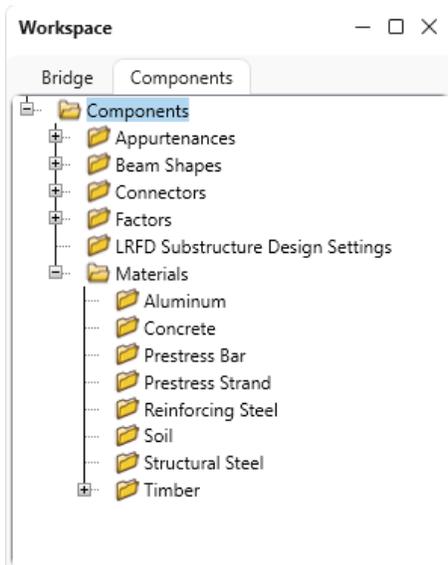
Bridge association...     BrR     BrD     BrM

OK    Apply    Cancel

Close the window by clicking **OK**.

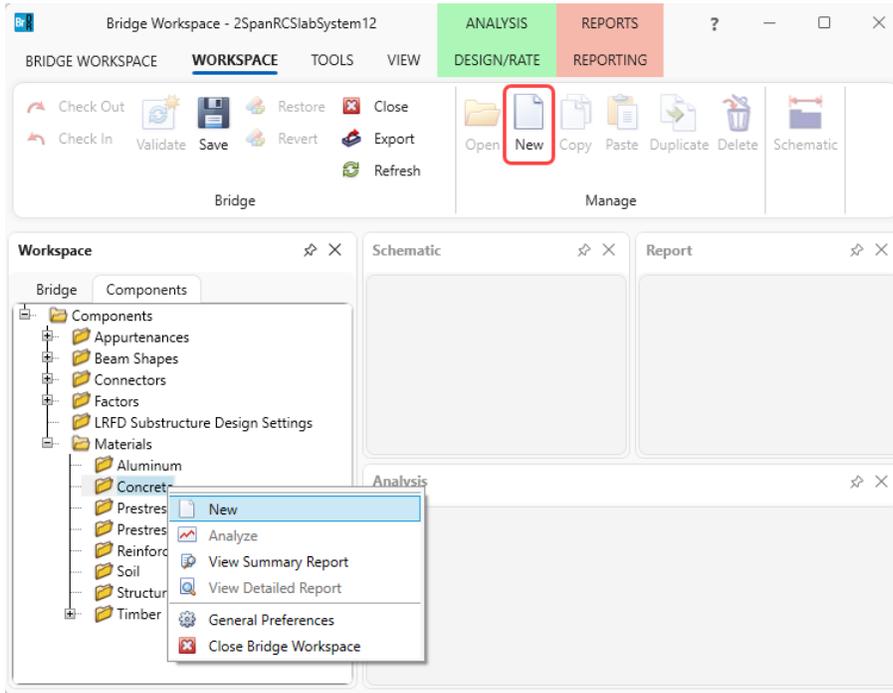
### Bridge Components

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

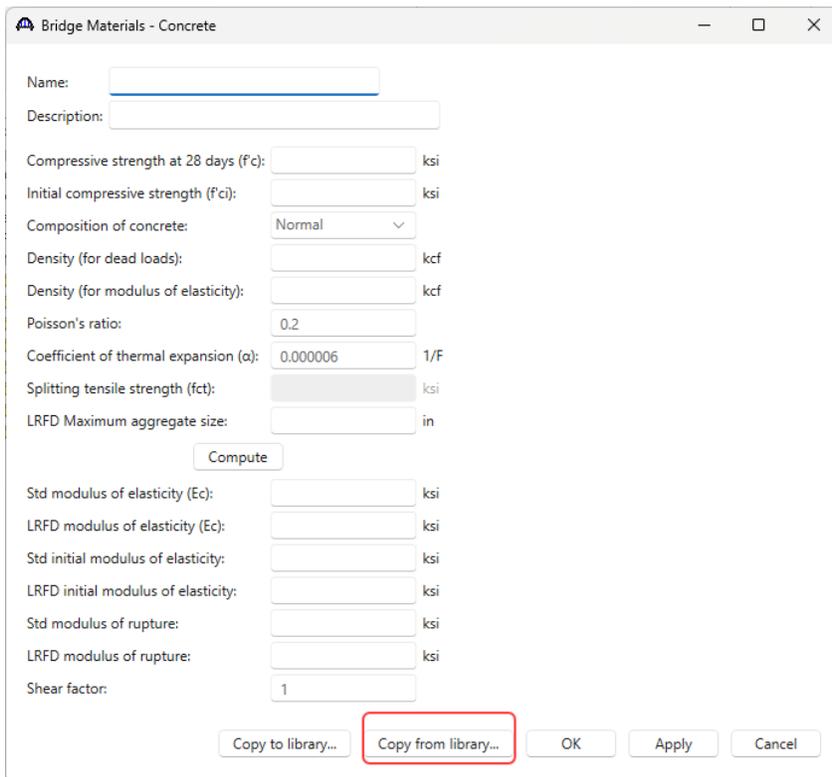


## RC6 – Two Span RC Slab System

To add a new concrete material, click on **Concrete** in the **Components** tree and select **New** from the **Manage** group of the **Workspace** ribbon (or right mouse click on **Concrete** and select **New**).



Add the concrete material by selecting from the **Concrete Materials Library** by clicking the **Copy from Library** button.



## RC6 – Two Span RC Slab System

The following window opens:

Name	Description	Library	Units	f <sub>c</sub>	f <sub>ci</sub>	alpha	DL density	Modulus density	Std modulus of elasticity	LRFD modulus of elasticity	Poisson's ratio	Std Modulus of rupture	LRFD M of ru
Class A	Class A cement concrete	Standard	SI / Metric	28		0.0000108	2400	2320	25426.0823	27730.359798	0.2		
> Class A (US)	Class A cement concrete	Standard	US Customary	4.0...		0.000006	0.15	0.145	3644.149254	3986.548657	0.2		C
Class B	Class B cement concrete	Standard	SI / Metric	17		0.0000108	2400	2320	19811.8437	23520.226422	0.2		
Class B (US)	Class B cement concrete	Standard	US Customary	2.4...		0.000006	0.15	0.145	2822.746208	3368.115517	0.2		C
Class C	Class C cement concrete	Standard	SI / Metric	28		0.0000108	2400	2320	25426.0823	27730.359798	0.2		
Class C (US)	Class C cement concrete	Standard	US Customary	4.0...		0.000006	0.15	0.145	3644.149254	3986.54846	0.2		C

Select the **Class A (US)** material and click **OK**. The selected material properties are copied to the **Bridge Materials – Concrete** window as shown below.

Name:	<input type="text" value="Class A (US)"/>
Description:	<input type="text" value="Class A cement concrete"/>
Compressive strength at 28 days (f <sub>c</sub> ):	<input type="text" value="4.0000006"/> ksi
Initial compressive strength (f <sub>ci</sub> ):	<input type="text"/>
Composition of concrete:	<input type="text" value="Normal"/> ▼
Density (for dead loads):	<input type="text" value="0.15"/> kcf
Density (for modulus of elasticity):	<input type="text" value="0.145"/> kcf
Poisson's ratio:	<input type="text" value="0.2"/>
Coefficient of thermal expansion (α):	<input type="text" value="0.000006"/> 1/F
Splitting tensile strength (f <sub>ct</sub> ):	<input type="text"/>
LRFD Maximum aggregate size:	<input type="text"/>
<input type="button" value="Compute"/>	
Std modulus of elasticity (E <sub>c</sub> ):	<input type="text" value="3644.149254"/> ksi
LRFD modulus of elasticity (E <sub>c</sub> ):	<input type="text" value="3986.548657"/> ksi
Std initial modulus of elasticity:	<input type="text"/>
LRFD initial modulus of elasticity:	<input type="text"/>
Std modulus of rupture:	<input type="text"/>
LRFD modulus of rupture:	<input type="text" value="0.479857"/> ksi
Shear factor:	<input type="text" value="1"/>
<input type="button" value="Copy to library..."/> <input type="button" value="Copy from library..."/> <input type="button" value="OK"/> <input type="button" value="Apply"/> <input type="button" value="Cancel"/>	

Click **OK** to apply the data and close the window.

## RC6 – Two Span RC Slab System

Add the following **Reinforcing Steel** in the same manner.

Bridge Materials - Reinforcing Steel

Name:

Description:

Material properties

Specified yield strength (fy):  ksi

Modulus of elasticity (Es):  ksi

Ultimate strength (Fu):  ksi

Type

Plain

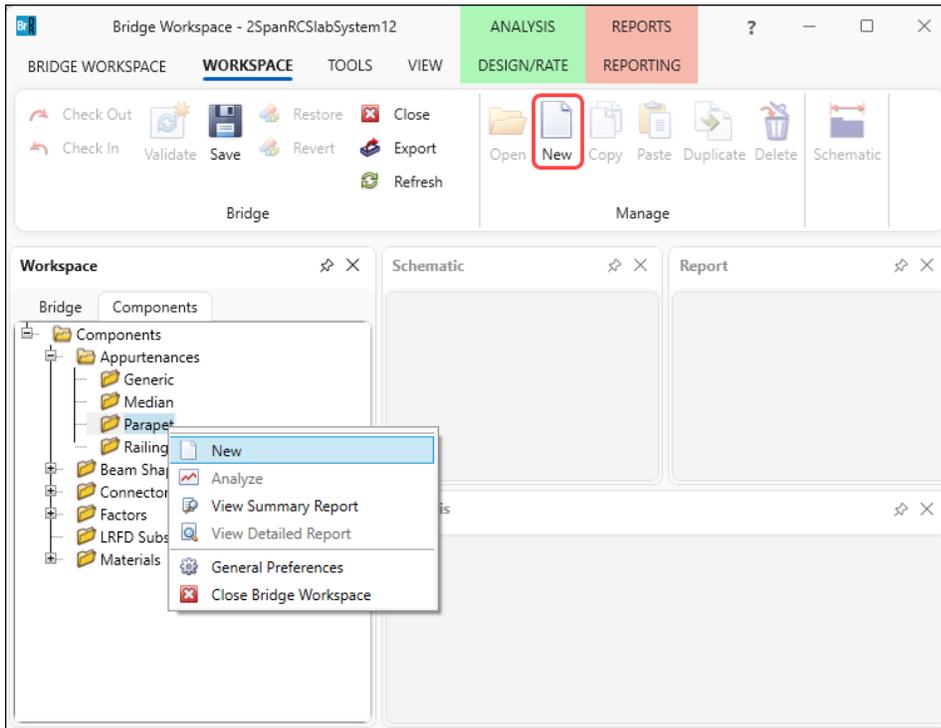
Epoxy

Galvanized

Click **OK** to apply the data and close the window.

### Bridge Appurtenances

Add parapet information in a similar manner under **Appurtenances**. To enter the appurtenances to be used within the bridge expand the tree branch labeled **Appurtenances**. To define a parapet, select **Parapet** and click on **New** from the **Manage** button on the **Workspace** ribbon (double click on **Parapet** in the **Components** tree).



# RC6 – Two Span RC Slab System

Enter the data as shown below.

Bridge Appurtenances - Parapet

Name:

Description:

All dimensions are in inches

Additional load:  kip/ft

Parapet unit load:  kcf

Reference Line:

Back:

Front:

Roadway Surface

Calculated properties

Net centroid (from reference line):  in

Total load:  kip/ft

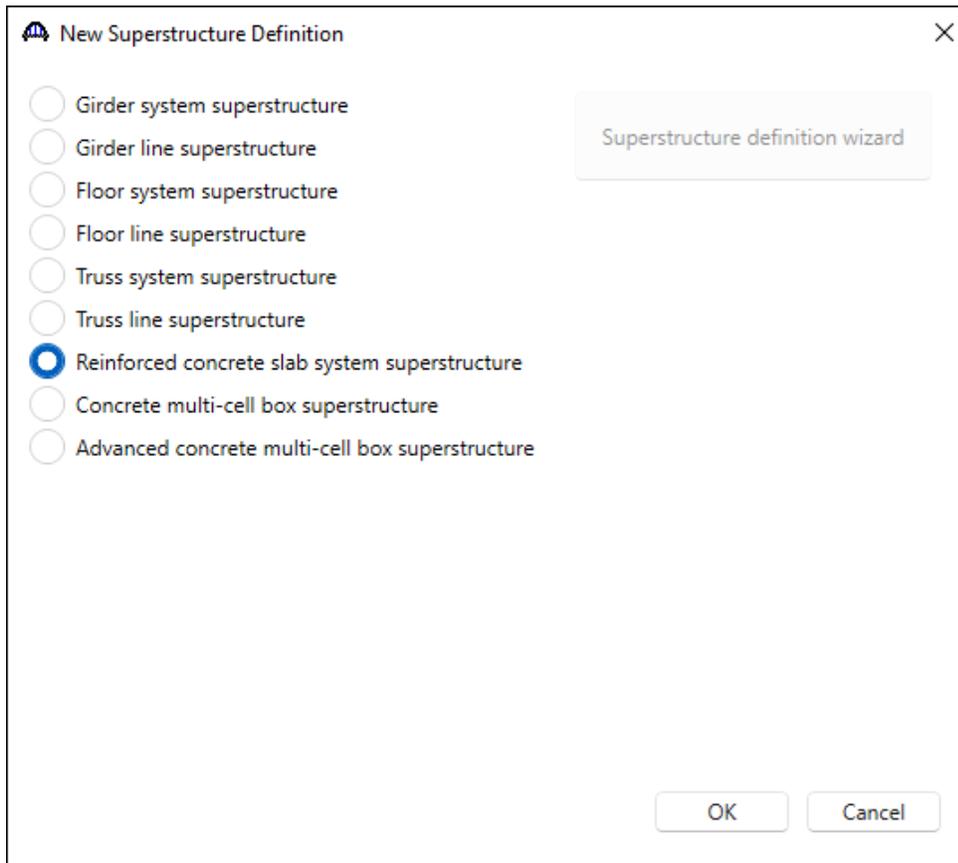
Click **OK** to apply the data and close the window.

Since a reinforced concrete slab is used, beam shapes need not be defined. The slab details will be entered later when the strip profile is defined. The default impact factors, standard LRFD and LFR factors will be used so the next step will be to define a Superstructure. A **Bridge Alternatives** will be added after a superstructure is defined.

## RC6 – Two Span RC Slab System

### Superstructure Definition

Navigate to the **Bridge** tab in the **Bridge Workspace** tree and double-click on **SUPERSTRUCTURE DEFINITIONS** (or click on **SUPERSTRUCTURE DEFINITIONS** and select **New** from the **Manage** group of the Workspace ribbon or right mouse click on **SUPERSTRUCTURE DEFINITIONS** and select **New** from the popup menu) to create a new structure definition.



Select **Reinforced concrete slab system superstructure**, click **OK** and the **RC Slab System Superstructure Definition** window will open.

# RC6 – Two Span RC Slab System

Enter data as shown below.

RC Slab System Superstructure Definition

Definition Analysis Specs Engine

Name: Slab System

Description:

Default units: US Customary

Number of spans: 2

Number of slab strips: 3

Enter span lengths along the reference line:

Span	Length (ft)
1	30
2	30

Member alt. types

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

Slab structure type

- Frame structure simplified definition
- Slab integral with pier
- Consider pier skew in FE section pro
- Slab not integral with pier

Contains voids

OK Apply Cancel

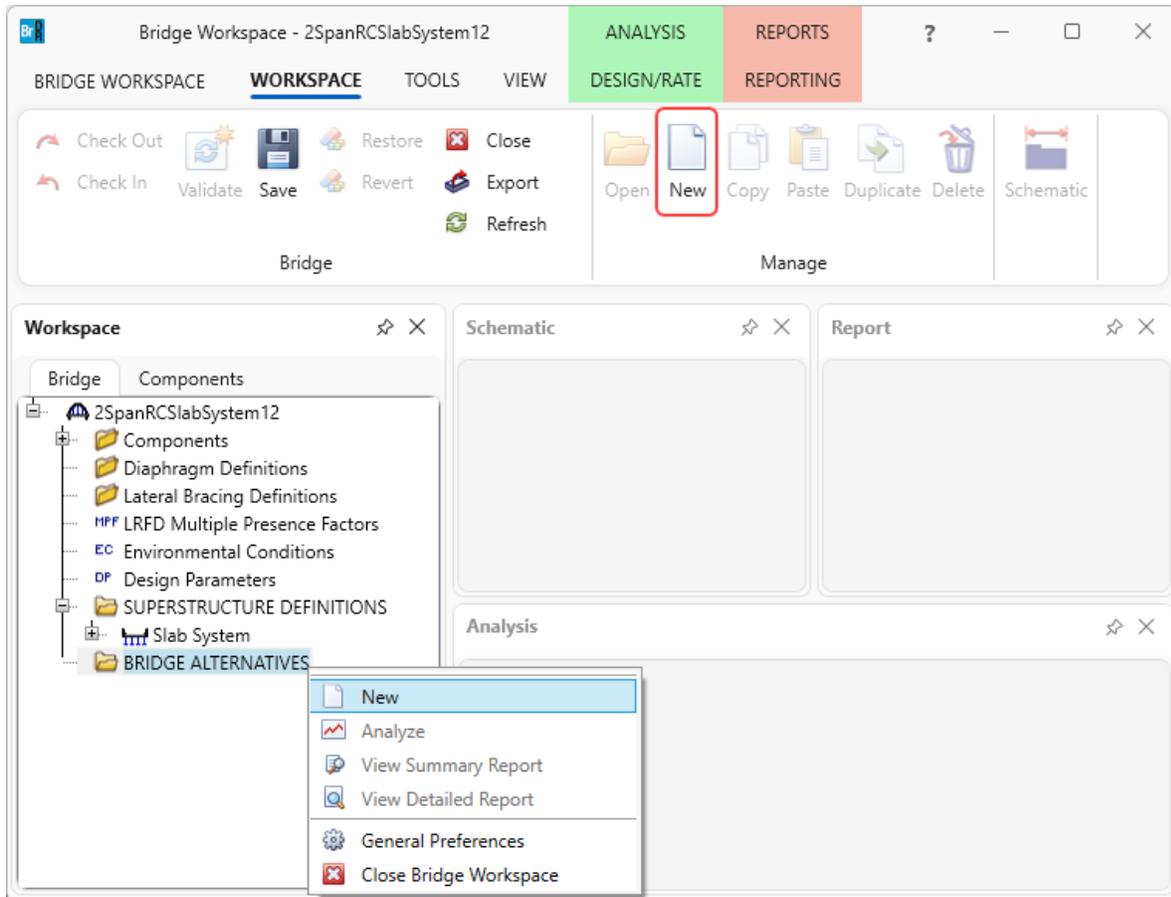
For this superstructure definition, select **Slab structure type** as **Slab not integral with pier**. The **Number of spans** is 2 and the **Number of slab** strips is 3. The width of the edge strips to 7.5 ft and the width of the interior strip to 12 ft. Enter the rest of the data as shown above and click on **OK** to apply the data and close the window.

To enter a slab with voids, select **Contains voids** in the superstructure definition window which allows the user to define void patterns and assign the patterns along the slab. For this example, a solid slab will be defined so **Contains voids** should remain unchecked.

## RC6 – Two Span RC Slab System

### BRIDGE ALTERNATIVES

Navigate to the **BRIDGE ALTERNATIVES** node in the **Bridge Workspace** tree and create a new bridge alternative by double-clicking on **BRIDGE ALTERNATIVES** (or click on **BRIDGE ALTERNATIVES** and select **New** from the **Manage** group of the **WORKSPACE** ribbon).



## RC6 – Two Span RC Slab System

Enter the following data.

Bridge Alternative

Alternative name: Bridge Alt #1

Description Substructures

Description:

Horizontal curvature

Reference line length:  ft

Start bearing  End bearing

Starting station:  ft

Bearing: N 90^ 0' 0.00" E

Global positioning

Distance: 0 ft

Offset: 0 ft

Elevation:  ft

Bridge alignment

Curved

Tangent, curved, tangent

Tangent, curved

Curved, tangent

Start tangent length:  ft

Curve length:  ft

Radius:  ft

Direction: Left

End tangent length:  ft

Superstructure wizard...

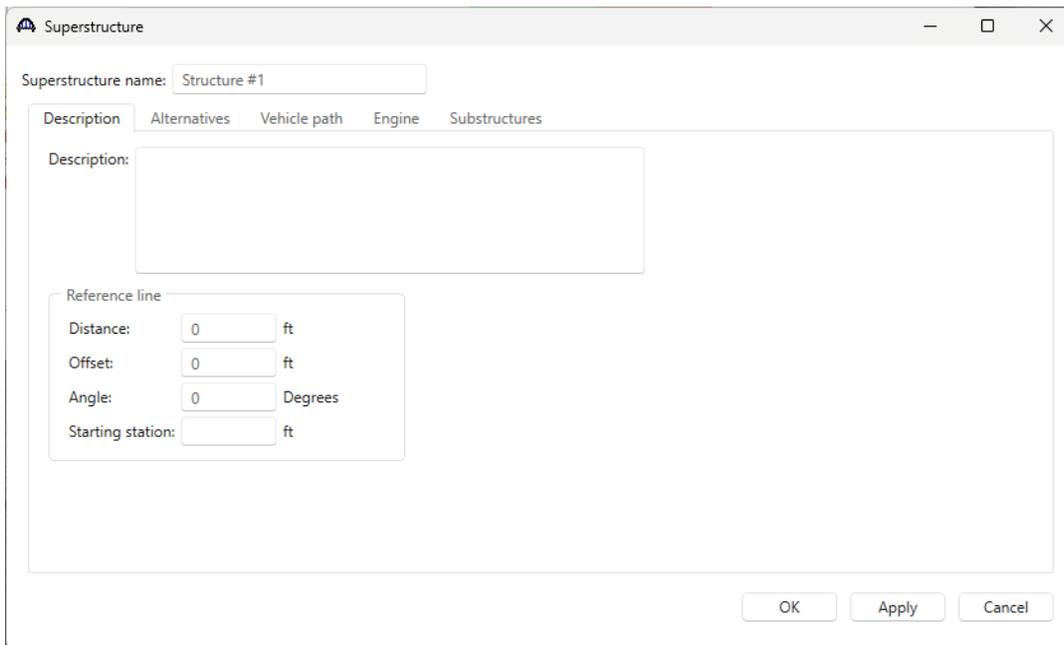
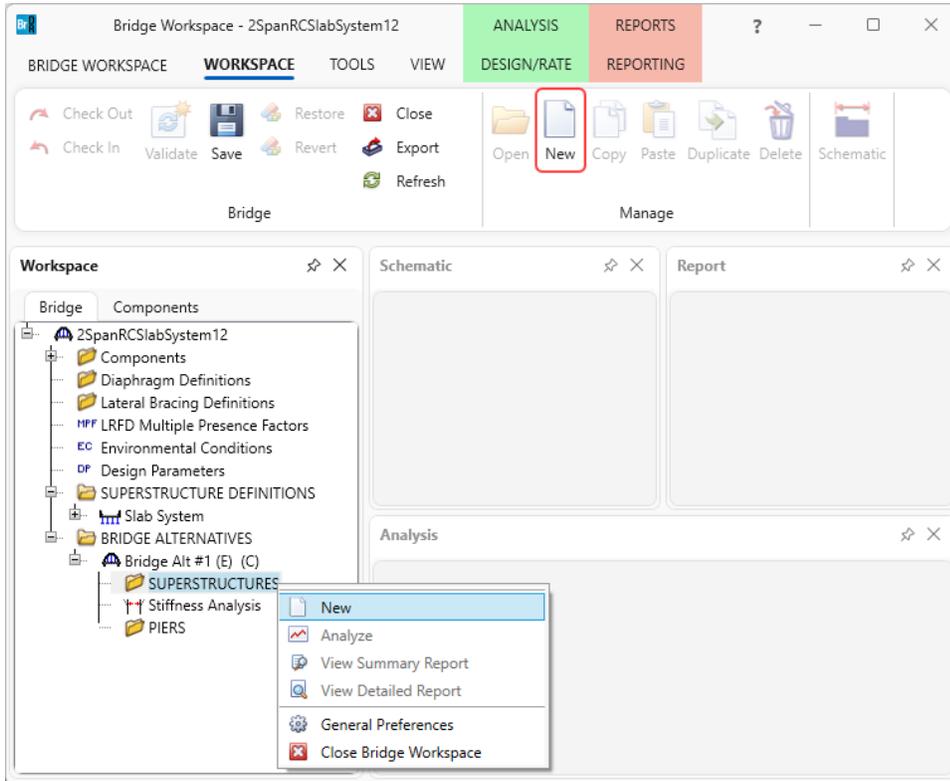
Culvert wizard...

OK Apply Cancel

Click **OK** to apply the data and close the window.

## RC6 – Two Span RC Slab System

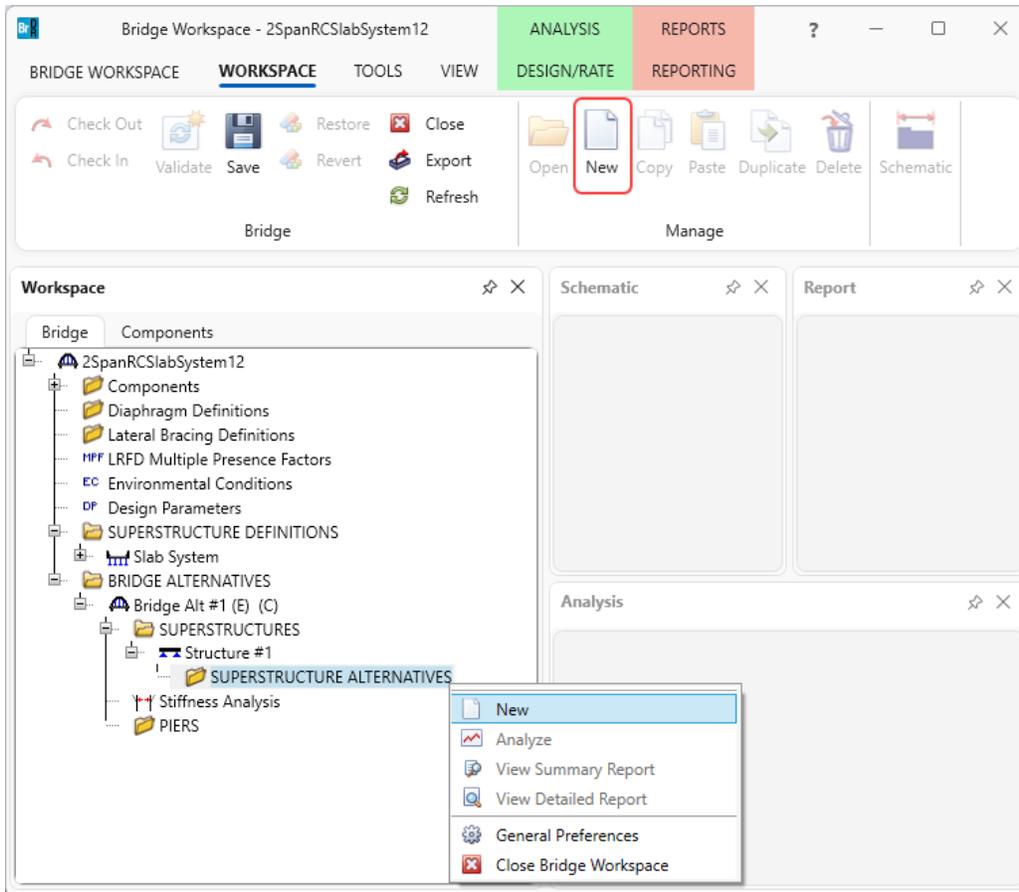
Expand the **Bridge Alt #1** node in the **Bridge Workspace** tree by clicking the **+** button. Double-click on the **SUPERSTRUCTURES** node (or select **SUPERSTRUCTURES**, click **New** from the **Manage** group of the **WORKSPACE** ribbon) and enter the following new superstructure.



Click **OK** to apply the data and close the window.

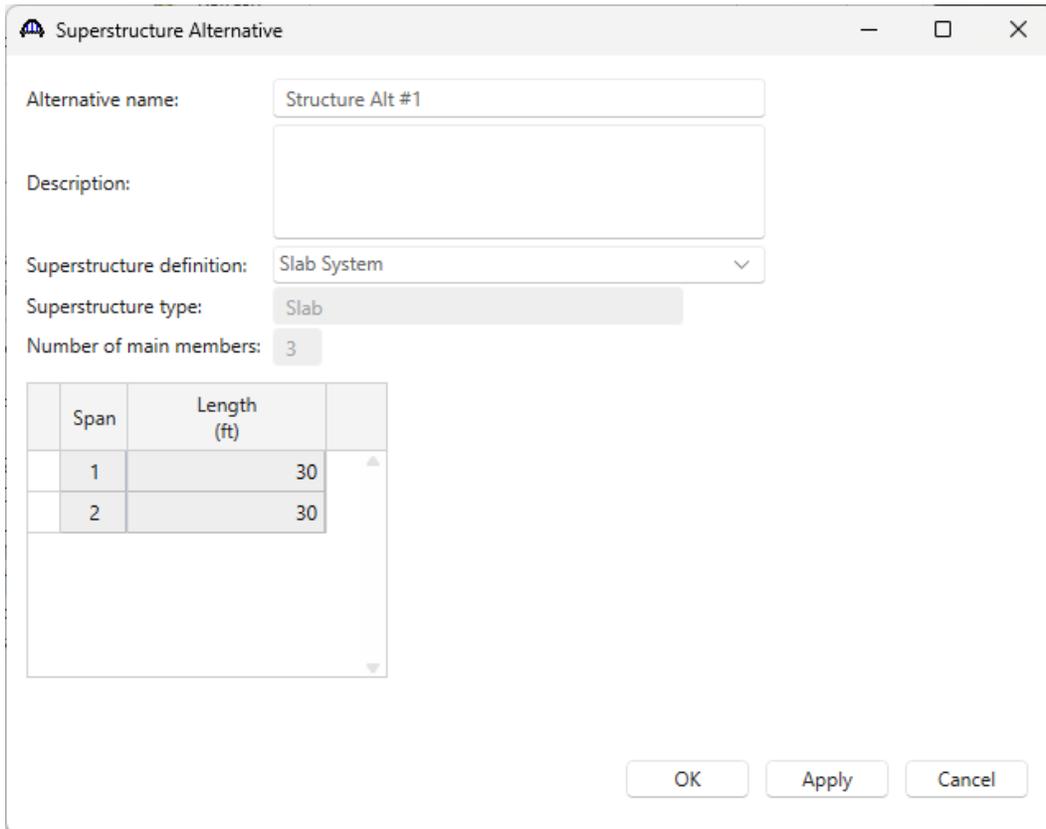
## RC6 – Two Span RC Slab System

Expand the **Structure #1** node in the **Bridge Workspace** tree by clicking the **+** button. Double-click on the **SUPERSTRUCTURE ALTERNATIVES** node (or select **SUPERSTRUCTURE ALTERNATIVES** and click **New** from the **Manage** group of the **WORKSPACE** ribbon) and enter the following new superstructure alternative.



## RC6 – Two Span RC Slab System

Select the **Superstructure definition Slab System** as the current superstructure definition for this Superstructure Alternative.



Superstructure Alternative

Alternative name: Structure Alt #1

Description:

Superstructure definition: Slab System

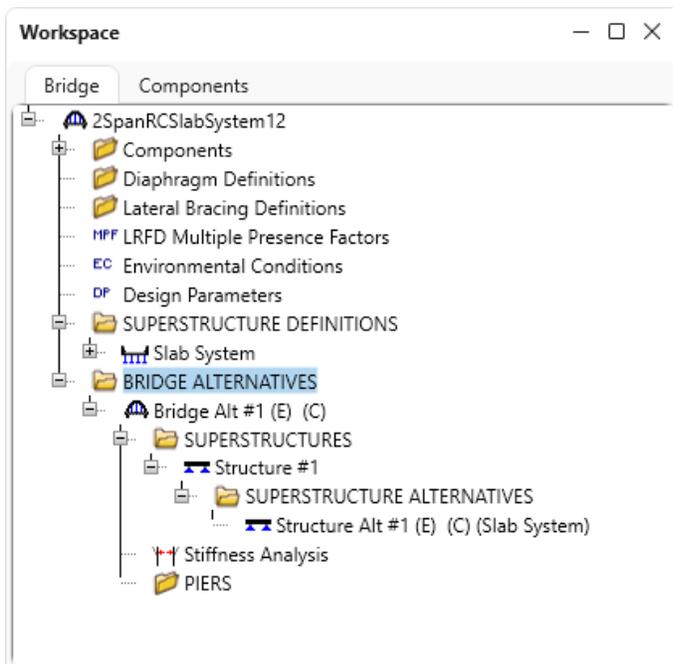
Superstructure type: Slab

Number of main members: 3

Span	Length (ft)
1	30
2	30

OK Apply Cancel

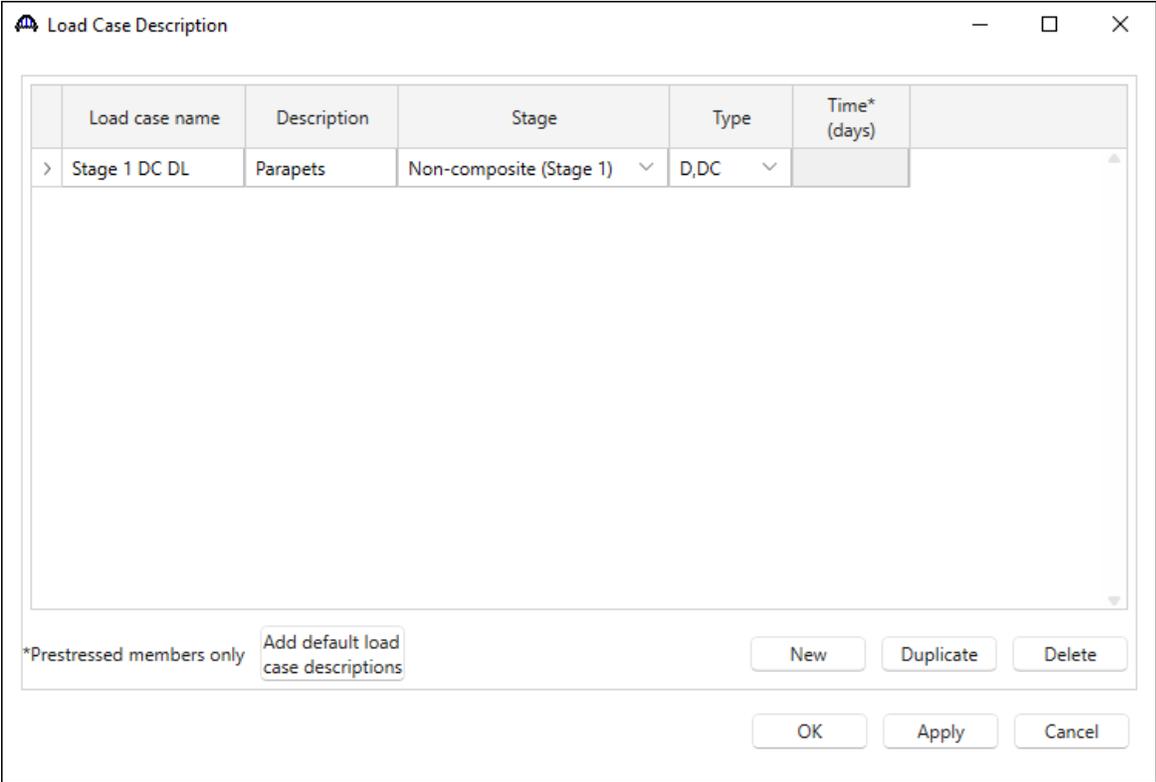
The partially expanded **Bridge Workspace tree** is shown below.



# RC6 – Two Span RC Slab System

## Load Case Description

Navigate back the Superstructure definition **Slab System**. Double click on the **Load Case Description** node in the **Bridge Workspace** tree to open the **Load Case Description** window and define the dead load case to be used by the parapets. The completed **Load Case Description** window is shown below.

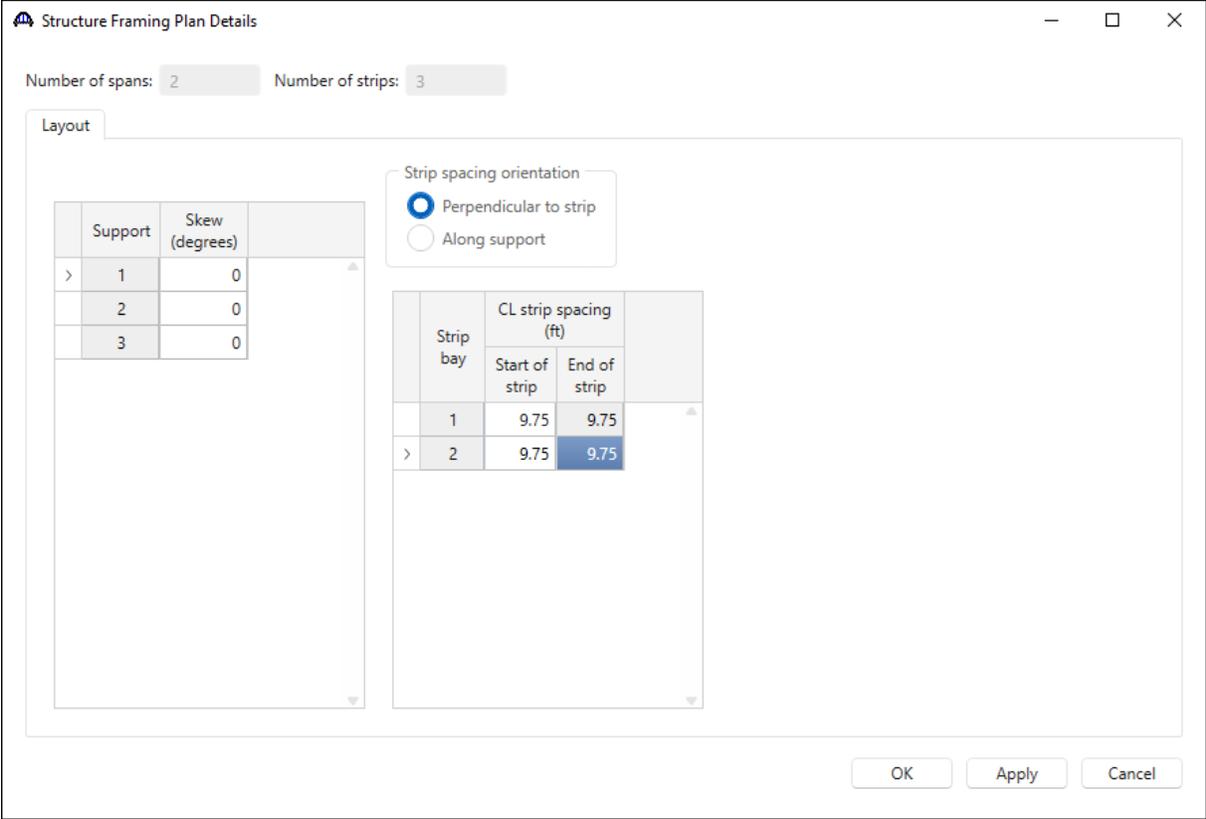


Click **OK** to apply the data and close the window.

# RC6 – Two Span RC Slab System

## Framing Plan Details - Layout

Double-click on **Framing Plan Detail** in the **Bridge Workspace** tree to describe the framing plan in the **Structure Framing Plan Details** window. Enter the data as shown below. For this example, since the width of the edge strips will be set to 7.5 ft and the width of the interior strip will be set to 12 ft, enter the **CL Strip Spacing** as **9.75 ft** for both bays.



Click **OK** to apply the data and close the window.

# RC6 – Two Span RC Slab System

## Structure Typical Section –Deck

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

The screenshot shows a software dialog box titled "Structure Typical Section". At the top, there is a diagram of a bridge deck cross-section. The diagram shows a central "Superstructure Definition Reference Line" with two "CL Strip" areas on either side. Dimensions are indicated: "Distance from left edge of deck to superstructure definition ref. line" and "Distance from right edge of deck to superstructure definition ref. line" are both 13.5 ft. "Half left strip width" and "Half right strip width" are both 3.75 ft.

Below the diagram is a tabbed interface with the following tabs: Deck, Deck (cont'd), Parapet, Median, Railing, Generic, Sidewalk, Lane position, Striped lanes, and Wearing surface. The "Deck" tab is selected.

Under the "Deck" tab, the "Superstructure definition reference line is" dropdown is set to "within" and "the bridge deck". Below this, there are input fields for "Start" and "End" values in feet:

Parameter	Start (ft)	End (ft)
Distance from left edge of deck to superstructure definition reference line:	13.5	13.5
Distance from right edge of deck to superstructure definition reference line:	13.5	13.5
Half left strip width:	3.75	3.75
Computed half right strip width:	3.75	3.75

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

# RC6 – Two Span RC Slab System

## Structure Typical Section – Parapet

Switch to the **Parapet** tab and enter data as shown below.

The screenshot shows the 'Structure Typical Section' software interface. At the top left, there is a small diagram of a parapet cross-section with 'Back' and 'Front' labels. Below the diagram are several tabs: 'Deck', 'Deck (cont'd)', 'Parapet', 'Median', 'Railing', 'Generic', 'Sidewalk', 'Lane position', 'Striped lanes', and 'Wearing surface'. The 'Parapet' tab is currently selected. Below the tabs is a table with the following columns: Name, Load case, Measure to, Edge of deck dist. measured from, Distance at start (ft), Distance at end (ft), and Front face orientation. The table contains two rows of data for 'Jersey Barrier'.

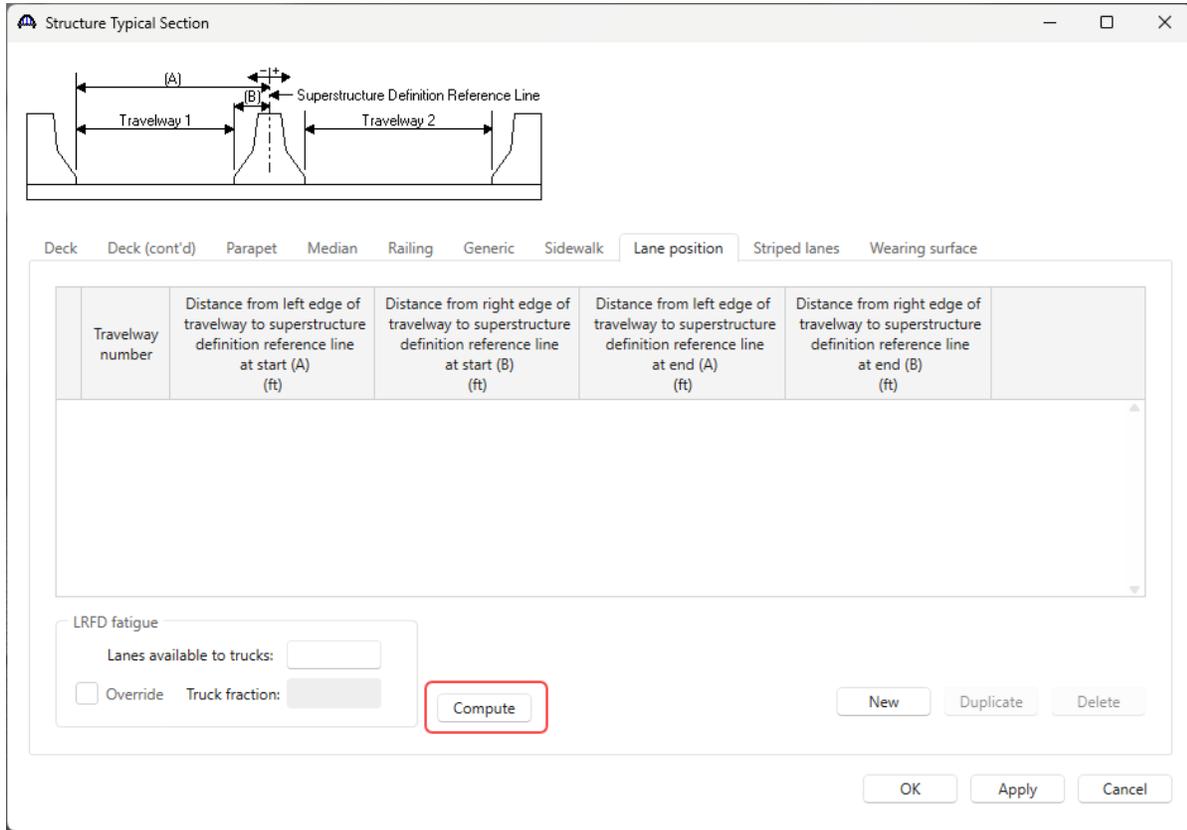
Name	Load case	Measure to	Edge of deck dist. measured from	Distance at start (ft)	Distance at end (ft)	Front face orientation
Jersey Barrier	Stage 1 DC DL	Back	Left Edge	0	0	Right
> Jersey Barrier	Stage 1 DC DL	Back	Right Ed...	0	0	Left

Below the table are three buttons: 'New', 'Duplicate', and 'Delete'. At the bottom of the window are three buttons: 'OK', 'Apply', and 'Cancel'.

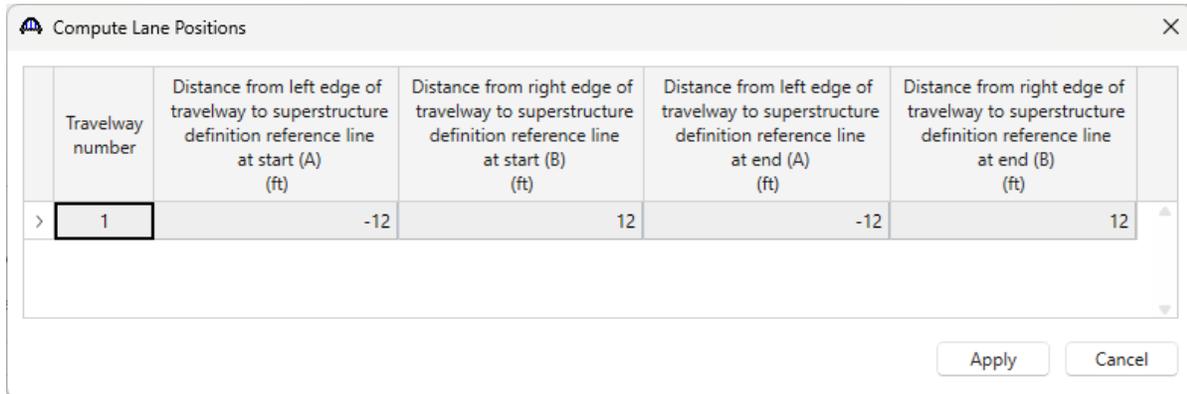
# RC6 – Two Span RC Slab System

## Structure Typical Section – Lane Position

Navigate to the **Lane position** tab and click on the Compute button to compute the lane positions based on the information entered in this window.



The **Compute Lane Positions** window appears as shown below. Click **Apply** to use the computed lane positions.



## RC6 – Two Span RC Slab System

The **Lane positions** tab is populated as shown below.

Structure Typical Section

Deck Deck (cont'd) Parapet Median Railing Generic Sidewalk **Lane position** Striped lanes Wearing surface

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	-12	12	-12	12

LRFD fatigue

Lanes available to trucks:

Override Truck fraction:

Compute New Duplicate Delete

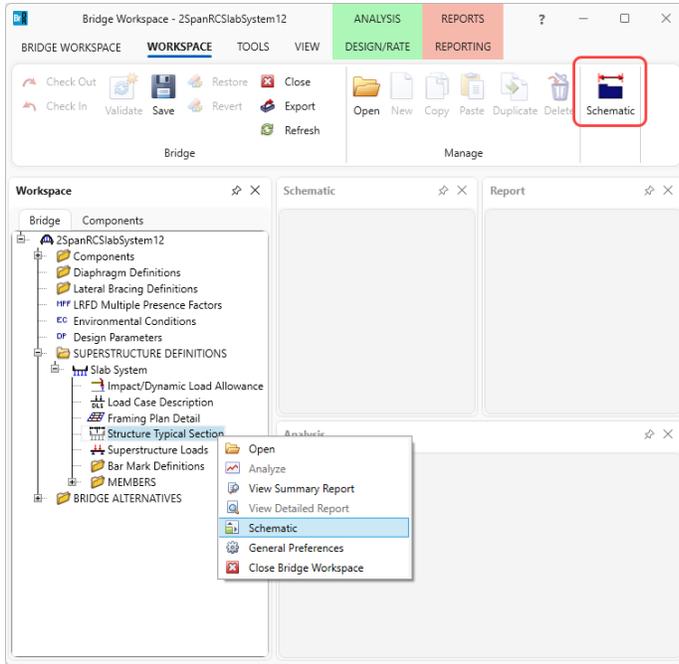
OK Apply Cancel

Click **OK** to apply the data and close the window.

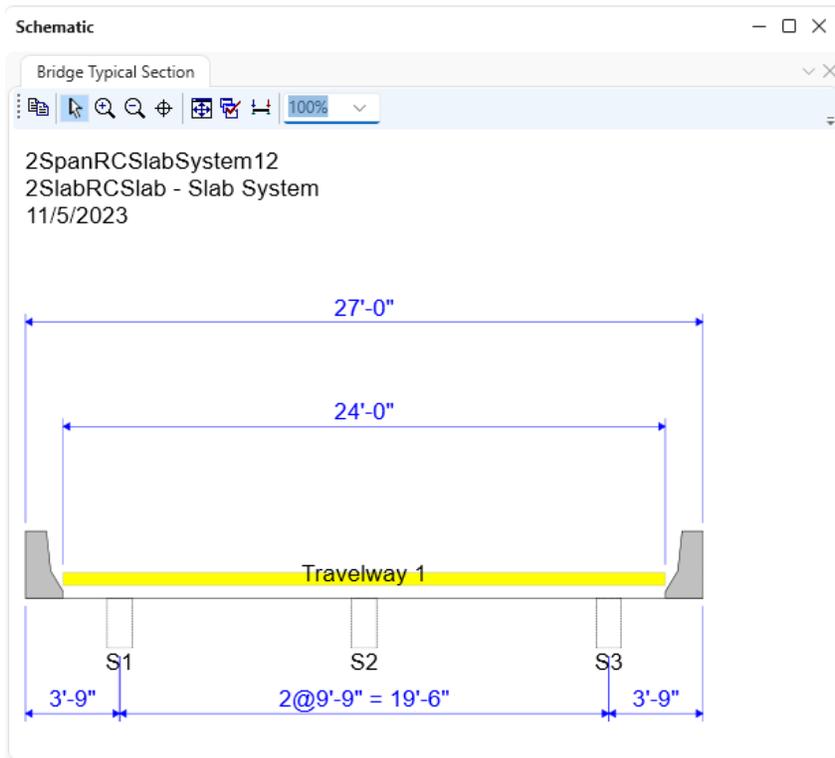
# RC6 – Two Span RC Slab System

## Structure Typical Section – Schematics

Select **Structure Typical Section** in the **Bridge Workspace** tree and click on the **Schematics** button from the **Workspace** ribbon (or right click and select **Schematic**) to open **Schematic: Typical section** window as shown below.



Since the slab strip profile is not yet entered, the slab strips are represented by dotted line boxes in the schematic.



## RC6 – Two Span RC Slab System

### Bar Mark Definitions

Double-click on **Bar Mark Definitions** in the **Bridge Workspace** tree to create a new **Bar Mark Definition**. Enter data for BarMark #1 as shown below. Then click on **OK** to apply the data and close the window. Create another **Bar Mark Definition** for BarMark #2 in the same manner.

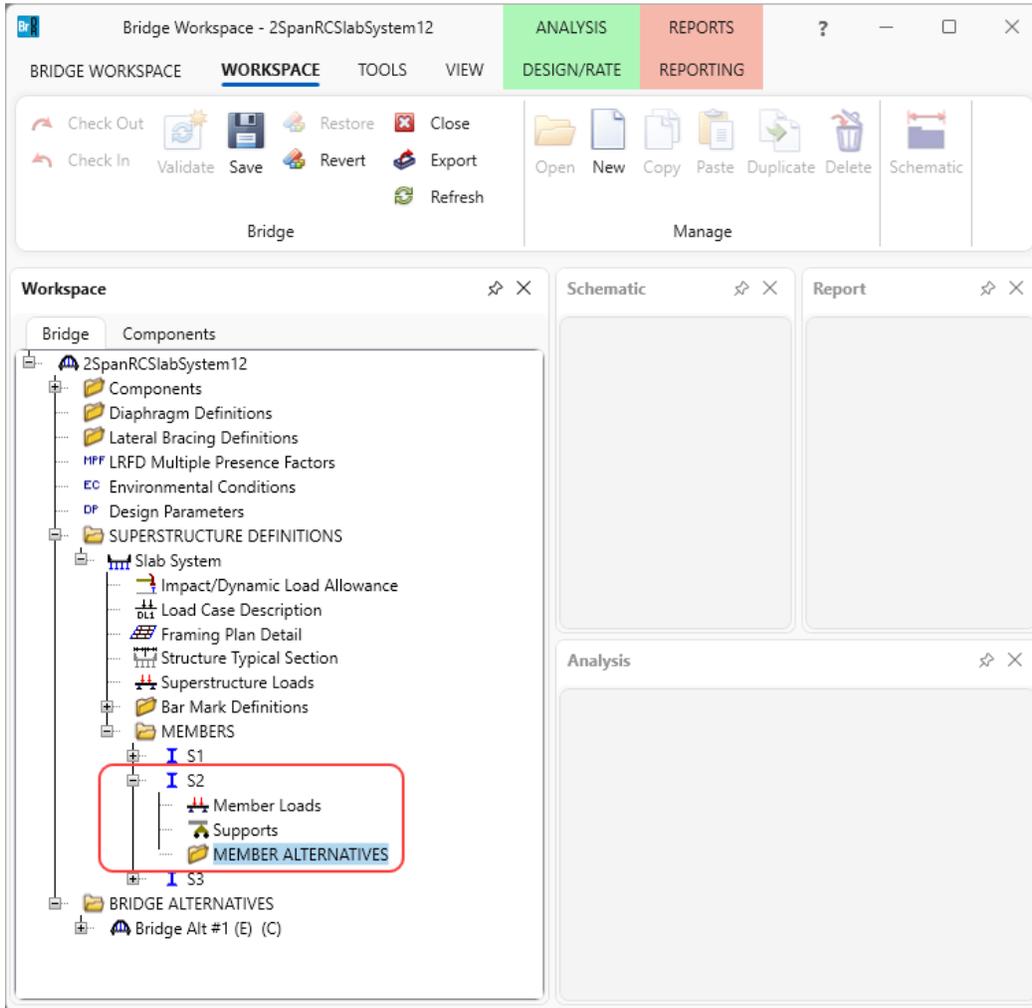
The screenshot shows the 'Bar Mark Definition' dialog box for 'BarMark #1'. The 'Name' field contains 'BarMark #1'. The 'Material' dropdown is set to 'Grade 60'. The 'Bar size' dropdown is set to '11'. The 'Bar type' dropdown is set to 'Straight'. The 'Dimension' section shows 'A' set to '30' ft. On the left, under 'Bar types', there are four diagrams: 'Type: Straight' (a simple horizontal bar), 'Type: 1' (a bar with a U-shaped hook at the end), 'Type: 2' (a bar with hooks at both ends and a central section labeled 'B'), and 'Type: 3' (a bar with hooks at both ends and a central section labeled 'C', with additional labels 'A', 'B', 'D', and 'E' indicating different segments). At the bottom right, there are three buttons: 'OK', 'Apply', and 'Cancel'.

The screenshot shows the 'Bar Mark Definition' dialog box for 'BarMark #2'. The 'Name' field contains 'BarMark #2'. The 'Material' dropdown is set to 'Grade 60'. The 'Bar size' dropdown is set to '11'. The 'Bar type' dropdown is set to 'Straight'. The 'Dimension' section shows 'A' set to '10' ft. On the left, under 'Bar types', there are four diagrams: 'Type: Straight' (a simple horizontal bar), 'Type: 1' (a bar with a U-shaped hook at the end), 'Type: 2' (a bar with hooks at both ends and a central section labeled 'B'), and 'Type: 3' (a bar with hooks at both ends and a central section labeled 'C', with additional labels 'A', 'B', 'D', and 'E' indicating different segments). At the bottom right, there are three buttons: 'OK', 'Apply', and 'Cancel'.

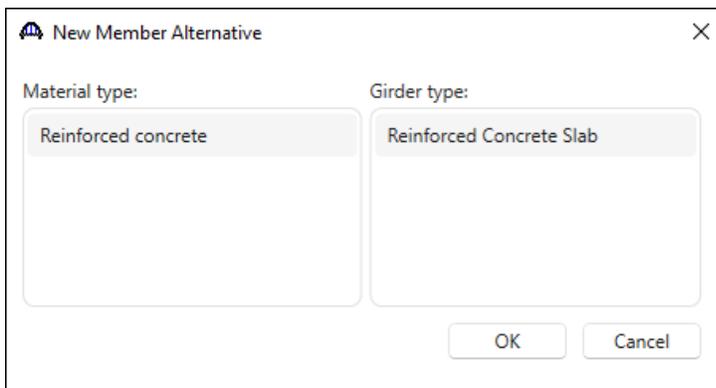
## RC6 – Two Span RC Slab System

### Defining a Member Alternative

Expand the member **S2**.



Double-click **MEMBER ALTERNATIVES** in the tree under the interior strip **S2** to create a new alternative. The **New Member Alternative** window shown below will open. Select **Reinforced concrete** for the **Material type** and **Reinforced Concrete Slab** for the **Girder type**.



Click **OK** to close the window and create a new member alternative.

## RC6 – Two Span RC Slab System

Member Alternative Description

Member alternative: Slab Strip S2

Description Specs Factors Engine Import Control options

Description:

Material type: Reinforced Concrete

Girder type: Reinforced Concrete Slab

Default units: US Customary

Girder property input method

Schedule based

Cross-section based

End bearing locations

Left: 6 in

Right: 6 in

Edge beam

Self load

Additional self load: kip/ft

Additional self load: %

Default rating method: LFR

Analysis strip

Full slab section width

User defined in

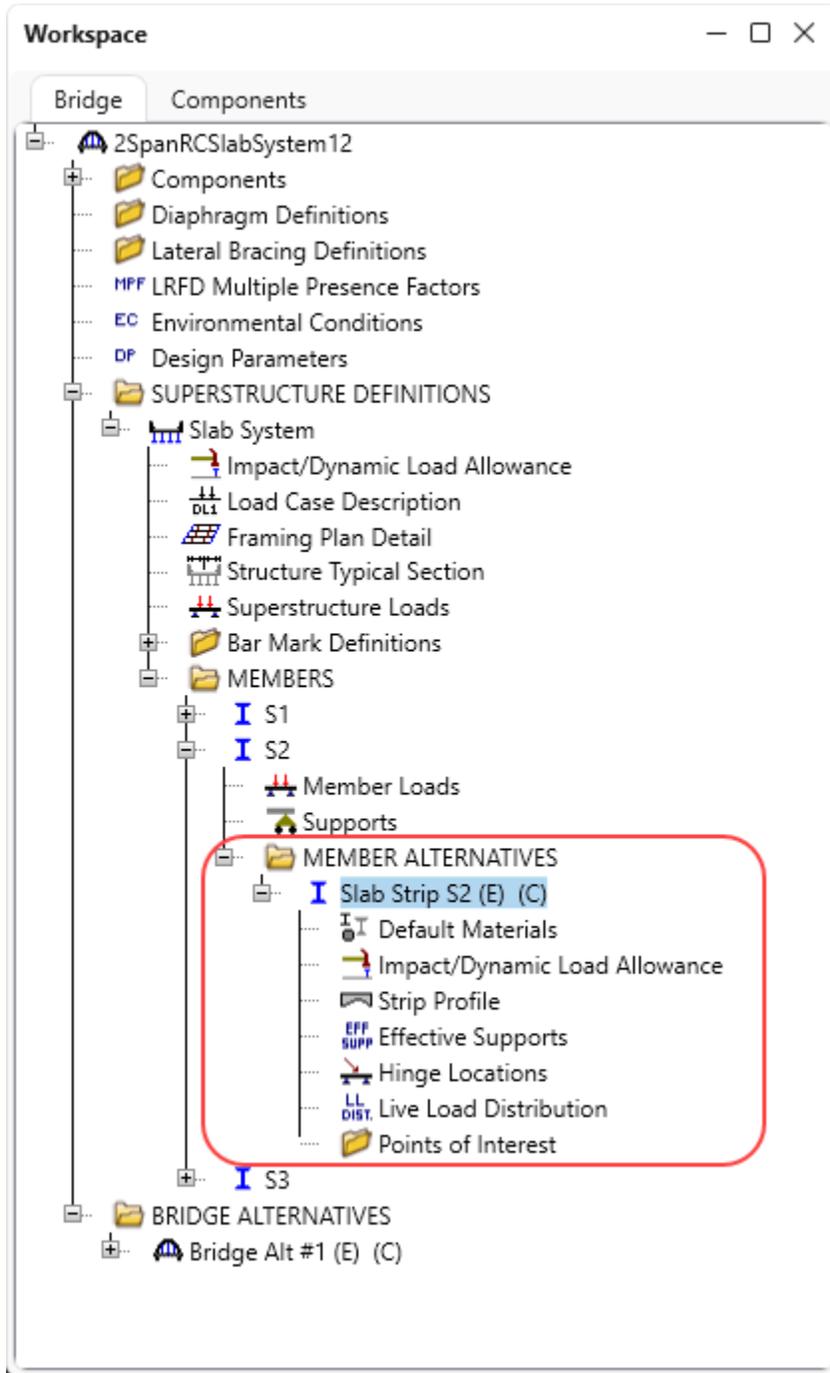
OK Apply Cancel

The first Member Alternative created will automatically be assigned as the **Existing** and **Current** member alternative for this member. In the **Member Alternative Description** window enter the data as shown above. The **Analysis strip** selection allows the user to specify the width of the strip for the analysis. If **User defined** is selected, an average reinforcement area per user defined width will be computed based on the reinforcement defined for the full slab section width. For this example, select **Full slab section width**. The **Edge beam** selection indicates the member alternative is an edge beam in the LRF live load distribution factors computation. Since this is an interior strip, leave **Edge beam** unchecked.

Click **OK** to apply the data and close the window.

## RC6 – Two Span RC Slab System

Expand the newly added member alternative. The partially expanded **Bridge Workspace** tree is shown below.



# RC6 – Two Span RC Slab System

## Strip Profile

Live Load Distribution factors can be computed only after **Strip Profile** information is entered. To enter **Strip Profile** information, double-click on **Strip Profile** in the **Bridge Workspace** tree to open the **Strip Profile** window. Enter the strip **Section, Depth and Reinforcement** details as shown below.

## Strip Profile - Section

The screenshot shows the 'Strip Profile' window with the 'Section' tab selected. The window title is 'Strip Profile' and it has standard minimize, maximize, and close buttons. Below the title bar, there is a 'Type:' dropdown menu set to 'Reinforced Concrete Slab'. Below that are three tabs: 'Section', 'Depth', and 'Reinforcement', with 'Section' being the active tab. A table is displayed with the following columns: 'Support number', 'Start distance (ft)', 'Length (ft)', 'End distance (ft)', 'Start width (in)', 'End width (in)', 'Concrete material', and 'Modular ratio'. The table contains one row of data: Support number 1, Start distance 0, Length 60, End distance 60, Start width 144, End width 144, and Concrete material Class A (US). Below the table are three buttons: 'New', 'Duplicate', and 'Delete'. At the bottom of the window are three buttons: 'OK', 'Apply', and 'Cancel'.

Support number	Start distance (ft)	Length (ft)	End distance (ft)	Start width (in)	End width (in)	Concrete material	Modular ratio
> 1	0	60	60	144	144	Class A (US)	

# RC6 – Two Span RC Slab System

## Strip Profile - Depth

Strip Profile

Type: Reinforced Concrete Slab

Section Depth Reinforcement

Begin depth (in)	Depth vary	End depth (in)	Support number	Start distance (ft)	Length (ft)	End distance (ft)
18	None	18	1	0	20	20
18	Parabolic Concave	36	1	20	9	29
36	None	36	1	29	2	31
36	Parabolic Concave	18	2	1	9	10
18	None	18	2	10	20	30

New Duplicate Delete

OK Apply Cancel

## Strip Profile - Reinforcement

Strip Profile

Type: Reinforced Concrete Slab

Section Depth Reinforcement

Vary bar spacing

Set	Bar mark	Invert	Measured from	Clear cover (in)	Number	Start bar spacing (in)	End bar spacing (in)	Start side cover (in)	End side cover (in)	Support number	Direction	Start distance (ft)	Straight length (ft)	End distance (ft)	Start fully developed	End fully developed
1	BarMark #1	<input type="checkbox"/>	Top of Slab	1.5	13	12	12	2	2	1	Left	0	30	30	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2	BarMark #1	<input type="checkbox"/>	Top of Slab	1.5	13	12	12	2	2	2	Left	0	30	30	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3	BarMark #1	<input type="checkbox"/>	Bottom of Slab	2	24	6	6	2	2	1	Left	0	30	30	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
4	BarMark #1	<input type="checkbox"/>	Bottom of Slab	2	24	6	6	2	2	2	Left	0	30	30	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
5	BarMark #2	<input type="checkbox"/>	Top of Slab	1.5	13	12	12	2	2	1	Right	20	10	30	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6	BarMark #2	<input type="checkbox"/>	Top of Slab	1.5	13	12	12	2	2	2	Left	0	10	10	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

New Duplicate Delete

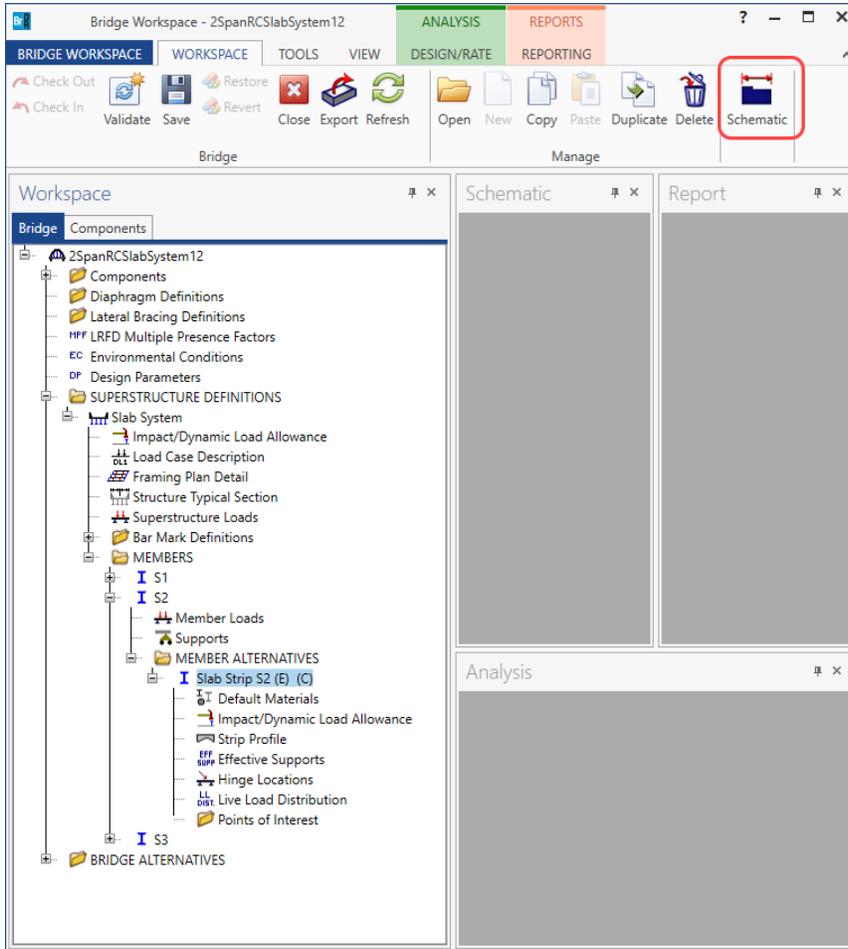
OK Apply Cancel

After strip profile is defined, click on **OK** to apply the data and close the window.

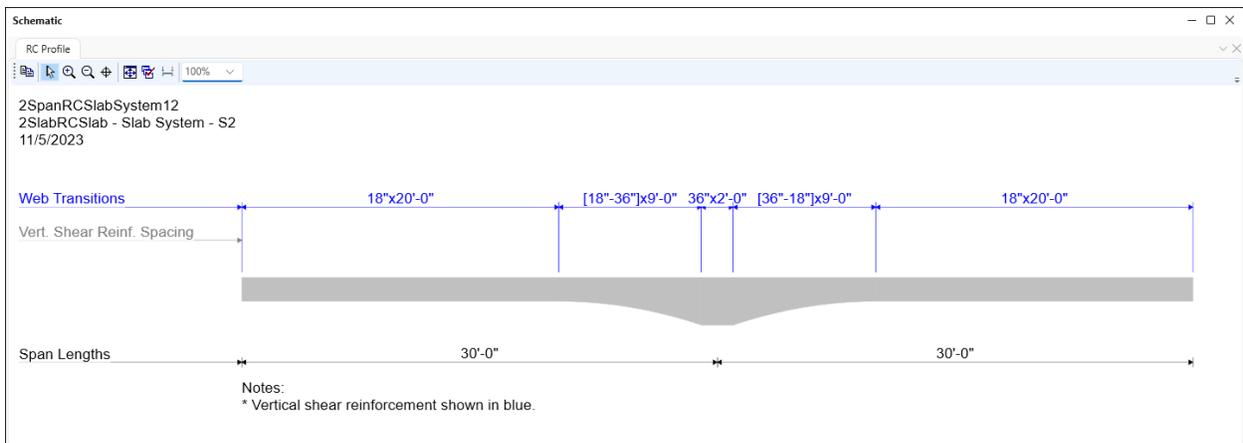
# RC6 – Two Span RC Slab System

## Strip Profile – Schematics

The profile of the slab strip can be viewed by selecting the member alternative **Slab Strip S2** and clicking on the **Schematic** button on the **Workspace** ribbon.



**Schematic** for Slab Strip S2 member alternative is as shown below.



## RC6 – Two Span RC Slab System

### Live Load Distribution

Live load distribution factors for this member can now be entered. Open **Live Load Distribution** window by double-clicking the **Live Load Distribution** node in the **Bridge Workspace** tree. Under the **Standard** tab, click on the **Compute from Typical Section** button. Live load distribution factors will be populated as shown below. If live load distribution factors are not entered, the AASHTO Engine will compute the distribution factors during the analysis.

Lanes loaded	Distribution factor (wheels)			
	Shear	Shear at supports	Moment	Deflection
> 1 Lane			2.0689655	1
Multi-lane			2.0689655	1

Click on **OK** to apply the data and close the window.

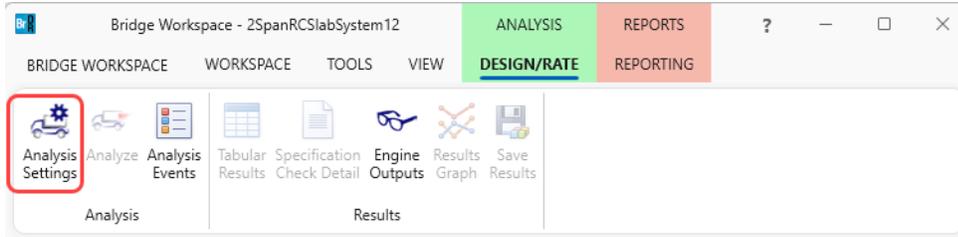
There is no requirement to define any **points of interest** since none of the information entered will be overridden in this example.

The description of this member alternative is complete. The member alternative **Slab Strip S2** can now be analyzed.

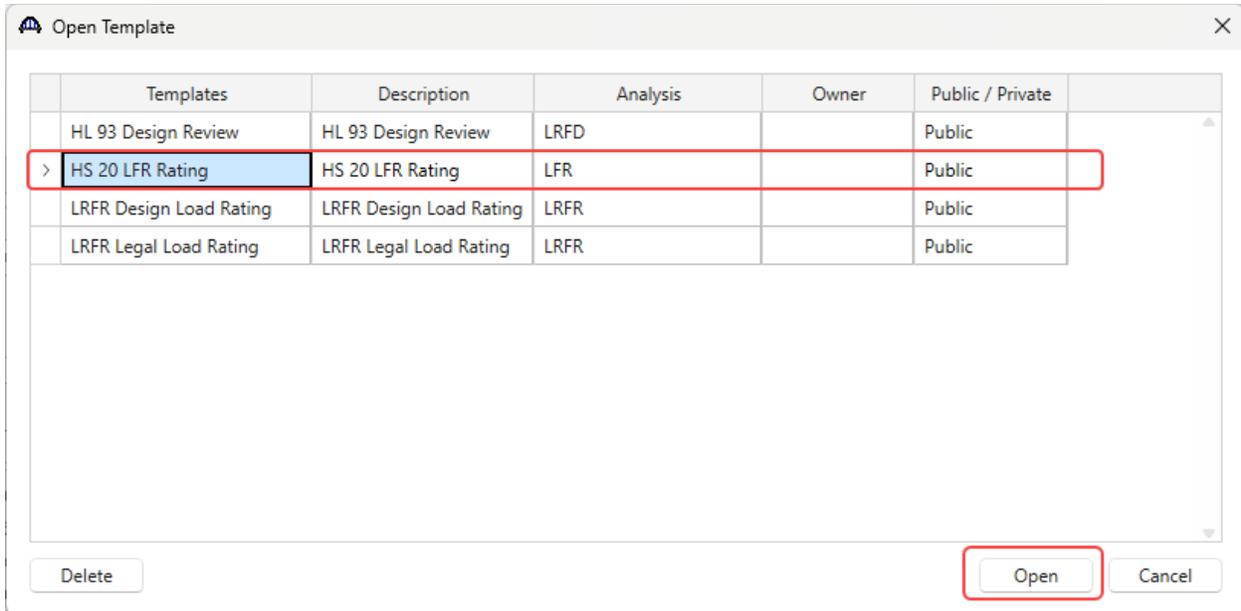
## RC6 – Two Span RC Slab System

### LFR Analysis

To perform an LFR analysis on the **Slab Strip S2** member alternative, select the **Analysis Settings** button on the **Analysis** group of the **DESIGN/RATE** ribbon to open the window shown below.

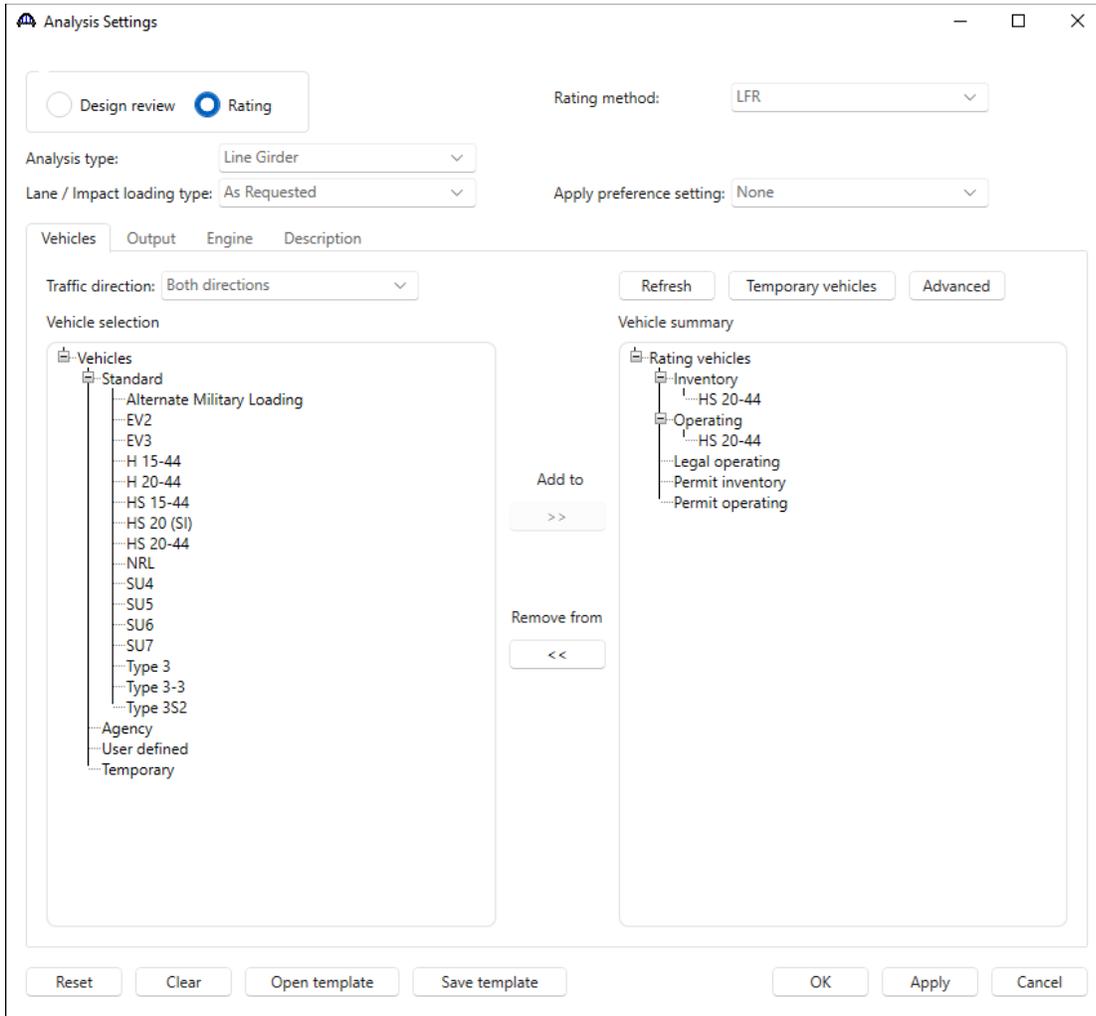


Click the **Open Template** button and select the **HS 20 LFR Rating** template to be used in the rating. Click **Open** to apply the settings and close the window.



# RC6 – Two Span RC Slab System

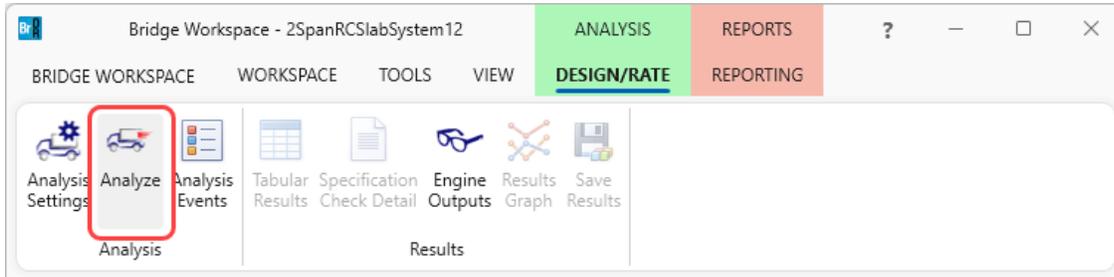
The **Analysis Settings** window will be updated as shown below.



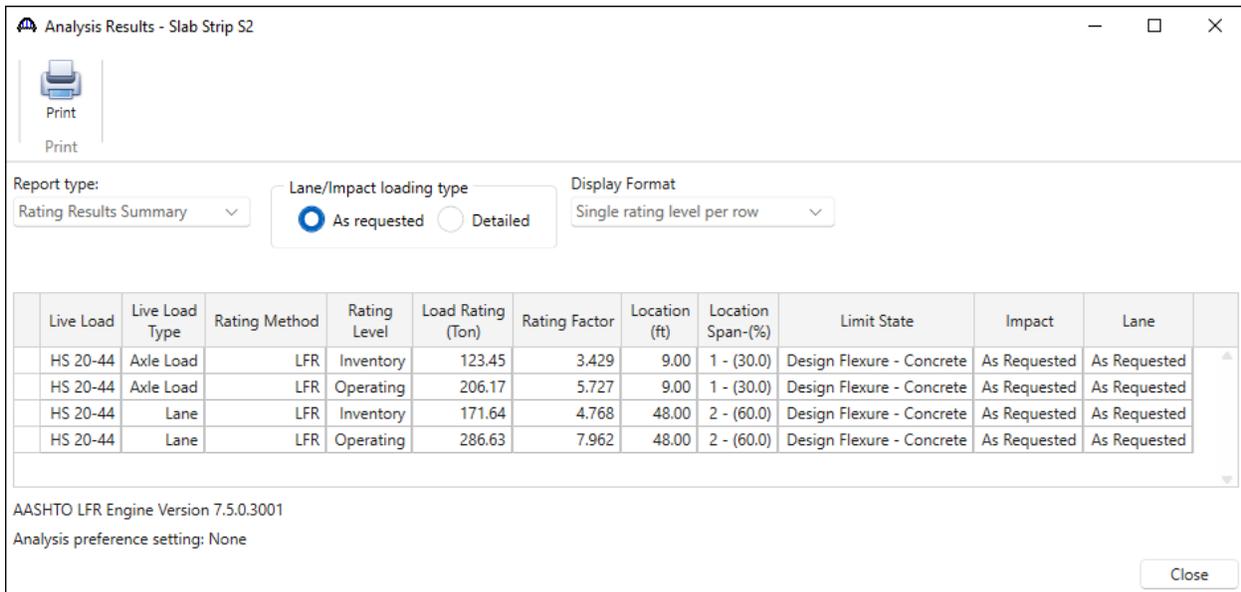
# RC6 – Two Span RC Slab System

## Tabular Results

With member alternative **Slab Strip S2** selected, click the **Analyze** button on the **Analysis** group of the **DESIGN/RATE** ribbon to perform the rating.



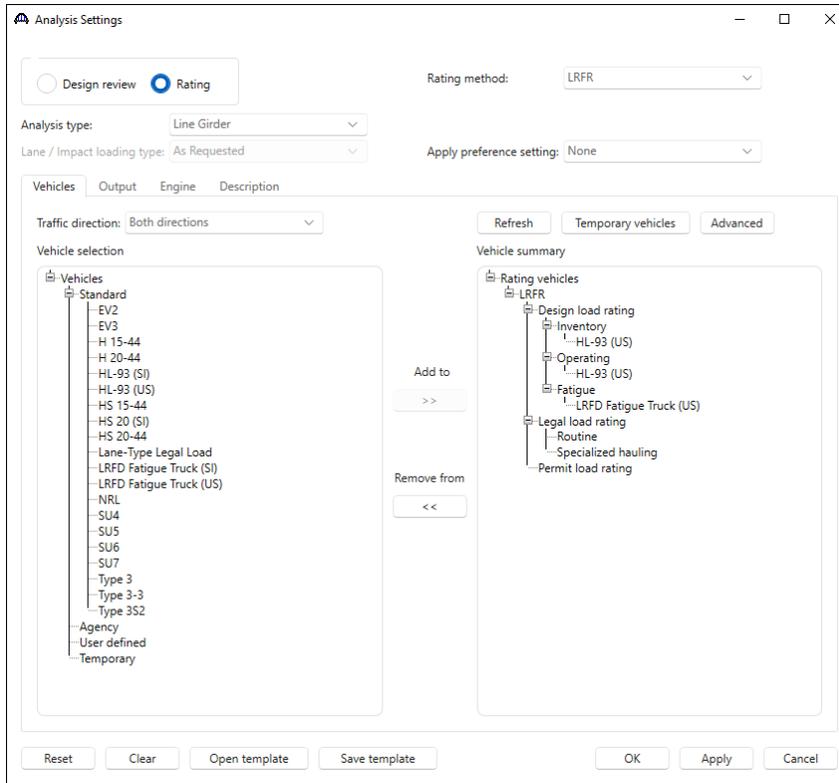
When the rating is finished, the results can be reviewed by clicking the **Tabular Results** button on the **Results** group of the ribbon. The window shown below will open.



# RC6 – Two Span RC Slab System

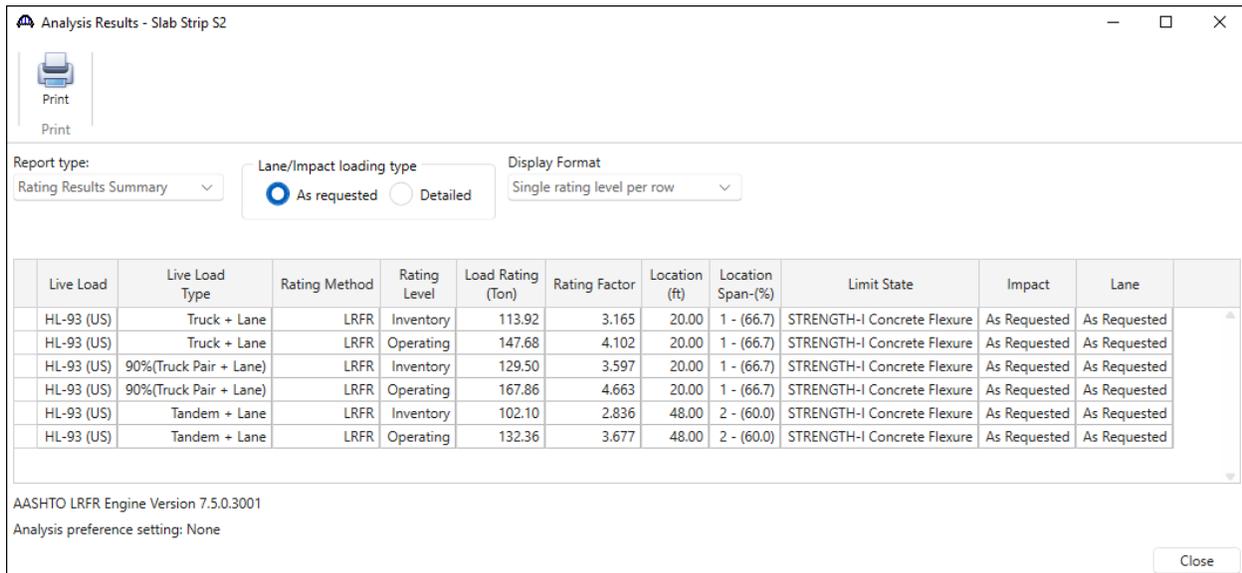
## LRFR Analysis

Similarly apply the **LRFR Design Load Rating** template as shown below and perform an **LRFR** analysis on the same member alternative.



## Tabular Results

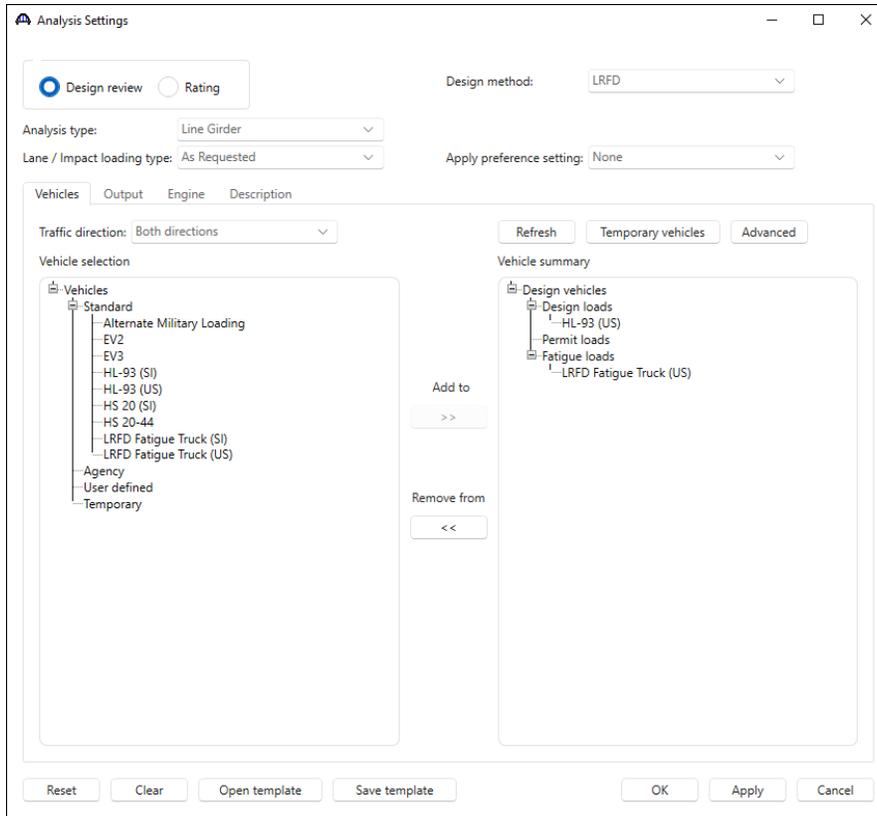
When the rating is finished the results can be reviewed by clicking the **Tabular Results** button on the **Results** group of the **DESIGN/RATE** ribbon. The window shown below will open.



## RC6 – Two Span RC Slab System

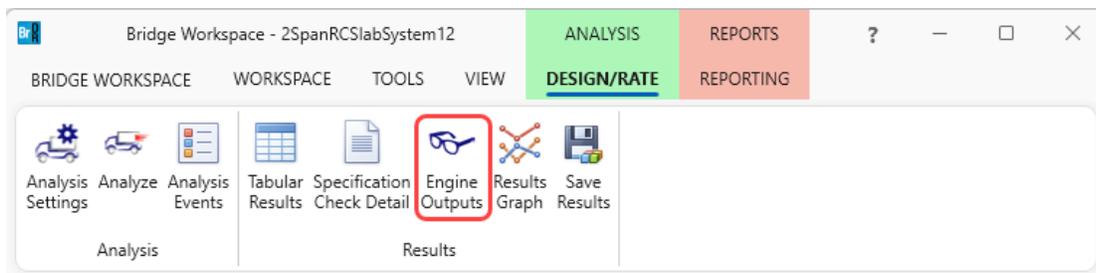
### LRFD Design Review

Similarly apply the **HL 93 Design Review** template as shown below and perform an **LRFD Design Review** on the same member alternative.

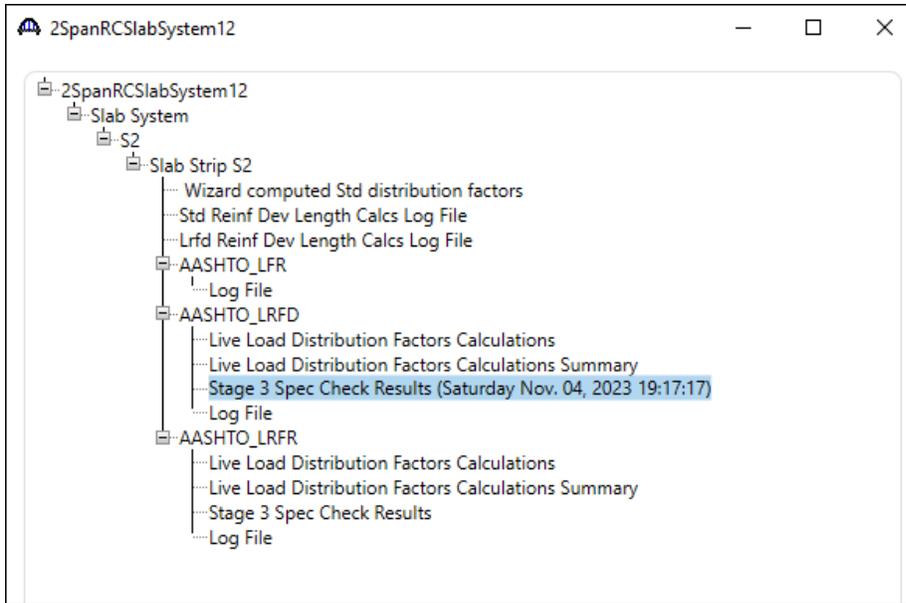


### Engine Outputs

When the design review is complete, click the **Engine Outputs** button on **Results** group of the **DESIGN/RATE** ribbon and double-click **Stage 3 Spec Check Results** for a summary of the specification check results.



# RC6 – Two Span RC Slab System



Bridge ID : 2SpanRCslabSystem12  
 Bridge : 2SpanRCslab  
 Superstructure Def : Slab System  
 Member : S2  
 Analysis Preference Setting :

NBI Structure ID : 2SpanRCslabSys5  
 Bridge Alt :  
 Member Alt : Slab Strip S2

AASHTO LRFD Specification, Edition 9, Interim 0

## Specification Check Summary

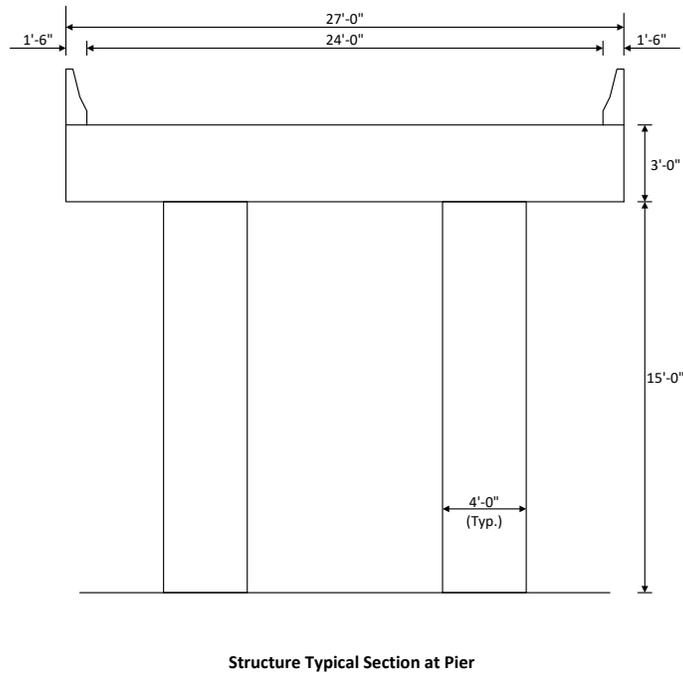
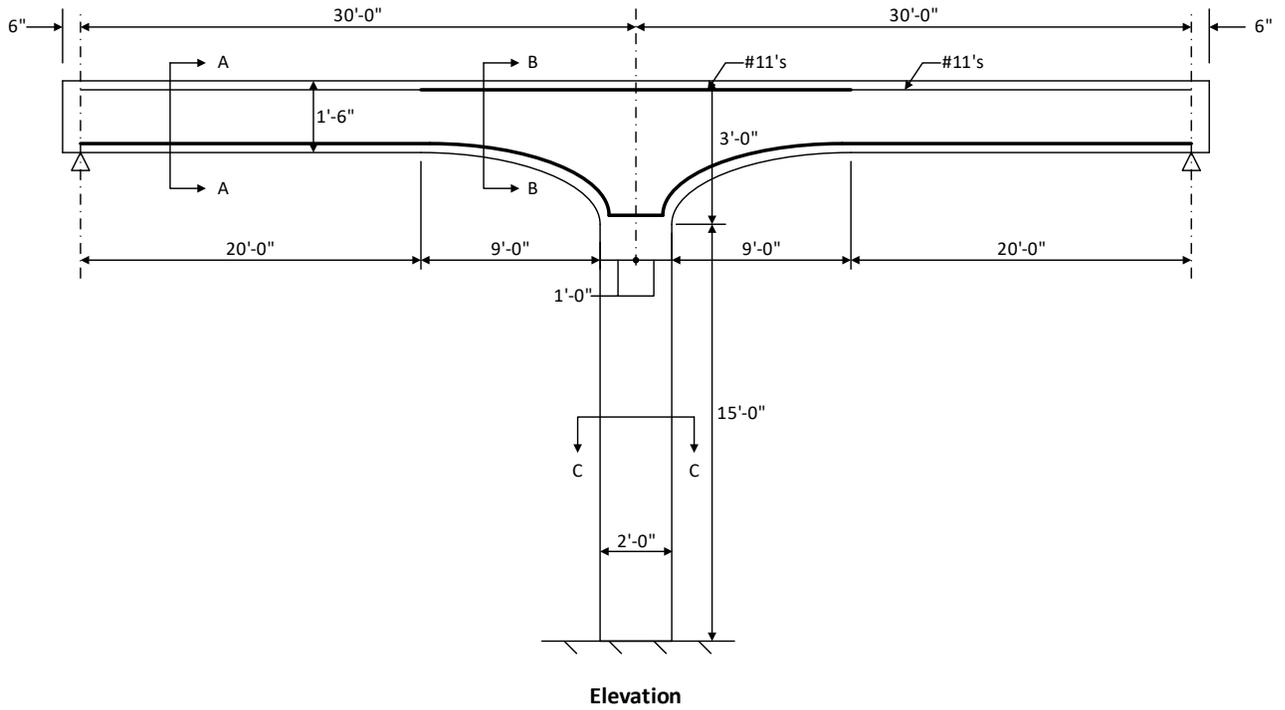
Article	Status
Flexure (5.6.3.2, 5.6.3.3)	Pass
Crack Control (5.6.7)	Pass
Shear (5.7.3.3, 5.7.2.5, 5.7.2.6, 5.7.3.5)	Ignore by User
Fatigue (5.5.3.2)	Pass
Deflection (2.5.2.6.2)	Pass

## Girder Positive Flexure Analysis

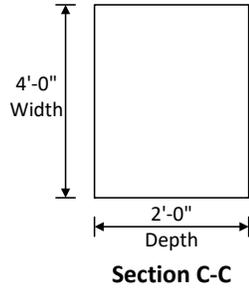
Location (ft)	LS	Load Comb	Mr (kip-ft)	Mu (kip-ft)	Design Ratio Mr/Mu	Code
0.000	STR-I	1	2275.67	0.00	99.000	Pass
3.000	STR-I	2	2275.67	437.40	5.203	Pass
6.000	STR-I	2	2275.67	727.47	3.128	Pass
9.000	STR-I	2	2275.67	878.22	2.591	Pass
12.000	STR-I	2	2275.67	901.62	2.524	Pass

# RC6 – Two Span RC Slab System

Frame structure simplified definition slab structure type



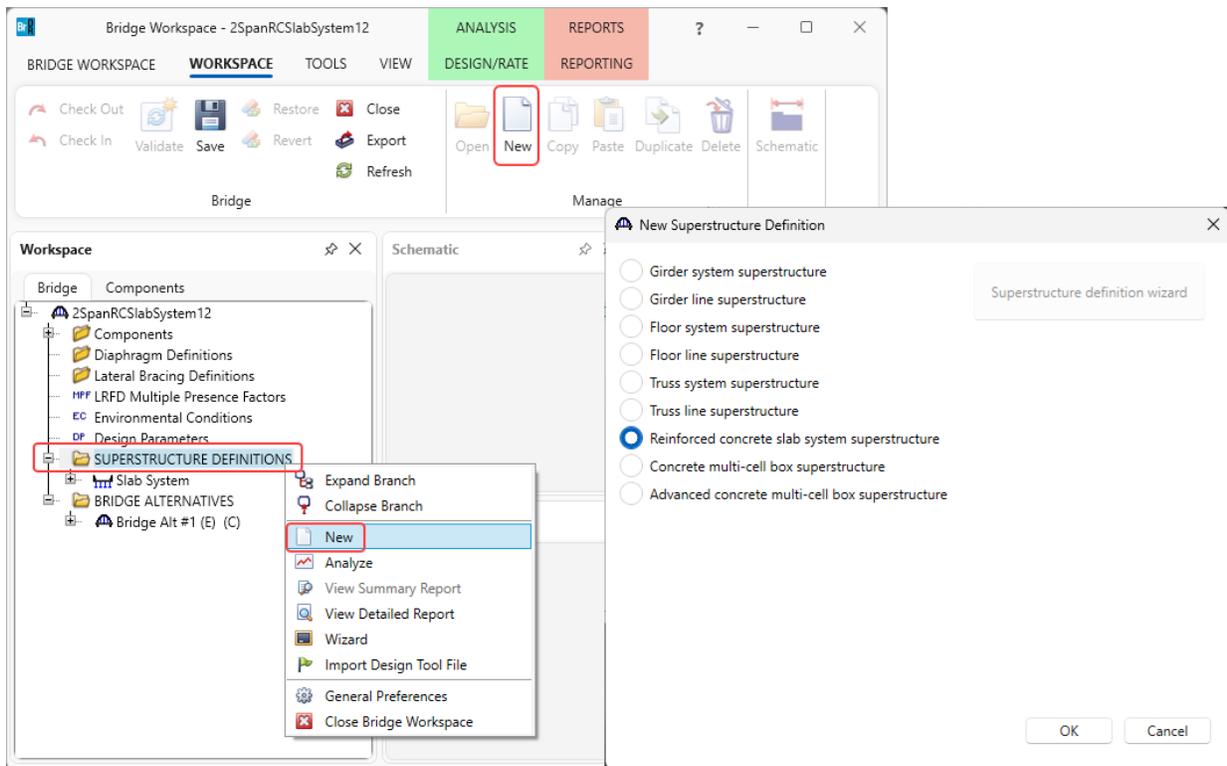
## RC6 – Two Span RC Slab System



### Superstructure Definitions

Slab system with frame leg support can be defined by selecting **Slab Structure Type** as **Frame structure simplified definition** in the **RC Slab System Superstructure Definition** window.

Double-click on **SUPERSTRUCTURE DEFINITIONS** in the **Bridge Workspace** tree and create a new **Reinforced Concrete Slab System** Superstructure like the one in the previous step.



## RC6 – Two Span RC Slab System

Select **Frame structure simplified definition** for **Slab Structure Type** and specify **Frame Connection** for **support 2**.

RC Slab System Superstructure Definition

Definition Analysis Specs Engine

Name: Frame Slab System

Description:

Default units: US Customary

Number of spans: 2

Number of slab strips: 3

Enter span lengths along the reference line:

Span	Length (ft)
1	30
2	30

Frame connections:

Support	Frame connection
1	<input type="checkbox"/>
2	<input checked="" type="checkbox"/>
3	<input type="checkbox"/>

Member alt. types

Steel

P/S

R/C

Timber

Slab structure type

Frame structure simplified definition

Slab integral with pier

Consider pier skew in FE section pro

Slab not integral with pier

Contains voids

OK Apply Cancel

Click **OK** to apply the data and close the window.

Follow the instructions in Part 1 to enter the following data for this superstructure definition.

1. Load Case Description
2. Structure Framing Plan
3. Structure Typical Section
4. BarMark #1 and BarMark #2
5. Member Alternative Description
6. Strip Profile

Now begin defining the windows with specific information for the **Frame structure simplified definition**.

# RC6 – Two Span RC Slab System

## Structure Framing Plan

Open the **Structure Framing Plan Detail** window, switch to the **Frame connections** tab and enter the data as show below.

Structure Framing Plan Details

Number of spans: 2    Number of strips: 3

Layout    Frame connections

Support line	Bent cap width (in)	Number of columns	Material	Column length (ft)	Percent fixity at base at (%)	Column type	Constant/tapered	Top depth (in)	Bottom depth (in)	Top width (in)	Bottom width (in)	Column stiffness per girder (kip-in/rad)
> 2	48	2	Class A (US) ▾	15	100	Rectangular ▾	Constant ▾	24	24	48	48	

Compute

OK    Apply    Cancel

Place the cursor on **Column stiffness per girder** column and select the **Compute** button to open the **Compute Column Stiffness** window.

Structure Framing Plan Details

Number of spans: 2    Number of strips: 3

Layout    Frame connections

Support line	Bent cap width (in)	Number of columns	Material	Column length (ft)	Percent fixity at base at (%)	Column type	Constant/tapered	Top depth (in)	Bottom depth (in)	Top width (in)	Bottom width (in)	Column stiffness per girder (kip-in/rad)
2	48	2	Class A (US) ▾	15	100	Rectangular ▾	Constant ▾	24	24	48	48	

Compute

OK    Apply    Cancel

## RC6 – Two Span RC Slab System

Click on the **Compute** button to compute the column stiffness coefficient.

Support line: 2      Number of strips: 3

**Column**

Bent cap width: 48 in      Column length: 15 ft  
Number of columns: 2      Percent fixity at base: 100 %

**Column cross section**

Cross section type:  Rectangular  Circular      Material: Class A (US)  
Top depth: 24 in      Top width: 48 in  
Bottom depth: 24 in      Bottom width: 48 in

Cross section dimensions:  Constant  Tapered

**Computed column stiffness**

Properties at top of column  
Area: 1152 in<sup>2</sup>  
Moment of inertia: 55296 in<sup>4</sup>

Modulus of elasticity: 3986.54865 ksi

Properties at bottom of column  
Area: 1152 in<sup>2</sup>  
Moment of inertia: 55296 in<sup>4</sup>

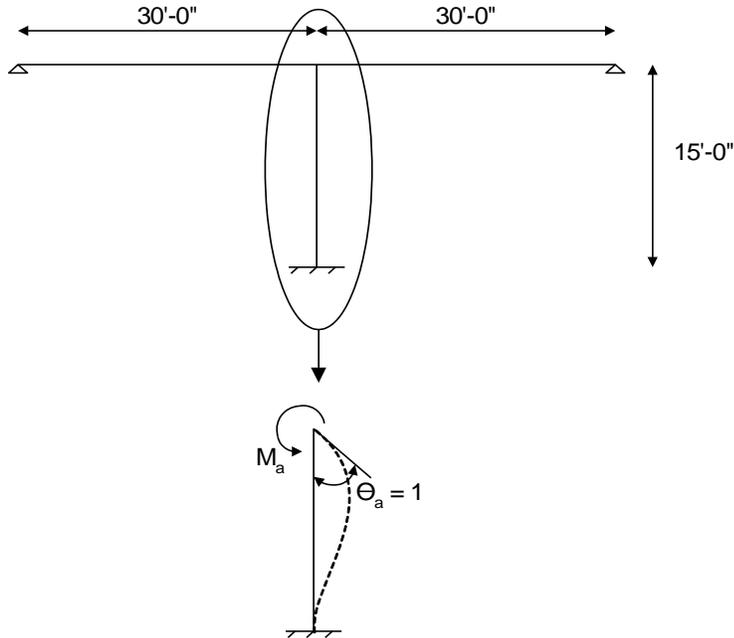
Computed column stiffness per girder: 3265780.65 kip-in/rad

**Compute**      Apply      Cancel

The column stiffness coefficient is computed using the Stiffness Method. In the stiffness method, a unit rotation in the Z direction is applied to the top of the column with all other displacements equal to zero. The member end loads that are required to produce this unit rotation are the stiffness coefficients. The moment applied at the top of the column to produce this unit rotation is the stiffness coefficient computed in this window.

The following diagram shows the frame leg and the moment applied to produce the unit rotation. Engineering judgment needs to be applied to determine the length of the frame leg based on the geometry and reinforcement of the frame structures the user wishes to analyze.

## RC6 – Two Span RC Slab System



The moment required to produce a unit rotation at the top of the cantilever column is  $M_a = 4EI/L$ .

The computed column stiffness coefficient is based on the entered number of columns. Click on the **Apply** button to apply this stiffness coefficient to Support 2.

Structure Framing Plan Details

Number of spans: 2    Number of strips: 3

Layout    Frame connections

Support line	Bent cap width (in)	Number of columns	Material	Column length (ft)	Percent fixity at base at (%)	Column type	Constant/tapered	Top depth (in)	Bottom depth (in)	Top width (in)	Bottom width (in)	Column stiffness per girder (kip-in/rad)
> 2	48	2	Class A (US) ▾	15	100	Rectangular ▾	Constant ▾	24	24	48	48	3265780.6598144

Compute

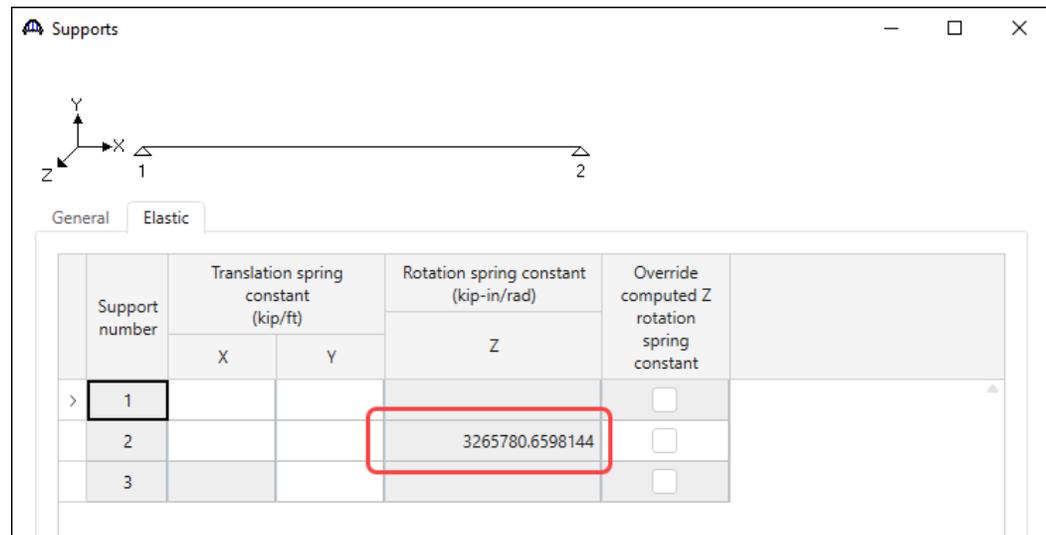
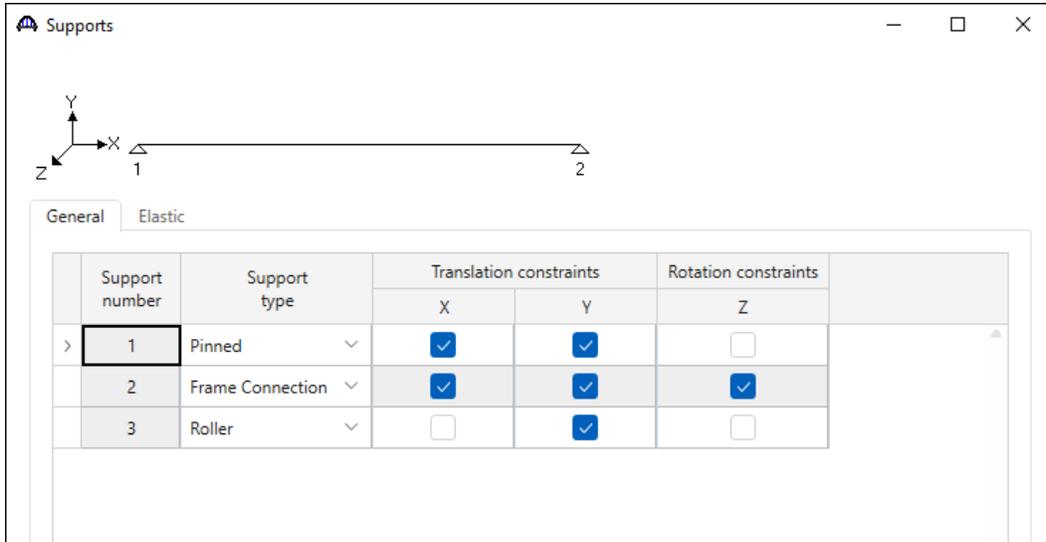
OK    Apply    Cancel

Click **OK** to apply the data and close the **Structure Framing Plan Detail** window.

## RC6 – Two Span RC Slab System

### Supports

For member **S2** of the **Frame Slab System** superstructure, open the **Supports** window by double-clicking **Supports** in the **Bridge Workspace** tree. **Support 2** is a frame connection with all constraints fixed. The computed column stiffness coefficient is entered in the **Elastic** tab as the **Z rotation spring constant**.



In a similar manner as performed above, an LFR, LRFR and LRFD analysis can be performed by selecting their respective templates. As this slab bridge is not designed with a framed connection at the pier, the rating and design review will not be performed in this example.