AASHTOWare BrDR 7.5.0

Reinforced Concrete Structure Tutorial

RC4 – Two Span Reinforced Concrete Slab Example

BrDR Training

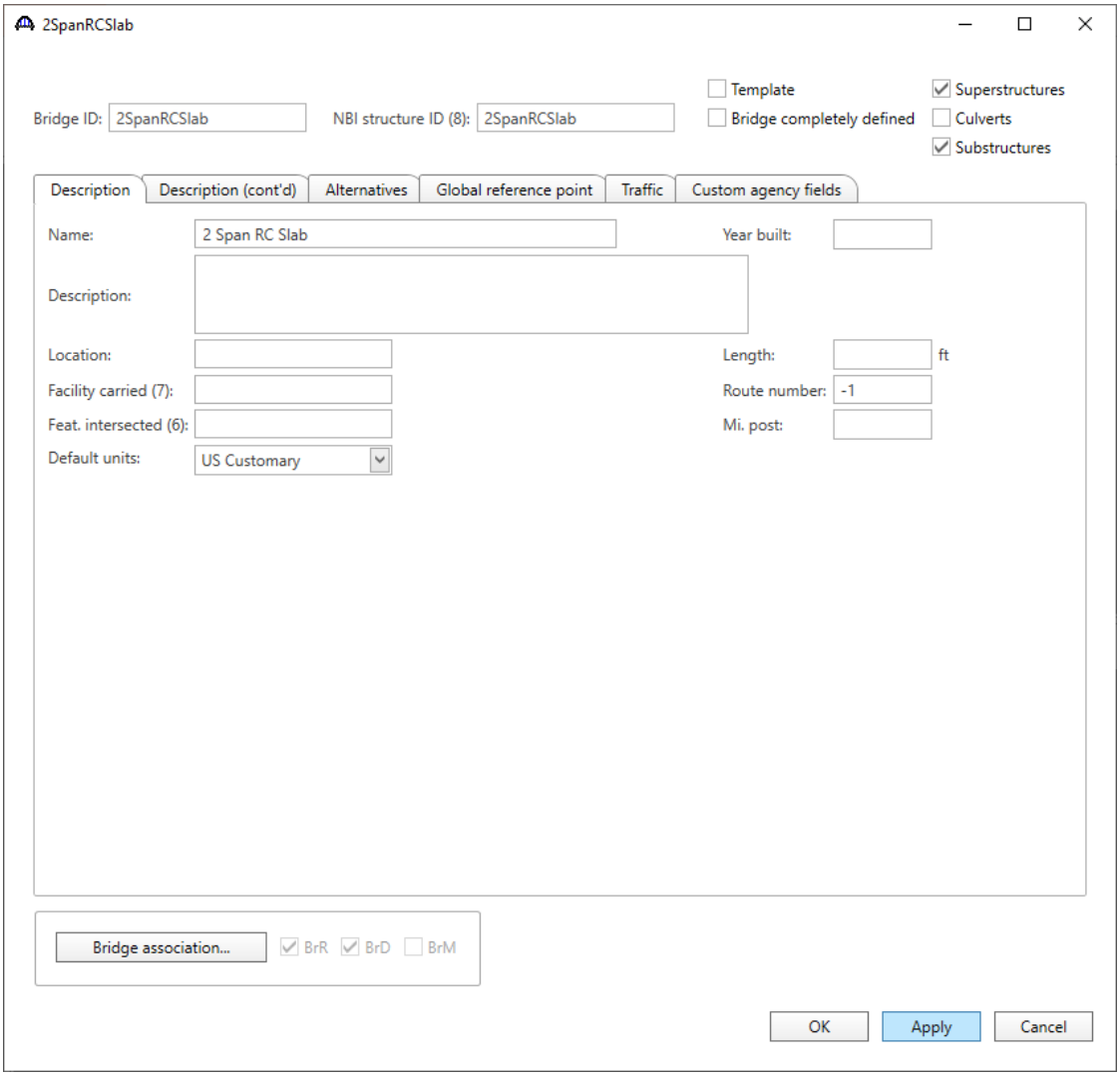
RC4 – Two Span Reinforced Concrete Slab Example

Topics Covered

- Reinforced concrete slab input as girder line.
- Cross section based input.
- Slab depth varies parabolically over the pier.

Reinforced concrete slab input as girder line

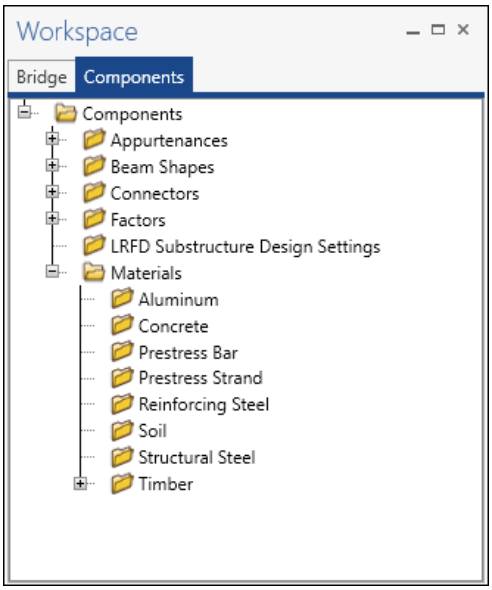
From the **Bridge Explorer** create a **new bridge** and enter the following description data:



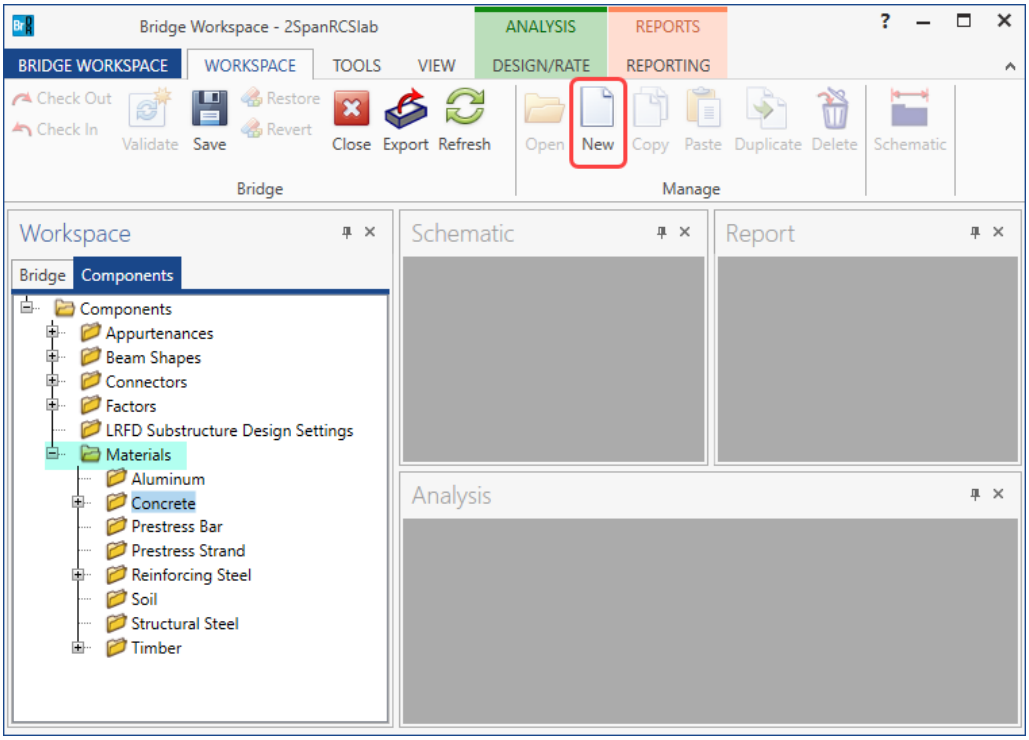
Close the window by clicking **OK**. This saves the data to memory and closes the window.

Bridge Components

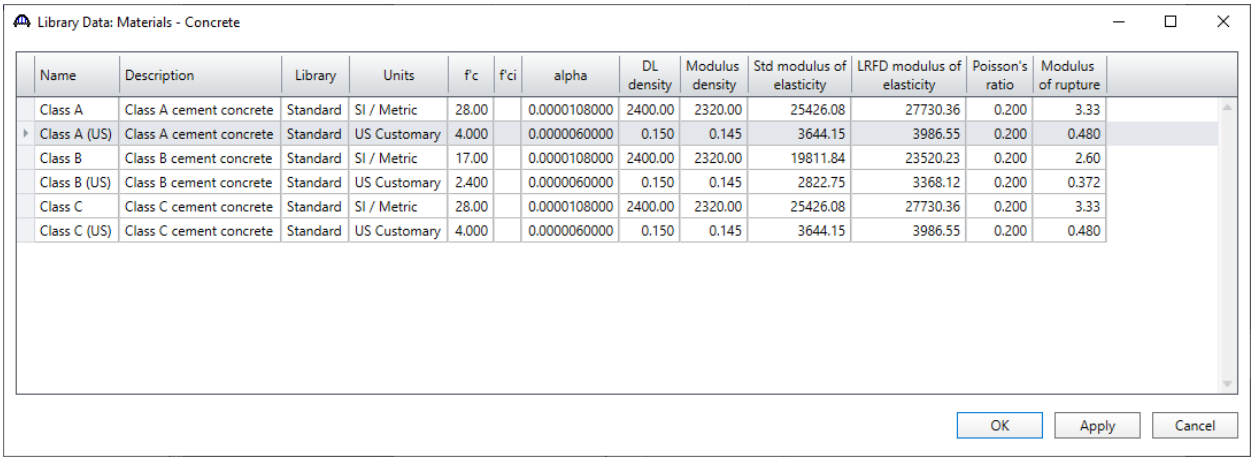
To enter the materials to be used by members of the bridge, go to the **Components** tab of the Bridge Workspace, and click on ⊞ to expand the tree for **Materials**. The tree with the expanded Materials branch is shown below:



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

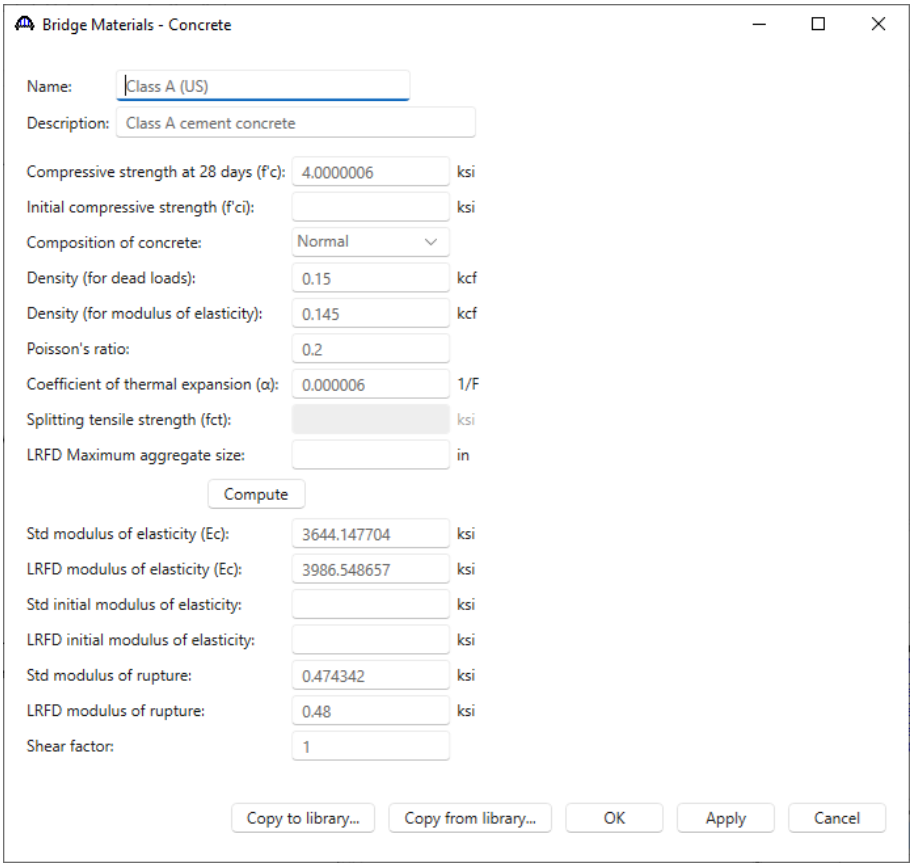


Add the concrete material by selecting from the Concrete Materials Library by clicking the **Copy from library** button. The following window opens:



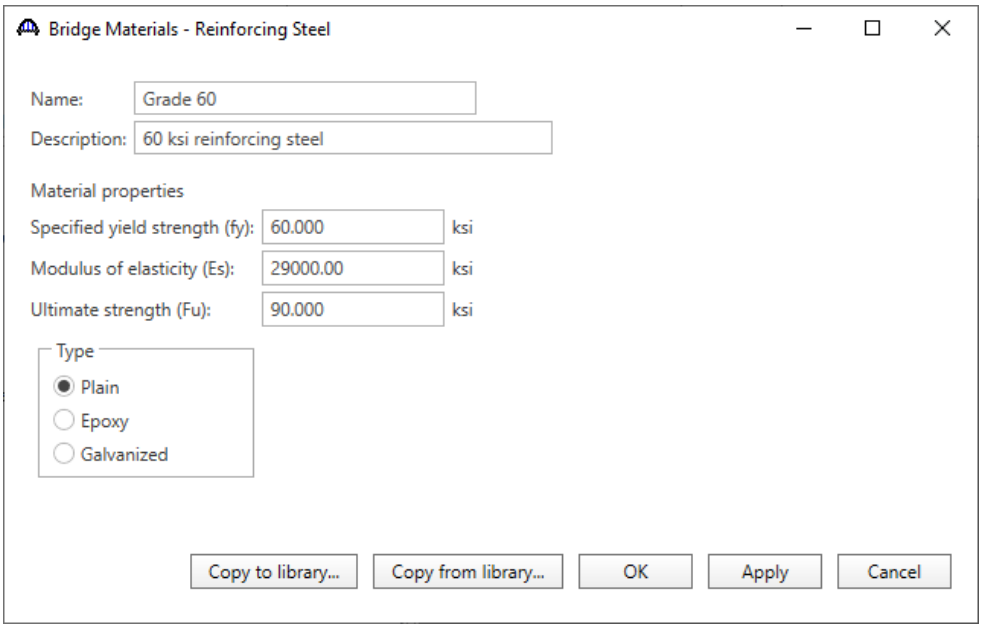
Select the **Class A (US)** material and click **OK**.

The selected material properties are copied to the **Bridge Materials – Concrete** window as shown below.



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

Add the following **Reinforcement Steel (Grade 60)** in the same manner.



Since this example is a reinforced concrete slab , beam shapes need not be defined. The slab will be entered later as a cross section.

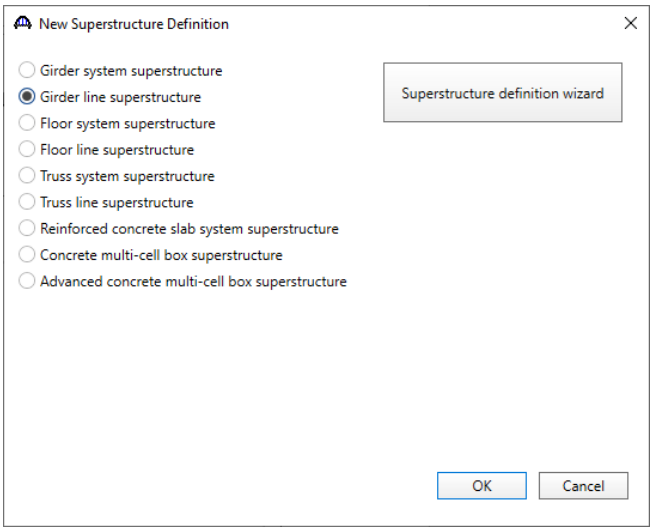
The reinforced concrete slab will be entered as **Girder line Structure Definition** in BrDR. Since a Structure Typical Section is not defined for girder line structures, appurtenances are not defined. The dead load due to the appurtenances will be entered later as member loads.

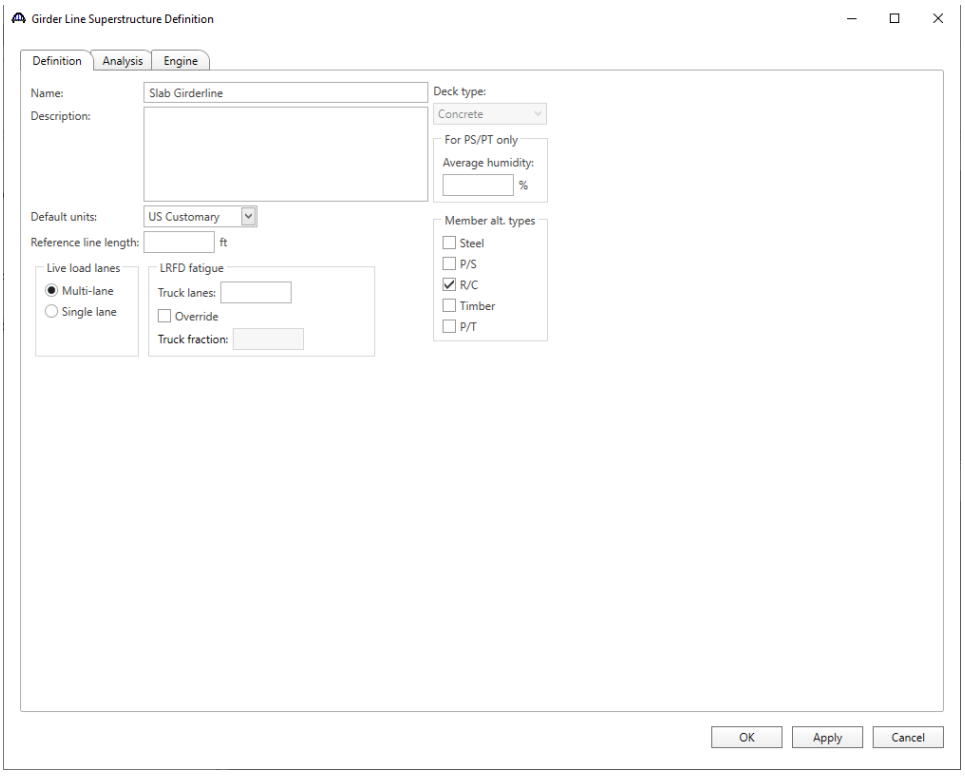
The default impact factors for LRFD and LFD will be used, so the next step will be to define a Superstructure. Bridge Alternatives will be added after a superstructure is defined.

Superstructure Definition

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 **Girder line Superstructure** from the **New Superstructure Definition** window, click **OK** to open the **Girder Line Superstructure Definition** window. Enter the data as shown below.

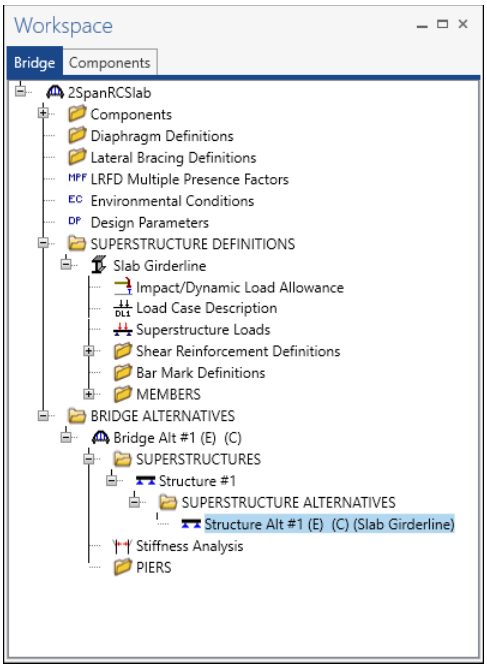




Click **OK** to apply the data and close the window.

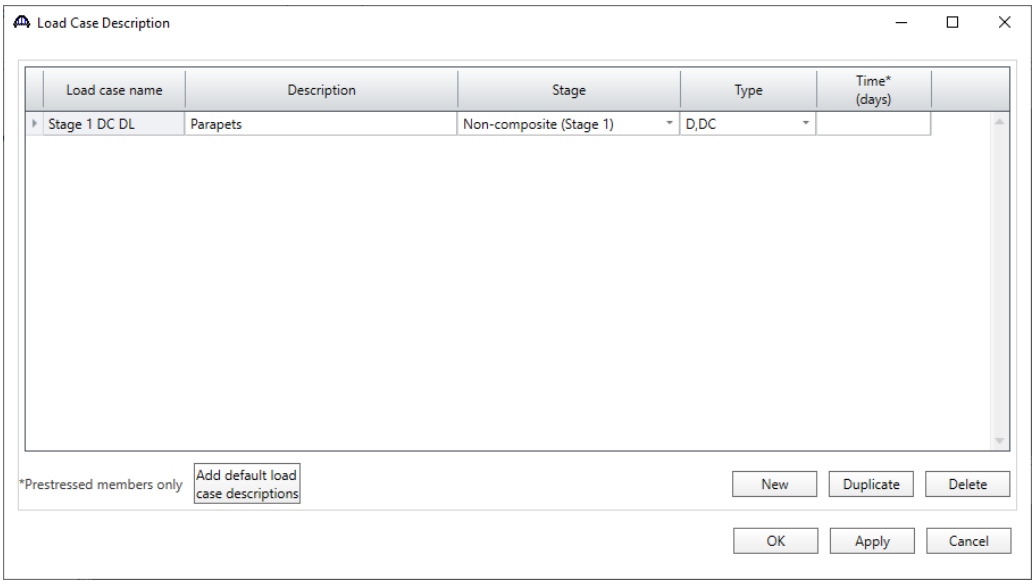
Navigate to the **Bridge Alternatives** node in the **Bridge Workspace** tree and create a new **Bridge Alternative**, a new **Structure**, and a new **Structure Alternative** as shown in **STL1 tutorial**.

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



Load Case Description

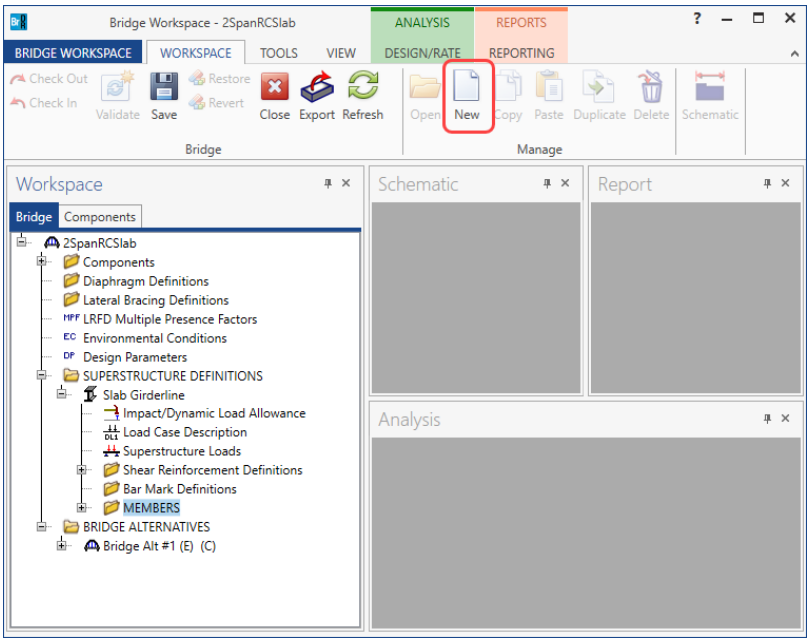
Double click on the **Load Case Description** node in the Bridge Workspace tree to open the **Load Case Description** window and define the dead load cases as shown below. The completed **Load Case Description** window is shown below.



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

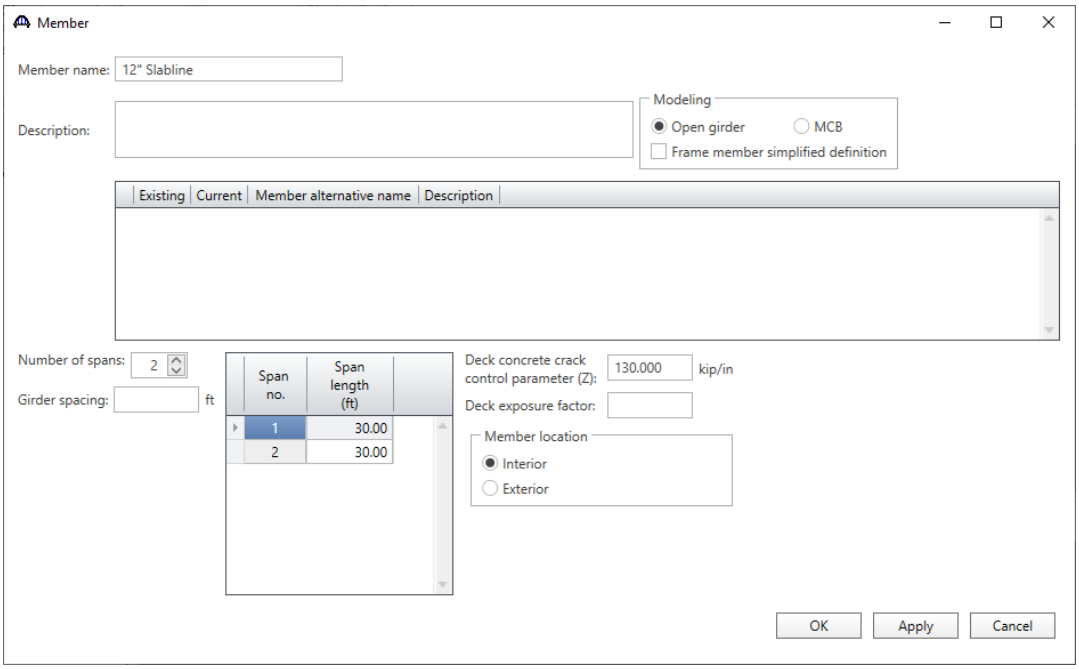
Member

Open the **Member** window by selecting **Member** in **Bridge Workspace** tree and click on **New** from the **Manage** tab of the **WORKSPACE** ribbon (or by double clicking on **Member** in bridge workspace tree).



Fill in the window with the following information. If F1 is pressed while this window is active, the Help topic for the Member window will be displayed. This **Help** topic describes that girder spacing, and member location are not required for a slab member, therefore no data will be entered for those items.

The first Member Alternative created will automatically be assigned as the **Existing** and **Current** Member alternative for this Member.

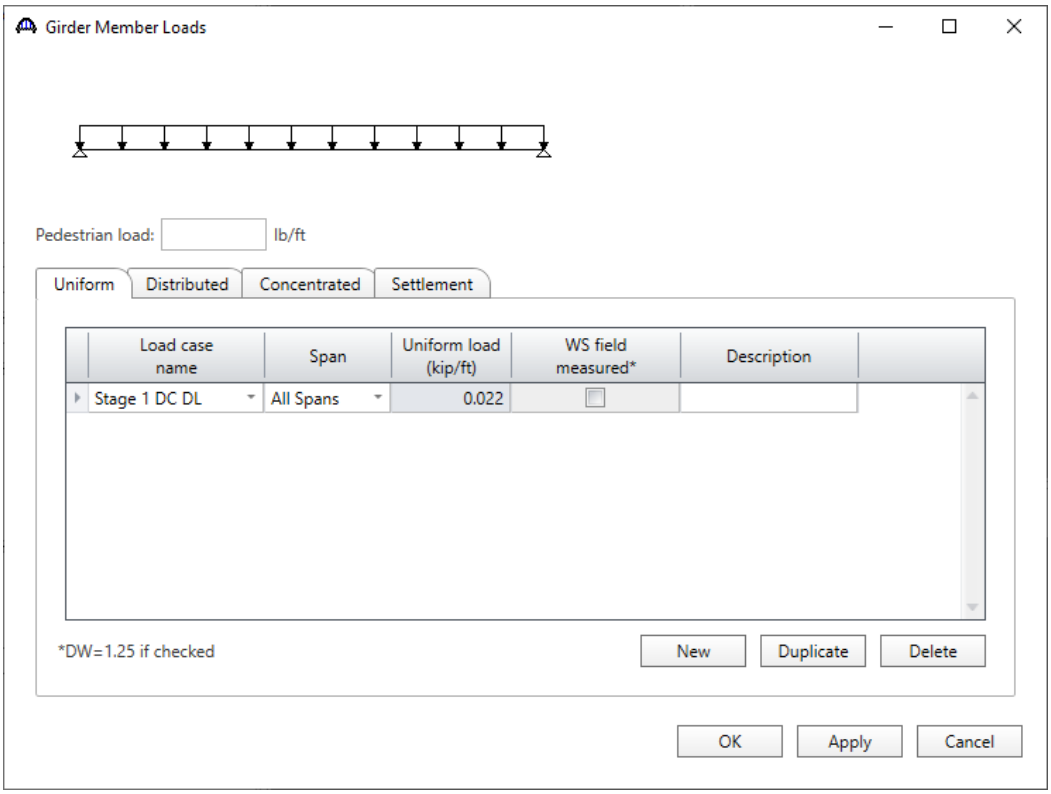


Click **OK** to apply the data and close the window.

Member Loads

Expand **12" Slabline** in the **Bridge Workspace** tree and double click on **Member Loads** to open the **Girder Member Loads** window. This structure has 2 parapets each weighing 300 lb/ft. A 12" wide strip of slab is defined as the member, and the bridge cross section has a width of 27 ft. So, the parapet load applied to this member will be (2*300 lb/ft)*1'/27' = 22 lb/ft.

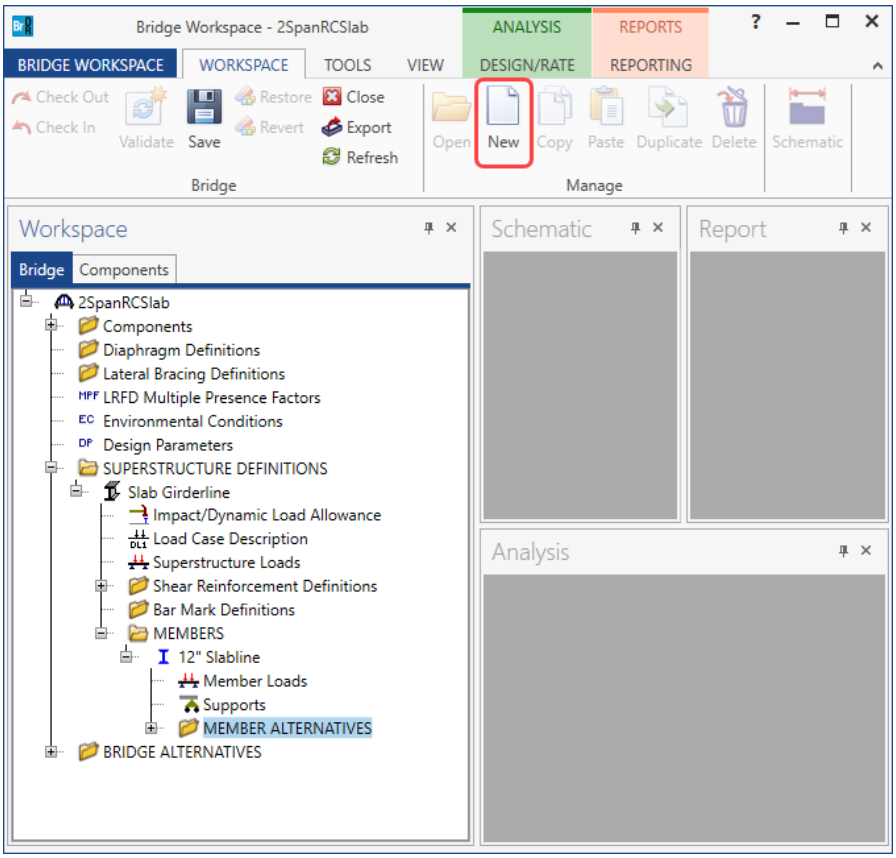
Click **New** to add a row in **Uniform** tab of this window and enter the data as shown below:



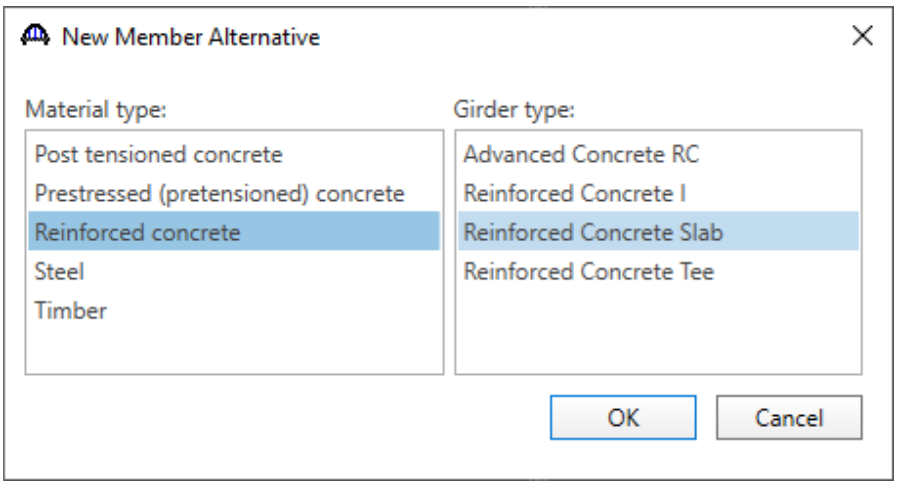
Click **OK** to apply the data and close the window.

Member Alternative

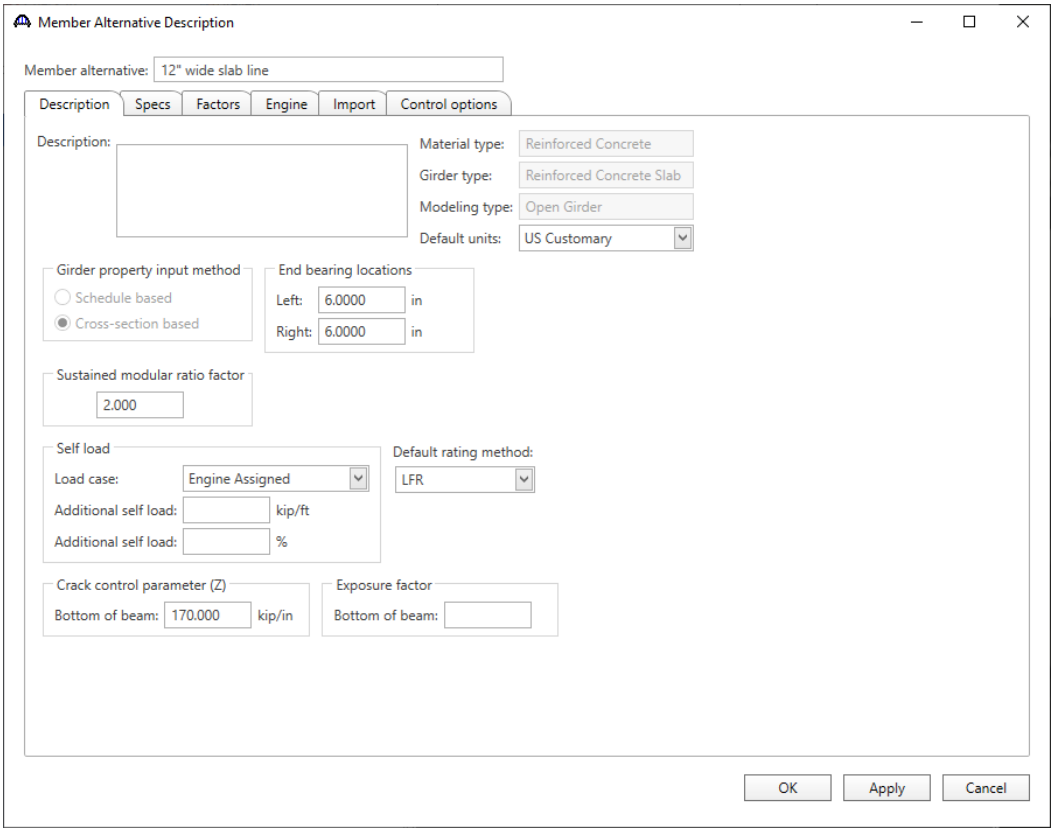
Select **MEMBER ALTERNATIVES** in the **Bridge Workspace** tree and click on **New** from the **Manage** group of the **WORKSPACE** ribbon (or double-click **MEMBER ALTERNATIVES** in the tree) to create a new alternative.



The New Member Alternative window shown below will open. Select **Reinforced Concrete** for the **Material type**, **Reinforced Concrete Slab** for the **Girder type** and click **OK.**



The **Member Alternative Description** window will open. Enter the data as shown below.

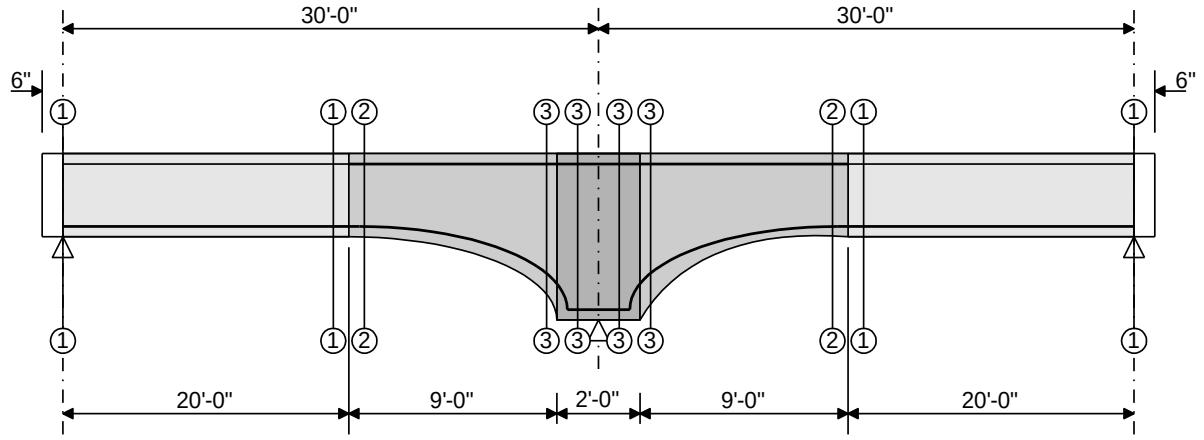


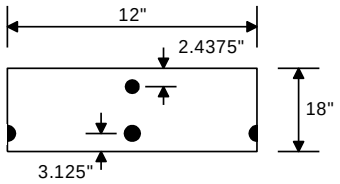
Click **OK** to apply the data and close the window.

Cross section based input

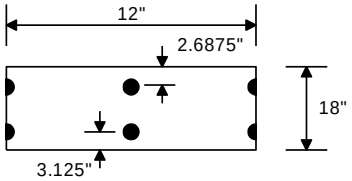
Cross Sections

Expand **12" wide slab line (E) (C)** member alternative on the **Bridge workspace** tree and double click on **Cross Sections** to open the **Cross Sections** window and create a new cross section. This member contains three cross sections as illustrated below.

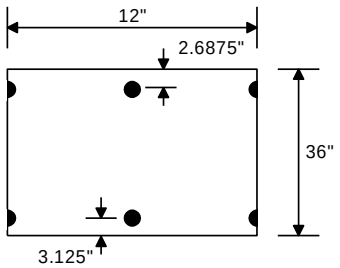




Section 1



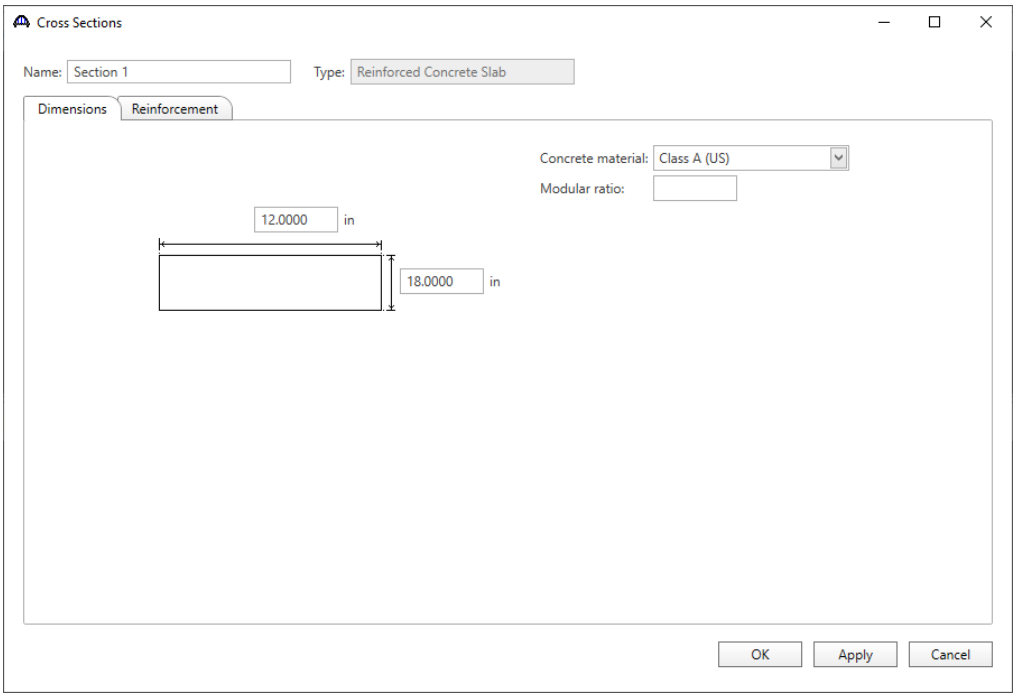
Section 2

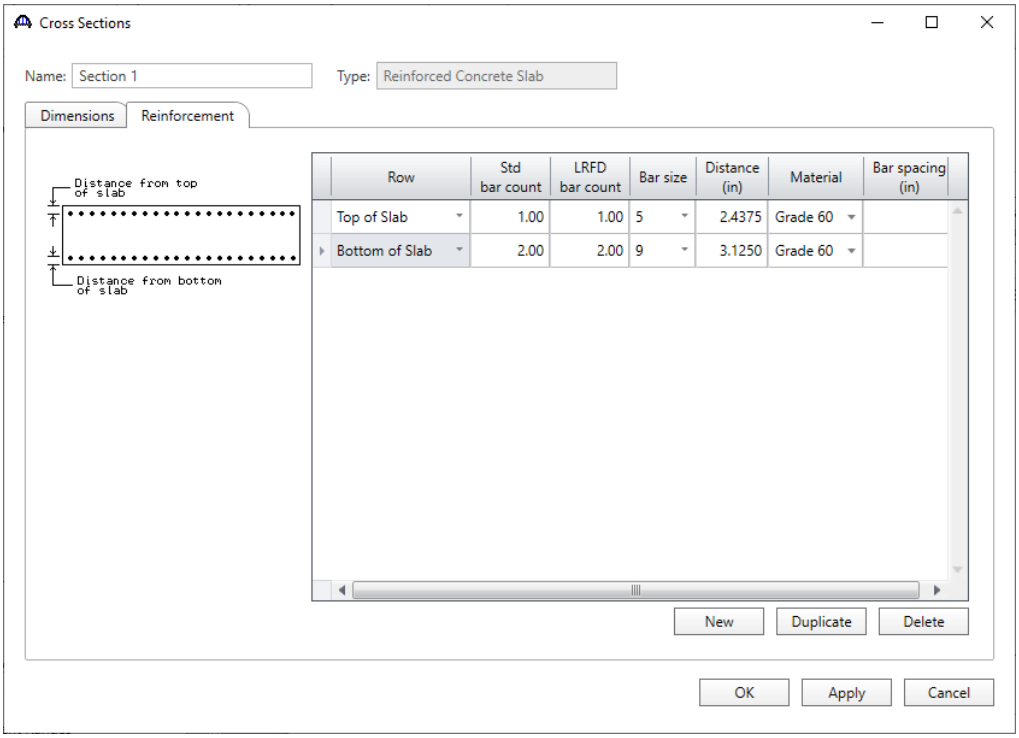


Section 3

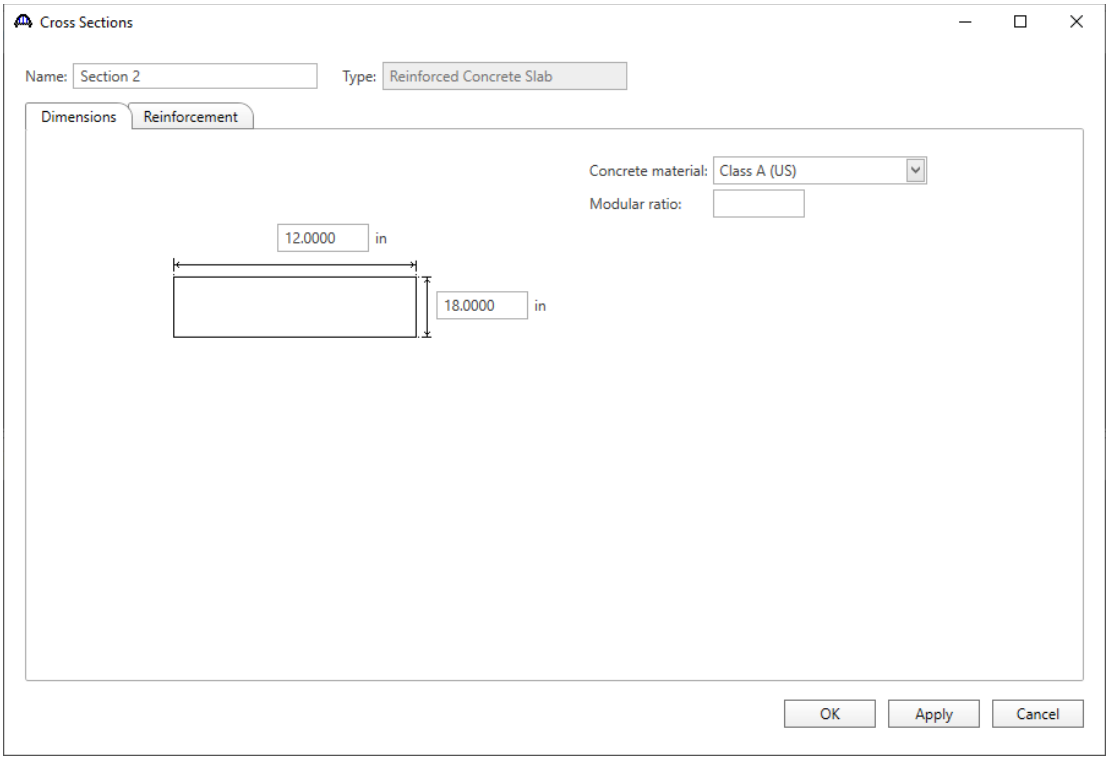
Enter each cross-section **Dimensions** and **Reinforcement** data as shown below:

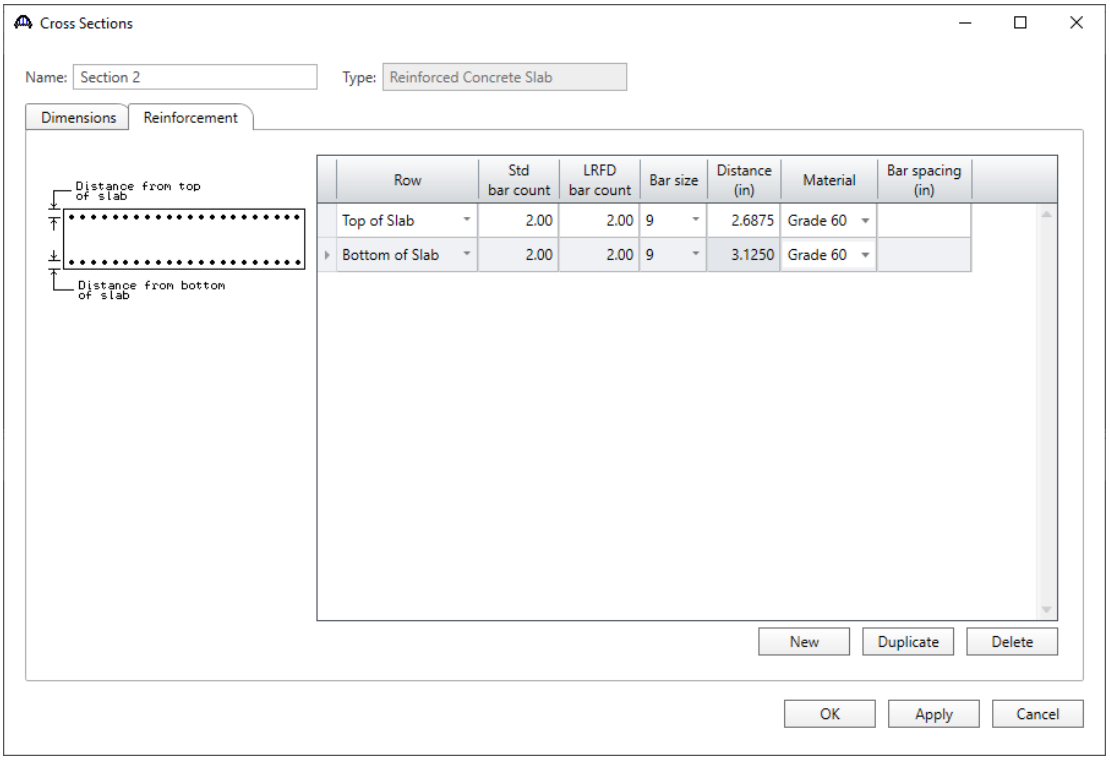
Section 1



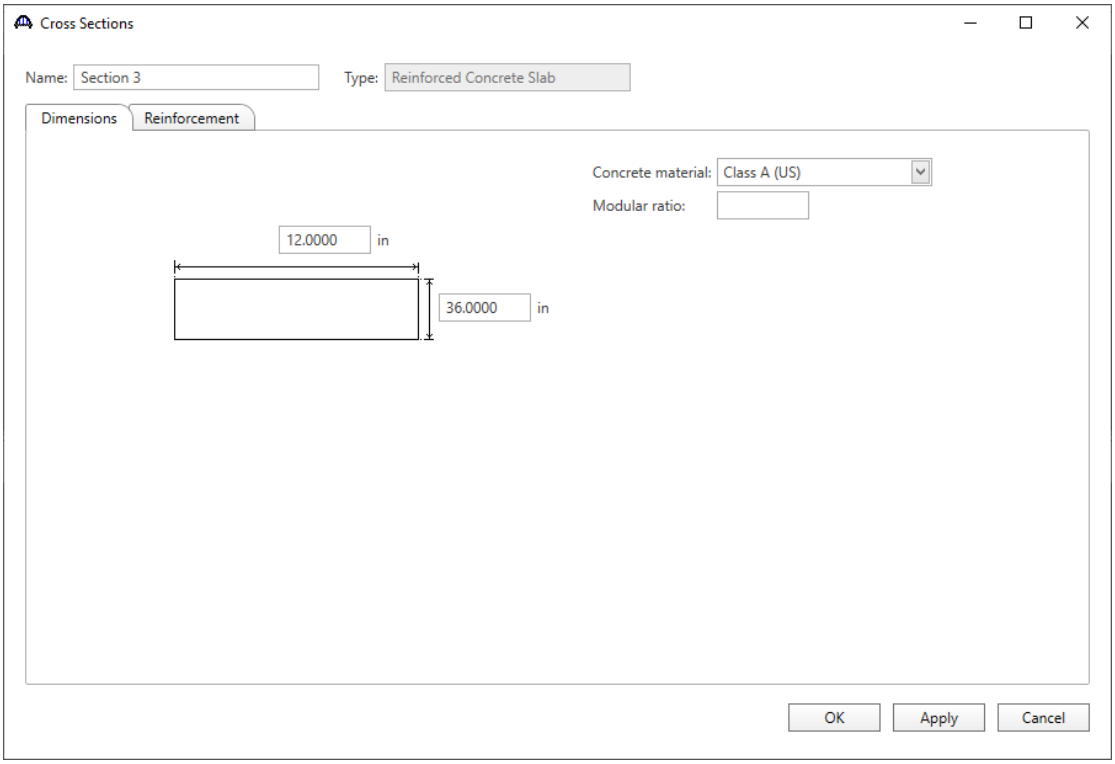


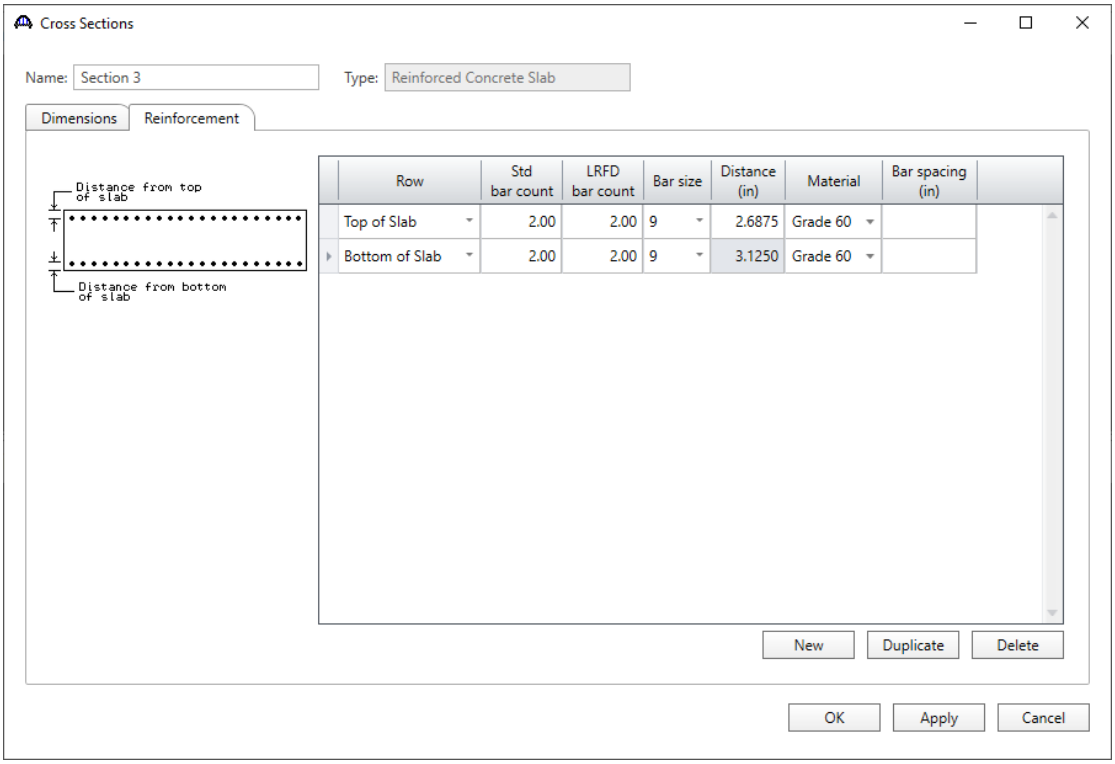
Section 2:


Cross Sections
Name: Section 2
Type: Reinforced Concrete Slab
Dimensions
Reinforcement
Concrete material: Class A (US)
Modular ratio:
12.0000 in
18.0000 in
OK
Apply
Cancel


Cross Sections
Name: Section 2
Type: Reinforced Concrete Slab
Dimensions
Reinforcement
Distance from top of slab
Distance from bottom of slab
Row
Std bar count
LRFD bar count
Bar size
Distance (in)
Material
Bar spacing (in)
Top of Slab 2.00 2.00 9 2.6875 Grade 60
Bottom of Slab 2.00 2.00 9 3.1250 Grade 60
New
Duplicate
Delete
OK
Apply
Cancel

Section 3:

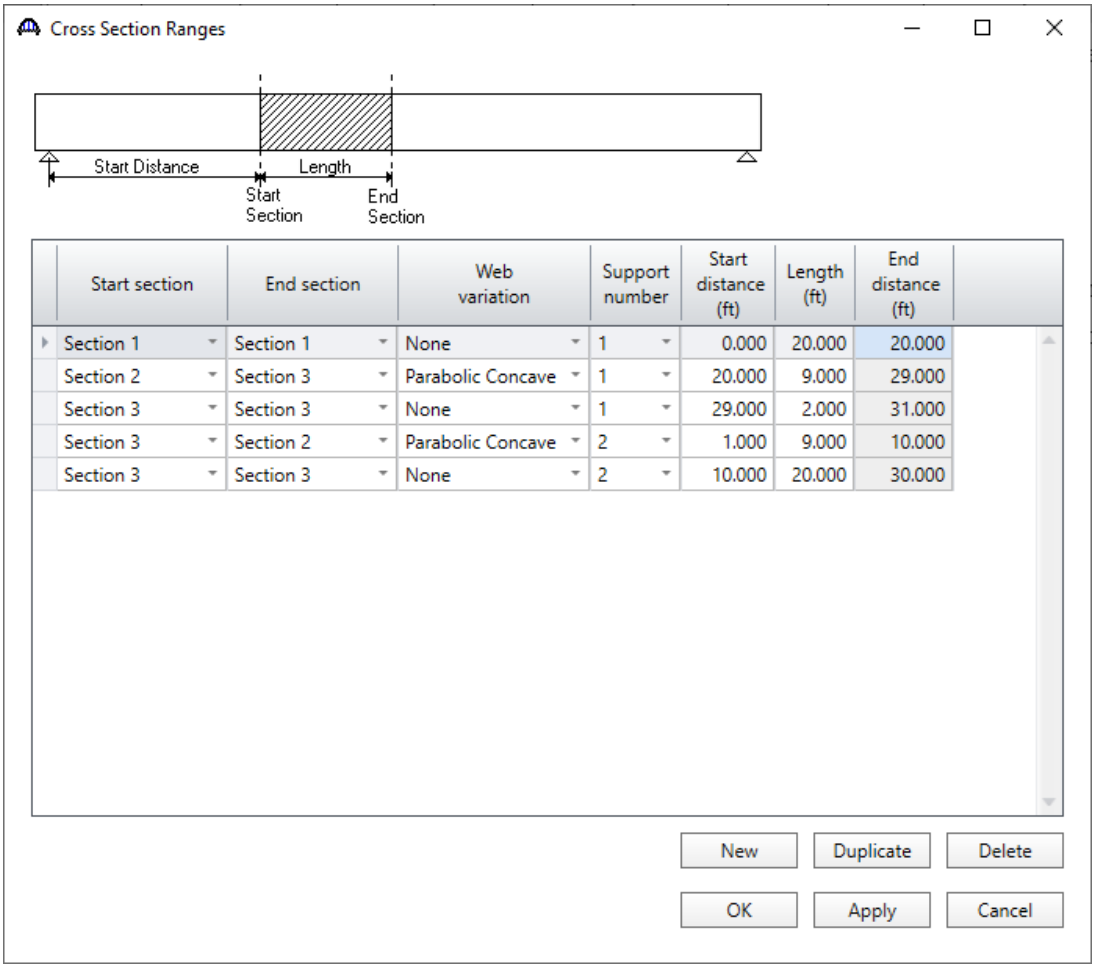

Cross Sections
Name: Section 3
Type: Reinforced Concrete Slab
Dimensions
Reinforcement
Concrete material: Class A (US)
Modular ratio:
12.0000 in
36.0000 in
OK
Apply
Cancel


Cross Sections
Name: Section 3
Type: Reinforced Concrete Slab
Dimensions
Reinforcement
Distance from top of slab
Distance from bottom of slab
Row
Std bar count
LRFD bar count
Bar size
Distance (in)
Material
Bar spacing (in)
Top of Slab 2.00 2.00 9 2.6875 Grade 60
Bottom of Slab 2.00 2.00 9 3.1250 Grade 60
New
Duplicate
Delete
OK
Apply
Cancel

Slab depth varies parabolically over the pier

Cross Section Ranges

Double click on the **Cross Section Ranges** in the **Bridge Workspace** tree to open the **Cross Section Ranges** window. Apply the cross sections over the length of the member as shown below:

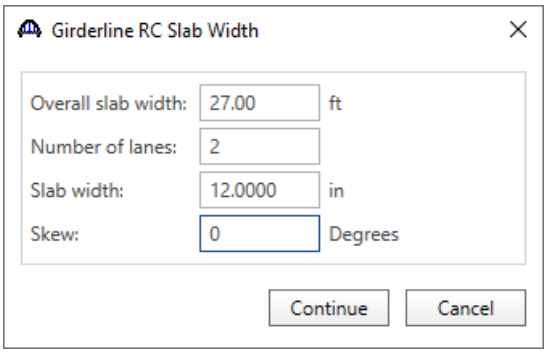


Click **OK** to apply the data and close the window.

Shear Reinforcement Ranges and **Bracing Ranges** are not applicable to this member so no data will be entered in these windows. There is no requirement to define any **points of interest** since none of the information entered will be overridden in this example.

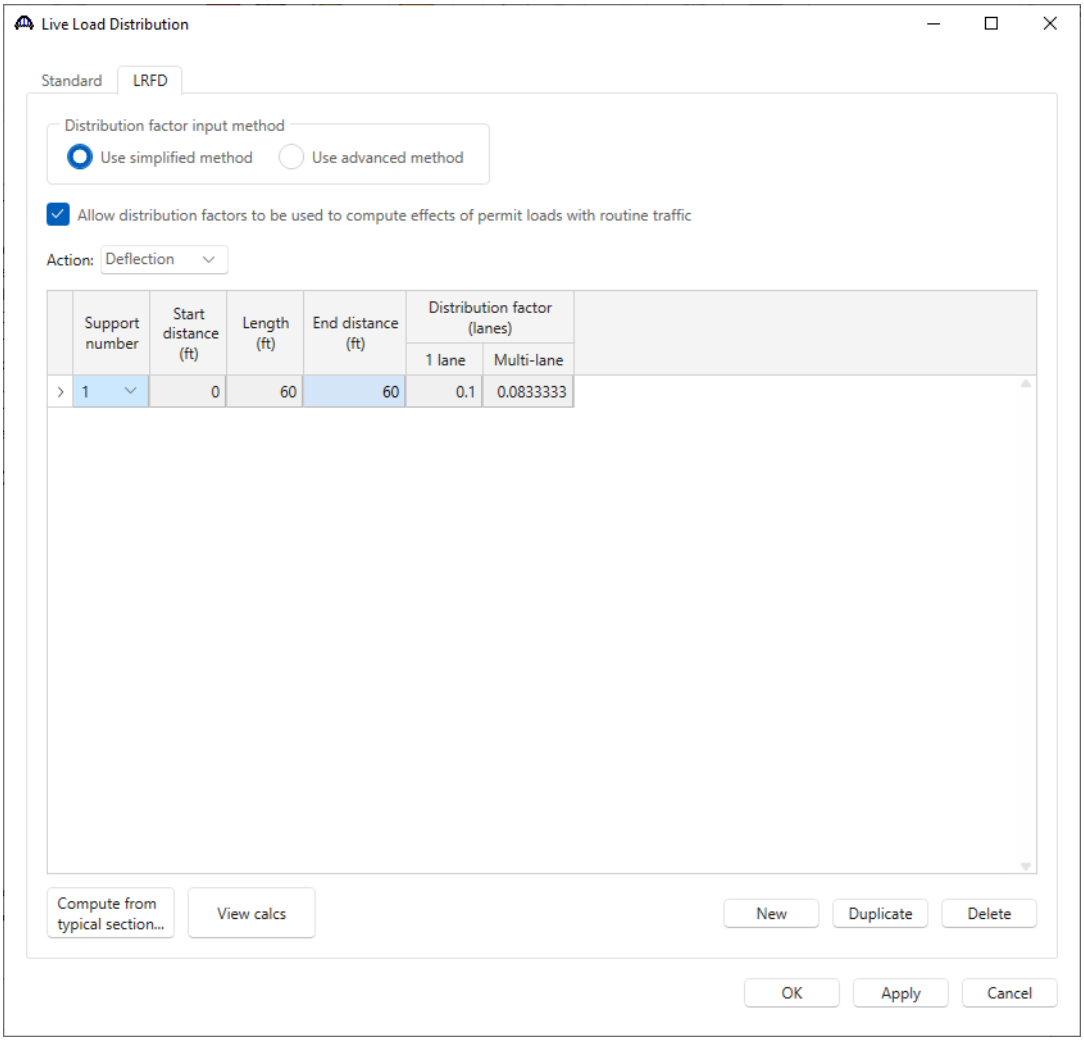
Live Load Distribution

Open the **Live Load Distribution** window from the **Bridge Workspace** tree and go to the **LRFD** tab. Click the **Compute from typical section…** button, enter values as shown below in the pop-up window.

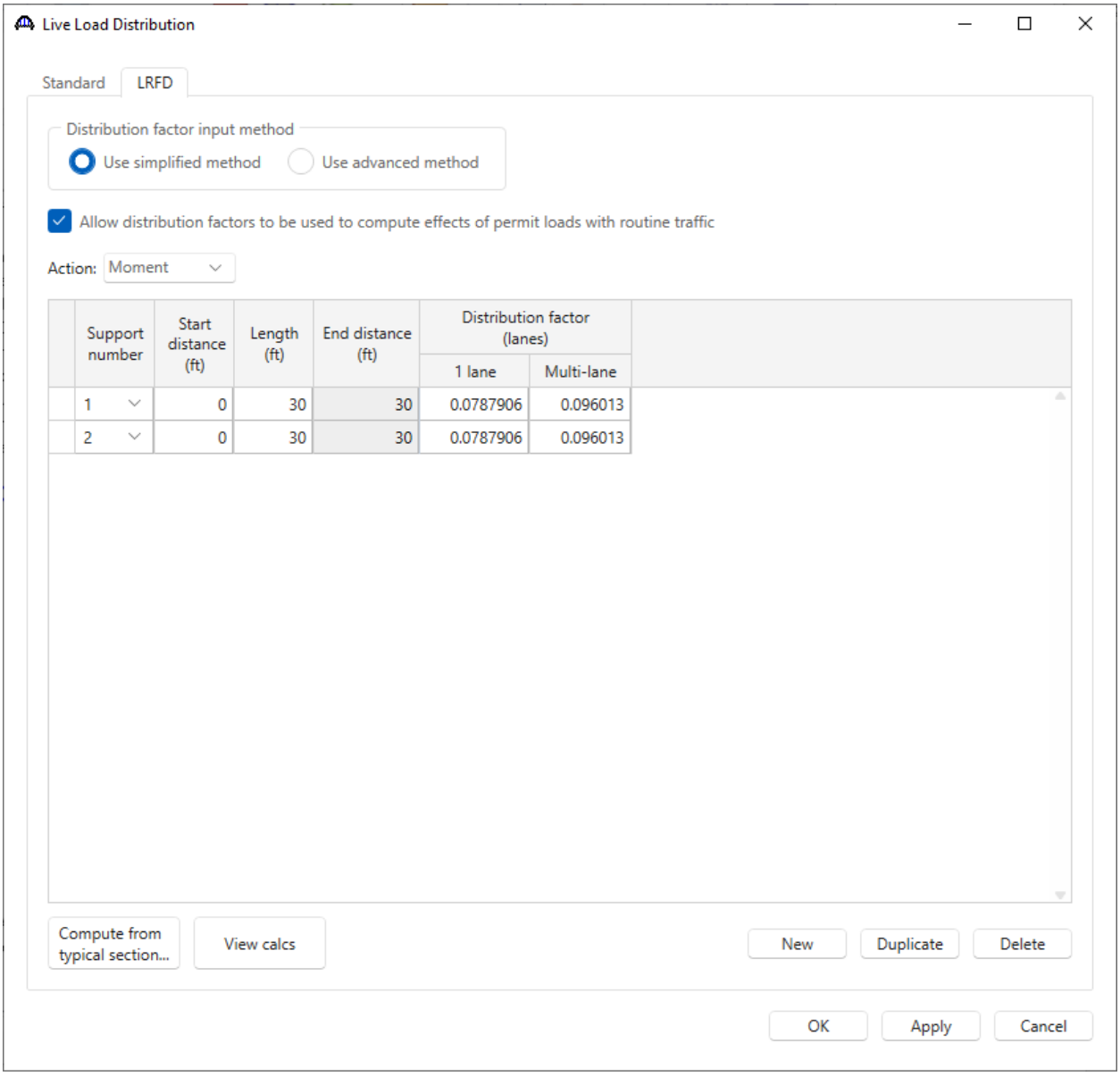


Click **Continue** to compute the live load distribution factors. Once the Analysis is complete, click the **OK** button in the **LRFD Distribution Factor** Progress window to apply these factors in the Live Load Distribution window.

Deflection distribution factors:



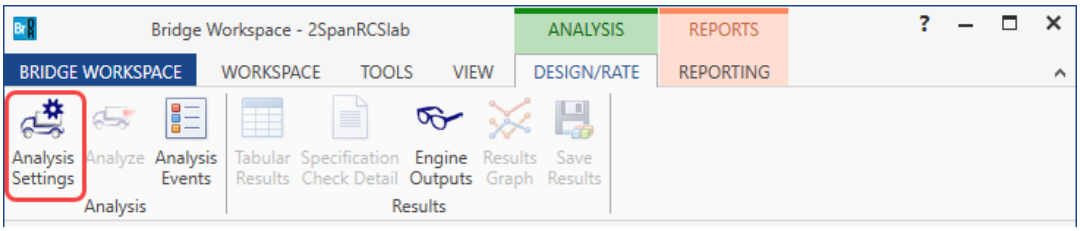
Moment and shear have the same distribution factors (moment is shown below).



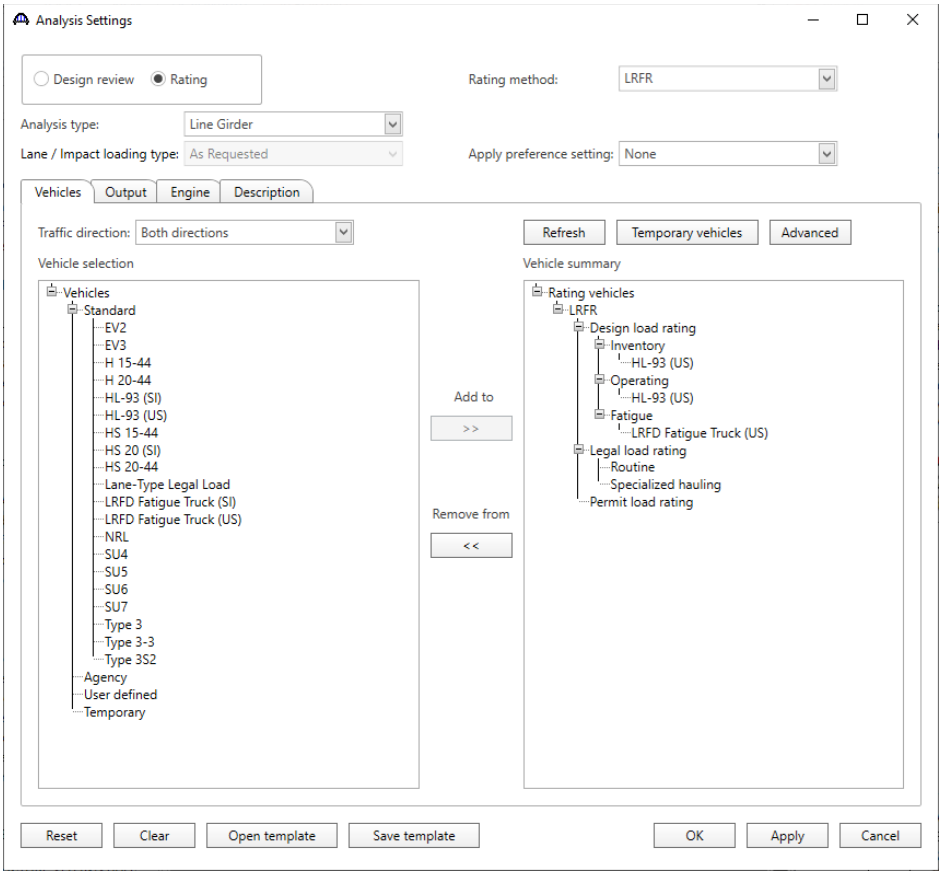
The member alternative can now be analyzed.

LRFR Rating

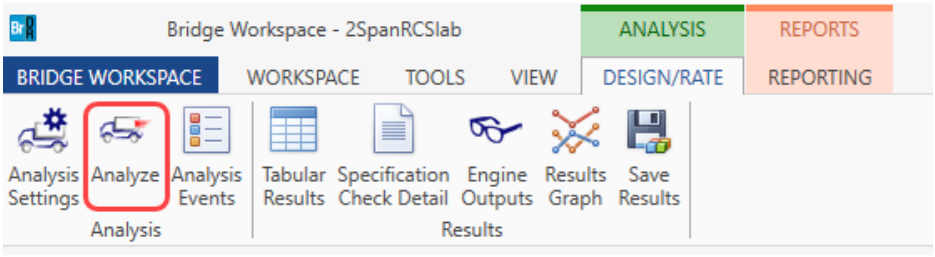
To perform an **LRFR** rating, click the **Analysis Settings** button on the **Analysis** group of the **DESIGN/RATE** ribbon which opens the **Analysis Settings** window.



Click the **Open template** button and select the **LRFR Design Load Rating** to be used in the rating and click **OK**. The **Analysis Settings** will be as shown below.

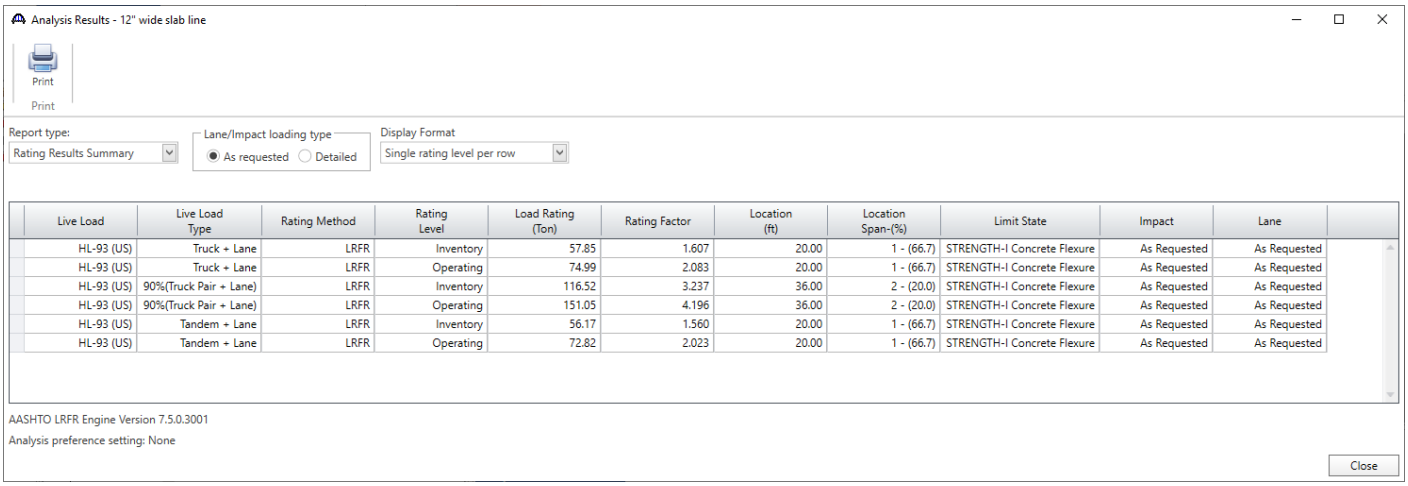


Next click the **Analyze** button on the **DESIGN/RATE** ribbon to perform the rating.



Tabular Results

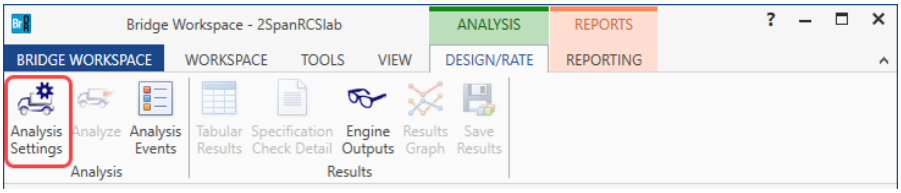
When the rating is finished you can review the results by clicking the **Tabular Results** button on the **Results** group of the **DESIGN/RATE** ribbon. The window shown below will open.



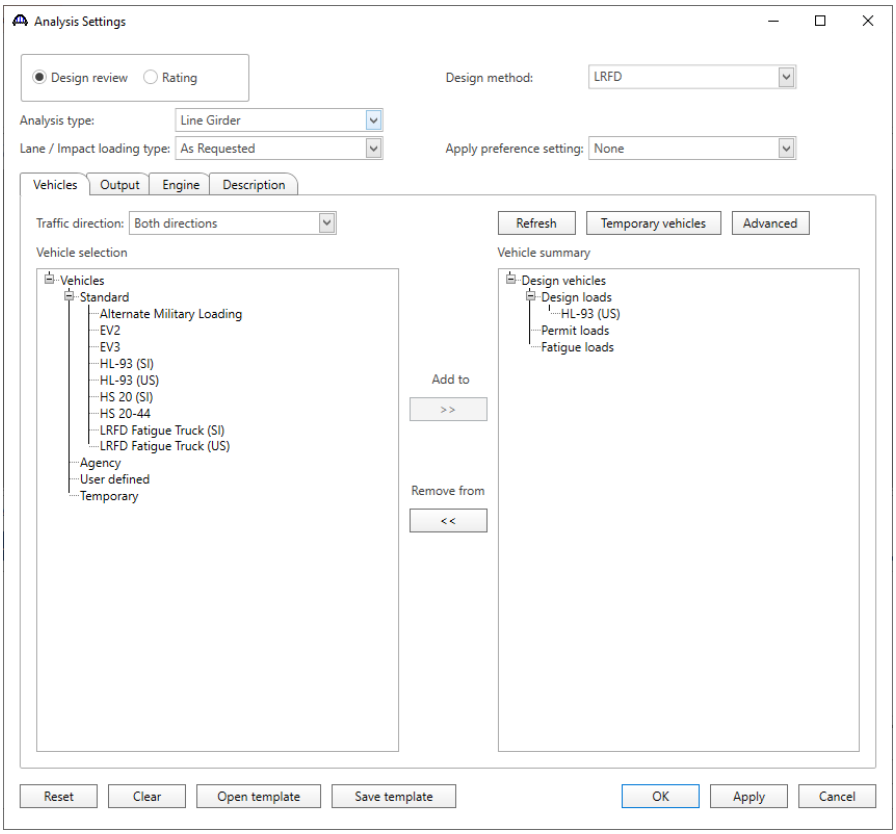
Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Limit State	Impact	Lane
HL-93 (US)	Truck + Lane	LRFR	Inventory	57.85	1.607	20.00	1 - (66.7)	STRENGTH-I Concrete Flexure	As Requested	As Requested
HL-93 (US)	Truck + Lane	LRFR	Operating	74.99	2.083	20.00	1 - (66.7)	STRENGTH-I Concrete Flexure	As Requested	As Requested
HL-93 (US)	90%(Truck Pair + Lane)	LRFR	Inventory	116.52	3.237	36.00	2 - (20.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
HL-93 (US)	90%(Truck Pair + Lane)	LRFR	Operating	151.05	4.196	36.00	2 - (20.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
HL-93 (US)	Tandem + Lane	LRFR	Inventory	56.17	1.560	20.00	1 - (66.7)	STRENGTH-I Concrete Flexure	As Requested	As Requested
HL-93 (US)	Tandem + Lane	LRFR	Operating	72.82	2.023	20.00	1 - (66.7)	STRENGTH-I Concrete Flexure	As Requested	As Requested

LRFD Design Review

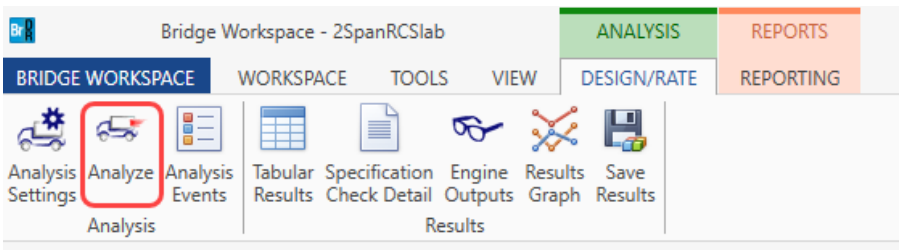
To perform an LRFD design review, click the **Analysis Settings** button on the **Analysis** group of the **DESIGN/RATE** ribbon which opens the **Analysis Settings** window. Note: The **Design review** option is only available if you have a license for the BrD software.



Select the vehicles to be used in the analysis as shown below and click **OK**.



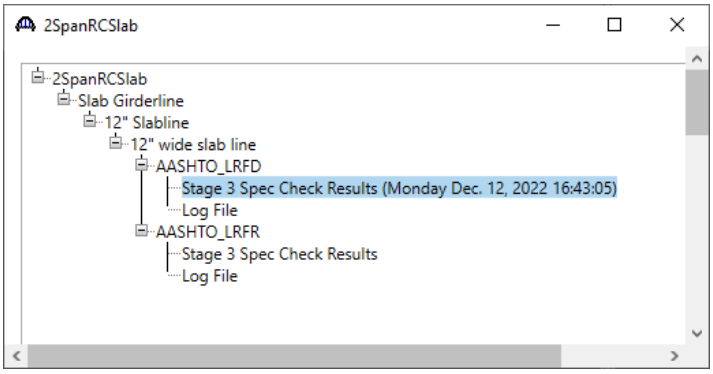
Next click the **Analyze** button on the ribbon to perform the analysis.



Engine Outputs

The BrDR **LRFD** analysis will generate a spec check results file. Click the **Engine Outputs** button on the **Results** group of the **DESIGN/RATE** ribbon to open the following window.

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



The spec check results file will be displayed as shown below.