Introducing BrDR Environment

Guide to Using BrDR 7.6.1

Getting Started

AASHTOWare Bridge Design and Rating Overview

What is AASHTOWare Bridge Design and Rating?

AASHTOWare Bridge Design and Rating is a software package that aids in the design and load rating of bridges. The software includes the applications BrD (Bridge Design) and BrR (Bridge Rating) with analytical engines that support AASHTO ASR/LFR and LRFD/LRFR. Additional engines are available through third party developers.

BrR

BrR (Bridge Rating) is used for a variety of bridge superstructure and culvert load rating. The application features a graphical user interface that aid in the preparation of the data and application of the results. Using the AASHTO ASR/LFR/LRFR as its analytical engine for load rating, BrR provides an integrated database where rating inputs and outputs can readily be stored, reviewed, and reused.

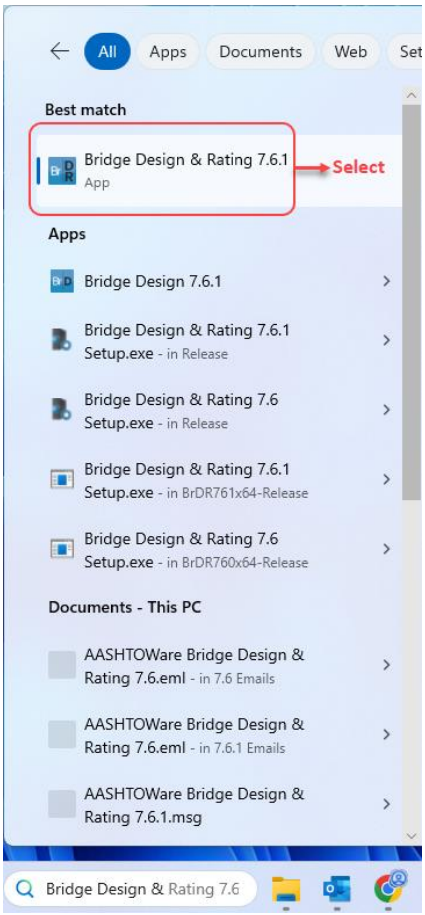
BrD

BrD (Bridge Design) is a bridge superstructure, substructure and culvert design software product using the AASHTO Load and Resistance Factor Design (LRFD) Bridge Specifications. BrD employs the same database and graphical user interface as BrR, and shares much of the same source code. Development of both products began in 1997. The AASHTO LRFD Engine provides the system's structural analysis and specification checking engines.

Starting AASHTOWare Bridge Design and Rating – Version 7.5.1

From the Desktop

The AASHTOWare Bridge Design and Rating software may be accessed through the desktop icon (see figure to the right). Using the BrDR icon provides the features of both BrD and BrR in one environment.

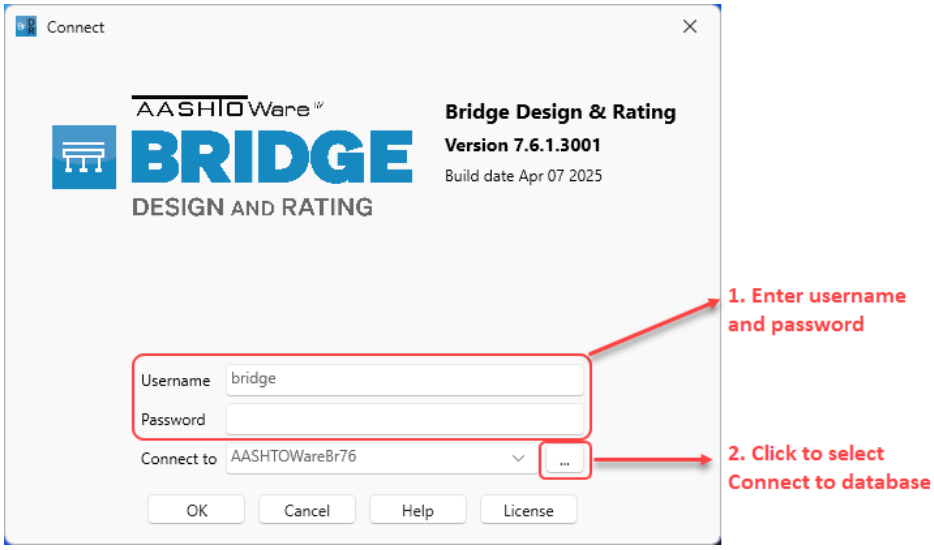


From the Start Menu

The software may also be accessed from the start menu if the icons are not in the desktop.

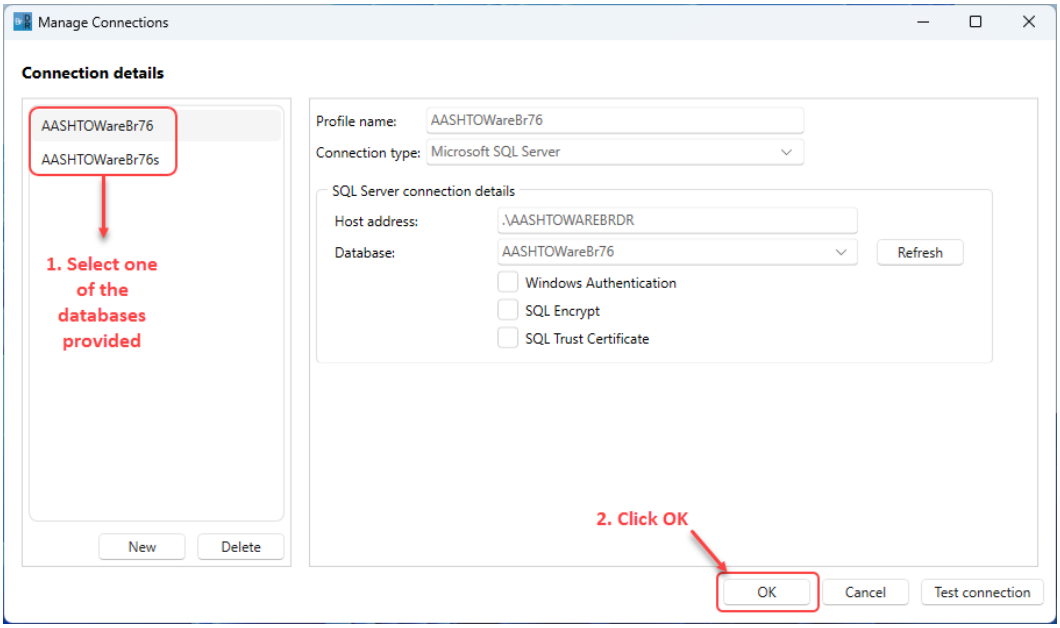
Entering Username and Password

Once initiated, the AASHTOWare Bridge Design and Rating **Connect** window will pop up. Enter the username and password in the provided fields. To connect to a different database, or if **Connect to** field is empty, click on the ellipsis button (**…**)



Connecting to the Database

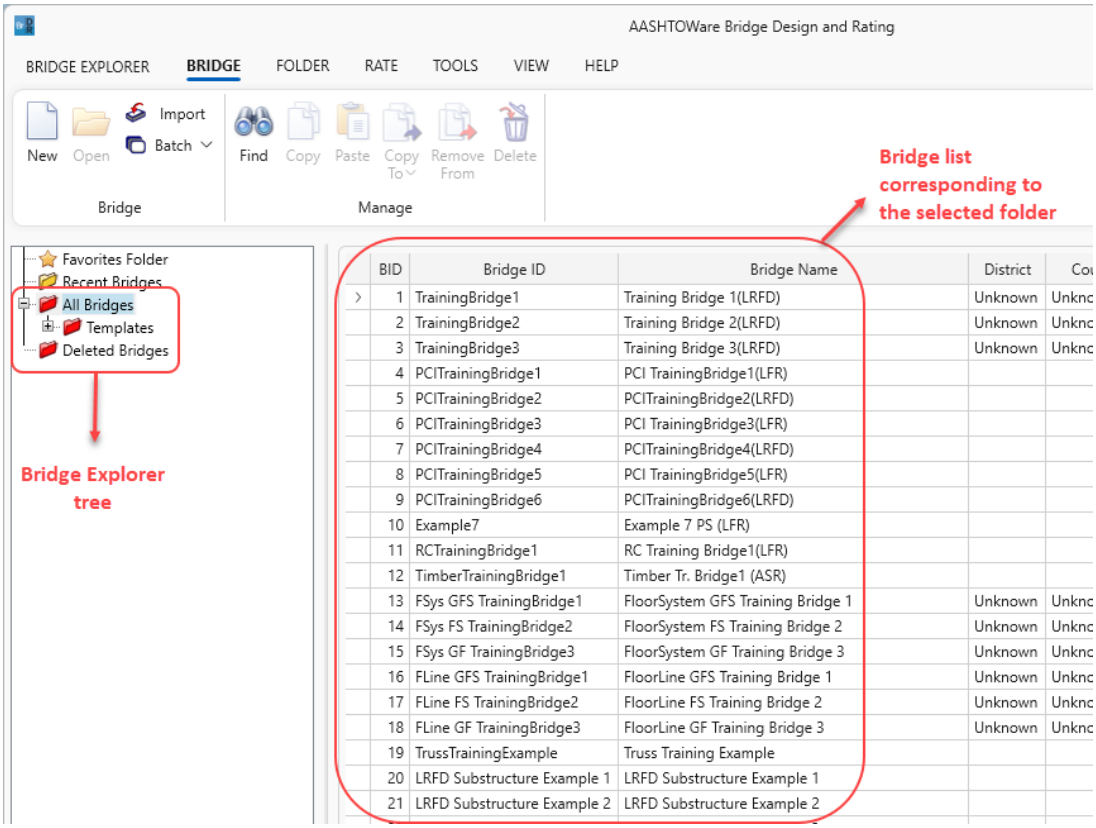
Once in the **Manage Connections** window, follow the instructions in the figure below.



AASHTOWare Bridge Design and Rating Basics

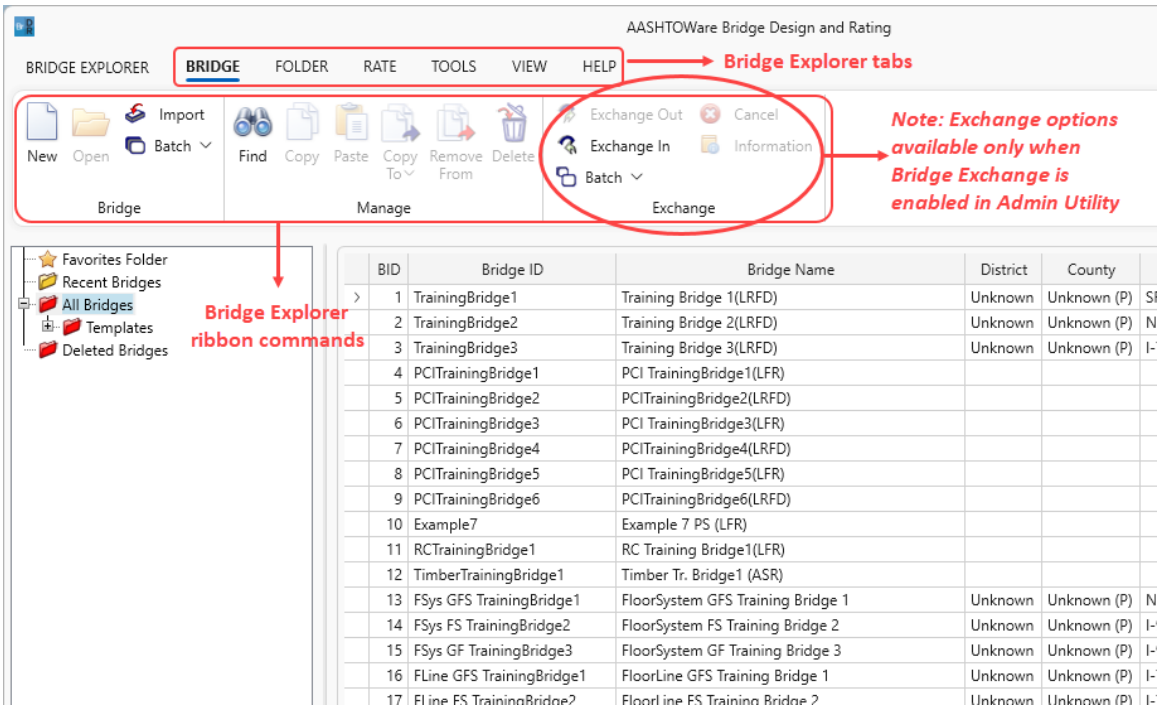
AASHTOWare Bridge Design and Rating Environment Tour

Once successfully connected, the **Bridge Explorer** opens. The **Bridge Explorer** allows the entry of new bridge information into BrD/BrR or access existing bridge information. The left portion of the **Bridge Explorer** contains a tree. Each tree item includes a button, a folder and a name. The right portion of the **Bridge Explorer** presents a complete list of the bridges corresponding to the folder selected on the tree.



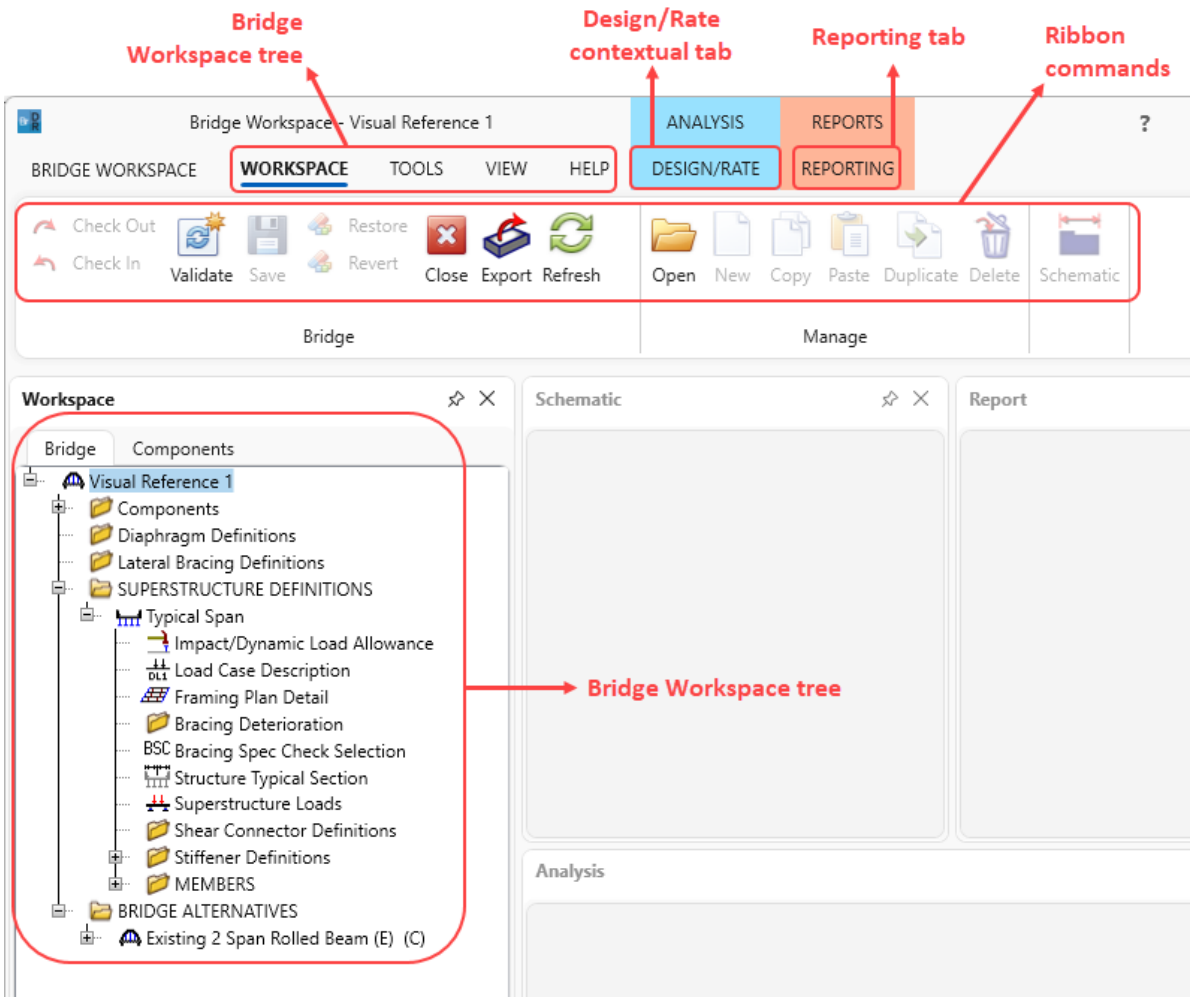
AASHTOWare Bridge Design and Rating Environment Overview

Bridge Explorer Window



AASHTOWare Bridge Design and Rating Environment Overview

Bridge Workspace Window



Bridge Explorer Window

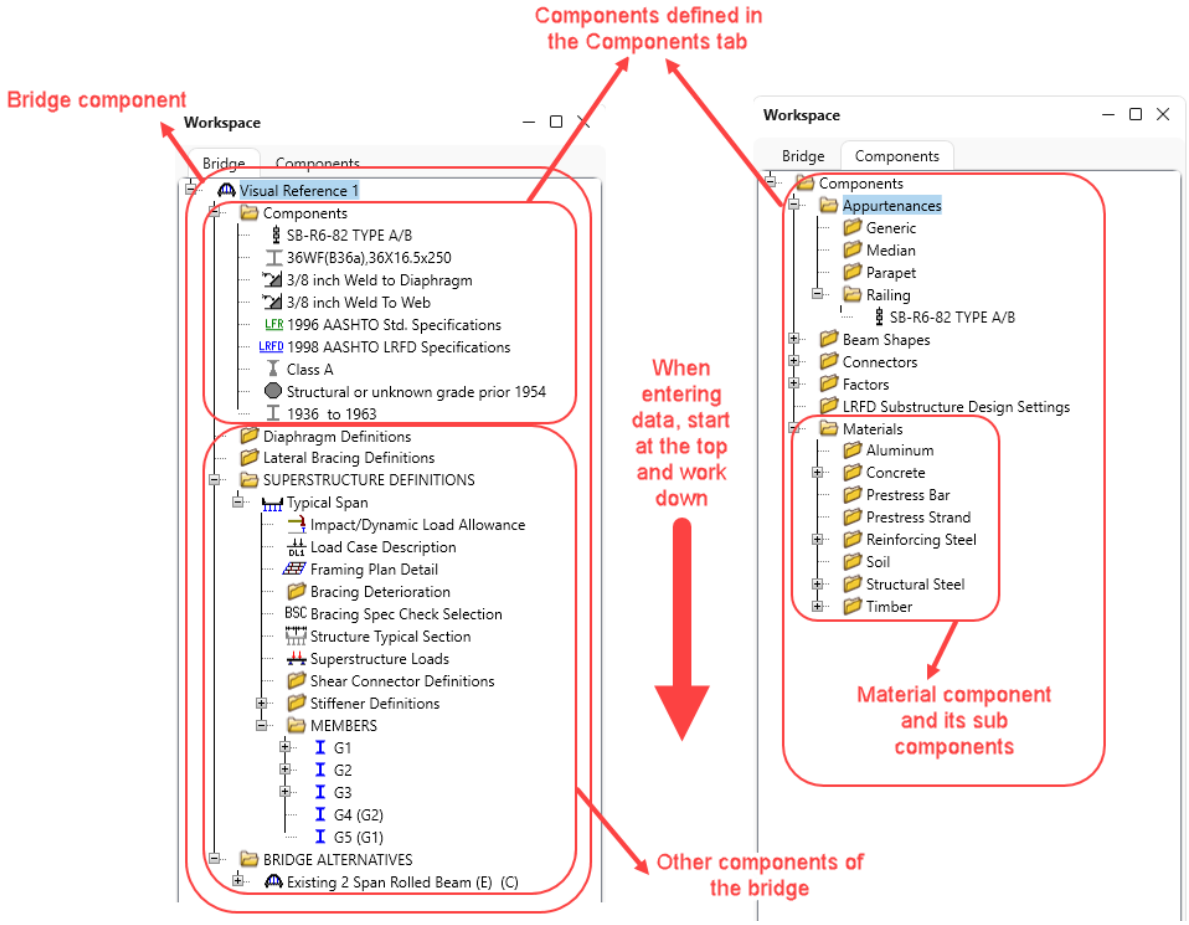
Sorting the Bridge List

Once a folder is selected to find a bridge, the corresponding bridge list may be sorted to make the search easier. Sorting the bridge list requires double clicking on a column heading. The first time this is done, it will sort alphabetically in ascending order. Double clicking again will result in a descending sort. This sorting works for all the columns in the Bridge Explorer.

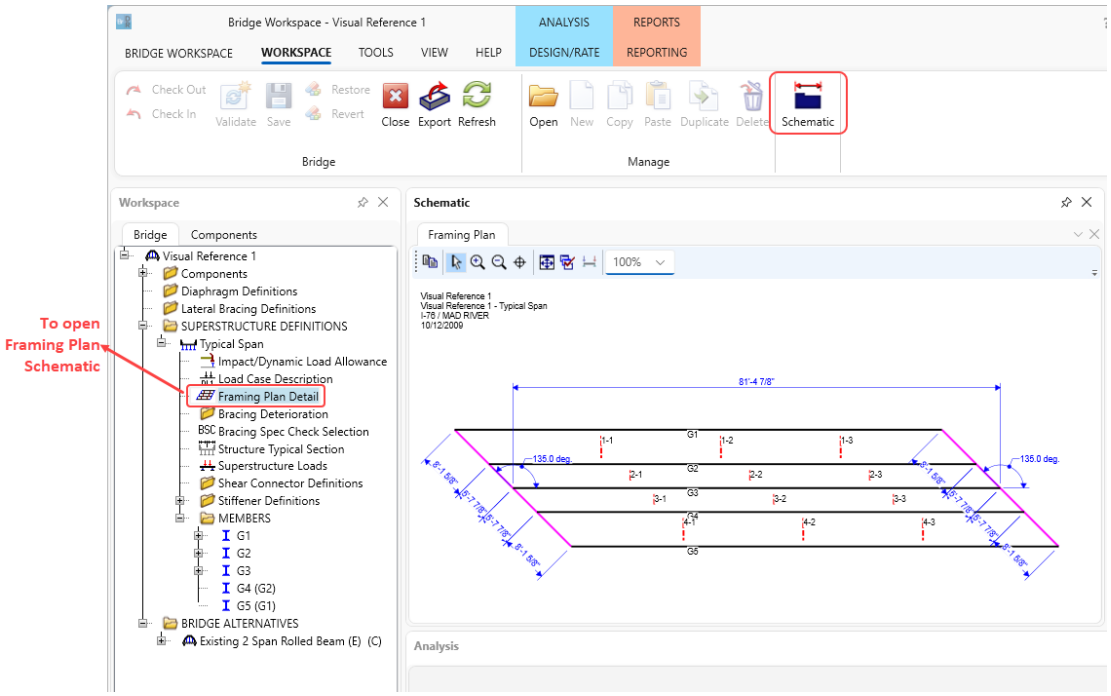
BID	Bridge ID	Bridge Name	District	County	Facility	Location	Route	Fe
1	TrainingBridge1	Training Bridge 1(LRFD)	Unknown	Unknown (P)	SR 0051	Pittsburgh	0051	SR
2	TrainingBridge2	Training Bridge 2(LRFD)	Unknown	Unknown (P)	N/A	N/A	-1	N/
3	TrainingBridge3	Training Bridge 3(LRFD)	Unknown	Unknown (P)	I-79	Pittsburgh	0079	OH
4	PCITrainingBridge1	PCI TrainingBridge1(LFR)					-1	
5	PCITrainingBridge2	PCITrainingBridge2(LRFD)					-1	
6	PCITrainingBridge3	PCI TrainingBridge3(LFR)					-1	
7	PCITrainingBridge4	PCITrainingBridge4(LRFD)					-1	
8	PCITrainingBridge5	PCI TrainingBridge5(LFR)					-1	
9	PCITrainingBridge6	PCITrainingBridge6(LRFD)					-1	
10	Example7	Example 7 PS (LFR)					-1	
11	RCTrainingBridge1	RC Training Bridge1(LFR)					-1	
12	TimberTrainingBridge1	Timber Tr. Bridge1 (ASR)					-1	
13	FSys GFS TrainingBridge1	FloorSystem GFS Training Bridge 1	Unknown	Unknown (P)	NJ-Turnpike	NJCity	-1	
14	FSys FS TrainingBridge2	FloorSystem FS Training Bridge 2	Unknown	Unknown (P)	I-95	NYC	-1	
15	FSys GF TrainingBridge3	FloorSystem GF Training Bridge 3	Unknown	Unknown (P)	I-95	ATL	-1	
16	FLine GFS TrainingBridge1	FloorLine GFS Training Bridge 1	Unknown	Unknown (P)	I-75	JAX	-1	
17	FLine FS TrainingBridge2	FloorLine FS Training Bridge 2	Unknown	Unknown (P)	I-75	GNV	-1	
18	FLine GF TrainingBridge3	FloorLine GF Training Bridge 3	Unknown	Unknown (P)	I-95	NY	15	
19	TrussTrainingExample	Truss Training Example					5	
20	LRFD Substructure Example 1	LRFD Substructure Example 1						
21	LRFD Substructure Example 2	LRFD Substructure Example 2			SR 4034	ERIE COUNTY	4034	FC
22	LRFD Substructure Example 3	LRFD Substructure Example 3						
23	LRFD Substructure Example 4	LRFD Substructure Example 4 (NHI Hammer Head)					-1	
24	Visual Reference 1	Visual Reference 1	Unknown	Unknown (P)	I-76	WAITSFIELD	I-76	M
25	Culvert Example 1	Culvert Example 1					STH60	
26	Curved Guide Spec	Curved Guide Spec Example(LFR)					1	
27	MultiCell Box Examples	Multi Cell Box Examples					100	
28	Gusset Plate Example	Gusset Plate Example	Unknown			Some Highway		
29	Splice Example	Splice Example					-1	
30	Simple DL-Cont LL-Splice	Simple DL Splice	Unknown	Unknown (P)	N/A	N/A	-1	N/
31	MetalCulvertExample1	MetalCulvertExample 1					1	

Double-clicking on a bridge from the bridge list opens the **Bridge Workspace**. The **Bridge Workspace** houses multiple docked panels namely **Workspace**, **Schematic**, **Report** and **Analysis**. These panels can be docked, undocked, moved, or resized.

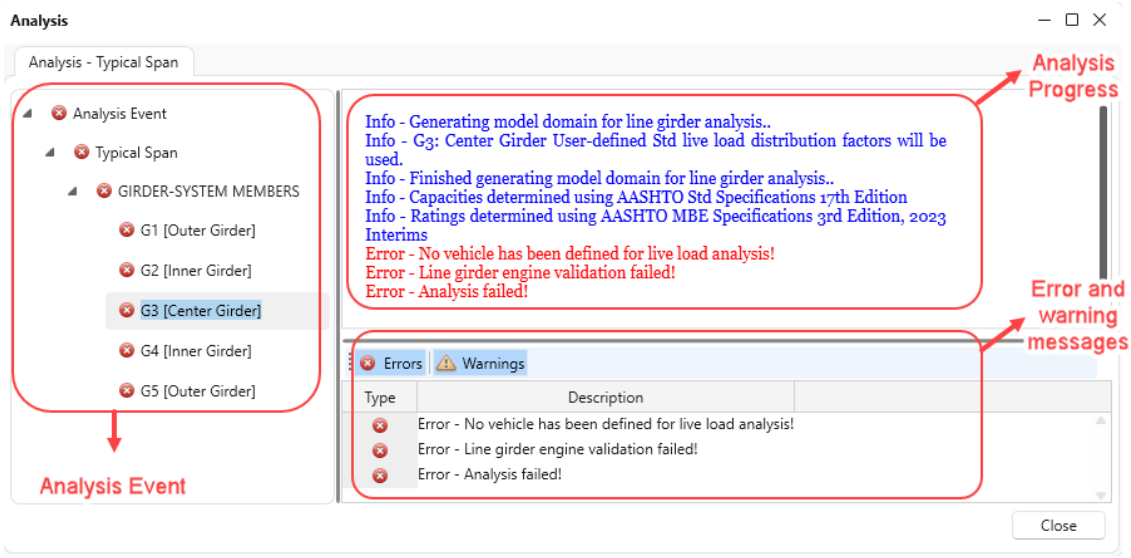
The **Workspace** window consists of **Bridge** and **Components** tab. The tree in these tabs work like the File Explorer file tree, except that instead of sorting files and folders, these tabs sort out different components of a bridge. The components include the items the bridge uses, girders or beams, and deck to name a few. The **Components** folder consists of all the items defined in the **Components** tab. Each major component has components unto itself. The **Materials** component of the **Components** tab, for example, is broken down into **Structural** and **Reinforcing Steel**, **Concrete**, **Prestress Strand/Bar**, **Soil** and **Timber**. These separate divisions are again broken down to the different materials of that division's type. For example, under Concrete, there may be a description for concrete class A, B and C.



The schematics of various items in **Bridge Workspace** can be viewed in the **Schematic** window. To view a schematic, highlight the item on the **Bridge Workspace** tree and click on the **Schematic** button on **WORKSPACE** tab.

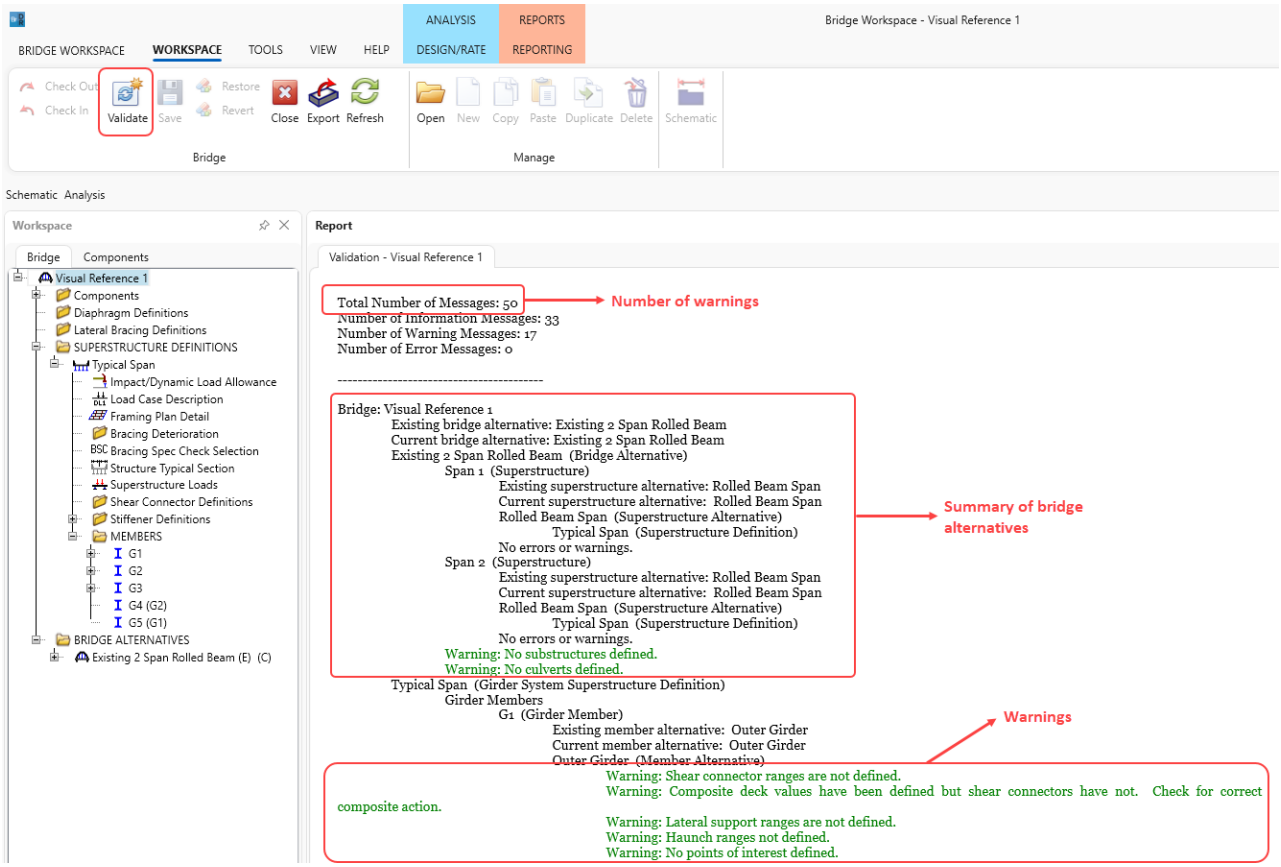


The **Analysis** Window of **Bridge Workspace** has panels to display the analysis event, analysis progress, and error/warning messages. The analysis progress and the error/warning messages displayed are corresponding to the highlighted item in the Analysis Event panel.



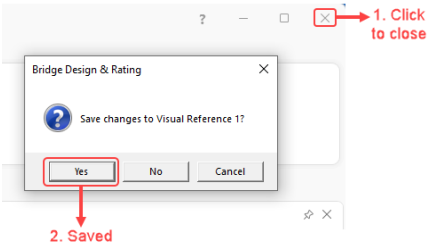
Checking Data Integrity

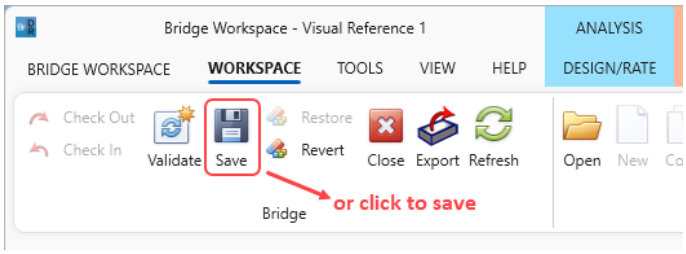
After completing data entry for a bridge, the next step is to check the data for missing components. In some cases, this may not be necessary, but in general practice, it is always good to ensure all the data is entered for bridge design or rating. To run the check, click on the **Validate** button from the **WORKSPACE** tab. The **Validation** tab will appear on the **Report** Window. This window will provide a summary of the bridge data that has been entered. It will also list a series of warnings regarding the data. If something is missing, it will be listed here. Use this as a guide to ensure data entry is complete.

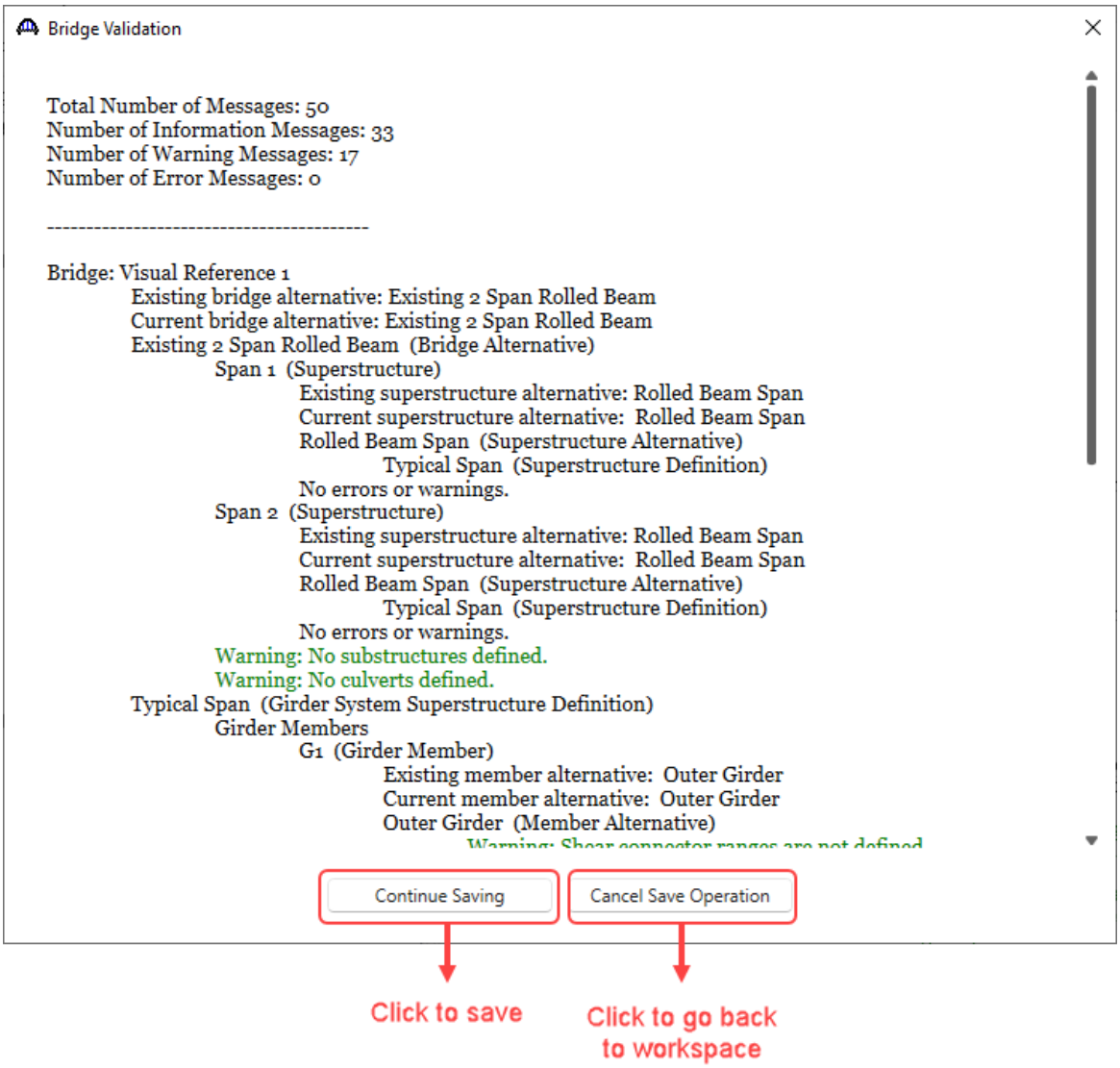


Saving the Bridge Data

Once the data has been entered and verified, click on the **Save** button from the **WORKSPACE** tab to save the data. If the bridge workspace is closed before saving, AASHTOWare Bridge Design and Rating will prompt to save the data. Before saving, AASHTOWare Bridge Design and Rating will validate the data and ask if you want to continue.







Starting a new Bridge

Project Description

The bridge selected for this exercise is called Introduction to BrDR Environment carrying I-76 over the MAD River. The bridge was approved for construction in 1938. It is a two simple span steel structure. Each span was constructed with 36 inch deep wide flange steel rolled sections (36 WF 250). At the pier, a joint was constructed in the deck. The following data shall be entered into BrDR.

The units for this example will be in English.

Materials

Structural Steel: Unknown from 1938 to 1939.

Concrete: From Plans, Concrete Class “A” assume this was 3500 psi.

Reinforcing Steel: Unknown from 1938 to 1939.

Members:

Rolled Beam: 36WF250

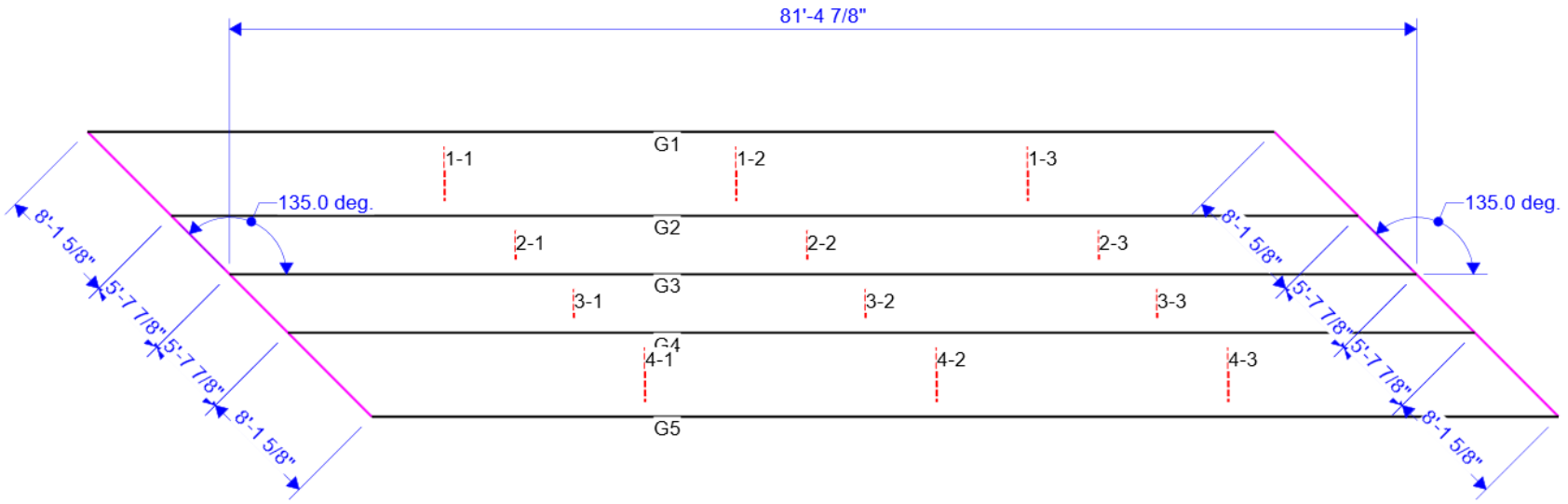
Other items:

The deck is 7” thick concrete – no haunches over beams.

The bridge has concrete railing.

Bridge Layout: See image below.

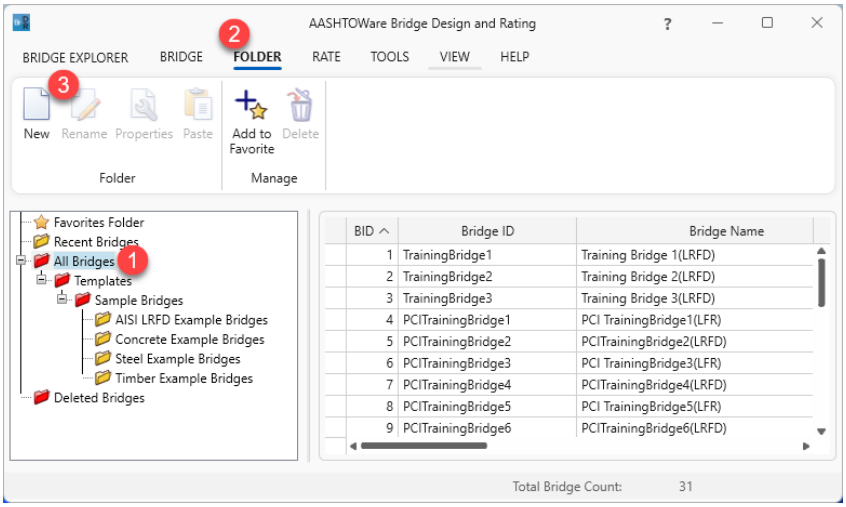
Visual Reference 1
Visual Reference 1 - Typical Span
I-76 / MAD RIVER
10/12/2009



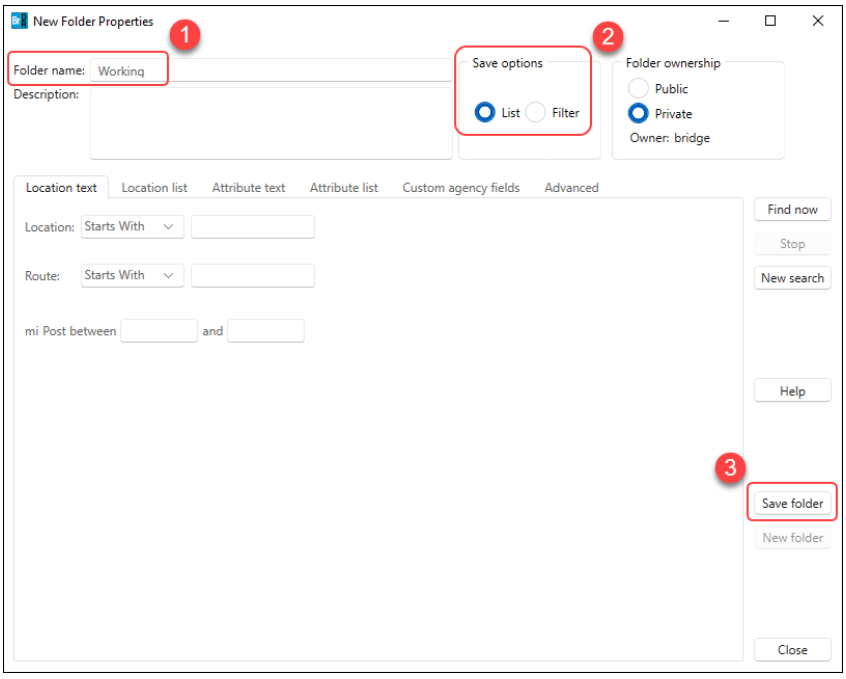
Starting BrDR and Opening Bridge Data

Creating and Deleting Shortcut

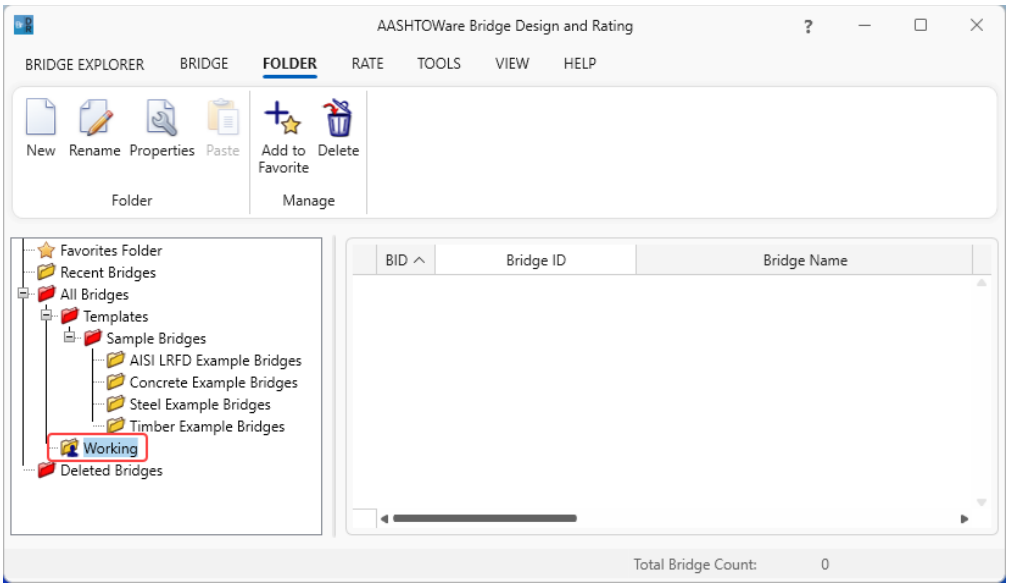
Shortcuts in BrDR are created in file list such as a user defined local folder. In some cases, folders with a filter can be created. To illustrate this, let's create a new folder using the list option. With **All Bridges** selected, select **Folder** from the ribbon and click the **New** button.



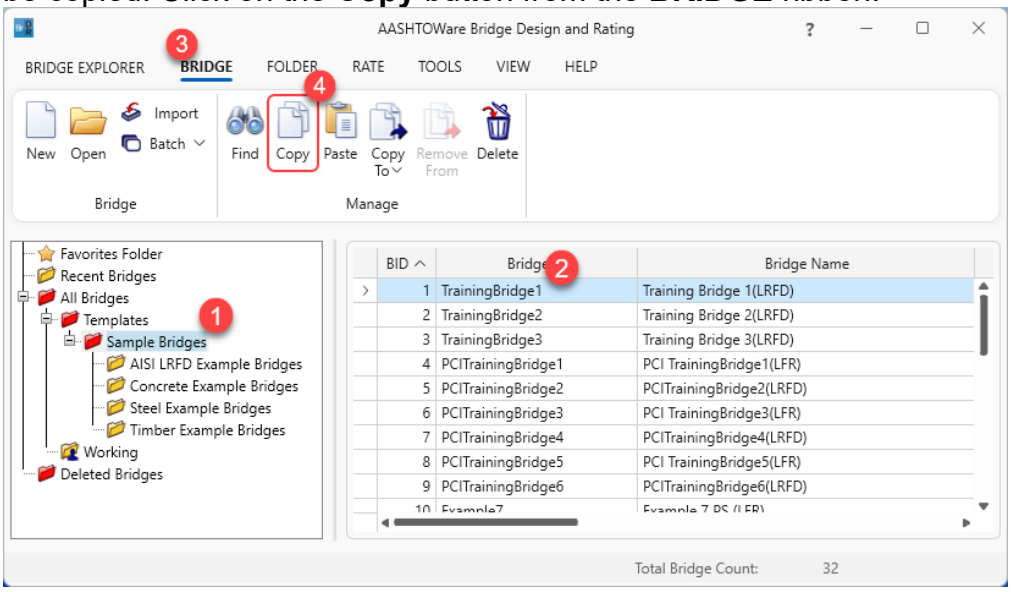
Enter a **Folder Name** (e.g. Working), select **List** under **Save options** and click on the **Save folder** button.



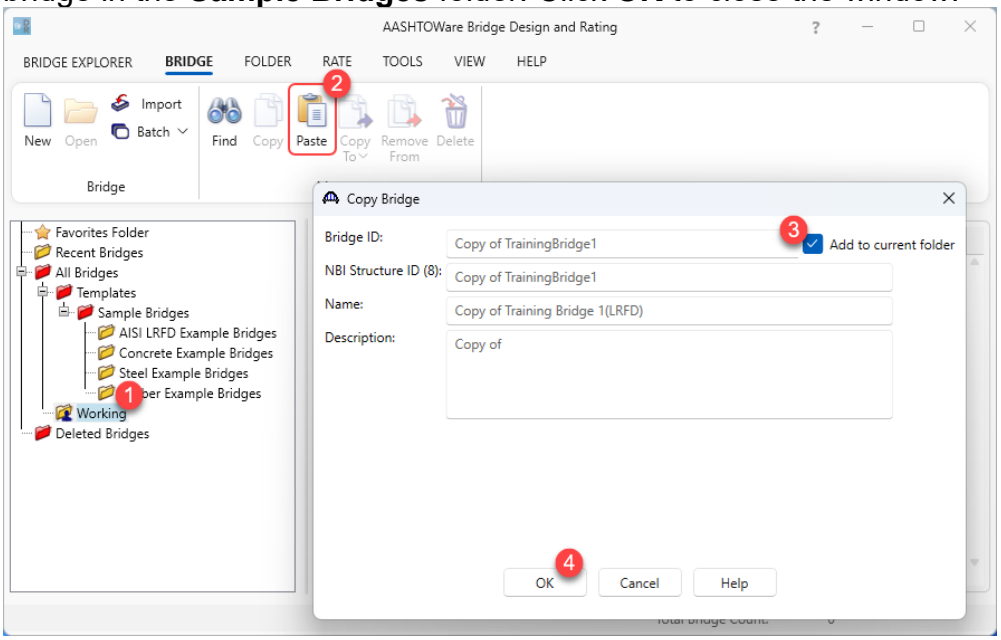
The created folder appears in the left pane of **Bridge Explorer** as shown below.



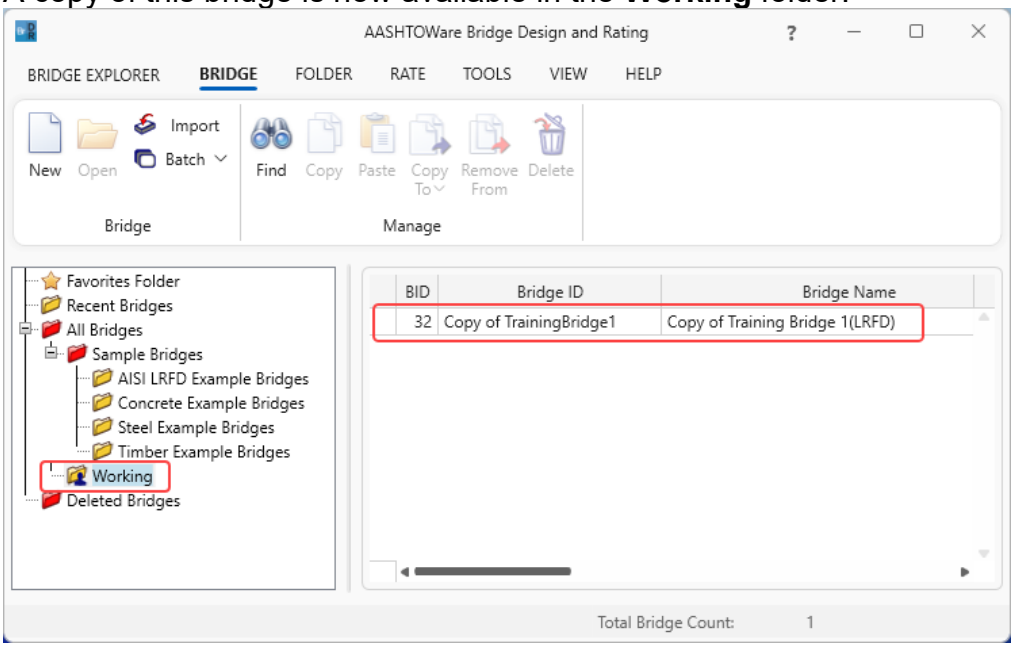
Navigate back to the **Sample Bridges** folder and select the bridge to be copied. Click on the **Copy** button from the **BRIDGE** ribbon.

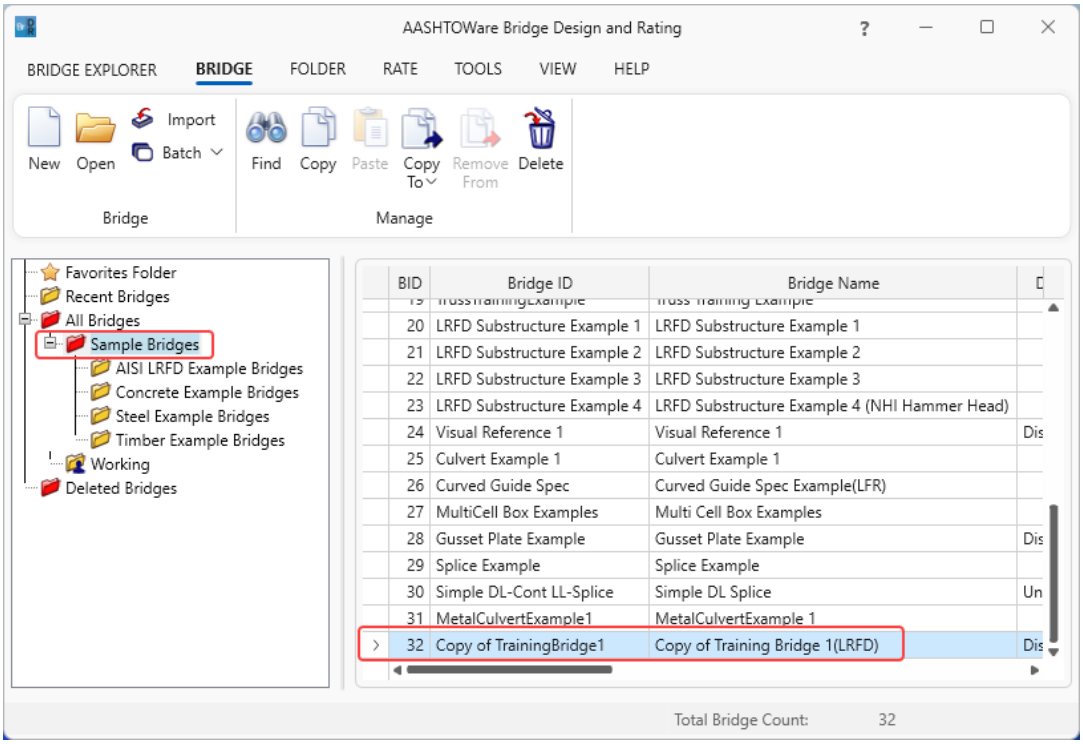


With the newly added **Working** folder selected, click on the **Paste** button from the ribbon. The following window appears. Verify the bridge details, rename if desired and check the **Add to current folder** checkbox to copy this bridge to the **Working** folder. Checking this checkbox adds the created copy to the **Working** folder along with saving the bridge in **All Bridges -> Sample Bridges** folder. This implies that unchecking this checkbox only creates a copy of this bridge in the **Sample Bridges** folder. Click **OK** to close the window.



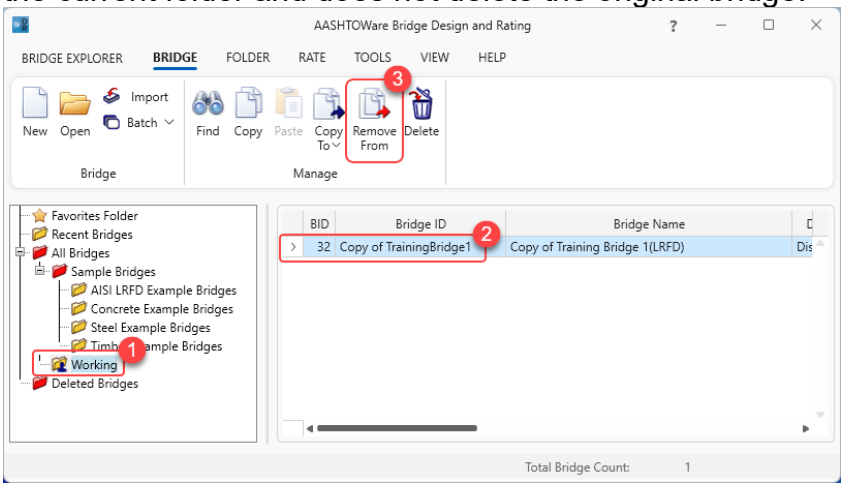
A copy of this bridge is now available in the **Working** folder.





It is to be noted that when copying a bridge, a shortcut of the original file is created. Any changes made to this copy is making changes in the original bridge file as well. The advantage of creating a shortcut in the local folder is being able to return to the work quickly. Several shortcuts of all bridges you are currently working on in your local folder may be stored.

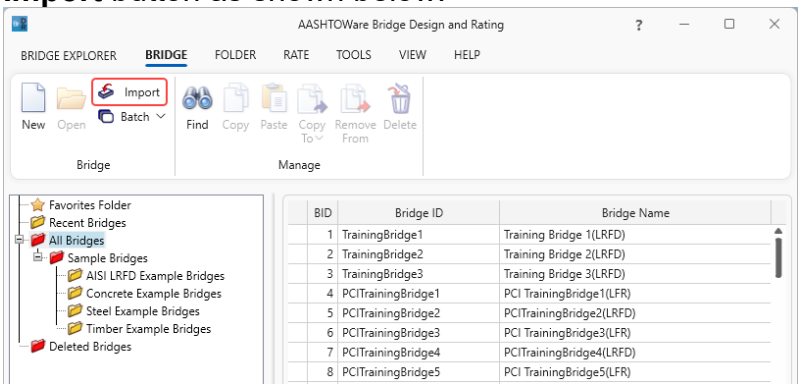
To remove a bridge from a folder, navigate to the **Working** folder, select the bridge to remove and click on the **Remove from** button from the ribbon. This option only removes the selected bridge from the current folder and does not delete the original bridge.



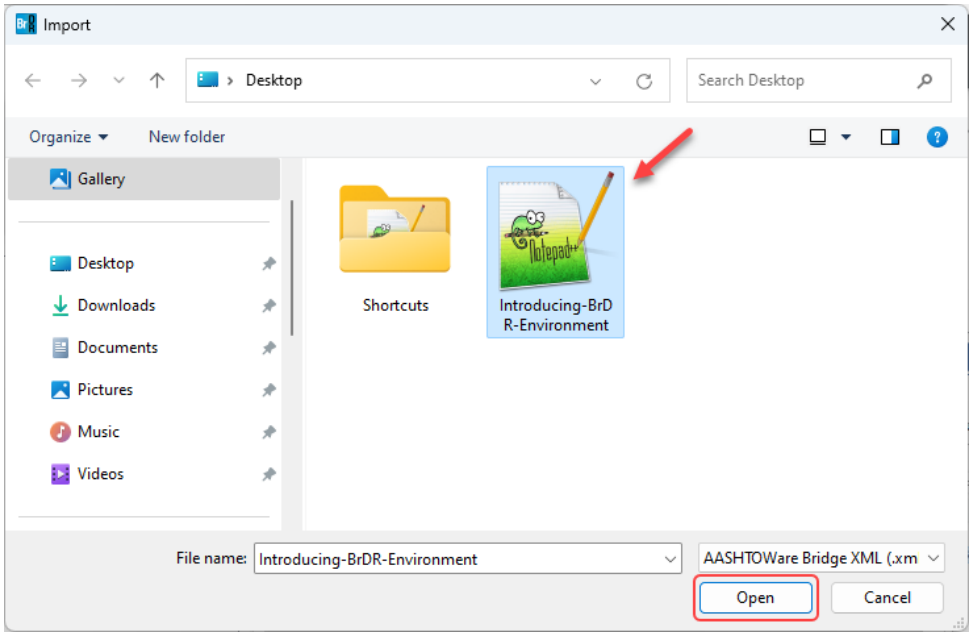
Importing a bridge file / Creating a new bridge

This example uses the bridge provided with this tutorial. Import the bridge provided with this tutorial. You may choose to create a new bridge and follow the steps provided to create the same bridge or import the provided bridge and review each window.

To import, from the **Bridge** group of the **BRIDGE** ribbon, click on the **Import** button as shown below.

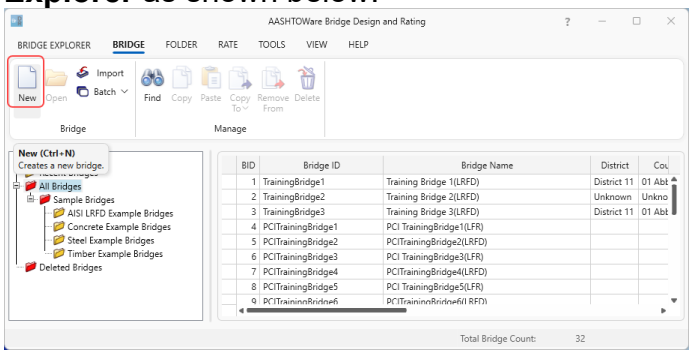


Select the bridge provided with this tutorial – **Introducing-BrDR-Environment** and click the **Open** button to import this bridge into BrDR.



The **Bridge** window of the imported bridge appears. Click **OK** to close the window.

To create a new bridge, click on the **New** button from the **Bridge Explorer** as shown below.

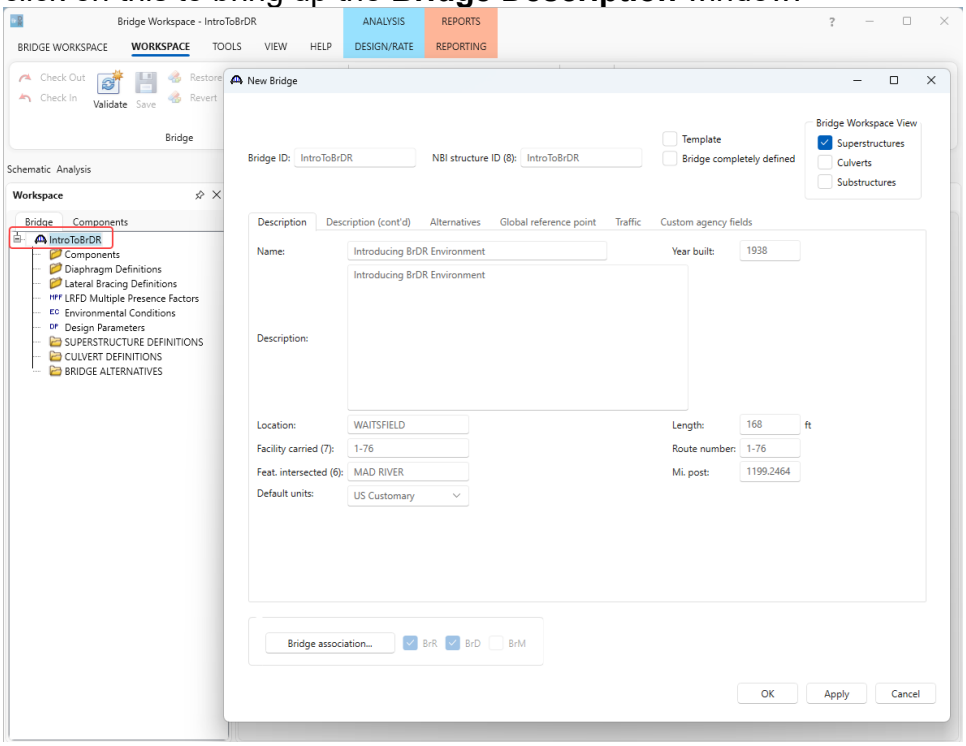


Bridge Description Information

Opening the Bridge Description Window

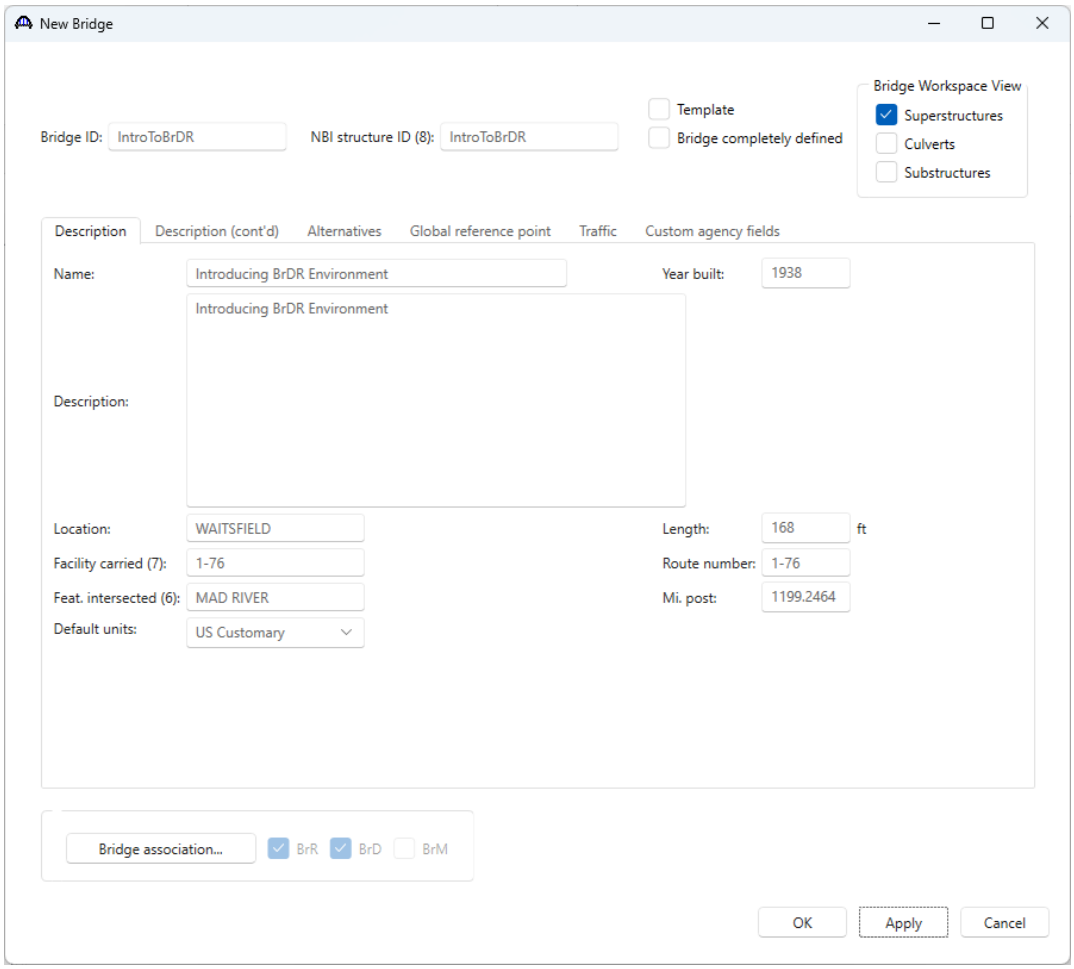
The **Bridge Workspace** contains a tree of components that will be used to build the model of the bridge. These components include materials, members, load factors, distribution factors, bridge typical section, railings, deck toppings, framing diaphragms and so on. In addition to these components, a bridge file may also contain bridge alternatives and for each bridge alternative, there may also be several member type alternatives.

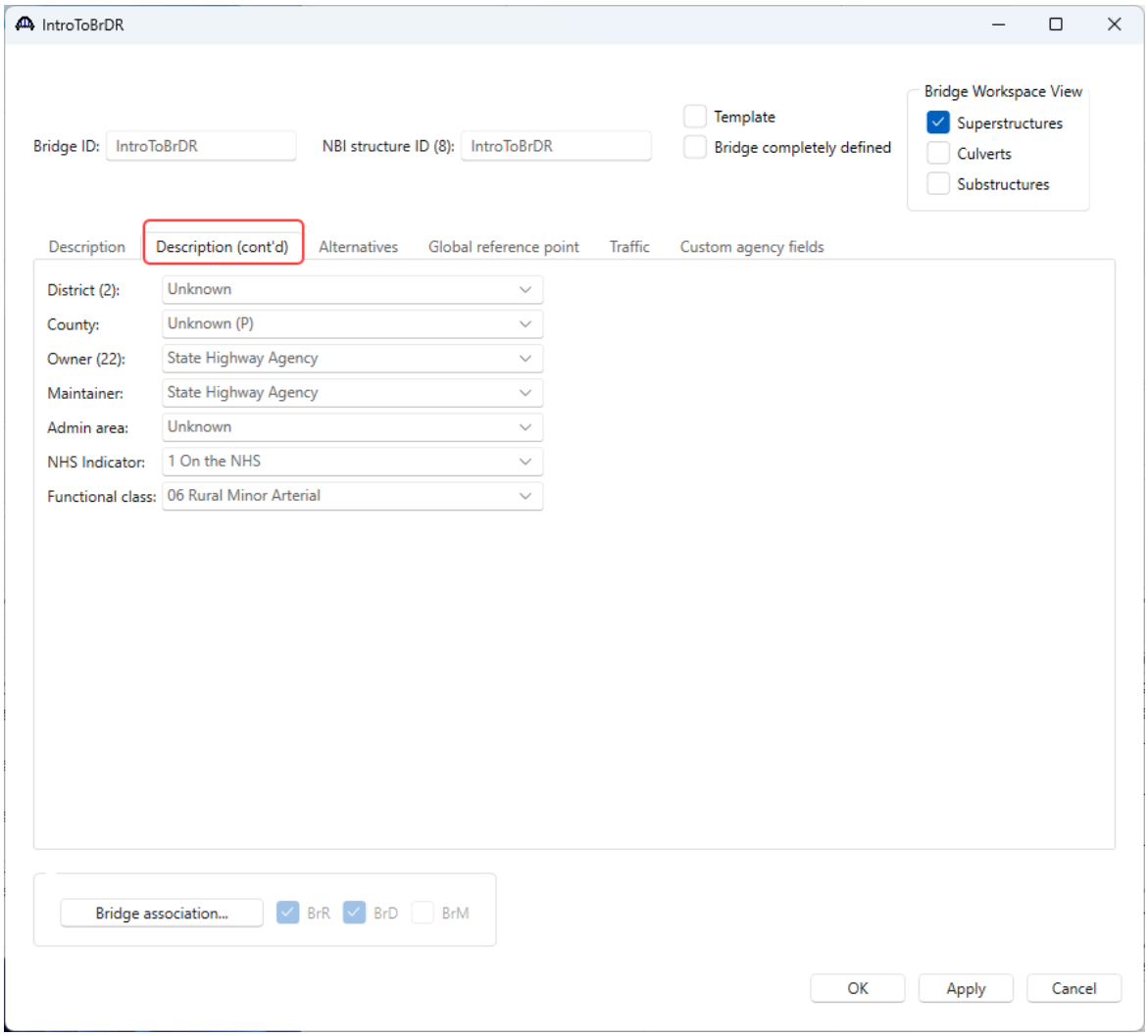
The first item in the **Bridge Workspace** tree is the **Bridge Description** window. This will be titled with the **Bridge ID**. Double click on this to bring up the **Bridge Description** window.

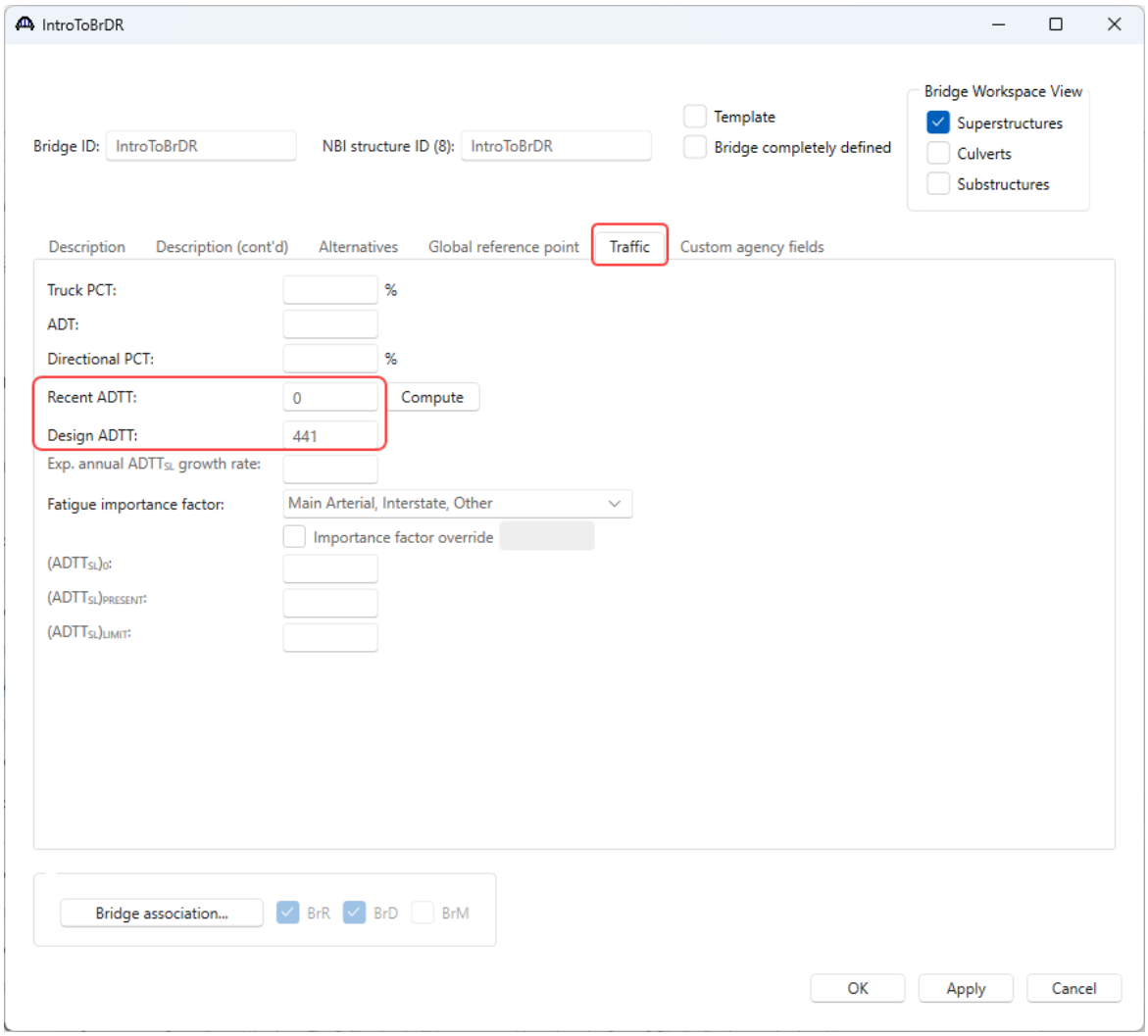


Bridge Description Information

Enter data in Description, Description (cont'd) and Traffic tabs as shown below.




IntroToBrDR
Bridge ID: IntroToBrDR
NBI structure ID (8): IntroToBrDR
Template
Bridge completely defined
Bridge Workspace View
Superstructures
Culverts
Substructures
Description
Description (cont'd)
Alternatives
Global reference point
Traffic
Custom agency fields
District (2): Unknown
County: Unknown (P)
Owner (22): State Highway Agency
Maintainer: State Highway Agency
Admin area: Unknown
NHS Indicator: 1 On the NHS
Functional class: 06 Rural Minor Arterial
Bridge association...
BrR
BrD
BrM
OK
Apply
Cancel



The following is a brief description of the information found in the Bridge Description window. Most of the information in this window has been filled out in advance. However, the data should be reviewed and modified as required.

Bridge ID

Enter the bridge identification number assigned to the bridge. This must be unique within the system.

NBI Structure ID

Enter the National Bridge Inventory (NBI) structure identification number assigned to the bridge. This value corresponds with Item 8 – Structure Number in the Federal Highway Administration's Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges (December 1988 and December 1995 Editions). This must be unique within the system. See the Bridge Inspection Manual Item 8 for more information.

Template / Bridge completely defined
Select the appropriate box. If the template box is unchecked, BrDR will see the bridge as being in the physical inventory as opposed to being a scratch design or a bridge example in a personal library. BrDR will include all bridges in the inventory for batch rating calculations.

Bridge workspace view
Select the required checkboxes to populate the **Bridge Workspace** accordingly. Options related to the selected checkbox items will be available in the **Bridge Workspace**.

Name [Optional]
(Max of 50 characters)
Descriptive name – as from the title block of the plans.

Year built: YYYY
The year the current in-place structure was built.

Description
May include previous project numbers, designer and checker names and project descriptions. This field should be considered a log of the structures history including design, construction, rehabilitation, and modification information to the best of the designers knowledge.

Location: LOCATION
(Max of 25 characters) Location of the structure.

Facility carried (7): FACILITY
(Max of 18 characters)
Enter the name of the road, highway, railroad, or other facility carried by the bridge. This value corresponds with Item 7 – Facility Carried by Structure in the Federal Highway Administration's *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges* (December 1988 and December 1995 Editions).

Feat. Intersected (6): FEATURE
(Max of 24 characters)
Enter the name of the river, highway, railroad, or other features intersected by the bridge. This value corresponds with Item 6 – Features Intersected in the Federal Highway Administration's *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges* (December 1988 and December 1995 Editions).

Default units

SI/Metric or US Customary unit system. This needs to be reviewed and specified by the user.

Length: LENGTH
Length of the structure in feet (back to back). May need conversion if design is in metric units. This may need to be edited if you are changing the bridge's length.

Route number: ROUTE
(Max. of 5 characters)
Enter the route number of the road carried by the bridge.

Mi post: POST
Mile marker of bridge location. (Max. of 9 characters)
If US customary units are being used, enter the mile post of the bridge. If SI/Metric units are being used, enter the kilometer post of the bridge.

Bridge association
Opens the **Bridge Association** window allowing you to specify this current bridge as a BrR, BrD or BrR/BrD bridge and also allows the bridge to be linked with BrM if this database is associated with BrM.

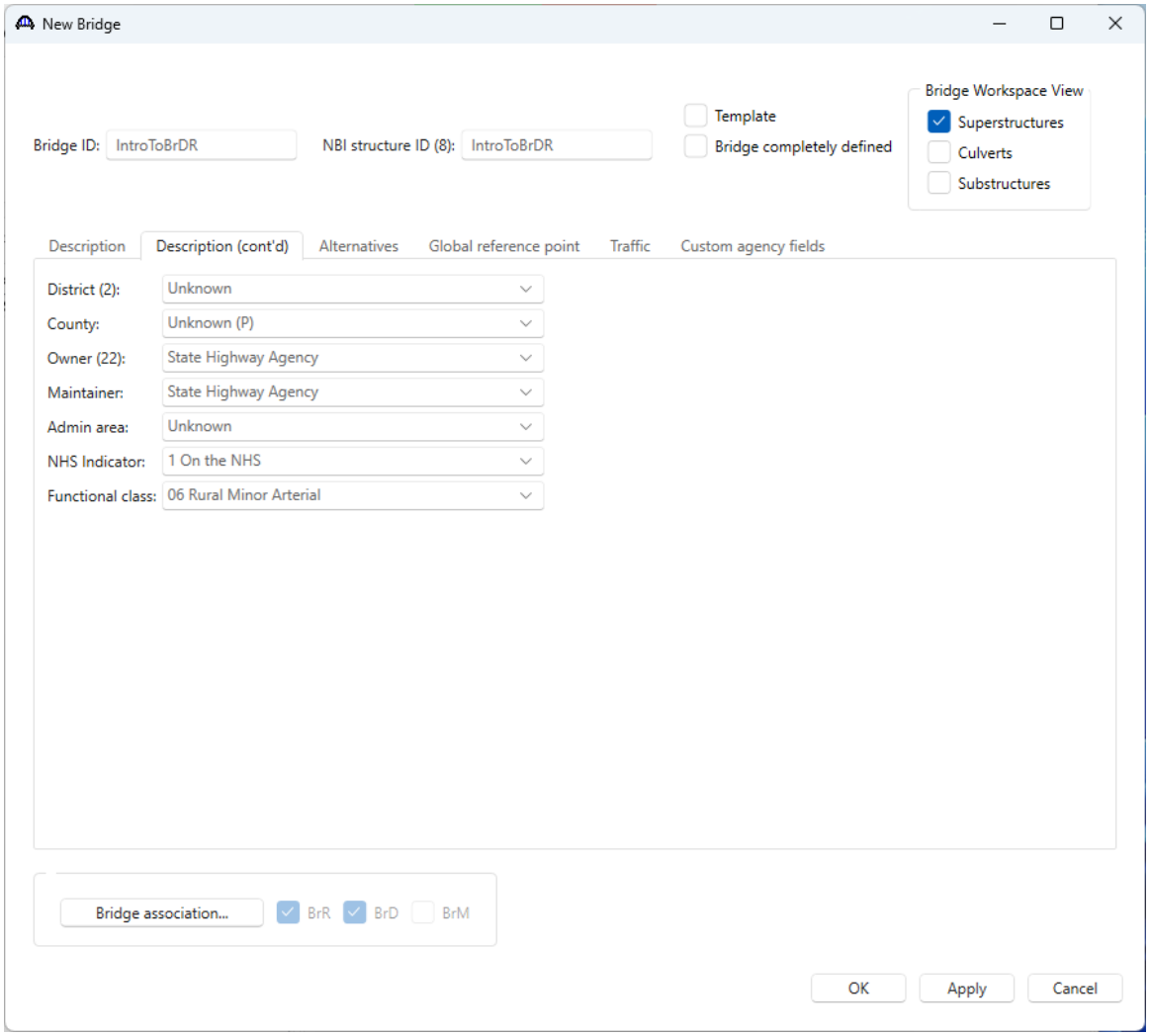
BrR
A checkmark in this field indicates this bridge is available to BrR. This field is read-only. Select the **Bridge Association** button to change this selection.

BrD
A checkmark in this field indicates this bridge is available to BrD. This field is read-only. Select the **Bridge Association** button to change this selection.

BrM
A checkmark in this field indicates this bridge is linked with BrM. This field is read-only. Select the **Bridge Association** button to change this selection.

Description (cont'd)

In this tab, all items are selected from a drop down list. Though this information is picked up from the database, it needs to be updated if necessary.



District (2)

Select the highway district in which the bridge is located. This value corresponds with Item 2 – State Highway Department District or Highway Agency District in the Federal Highway Administration's *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges* (December 1988 and December 1995 Editions). This field will be disabled if the bridge is linked with BrM.

County
Select the county in which the bridge is located.

Owner (22)
Select the name(s) of the owner(s) of the bridge. This value corresponds with Item 22 – Owner in the Federal Highway Administration's *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges* (December 1988 and December 1995 Editions).

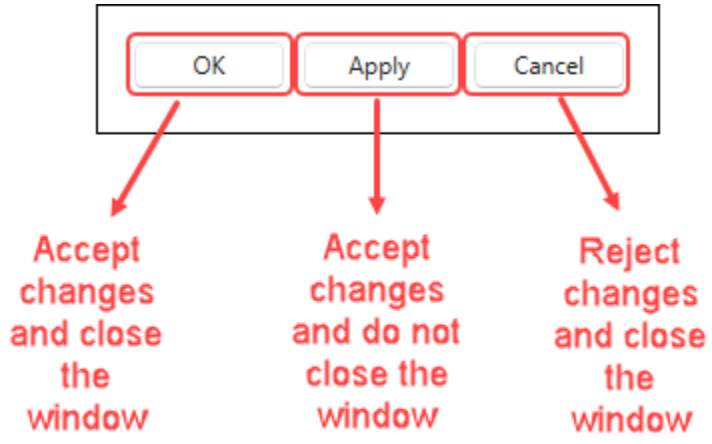
Maintainer
Select the name(s) of the maintainer(s) of the bridge.

Admin area
Select the administrative area for the bridge.

NHS Indicator
Select the National Highway System (NHS) indicator for the bridge.

Functional class
Select the functional class of the bridge.

The **Apply** button updates this window with all the changes made but doesn't close the window. The **OK** button applies the changes and closes the window. Clicking on the Cancel window closes the window without updating any changes made. This is true for all windows in BrDR.



Entering Bridge Data

At this point the bridge data has been updated to reflect the field conditions. Now we need to enter the materials, bridge members, load factors and other required information to run an analysis. The data should be entered in the order listed in the **Bridge Workspace**. This requires us to begin with components of the bridge, starting with appurtenances. Navigate to the **Components** tab.

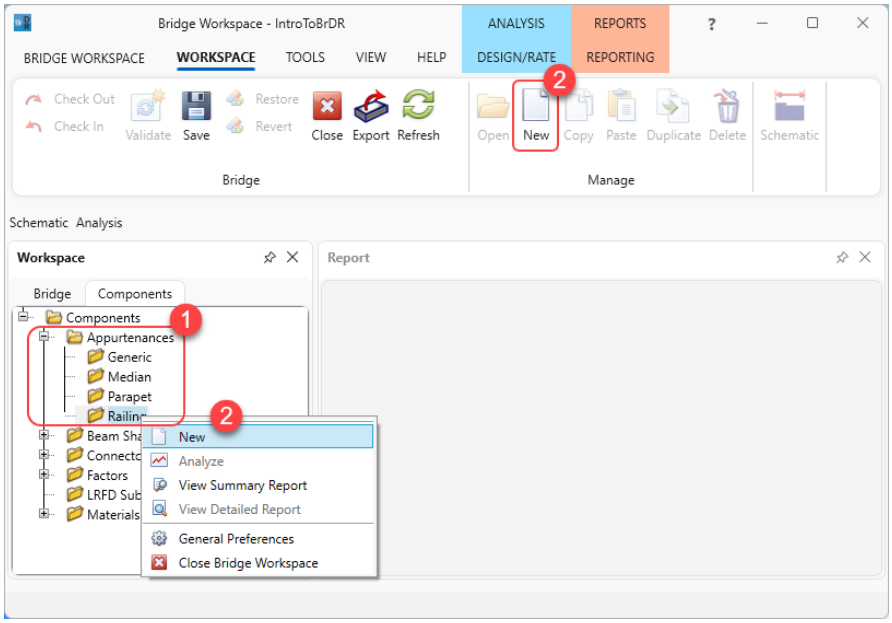
Railings

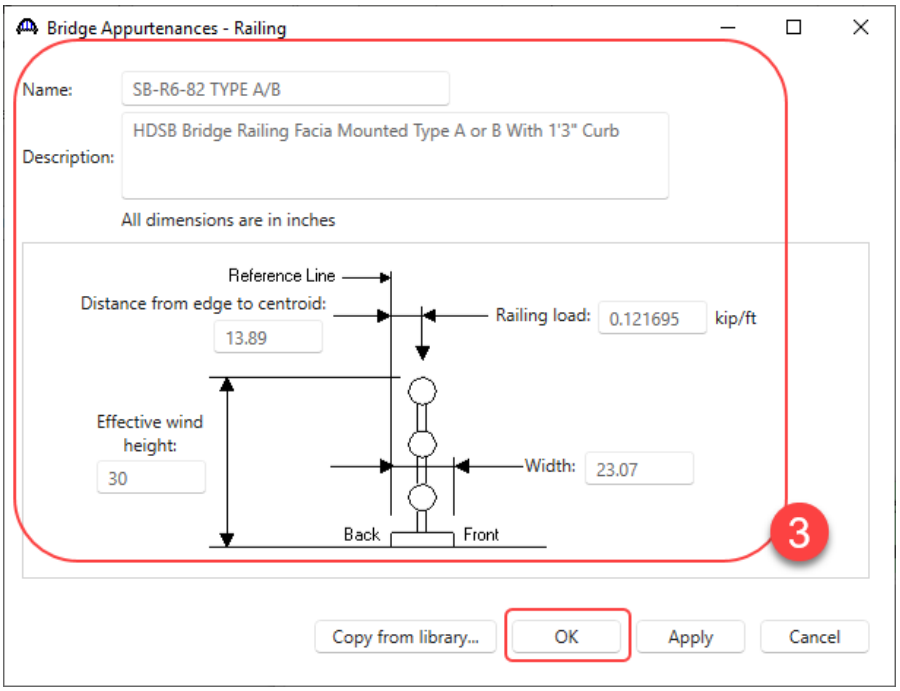
Let us begin with the first item on the list – **Appurtenances**. This bridge as described has concrete railings.

1. Expand the **Appurtenances** folder and select **Railing**.

2. Double click on **Railing** or click on **New** from the **WORKSPACE** ribbon, or right click and select **New** from the menu to open the **Bridge Appurtenances - Railing** window.

3. Enter the railing as shown below and click **OK** to apply this data and close the window.





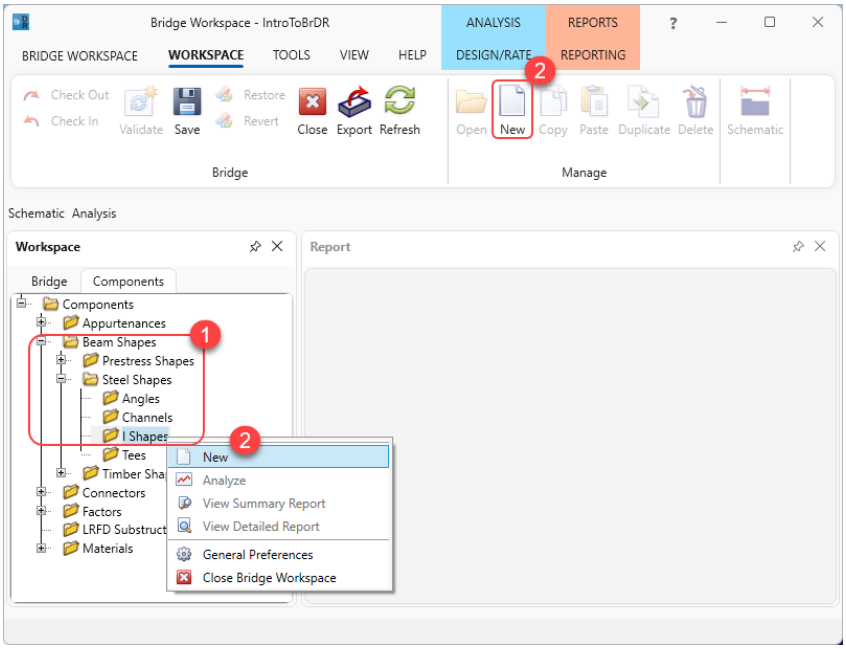
Bridge Members

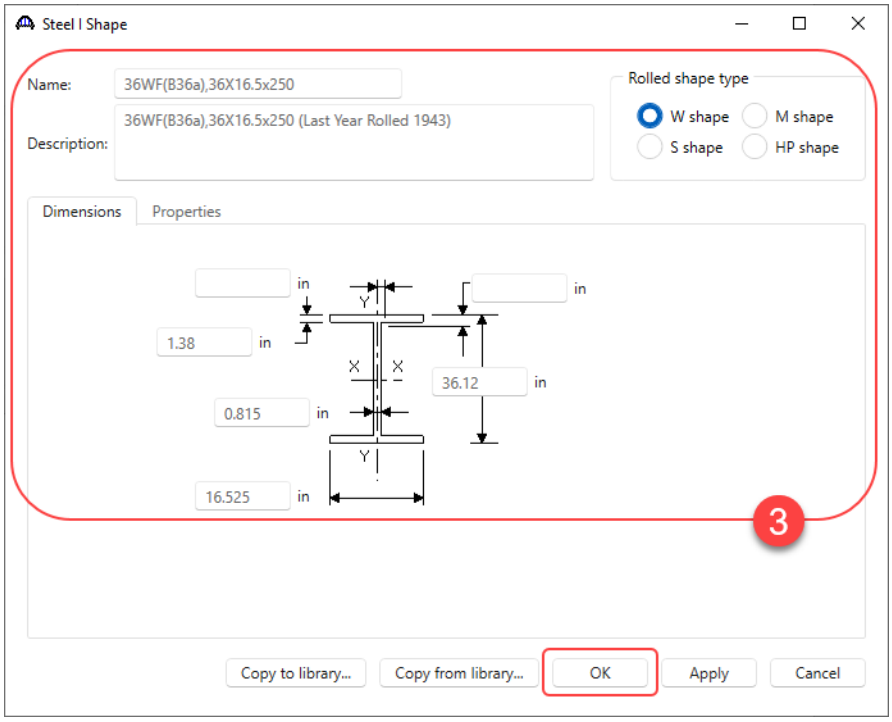
The next step is to enter bridge members. For this example, an old rolled steel beam section (36WF250) will be entered.

1. Expand the **Beam Shapes -> Steel Beam Shapes** and select **I Shapes**.

2. Double click on **I Shapes** or click on **New** from the **WORKSPACE** ribbon, or right click and select **New** from the menu to open the **Steel I Shape** window.

3. Enter the data as shown below and click **OK** to apply this data and close the window.


Bridge Workspace - IntroToBrDR
ANALYSIS
REPORTS
BRIDGE WORKSPACE
WORKSPACE
TOOLS
VIEW
HELP
DESIGN/RATE
REPORTING
Check Out
Check In
Validate
Save
Restore
Revert
Close
Export
Refresh
Open
New
Copy
Paste
Duplicate
Delete
Schematic
Bridge
Manage
Schematic Analysis
Workspace
Report
Bridge
Components
Components
Appurtenances
Beam Shapes
Prestress Shapes
Steel Shapes
Angles
Channels
I Shapes
Tees
Timber Sha
Connectors
Factors
LRFD Substruct
Materials
New
Analyze
View Summary Report
View Detailed Report
General Preferences
Close Bridge Workspace
1
2
2

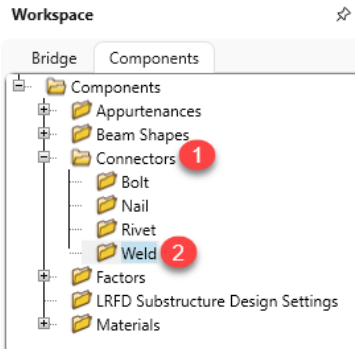

Steel I Shape
Name:
36WF(B36a),36X16.5x250
Description:
36WF(B36a),36X16.5x250 (Last Year Rolled 1943)
Rolled shape type
W shape
M shape
S shape
HP shape
Dimensions
Properties
in
1.38
in
0.815
in
16.525
in
36.12
in
X
X
Y
Y
3
Copy to library...
Copy from library...
OK
Apply
Cancel

Connectors

The next thing on the list is entering the connectors used in the bridge. The plans indicate that the diaphragm connector angles are connected to the girder flange by 100% electric welds. Since the angle is a 3/8” thick angle we will assume a 3/8” weld.

1. Expand the **Connectors** folder in the tree.

2. Double click on **Weld** to define the weld.



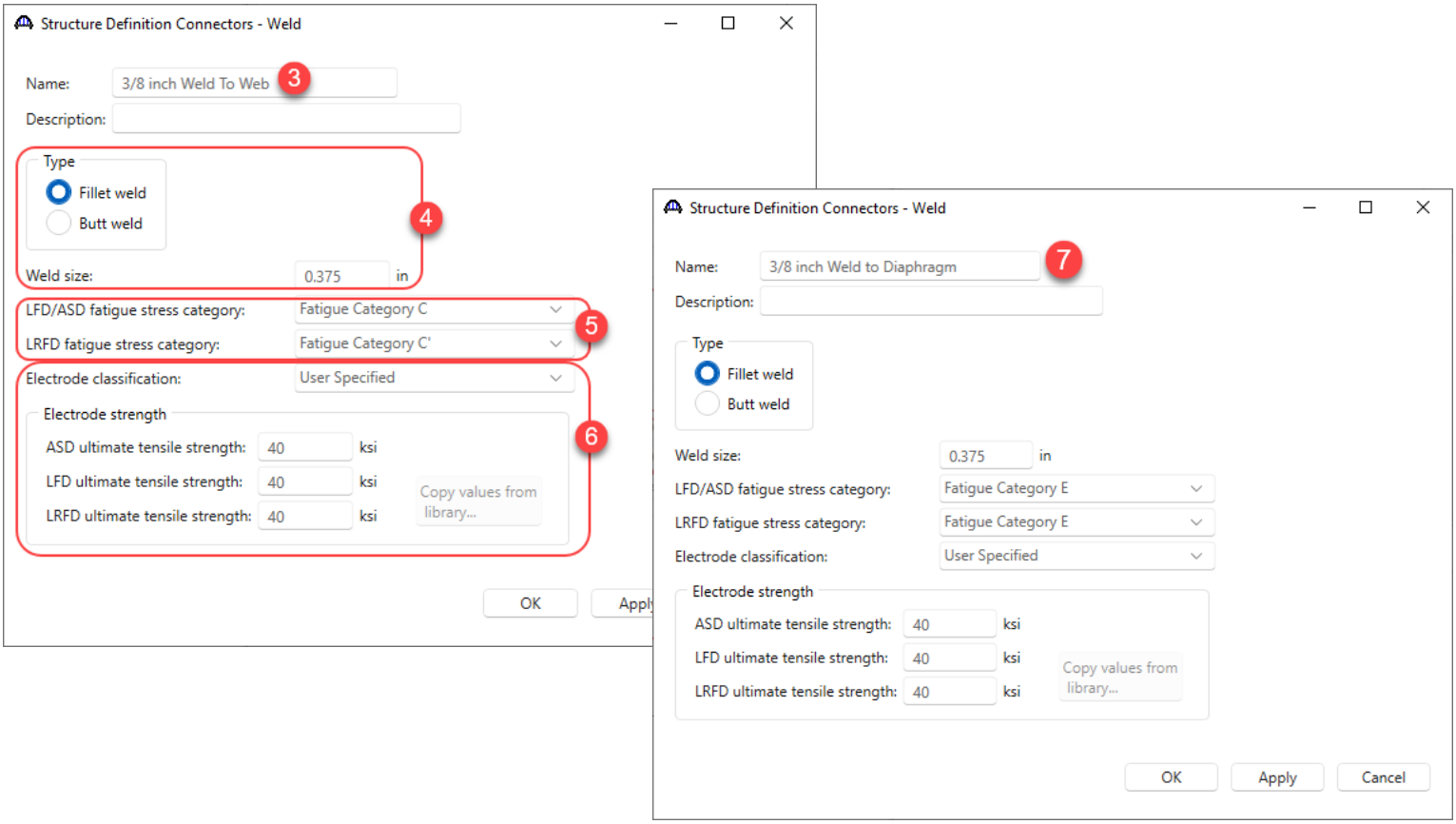
3. Enter the weld name.

4. Indicate that the weld will be a fillet weld and enter the weld size.

5. AASHTO indicates this weld falls under the C category.

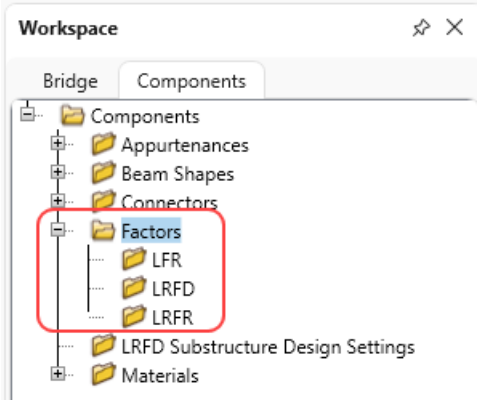
6. Will assume the weld to be of 40 ksi weld material. Requires a user specification.

7. Repeat this process to enter another weld definition for an E category 3/8” filled weld with same material. (See images below)



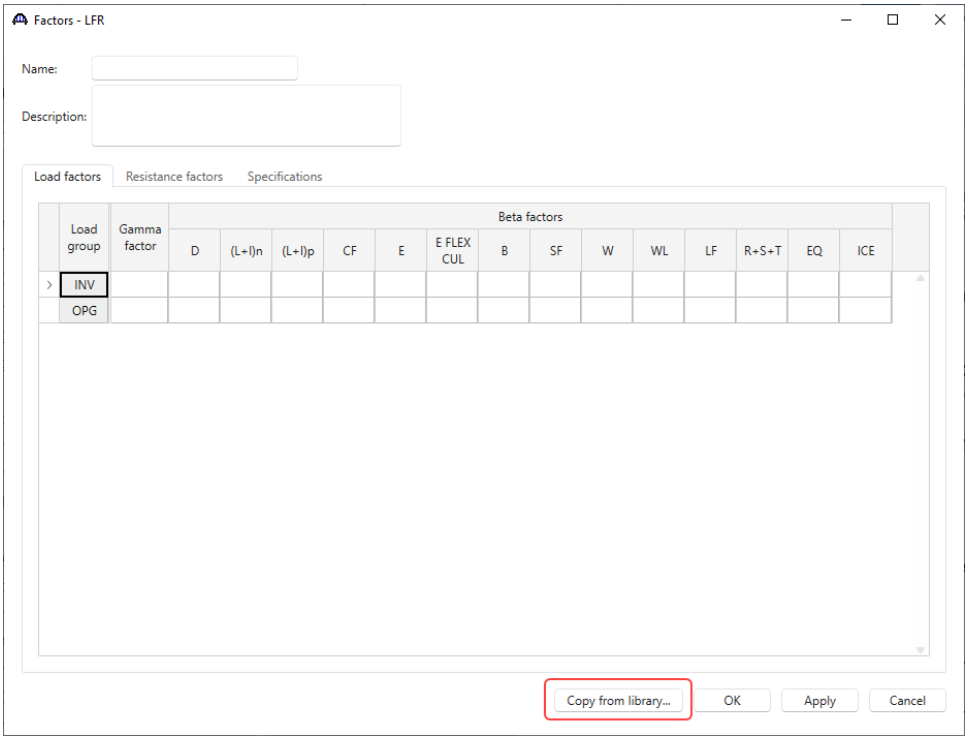
Load Factors

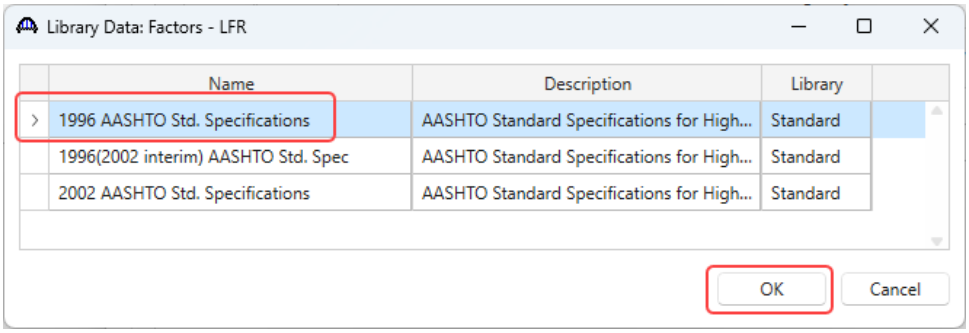
The next step is to enter load factors. The load factor input provides flexibility for states that may use different load factors. There are settings for LFR, LRFD and LRFR methods. When the **Factors** heading in the **Components** tree is expanded three methods will be listed. Double-clicking on each will open a window to enter the factors. As with prior components of the bridge data, you may copy these values from the library.



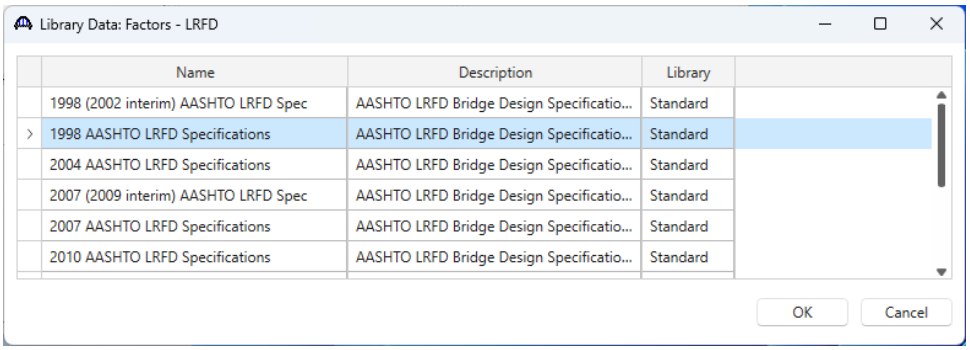
Use the **Copy from library…** button and copy the following specifications for LFR and LRFD.

LFR





LRFD

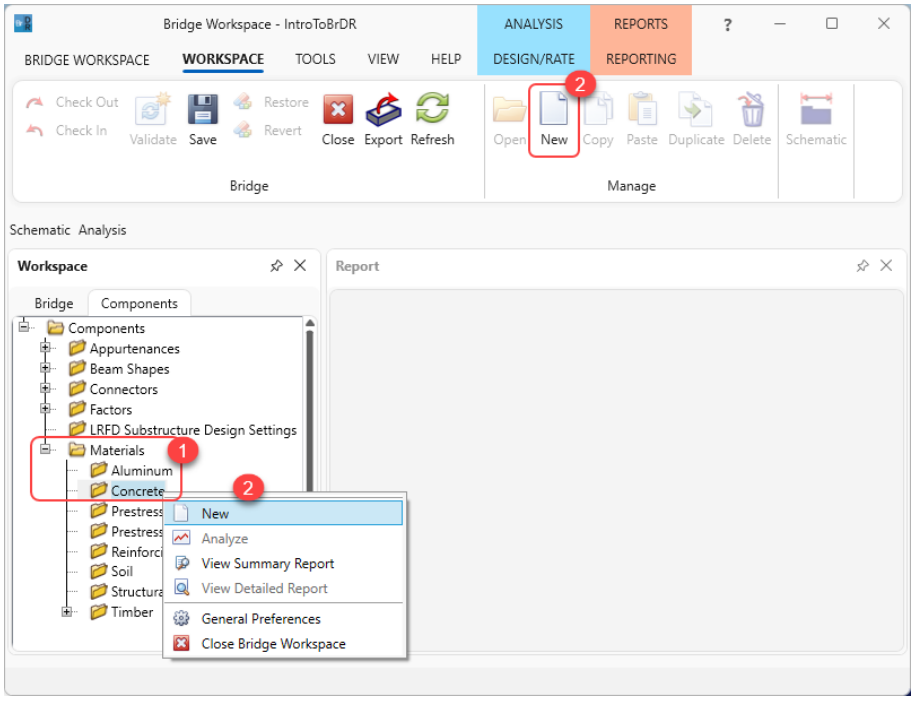


Materials

As stated earlier in this tutorial, the steel members were made somewhere around 1938 to 1939. The concrete used was Class “A” concrete, again from 1939. For this example, the strength of the concrete is assumed to be 3500 psi. The reinforcing steel used is also from the same period. With this information, let’s begin.

1. Expand the **Materials** list by clicking on the plus icon.

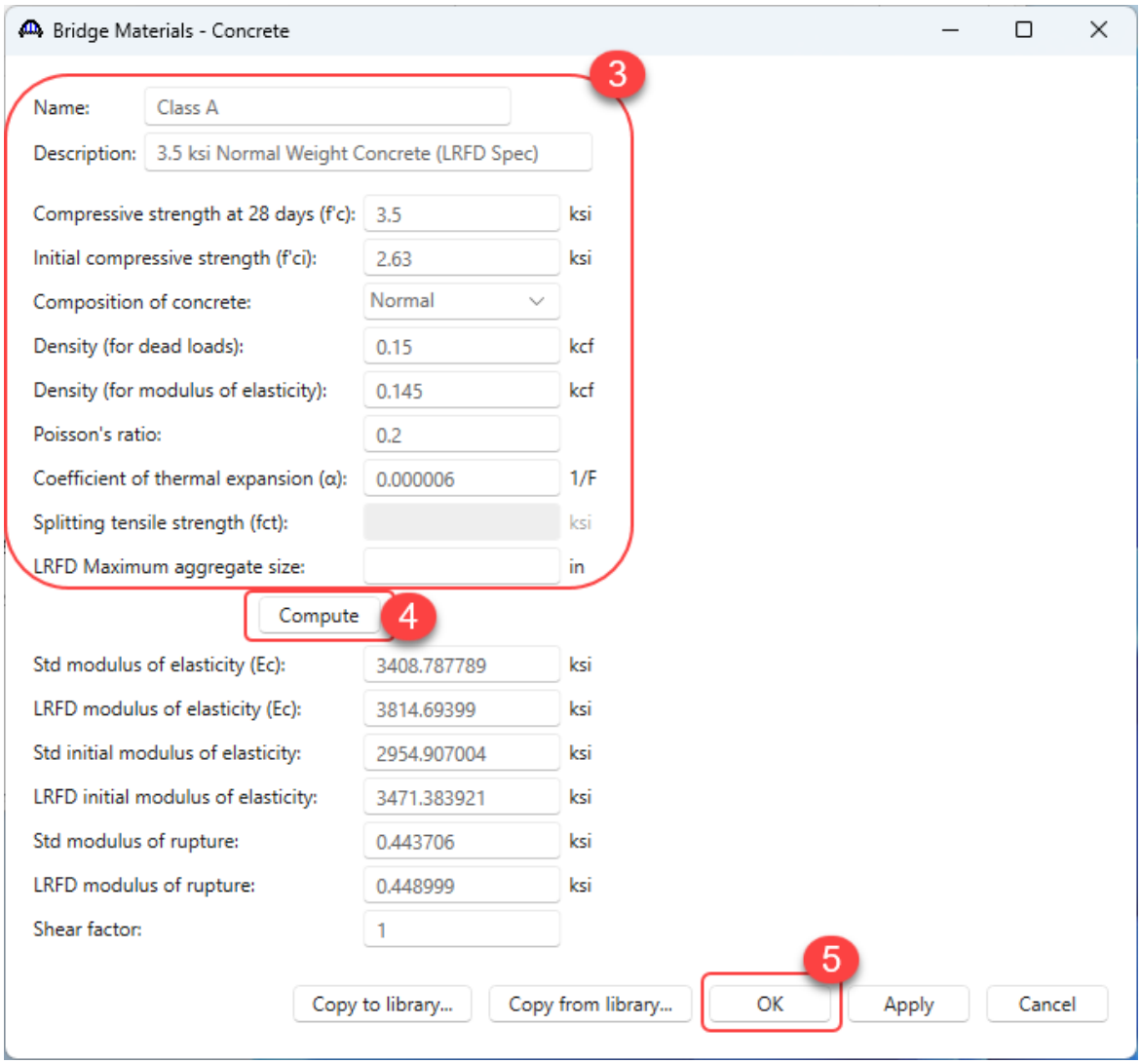
2. Double click on **Concrete** or click on **New** from the **WORKSPACE** ribbon, or right click and select **New** from the menu to open the **Bridge Materials - Concrete** window.



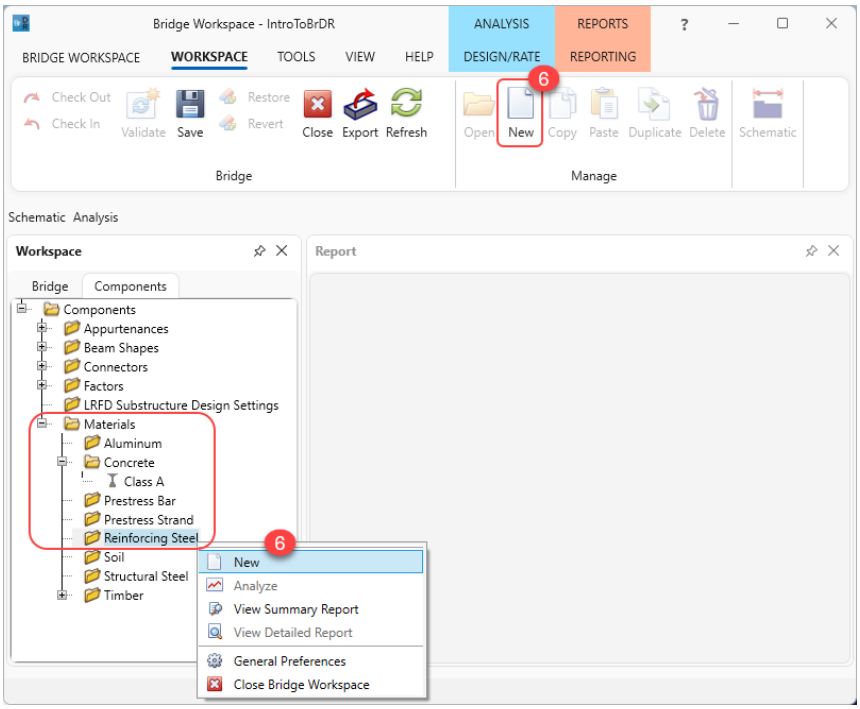
3. Enter the data above the **Compute** button as shown in the image below.

4. Click on the **Compute** button to compute the material properties based on the input.

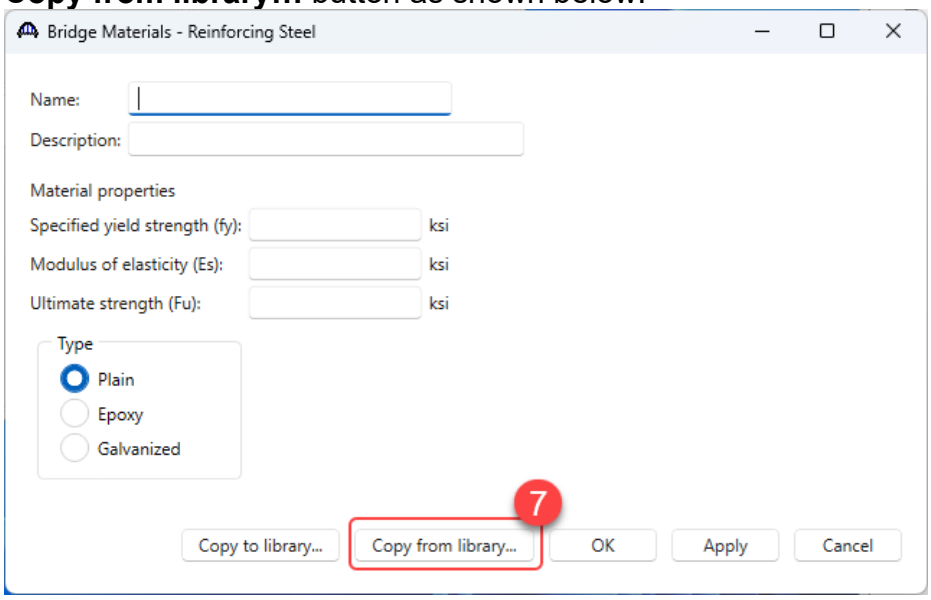
5. Click **OK** to apply this data and close the window.



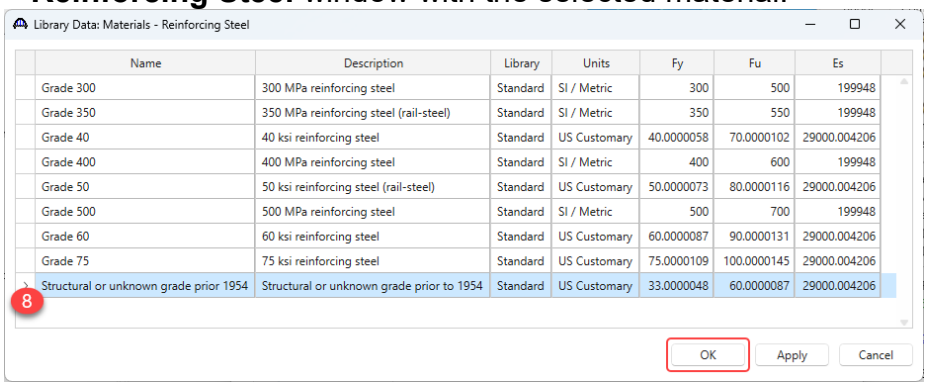
6. Similarly, to enter a reinforcing steel material, click on the **Reinforcing Steel** folder in the tree and select **New** from the **WORKSPACE** ribbon or right click and select **New** or double click on **Reinforcing Steel**. This step is the same as concrete and will be the same for any component in BrDR.



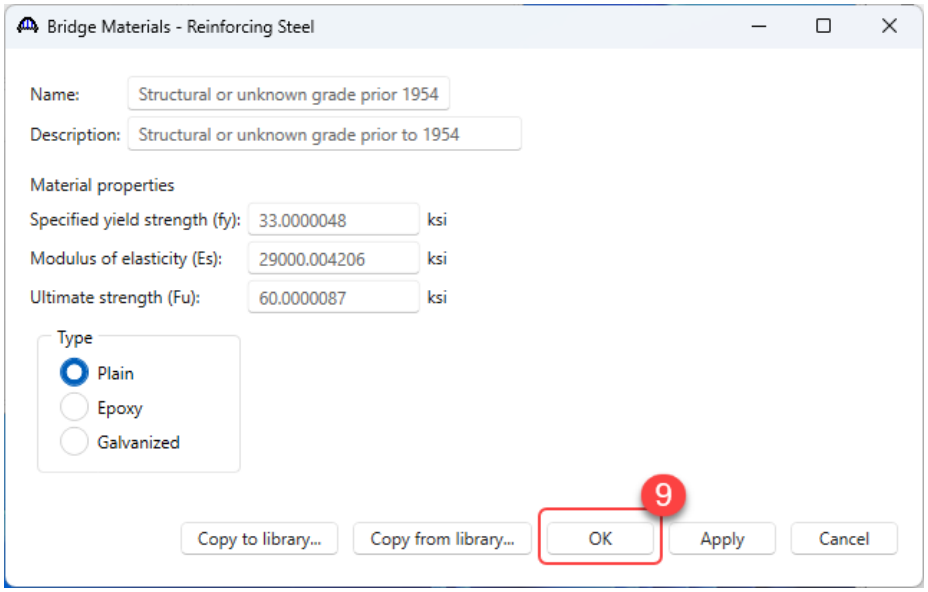
7. In the **Bridge Materials – Reinforcing Steel** window, click on the **Copy from library…** button as shown below.



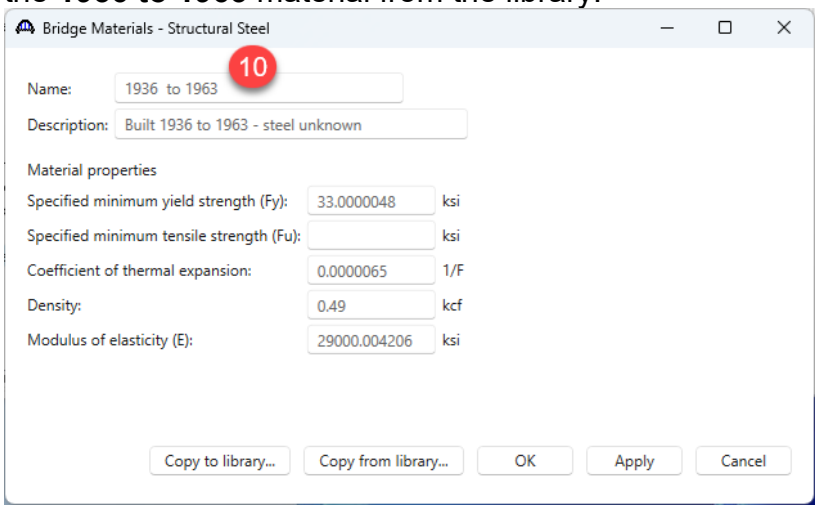
8. This opens the **Library Data – Reinforcing Steel window.** Since the steel installed was from 1939, select the **Structural or unknown grade prior to 1954** from the library and click on the **OK** button to close this window and update the **Bridge Materials – Reinforcing Steel** window with the selected material.



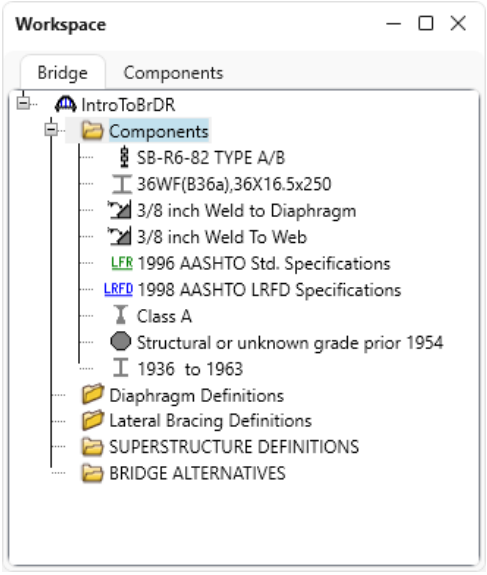
9. The updated window is shown below. Click **OK** to apply this material and close the window.



10. Similarly add the following **Structural Steel** material by copying the **1936 to 1963** material from the library.

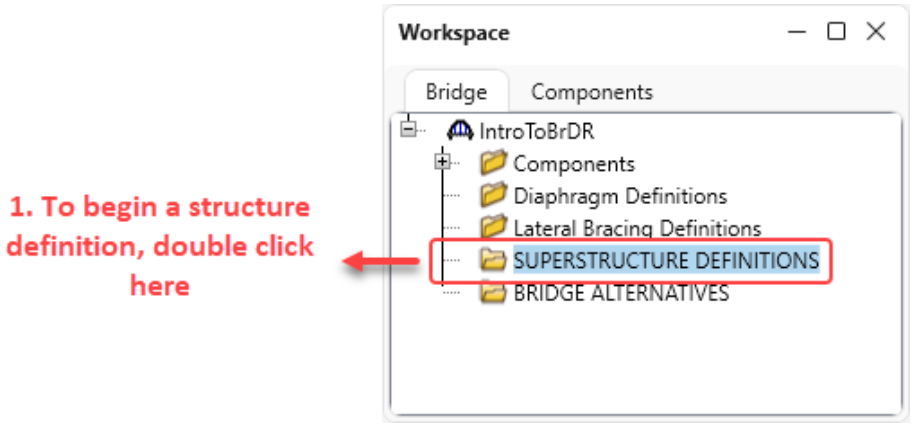


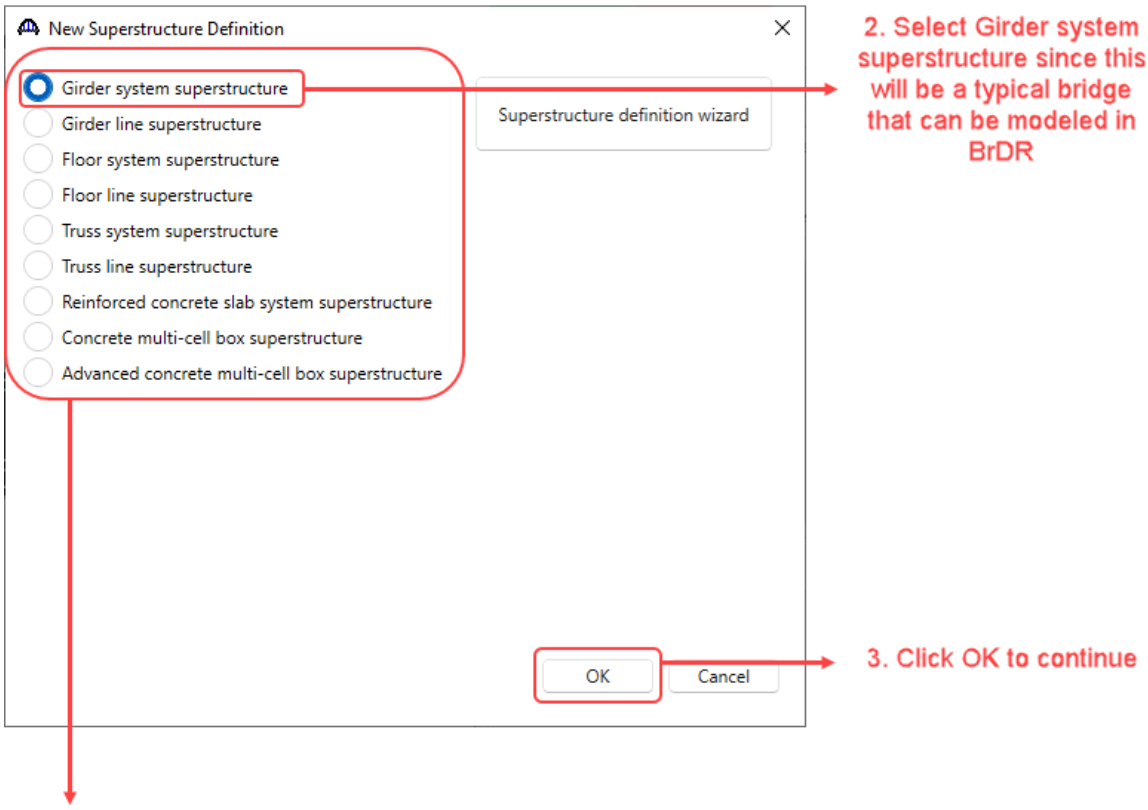
At this point the entering of all the supporting data for the bridge is completed. Navigate back to the **Bridge** tab of the **Bridge Workspace** tree. The **Components** folder should be updated as shown below.



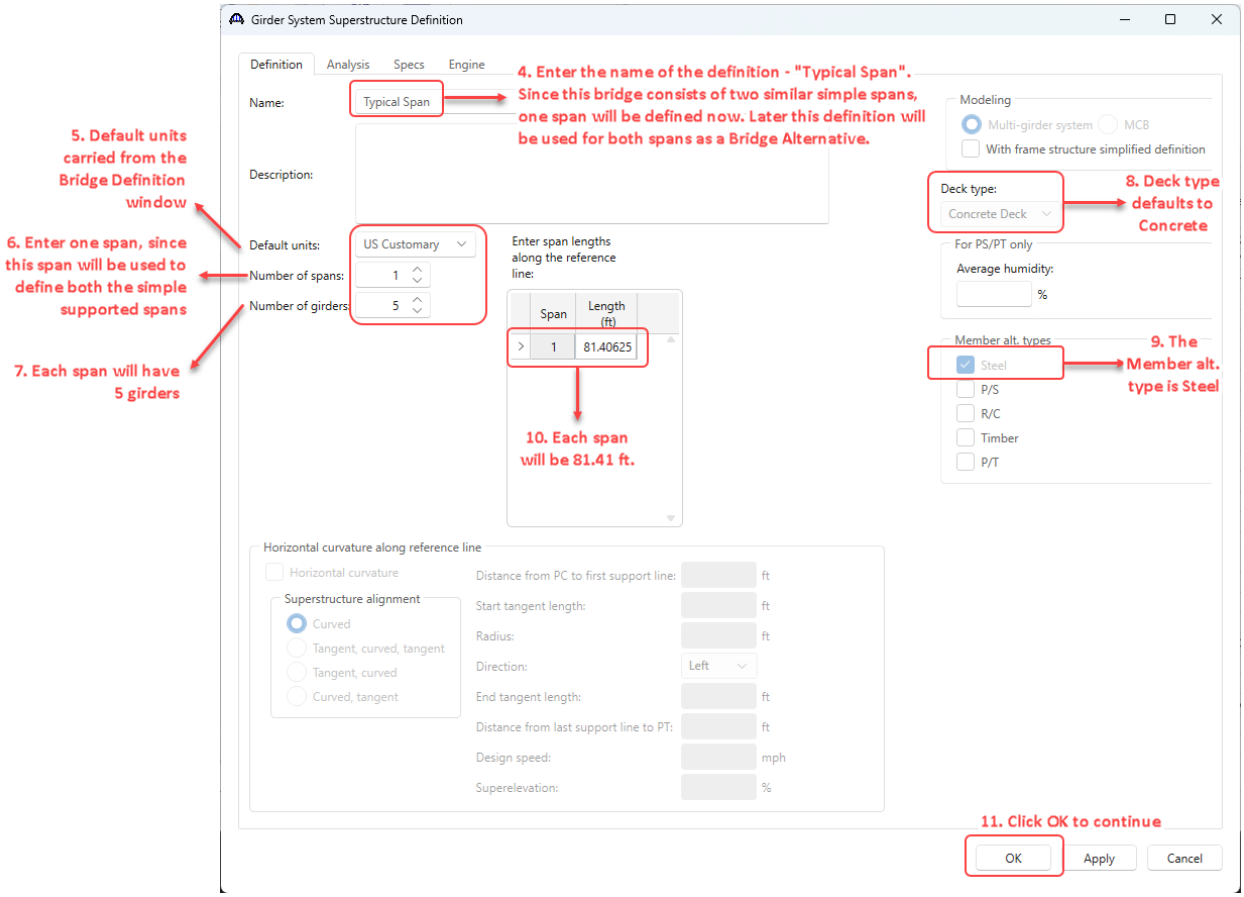
Creating a Bridge Definition – Defining the Superstructure

To start a new bridge definition, double click on the **SUPERSTRUCTURE DEFINITIONS** folder. This will initiate a window that has input options for entering the bridge dimensions and materials. It will also create a new branch of the tree which allows for the entry of more components for this definition.



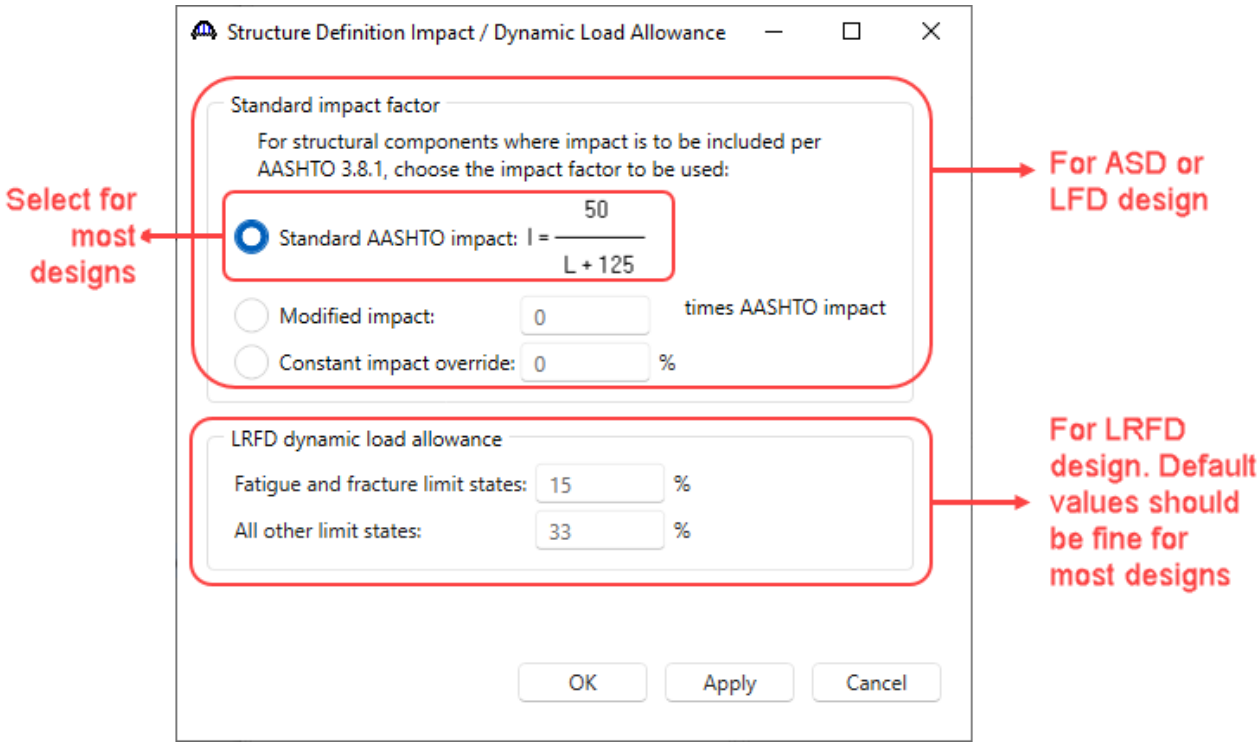


Superstructure types	
Girder system	Defines a set of girders within a cross section including each girders relationship to the others
Girder line	Defines a single girder as a standalone girder, independent of other girders within the cross section
Floor system	Defines a set of girders, floorbeams and stringers within a cross section, including each members relationship to others
Floor line	Defines a single girder, floorbeam and stringer as a standalone member, independent of the other members within the cross section
Truss system	Defines a set of trusses, floorbeams and stringers within a cross section, including each member's relationship to the others
Truss line	Defines a single truss, floorbeam and stringer as a standalone member, independent of the other members within the cross section
Reinforced concrete slab system	Defines a set of slabstrips within a cross section including each slabstrip's relationship to the others
Concrete multi-cell box	Defines a reinforced concrete or a post-tensioned multi-cell box superstructure
Advanced concrete multi-cell box	Defines an advanced post-tensioned multi-cell box superstructure


Girder System Superstructure Definition
Definition
Analysis
Specs
Engine
Name:
Typical Span
4. Enter the name of the definition - "Typical Span". Since this bridge consists of two similar simple spans, one span will be defined now. Later this definition will be used for both spans as a Bridge Alternative.
Description:
5. Default units carried from the Bridge Definition window
Default units:
US Customary
6. Enter one span, since this span will be used to define both the simple supported spans
Number of spans:
1
7. Each span will have 5 girders
Number of girders:
5
Enter span lengths along the reference line:
Span
Length (ft)
1
81.40625
10. Each span will be 81.41 ft.
Modeling
Multi-girder system
MCB
With frame structure simplified definition
Deck type:
Concrete Deck
8. Deck type defaults to Concrete
For PS/PT only
Average humidity:
%
Member alt. types
Steel
9. The Member alt. type is Steel
P/S
R/C
Timber
P/T
Horizontal curvature along reference line
Horizontal curvature
Superstructure alignment
Curved
Tangent, curved, tangent
Tangent, curved
Curved, tangent
Distance from PC to first support line:
Start tangent length:
Radius:
Direction:
Left
End tangent length:
Distance from last support line to PT:
Design speed:
Superelevation:
ft
mph
%
11. Click OK to continue
OK
Apply
Cancel

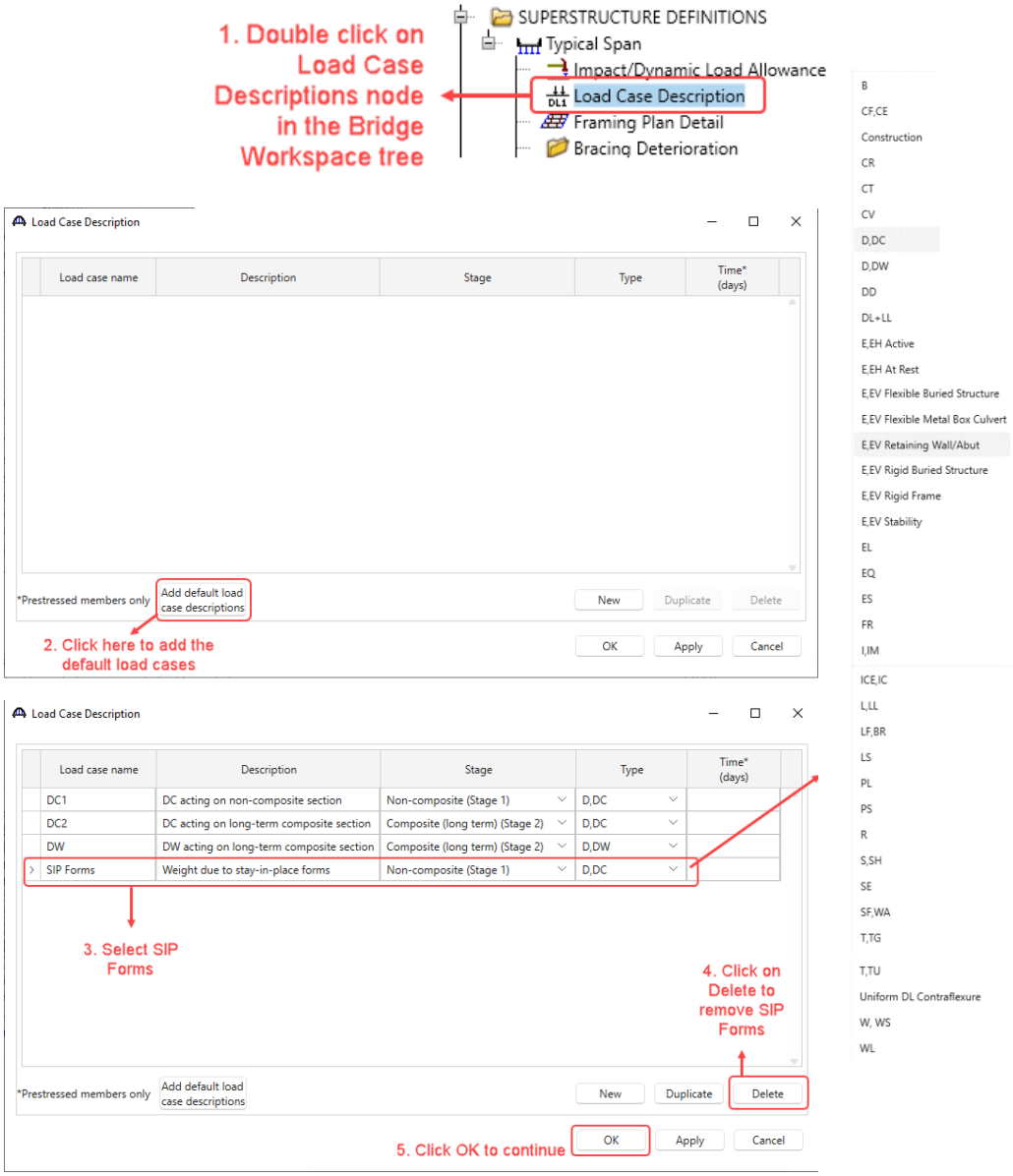
Bridge Impact / Dynamic Load Allowances

The first step in defining the superstructure is to define the Impact/Dynamic load allowance factors. These values may either be entered for Standard and/or LRFD specification or use the BrDR default values. For Allowable Stress Design or Load Factor Design, select a method for the standard impact factor. In this case the first radio button should be OK for most designs. For Load Resistance Factor Design, the default values should be OK for any typical design.



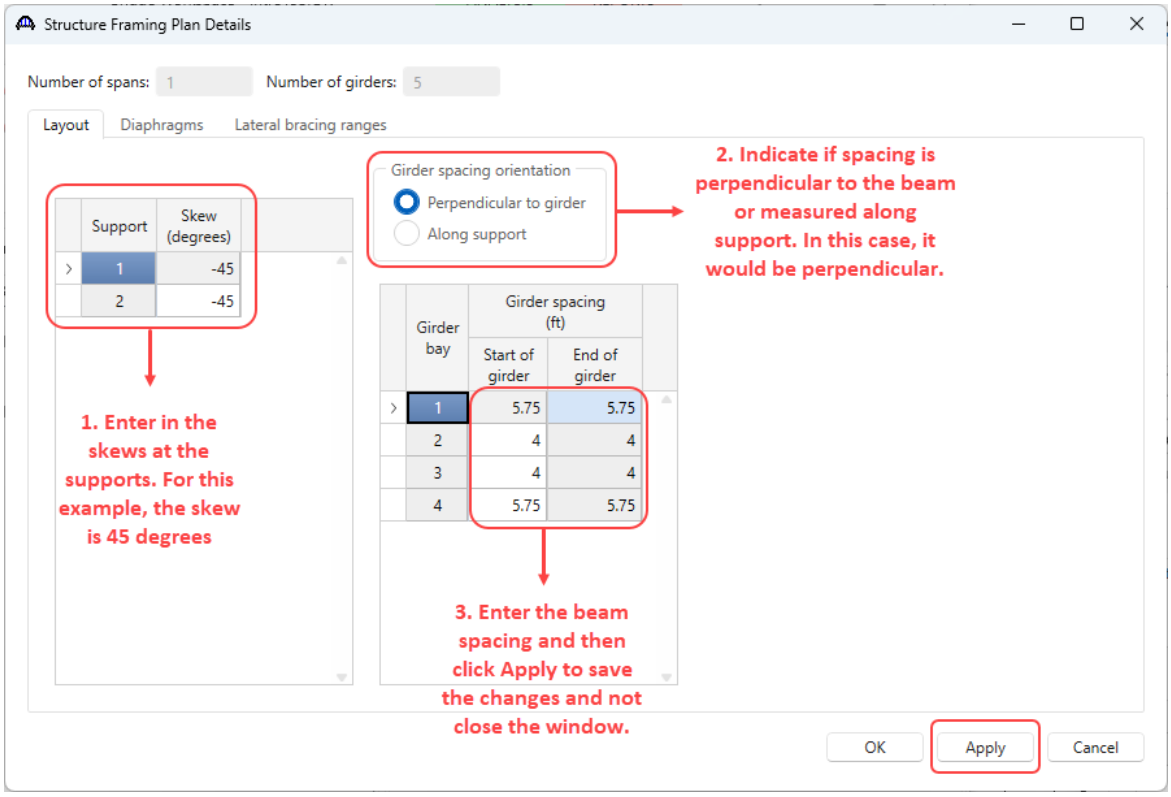
Load Case Description

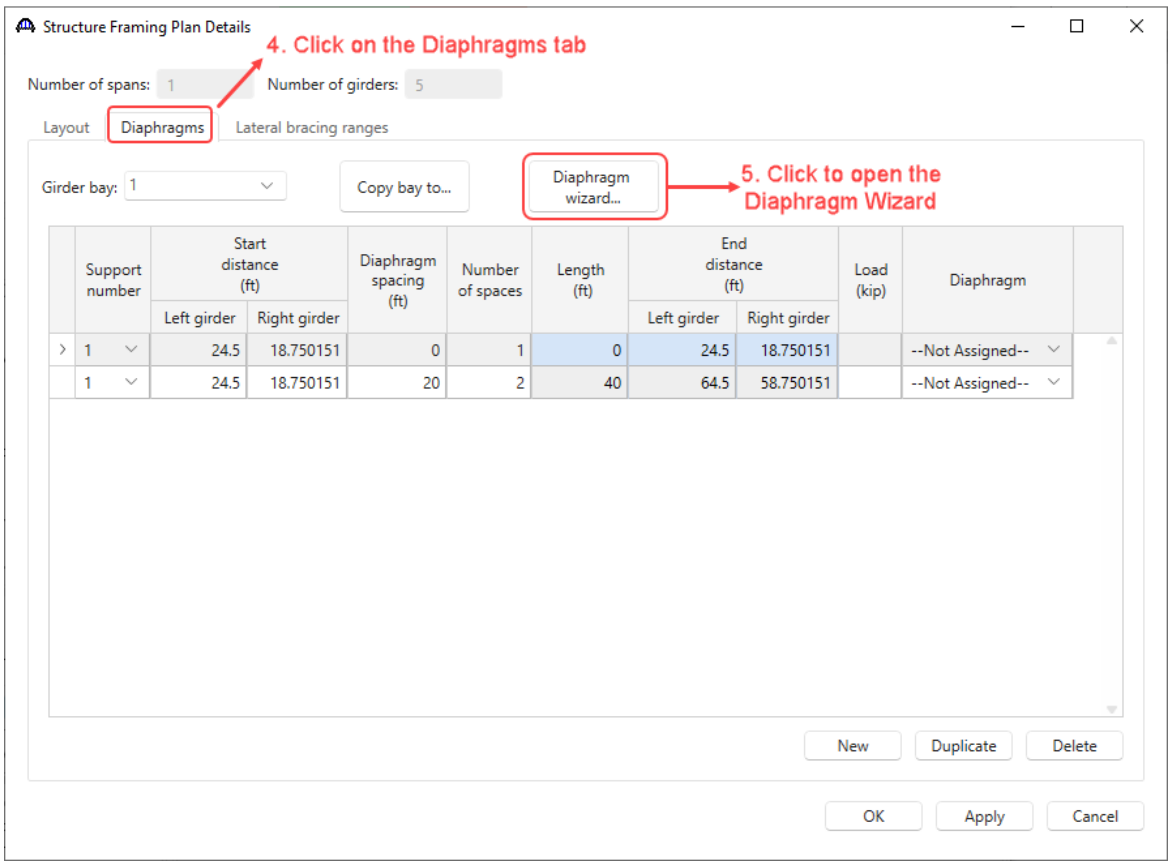
The next step is to enter Load Case Descriptions. BrDR provides a default list of load cases for all designs. This includes DC1, non-composite loads; DC2, composite superimposed loadings; DW, composite wearing surface loads; and SIP, non-composite stay in place forms. Any load case may be added , but each load case needs to fall under one of the three construction stages. Stage 1 are non-composite loadings; stage 2 are composite loadings under the long term and stage 3 are composite loadings under the short term. Accept the three first default load cases and delete the SIP load case. First, double click on **Load Case Description** to open the window.



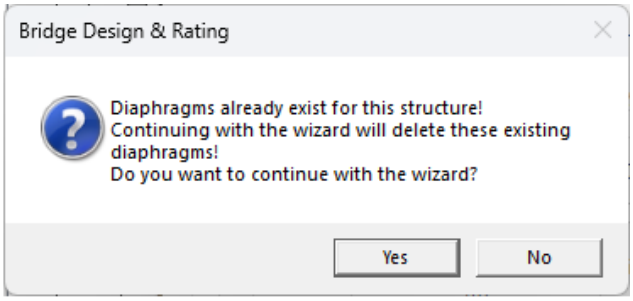
Framing Plan Details

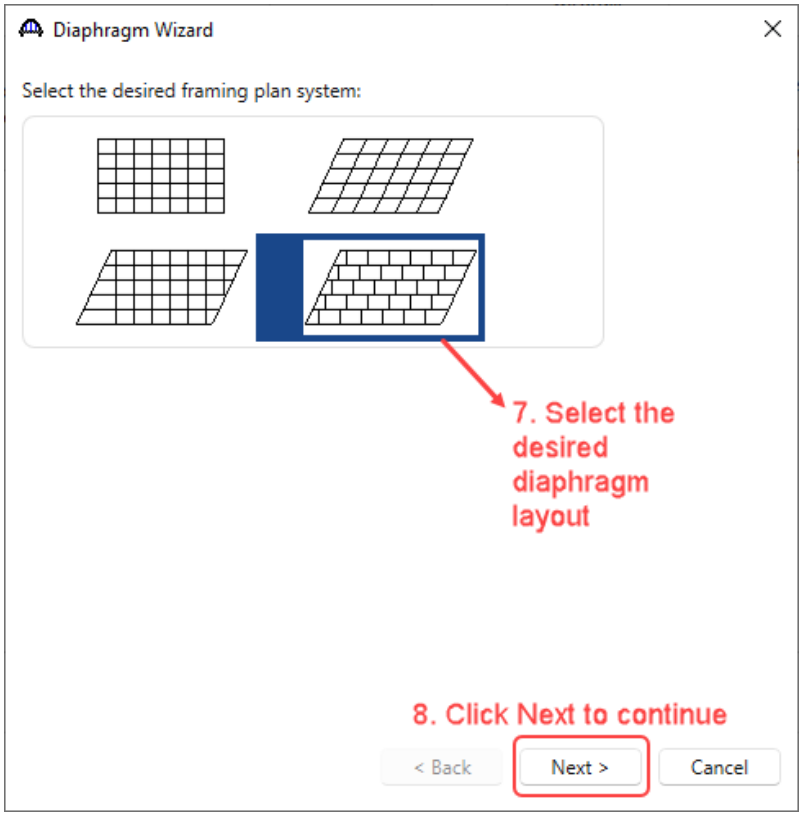
The next step is to define the framing plan. BrDR provides some tools to automate this process. The **Layout** tab provides the ability to enter the support skews and the beam spacing. The **Diaphragms** tab is used to enter the diaphragm locations. BrDR also helps make this process easy for a typical bridge, by providing a wizard to aid in this task. Start by double clicking on the **Framing Plan Details** node in the **Bridge Workspace** tree, then…

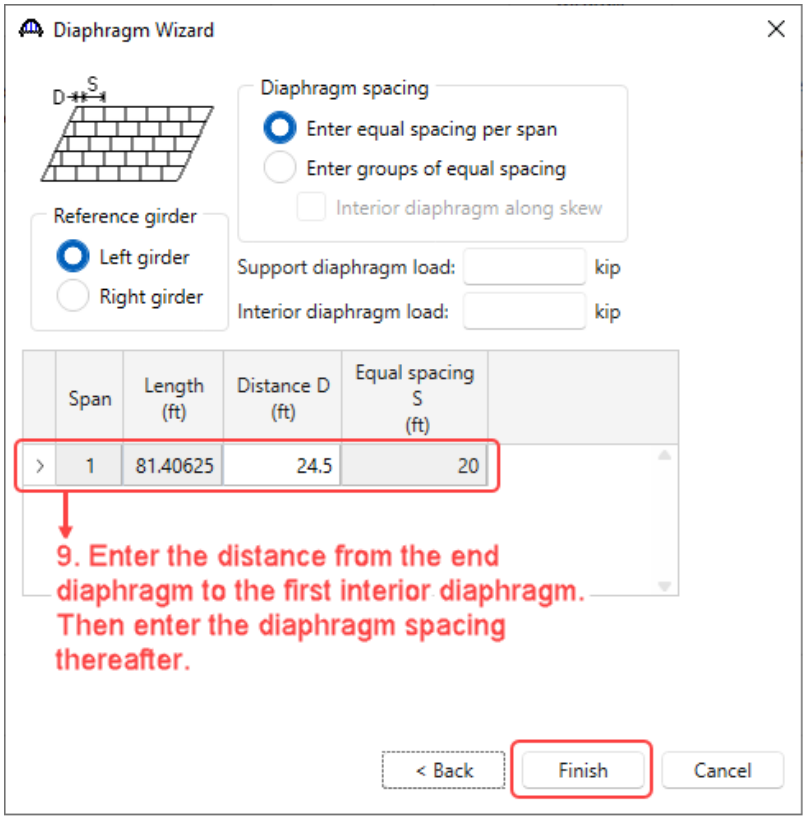




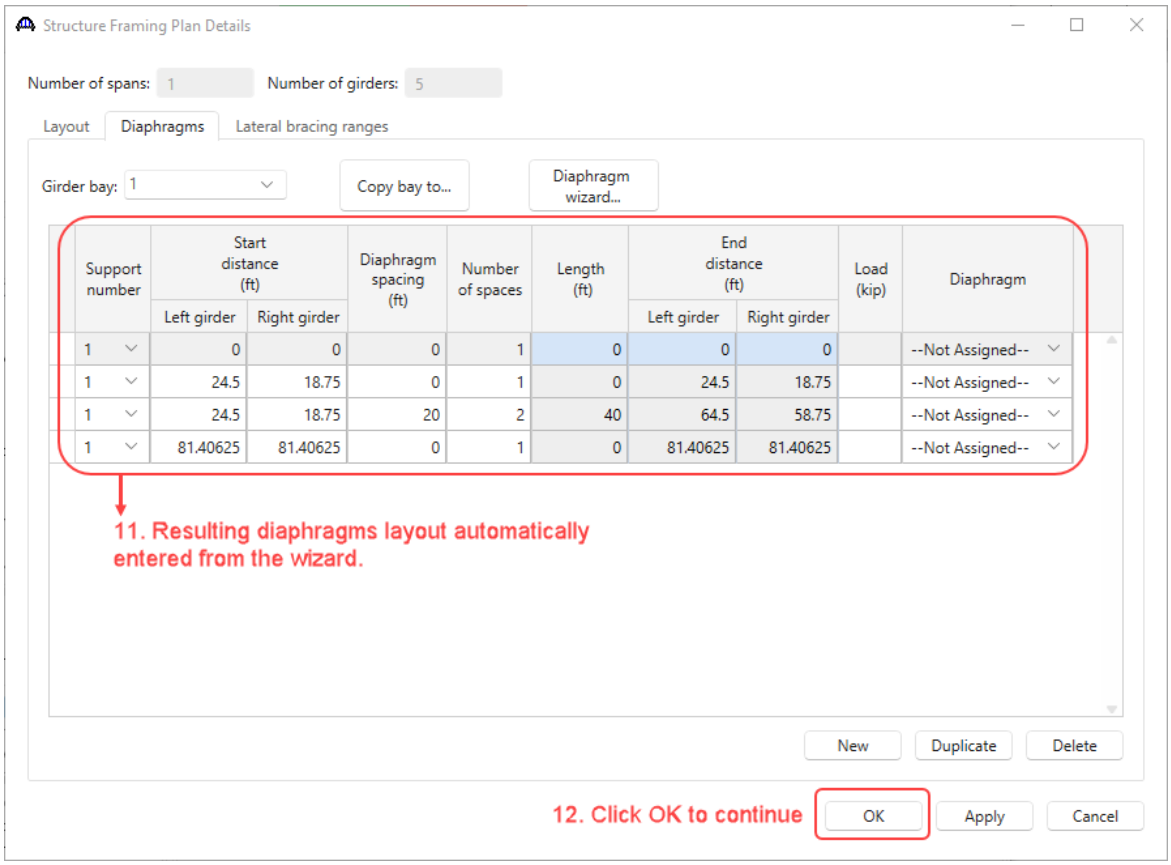
6. This window may pop, if there is any existing diaphragm data to indicate that the existing data will be deleted if continued. Click Yes to continue.





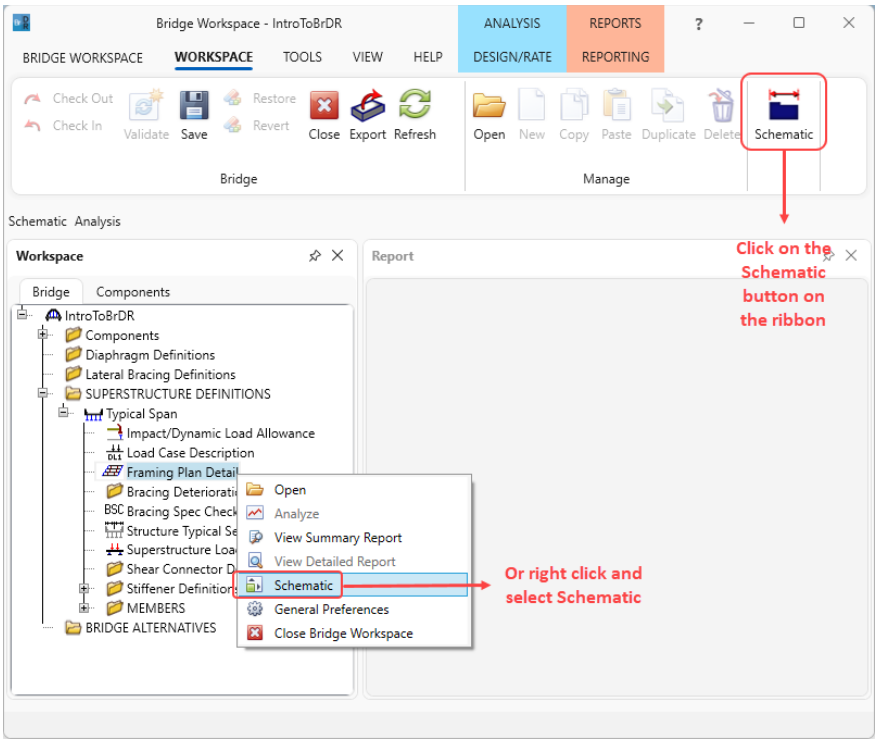


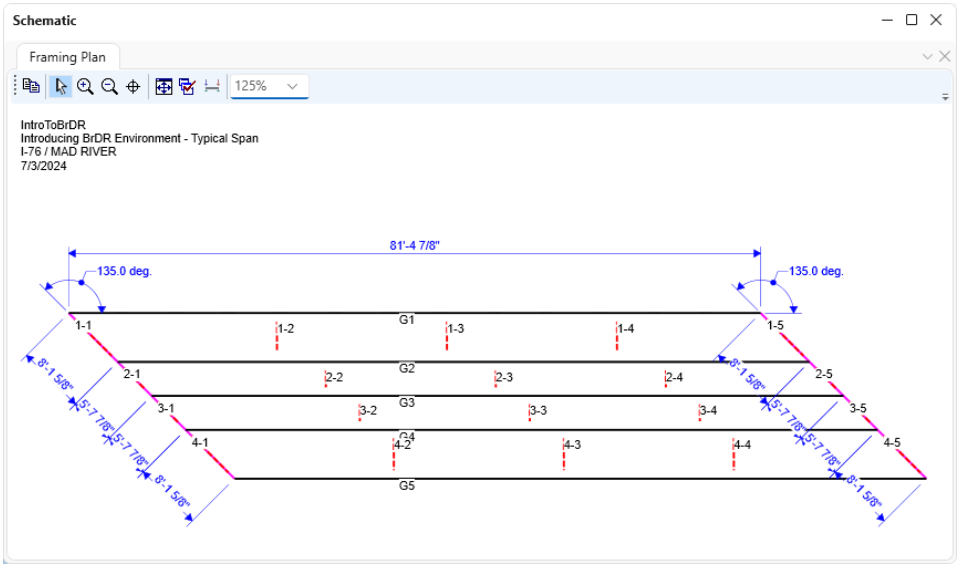
10. Click Finish to populate the diaphragm layout window.


Structure Framing Plan Details
Number of spans: 1
Number of girders: 5
Layout
Diaphragms
Lateral bracing ranges
Girder bay: 1
Copy bay to...
Diaphragm wizard...
Support number
Start distance (ft)
Left girder
Right girder
Diaphragm spacing (ft)
Number of spaces
Length (ft)
End distance (ft)
Left girder
Right girder
Load (kip)
Diaphragm
1 0 0 0 1 0 0 0 --Not Assigned--
1 24.5 18.75 0 1 0 24.5 18.75 --Not Assigned--
1 24.5 18.75 20 2 40 64.5 58.75 --Not Assigned--
1 81.40625 81.40625 0 1 0 81.40625 81.40625 --Not Assigned--
11. Resulting diaphragms layout automatically entered from the wizard.
New
Duplicate
Delete
12. Click OK to continue
OK
Apply
Cancel

Schematic - Framing Plan Details

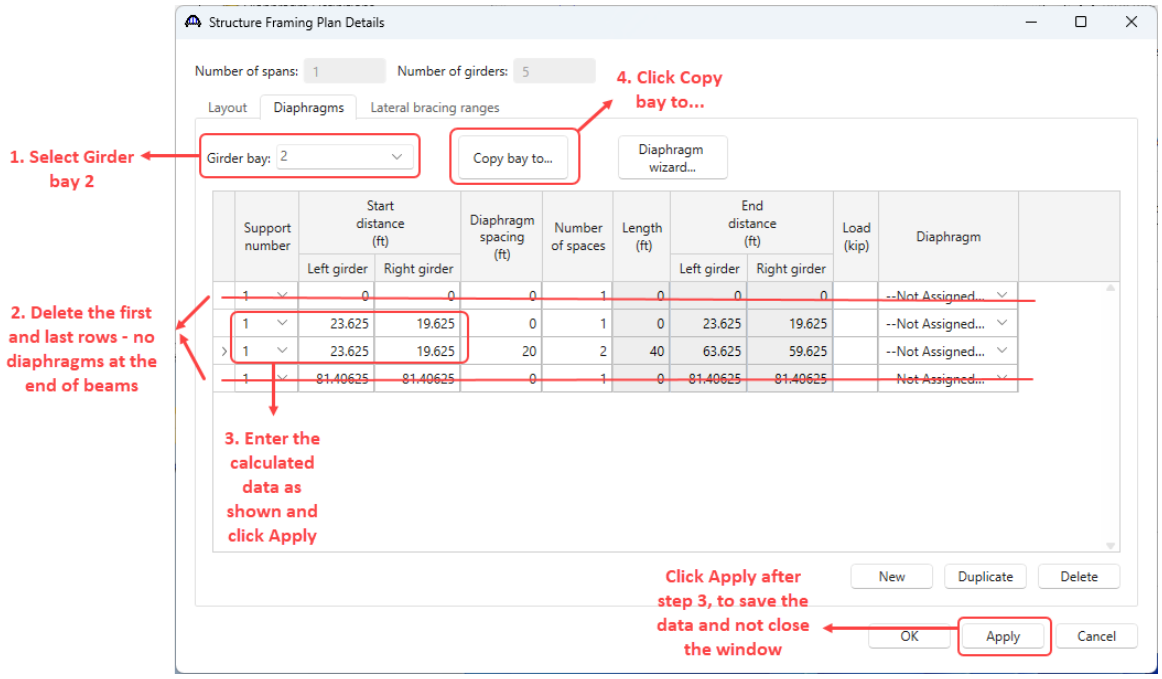
To view the framing plan schematic, right click the **Framing Plan Detail** node in the **Bridge Workspace** tree and select **Schematic** or click on the **Schematic** button from the **WORKSPACE** ribbon.

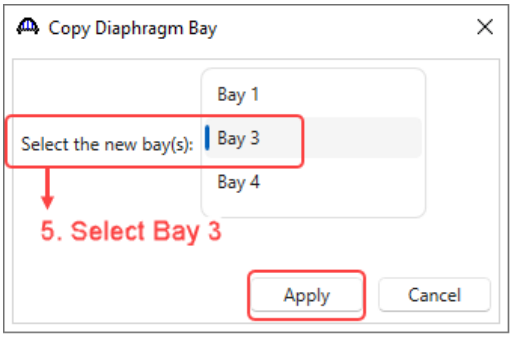


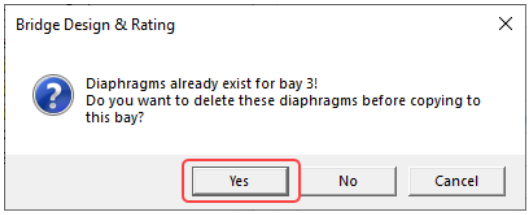


From the schematic it can be seen that the diaphragms are not entered correctly. The mid bays are incorrectly placed by the wizard. In this example, since the girders have uneven spacing, the mid-bays need to manually be fixed . The distance from the end of the left girder of the interior bays is 24'-6" + 4'-10.5" – 5'9" = 23'-7.5". Navigate to the **Diaphragms** tab of the **Framing Plan Detail** window and re-enter the data as described below.

Select **Girder bay 2**. With the dimension calculated above, we will correct the diaphragm spacing as shown. This process should be repeated for the third bay. To simplify this process, after entering Bay 2 data, click on the **Copy bay to**… button and copy the data to Bay 3. There are no end diaphragms, so they need to be deleted as shown in Step 2 for all 4 girder bays.

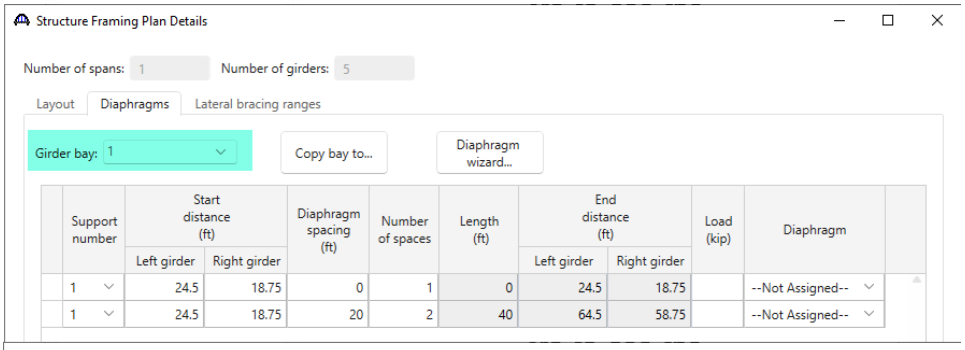


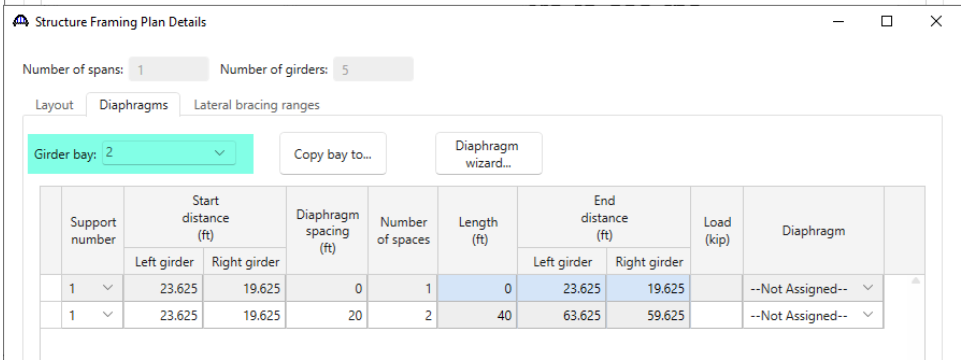


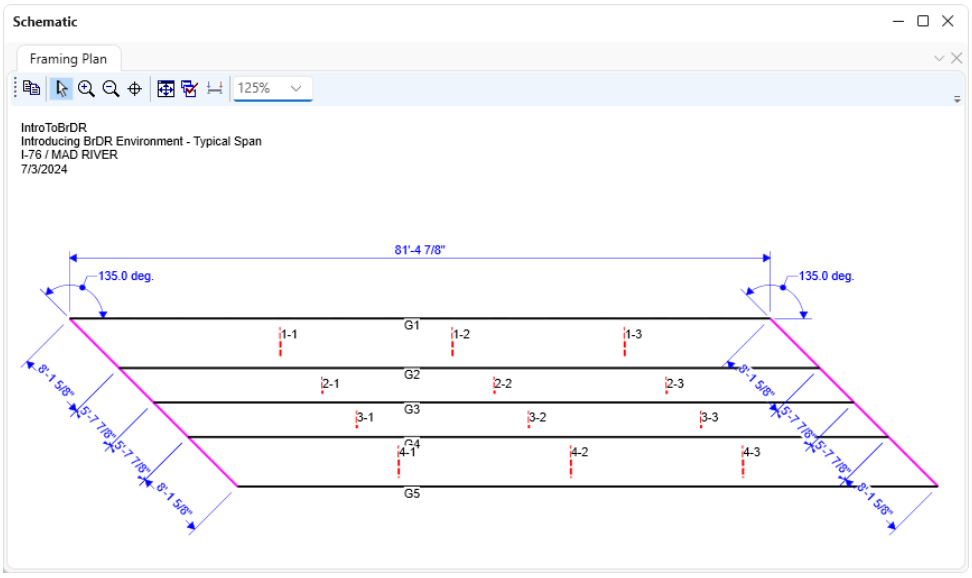


7. Click Yes to continue

Similarly make changes to Girder bay 1 as shown below and copy this bay to Bay 4. Once all the corrections are made, review the schematic once more to see the changes. The mid bay diaphragms should have moved closer to abutment 1. Girder Bay 1 (same as Bay 4) and 2 (same as Bay 3) and the resulting schematic from the changes made are shown below.

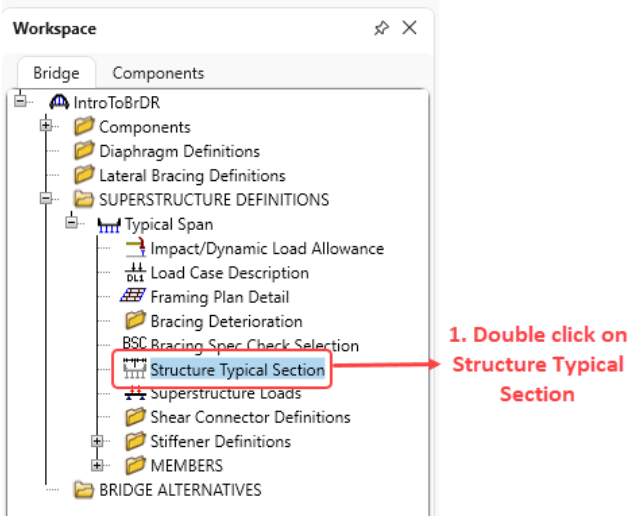


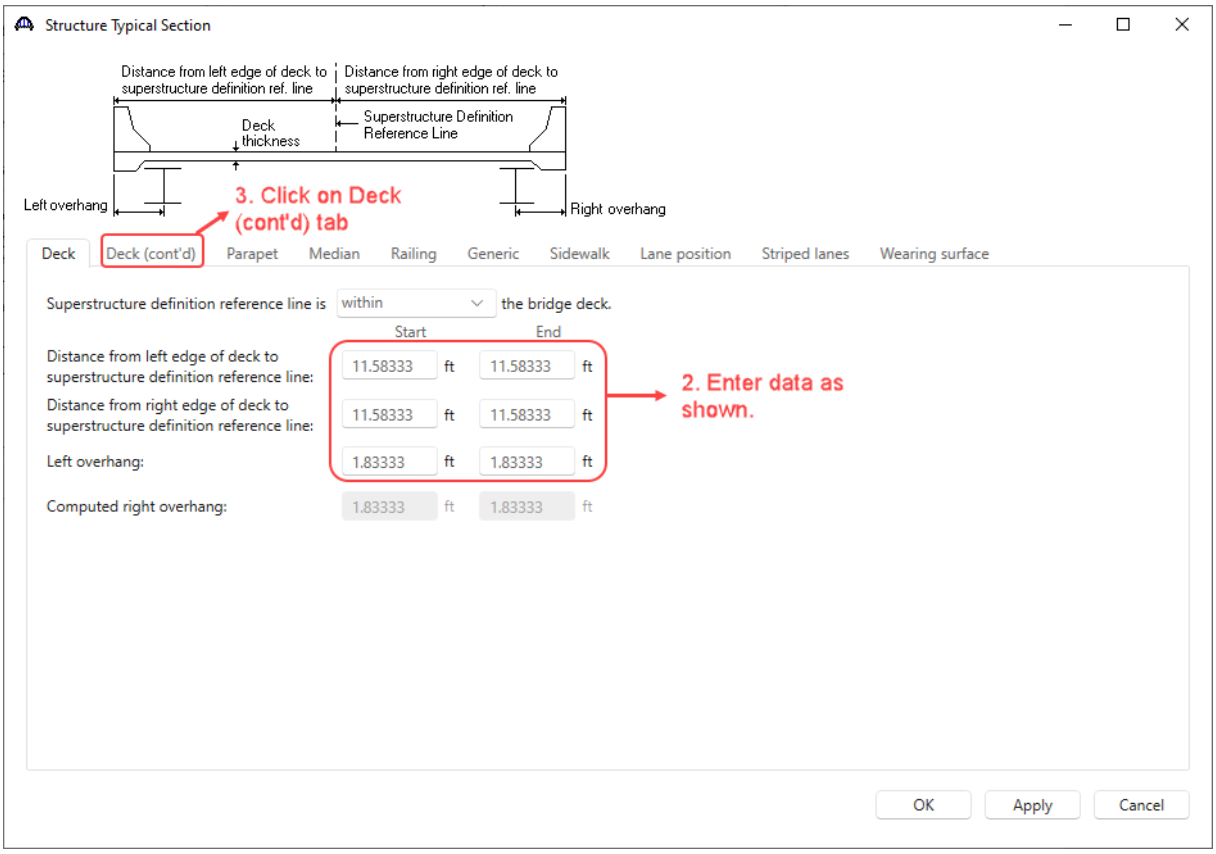


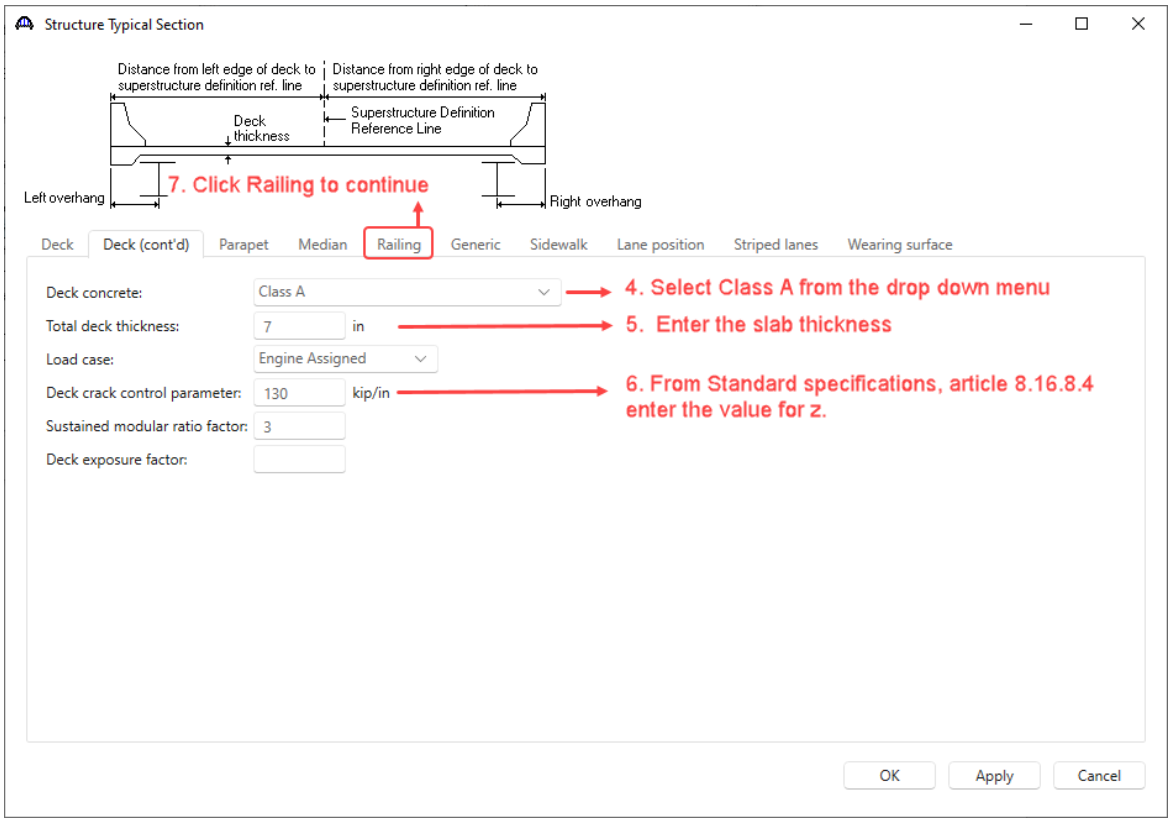


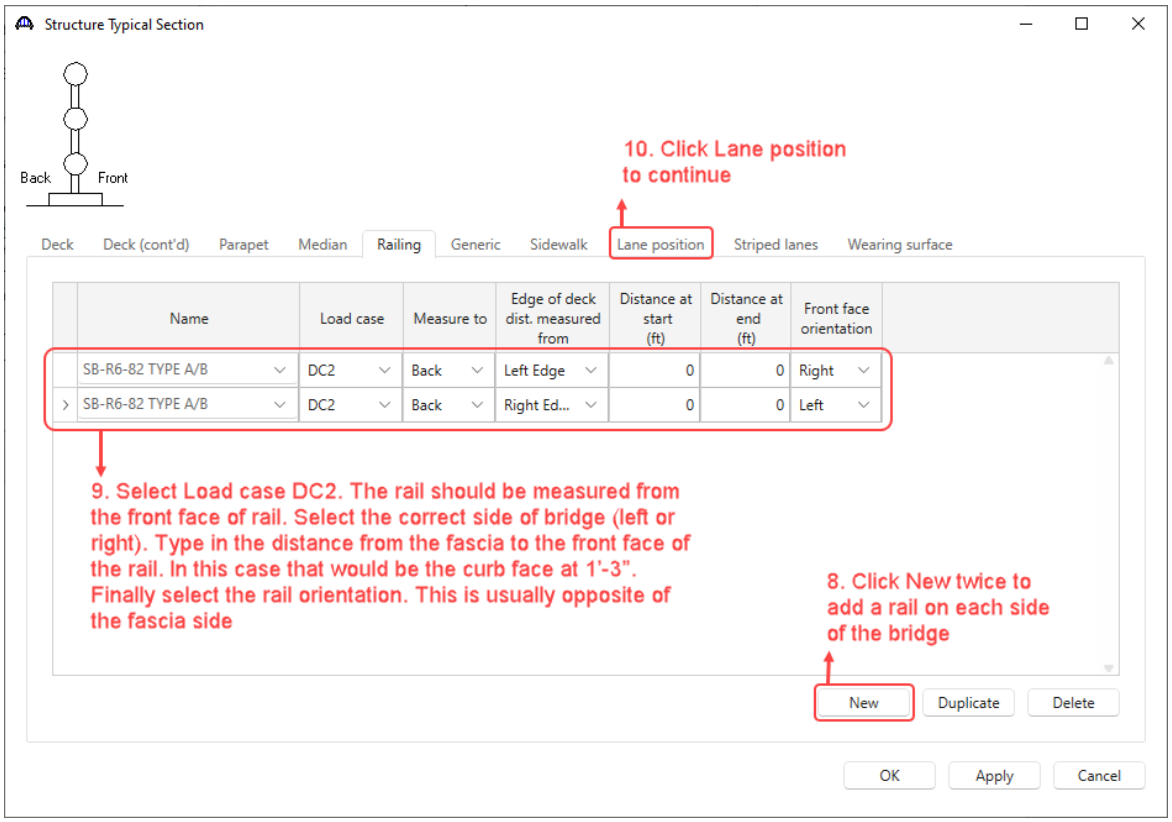
Structure Typical Section

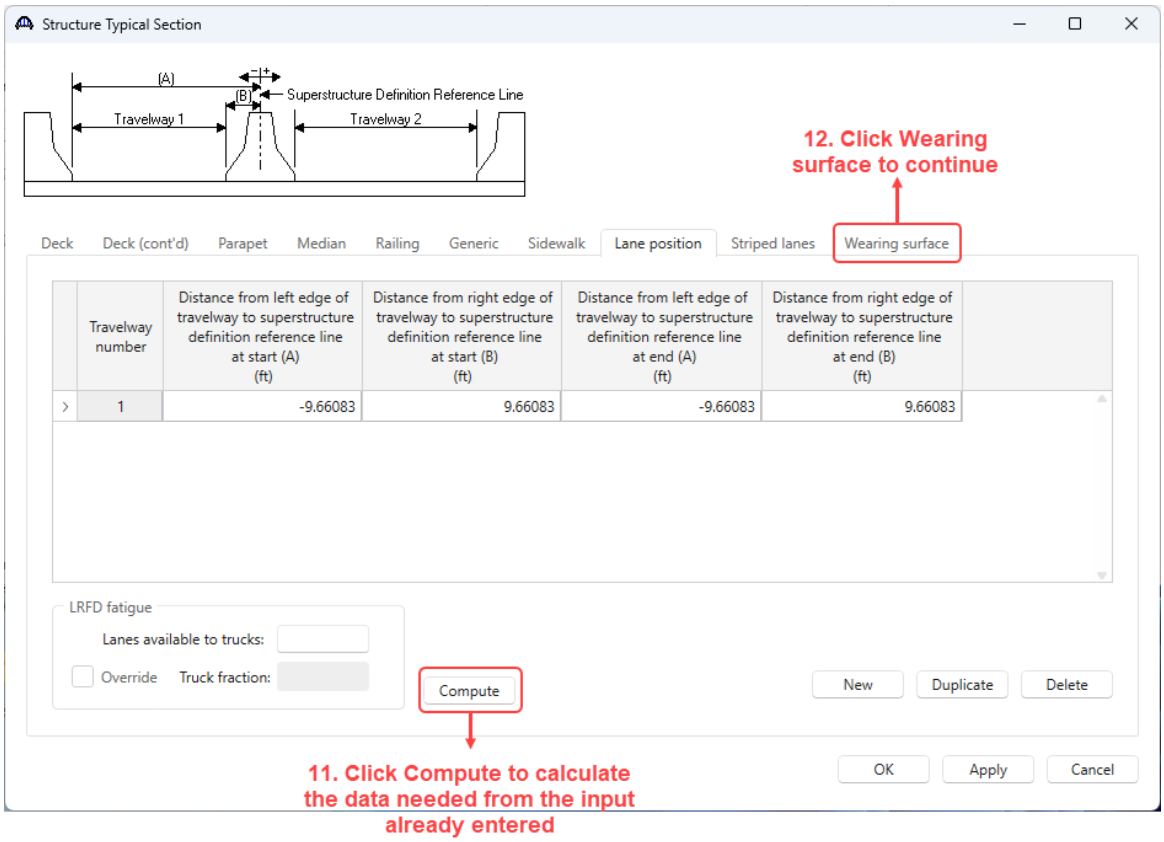
By double clicking on the **Structure Typical Section** node in the **Bridge Workspace** tree, you will be able to enter data regarding the bridge cross section. This includes items such as deck thickness, pavement, barriers, and sidewalks. The following procedure will guide you through this data entry.

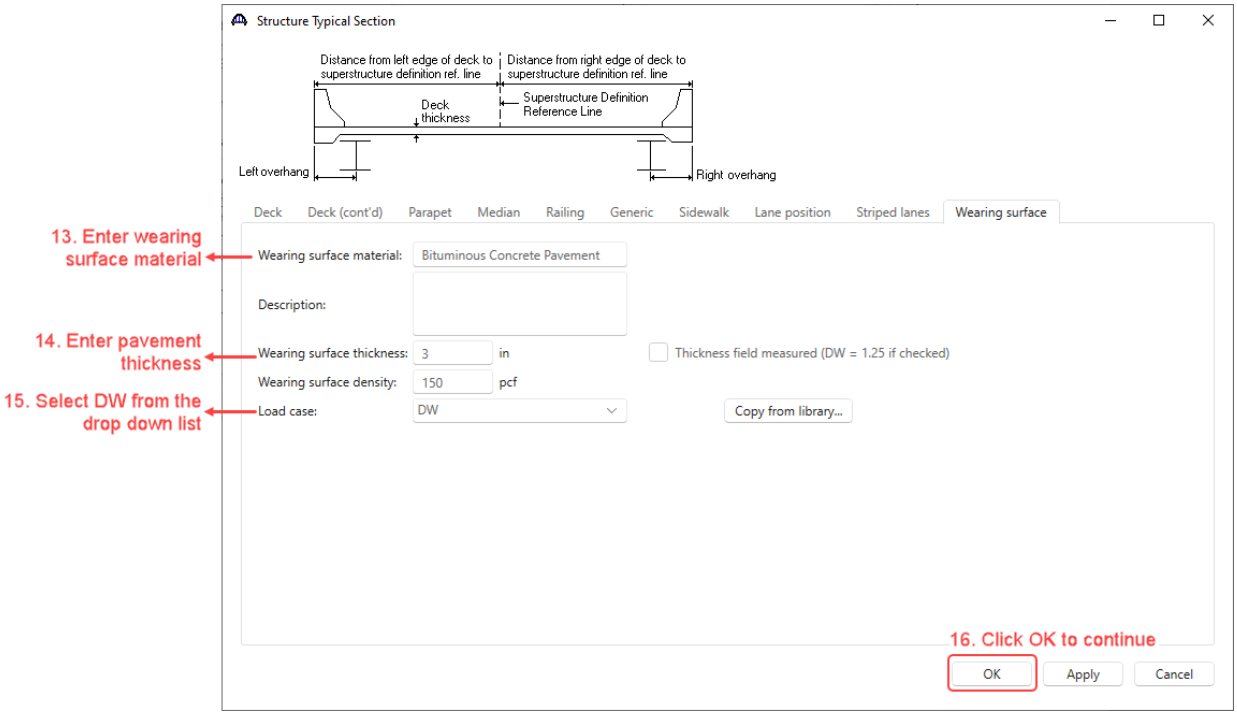



Structure Typical Section
Distance from left edge of deck to superstructure definition ref. line
Distance from right edge of deck to superstructure definition ref. line
Deck thickness
Superstructure Definition Reference Line
Left overhang
Right overhang
3. Click on Deck (cont'd) tab
Deck
Deck (cont'd)
Parapet
Median
Railing
Generic
Sidewalk
Lane position
Striped lanes
Wearing surface
Superstructure definition reference line is within the bridge deck.
Start
End
Distance from left edge of deck to superstructure definition reference line:
11.58333 ft 11.58333 ft
Distance from right edge of deck to superstructure definition reference line:
11.58333 ft 11.58333 ft
Left overhang:
1.83333 ft 1.83333 ft
Computed right overhang:
1.83333 ft 1.83333 ft
2. Enter data as shown.
OK
Apply
Cancel


Structure Typical Section
Distance from left edge of deck to superstructure definition ref. line
Distance from right edge of deck to superstructure definition ref. line
Deck thickness
Superstructure Definition Reference Line
Left overhang
Right overhang
7. Click Railing to continue
Deck
Deck (cont'd)
Parapet
Median
Railing
Generic
Sidewalk
Lane position
Striped lanes
Wearing surface
Deck concrete:
Class A
4. Select Class A from the drop down menu
Total deck thickness:
7
in
5. Enter the slab thickness
Load case:
Engine Assigned
Deck crack control parameter:
130
kip/in
6. From Standard specifications, article 8.16.8.4 enter the value for z.
Sustained modular ratio factor:
3
Deck exposure factor:
OK
Apply
Cancel

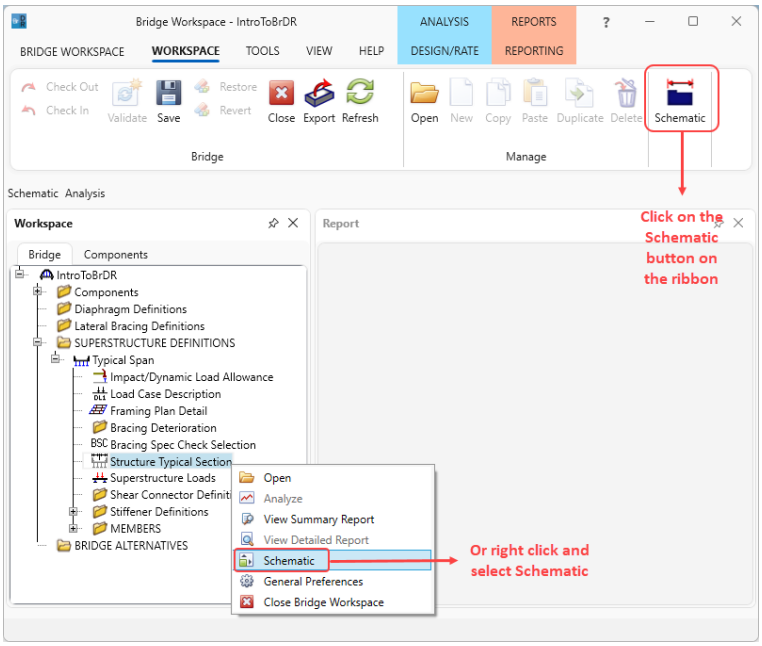

Structure Typical Section
Back
Front
10. Click Lane position to continue
Deck
Deck (cont'd)
Parapet
Median
Railing
Generic
Sidewalk
Lane position
Striped lanes
Wearing surface
Name
Load case
Measure to
Edge of deck dist. measured from
Distance at start (ft)
Distance at end (ft)
Front face orientation
SB-R6-82 TYPE A/B
DC2
Back
Left Edge
0
0
Right
SB-R6-82 TYPE A/B
DC2
Back
Right Ed...
0
0
Left
9. Select Load case DC2. The rail should be measured from the front face of rail. Select the correct side of bridge (left or right). Type in the distance from the fascia to the front face of the rail. In this case that would be the curb face at 1'-3". Finally select the rail orientation. This is usually opposite of the fascia side
8. Click New twice to add a rail on each side of the bridge
New
Duplicate
Delete
OK
Apply
Cancel

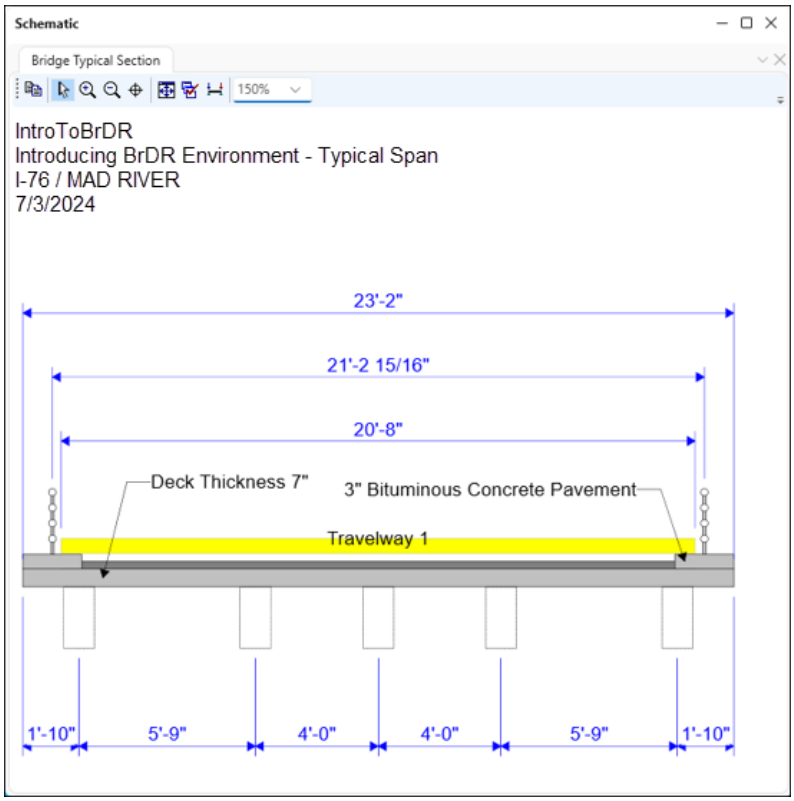

Structure Typical Section
(A)
(B)
Superstructure Definition Reference Line
Travelway 1
Travelway 2
12. Click Wearing surface to continue
Deck
Deck (cont'd)
Parapet
Median
Railing
Generic
Sidewalk
Lane position
Striped lanes
Wearing surface
Travelway number
Distance from left edge of travelway to superstructure 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
-9.66083
9.66083
-9.66083
9.66083
LRFD fatigue
Lanes available to trucks:
Override
Truck fraction:
Compute
New
Duplicate
Delete
11. Click Compute to calculate the data needed from the input already entered
OK
Apply
Cancel


Structure Typical Section
Distance from left edge of deck to superstructure definition ref. line
Distance from right edge of deck to superstructure definition ref. line
Deck thickness
Superstructure Definition Reference Line
Left overhang
Right overhang
Deck
Deck (cont'd)
Parapet
Median
Railing
Generic
Sidewalk
Lane position
Striped lanes
Wearing surface
13. Enter wearing surface material
Wearing surface material:
Bituminous Concrete Pavement
Description:
14. Enter pavement thickness
Wearing surface thickness:
3
in
Thickness field measured (DW = 1.25 if checked)
Wearing surface density:
150
pcf
15. Select DW from the drop down list
Load case:
DW
Copy from library...
16. Click OK to continue
OK
Apply
Cancel

Schematic – Structure Typical Section

To view the typical section schematic, right click the **Structure Typical Section** node in the **Bridge Workspace** tree and select **Schematic** or click on the **Schematic** button from the **WORKSPACE** ribbon.



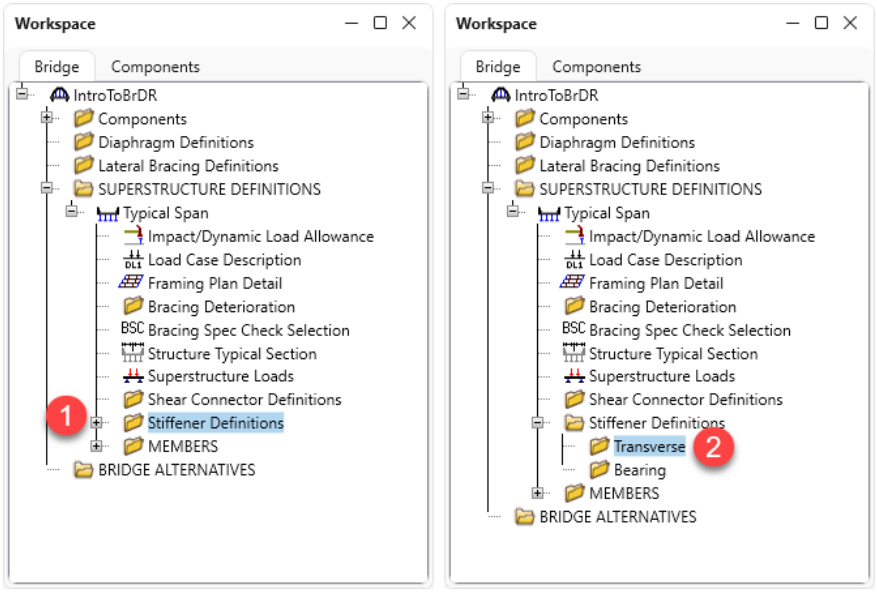


Stiffeners

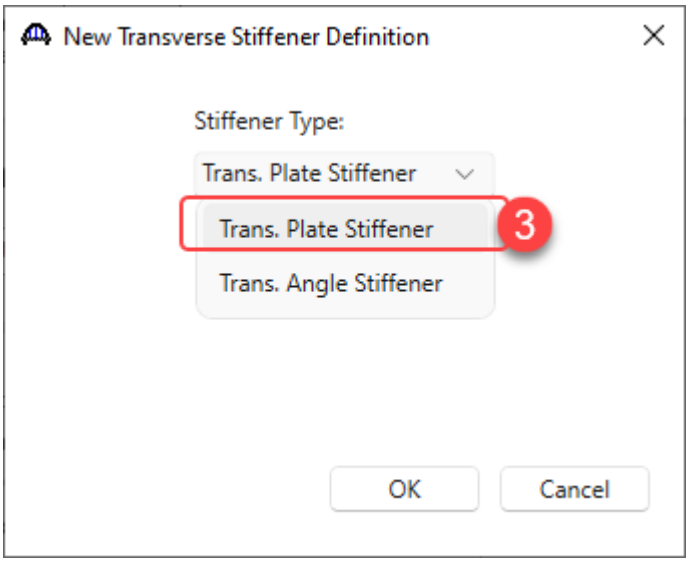
The next step requires defining stiffeners to be used in the structure. These will act as connection plates for the diaphragms. In this example, let us assume that the steel used for angles is same as the beams.

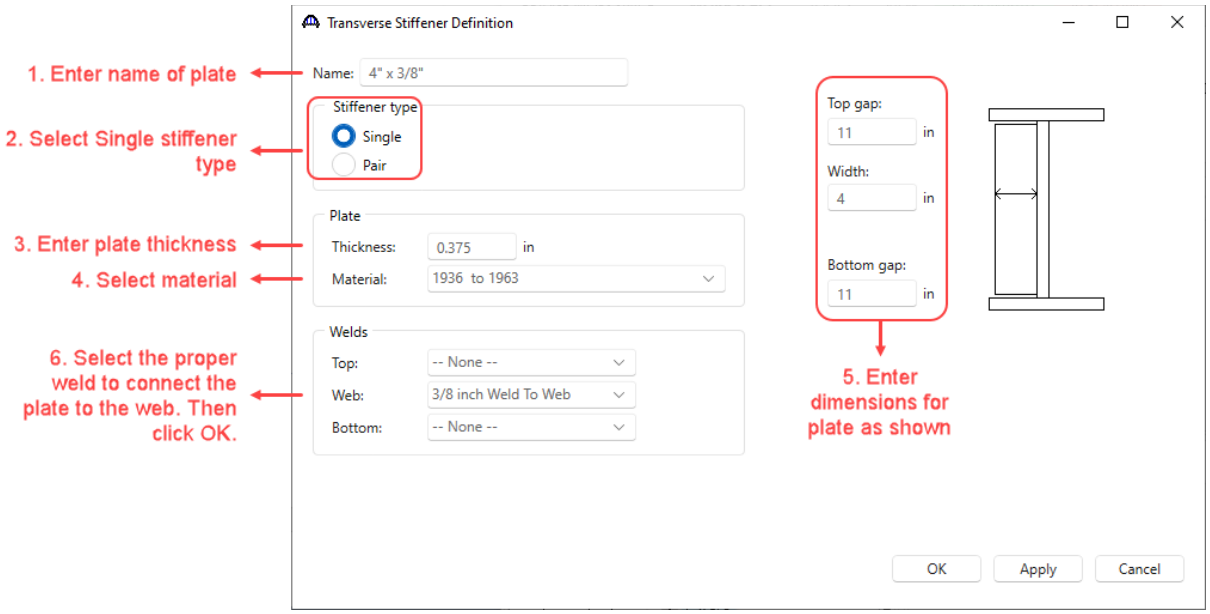
1. Expand the **Stiffener Definitions** node.

2. Double click on the **Transverse** node.



3. Select **Trans. Plate Stiffener** and click **OK**.

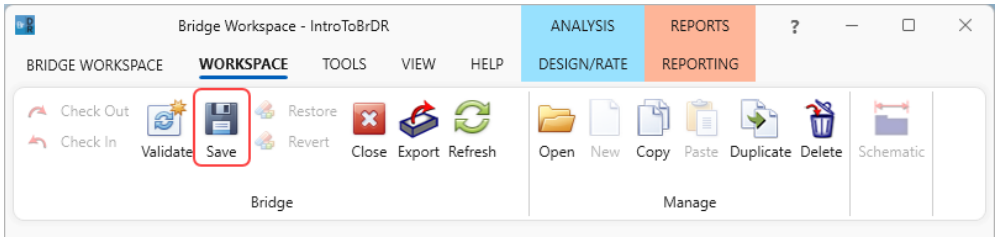


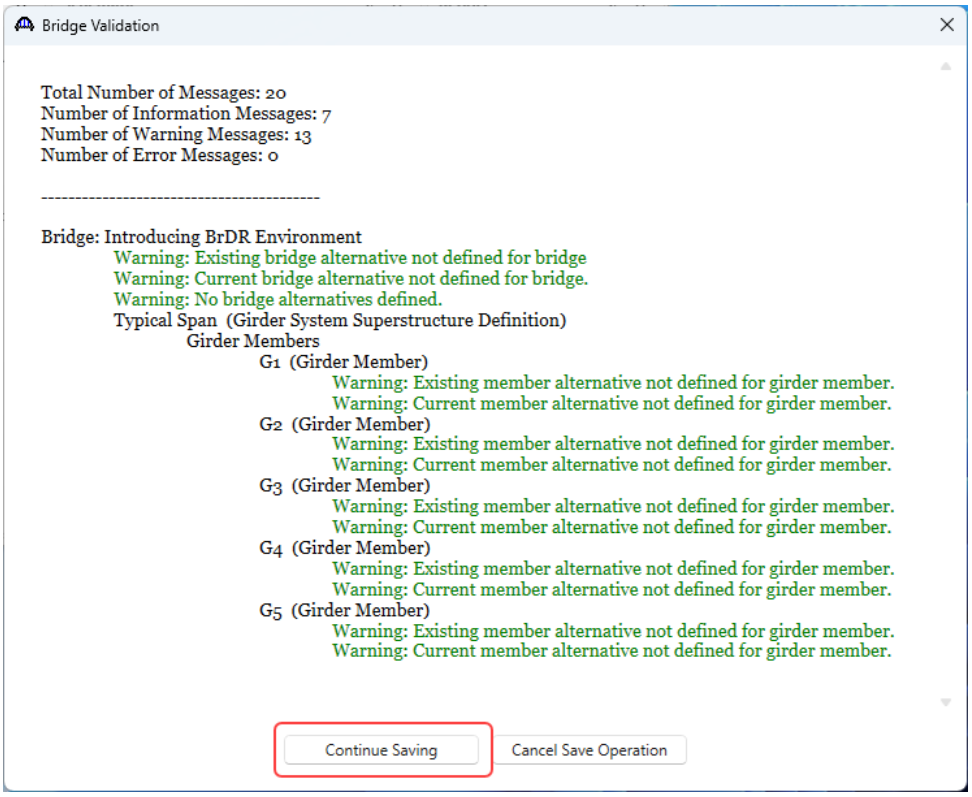


Saving the file

Because much data has been input up to this point, this would be a good time to save the file. Periodic saving helps prevent loss of data that has been entered. It is a good way to check the validity of your data.

To save, click on the **Save** button from the **WORKSPACE** ribbon as shown below. The **Bridge Validation** window opens. Click on **Continue saving** after reviewing the bridge validation.

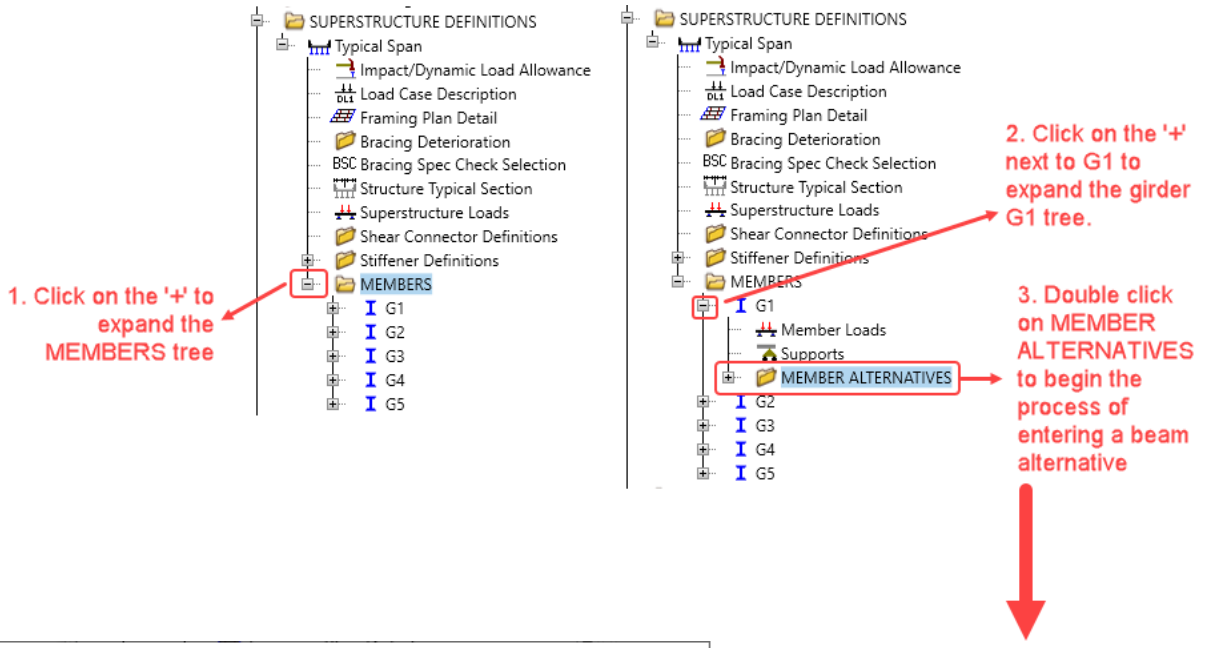


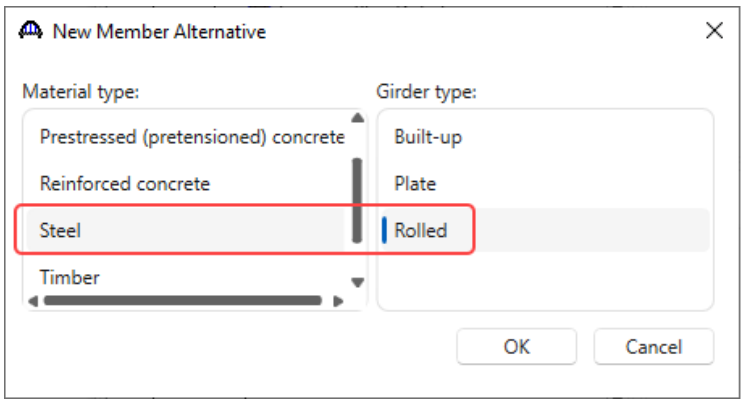

Bridge Validation
Total Number of Messages: 20
Number of Information Messages: 7
Number of Warning Messages: 13
Number of Error Messages: 0

Bridge: Introducing BrDR Environment
Warning: Existing bridge alternative not defined for bridge
Warning: Current bridge alternative not defined for bridge.
Warning: No bridge alternatives defined.
Typical Span (Girder System Superstructure Definition)
Girder Members
G1 (Girder Member)
Warning: Existing member alternative not defined for girder member.
Warning: Current member alternative not defined for girder member.
G2 (Girder Member)
Warning: Existing member alternative not defined for girder member.
Warning: Current member alternative not defined for girder member.
G3 (Girder Member)
Warning: Existing member alternative not defined for girder member.
Warning: Current member alternative not defined for girder member.
G4 (Girder Member)
Warning: Existing member alternative not defined for girder member.
Warning: Current member alternative not defined for girder member.
G5 (Girder Member)
Warning: Existing member alternative not defined for girder member.
Warning: Current member alternative not defined for girder member.
Continue Saving
Cancel Save Operation

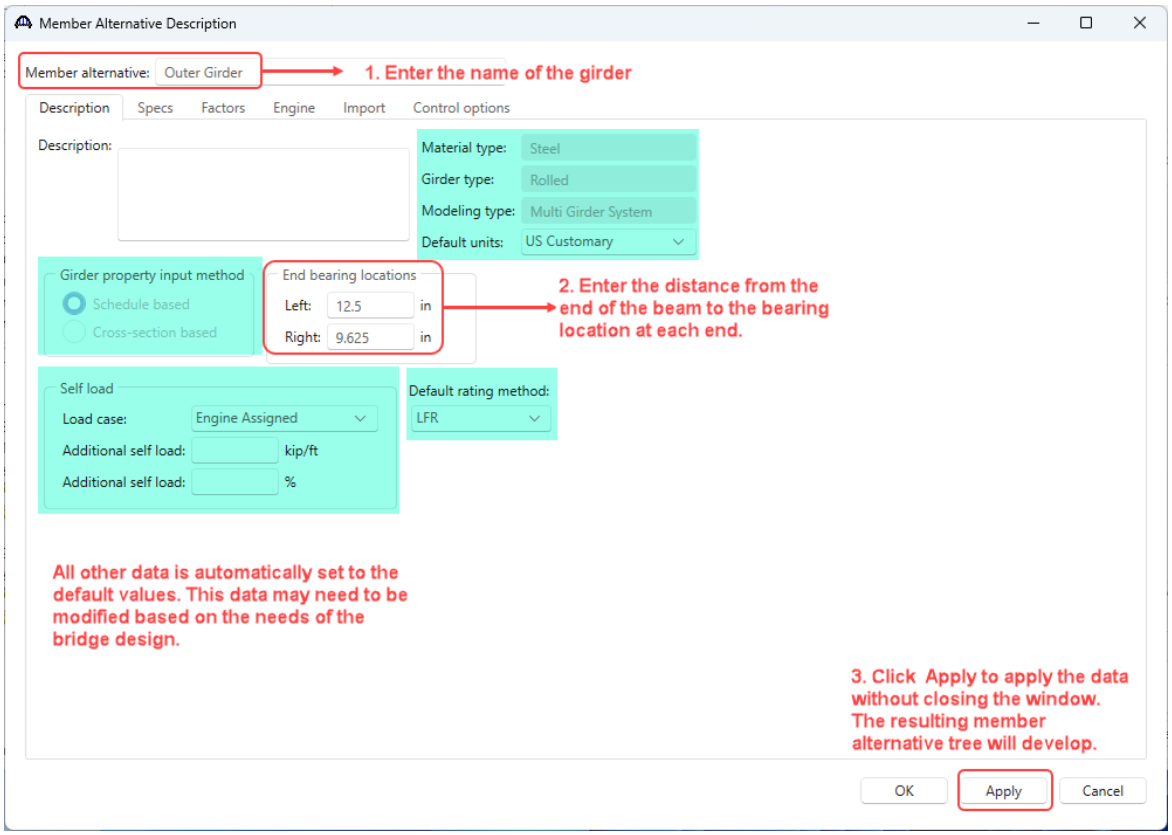
Entering Girders

At this point, the only remaining task is to define the girders. The girder elements have already been defined earlier in this chapter. Other elements have also been defined, such as connection plates and welds to connect the plates to the web. The remaining task is to define how these girders are placed on the bridge. As can be seen from the **Structure Typical Section Schematic**, the girder spacing is not even. This will play an important role in defining the girder lines. If all girders had been spaced evenly, then we would only need to define one girder then the rest would simply be a reference to the first. But since the spacing varies, the girder lines will need to be defined with different spaces.

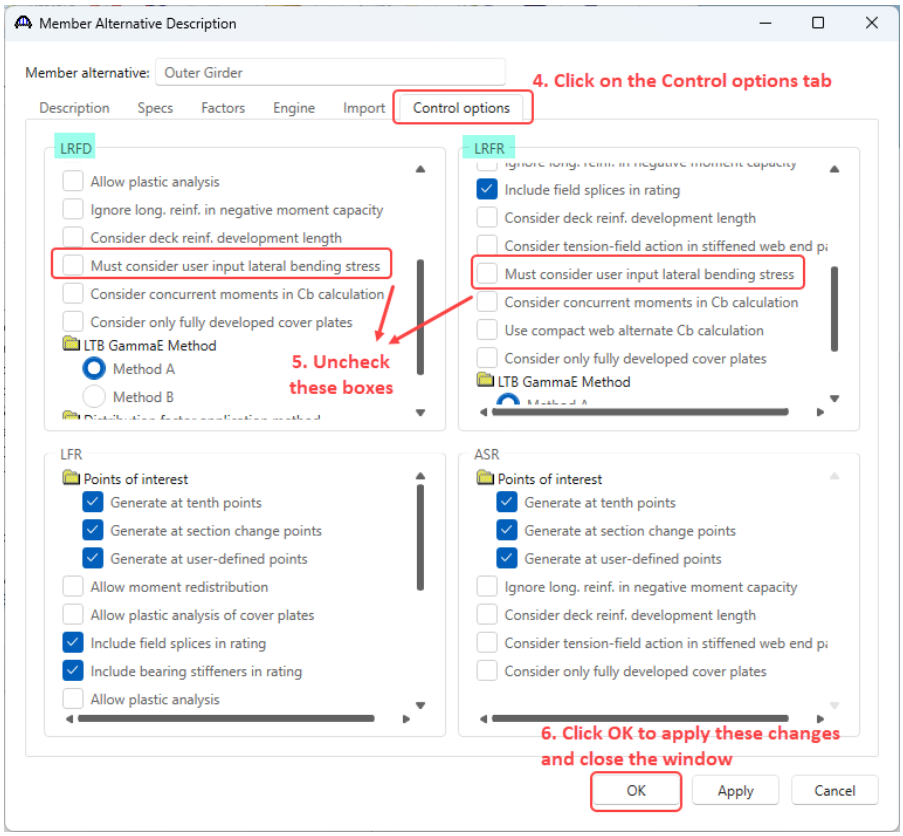




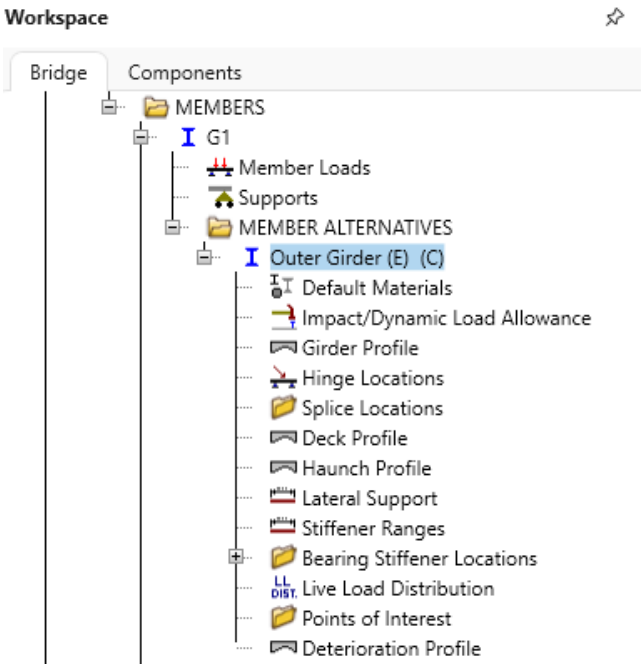
4. Select Steel as the Material type and Rolled as the Girder type and click OK.


Member Alternative Description
Member alternative: Outer Girder
1. Enter the name of the girder
Description
Specs
Factors
Engine
Import
Control options
Description:
Material type: Steel
Girder type: Rolled
Modeling type: Multi Girder System
Default units: US Customary
Girder property input method
Schedule based
Cross-section based
End bearing locations
Left: 12.5 in
Right: 9.625 in
2. Enter the distance from the end of the beam to the bearing location at each end.
Self load
Load case: Engine Assigned
Additional self load: kip/ft
Additional self load: %
Default rating method:
LFR
All other data is automatically set to the default values. This data may need to be modified based on the needs of the bridge design.
3. Click Apply to apply the data without closing the window. The resulting member alternative tree will develop.
OK
Apply
Cancel

Navigate to the **Control Options** button and uncheck the **"Must consider user input lateral bending stress"** option for both **LRFD** and **LRFR** as shown below.

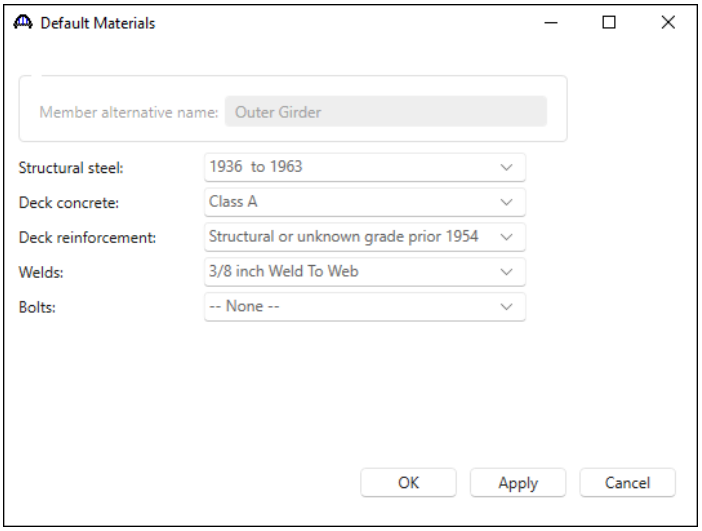


Expand the **Outer Girder** member alternative.



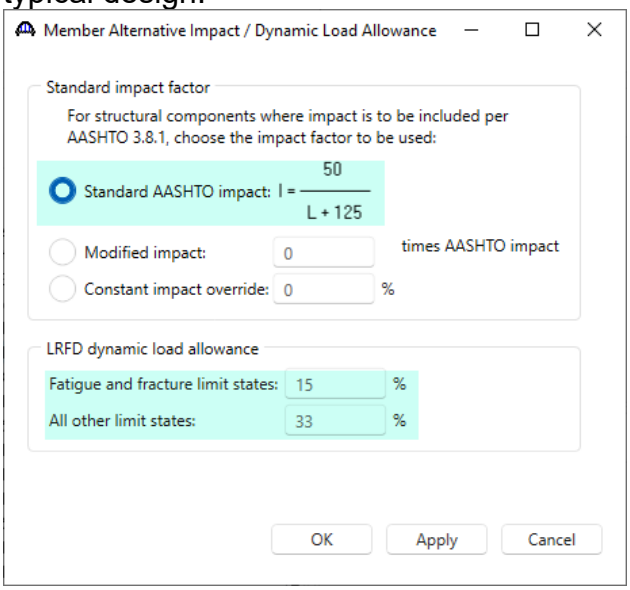
Default Materials

Default materials are entered automatically, with the materials entered previously. It is good to review the defaults to ensure that correct data was assumed. This is important to do if there are multiple materials. In this example, there is only one type of steel, concrete and reinforcement. There are two types of welds, so care should be taken to make sure the correct one was selected. Select **3/8 inch Weld to Web** as the default weld and click **OK** to apply the data and close the window.



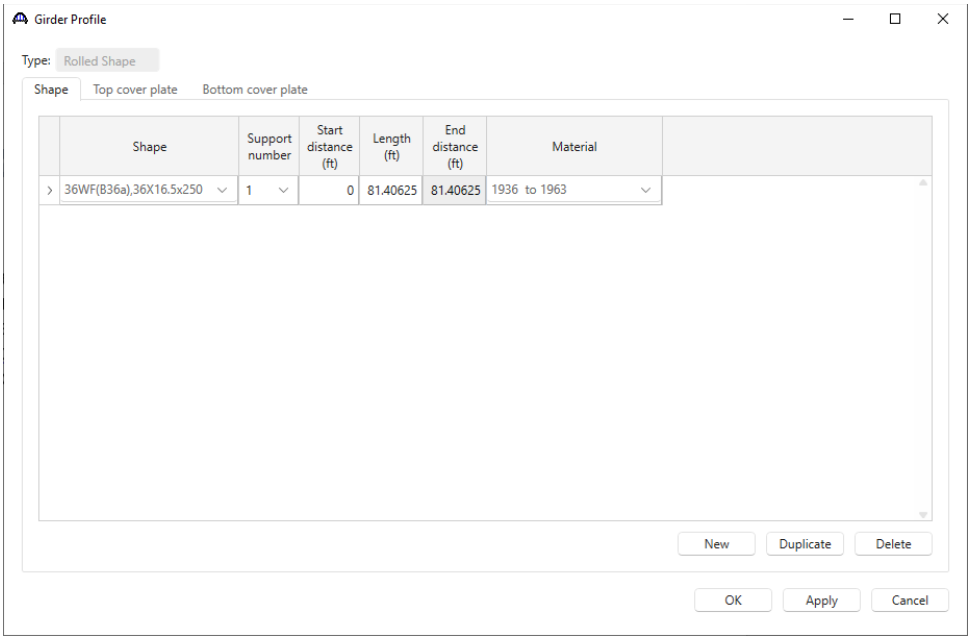
Impact/Dynamic Load Allowance

You may either enter the values necessary for standard or the LRFD specifications or both. For Allowable Stress Design or Load Factor Design, you will need to select a method for the standard impact factor. For this example, the first radio button should be OK. For Load Resistance Factor Design, the default values should be OK for any typical design.



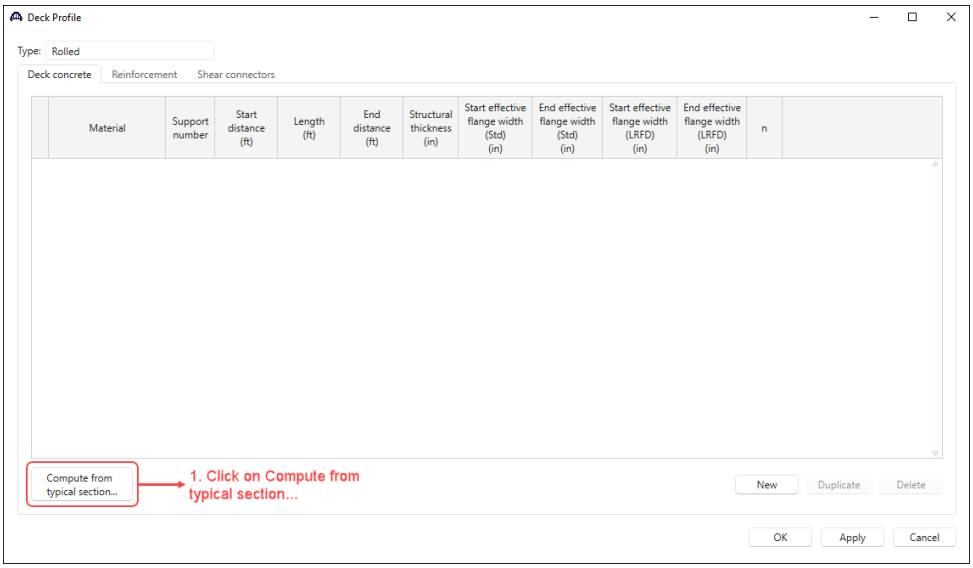
Girder Profile

The next step in entering this bridge is defining a girder profile. The input for this window provides the physical dimensions of the girder. This may mean having a variable section throughout its length either by the use of differing girder sections or by the use of cover plates. The rolled beam section that will be used does not have cover plates and the section is continuous. Therefore, the entire length of the beam is defined as a single section, as shown below. Enter data as shown and click **OK** to apply the data and close the window.

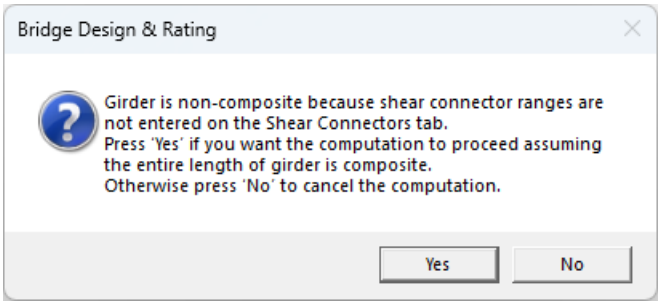


Deck Profile

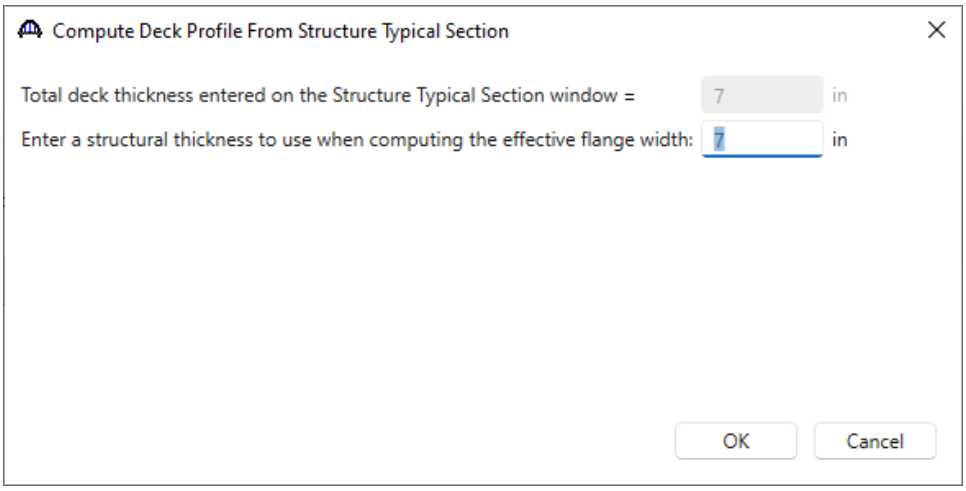
Since this structure is a simple span, there is no need for placing hinge locations, nor are there any splices. The next step in entering this bridge is defining the deck profile. This is where certain regions in the deck reinforcing changes and where shear connector ranges are located are defined. BrDR provides a quick way to enter this data from information previously entered. Since no other beams have been defined yet, the calculated numbers are not accurate. We will need to redo the calculations after the entire bridge deck is defined. Follow the instructions below to fill out the window.



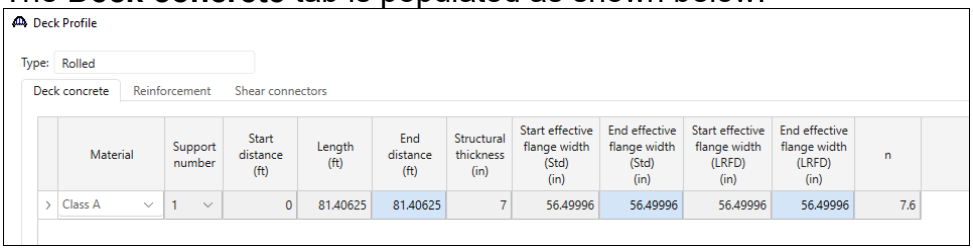
The following window appears. This is a warning message stating that since shear connector ranges have not been defined, the girder will be assumed to be composite over its entire length. This can be changed later in the **Shear connectors** tab of this window. For now, click **Yes** to proceed with the calculations.



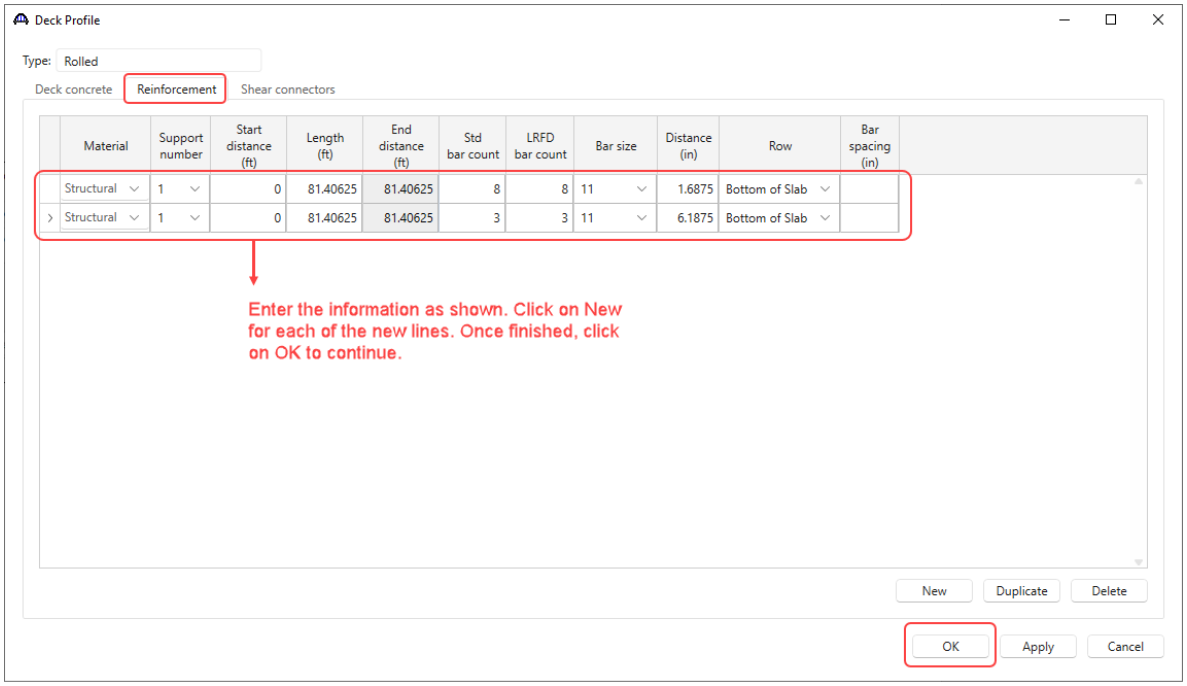
Enter structural thickness for effective flange width computation as shown below and click **OK**.



The **Deck concrete** tab is populated as shown below.



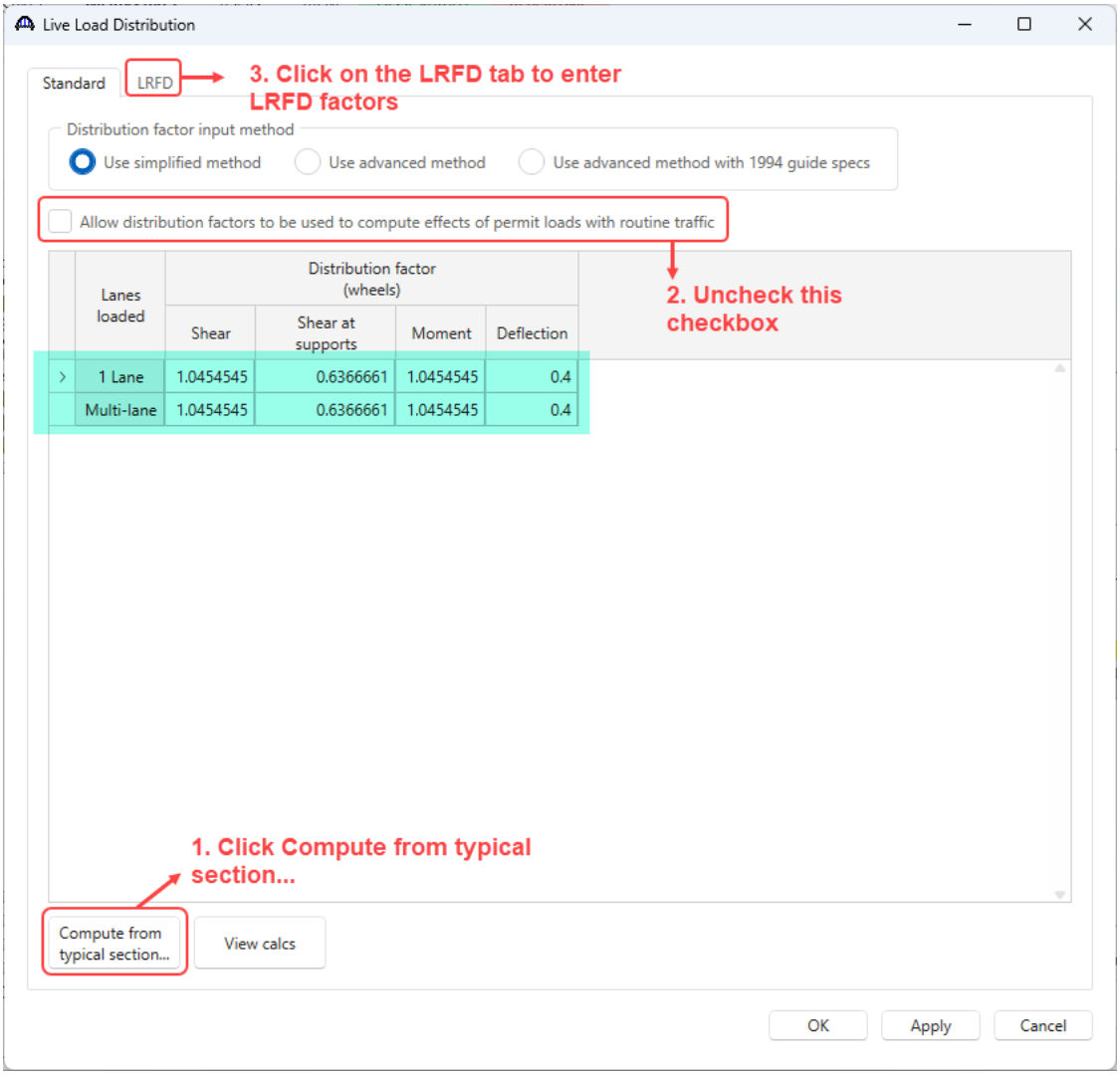
Navigate to the **Reinforcement** tab and enter the longitudinal reinforcement as shown below.



2. Click OK to use the full deck thickness for the structural component of the deck.

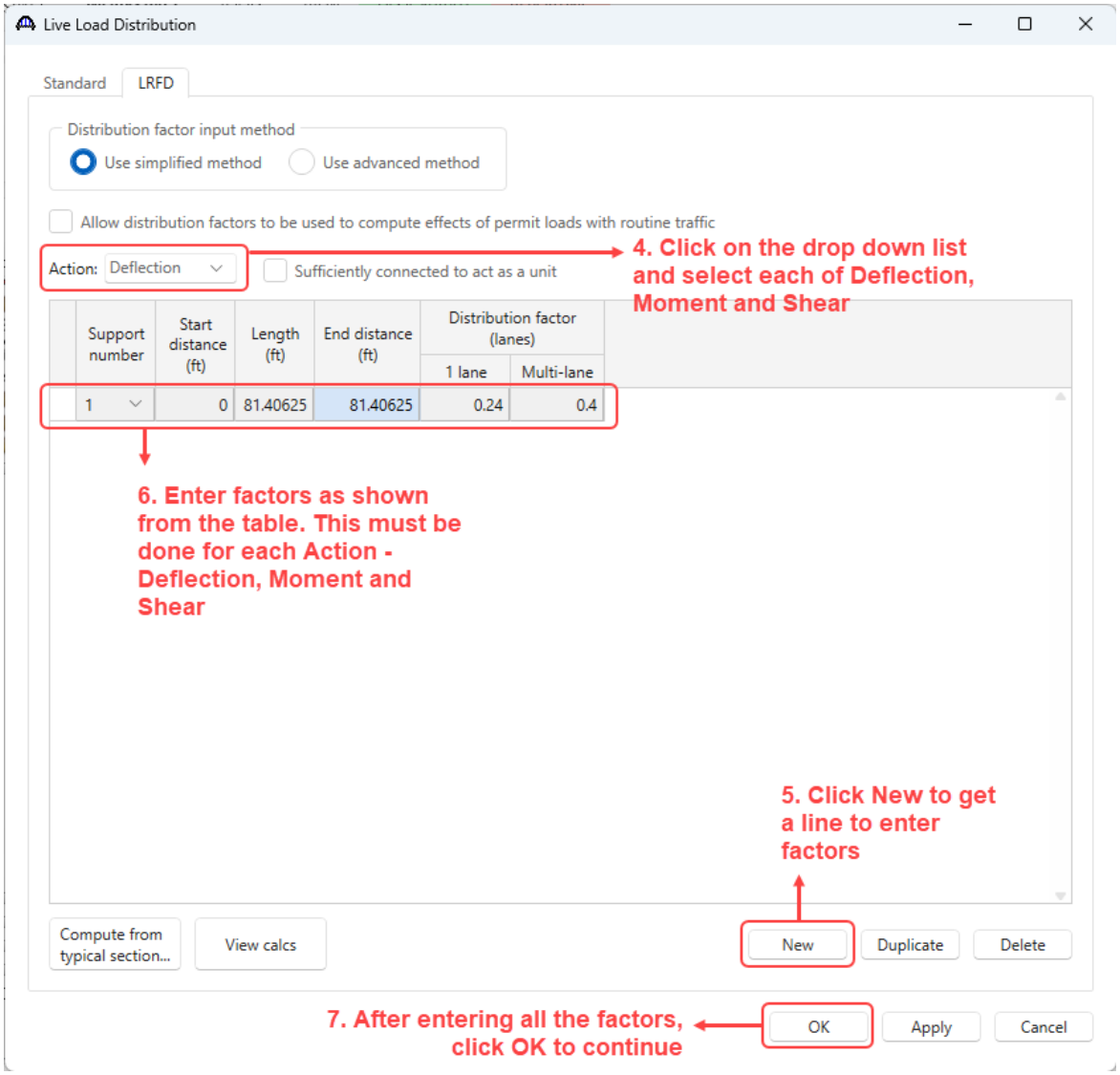
Live Load Distribution

Distribution factors should be entered for both sets – Standard and LRFD for this example. The software does provide an option to compute these factors.



You will need to calculate the LRFD live load distribution factors. For this example, the values are provided in the following table. These factors are for an external girder.

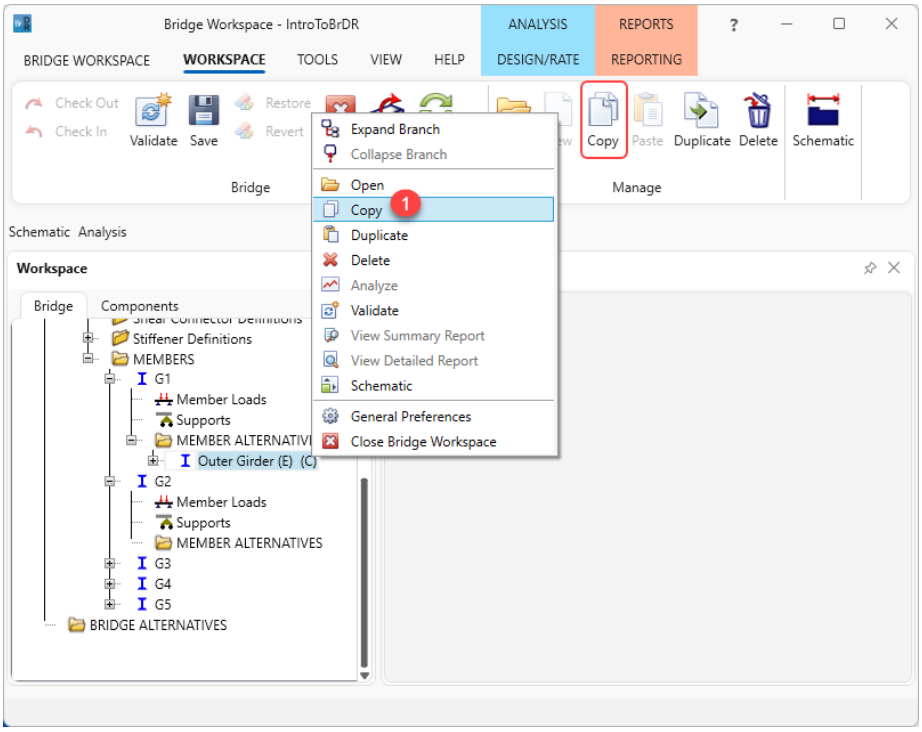
	1 Lane	2 Lane
Deflection	0.240	0.400
Moment	0.468	0.386
Shear	0.597	0.484



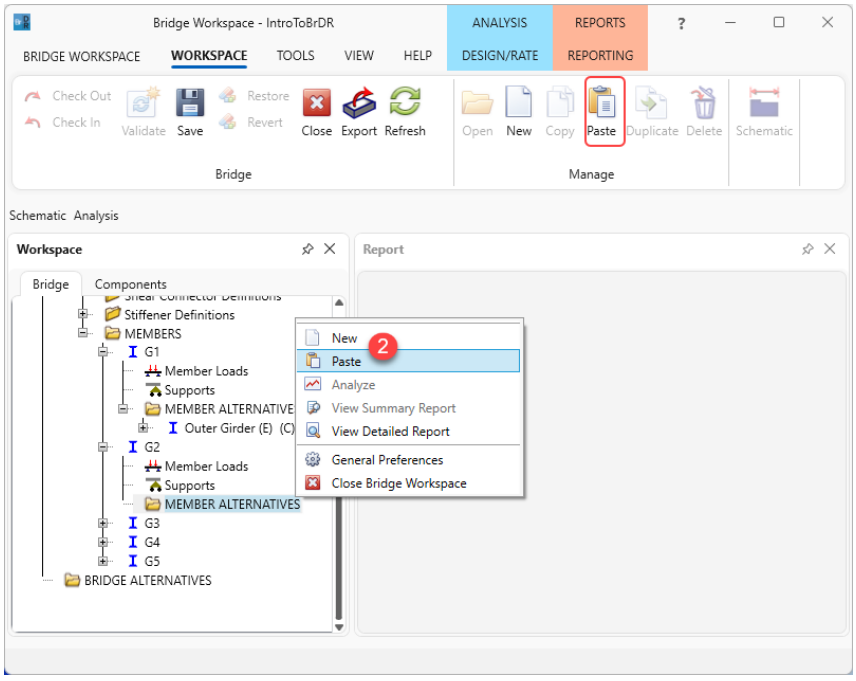
Copying objects

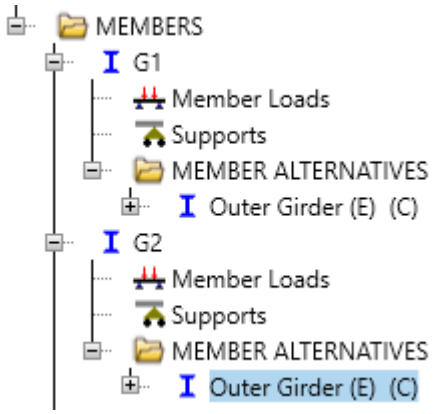
In BrDR each item can be considered as an object. Each object can be deleted, copied and moved. This is what we will do with the beam definition just entered. Since every beam is the same in this bridge design, the definition of the beam can be copied to another girder line. Once copied, the second beam can be edited to fit the design.

1. Right click on the beam to be copied. Select **Copy** from the menu (or select the beam and click on the **Copy** button from the **WORKSPACE** ribbon).



2. Right click on the **MEMBER ALTERNATIVES** node for Girder **G2**. Select **Paste** from the menu (or click on the **Paste** button from the **WORKSPACE** ribbon).





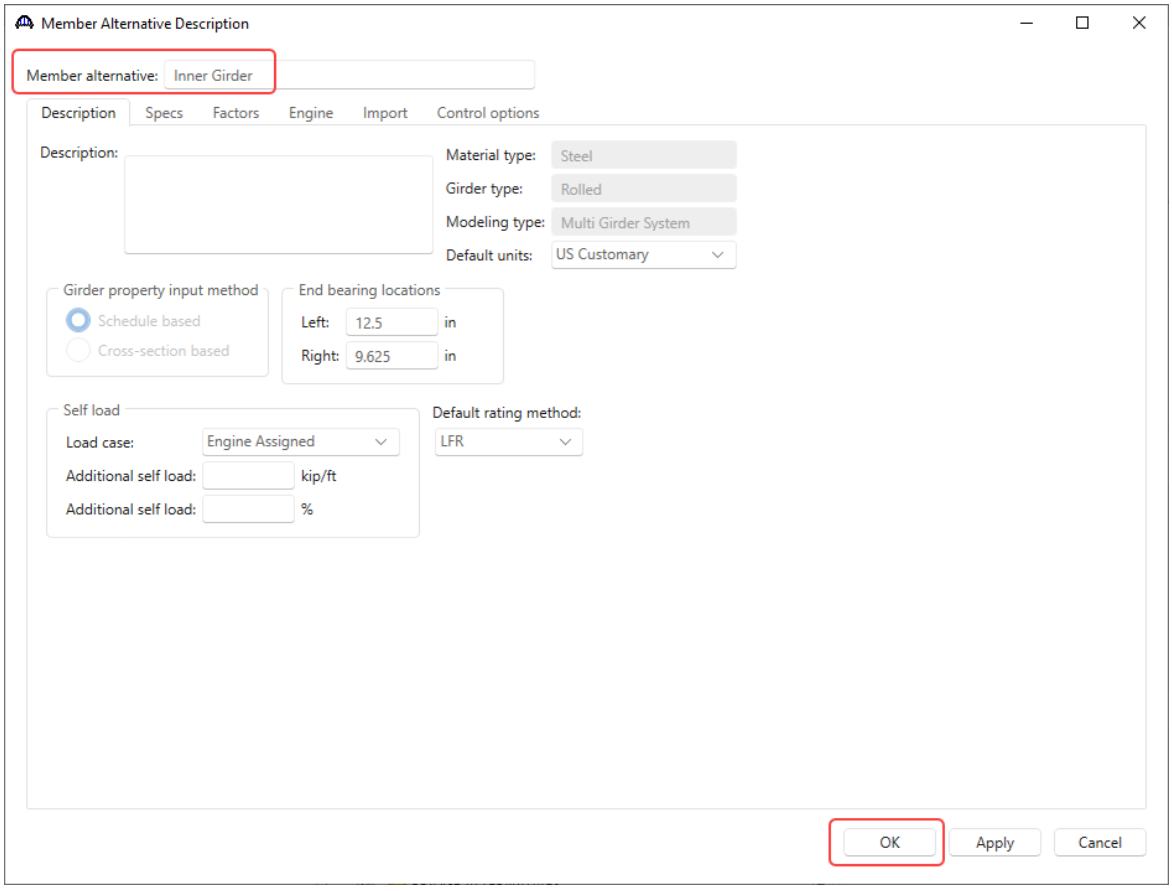
Modifying the copied beam

The first thing is to rename the newly copied beam for member G2. Rename this to “Inner Girder”. Follow the procedure defined with the “Outer Girder” while following the instructions listed below.

1. Double click on **Outer Girder** for member G2.

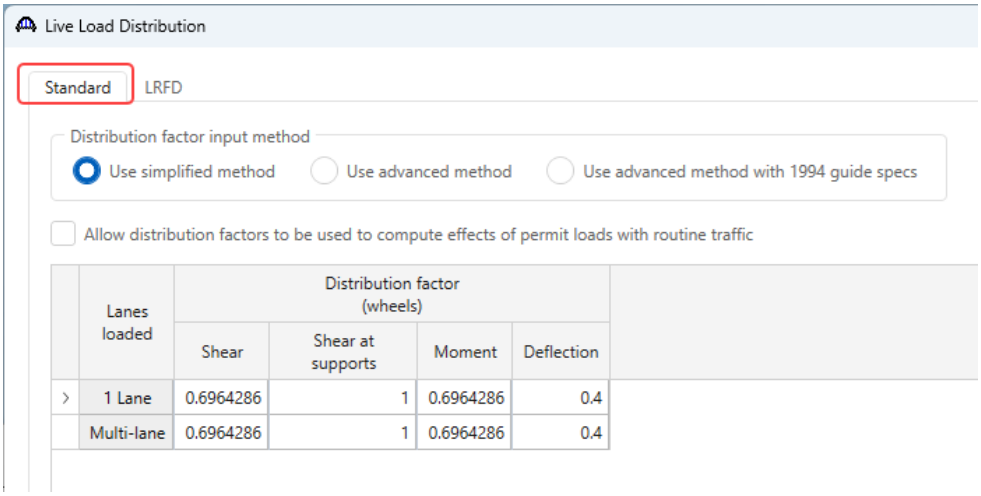
2. When the **Member Alternative Description** window appears, change the name in this window to **Inner Girder**.

3. Click **OK** to continue.



The only data that needs to be changed for this girder is the live load distribution factors. For **Standard** factors, click on the button for calculating from typical section. For LRFD, use the following values and enter into the respective action type as done before.

	1 Lane	2 Lane
Deflection	0.240	0.400
Moment	0.357	0.484
Shear	0.700	0.774



At this point, the outer girder and the first inner girder is created. Now define the center girder to be completed with the girder definitions.

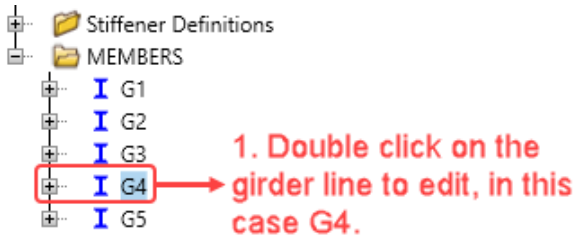
Creating the center beam

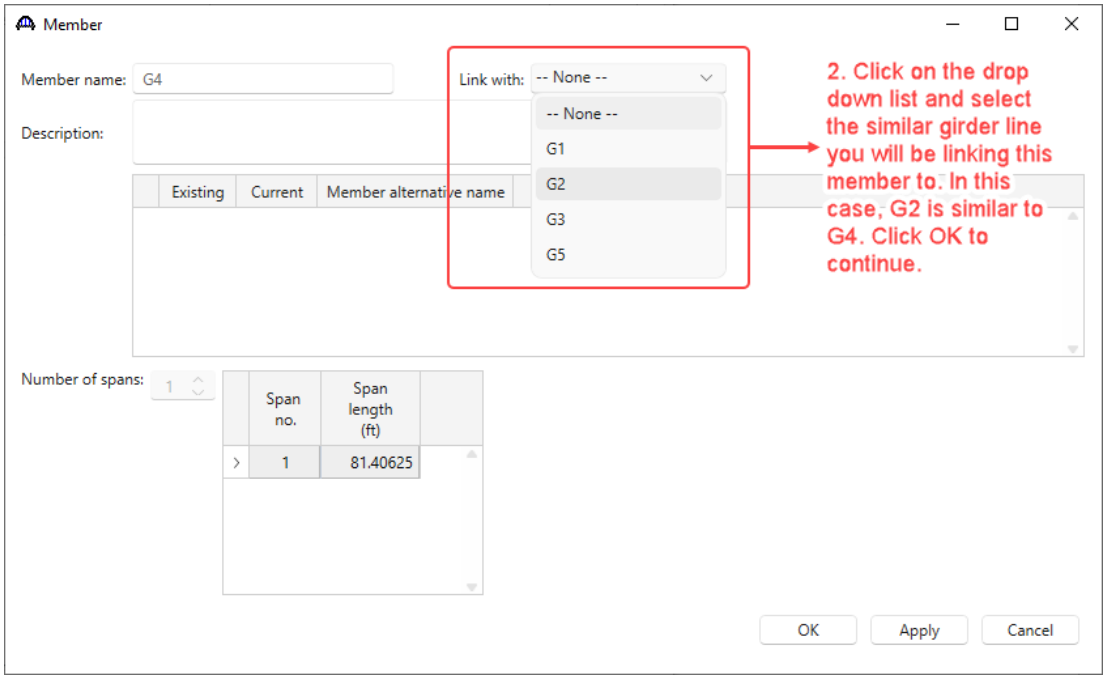
The previous procedure needs to be repeated to copy the second beam (Inner Girder) to the center beam. Since both the second beam and the third beam are interior beams, the Load Distribution Factors will not need to be changed. Just change the name of the third beam to **Center Girder**

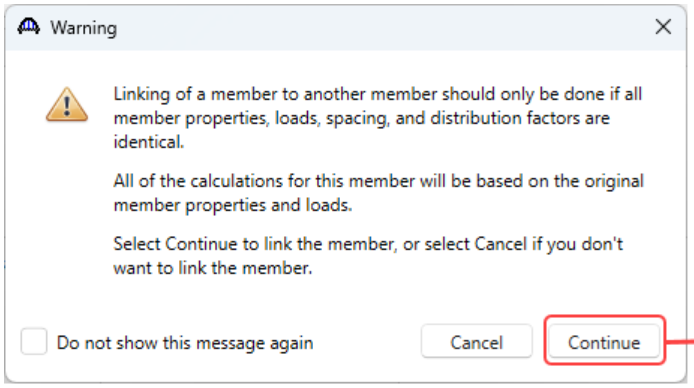
Now girder 1, 2, and 3 are defined. The fourth and fifth girder lines will be defined in a different way.

Linking members

Once a girder line is defined, that girder line can be used to define another girder line. If the bridge had equal girder spacing, only two girder lines would have to be defined, one for the exterior beams and one for all the internal beams. However, there is unequal spacing in this example, though symmetrical. In this case, the two exterior beams are identical, and the two first interior beams are identical.
The next task is to create the last two girder lines by referencing already defined beams.



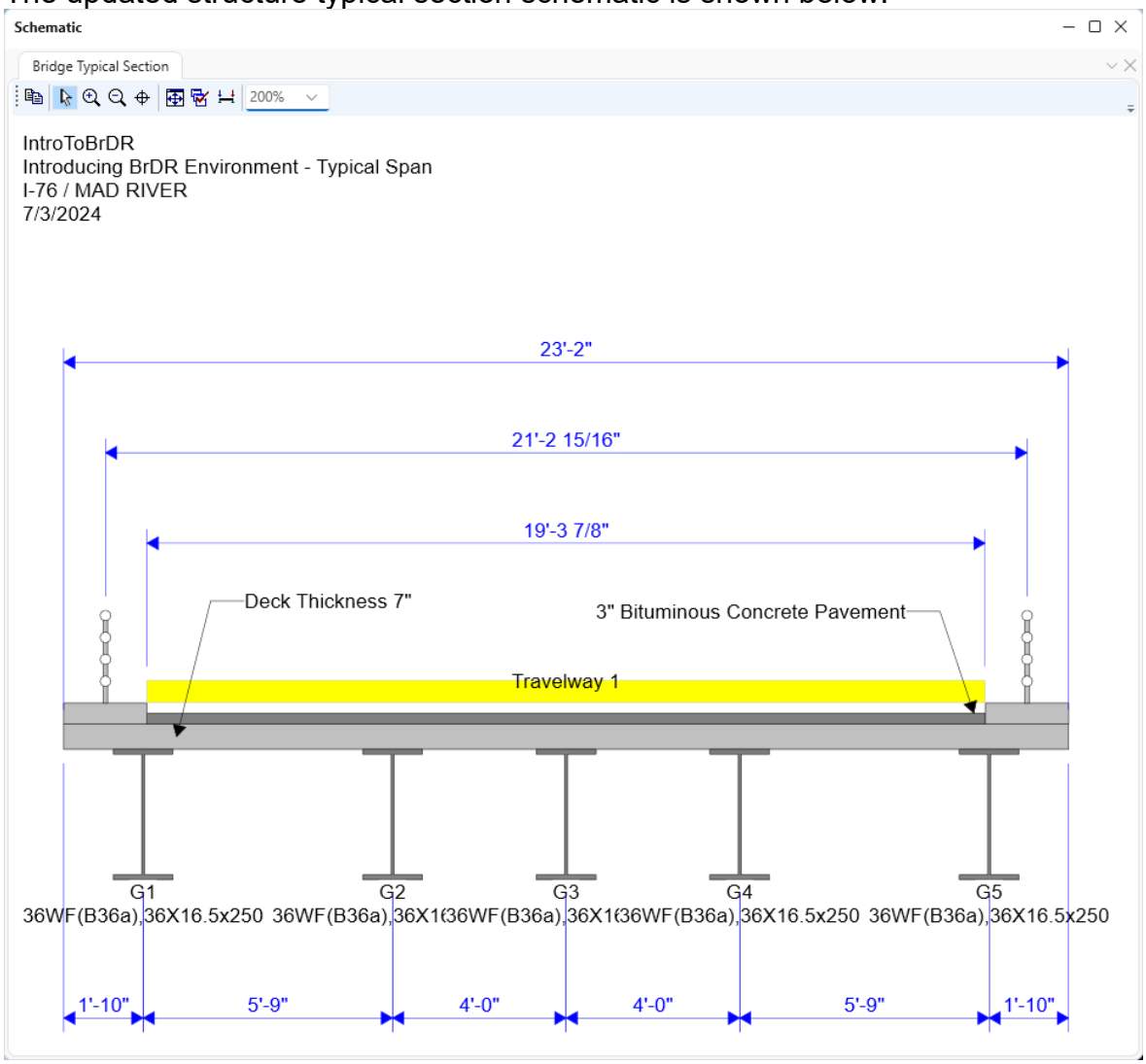




3. BrDR will give a warning that all properties should be the same in both the girder line being worked on and the girder line being linked. Click Continue

4. Repeat this procedure for girder G5 by linking it with girder G1.

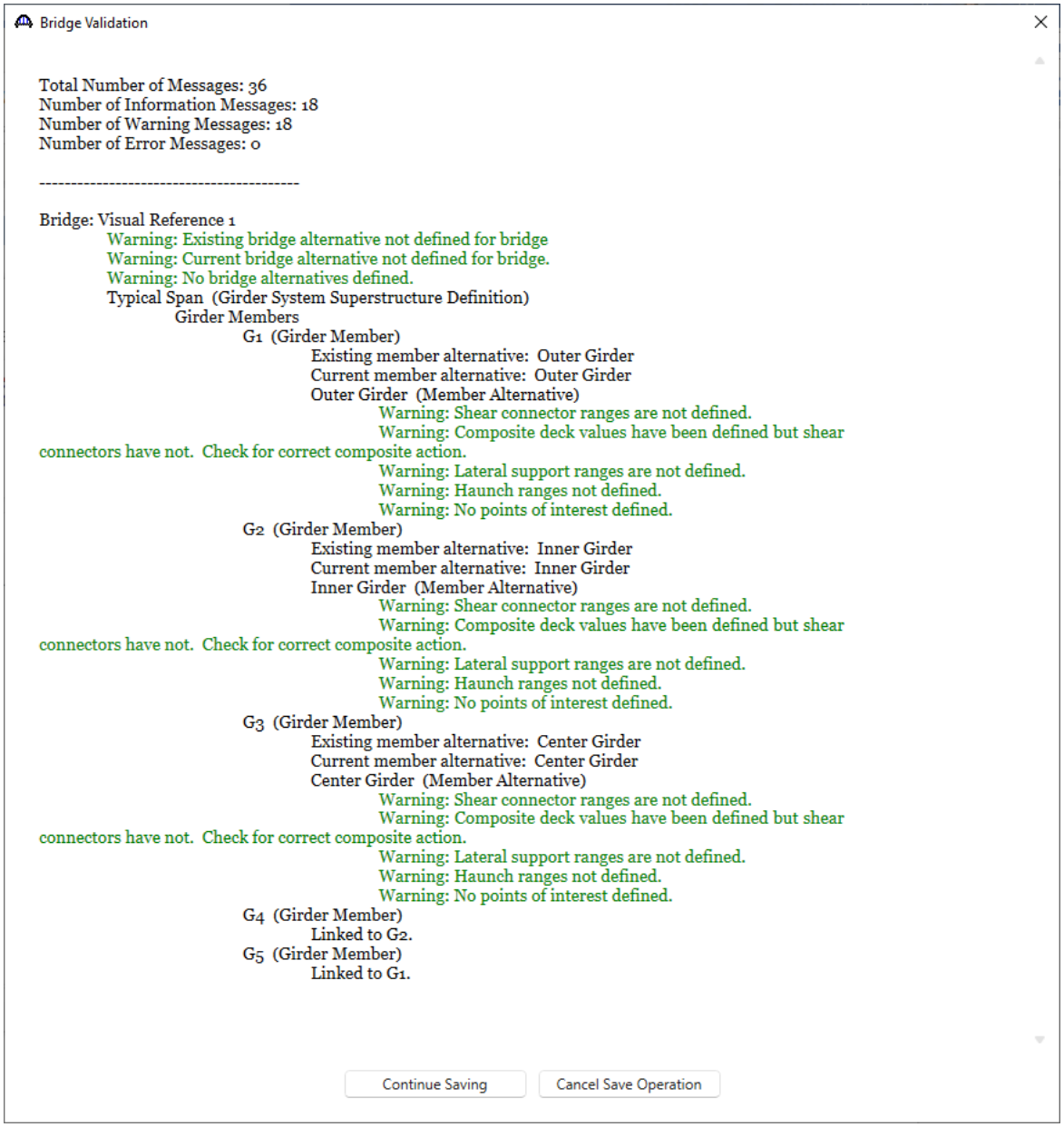
The updated structure typical section schematic is shown below.



Saving a structure

Saving a structure is an interactive step. BrDR evaluates what has been entered and provides warnings of what is not yet defined or what it thinks is missing. At this point the warnings will be reviewed to provide a guide for the next step.

The warning messages appear in green text in the **Bridge Validation** window as shown below.



Explanation of warnings

The first three warnings listed above refer to the same thing. A bridge alternative has yet to be defined. This will come in a later step. At this point, check to see if the bridge definition that has been entered is valid. So, for now the first three warnings will be skipped.

Each of the three girder lines, G1, G2 and G3, have identical warnings. According to the bridge file the bridge deck is not composite. Therefore, the first two warnings can be ignored.

The plans in the file also did not include any haunches. The deck essentially is placed on top of the top flange. This being the case, the top flange is not being laterally restrained. Therefore, the third and fourth warning may be ignored.

Regarding the last warning, we have not entered any points of interest. This can also be ignored.

Since the bridge definition has been reviewed for all warning, the next step is to create a Bridge Alternative.

Bridge Alternative

What is a Bridge Alternative?

A **Bridge Alternative** is essentially a bridge location or a bridge length. For an already existing Bridge, this would be the current location, and therefore, there would only be one alternative. A design may have a few different alignments. If that's the case, there may be an individual bridge location for each alignment. There may also be several different lengths or configurations of the bridge to study. In any case, each bridge study shall have their own alternative definition.

Now it's asking for Structures!

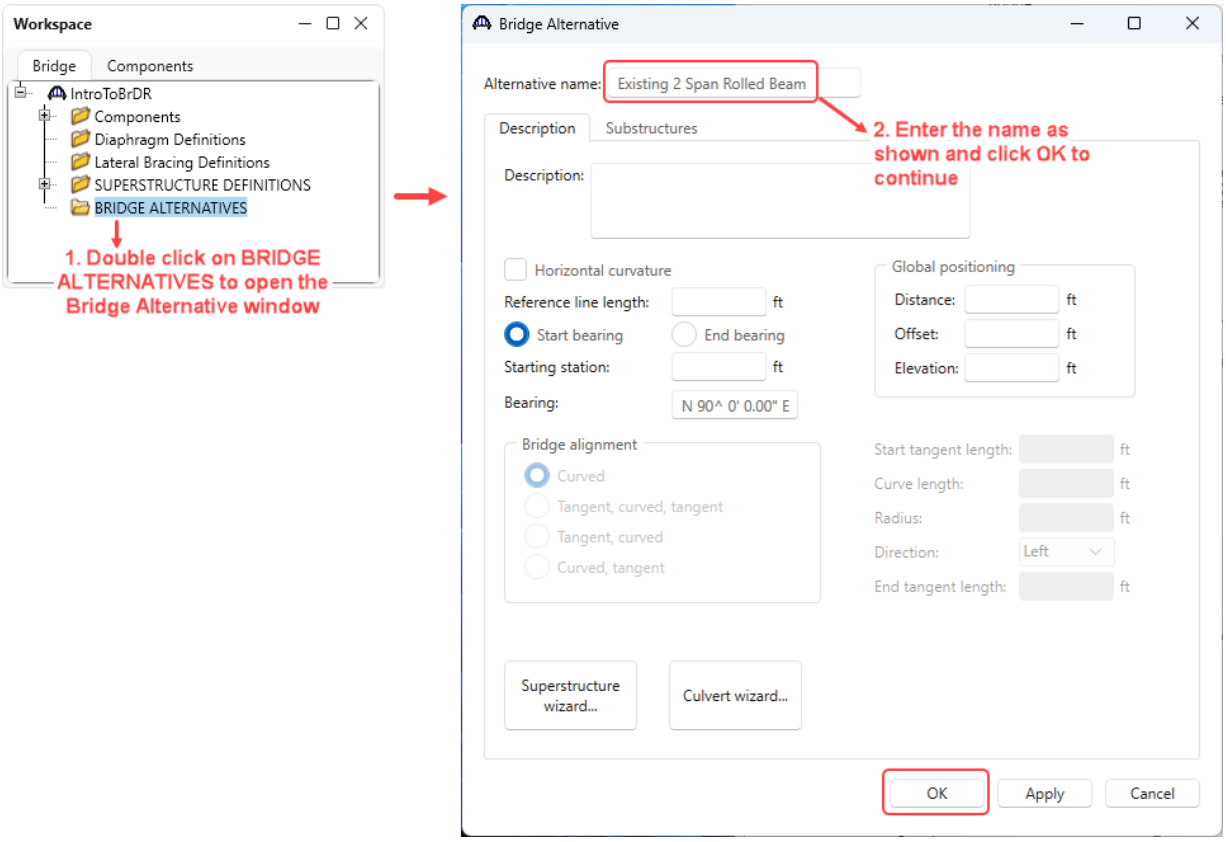
After a **Bridge Alternative** is defined, it will now ask for the structures in the bridge. What this means is that now the make up of the bridge needs to be defined. If the bridge is a single simple span bridge, a single structure will be defined. If, however, the bridge contains a prestressed bridge slab span going over a railroad followed by a steel girder span going over a river, this single **Bridge Alternative** should be comprised of two structures. In this case each structure will need to be entered.

What is a Structure Alternative? Didn't I already enter that?

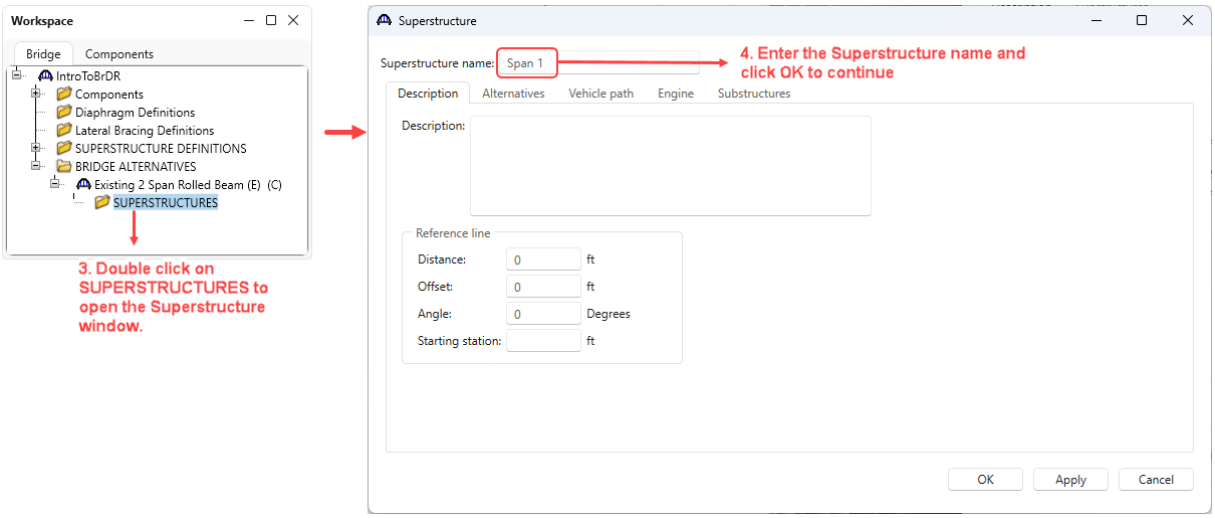
A **Structure Alternative** is where the different bridge types to be studied are entered. For a particular span, a comparison may be made between a steel girder and a concrete girder deck system. In this case these bridge definitions will have been entered as described above for each bridge type. Then in the **Structure Alternatives**, the chosen alternatives to study will be entered. This essentially is where the bridge definition is connected to the **Bridge Alternative**. There is no rule that prevents more bridge definitions from being defined, than are entered in the alternatives. Consider the bridge definitions section as a library, and the **Structure Alternative** entries are where the book is checked out!

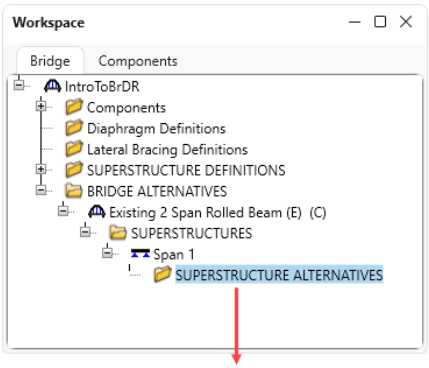
In this example…

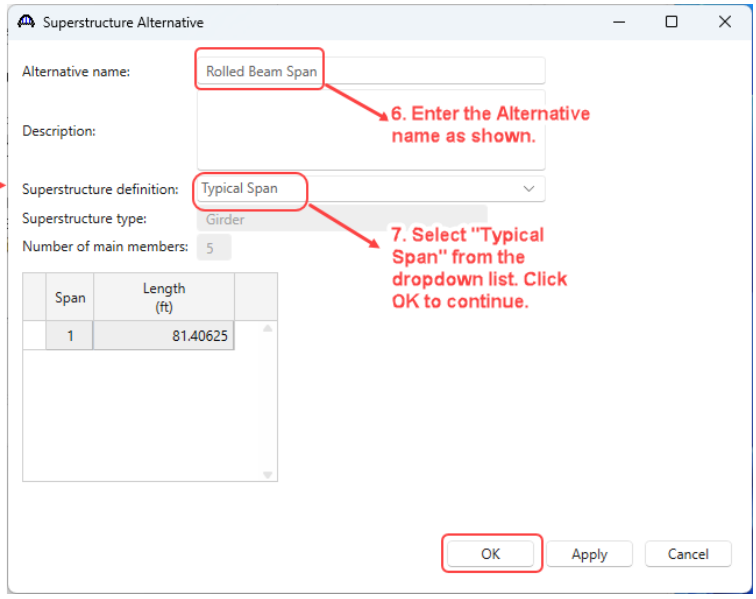
There is a single **Bridge Alternative** with two identical spans. The first step is to define a single **Bridge Alternative**. Following that, define a single structure for that alternative. Finally describe that structure as being two spans, using the bridge definition entered earlier for both spans.

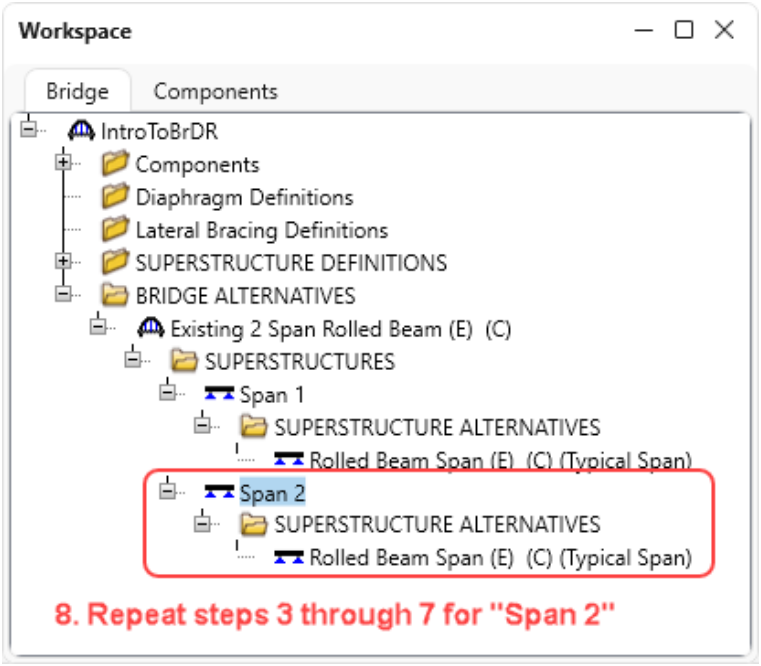


In the **Bridge Alternative** window, there were several fields that were not filled in. This data is more for informational purposes than for calculations.




Workspace
Bridge
Components
IntroToBrDR
Components
Diaphragm Definitions
Lateral Bracing Definitions
SUPERSTRUCTURE DEFINITIONS
BRIDGE ALTERNATIVES
Existing 2 Span Rolled Beam (E) (C)
SUPERSTRUCTURES
Span 1
SUPERSTRUCTURE ALTERNATIVES
5. Double click on SUPERSTRUCTURE ALTERNATIVES to enter the structure type.

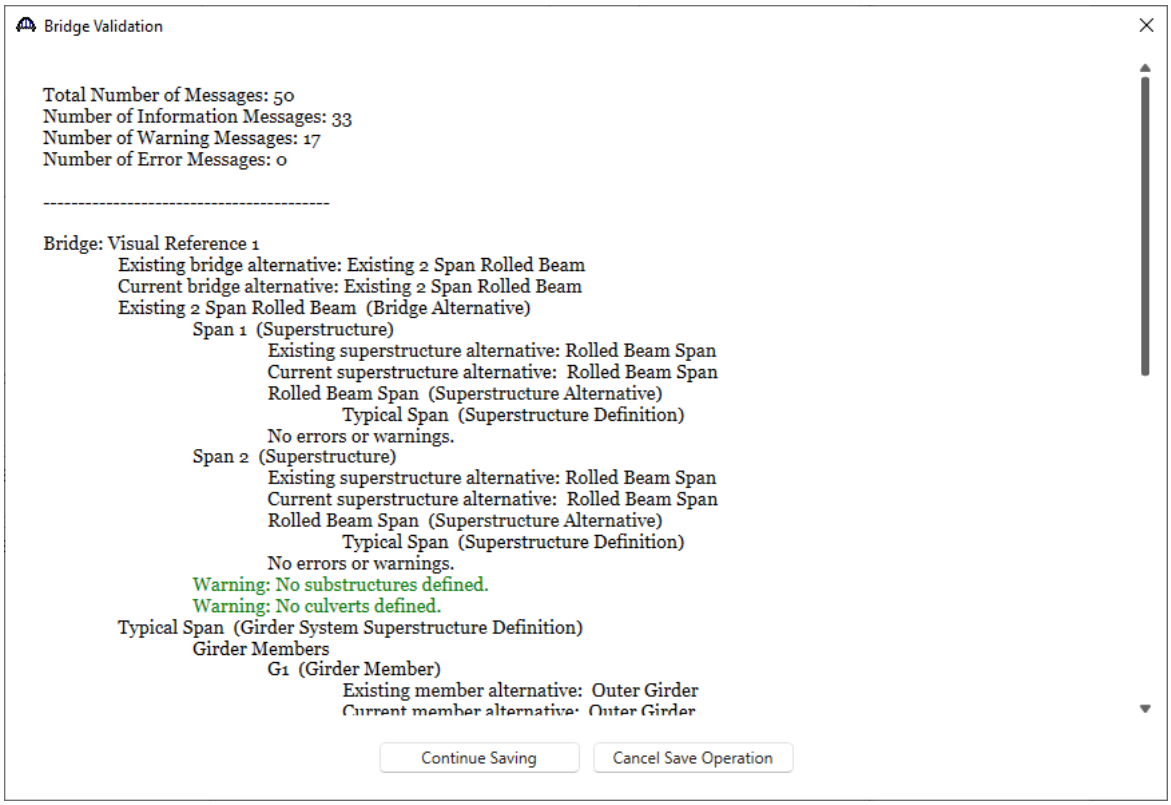

Superstructure Alternative
Alternative name:
Rolled Beam Span
6. Enter the Alternative name as shown.
Description:
Superstructure definition:
Typical Span
Superstructure type:
Girder
Number of main members:
5
7. Select "Typical Span" from the dropdown list. Click OK to continue.
Span
Length (ft)
1
81.40625
OK
Apply
Cancel


Workspace
Bridge
Components
IntroToBrDR
Components
Diaphragm Definitions
Lateral Bracing Definitions
SUPERSTRUCTURE DEFINITIONS
BRIDGE ALTERNATIVES
Existing 2 Span Rolled Beam (E) (C)
SUPERSTRUCTURES
Span 1
SUPERSTRUCTURE ALTERNATIVES
Rolled Beam Span (E) (C) (Typical Span)
Span 2
SUPERSTRUCTURE ALTERNATIVES
Rolled Beam Span (E) (C) (Typical Span)
8. Repeat steps 3 through 7 for "Span 2"

At this point, the bridge alternative is fully defined. The bridge design can now begin.

Checking the Bridge data

Before continuing, the work should be saved as well as a check of the input. In the earlier check of the input, some warnings were discovered regarding not having a Bridge Alternative defined. As the bridge data has been saved, notice that those warnings are now gone.

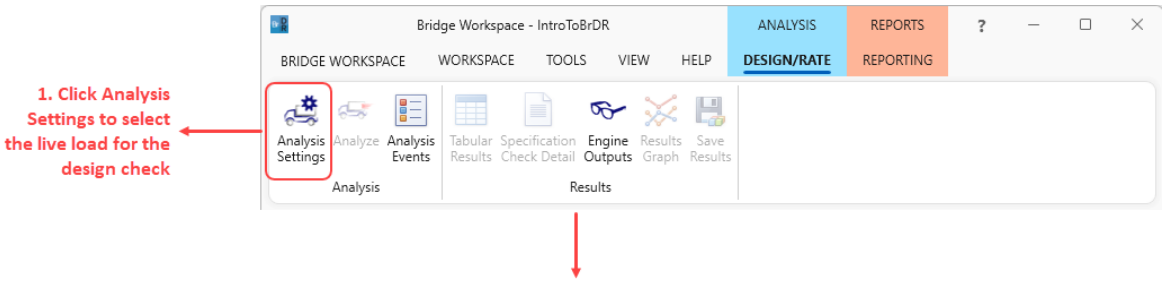


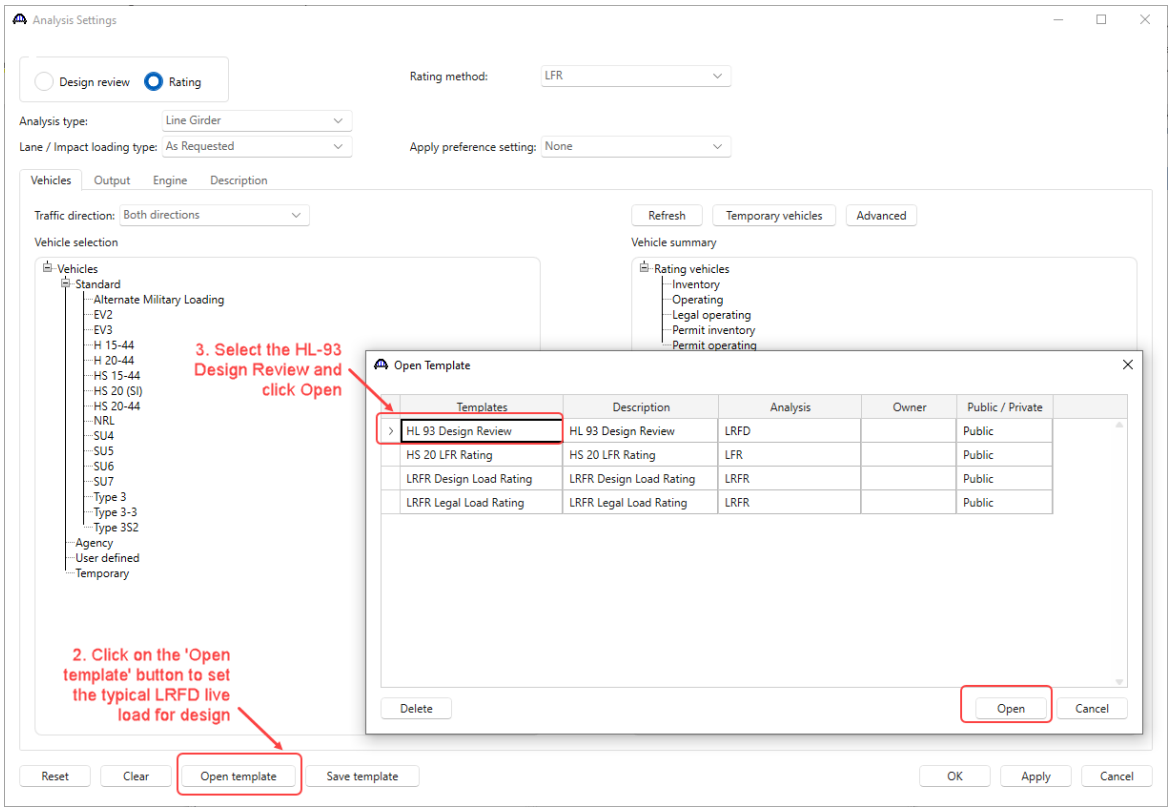
At this point the design run can be performed.

Running a design

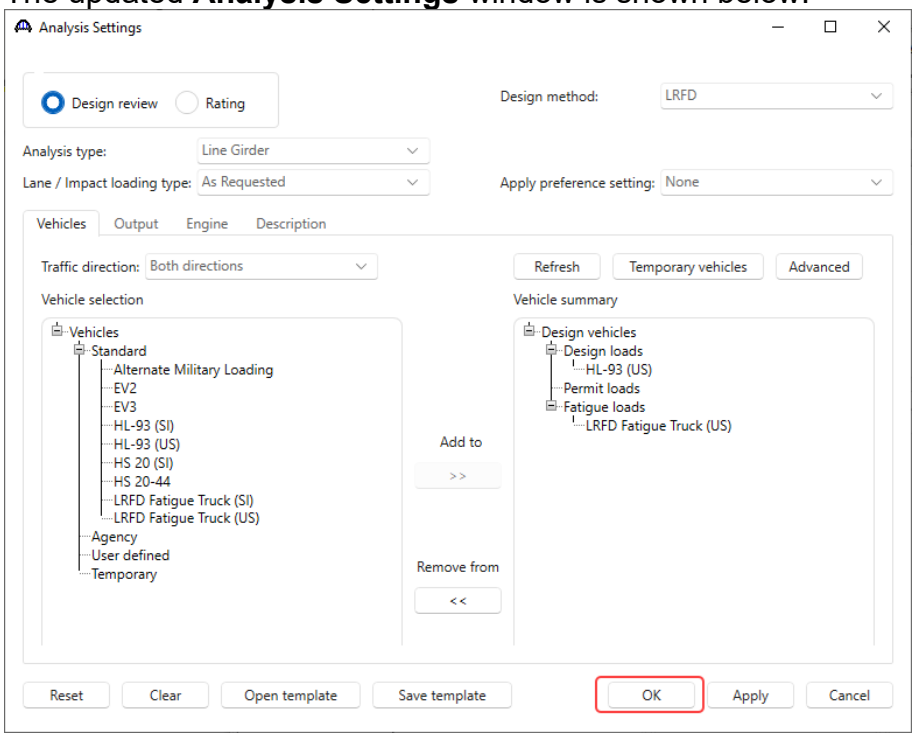
Define design trucks

The first step is to define the live load. This is done by bringing up the **Analysis Settings** window. Click on the **Analysis Settings** button from the **DESIGN/RATE** ribbon as shown below.

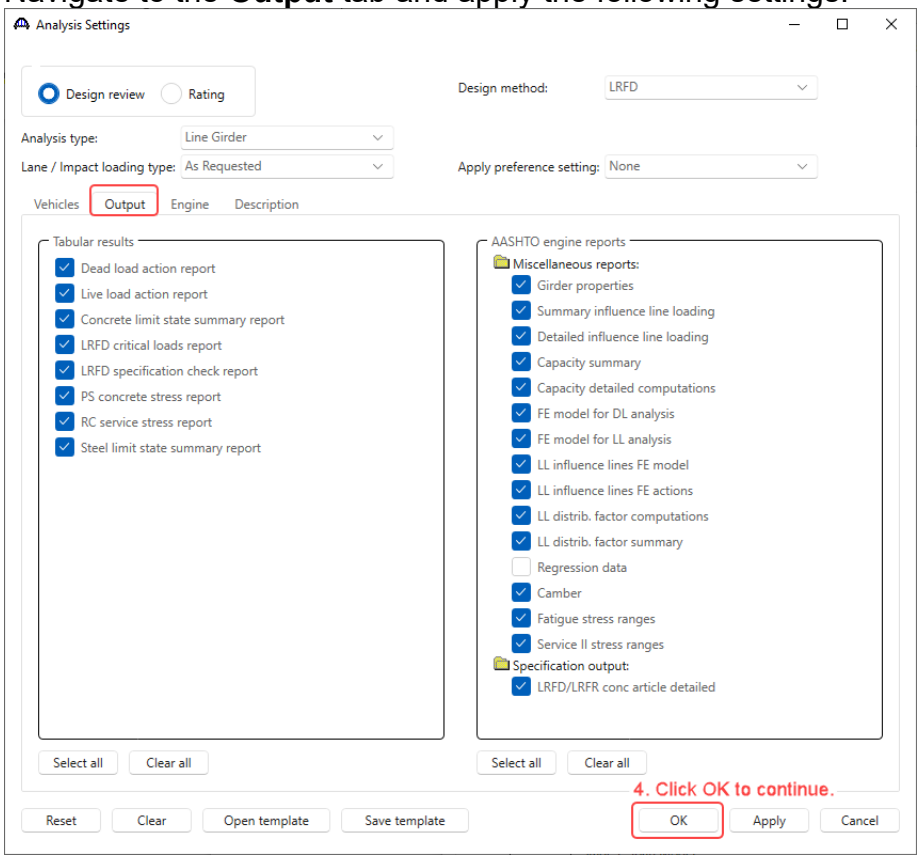




The updated **Analysis Settings** window is shown below.

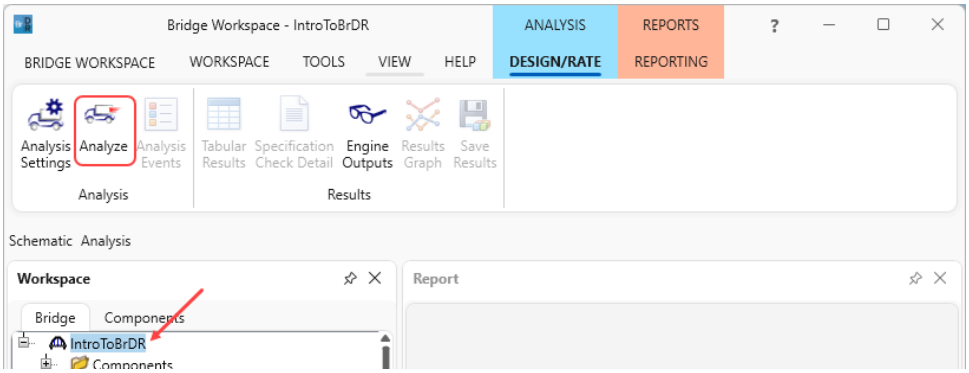


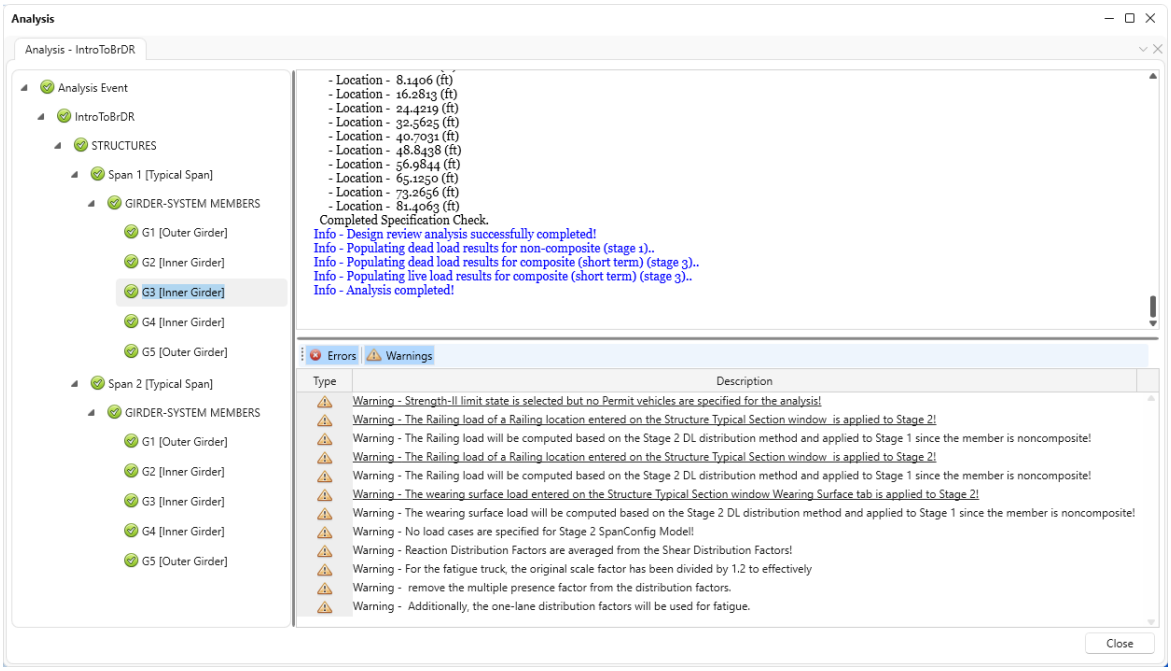
Navigate to the **Output** tab and apply the following settings.



Running the analysis

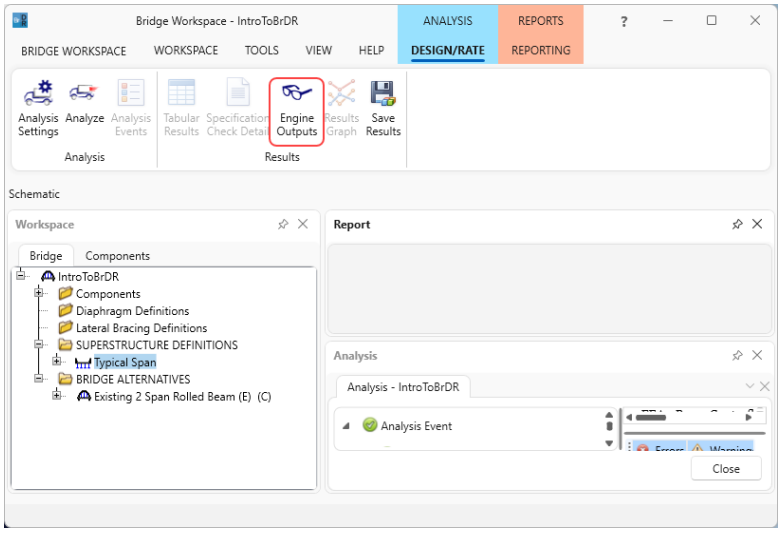
To run the analysis, with IntroToBrDR selected, click on the Analyze button from the ribbon. The analysis window displays the progress of analysis.

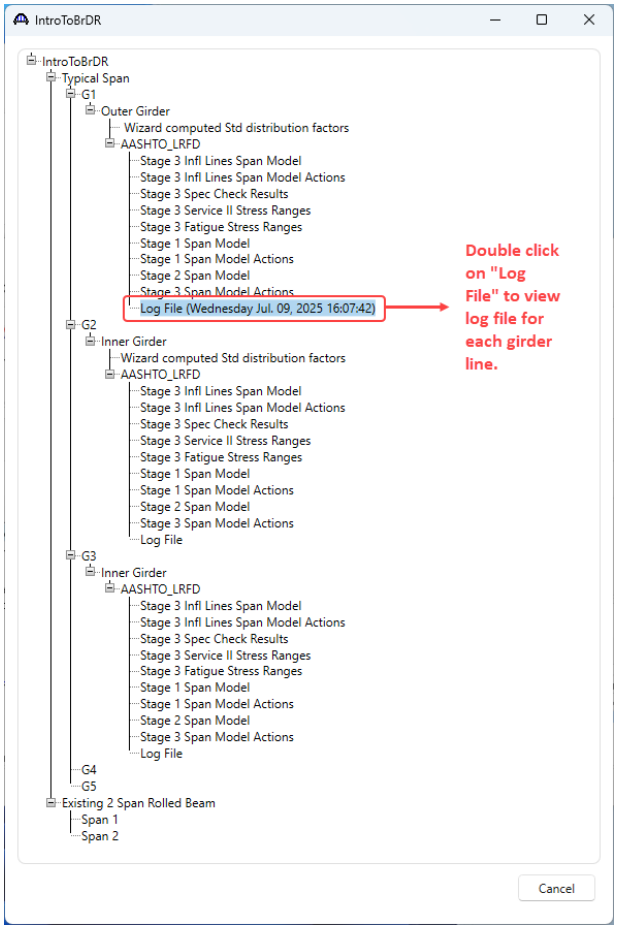




Engine Outputs

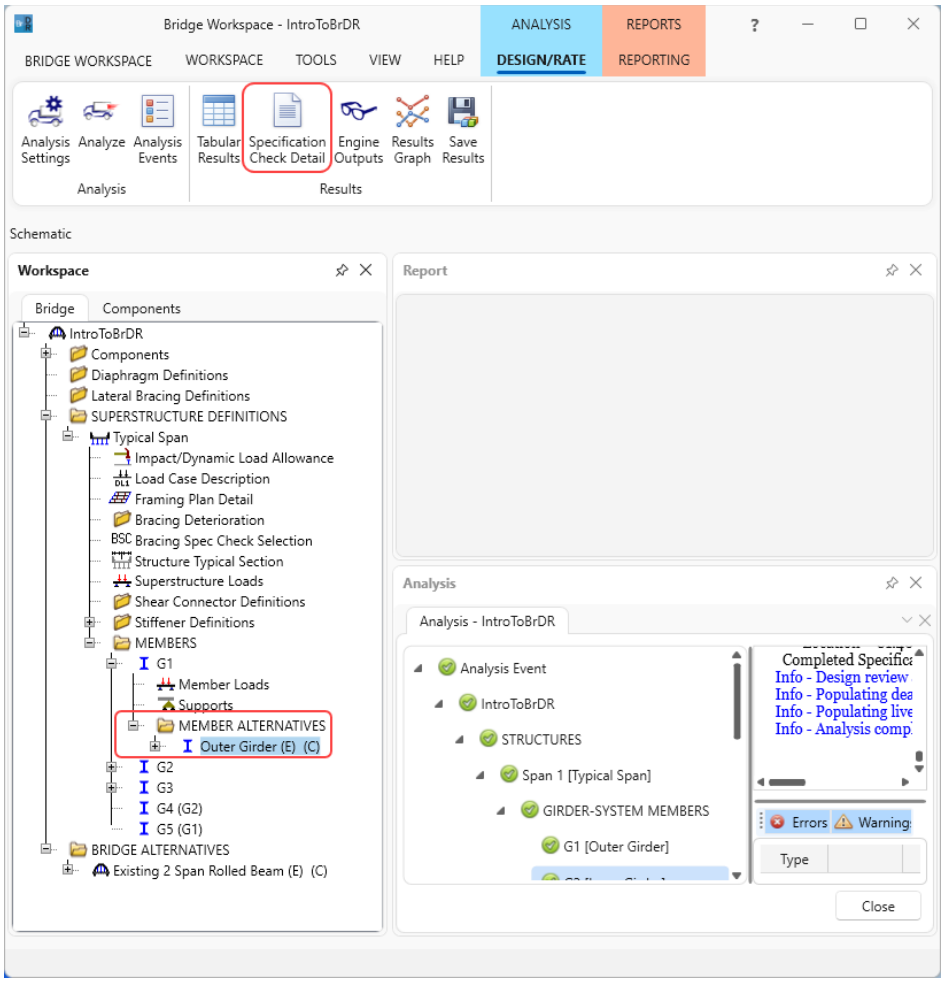
To view the engine outputs, with **Typical Span** selected in the **Bridge Workspace** tree, click on the Engine Outputs button from the **DESIGN/RATE** ribbon as shown below.

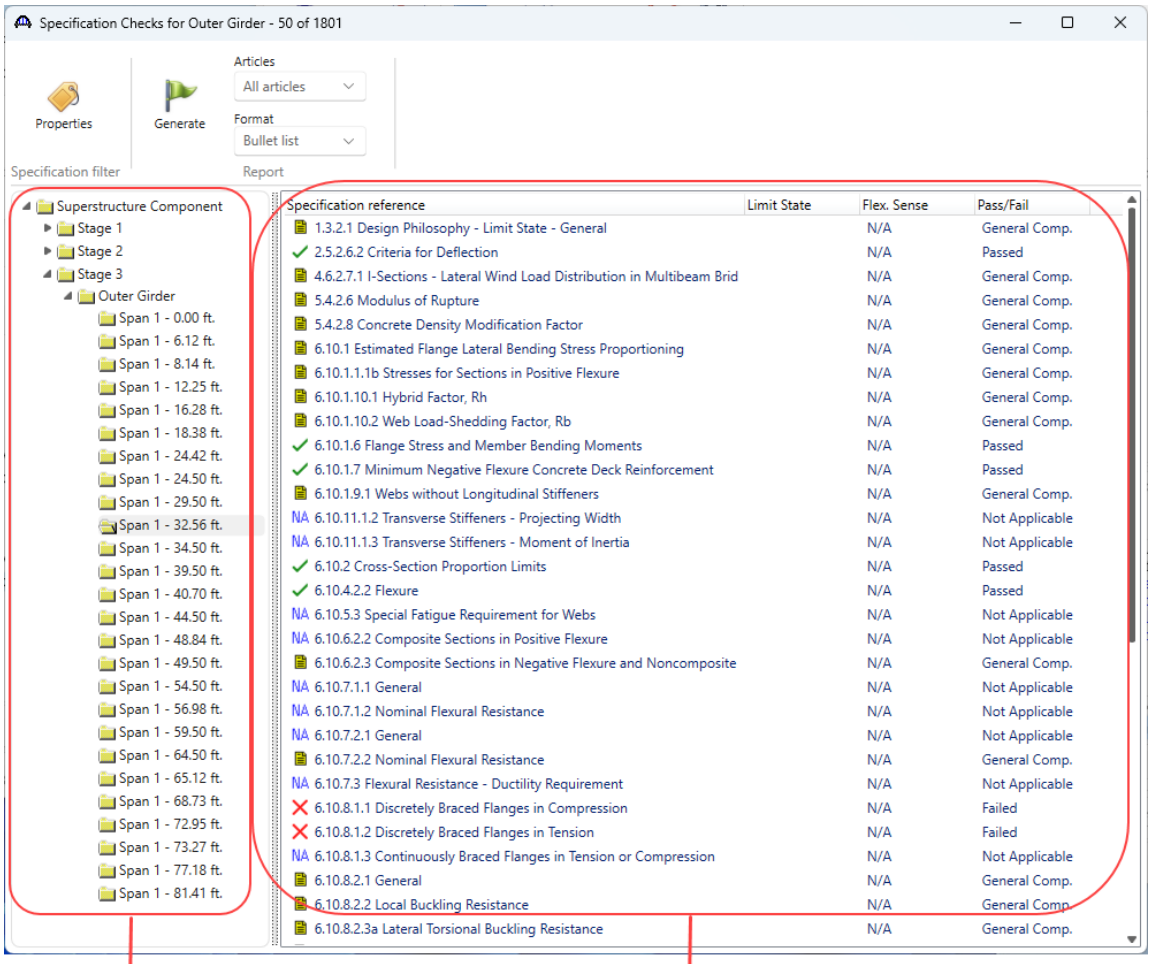




Specification Check

One of the features of BrDR is the specification check capabilities. Once the structure has been analyzed and the results are available, BrDR then goes through a series of specification checks to see if the structure complies with the appropriate design specifications. To get a spec check, first, select a member alternative. The spec check button will be activated. To view spec check for Girder **G1**, select the **Outer Girder** member alternative and click on the **Specification Check Detail** button from the ribbon as shown below.




Specification Checks for Outer Girder - 50 of 1801
Properties
Generate
Articles
All articles
Format
Bullet list
Specification filter
Report
Superstructure Component
Stage 1
Stage 2
Stage 3
Outer Girder
Span 1 - 0.00 ft.
Span 1 - 6.12 ft.
Span 1 - 8.14 ft.
Span 1 - 12.25 ft.
Span 1 - 16.28 ft.
Span 1 - 18.38 ft.
Span 1 - 24.42 ft.
Span 1 - 24.50 ft.
Span 1 - 29.50 ft.
Span 1 - 32.56 ft.
Span 1 - 34.50 ft.
Span 1 - 39.50 ft.
Span 1 - 40.70 ft.
Span 1 - 44.50 ft.
Span 1 - 48.84 ft.
Span 1 - 49.50 ft.
Span 1 - 54.50 ft.
Span 1 - 56.98 ft.
Span 1 - 59.50 ft.
Span 1 - 64.50 ft.
Span 1 - 65.12 ft.
Span 1 - 68.73 ft.
Span 1 - 72.95 ft.
Span 1 - 73.27 ft.
Span 1 - 77.18 ft.
Span 1 - 81.41 ft.
Specification reference
Limit State
Flex. Sense
Pass/Fail
1.3.2.1 Design Philosophy - Limit State - General N/A General Comp.
2.5.2.6.2 Criteria for Deflection N/A Passed
4.6.2.7.1 I-Sections - Lateral Wind Load Distribution in Multibeam Brid N/A General Comp.
5.4.2.6 Modulus of Rupture N/A General Comp.
5.4.2.8 Concrete Density Modification Factor N/A General Comp.
6.10.1 Estimated Flange Lateral Bending Stress Proportioning N/A General Comp.
6.10.1.1.1b Stresses for Sections in Positive Flexure N/A General Comp.
6.10.1.10.1 Hybrid Factor, Rh N/A General Comp.
6.10.1.10.2 Web Load-Shedding Factor, Rb N/A General Comp.
6.10.1.6 Flange Stress and Member Bending Moments N/A Passed
6.10.1.7 Minimum Negative Flexure Concrete Deck Reinforcement N/A Passed
6.10.1.9.1 Webs without Longitudinal Stiffeners N/A General Comp.
NA 6.10.11.1.2 Transverse Stiffeners - Projecting Width N/A Not Applicable
NA 6.10.11.1.3 Transverse Stiffeners - Moment of Inertia N/A Not Applicable
6.10.2 Cross-Section Proportion Limits N/A Passed
6.10.4.2.2 Flexure N/A Passed
NA 6.10.5.3 Special Fatigue Requirement for Webs N/A Not Applicable
NA 6.10.6.2.2 Composite Sections in Positive Flexure N/A Not Applicable
6.10.6.2.3 Composite Sections in Negative Flexure and Noncomposite N/A General Comp.
NA 6.10.7.1.1 General N/A Not Applicable
NA 6.10.7.1.2 Nominal Flexural Resistance N/A Not Applicable
NA 6.10.7.2.1 General N/A Not Applicable
6.10.7.2.2 Nominal Flexural Resistance N/A General Comp.
NA 6.10.7.3 Flexural Resistance - Ductility Requirement N/A Not Applicable
6.10.8.1.1 Discretely Braced Flanges in Compression N/A Failed
6.10.8.1.2 Discretely Braced Flanges in Tension N/A Failed
NA 6.10.8.1.3 Continuously Braced Flanges in Tension or Compression N/A Not Applicable
6.10.8.2.1 General N/A General Comp.
6.10.8.2.2 Local Buckling Resistance N/A General Comp.
6.10.8.2.3a Lateral Torsional Buckling Resistance N/A General Comp.
Member stage and location explorer
Articles