Continuous Span Reinforced Concrete Tee Beam Bridge

As-Built Model Only

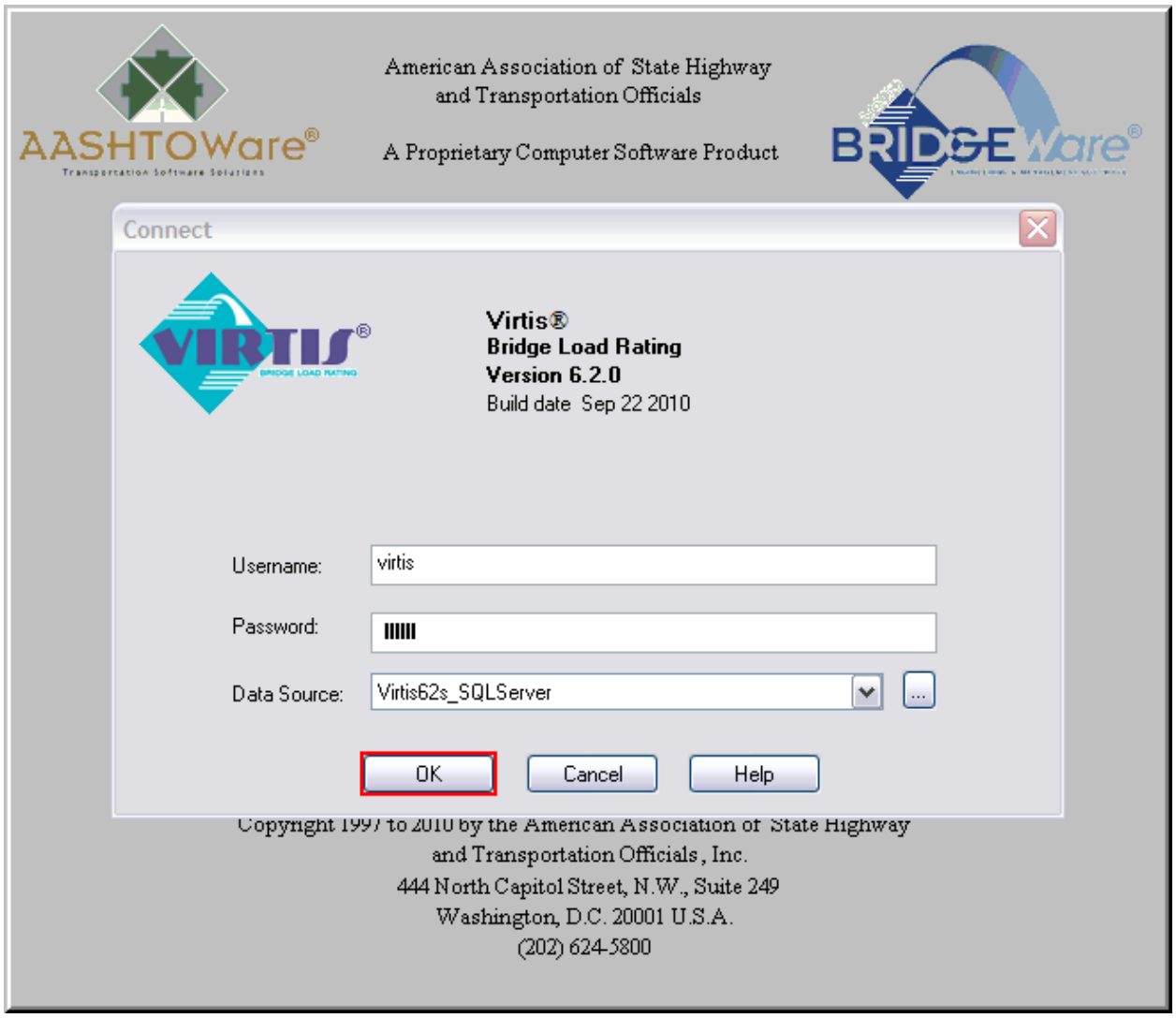
December, 2011

Virtis V6.2

DETAILED EXAMPLE

CONTINUOUS SPAN REINFORCED CONCRETE TEE BEAM BRIDGE INPUT

AS-BUILT MODEL ONLY


AASHTOWare®
American Association of State Highway and Transportation Officials
A Proprietary Computer Software Product
BRIDGEWare®
Connect
VIRTIS®
Virtis®
Bridge Load Rating
Version 6.2.0
Build date Sep 22 2010
Username:
virtis
Password:
Data Source:
Virtis62s_SQLServer
OK
Cancel
Help
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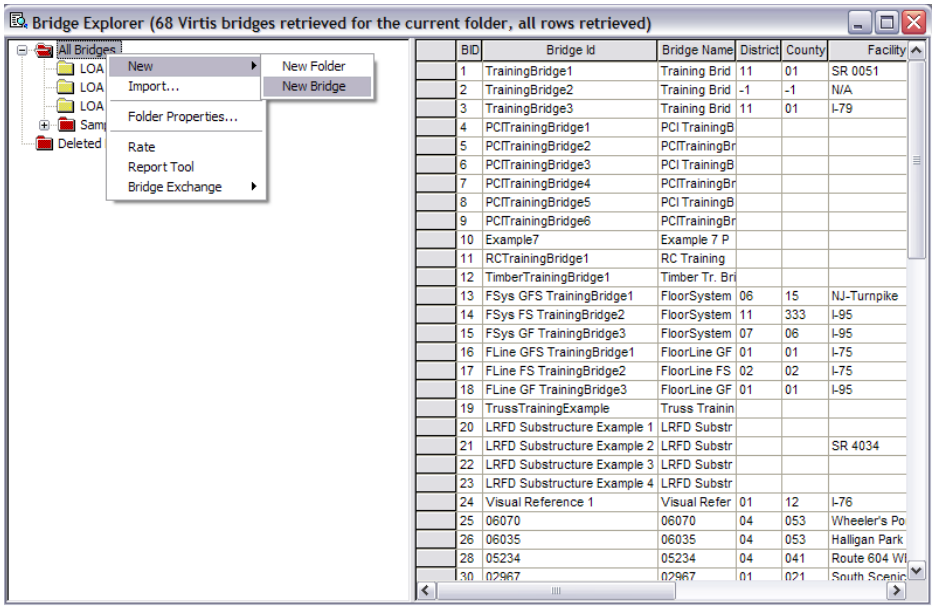
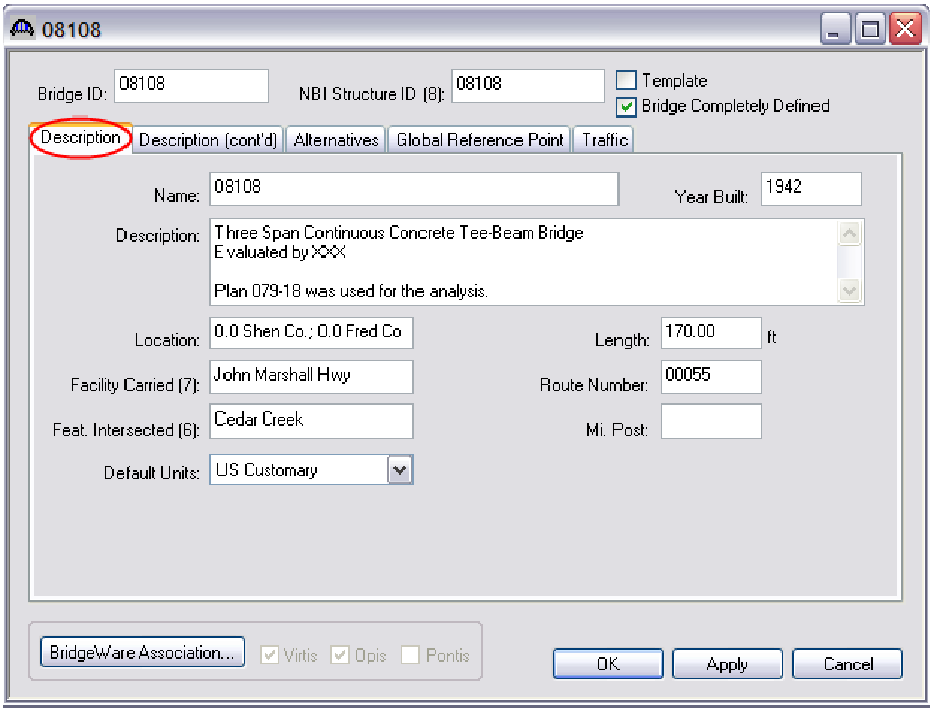
444 North Capitol Street, N.W., Suite 249
Washington, D.C. 20001 U.S.A.
(202) 624-5800

CREATE A NEW BRIDGE



To create a new bridge right click on the folder where you want to save the bridge and choose **New → New Bridge**.



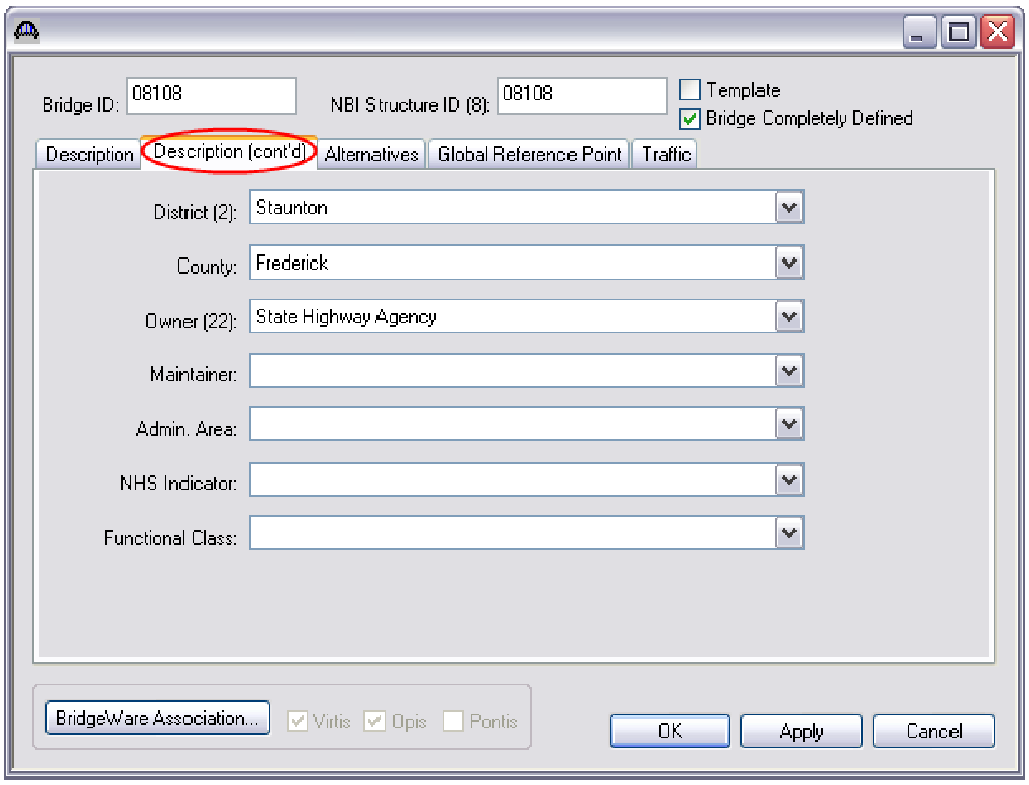
A new window will appear. Fill in the fields as appropriate under the **Description** tab:

Note: The description box is a good place to show the plan number used to analyze the structure.

Template: Template bridges serve as templates to help develop other bridges.

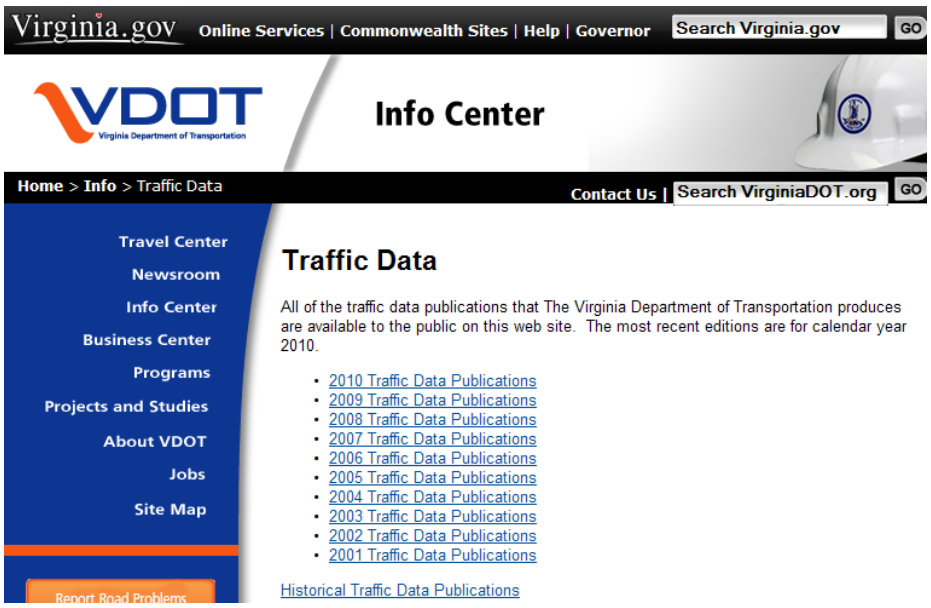
Bridge Completely Defined: Check the box if the specified bridge is completely defined within the Virtis/Opis database. Do not check this box if some of the structures making up the bridge are not in the database.

BridgeWare Association Button: Opens the BridgeWare Association window allowing you to specify this current bridge as a Virtis, Opis or Virtis/Opis bridge and also to link this current bridge to a bridge in the Pontis database if Pontis is installed.



Description (cont'd) tab: Fill in fields as appropriate.

No input required for the **Alternatives** and **Global Reference Point** tabs.

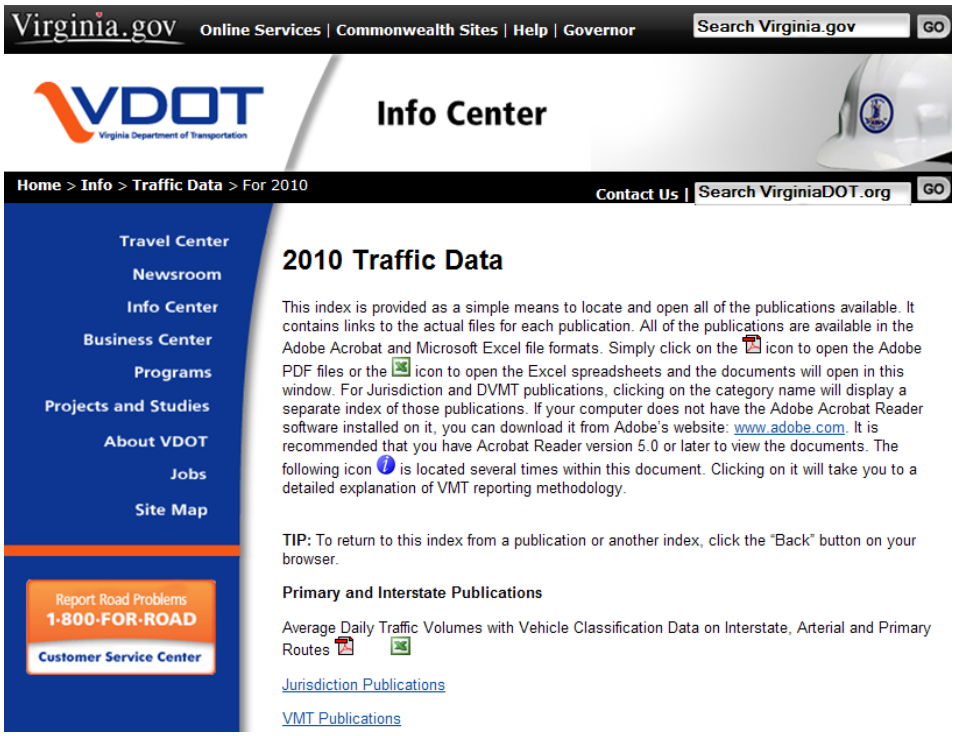


Traffic tab:

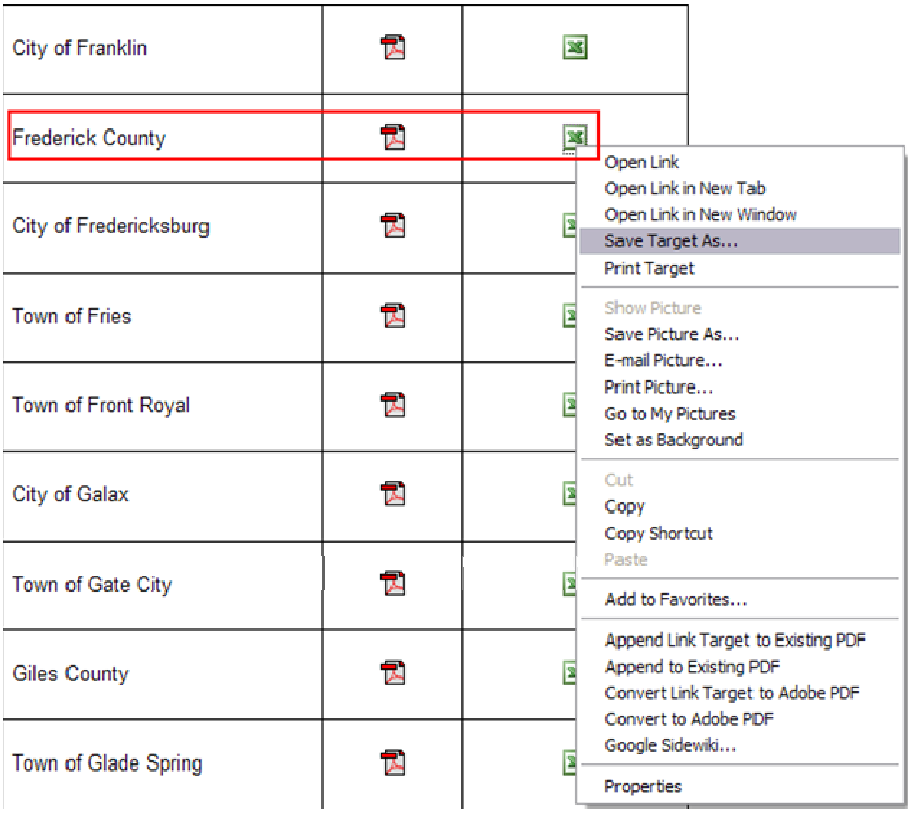
To find the traffic data follow the link below:

http://www.virginiadot.org/info/ct-TrafficCounts.asp

Left click the most current year.



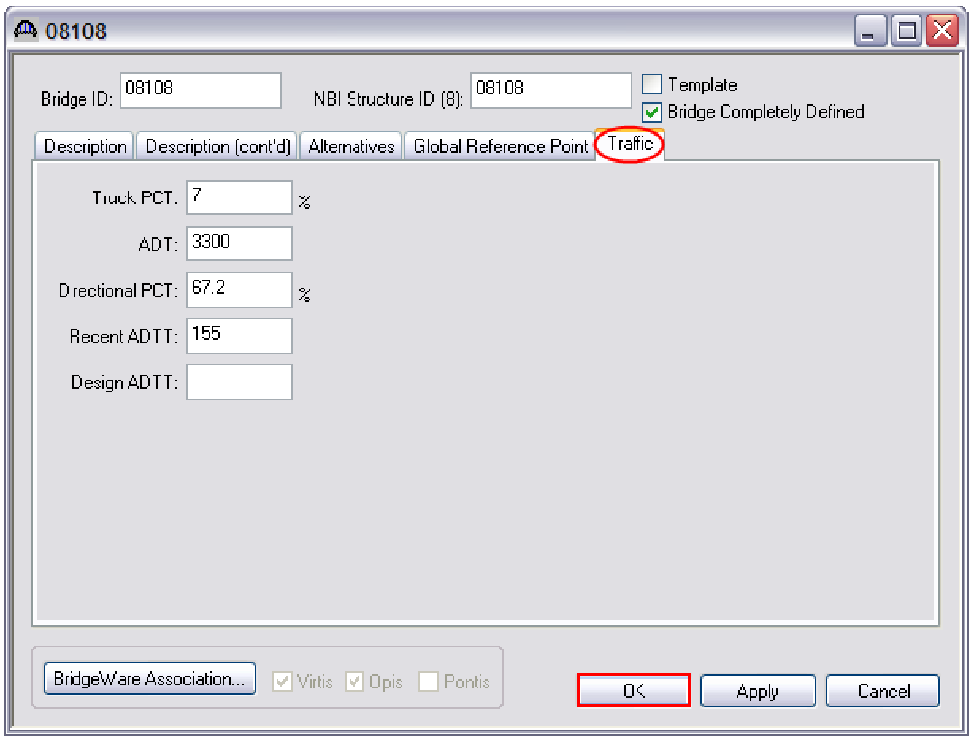
Left click **Jurisdiction Publications.**



Right click the excel icon for the appropriate jurisdiction.

Left click **Save Target As…** and save the file to a desired folder on user's computer.

Open the excel file and the user can locate the proper traffic data for the structure.



Truck PCT: The percentage of trucks in the average daily traffic.

ADT: Average Daily Traffic

Directional PCT: Percentage used to compute traffic in one direction

Recent ADTT: Virtis computes this value based on above inputs

Left click **OK** to accept and close.

For all Windows:

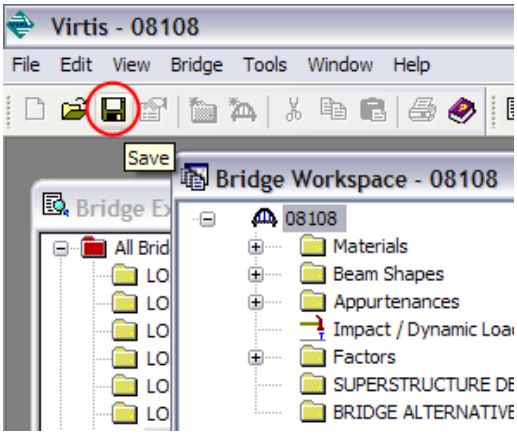
OK button: Saves the bridge description in this window and its tabs to memory and closes the window.

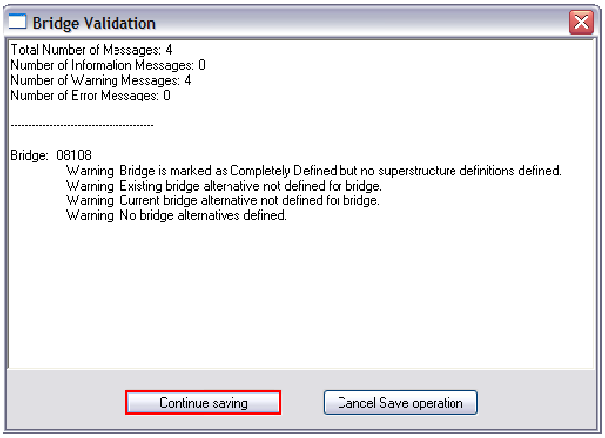
Apply button: Saves the bridge description in this window and its tabs to memory and keeps the window open.

Cancel button: Closes the window without saving the bridge description in this window and its tabs to memory.

NOTE:

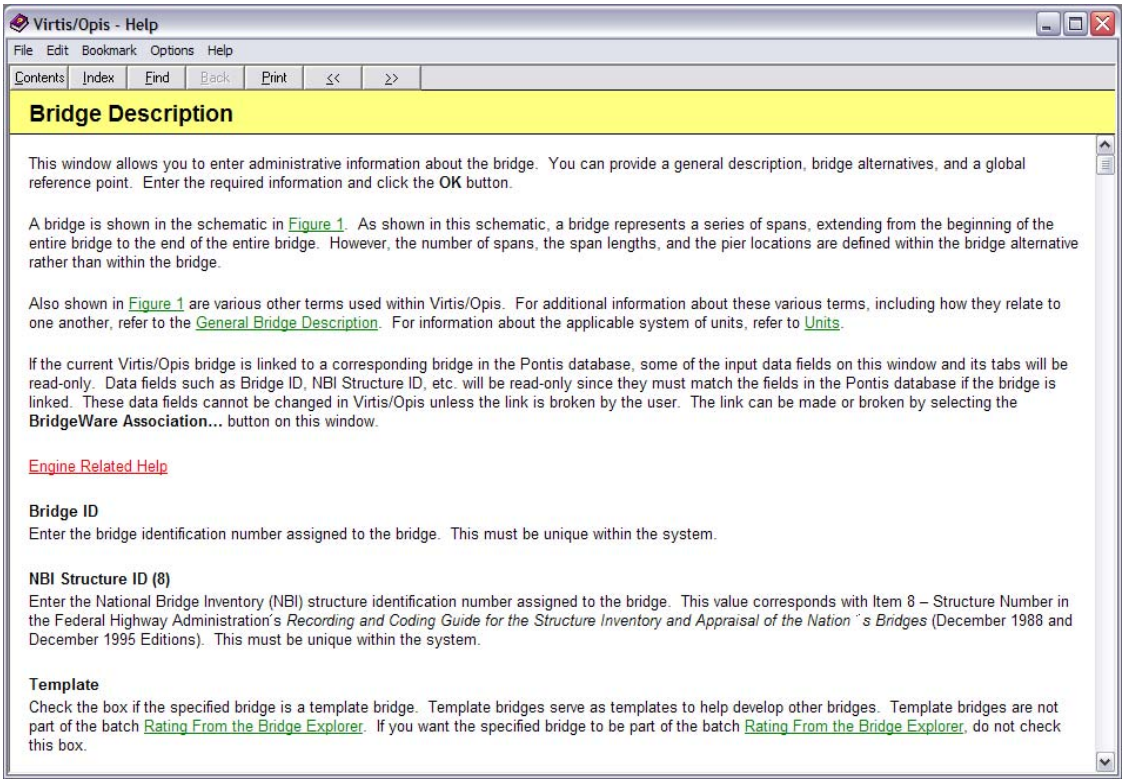
1. It is strongly recommended that the user save the bridge data at this time. In addition, the user should routinely save the bridge data during the input process.



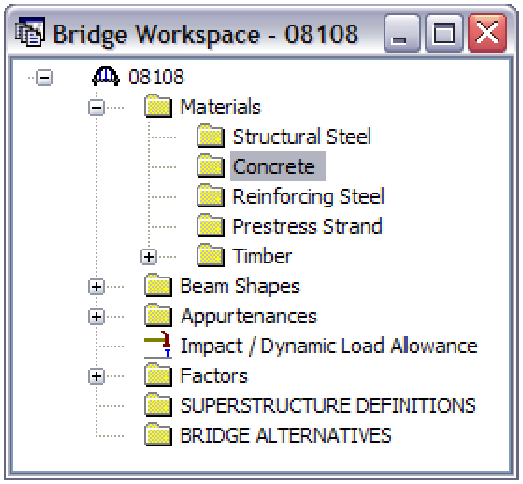


Left click the **Save** icon and the **Bridge Validation** window will appear. Left click **Continue Saving** to finish the save process.

2. The user can view the **Virtis/Opis - Help** window for any of the input windows shown in the example by pressing **F1** on the keyboard when a window is open.

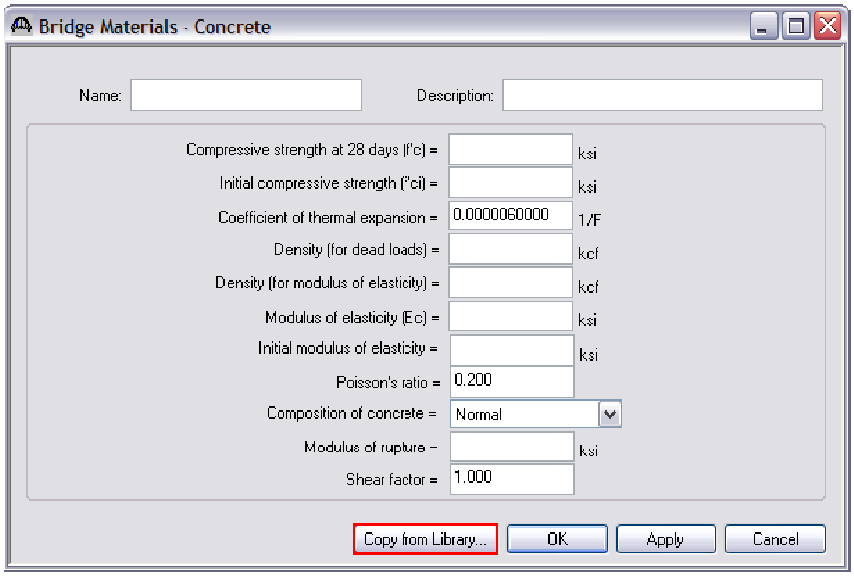


SELECT MATERIAL PROPERTIES

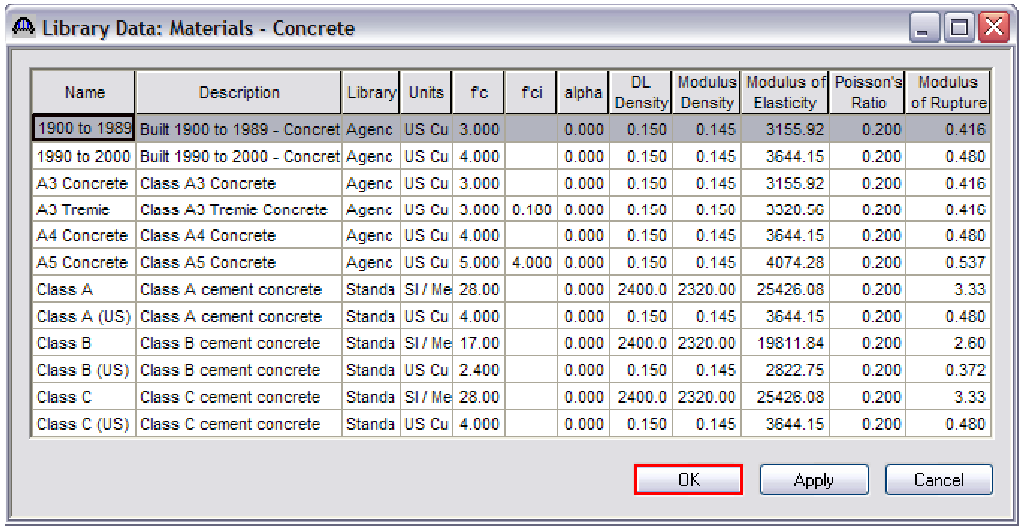


Expand the **Materials** folder.

Double click **Concrete** to open the **Bridge Materials – Concrete** Window.

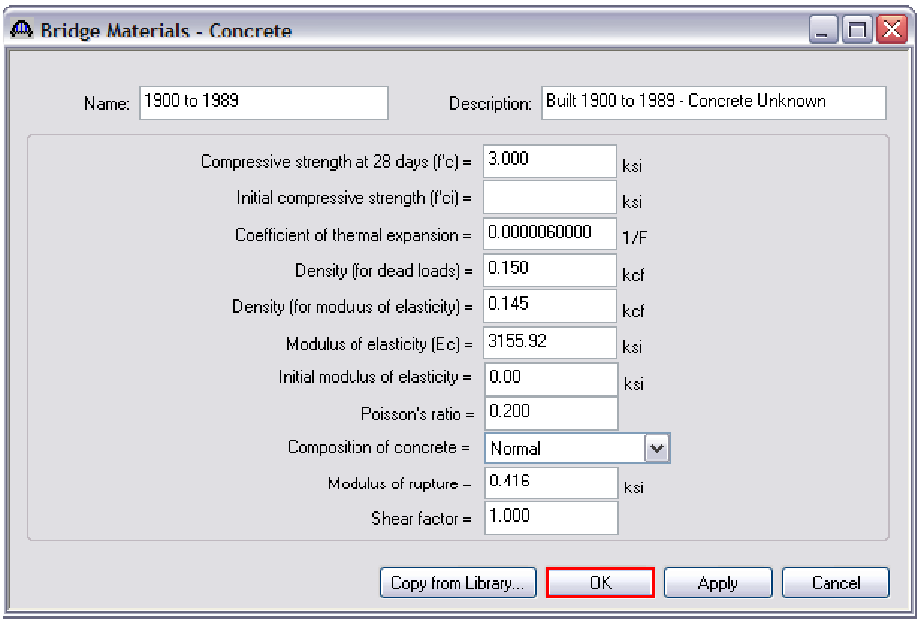


Copy from Library Button: Opens the Library - Materials – Concrete window, allowing you to copy a set of concrete material properties from the library to this window.

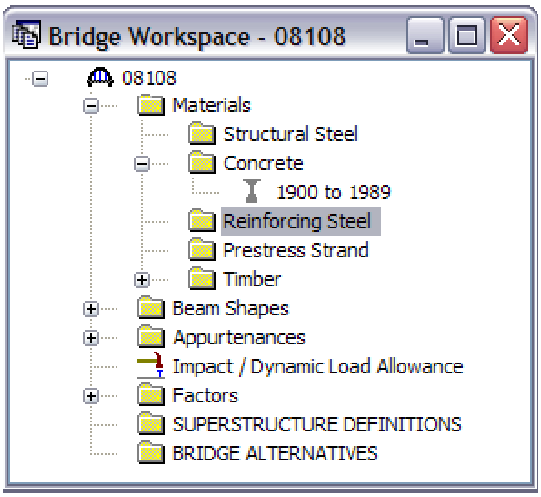


Name	Description	Library	Units	fc	fci	alpha	DL Density	Modulus Density	Modulus of Elasticity	Poisson's Ratio	Modulus of Rupture
1900 to 1989	Built 1900 to 1989 - Concret	Agenc	US Cu	3.000		0.000	0.150	0.145	3155.92	0.200	0.416
1990 to 2000	Built 1990 to 2000 - Concret	Agenc	US Cu	4.000		0.000	0.150	0.145	3644.15	0.200	0.480
A3 Concrete	Class A3 Concrete	Agenc	US Cu	3.000		0.000	0.150	0.145	3155.92	0.200	0.416
A3 Tremie	Class A3 Tremie Concrete	Agenc	US Cu	3.000	0.100	0.000	0.150	0.150	3320.56	0.200	0.416
A4 Concrete	Class A4 Concrete	Agenc	US Cu	4.000		0.000	0.150	0.145	3644.15	0.200	0.480
A5 Concrete	Class A5 Concrete	Agenc	US Cu	5.000	4.000	0.000	0.150	0.145	4074.28	0.200	0.537
Class A	Class A cement concrete	Standa	SI / Me	28.00		0.000	2400.0	2320.00	25426.08	0.200	3.33
Class A (US)	Class A cement concrete	Standa	US Cu	4.000		0.000	0.150	0.145	3644.15	0.200	0.480
Class B	Class B cement concrete	Standa	SI / Me	17.00		0.000	2400.0	2320.00	19811.84	0.200	2.60
Class B (US)	Class B cement concrete	Standa	US Cu	2.400		0.000	0.150	0.145	2822.75	0.200	0.372
Class C	Class C cement concrete	Standa	SI / Me	28.00		0.000	2400.0	2320.00	25426.08	0.200	3.33
Class C (US)	Class C cement concrete	Standa	US Cu	4.000		0.000	0.150	0.145	3644.15	0.200	0.480

Left click the appropriate concrete properties and left click the **OK** to accept.

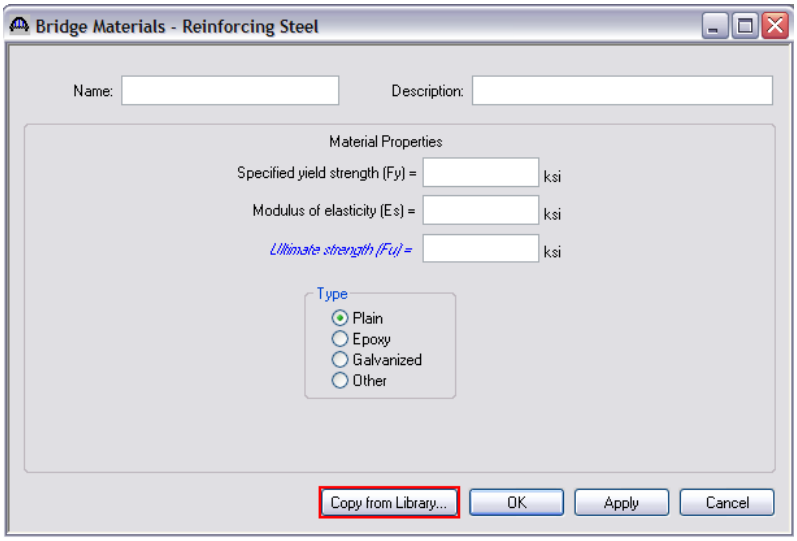


Left click **OK** to accept and close.

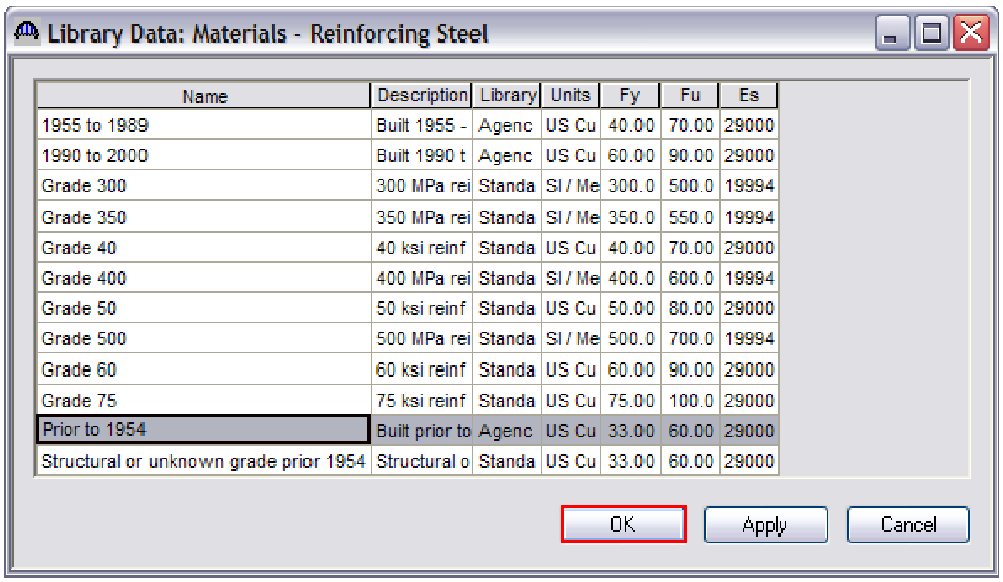


Repeat the process for **Reinforcing Steel**.

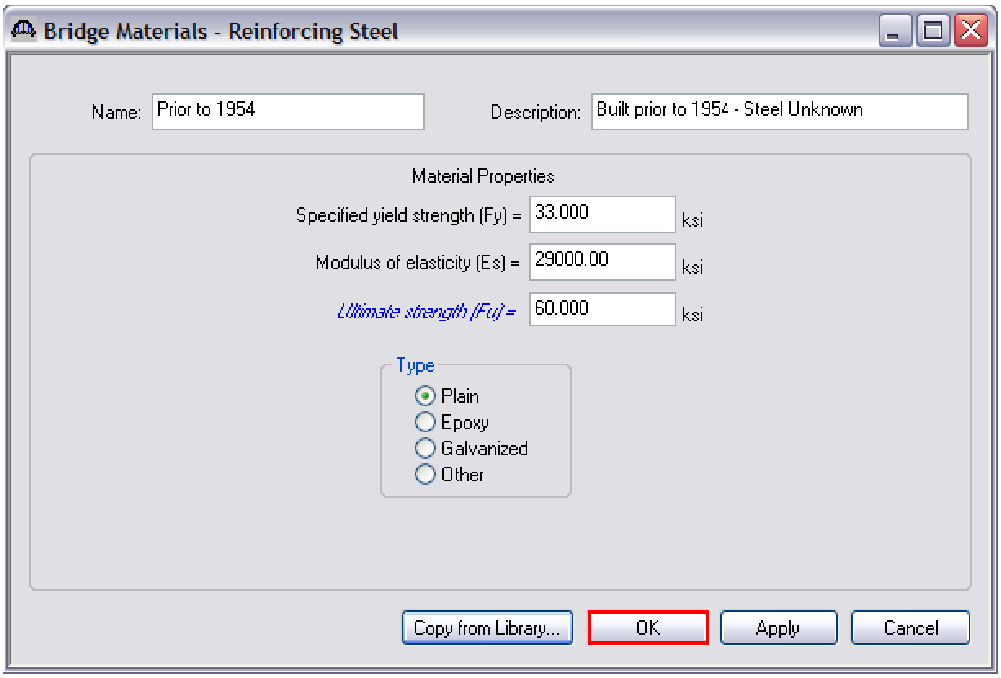
Double click **Reinforcing Steel** to open the **Bridge Materials – Reinforcing Steel** Window.



Copy from Library Button: Opens the Library - Materials – Reinforcing Steel window, allowing you to copy a set of steel reinforcing steel material properties from the library to this window.



Left click the appropriate reinforcing steel properties and left click the **OK** Button to accept.



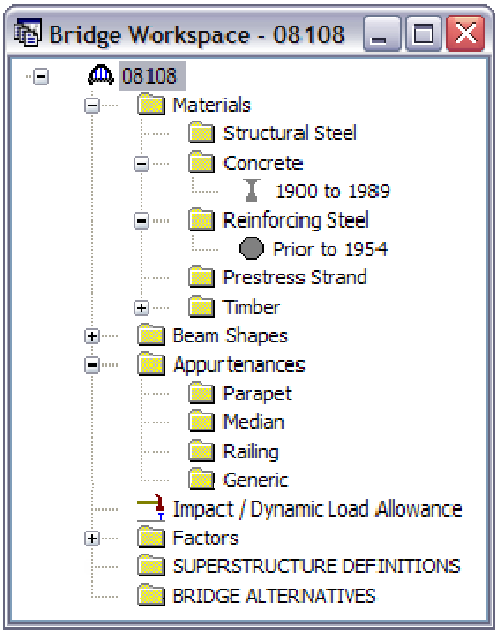
Type: User can select whether the reinforcing steel is **Plain**, **Epoxy**, **Galvanized**, or **Other**. For this example, select **Plain**.

Left click **OK** to accept and close.

DEFINE APPURTENANCES

The user can define parapets, medians, railing, and generic appurtenances. For parapets and medians, the user enters dimensions and a unit weight and Virtis computes the distributed load in kip/ft.

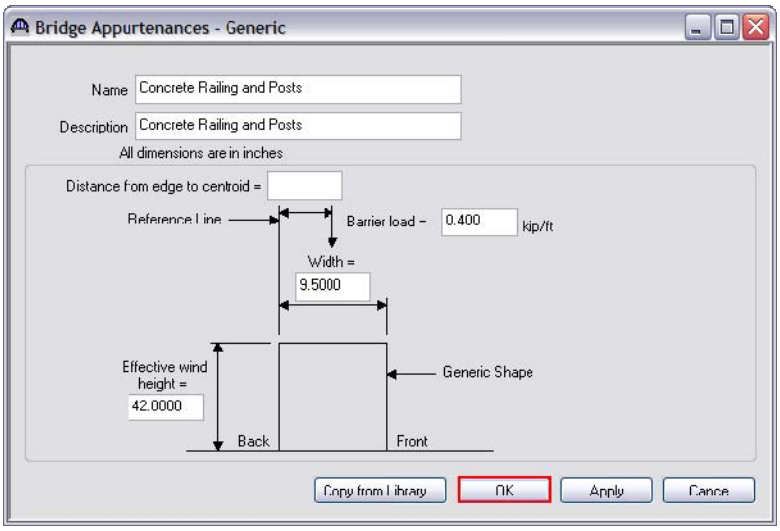
For the railing and generic definitions, the user must manually calculate a distributed load.



Expand the **Appurtenances** folder.

Since the barrier is not a standard parapet shape, it must be defined as a generic barrier.

Double click **Generic** to open the **Bridge Appurtenances – Generic** window.



Input the following fields:

Name: Concrete Railing and Posts

Description: Concrete Railing and Posts

Distance from edge to centroid: This field can be left blank.

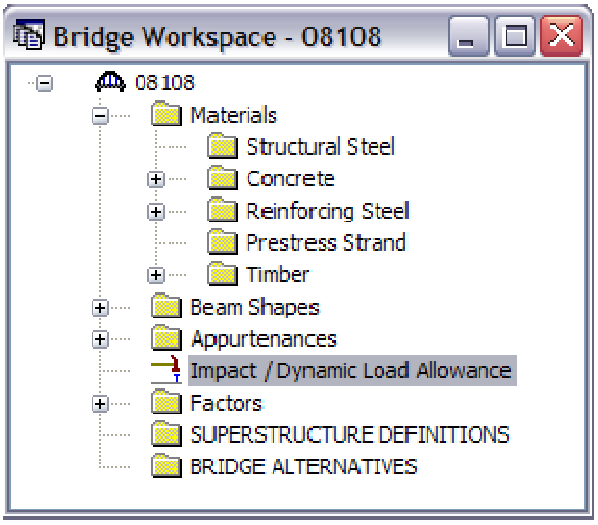
Effective wind height: Enter the overall height of the barrier from the top of the deck to the top of the barrier. For this example, enter **42.00** in.

Width: Enter the overall width of the barrier from the edge of deck to the inside face of the barrier (4 ft + 8 ft + 0.6667 ft + 1.125 ft – 13 ft = 0.7917 ft = 9.50 in).

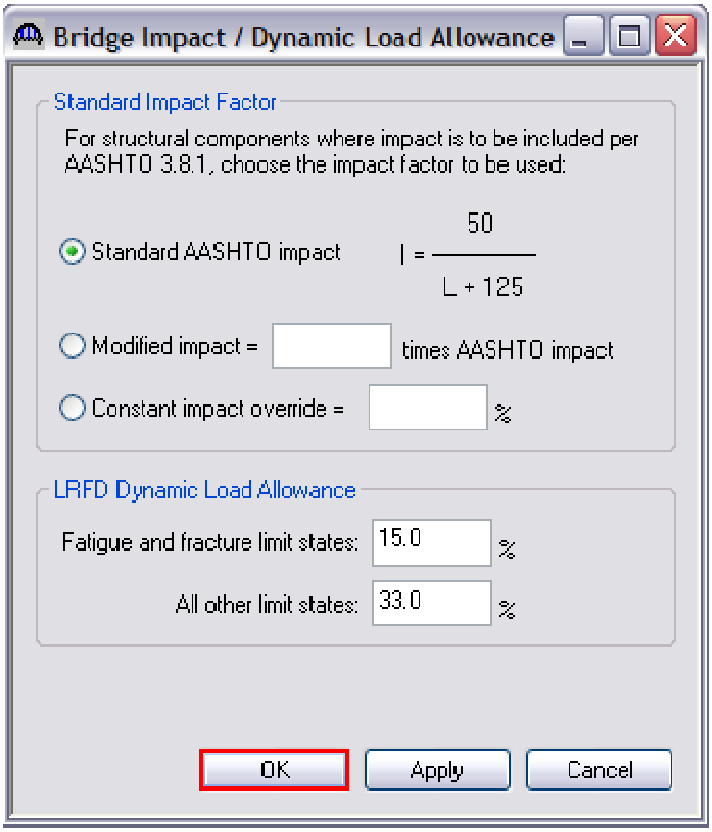
Barrier Load: User must calculate the barrier load. See Appendix B for the calculation.

Click **OK** to accept and close.

SELECT IMPACT / DYNAMIC LOAD ALLOWANCES



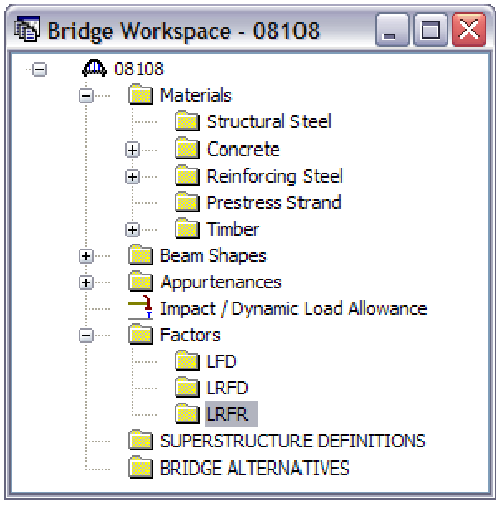
Double click **Impact / Dynamic Load Allowance** to open.



15.0% and 33.0% are AASHTO LRFD defaults.

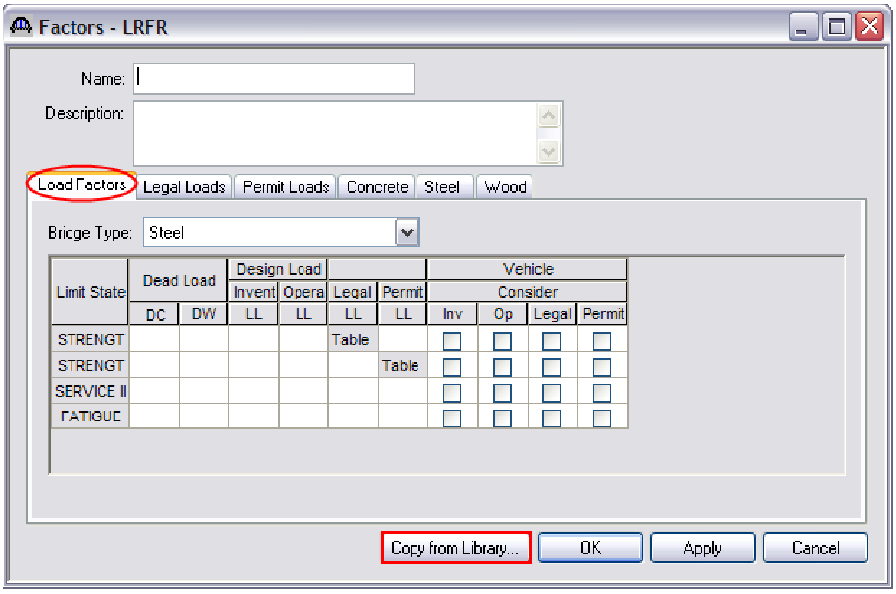
Left click the **OK** button to accept and close.

SELECT FACTORS

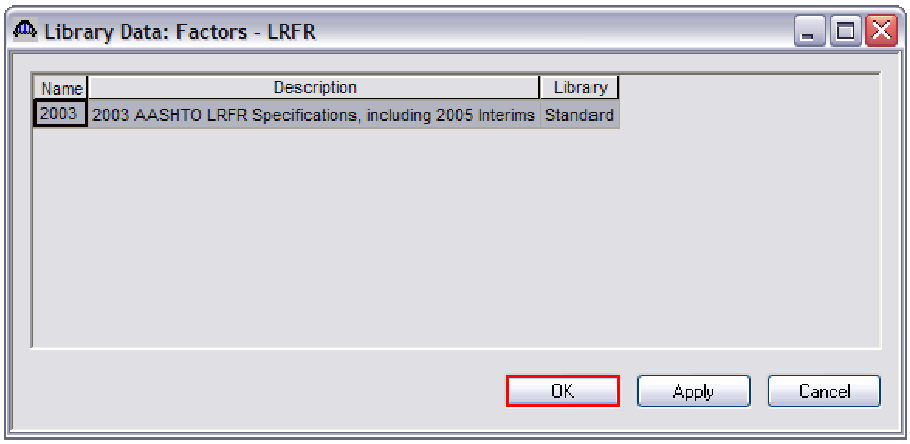


Expand the **Factors** folder.

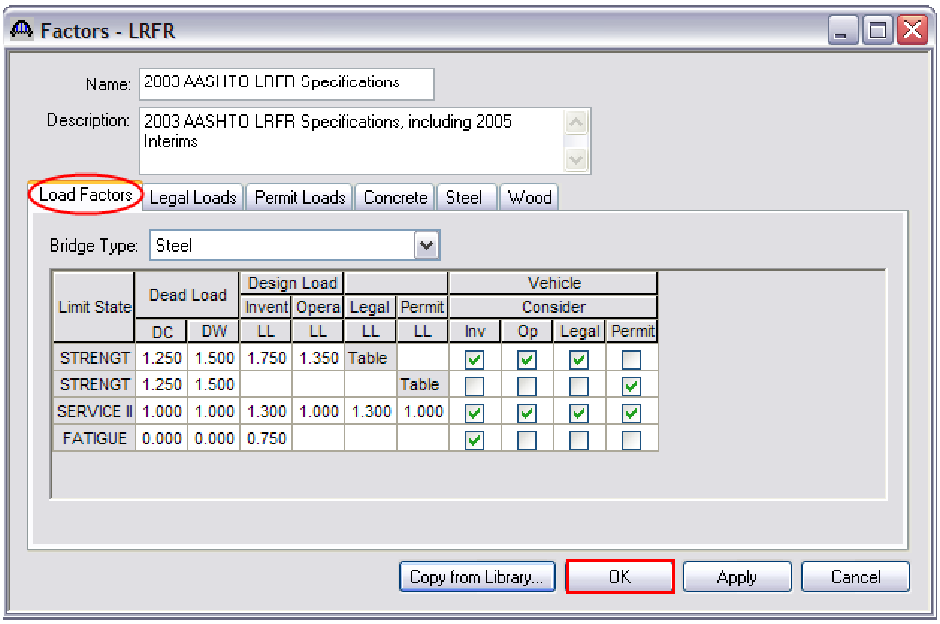
Double click **LRFR** to open.



Left click the **Copy from Library…** button to open the library data for LRFR factors.

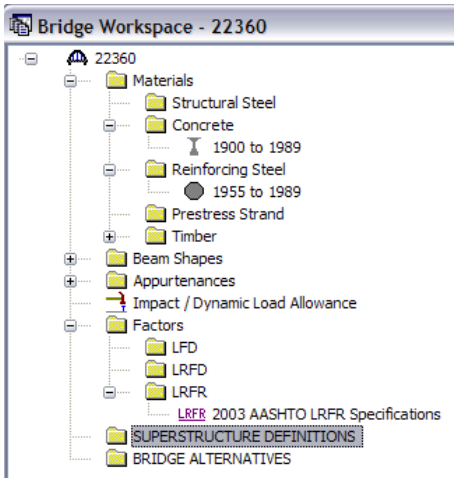


Select the appropriate factors and left click the **OK** button to accept.

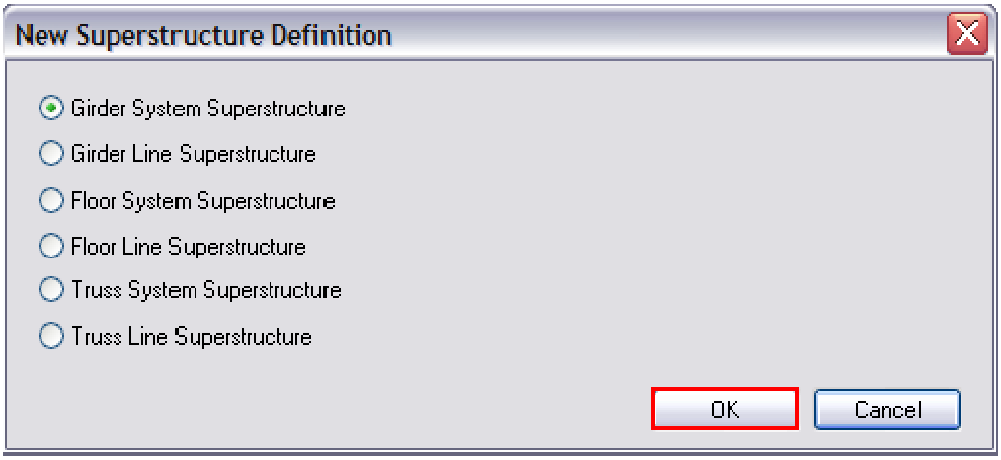


Left click the **OK** button to accept and close.

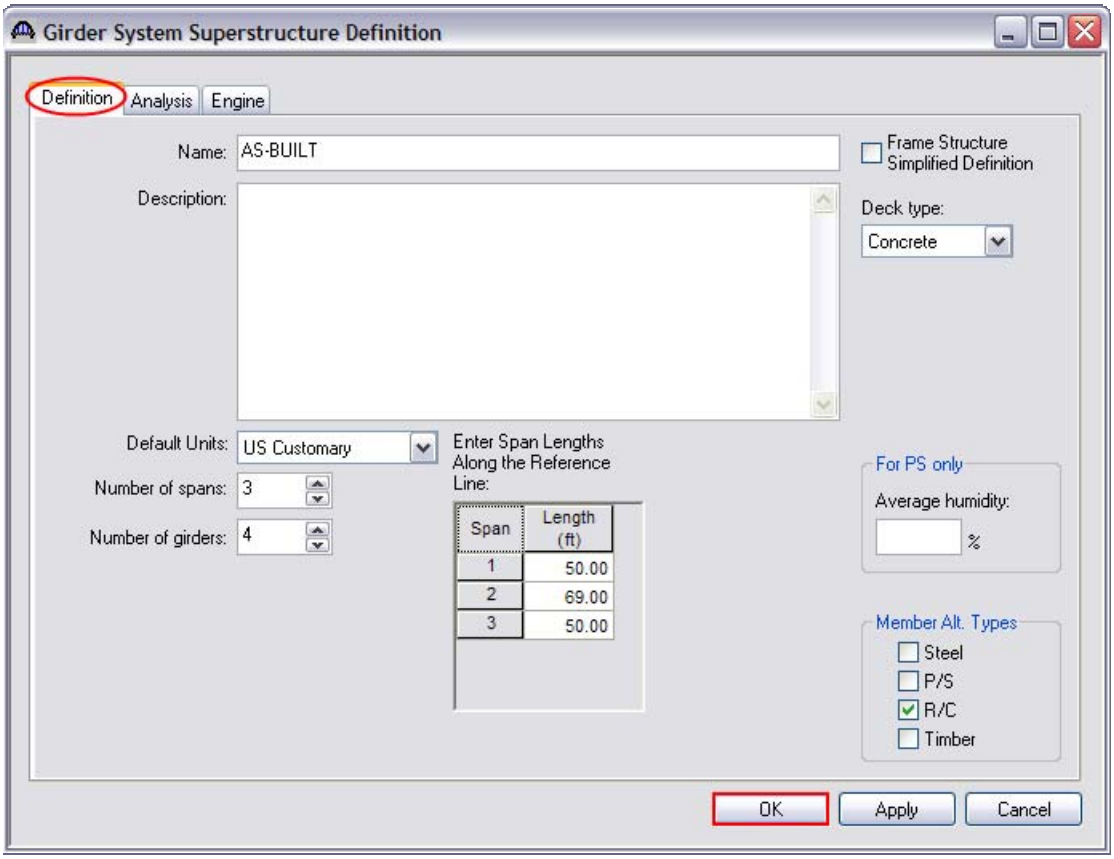
CREATE SUPERSTRUCTURE DEFINITIONS



Double click **SUPERSTRUCTURE DEFINITIONS** to open.



Select **Girder System Superstructure** and left click the **OK** button to accept and close.



Fill out the following fields:

Name: AS-BUILT

Description: No information required, but user can input additional information or assumptions if desired.

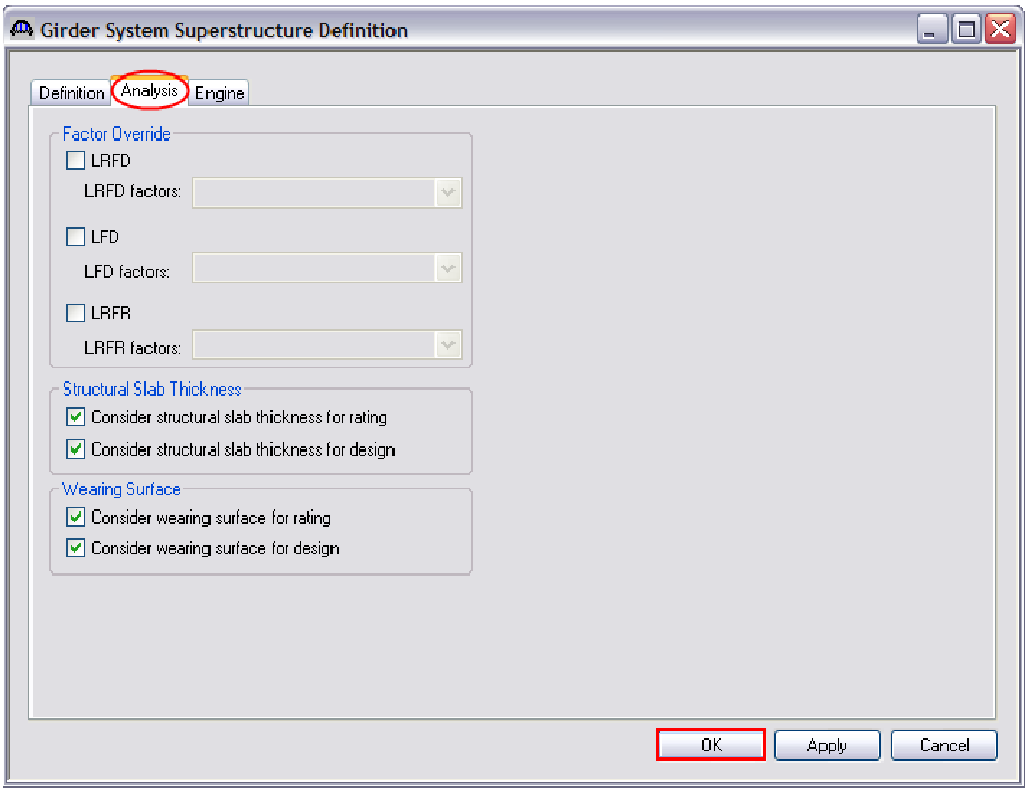
Deck Type: Concrete

Number of Spans: 3

Number of Girders: Enter the number of beams in the bridge cross section. For this example, enter 4 beams.

Span Length (ft): Enter the CL BRG to CL pier length for exterior spans and CL pier to CL pier lengths for interior spans. For this example, enter **50.00** ft for spans 1 and 3 and **69.00** for span 2.

Member Alt. Types: Select **R/C** since a reinforced concrete tee beam is rated.



Left click the **Analysis** tab:

Factor Override: None selected. Factor Override allows you to override the System Defaults library factors with a set of factors that have been entered for this bridge only. Factor overrides will remain when files are imported into future versions of Virtis. Unless factors specific to the bridge are required, overrides are not recommended as they can prevent updates to System Defaults in future versions (e.g., legal load SHV factors in the MBE).

Consider structural slab thickness for rating: Check this box if the structural slab thickness should be used to compute section properties for rating. If this box is not checked, the rating will use section properties computed from the total deck thickness.

Consider structural slab thickness for design: Check this box if the structural slab thickness should be used to compute section properties for design. If this box is not checked, the design will use section properties computed from the total deck thickness.

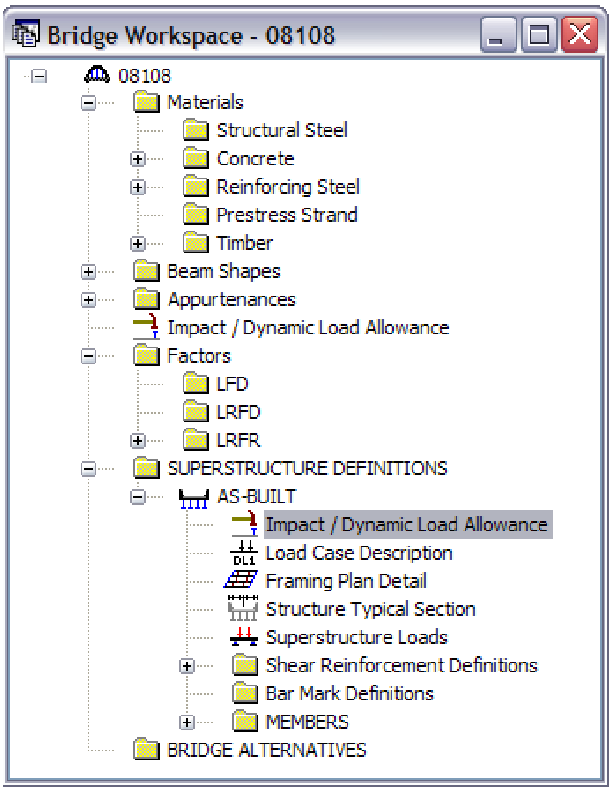
Consider wearing surface for rating: Check this box if the wearing surface should be included in the dead load for rating. If this box is not checked, the rating will ignore any wearing surface input.

Consider wearing surface for design: Check this box if the wearing surface should be included in the dead load for design. If this box is not checked, the design will ignore any wearing surface input.

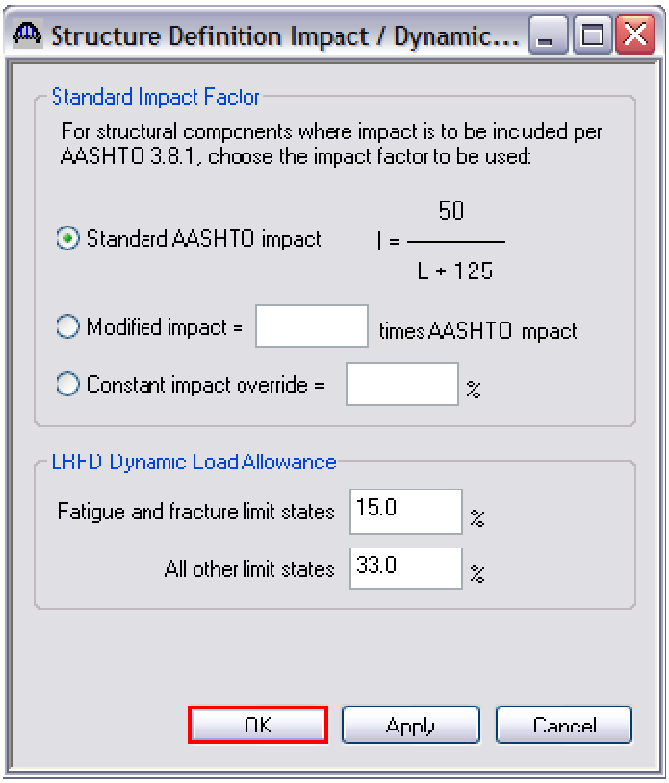
No input required for the **Engine** tab.

Left click **OK** to accept and close.

SELECT IMPACT / DYNAMIC LOAD ALLOWANCES



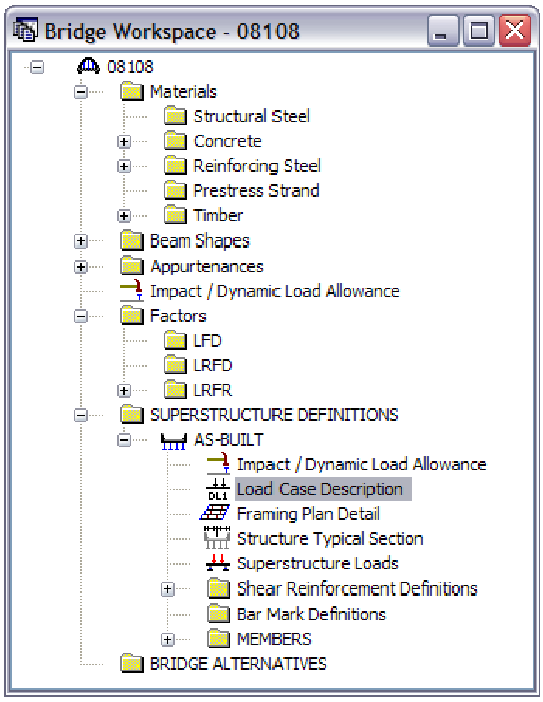
Double click **Impact / Dynamic Load Allowance** to open.



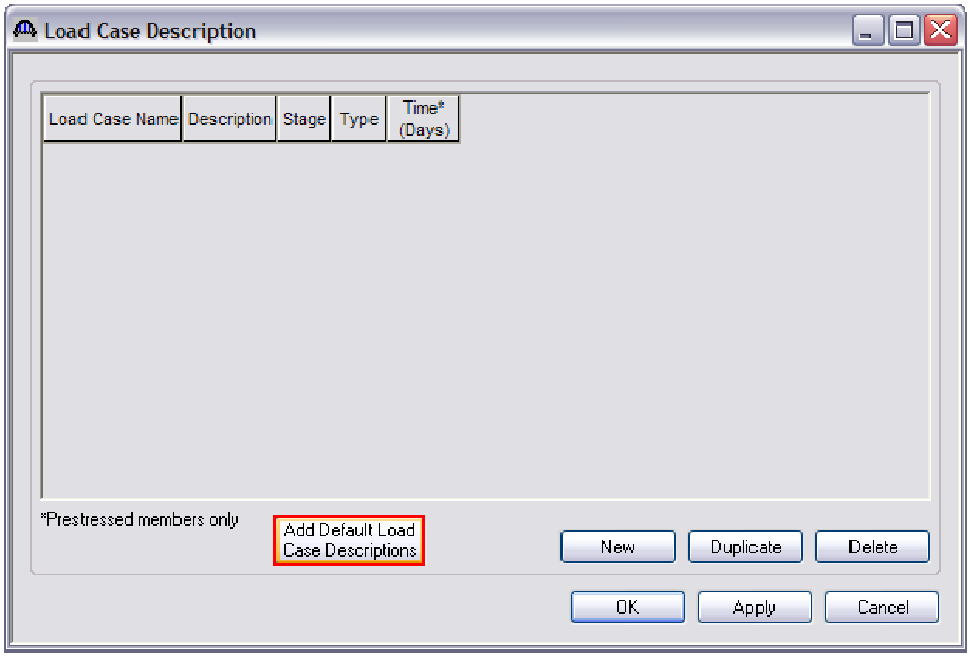
15.0% and 33.0% are AASHTO LRFD defaults.

Left click the **OK** button to accept and close.

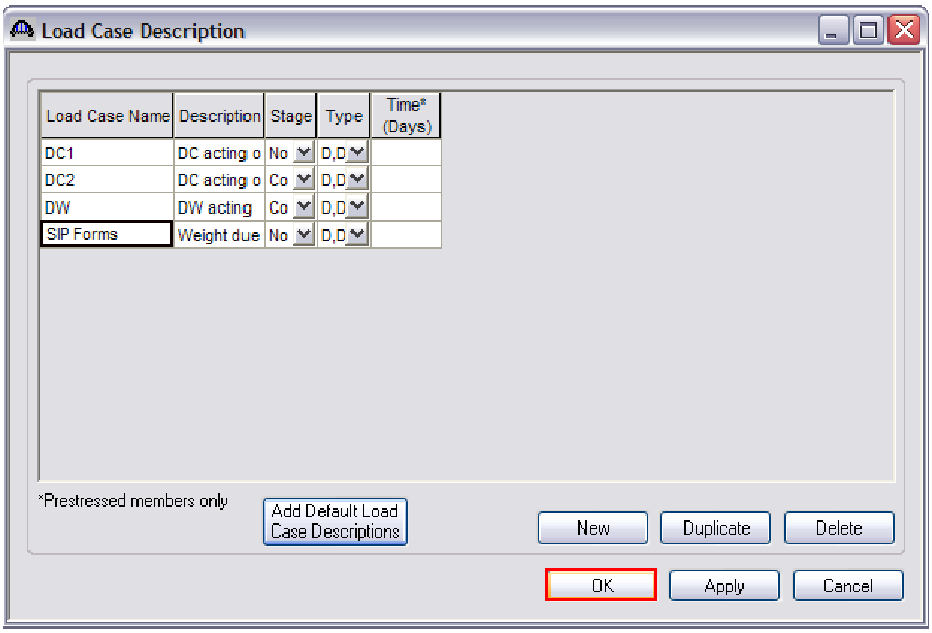
DEFINE LOAD CASES



Double click **Load Case Description** to open the Load Case Description window.

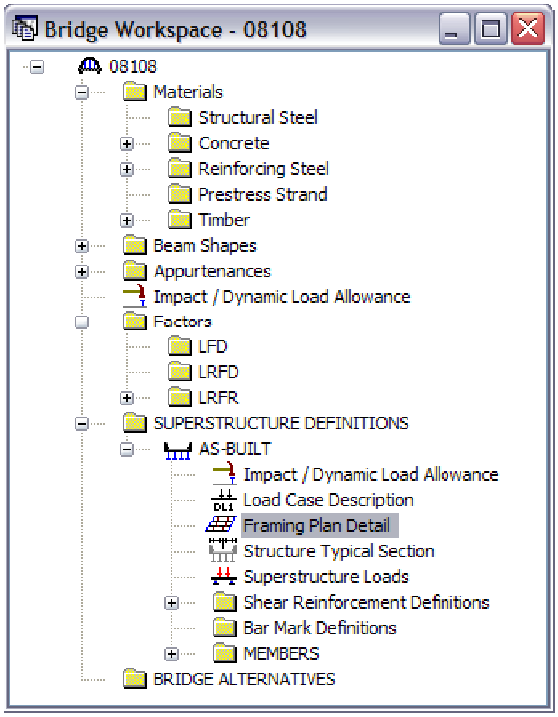


Left click **Add Default Load Case Descriptions** to apply default load cases. The default load cases include dead load (DC1) acting on non-composite section, dead load (DC2) acting on long term composite section, dead load (DW) acting on long term composite section and stay-in-place forms acting on non-composite section. These default load cases can be edited and modified as desired.

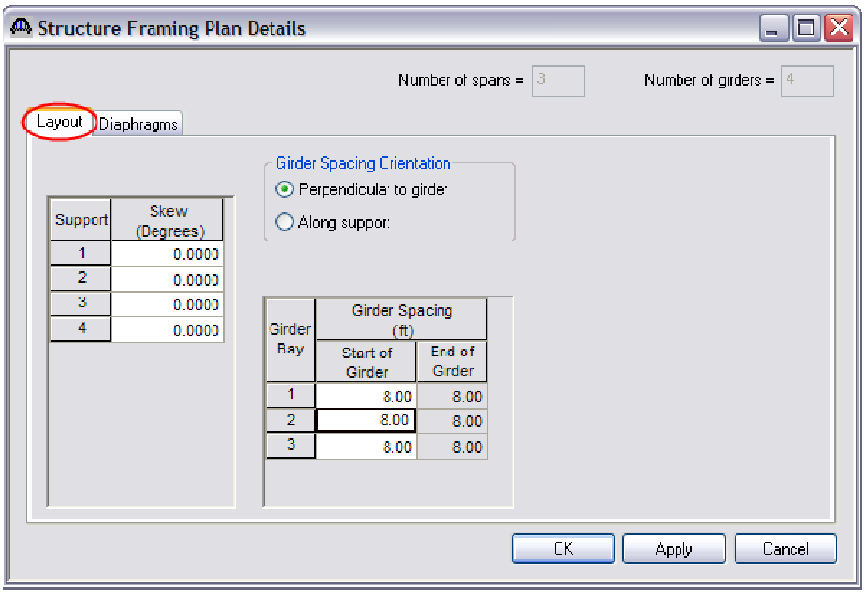


Left click the **OK** button to accept and close.

DEFINE FRAMING PLAN DETAIL



Double click **Framing Plan Detail** to open the framing plan detail window.



Layout Tab:

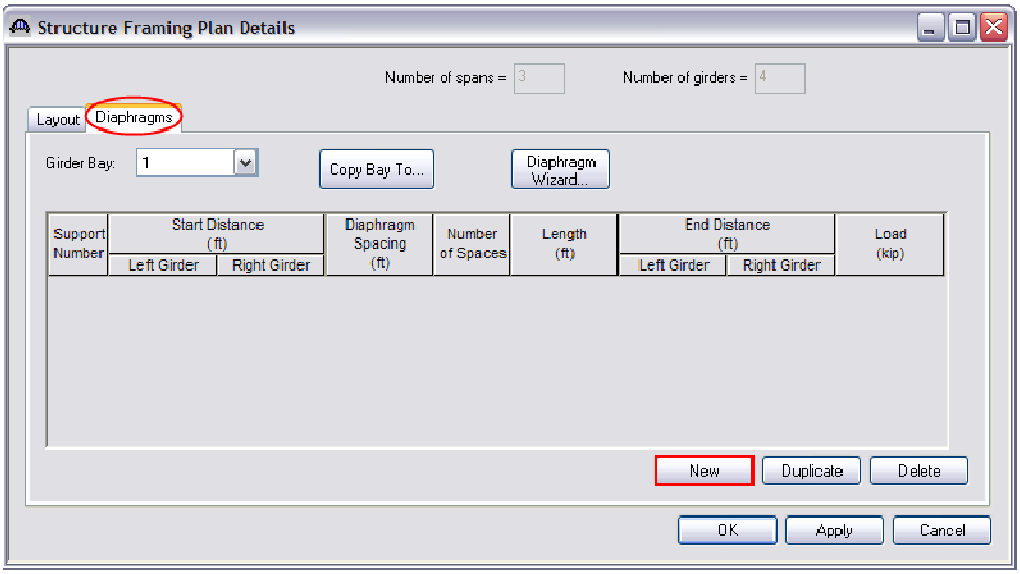
Fill out the following fields:

Skew (Degrees): Enter the AASHTO skew angle for the bridge per the design plans (See Appendix A). For this example, enter **0.000°** at all supports.

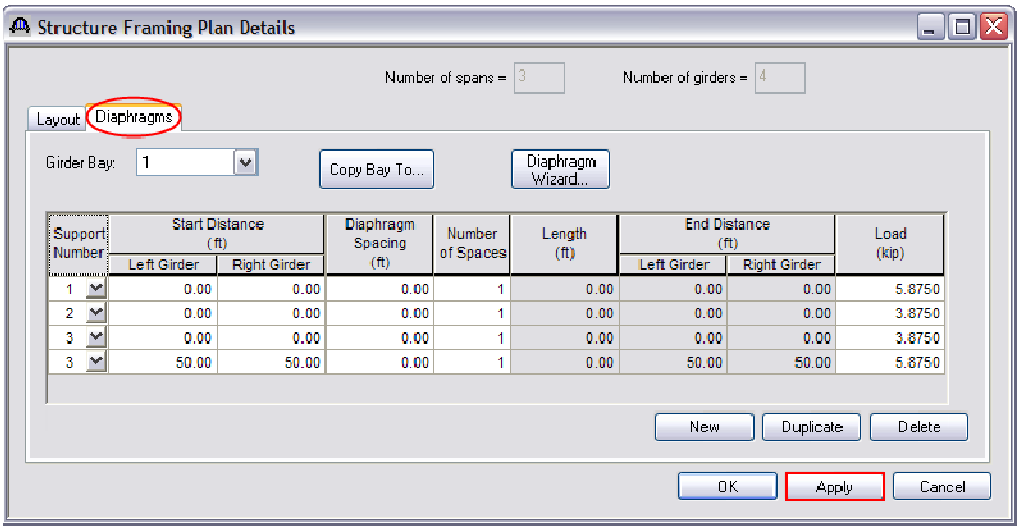
Note: Enter clockwise rotation as a positive value.

Girder Spacing Orientation: If the girder spacings are constant along the length of the bridge, the user should select **Perpendicular to Girder** (as done in this example). If the girder spacings vary, **Along Support** may be selected.

Girder Spacing (ft), Start of Girder: Enter the girder spacing from CL of beam to CL of beam. Enter **8.00 ft** for all bays for this example.



Left click the **Diaphragms** tab and left click the **New** button.



Girder Bay: Select Bay 1

Support Number: For the selected girder bay, select the number of the support from which the range will be dimensioned.

Start Distance (ft): For the selected girder bay, enter the distance along the centerline of girder from the selected support to the left end of the range. For each row, a diaphragm is not placed at the start distance. A diaphragm is placed at each space within the range, including the end distance.

Left Girder: Enter the start distance for the left girder in the selected girder bay (looking ahead station) for the diaphragm definition.

Right Girder: Enter the start distance for the right girder in the selected girder bay (looking ahead station) for the diaphragm definition.

Diaphragm Spacing (ft): For the selected girder bay, enter the spacing between adjacent diaphragms within the given diaphragm group. Diaphragm spacings must be equal within a given group.

For skewed structures, the location along the left girder will not be the same as the right girder unless the diaphragms are laid out parallel to the skew.

Number of Spaces: For the selected girder bay and diaphragm group, enter the number of spaces, beginning at the left diaphragm of the group, that are of equal spacing and that define a diaphragm location.

If the diaphragm spacing for the left girder is different than the diaphragm spacing for the right girder, enter 1 for the number of spaces and enter each diaphragm location individually in separate rows.

Load (kip): Enter the load of an individual diaphragm, which will be distributed to each beam equally by the program. See calculation below.

Concrete Diaphragm Weight Calculation

Diaphragms at Abutments

Length	80.000	in
Width	12.000	in
Depth	70.500	in
Cubic Feet	39.167	
Wt/cf	0.150	kcf
Weight/diaph	**5.875**	**k**

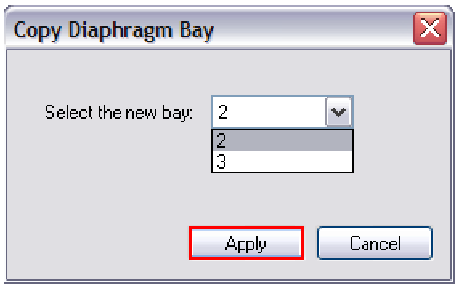
Diaphragms at Piers

Length	80.000	in
Width	12.000	in
Depth	46.500	in
Cubic Feet	25.833	
Wt/cf	0.150	kcf
Weight/diaph	**3.875**	**k**

For this example, enter the four lines of ranges shown on the previous sheet that define the diaphragm locations at all supports.

Left click **Apply** on the **Structure Framing Plan Details** window.

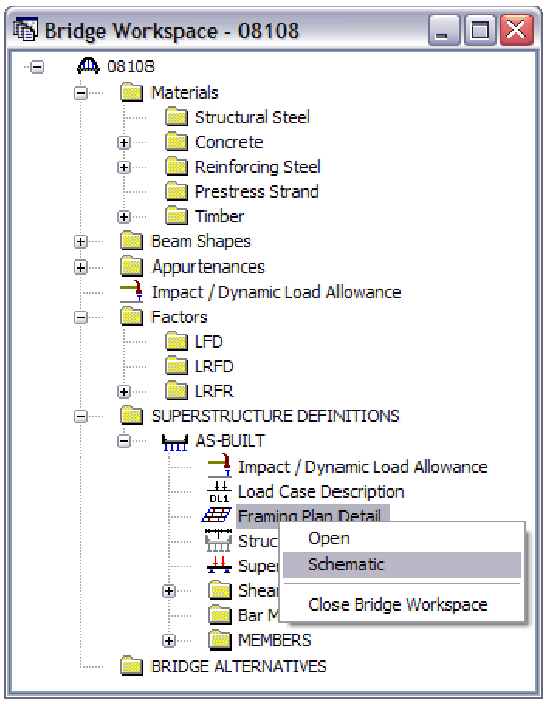
If the diaphragm locations and loads are identical for other bays, the user can use the **Copy Bay to…** function.



For this example, left click the **Copy Bay to…** button and the **Copy Diaphragm Bay** window will open. Select bay **2** and left click **Apply**. Then, left click **Apply** on the **Structure Framing Plan Details** window.

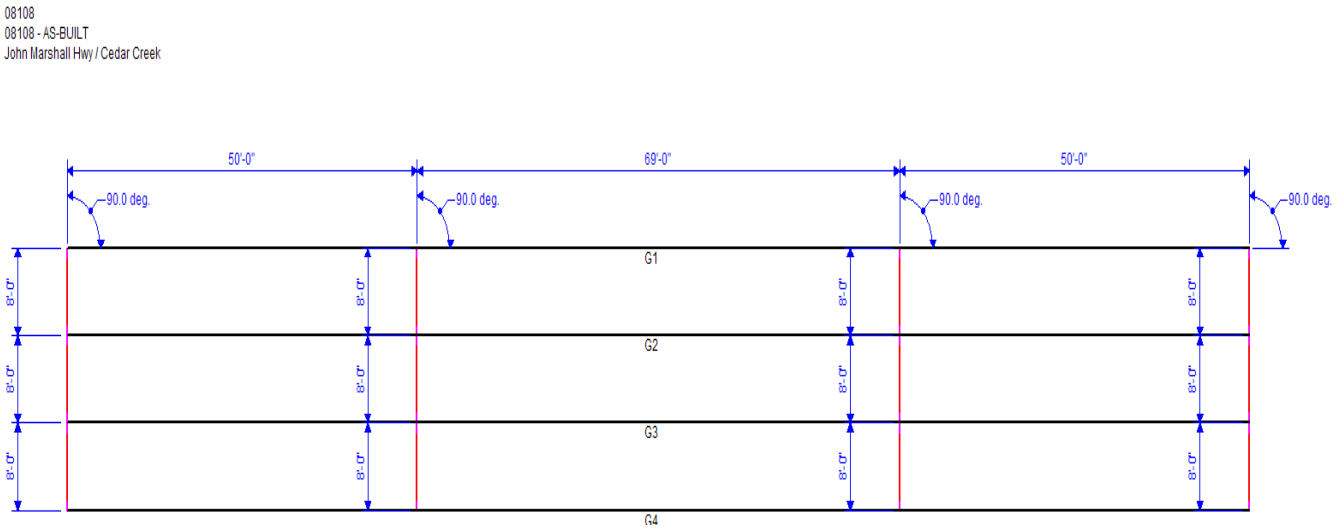
Repeat this process for bay **3**.

Left click **OK** on the **Structure Framing Plan Details** window to accept and close.

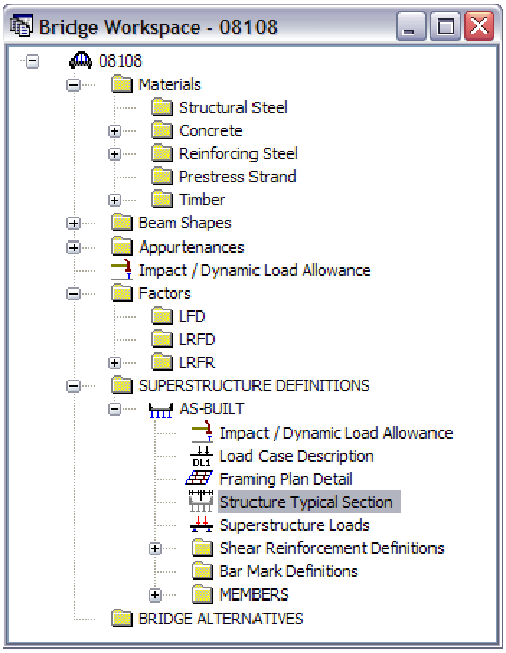


The user can compare the entered data to the design plans by right clicking **Framing Plan Detail** and selecting **Schematic**.

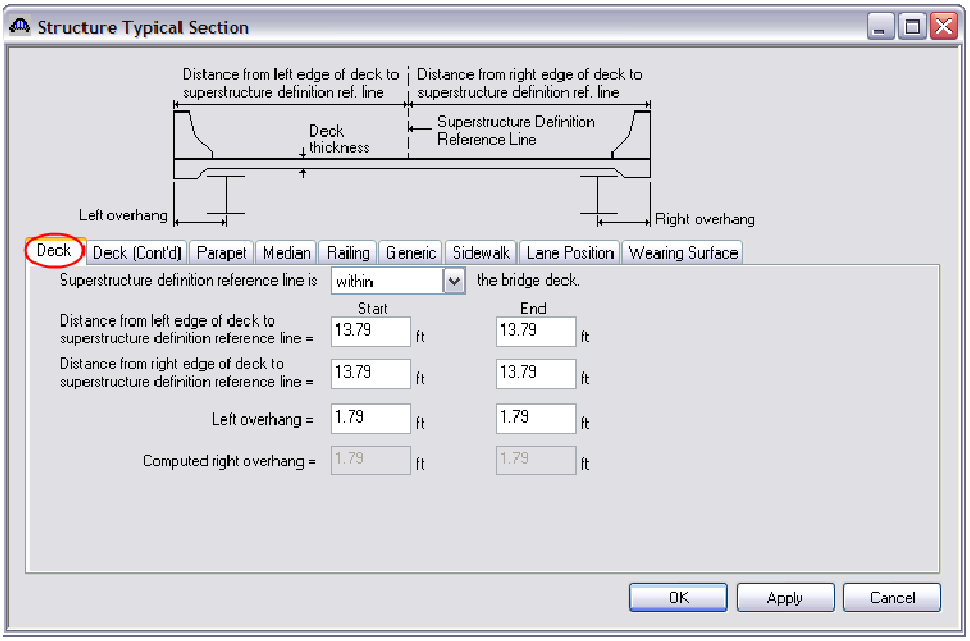
A schematic of the framing plan will appear that can be compared to the framing plan in the design plans.



DEFINE STRUCTURE TYPICAL SECTION



Double click **Structure Typical Section** to open the Structure Typical Section window.



Deck Tab:

Superstructure definition reference line is: User can select either **within**, **to the left of**, or **to the right of** the bridge deck. For this example, select **within** since the reference line will be placed at the CL of the deck.

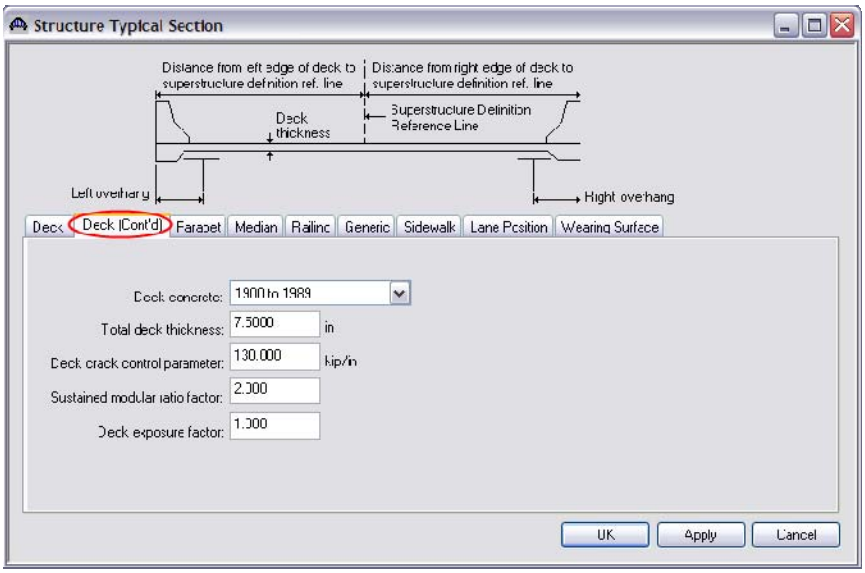
Distance from left edge of deck to superstructure definition reference line: To define the reference line at the bridge CL divide the deck out-to-out width by two. For this example, enter **13.7917 ft** (27.5833 ft / 2).

Distance from left edge of deck to superstructure definition reference line: 13.7917 ft.

Note: Since the bridge deck width does not vary along the length of the bridge, the distance at the start and end will be equal.

Left Overhang: Distance from the CL of exterior beam to the edge of deck. For this example, enter **1.7917** ft.

Computed Right Overhang: This value is computed by Virtis and can be used to verify the input above.



Deck (Cont'd) Tab:

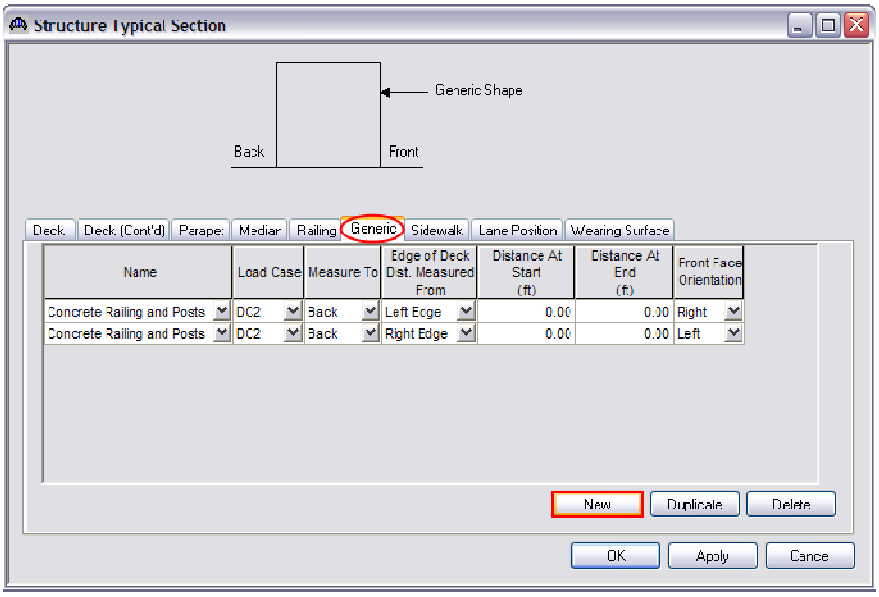
Deck Concrete: Select the appropriate concrete definition.

Total Deck Thickness: 7.5 in.

Deck Crack Control Parameter: Enter 130.00 kip/in since the top of the deck slab is directly exposed to environmental elements. For surfaces not directly exposed to the environment, such as the bottom of the deck, 170.00 kip/in is to be used.

Sustained Modular Ratio Factor: 2.00 for concrete members.

Deck Exposure Factor: Use 1.000 for a Class 1 exposure condition.



Generic Tab:

Since there is a barrier on both sides of the bridge, 2 barriers need to be entered.

Select **New** to enter a line. Duplicate to copy a line down.

Name: Select **Concrete Railing and Posts** from the drop down menu.

Load Case: DC2

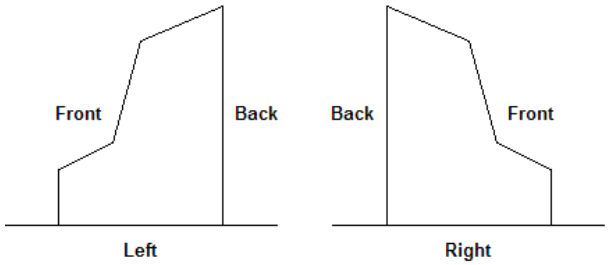
Measure To: Back

Edge of Deck Dist. Measured from: Select the edge of the deck from which the distance is measured as either left or right, as shown in the sketch for the Deck tab. For this example, select **Left Edge** for the 1st input line and **Right Edge** for the 2nd input line.

Distance at Start: Since the back of the parapet is flush with the edge of deck, enter **0.00 ft**. for both parapets.

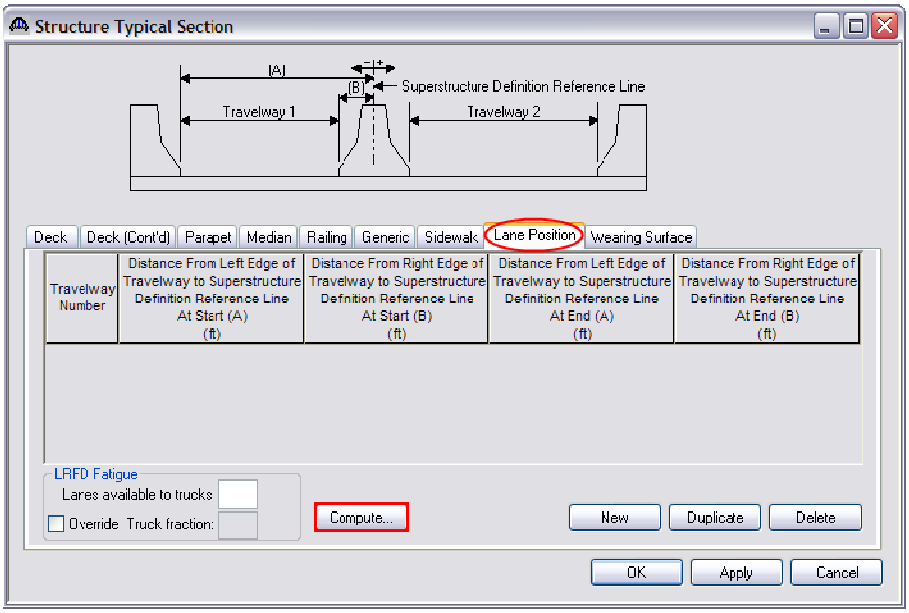
Distance at End: Since the back of the parapet is flush with the edge of deck, enter **0.00 ft**. for both parapets.

Front Face Orientation: Select the front face orientation as either left or right, as shown in the sketch. For this example, select **Right** for the 1st input line and **Left** for the 2nd input line.



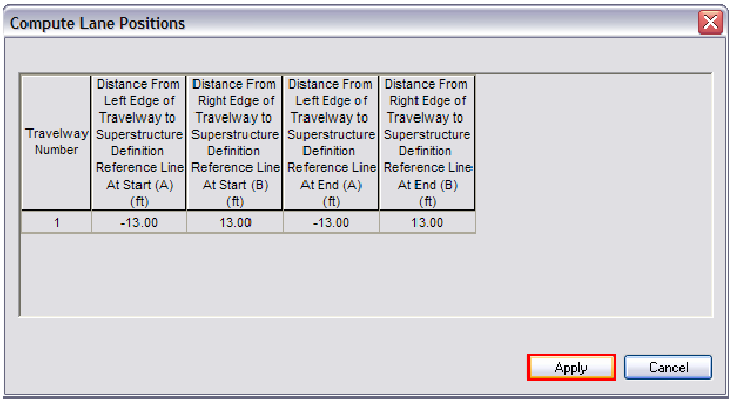
Front Face Orientation

Parapet, Median, Railing, Sidewalk, and Wearing Surface Tabs: No input for this example.



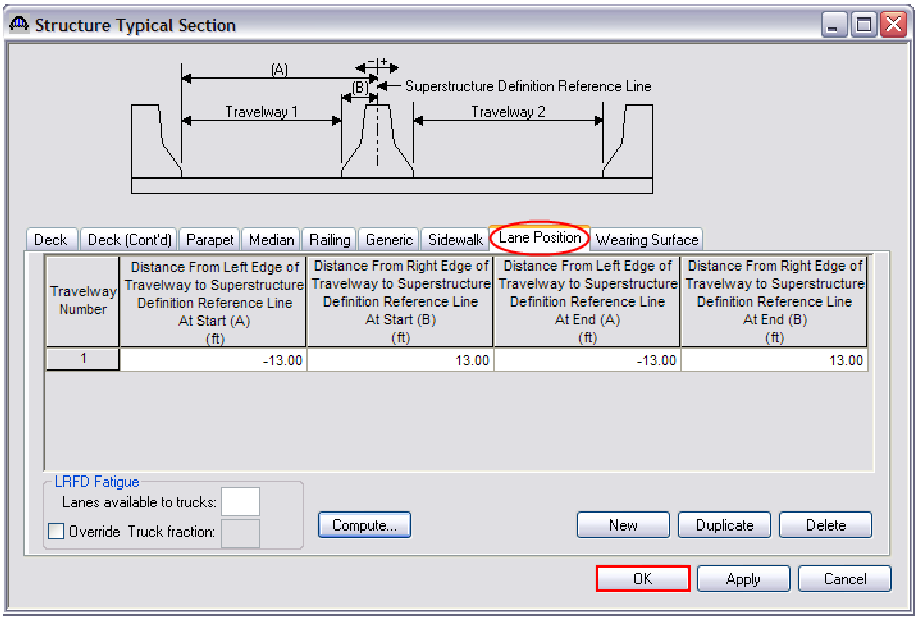
Lane Position Tab:

Left click the **Compute…** button.



The **Compute Lane Positions** window will appear displaying the values computed by Virtis.

Left click **Apply** to accept.



Left click **OK** to accept and close.

Note: A schematic of the typical section can be viewed similar to the framing plan by right clicking the **Structure Typical Section** and selecting **Schematic**.

08108
08108 - AS-BUILT
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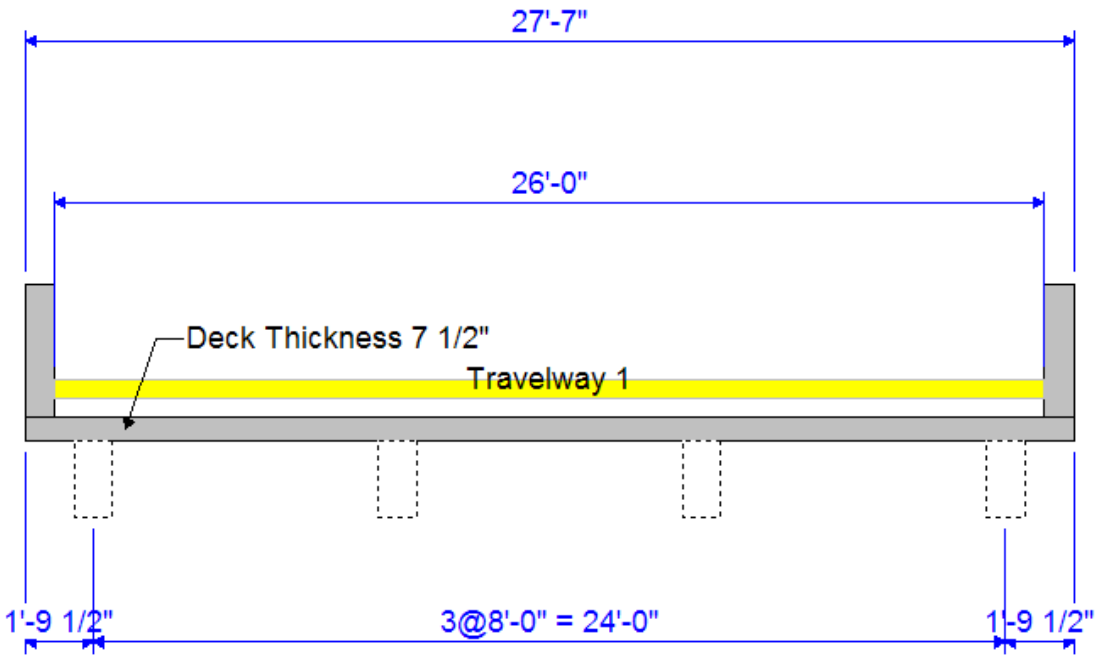
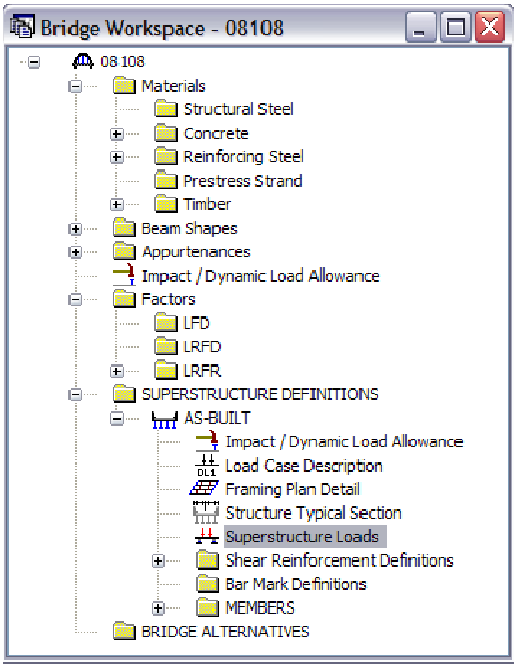
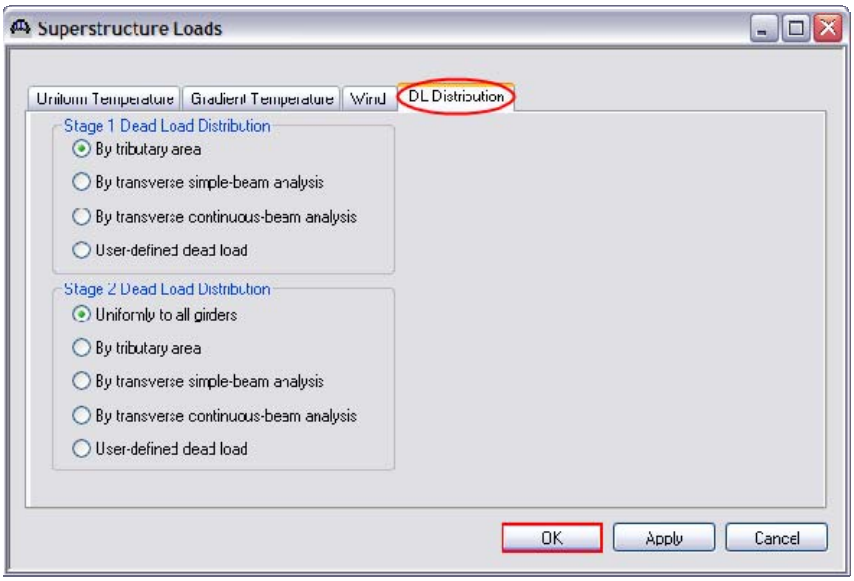


DEFINE SUPERSTRUCTURE LOADS



Double click **Superstructure Loads** to open the **Superstructure Loads** window.

Uniform Temperature, Gradient Temperature, and Wind Tabs: No input required.



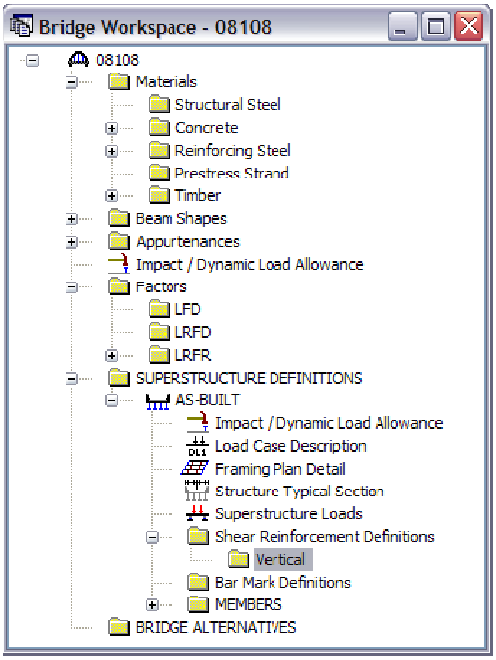
DL Distribution Tab:

Stage 1 Dead Load Distribution: Select **By tributary areas** to distribute DC1 loads based on girder spacing.

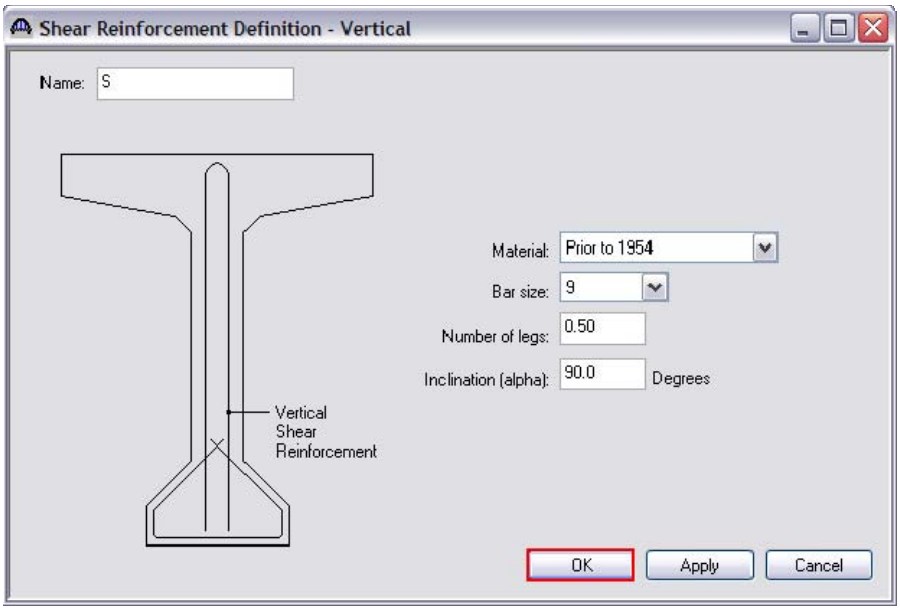
Stage 2 Dead Load Distribution: Select **Uniformly to all girders** to distribute the DC2 loads evenly to all girders. With 4 girders lines in this example, each girder will carry one-fourth of each barrier and is consistent with VDOT practice.

Left click **OK** to accept and close.

SPECIFY VERTICAL SHEAR REINFORCEMENT DEFINITIONS



Left click **Shear Reinforcement Definitions** to expand the folder and double click **Vertical**.



Fill out the fields as appropriate based on the information in the plans (See Appendix A for the design plans).

Name: S

Material: Select the appropriate material from the drop down menu.

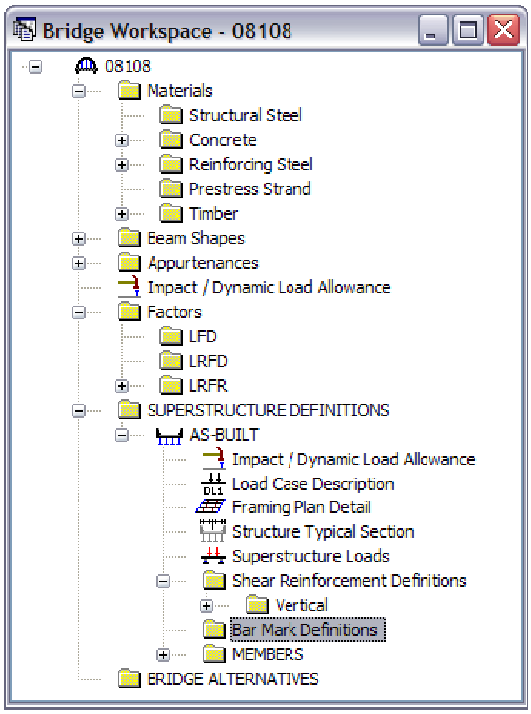
Bar Size: 9

Number of Legs: 0.50, since 0.5" square bar was used. (2 legs * 0.25 in^2 = 0.50 in^2. Compare with using No. 9 bar. 0.50 legs * 1.00 in^2 = 0.50 in^2).

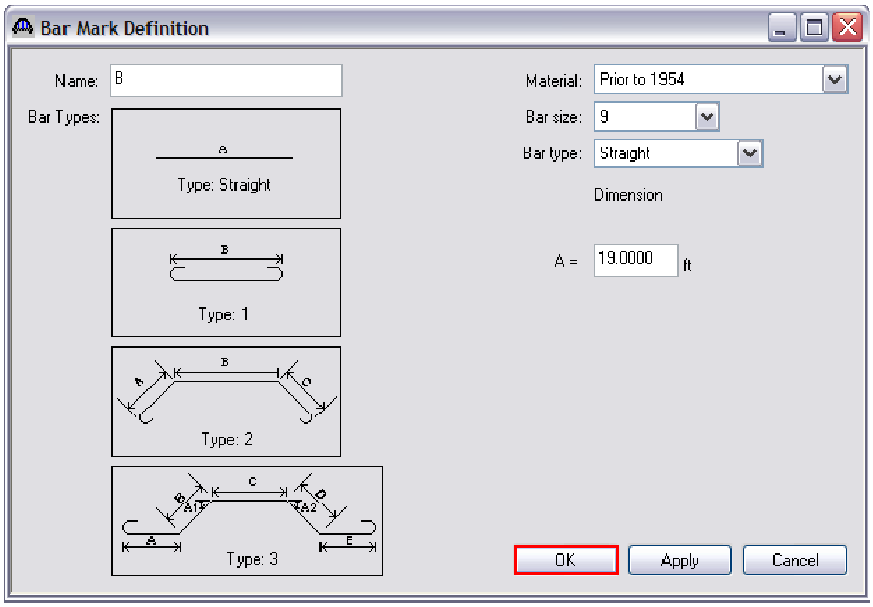
Inclination (alpha): 90.0°

Left click **OK** to accept and close.

SPECIFY BAR MARK DEFINITIONS



Double click **Bar Mark Definitions**.



Fill out the fields as appropriate based on the information in the plans (See Appendix A for the design plans).

Name: B

Material: Select the appropriate material from the drop down menu.

Bar Size: 9

Bar Type: Select the **Straight** bar type even if the bar has hooks at the end or is a bent bar. The user will be able to define the bar as fully developed later to model hooks at the start and end of the bar.

"A" Dimension: Use the CL-to-CL of bearing dimension for the bridge if the bar is effective for the full span length. For a bent bar, enter the middle straight length. Enter **19.00** ft.

Left click **OK** to accept and close.

Since the bridge has continuous spans, longitudinal reinforcement is required in the bottom and top of the beam which results in a number of unique bar mark definitions. See the summary table for a complete list of bar mark definitions and their input.

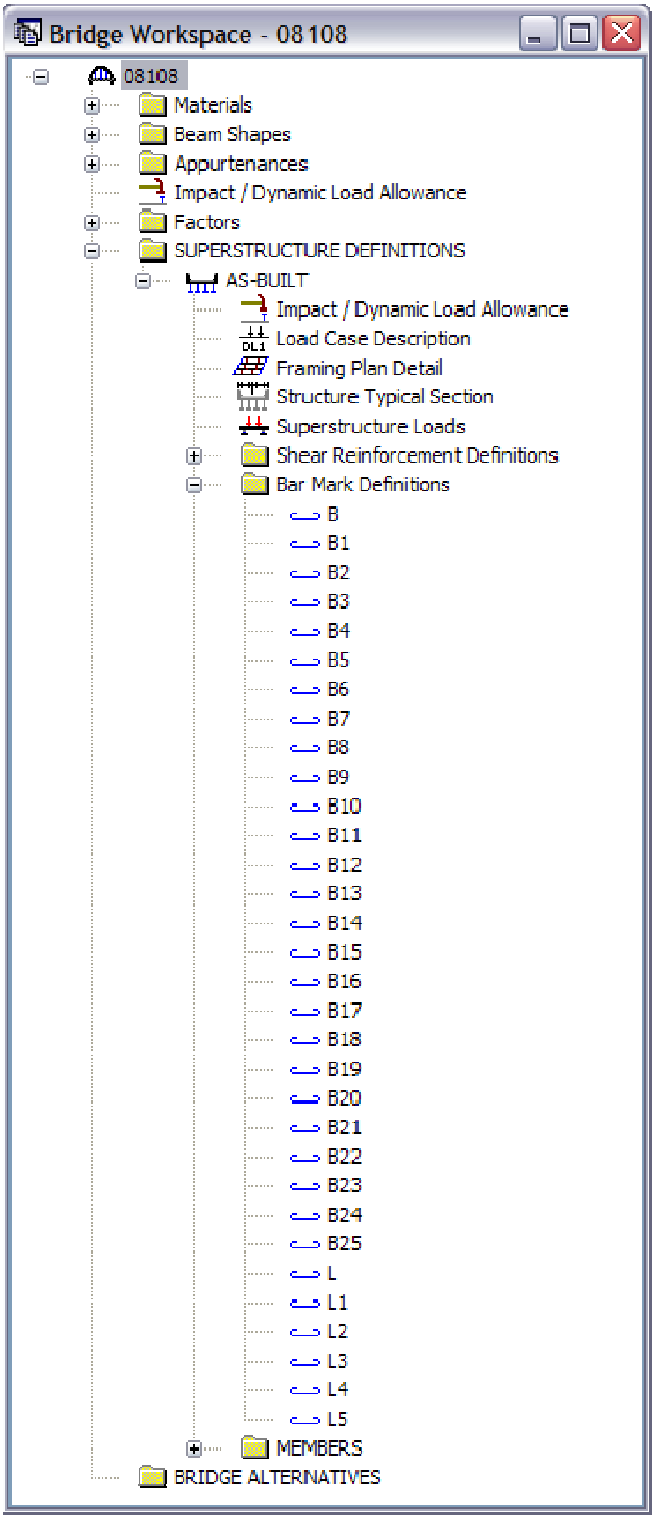
Bar Mark Definition Summary

Name	Bar Size	A Dimension
B	9	19.0000
B1	9	25.0000
B2	9	31.0000
B3	9	37.0000
B4	9	40.0000
B5	9	21.0000
B6	9	29.0000
B7	9	35.0000
B8	9	39.0000
B9	9	49.0000
B10	9	48.0000
B11	9	46.0000
B12	9	42.0000
B13	9	38.0000
B14	9	31.0000
B15	9	22.0000
B16	9	20.0000
B17	9	24.0000
B18	9	16.0000
B19	10	24.0000
B20	9	27.0000
B21	10	40.0000
B22	9	24.0000
B23	9	32.0000
B24	10	49.0000
B25	9	40.0000
L	4	169.0000
L1	4	27.8333
L2	4	12.0000
L3	4	43.6667
L4	4	29.5000
L5	4	25.0000

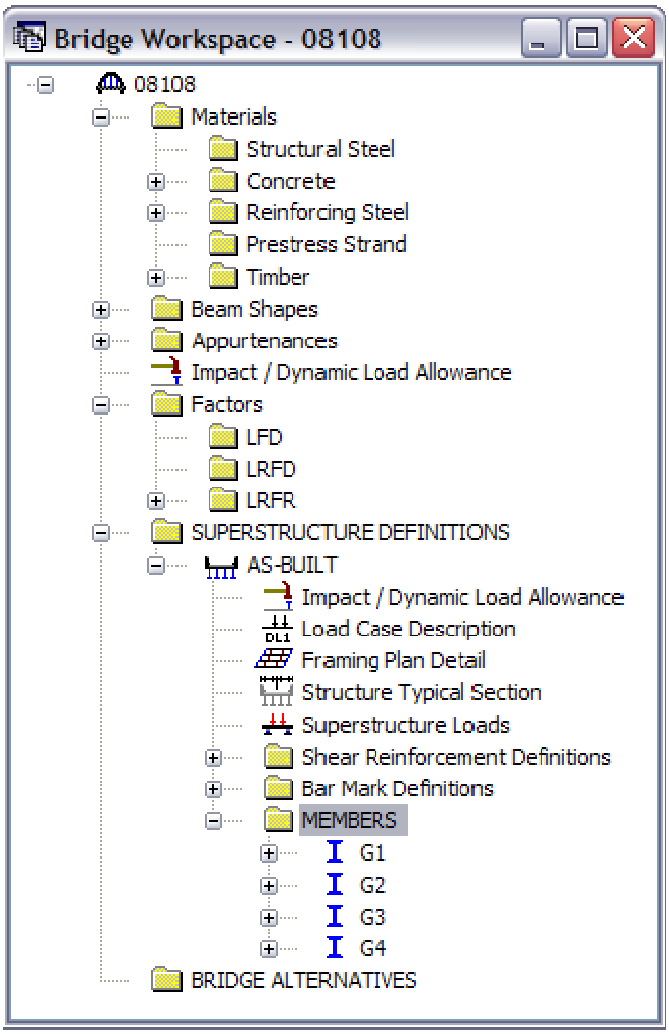
Note: For 1” square bars, No. 9 bars were used. Likewise, No. 10 bars were used for 1 ⅛” square bars.

Enter each definition found in the **Bar Mark Definition Summary** above. Double click on the **Bar Mark Definitions** folder each time a new definition is started and click **OK** to accept and close once the input is complete for each.

When all the bar mark definitions have been entered, the file should have the following bars defined.

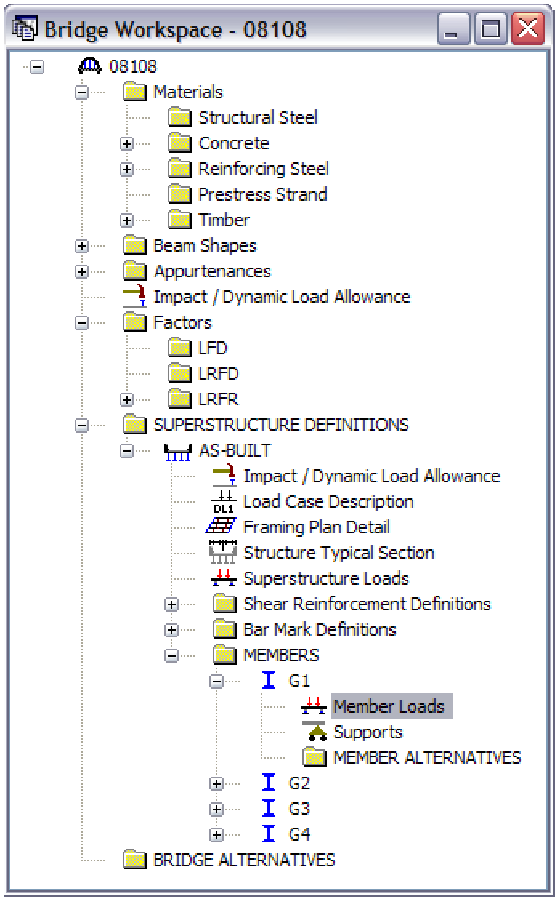


CREATING A MEMBER: G1



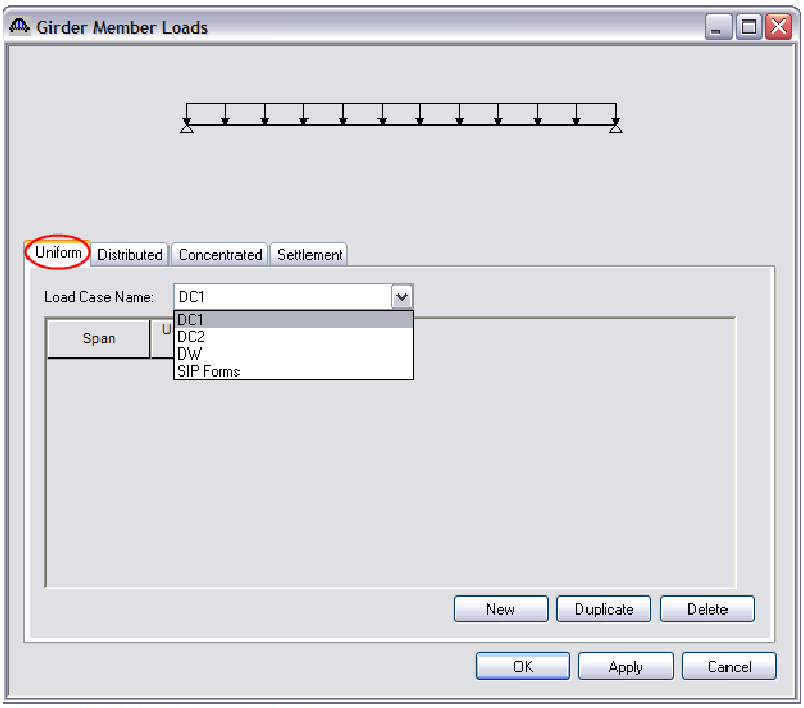
Virtis will automatically generate the appropriate members based on the number of girders entered in the **Superstructure Definition** window.

APPLYING MEMBER LOADS



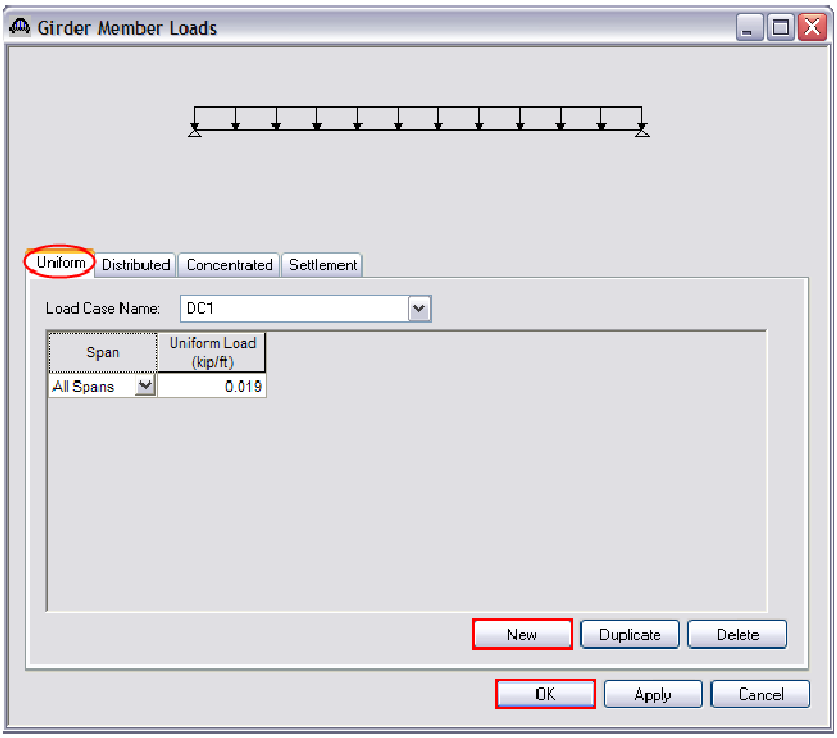
User defined dead loads can be applied to each member.

Expand member **G1** and Double click **Member Loads**.



Uniform Tab:

Left click the dropdown menu and left click the desired dead load case. For this example, select **DC1**.



Left click the **New** button and enter the appropriate uniform load. For this example, enter 0.019 kip/ft to account for the architectural blister on the exterior beams. See the hand calculation below.

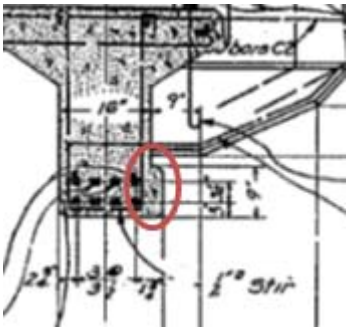
Left click **OK** to accept and close.

DC1 LOAD FOR G1

To Account for Extra Concrete on Tee-Beam

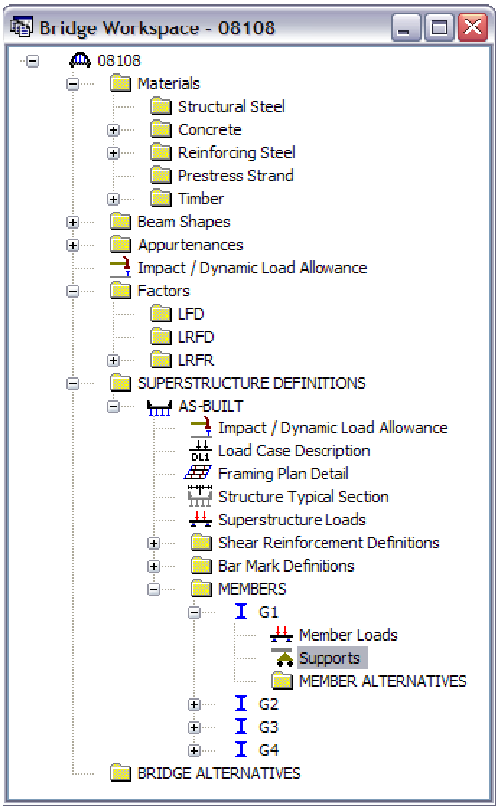
Height =	9.000	in
Width =	2.000	in
Area = 9.00 in * 2.00 in / 12² =	0.125	ft²

Dist. DC1 Load = 0.125 ft² * 0.150 lb/ft³ = **0.019** kip/ft

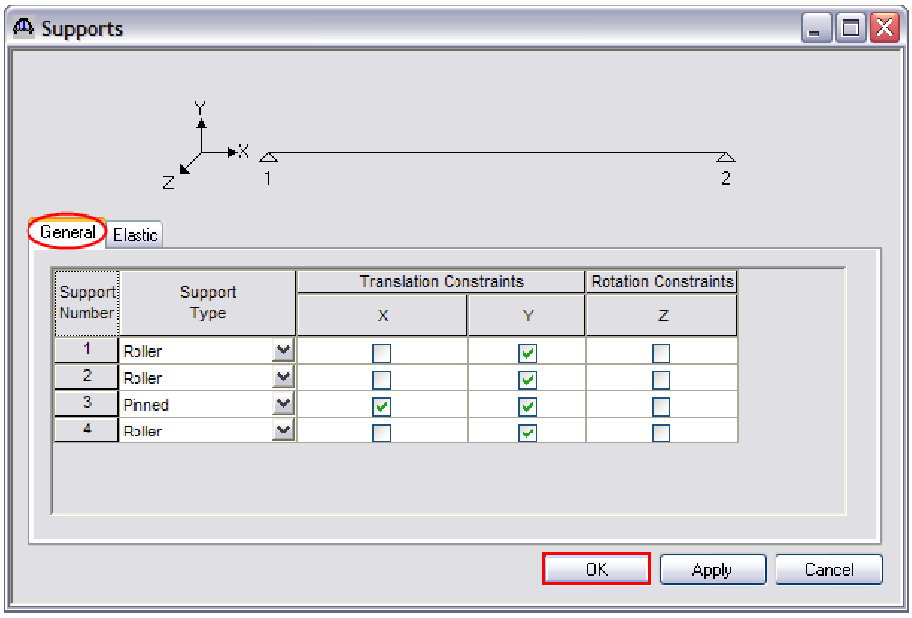


The uniform load for the architectural blister is not entered for G4 at this time because G4 will be linked to G1 later in this example.

DEFINING SUPPORTS



Double click **Supports**.



General Tab:

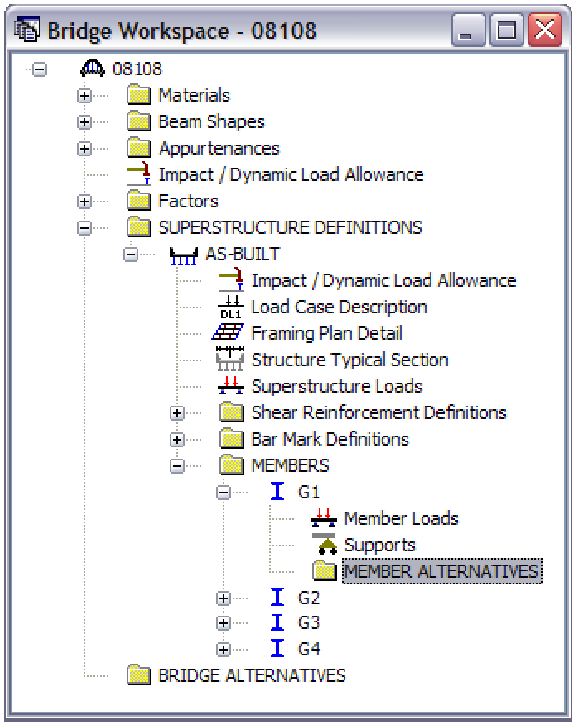
Select a **Roller** support type for supports 1, 2, and 4 since they are expansion supports.

Select a **Pinned** support type for support 3 since it is a fixed support.

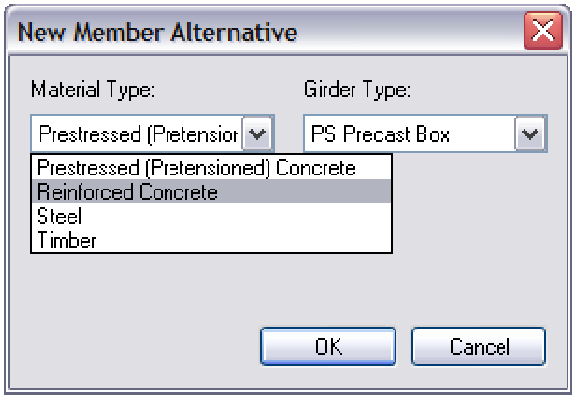
No input is required for the Elastic tab.

Left click **OK** to accept and close.

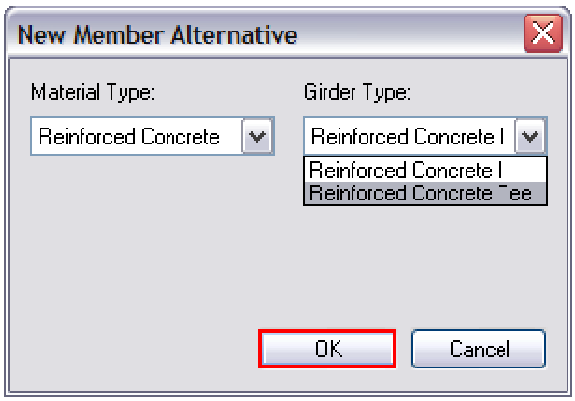
CREATING A MEMBER ALTERNATIVE: G1



Double click **MEMBER ALTERNATIVES** to further define the member.

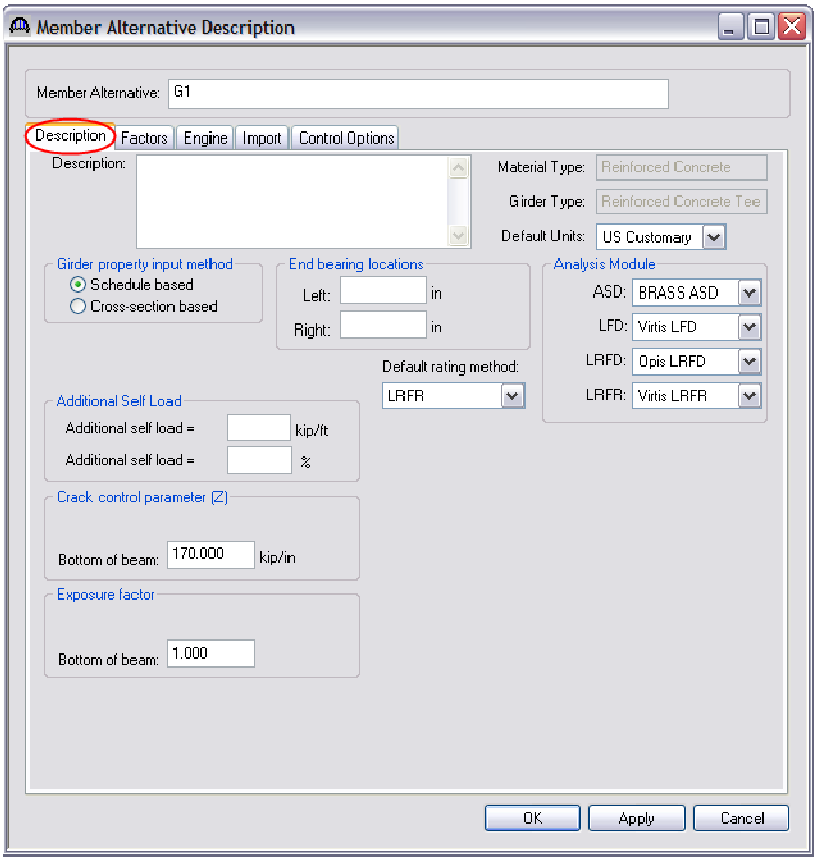


Select **Reinforced Concrete** from the left drop down menu.



Select **Reinforced Concrete Tee** from the right drop down menu.

Left Click **OK** to accept.



Member Alternative: G1

Description Tab:

Girder Property Input Method: User can select either **Schedule Based** or **Cross-section Based**.

The Schedule Based method views the beam as an elevation with **Bar Mark Definitions**.

The cross section based method views the beam as a series of cross sections with particular dimensions and rebar counts. For this example, select **Schedule Based**.

Additional Self Load: User can apply an additional load to the specific beam as a defined distributed load or as a distributed load calculated based on a percentage of the self-load of the beam. These fields are often used for items such as bolts and splice plates. Leave these fields blank for this example.

End Bearing Locations: This input is not used for a reinforced concrete tee beam and should be left blank.

Crack control parameter (Z): 170.00 kip/in since the bottom of the deck slab is not directly exposed to the environment.

Exposure Factor: 1.000 for a Class 1 exposure condition.

Default Rating Method: LRFR

Analysis Module:

ASD: Not used for rating. Use default.

LFD: Virtis LFD

LRFD: Not used for rating. Use default.

LRFR: Virtis LRFR

No changes to the following tabs:

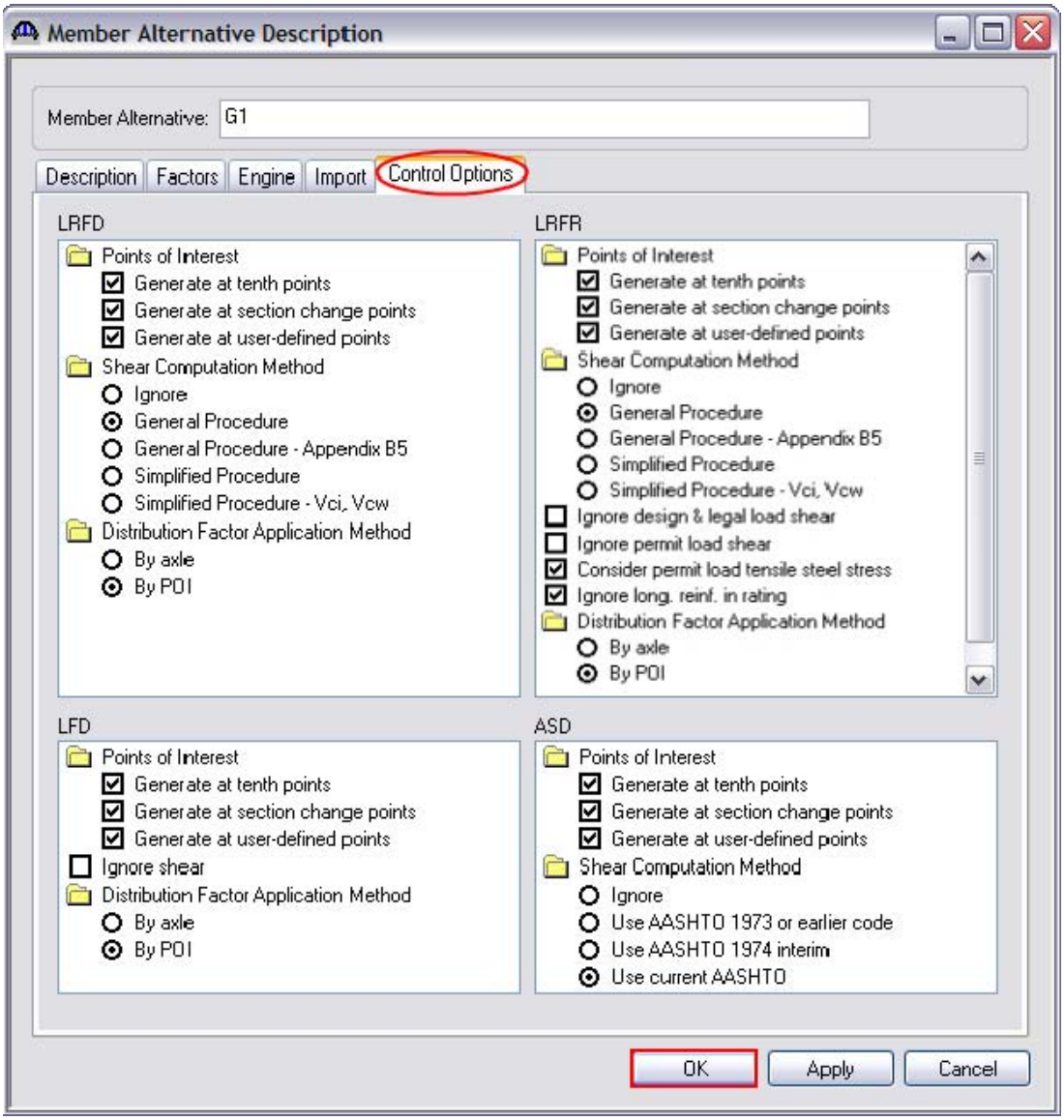
Factors

Engine

Import

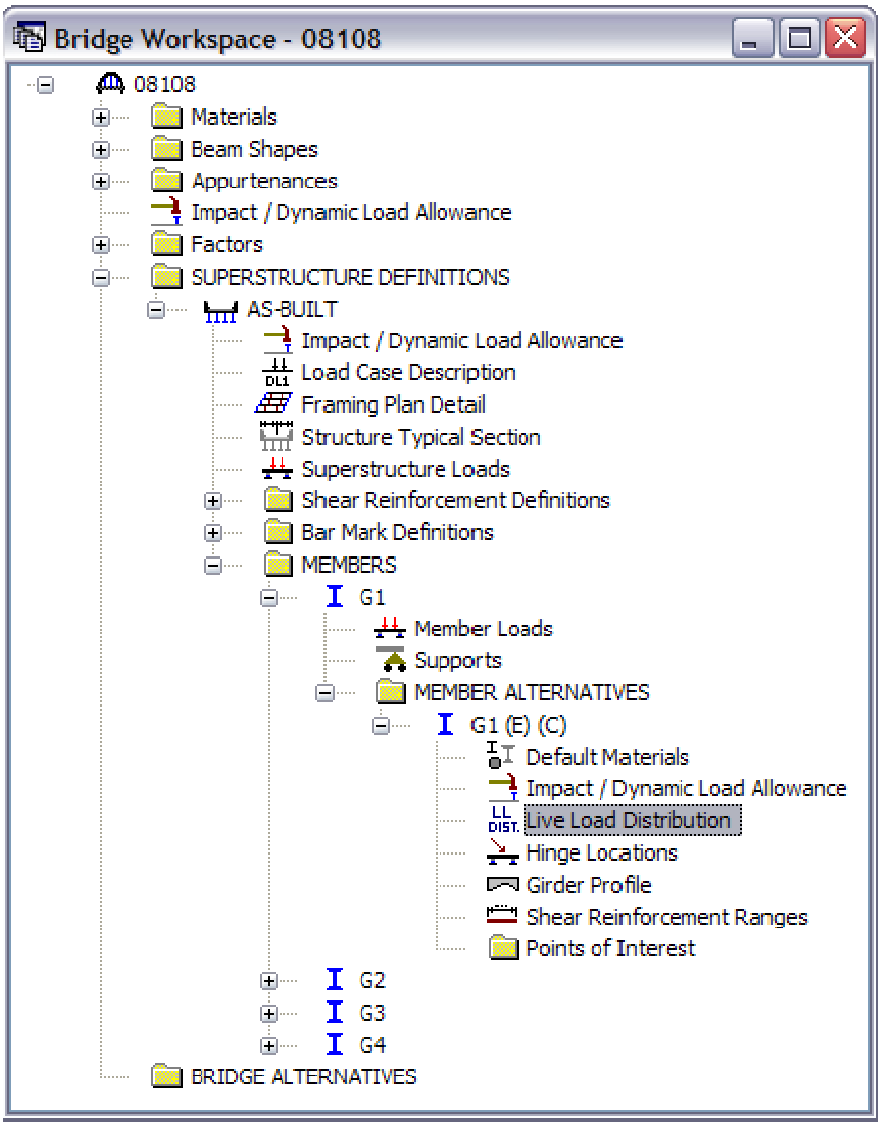
Control Options Tab:

Select the options shown in the screen shot below.



Left click **OK** to accept and close.

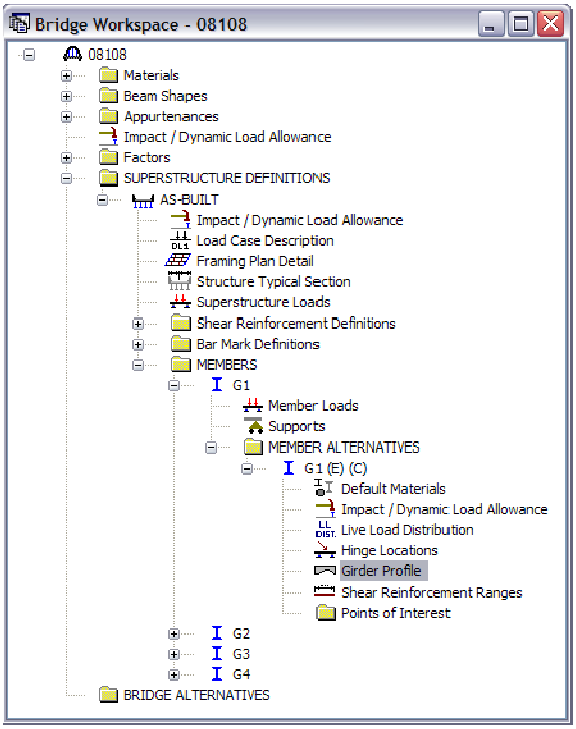
DEFINE LIVE LOAD DISTRIBUTION FACTORS



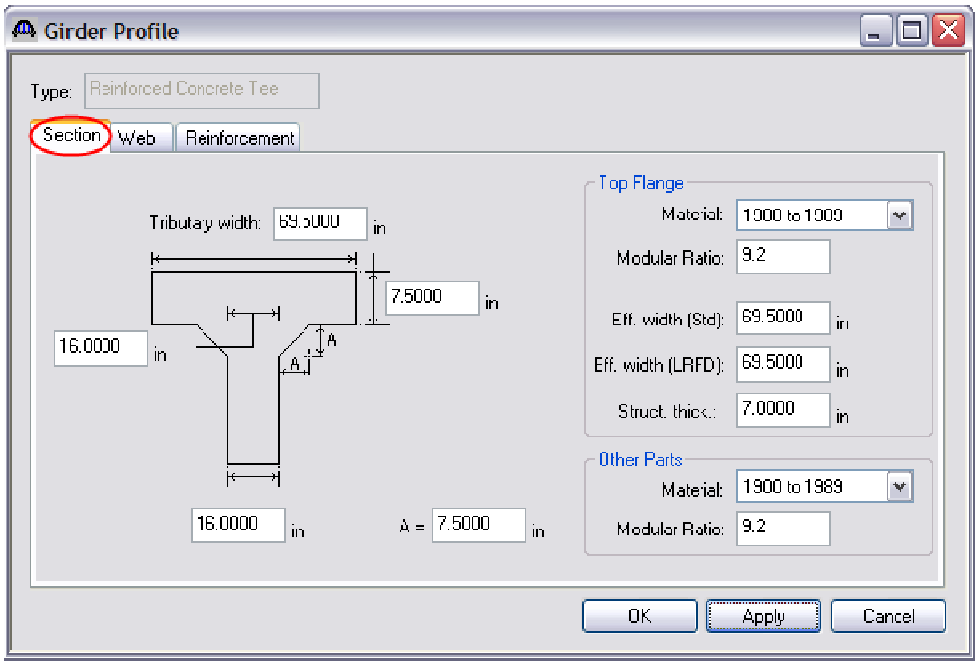
Expand the **MEMBER ALTERNATIVE** for **G1**.

G1 LRFR live load distribution factors cannot be computed from the typical section until the entire cross-section is defined. Continue with the other input for G1.

DEFINE THE GIRDER PROFILE



Double click **Girder Profile**.



Section Tab:

Tributary Width: The physical width of the deck between the girders which is the Overhang + 0.5 * Girder Spacing. For G1, 21.5 in + 96 in / 2 = 69.5 in.

Total Deck Thickness: 7.50 in.

Web Thickness at Top Flange: 16.00 in.

Web Thickness at Bottom of Beam: 16.00 in.

Chamfer Dimension, A: 7.5 in. (Average of vertical and horizontal chamfer dimensions).

Top Flange:

Material: Select the appropriate material from the drop down menu.

Modular Ratio: 9.2 (See calculation below)

Eff. Width (Std): The effective flange width for LFD. For this example, enter 69.50 in. See Appendix C for sample calculation.

Eff. Width (LRFD): The effective flange width for LRFR. For this example, enter 69.50 in. This value will equal the tributary width per AASHTO 2007 with 2008 Interims, *LRFD Bridge Design Specifications*, 4th Edition, section 4.6.2.6.

Struct. Thick.: Typically, 0.50 in. is removed from the actual thickness of the top flange. Therefore, enter 7.00 in. for this example.

Other Parts: (Other than the top flange)

Material: Select the appropriate material from the drop down menu.

Modular Ratio: 9.2 (See calculation below)

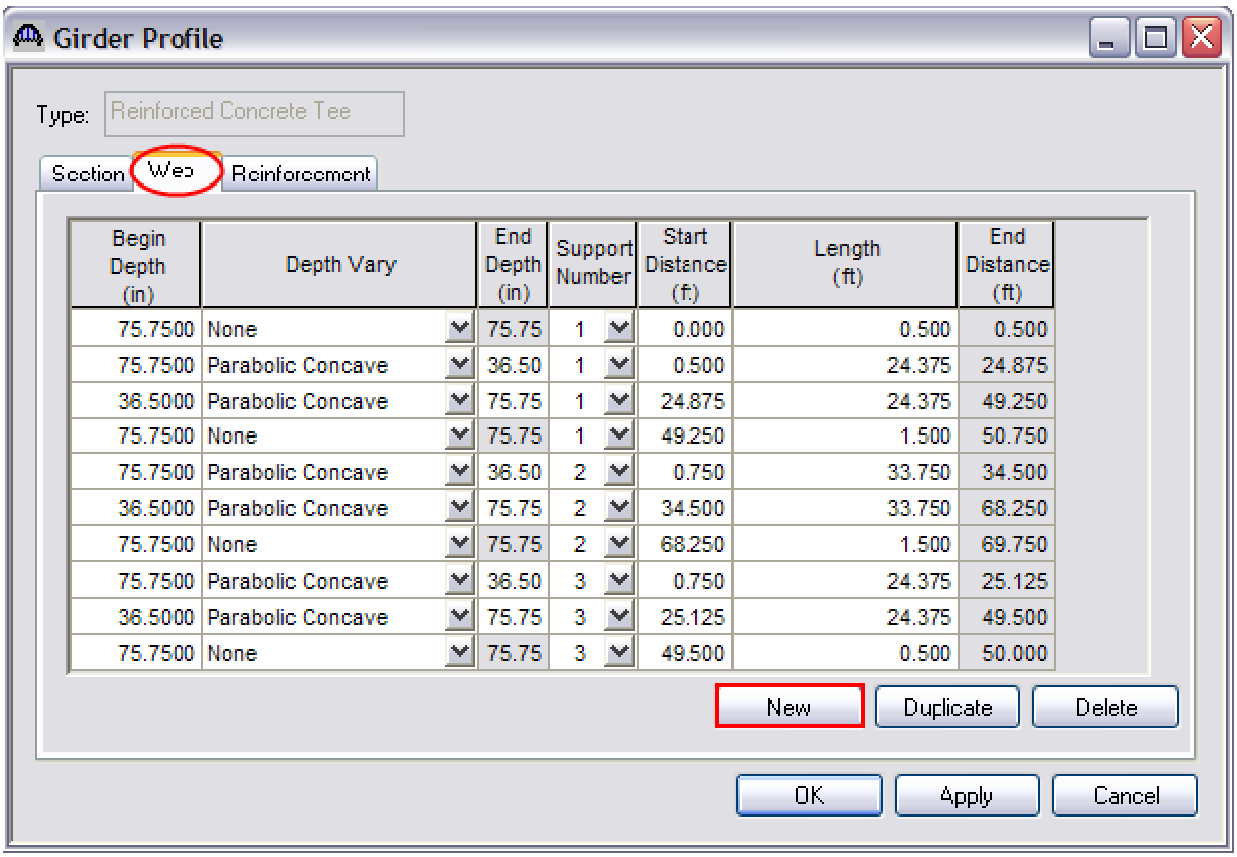
Modular Ratio Calculation

Note: References from AASHTO LRFD Bridge Design Spefications, 2007 with 2008 int.

Unit Weight of Concrete, w_c =	0.145	kip/ft³	
Compressive Strength of Concrete, f'_c =	3.00	ksi	
Modulus of Elasticity of Reinf. Steel, E_s =	29000	ksi	
Modulus of Elasticity of Concrete, $E_c = 33{,}000 * w_c^{1.5} * f'^{0.5}_c$			Eq. 5.4.2.4-1
$E_c = 33{,}000 * 0.145^{1.5} * 3.00^{0.5}$			
E_c = 3155.92 ksi			
Modular Ratio, n = Es / Ec			5.7.1
n = 29,000 / 3,155.92			
n = 9.2			

Web Tab:

Left click **New** to add rows. Enter rows as shown below.



Begin Depth: The distance from the top of the deck slab to the bottom of the beam at the start of the range.

Depth Vary: User can select the Girder web depth to be constant, have a linear variation or a parabolic concave variation.

End Depth: Only available if **Linear** or **Parabolic Concave** is selected for **Depth Vary**. Otherwise, this value will equal the **Begin Depth**.

Support Number: Select the number of the support from which the range will be dimensioned.

Start Distance: The start distance for the web range.

Length: The length of the web range.

End Distance: The end distance for the web range. This value is calculated by Virtis.

Reinforcement Tab:

Left click **New** to define a reinforcement set.

Bar Mark: Select the appropriate bar mark from the drop down menu.

Invert: This option is used to change the orientation of a bent bar. However, since only straight bars are used, this box can be left unchecked.

Measured from: The user can select to measure either from the bottom or top of the girder to the reinforcement set CL.

Distance (in): Distance from either the top or bottom of the girder to the reinforcement set CL.

Std Number: The number of rebar used for LFD calculations. This input should match the number of bars shown on the design plan for the given cross-section or effective slab width.

LRFD Number: The number of rebar used for LRFR calculations. This input should match the number of bars shown on the design plan for the given cross-section or effective slab width.

Bar Spacing (in): Distance from CL of rebar to CL of rebar in the reinforcement set.

Side Cover (in): Distance from the CL of rebar to the side edge of the girder.

Support Number: Select the number of the support from which the range will be dimensioned.

Direction: Select whether the start distance is located to the left or right of the selected support number.

Start Distance (ft): Enter the distance from the left end of the range to the selected support.

Straight Length (ft): The value is entered by Virtis based on the bar mark definitions previously defined.

End Distance (ft): The value is calculated by Virtis.

Fully Developed: This field should be checked if the bar mark used has hooks or is a bent bar, and has been modeled as straight. Otherwise, it should be left unchecked.

Enter the fields as shown on the next page and left click **OK**.

Girder Profile

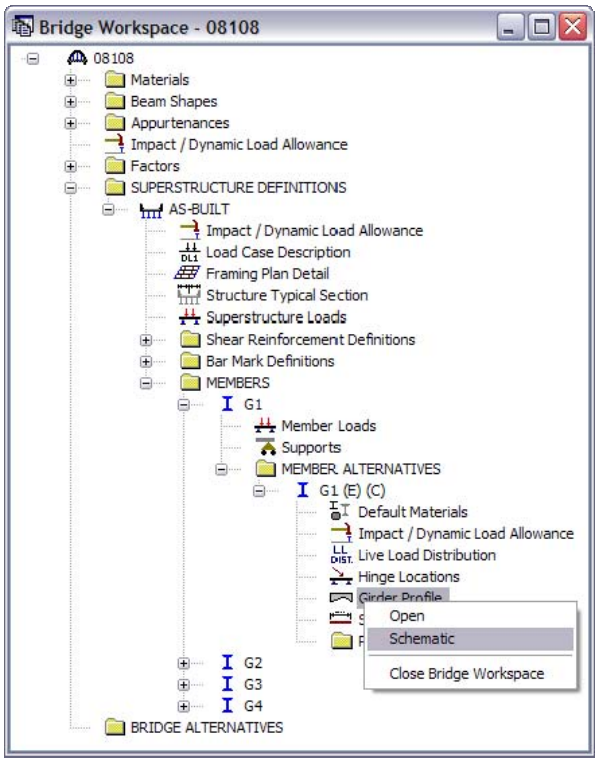
Type: Reinforced Concrete Tee

Section | Web | Reinforcement

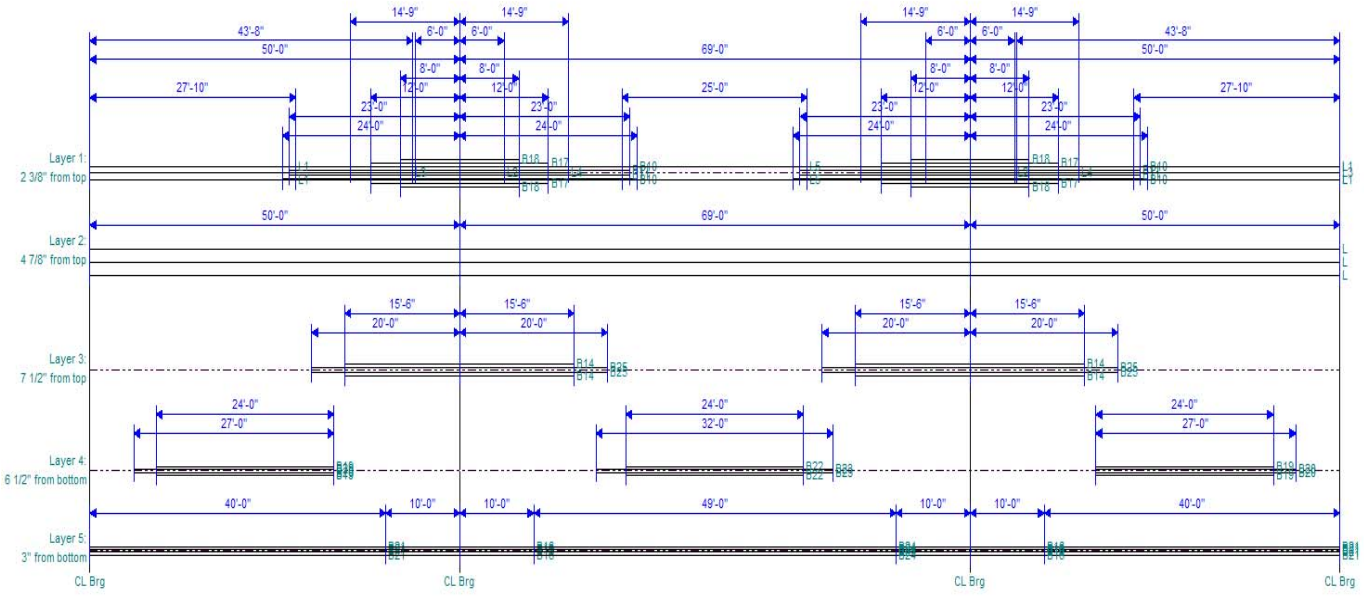
Set	Bar Mark	Invert	Measured From	Distance (in)	Std Number	LRFD Number	Bar Spacing (in)	Side Cover (in)	Support Number	Direction	Start Distance (ft)	Straight Length (ft)	End Distance (ft)	Fully Developed
1	B21	☐	Bottom of Girder	3.0000	4.00	4.00	3.5000	2.750	1	Right	0.000	40.000	40.000	☑
2	B20	☐	Bottom of Girder	6.5000	2.00	2.00	3.5000	6.250	1	Right	6.000	27.000	33.000	☑
3	B19	☐	Bottom of Girder	6.5000	2.00	2.00	10.5000	2.750	1	Right	9.000	24.000	33.000	☑
4	B21	☐	Bottom of Girder	3.0000	4.00	4.00	3.5000	2.750	3	Right	10.000	40.000	50.000	☑
5	B20	☐	Bottom of Girder	6.5000	2.00	2.00	3.5000	6.250	3	Right	17.000	27.000	44.000	☑
6	B19	☐	Bottom of Girder	6.5000	2.00	2.00	10.5000	2.750	3	Right	17.000	24.000	41.000	☑
7	B16	☐	Bottom of Girder	3.0000	4.00	4.00	3.5000	2.750	1	Right	40.000	20.000	60.000	☑
8	B16	☐	Bottom of Girder	3.0000	4.00	4.00	3.5000	2.750	2	Right	59.000	20.000	79.000	☑
9	B24	☐	Bottom of Girder	3.0000	4.00	4.00	3.5000	2.750	2	Right	10.000	49.000	59.000	☑
10	B23	☐	Bottom of Girder	6.5000	2.00	2.00	3.5000	6.250	2	Right	18.500	32.000	50.500	☑
11	B22	☐	Bottom of Girder	6.5000	2.00	2.00	10.5000	2.750	2	Right	22.500	24.000	46.500	☑
12	B10	☐	Top of Girder	2.3750	2.00	2.00	15.5000	3.000	2	Left	24.000	48.000	24.000	☑
13	B11	☐	Top of Girder	2.3750	2.00	2.00	6.0000	3.000	2	Left	23.000	46.000	23.000	☑
14	B17	☐	Top of Girder	2.3750	2.00	2.00	25.0000	3.000	1	Right	38.000	24.000	62.000	☑
15	B18	☐	Top of Girder	2.3750	2.00	2.00	34.5000	3.000	1	Right	42.000	16.000	58.000	☑
16	B10	☐	Top of Girder	2.3750	2.00	2.00	15.5000	3.000	3	Left	24.000	48.000	24.000	☑
17	B11	☐	Top of Girder	2.3750	2.00	2.00	6.0000	3.000	3	Left	23.000	46.000	23.000	☑
18	B17	☐	Top of Girder	2.3750	2.00	2.00	25.0000	3.000	3	Left	12.000	24.000	12.000	☑
19	B18	☐	Top of Girder	2.3750	2.00	2.00	34.5000	3.000	3	Left	8.000	16.000	8.000	☑
20	B25	☐	Top of Girder	7.5000	2.00	2.00	6.0000	3.000	2	Left	20.000	40.000	20.000	☑
21	B25	☐	Top of Girder	7.5000	2.00	2.00	6.0000	3.000	3	Left	20.000	40.000	20.000	☑
22	B14	☐	Top of Girder	7.5000	2.00	2.00	15.5000	3.000	2	Left	15.500	31.000	15.500	☑
23	B14	☐	Top of Girder	7.5000	2.00	2.00	15.5000	3.000	3	Left	15.500	31.000	15.500	☑
24	L1	☐	Top of Girder	2.3750	2.00	2.00	16.5000	3.000	1	Right	0.000	27.833	27.833	☐
25	L1	☐	Top of Girder	2.3750	2.00	2.00	16.5000	3.000	3	Right	22.167	27.833	50.000	☐
26	L5	☐	Top of Girder	2.3750	2.00	2.00	16.5000	3.000	2	Right	22.000	25.000	47.000	☐
27	L	☐	Top of Girder	2.3750	2.00	2.00	16.5000	3.000	1	Right	0.000	169.00	169.000	☐
28	L2	☐	Top of Girder	2.3750	1.00	1.00	24.7500	3.000	1	Right	44.000	12.000	56.000	☐
29	L2	☐	Top of Girder	2.3750	1.00	1.00	24.7500	3.000	2	Right	63.000	12.000	75.000	☐
30	L4	☐	Top of Girder	2.3750	1.00	1.00	16.5000	3.000	1	Right	35.250	29.500	64.750	☐
31	L4	☐	Top of Girder	2.3750	1.00	1.00	16.5000	3.000	2	Right	54.250	29.500	83.750	☐
32	L3	☐	Top of Girder	2.3750	1.00	1.00	16.5000	3.000	1	Right	0.000	43.667	43.667	☐
33	L3	☐	Top of Girder	2.3750	1.00	1.00	16.5000	3.000	3	Right	6.333	43.667	50.000	☐
34	L	☐	Top of Girder	4.8750	3.00	3.00	16.5000	3.000	1	Right	0.000	169.00	169.000	☐

New | Duplicate | Delete

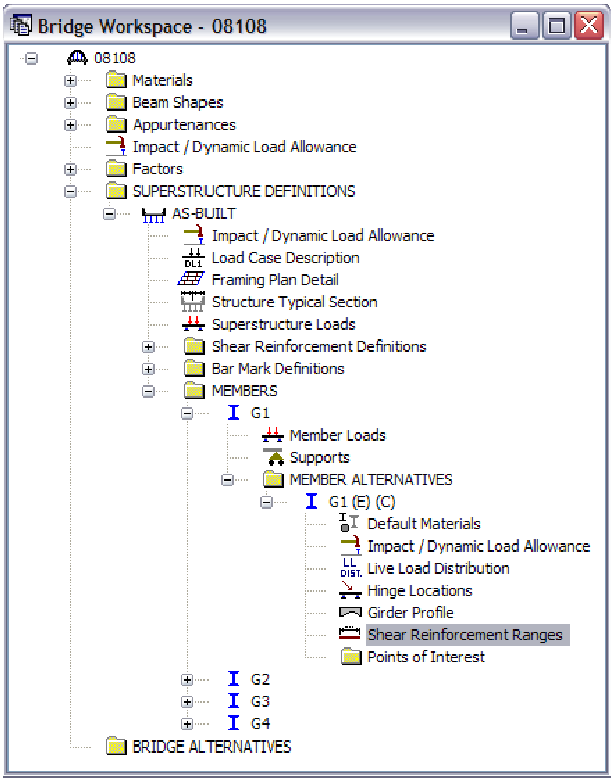
OK | Apply | Cancel



The user can compare the entered data to the design plans by right clicking **Girder Profile** and selecting **Schematic**.



DEFINE SHEAR REINFORCEMENT RANGES



Double click **Shear Reinforcement Ranges**.

Left click **New** to define a shear reinforcement set.

Name: Select the appropriate shear reinforcement definition from the drop down menu.

Support Number: Select the number of the support from which the range will be dimensioned.

Start Distance (ft): Enter the distance from the selected support to the left end of the range. The selected shear reinforcement for this range is not located at the start distance. However, it is located at all other locations within the range, including the end distance.

For example, if the user defines a reinforcement range starting at 0.00 ft from support 1 with 3 spaces at 4 inches. The first vertical shear bar will be located at 0.33 ft from support 1, not at 0.00 ft.

Number of Spaces: Enter the number of spaces, beginning at the start distance, that are of equal spacing and that define the location of the selected shear reinforcement.

Spacing (in): Enter the spacing between adjacent shear reinforcement within the given range. Spacings must be equal within a given range.

Length (ft): This value is calculated by Virtis. It is the total length of the shear reinforcement range.

End Distance (ft): This value is calculated by Virtis. It is the end distance of the shear reinforcement range.

Enter the fields as shown and left click **OK** to accept and close.

RC Shear Reinforcement Ranges

Name	Support Number	Start Distance (ft)	Number of Spaces	Spacing (in)	Length (ft)	End Distance (ft)
S	1	0.00	1	0.0000	0.00	0.00
S	1	0.00	12	15.0000	15.00	15.00
S	1	15.00	6	12.0000	6.00	21.00
S	1	21.00	6	10.0000	5.00	26.00
S	1	26.00	6	8.0000	4.00	30.00
S	1	30.00	18	7.0000	10.50	40.50
S	1	40.50	3	8.0000	2.00	42.50
S	1	42.50	2	9.0000	1.50	44.00
S	1	44.00	6	10.0000	5.00	49.00
S	1	49.00	1	12.0000	1.00	50.00
S	2	0.00	1	12.0000	1.00	1.00
S	2	1.00	16	10.0000	13.33	14.33
S	2	14.33	4	11.0000	3.67	18.00
S	2	18.00	5	12.0000	5.00	23.00
S	2	23.00	5	15.0000	6.25	29.25
S	2	29.25	7	18.0000	10.50	39.75
S	2	39.75	5	15.0000	6.25	46.00
S	2	46.00	5	12.0000	5.00	51.00
S	2	51.00	4	11.0000	3.67	54.67
S	2	54.67	16	10.0000	13.33	68.00
S	2	68.00	1	12.0000	1.00	69.00
S	3	0.00	1	12.0000	1.00	1.00
S	3	1.00	6	10.0000	5.00	6.00
S	3	6.00	2	9.0000	1.50	7.50
S	3	7.50	3	8.0000	2.00	9.50
S	3	9.50	18	7.0000	10.50	20.00
S	3	20.00	6	8.0000	4.00	24.00
S	3	24.00	6	10.0000	5.00	29.00
S	3	29.00	6	12.0000	6.00	35.00
S	3	35.00	12	15.0000	15.00	50.00

Stirrup Wizard... | New | Duplicate | Delete

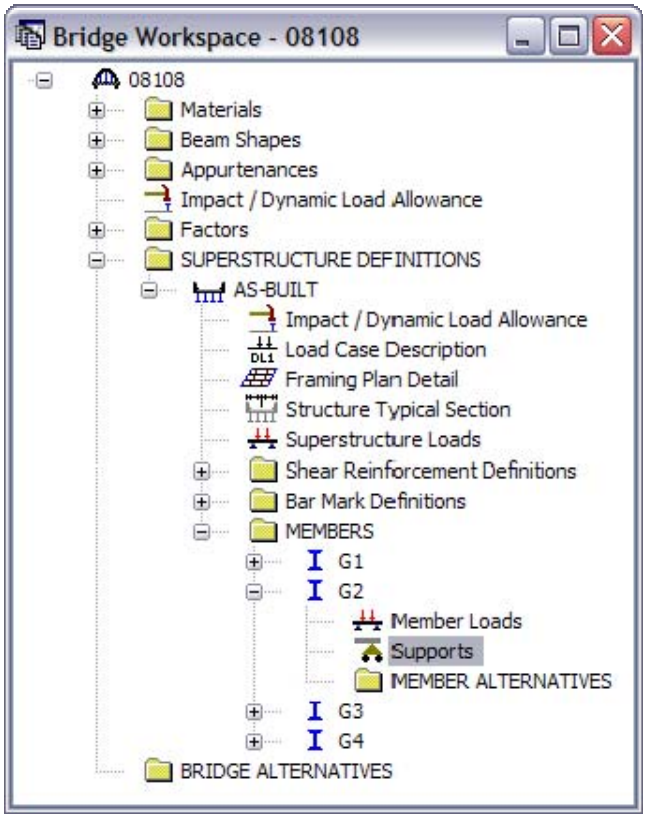
OK | Apply | Cancel

*****INPUT FOR MEMBER G1 IS COMPLETE. PROCEED TO G2**

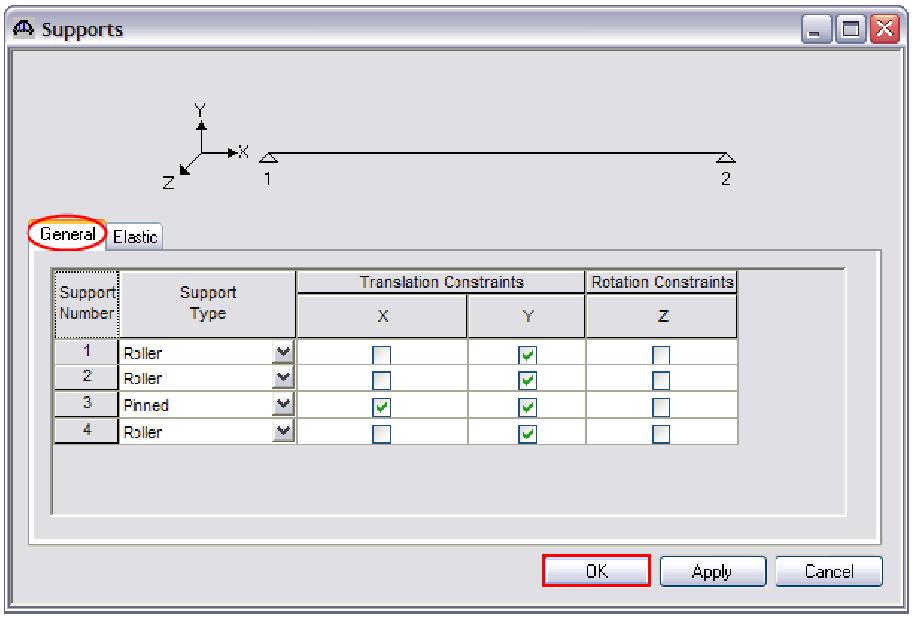
MEMBER G2

Member loads are not required for G2.

DEFINING SUPPORTS



Double click **Supports**.



General Tab:

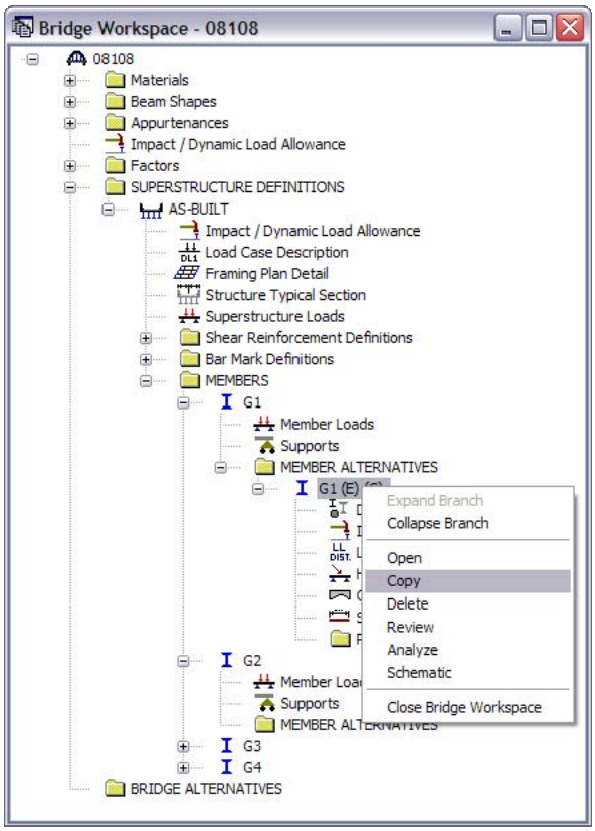
Select a **Roller** support type for supports 1, 2, and 4 since they are expansion supports.

Select a **Pinned** support type for support 3 since it is a fixed support.

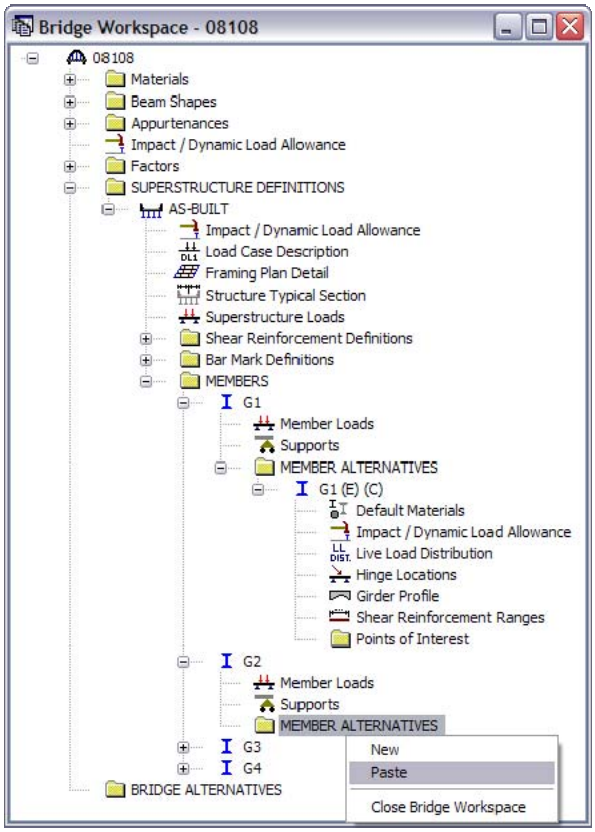
No input is required for the Elastic tab.

Left click **OK** to accept and close.

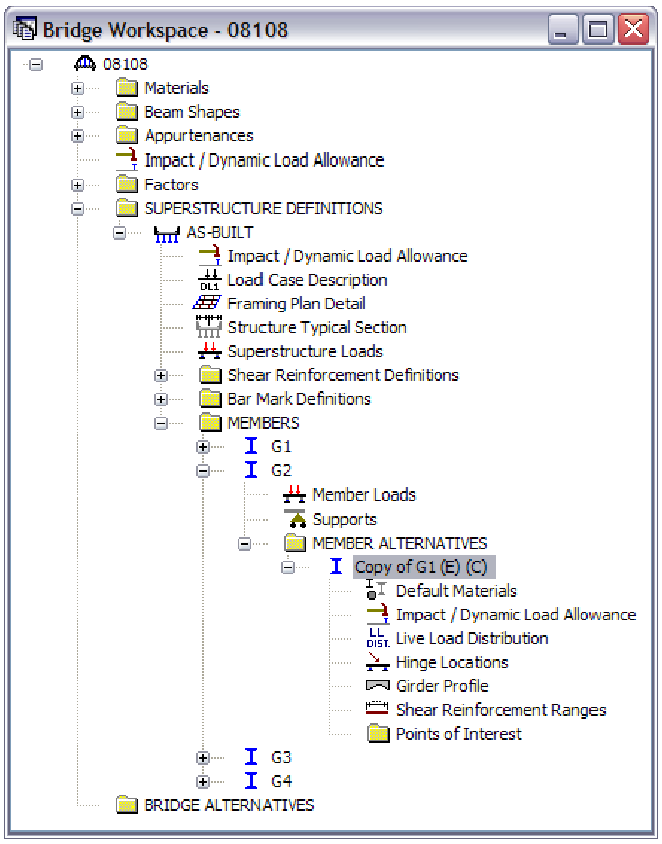
CREATING A MEMBER ALTERNATIVE: G2



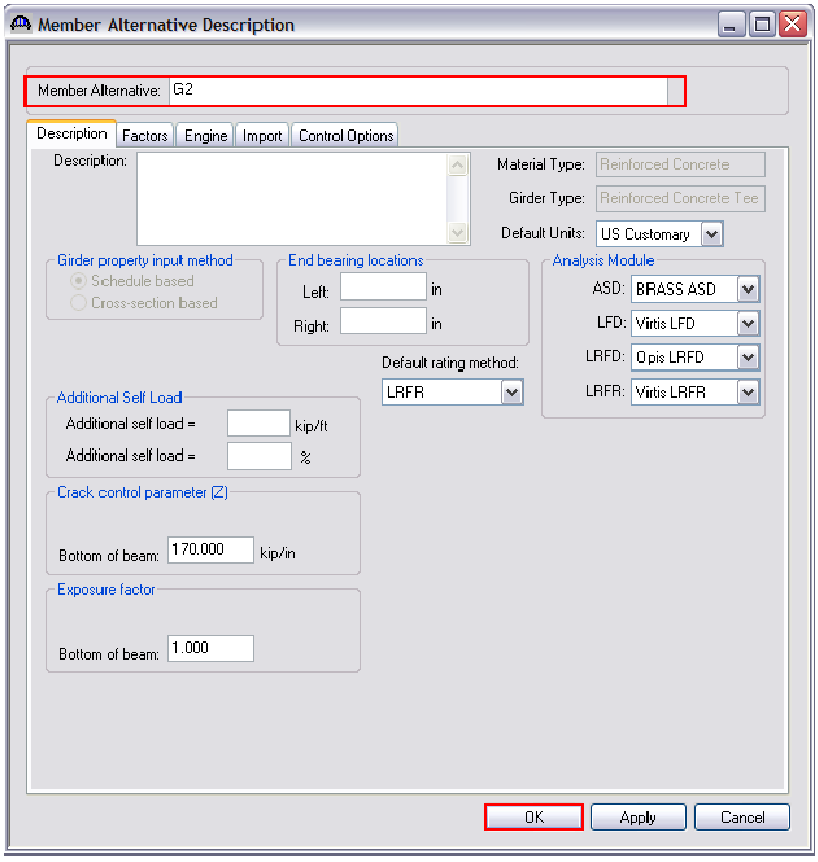
Right click **MEMBER ALTERNATIVE G1** and select **Copy**.



Right click the **MEMBER ALTERNATIVE** folder for **G2** and select **Paste**.



Double Click **Copy of G1 (E) (C)**.

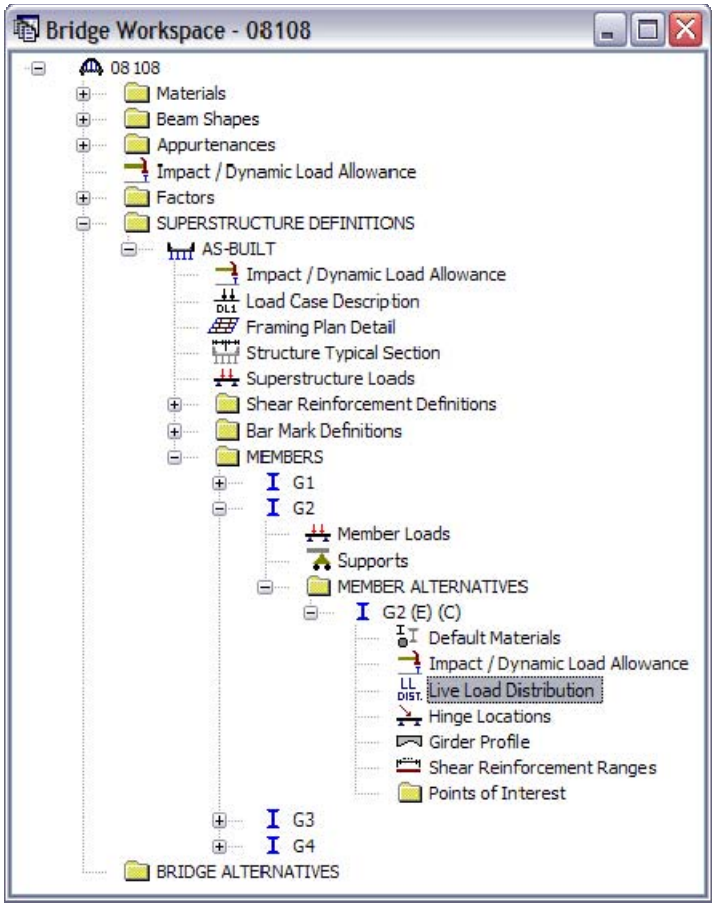


Change the Member Alterative name to **G2**.

No other changes are required.

Left click **OK** to accept and close.

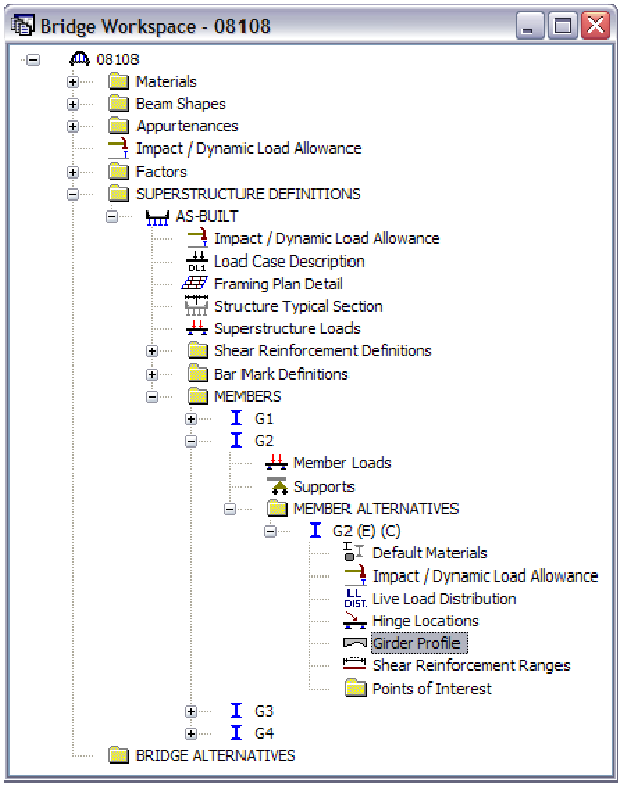
DEFINE LIVE LOAD DISTRIBUTION FACTORS



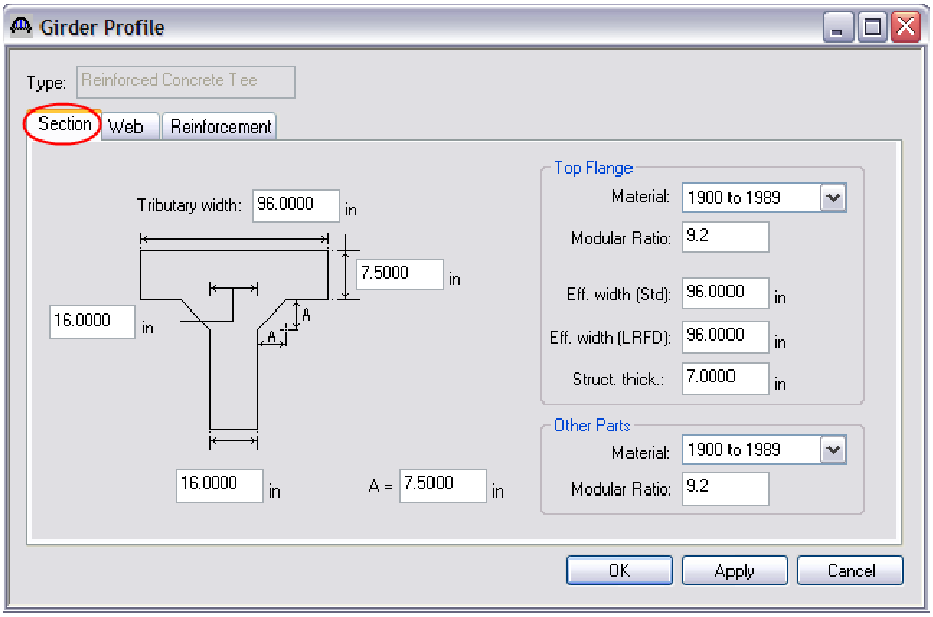
Expand the **MEMBER ALTERNATIVE** for **G2**.

G2 LRFR live load distribution factors cannot be computed from the typical section until the entire cross-section is defined. Continue with the other input for G2.

DEFINE THE GIRDER PROFILE



Double click **Girder Profile** to update the information currently in the following tabs.



Section Tab:

Tributary Width: The physical width of the deck between the girders. For this example, use the beam spacing of 96.00 in.

Total Deck Thickness: 7.50 in.

Web Thickness at Top Flange: 16.00 in.

Web Thickness at Bottom of Beam: 16.00 in.

Chamfer Dimension, A: 7.5 in. (Average of vertical and horizontal chamfer dimensions).

Top Flange:

Material: Select the appropriate material from the drop down menu.

Modular Ratio: 9.2 (See calculation below)

Eff. Width (Std): The effective flange width for LFD. For this example, enter 96.00 in. See Appendix C for sample calculation.

Eff. Width (LRFD): The effective flange width for LRFR. For this example, enter 96.00 in. This value will equal the tributary width per AASHTO 2007 with 2008 Interims, *LRFD Bridge Design Specifications*, 4th Edition, section 4.6.2.6.

Struct. Thick.: Typically, 0.50 in. is removed from the actual thickness of the top flange. Therefore, enter 7.00 in. for this example.

Other Parts: (Other than the top flange)

Material: Select the appropriate material from the drop down menu.

Modular Ratio: 9.2 (See calculation below)

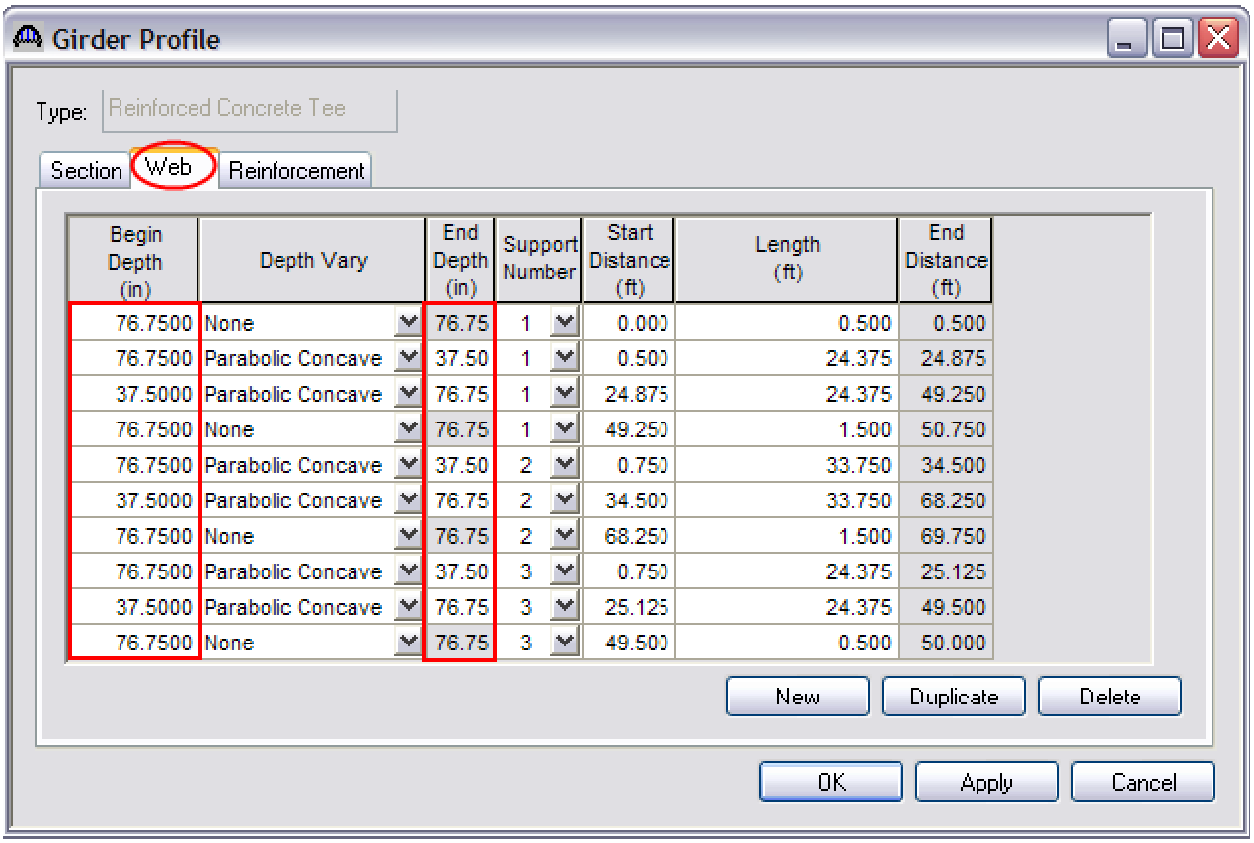
Modular Ratio Calculation

Note: References from AASHTO LRFD Bridge Design Spefications, 2007 with 2008 int.

Unit Weight of Concrete, w_c =	0.145	kip/ft³	
Compressive Strength of Concrete, f'_c =	3.00	ksi	
Modulus of Elasticity of Reinf. Steel, E_s =	29000	ksi	
Modulus of Elasticity of Concrete, $E_c = 33{,}000 * w_c^{1.5} * f'^{0.5}_c$			Eq. 5.4.2.4-1
$E_c = 33{,}000 * 0.145^{1.5} * 3.00^{0.5}$			
E_c = 3155.92	ksi		
Modular Ratio, n = Es / Ec			5.7.1
n = 29,000 / 3,155.92			
n = 9.2			

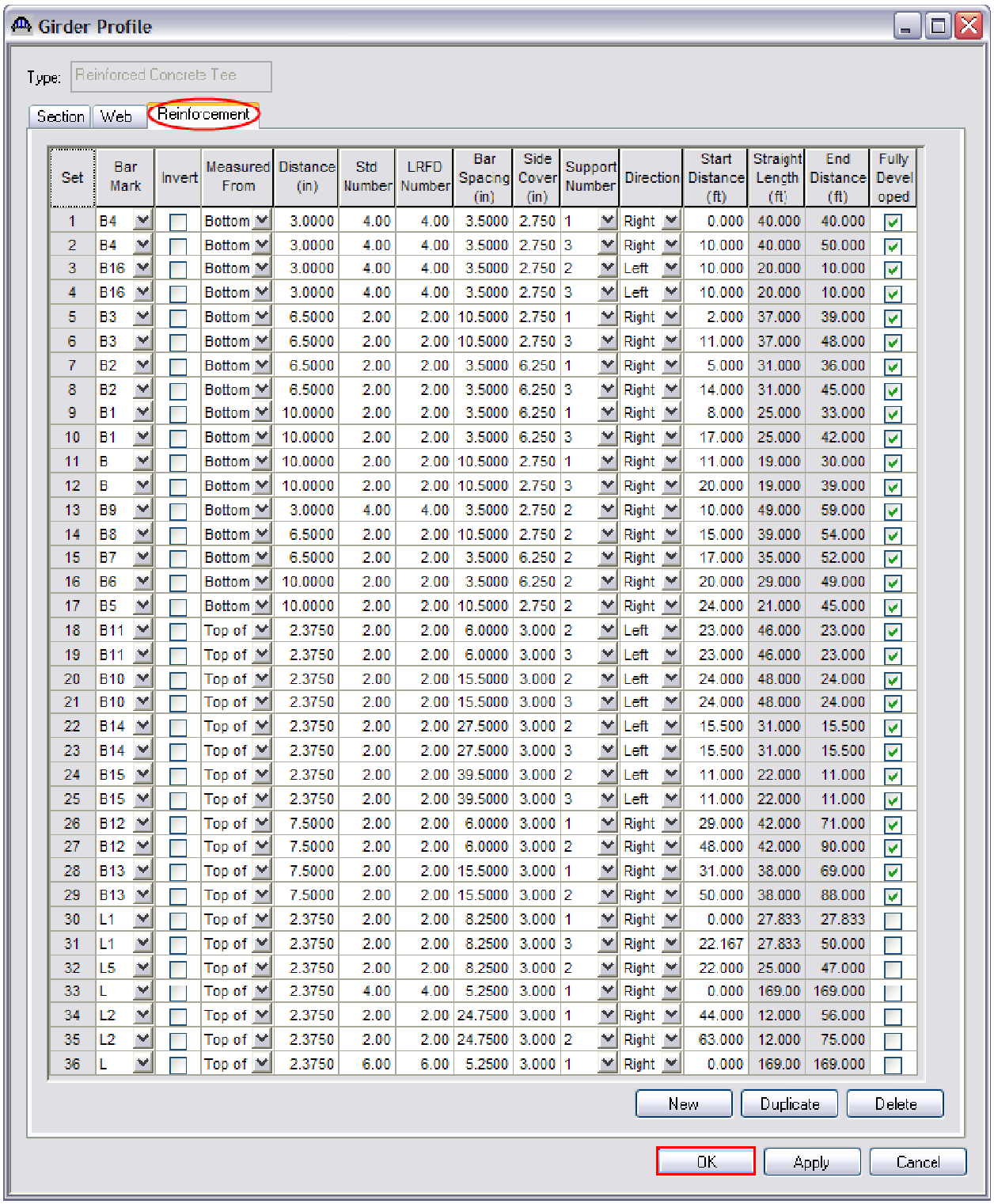
Web Tab:

Update the Begin and End Depths as shown.



Reinforcement Tab:

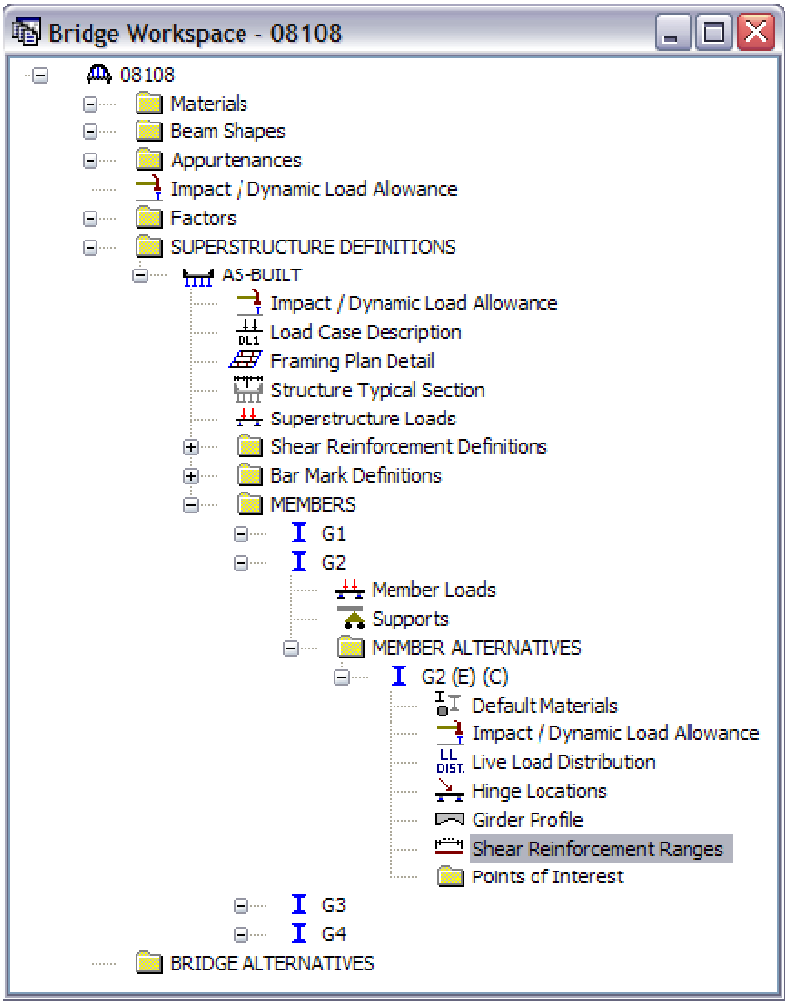
Update the reinforcement sets as shown below.



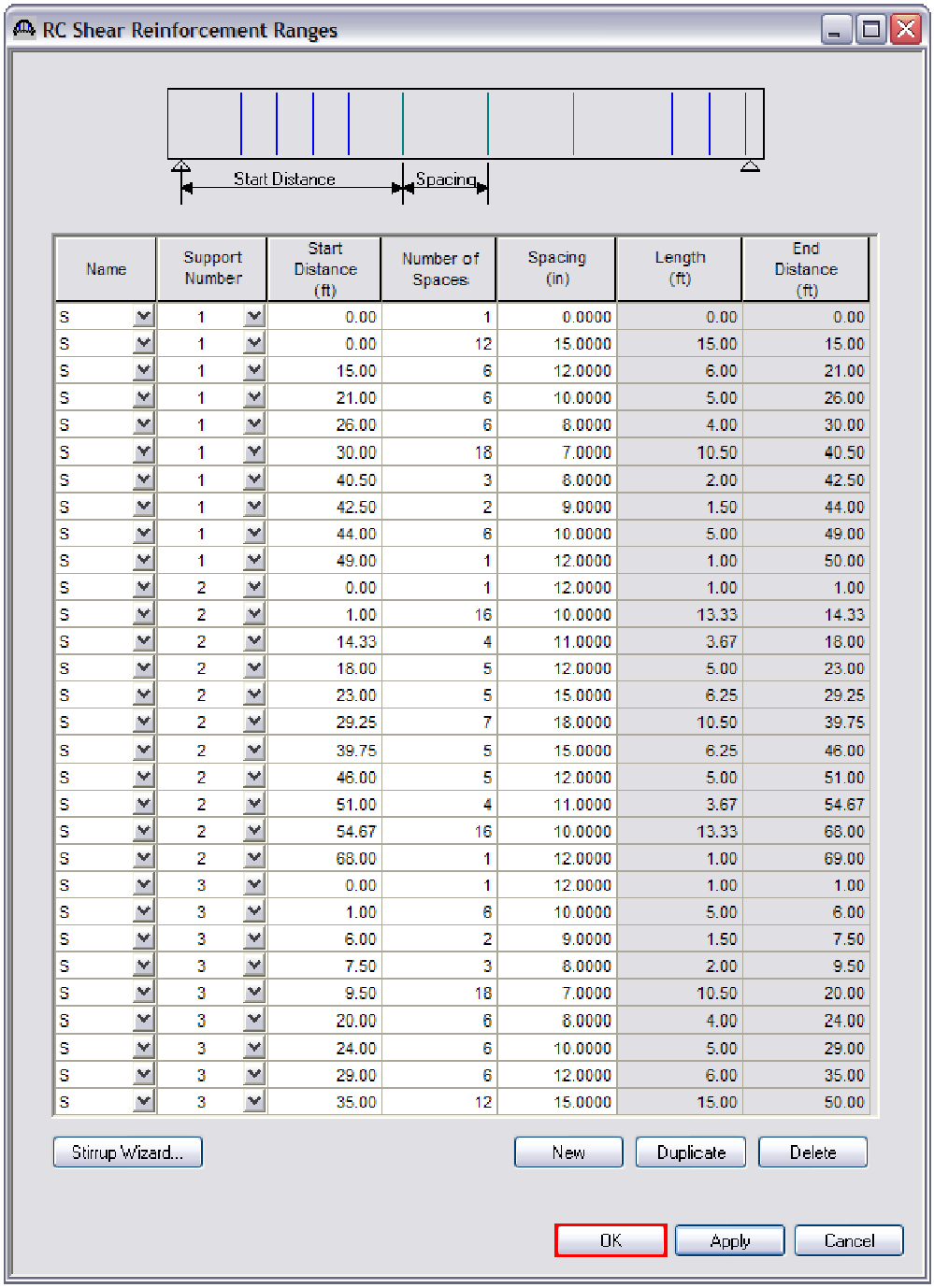
Set	Bar Mark	Invert	Measured From	Distance (in)	Std Number	LRFD Number	Bar Spacng (in)	Side Cover (in)	Support Number	Direction	Start Distance (ft)	Straight Length (ft)	End Distance (ft)	Fully Developed
1	B4		Bottom	3.0000	4.00	4.00	3.5000	2.750	1	Right	0.000	40.000	40.000	☑
2	B4		Bottom	3.0000	4.00	4.00	3.5000	2.750	3	Right	10.000	40.000	50.000	☑
3	B16		Bottom	3.0000	4.00	4.00	3.5000	2.750	2	Left	10.000	20.000	10.000	☑
4	B16		Bottom	3.0000	4.00	4.00	3.5000	2.750	3	Left	10.000	20.000	10.000	☑
5	B3		Bottom	6.5000	2.00	2.00	10.5000	2.750	1	Right	2.000	37.000	39.000	☑
6	B3		Bottom	6.5000	2.00	2.00	10.5000	2.750	3	Right	11.000	37.000	48.000	☑
7	B2		Bottom	6.5000	2.00	2.00	3.5000	6.250	1	Right	5.000	31.000	36.000	☑
8	B2		Bottom	6.5000	2.00	2.00	3.5000	6.250	3	Right	14.000	31.000	45.000	☑
9	B1		Bottom	10.0000	2.00	2.00	3.5000	6.250	1	Right	8.000	25.000	33.000	☑
10	B1		Bottom	10.0000	2.00	2.00	3.5000	6.250	3	Right	17.000	25.000	42.000	☑
11	B		Bottom	10.0000	2.00	2.00	10.5000	2.750	1	Right	11.000	19.000	30.000	☑
12	B		Bottom	10.0000	2.00	2.00	10.5000	2.750	3	Right	20.000	19.000	39.000	☑
13	B9		Bottom	3.0000	4.00	4.00	3.5000	2.750	2	Right	10.000	49.000	59.000	☑
14	B8		Bottom	6.5000	2.00	2.00	10.5000	2.750	2	Right	15.000	39.000	54.000	☑
15	B7		Bottom	6.5000	2.00	2.00	3.5000	6.250	2	Right	17.000	35.000	52.000	☑
16	B6		Bottom	10.0000	2.00	2.00	3.5000	6.250	2	Right	20.000	29.000	49.000	☑
17	B5		Bottom	10.0000	2.00	2.00	10.5000	2.750	2	Right	24.000	21.000	45.000	☑
18	B11		Top of	2.3750	2.00	2.00	6.0000	3.000	2	Left	23.000	46.000	23.000	☑
19	B11		Top of	2.3750	2.00	2.00	6.0000	3.000	3	Left	23.000	46.000	23.000	☑
20	B10		Top of	2.3750	2.00	2.00	15.5000	3.000	2	Left	24.000	48.000	24.000	☑
21	B10		Top of	2.3750	2.00	2.00	15.5000	3.000	3	Left	24.000	48.000	24.000	☑
22	B14		Top of	2.3750	2.00	2.00	27.5000	3.000	2	Left	15.500	31.000	15.500	☑
23	B14		Top of	2.3750	2.00	2.00	27.5000	3.000	3	Left	15.500	31.000	15.500	☑
24	B15		Top of	2.3750	2.00	2.00	39.5000	3.000	2	Left	11.000	22.000	11.000	☑
25	B15		Top of	2.3750	2.00	2.00	39.5000	3.000	3	Left	11.000	22.000	11.000	☑
26	B12		Top of	7.5000	2.00	2.00	6.0000	3.000	1	Right	29.000	42.000	71.000	☑
27	B12		Top of	7.5000	2.00	2.00	6.0000	3.000	2	Right	48.000	42.000	90.000	☑
28	B13		Top of	7.5000	2.00	2.00	15.5000	3.000	1	Right	31.000	38.000	69.000	☑
29	B13		Top of	7.5000	2.00	2.00	15.5000	3.000	2	Right	50.000	38.000	88.000	☑
30	L1		Top of	2.3750	2.00	2.00	8.2500	3.000	1	Right	0.000	27.833	27.833	☐
31	L1		Top of	2.3750	2.00	2.00	8.2500	3.000	3	Right	22.167	27.833	50.000	☐
32	L5		Top of	2.3750	2.00	2.00	8.2500	3.000	2	Right	22.000	25.000	47.000	☐
33	L		Top of	2.3750	4.00	4.00	5.2500	3.000	1	Right	0.000	169.00	169.000	☐
34	L2		Top of	2.3750	2.00	2.00	24.7500	3.000	1	Right	44.000	12.000	56.000	☐
35	L2		Top of	2.3750	2.00	2.00	24.7500	3.000	2	Right	63.000	12.000	75.000	☐
36	L		Top of	2.3750	6.00	6.00	5.2500	3.000	1	Right	0.000	169.00	169.000	☐

Left click **OK** to accept and close.

DEFINE SHEAR REINFORCEMENT RANGES



Double click **Shear Reinforcement Ranges**.

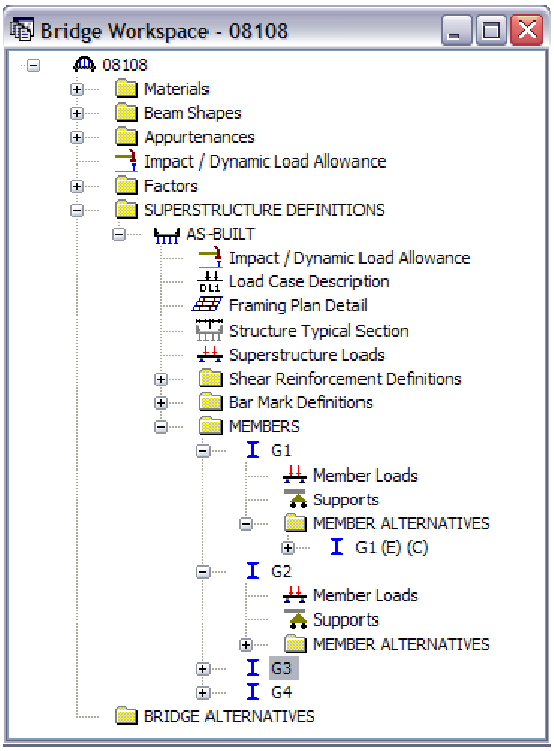


The shear reinforcement ranges for G2 are identical to G1. Therefore, left click **OK** to accept and close.

Once MEMBER G2 is complete, other MEMBERS can be linked with G1 and G2 since the beams are identical and the girder spacing and overhangs are equal.

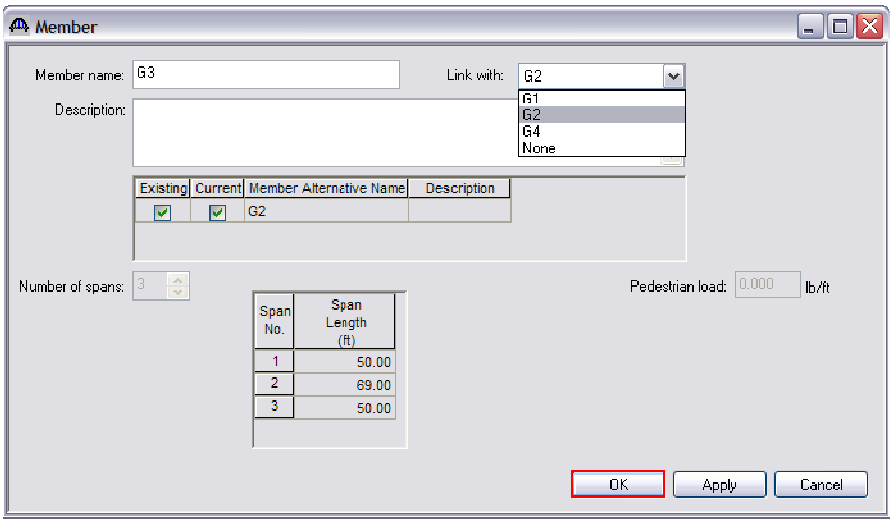
LINK MEMBERS

When a bridge has members that are identical, the user can specify a link to members that have already been entered to save both input and analysis time. Once a member is linked to a previously defined member, no other input is required.



For the example, the interior beams are identical to each other and both exterior beams are identical to each other.

Double click member **G3**.



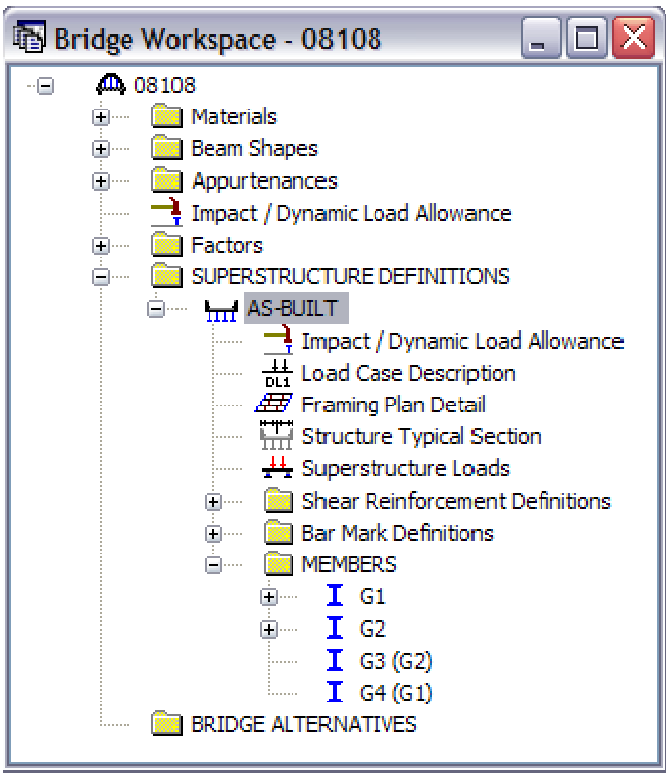
Select **G2** from the **Link with:** drop down menu.

Left click **OK** to accept and close.

Use this process for member **G4**. Link **G4** with **G1**.

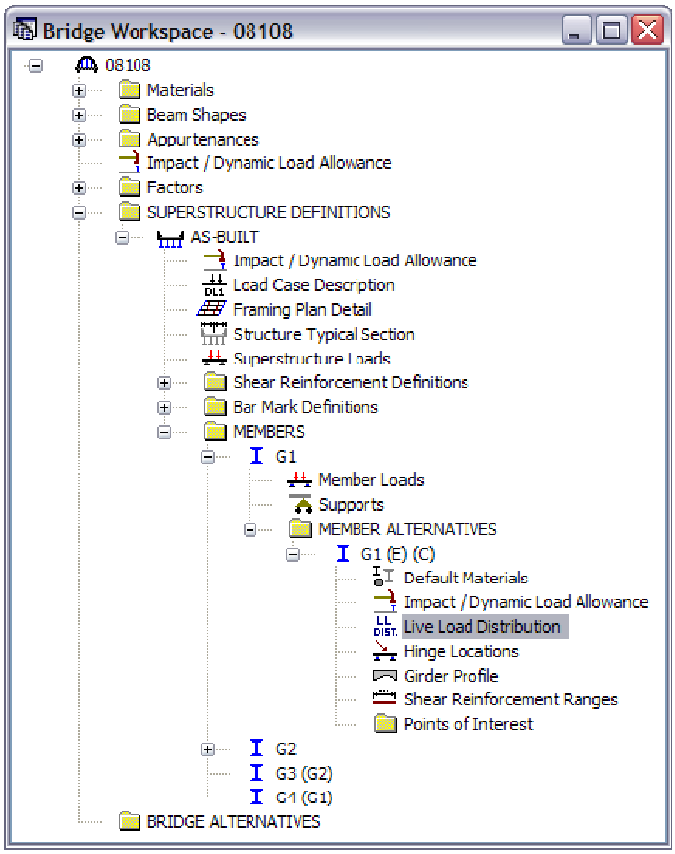
Click **Continue** each time the warning message appears.

Note: Engineering judgment should always be used to determine if linking girders is appropriate for a particular bridge.



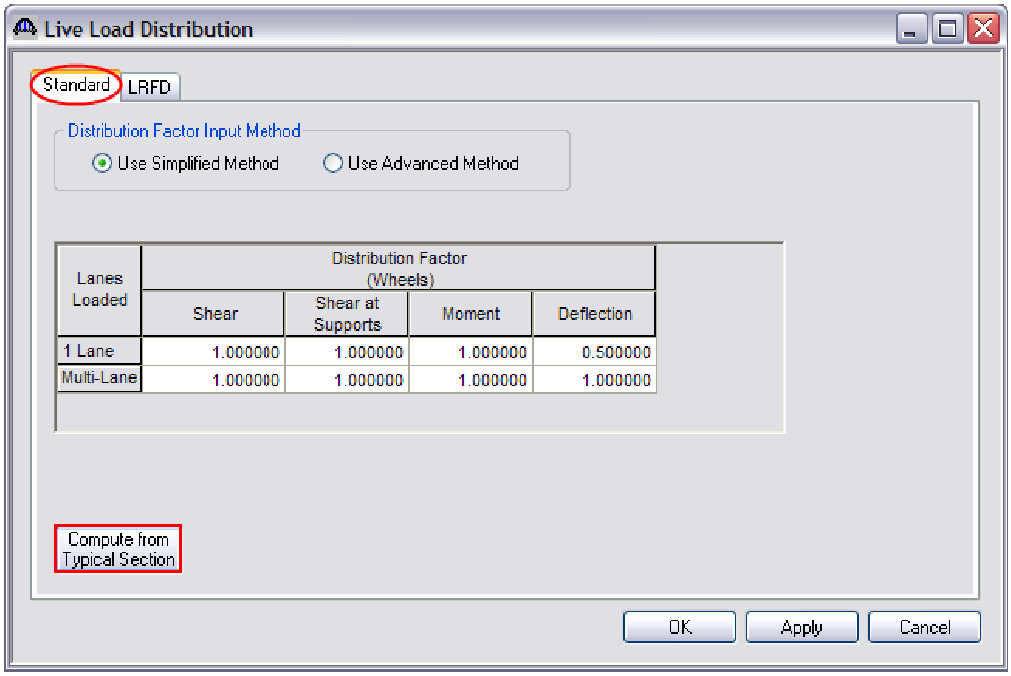
The screen shot to the left demonstrates how Virtis displays linked members.

DEFINE LIVE LOAD DISTRIBUTION FACTORS



Expand the **MEMBER ALTERNATIVE** for **G1**.

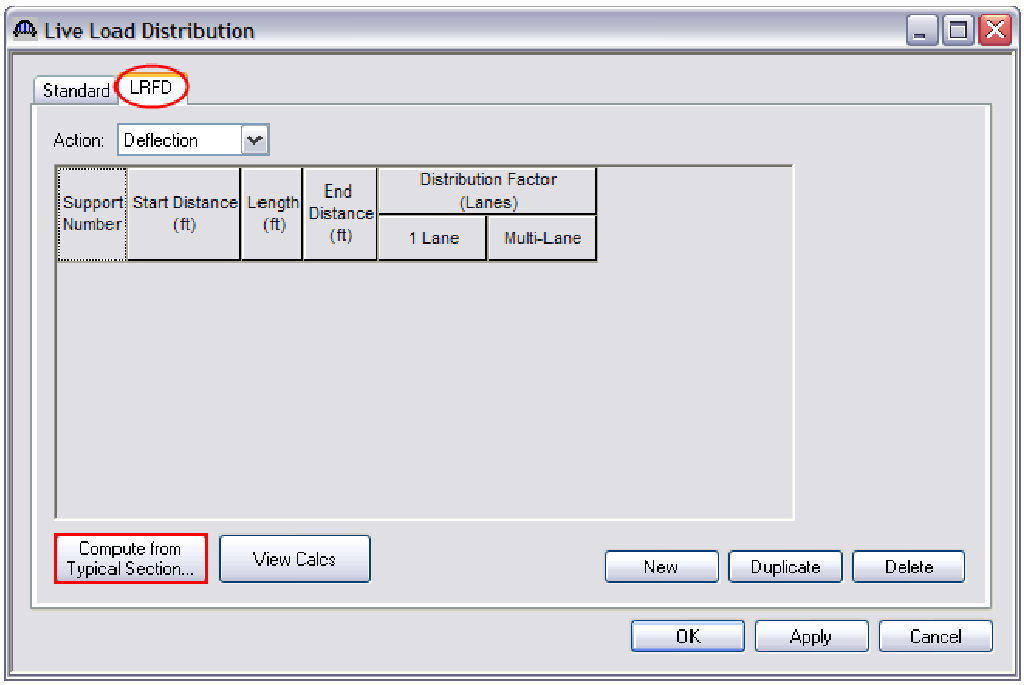
Double click **Live Load Distribution**.



Standard Tab:

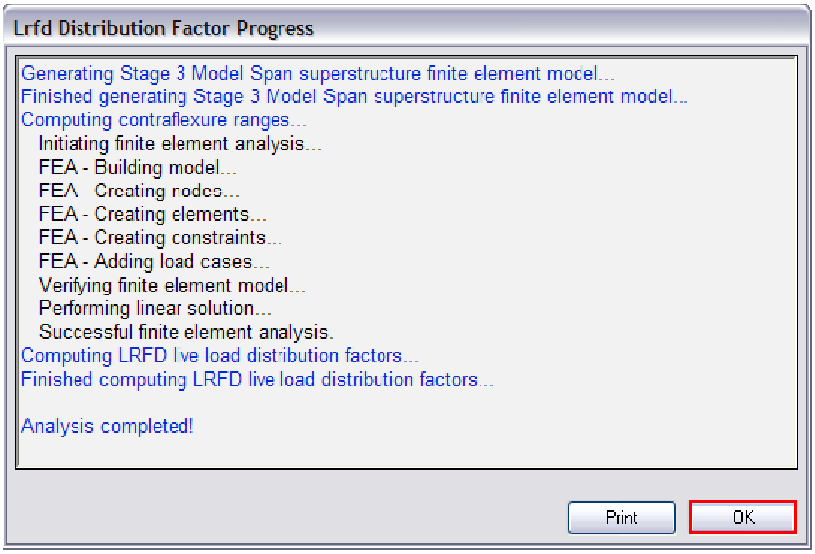
Distribution Factor Input Method: Use Simplified Method.

Left click **Compute from Typical Section**.



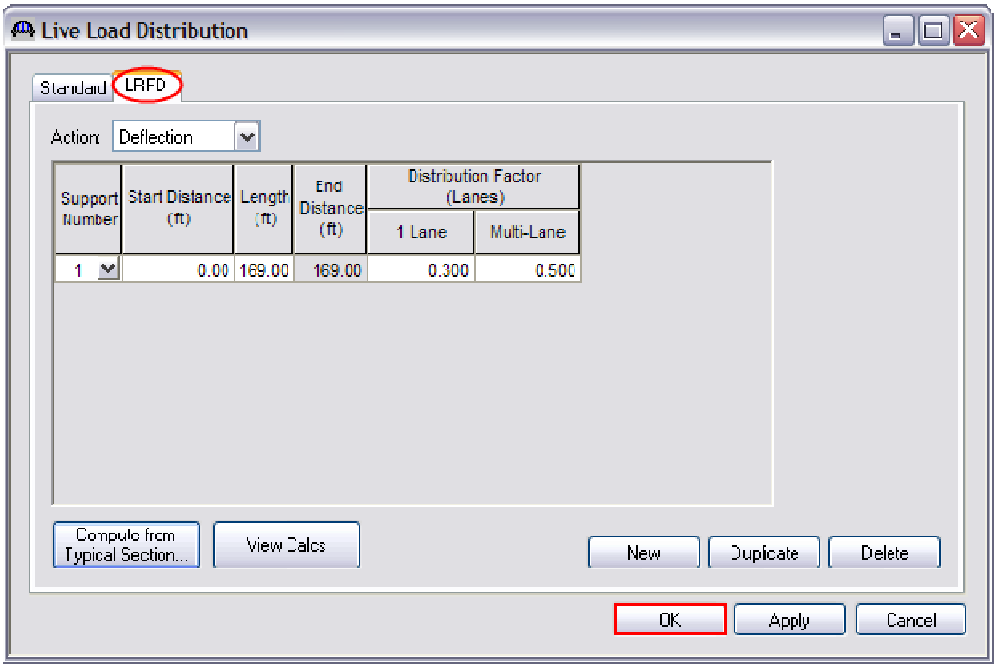
LRFD Tab:

Left click **Compute from Typical Section**.



The **LRFD Distribution Factor Progress** window will appear.

Left click **OK** to close the **LRFD Distribution Factor Progress** window once the analysis is complete.



This will compute live load distribution factors for deflection, moment, and shear.

The screen shots for moment and shear are as follows:

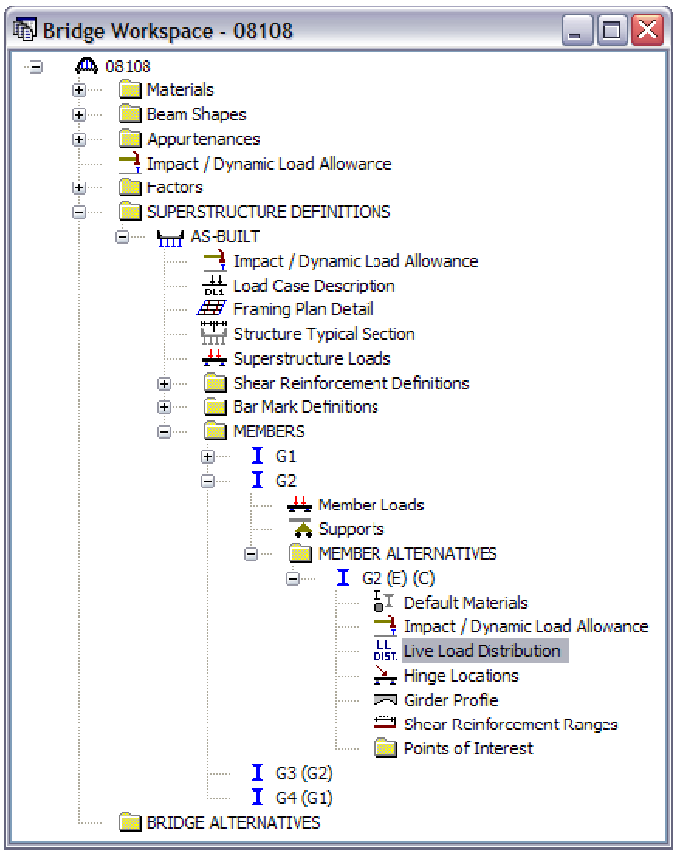
Action: Moment

Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Distribution Factor (Lanes)	
				1 Lane	Multi-Lane
1	0.00	30.90	30.90	0.660	0.660
1	30.90	38.32	69.22	0.660	0.723
2	19.22	30.55	49.78	0.660	0.660
2	49.78	38.32	88.10	0.660	0.723
3	19.10	30.90	50.00	0.660	0.660

Action: Shear

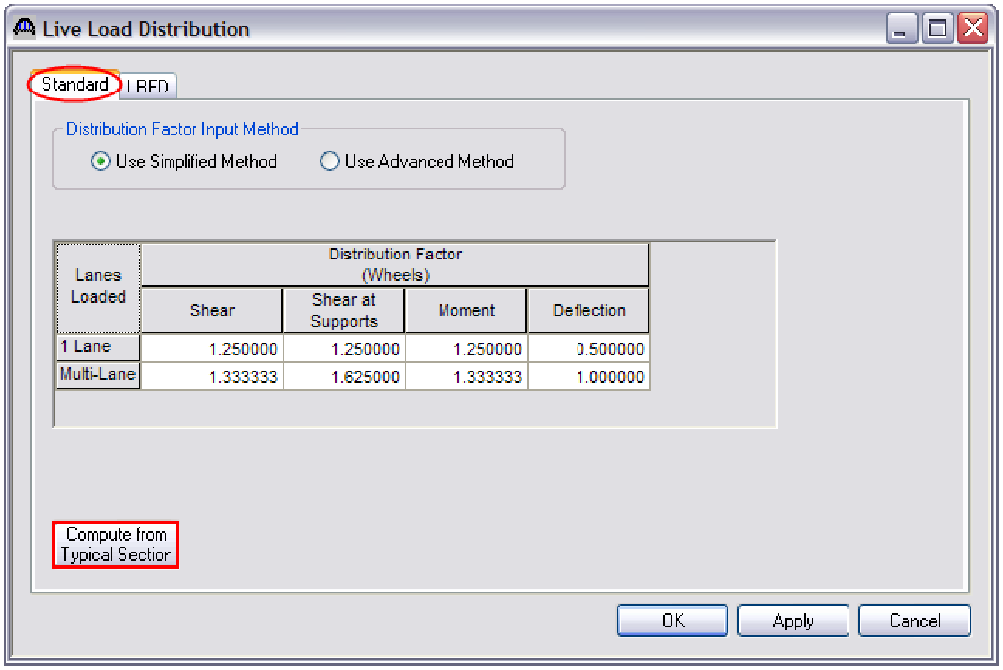
Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Distribution Factor (Lanes)	
				1 Lane	Multi-Lane
1	0.00	50.00	50.00	0.660	0.660
2	0.00	69.00	69.00	0.660	0.660
3	0.00	50.00	50.00	0.660	0.660

Left click **OK** to accept and close.



Expand the **MEMBER ALTERNATIVE** for **G2**.

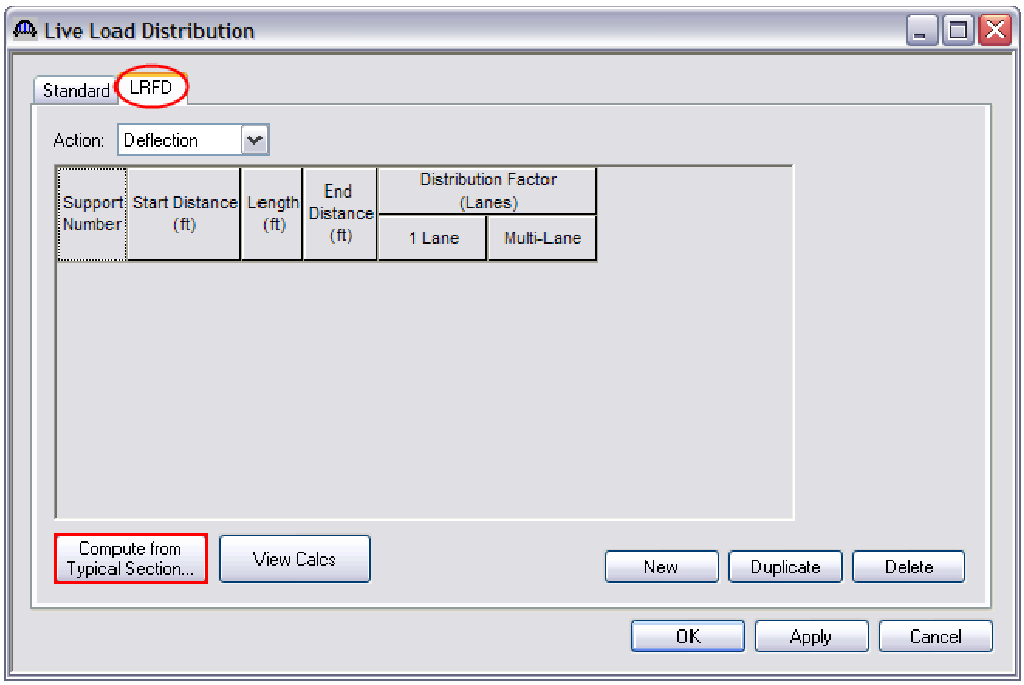
Double click **Live Load Distribution**.



Standard Tab:

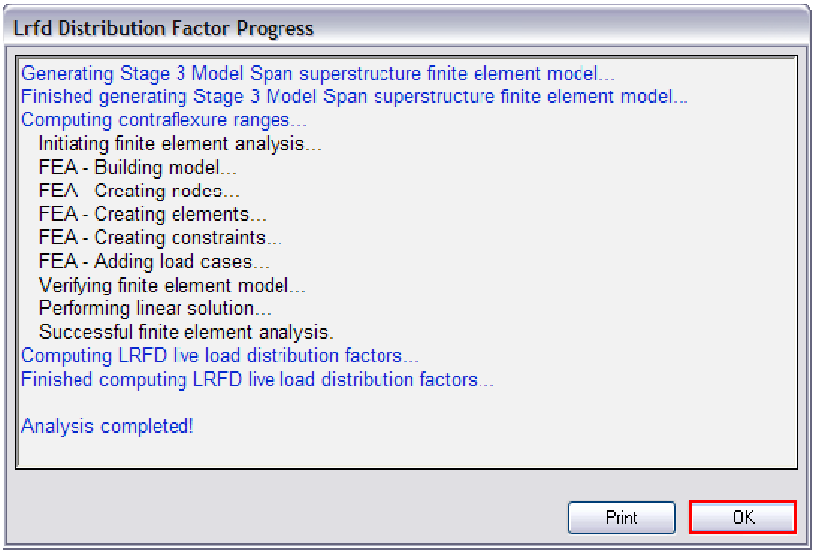
Distribution Factor Input Method: Use Simplified Method.

Left click **Compute from Typical Section**.



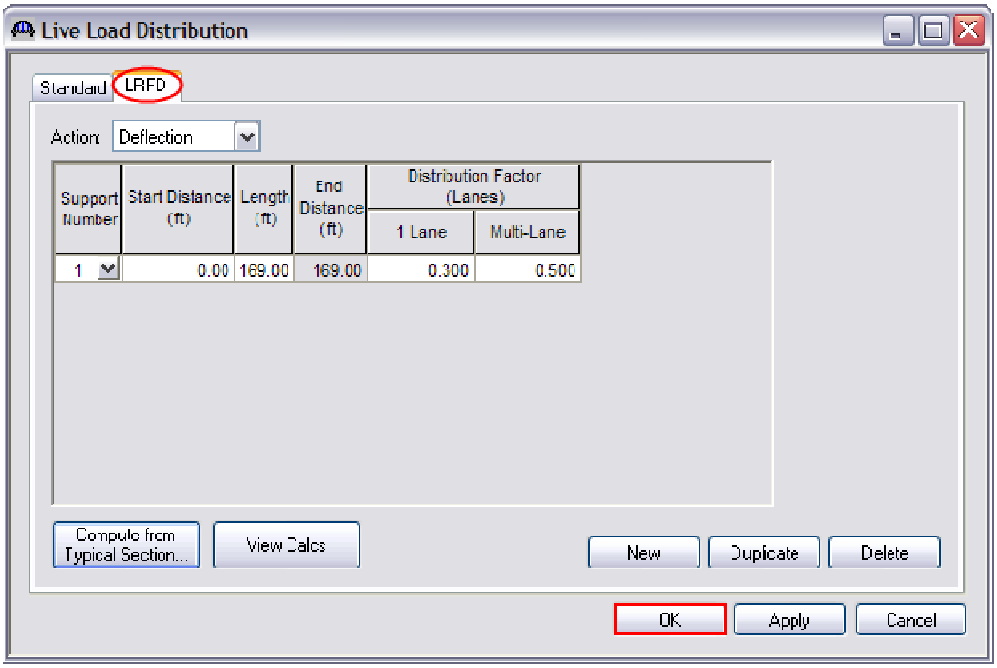
LRFD Tab:

Left click **Compute from Typical Section**.



The **LRFD Distribution Factor Progress** window will appear.

Left click **OK** to close the **LRFD Distribution Factor Progress** window once the analysis is complete.



This will compute live load distribution factors for deflection, moment, and shear.

The screen shots for moment and shear are as follows:

Action: Moment

Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Distribution Factor (Lanes)	
				1 Lane	Multi-Lane
1	0.00	30.96	30.96	0.543	0.730
1	30.96	38.18	69.14	0.602	0.822
2	19.14	30.72	49.86	0.465	0.642
2	49.86	38.18	88.04	0.602	0.822
3	19.04	30.96	50.00	0.543	0.730

Action: Shear

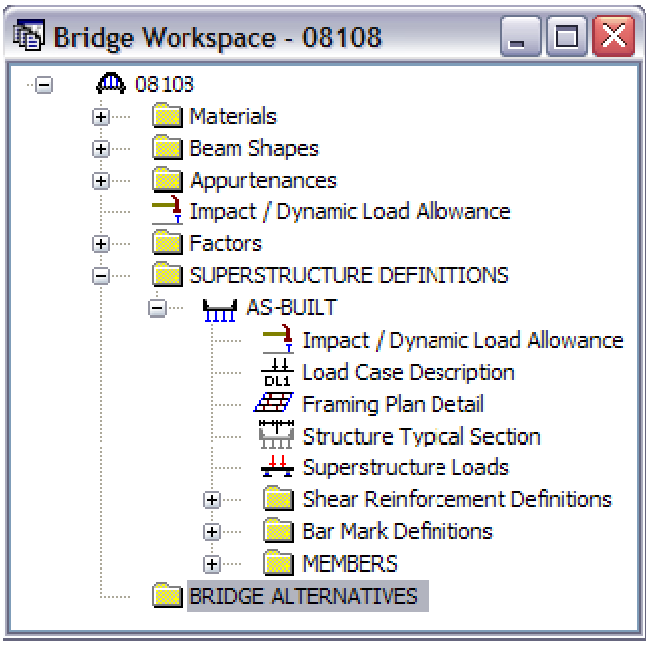
Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Distribution Factor (Lanes)	
				1 Lane	Multi-Lane
1	0.00	50.00	50.00	0.680	0.814
2	0.00	69.00	69.00	0.680	0.814
3	0.00	50.00	50.00	0.680	0.814

Left click **OK** to accept and close.

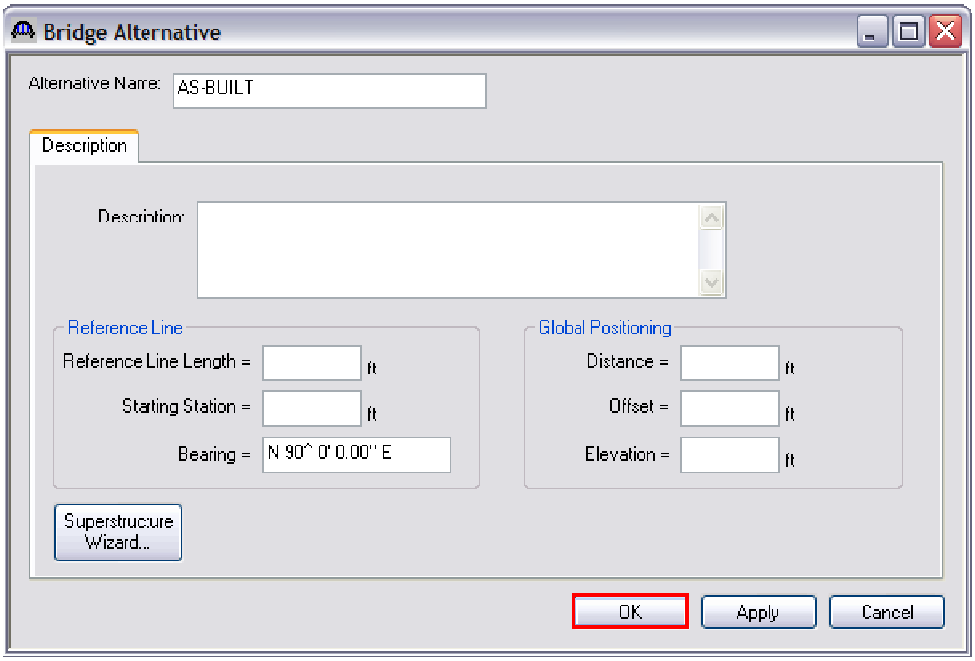
CREATE A BRIDGE ALTERNATIVE

A bridge can have several unique bridge alternatives. Each bridge alternative must include the entire bridge but can consist of a different layout of superstructures. The number of spans, the span lengths, and the pier locations are defined within the bridge alternative (and its accompanying windows). Entering different bridge alternatives can be useful when comparing various alternatives for a preliminary study.

BRIDGE ALTERNATIVES permit the user to determine which spans to include in an analysis. For a three span structure with identical exterior spans, the user can decide to only include AS-BUILT Spans 1 and 3 in the analysis and exclude AS-BUILT Span 2. The rating summary will then only have results from Spans 1 and 3 rather than comparing Spans 1 and 3 to Span 2. Typically however, every span entered will be included in a **BRIDGE ALTERNATIVE**.

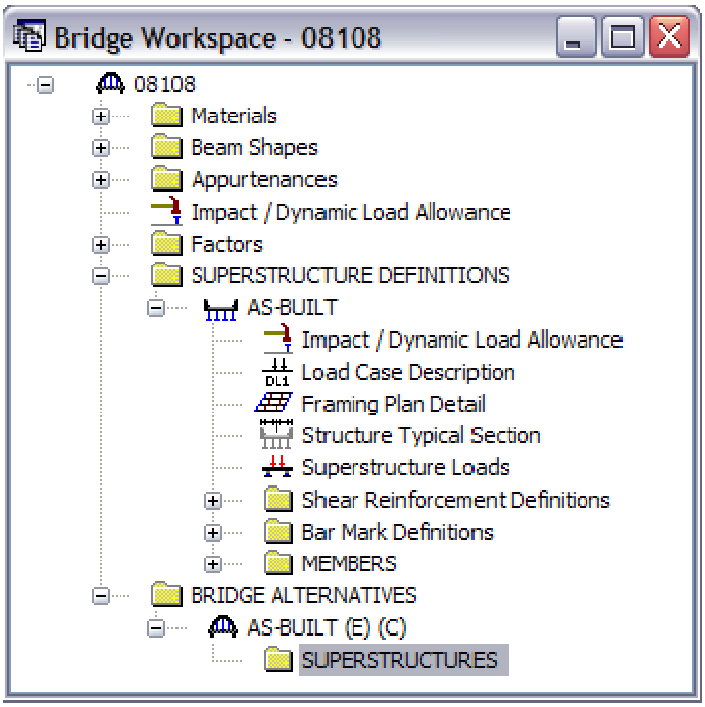


Double click **BRIDGE ALTERNATIVES.**



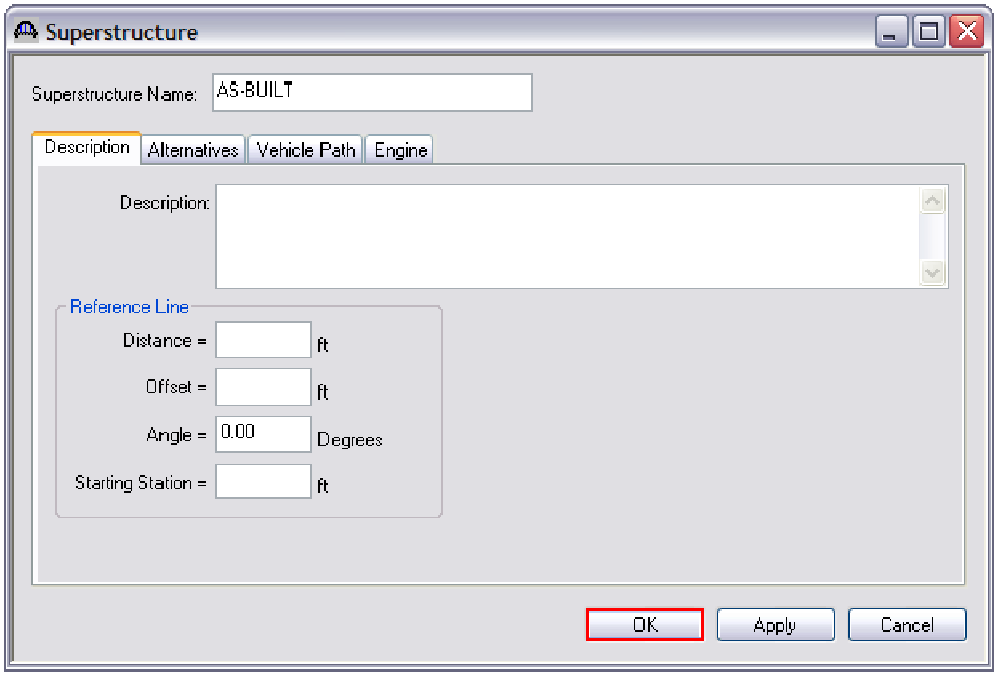
Alternative Name: AS-BUILT

Left click **OK** to accept and close.



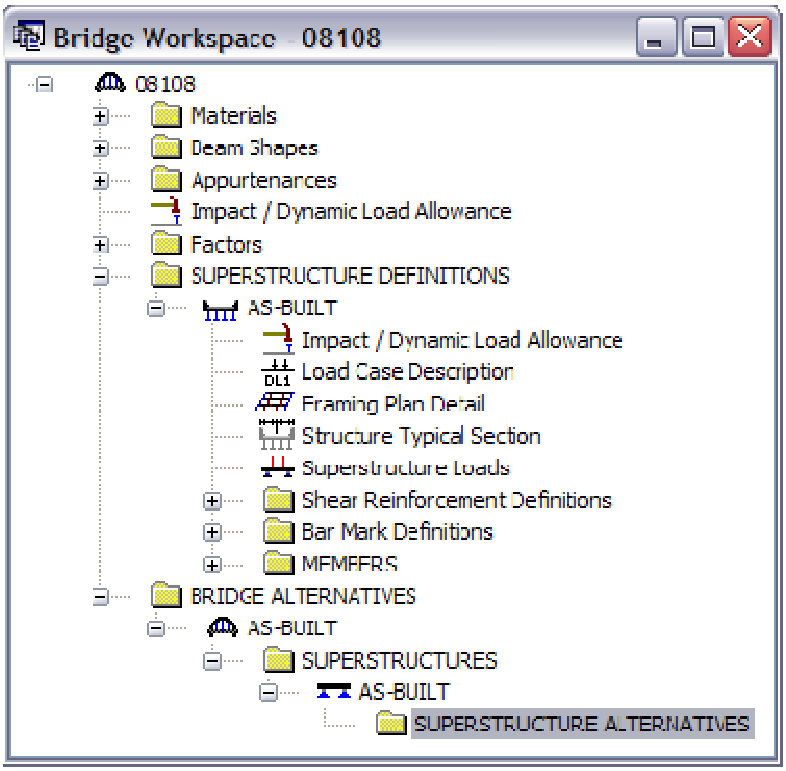
Expand **BRIDGE ALTERNATIVES** and **AS-BUILT** folders.

Double click **SUPERSTRUCTURES.**



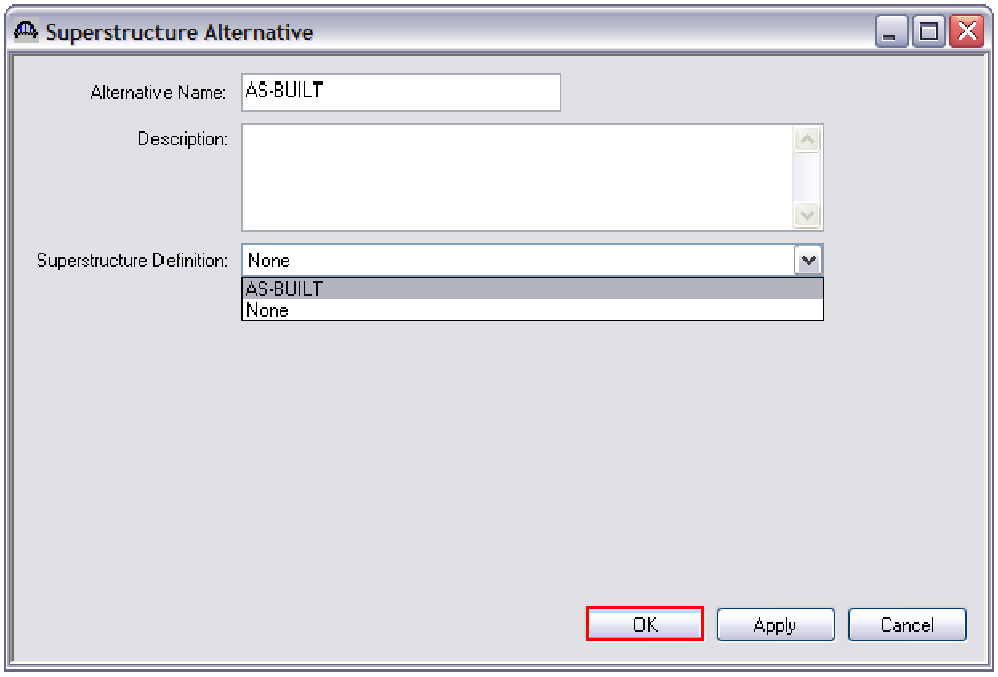
Superstructure Name: AS-BUILT

Left click **OK** to accept and close.



Expand **SUPERSTRUCTURES** and **AS-BUILT** folders.

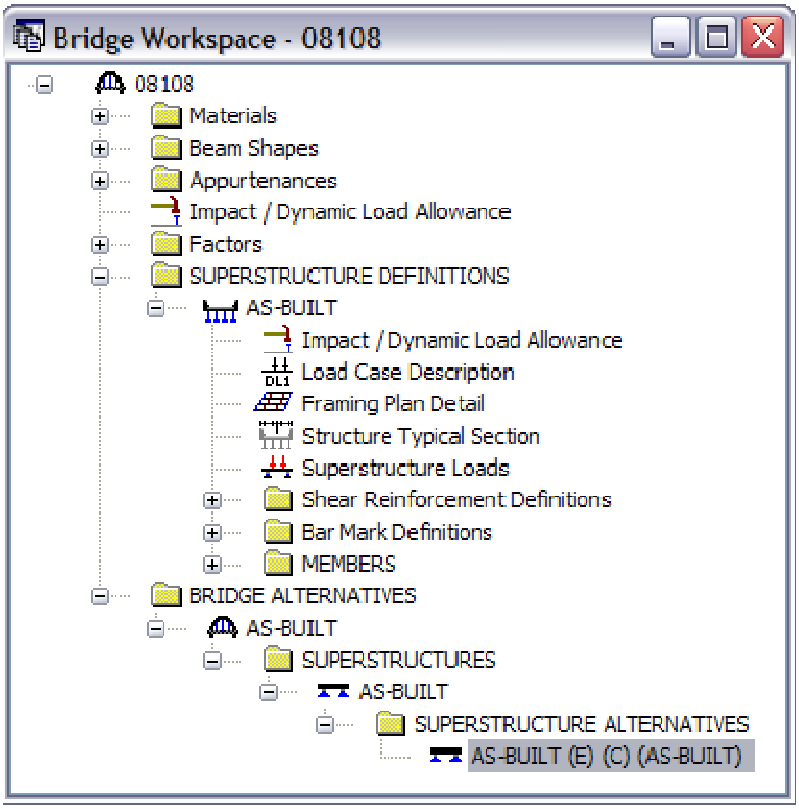
Double click **SUPERSTRUCTURE ALTERNATIVES.**



Alternative Name: AS-BUILT

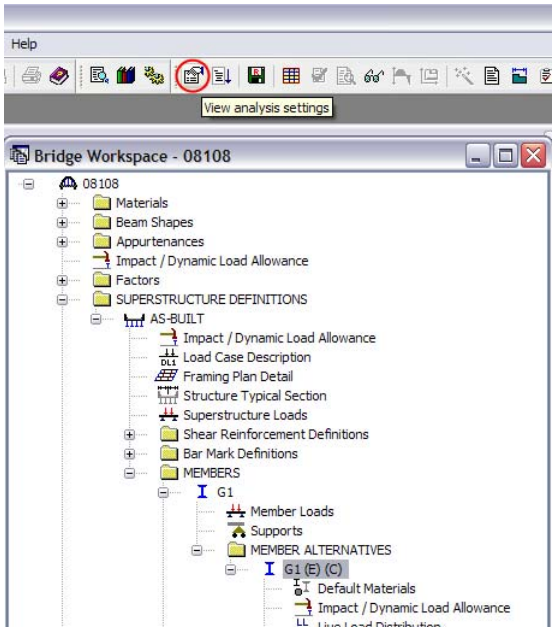
Superstructure Definition: Select AS-BUILT from the drop down menu.

Left click **OK** to accept and close.



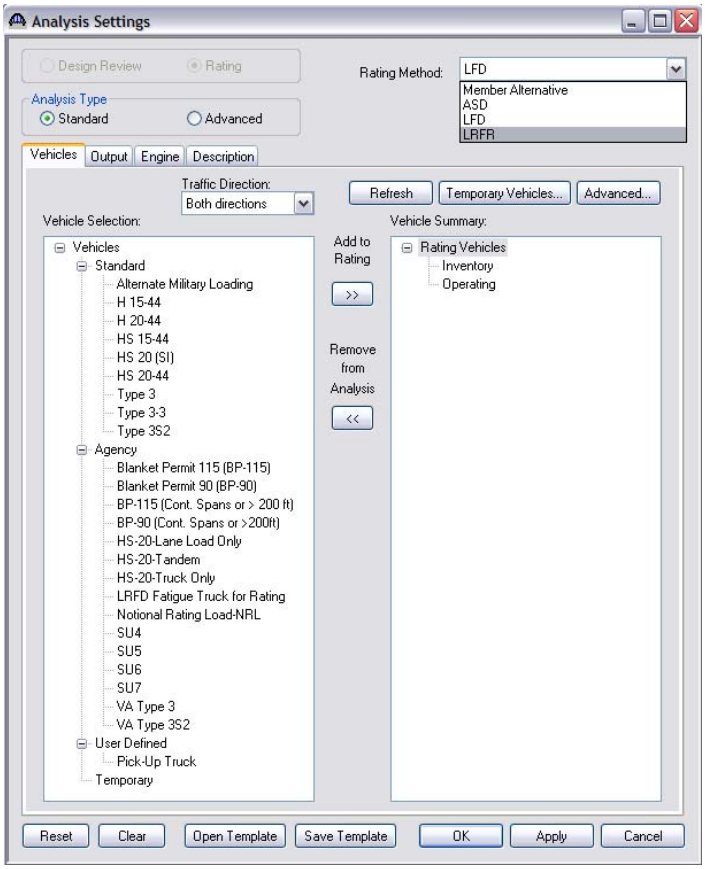
*****THE INPUT FOR THE BRIDGE IS NOW COMPLETE. MAKE SURE THE FILE IS SAVED PRIOR TO ANALYSIS.**

ANALYSIS



The file is now ready to be analyzed. The user can either analyze individual members with the file open or analyze the entire bridge with the file closed.

To analyze a single member, highlight an individual member and left click the **View Analysis Settings** icon.



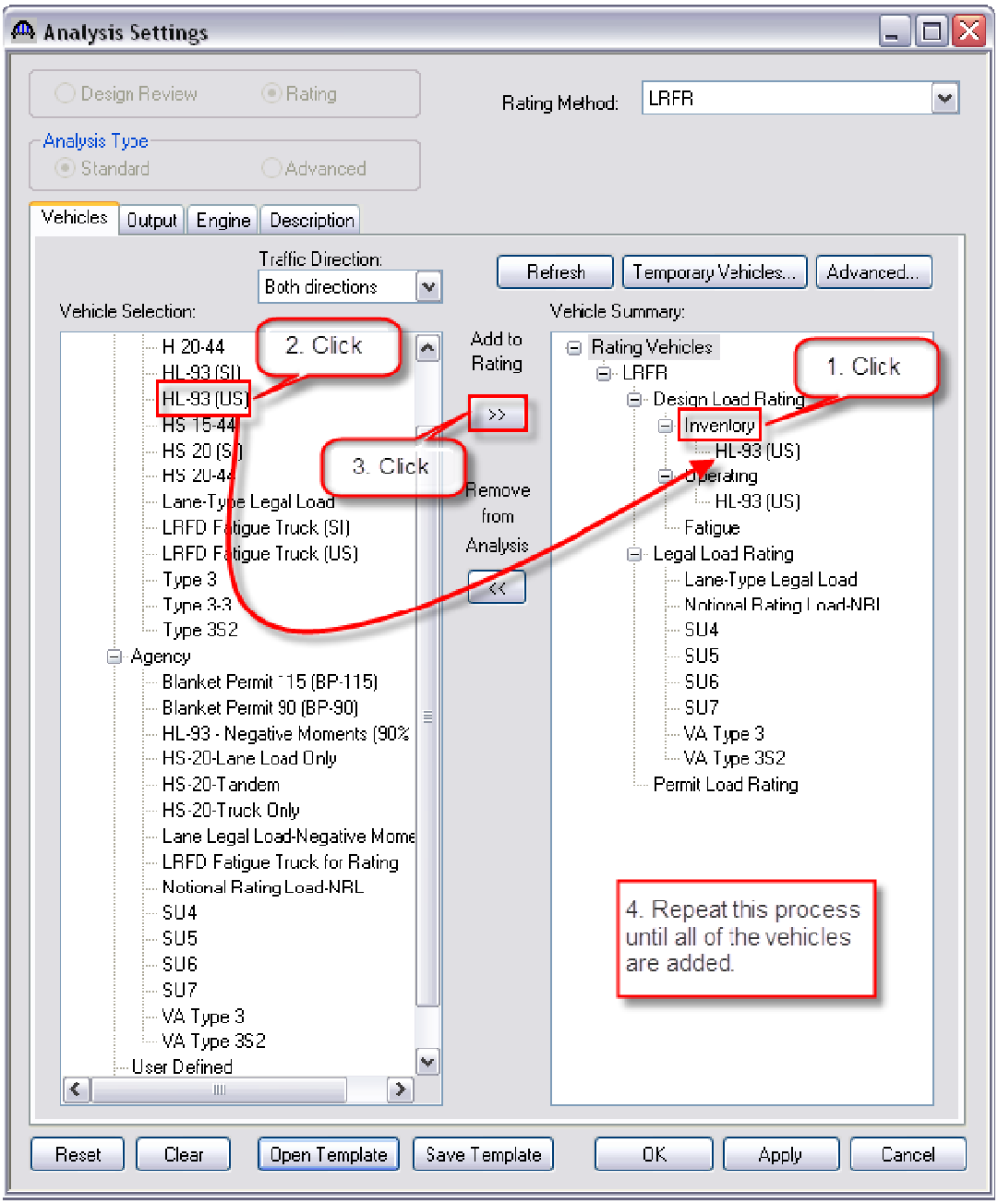
Either select **Open Template** from the database OR create a new template by following these instructions:

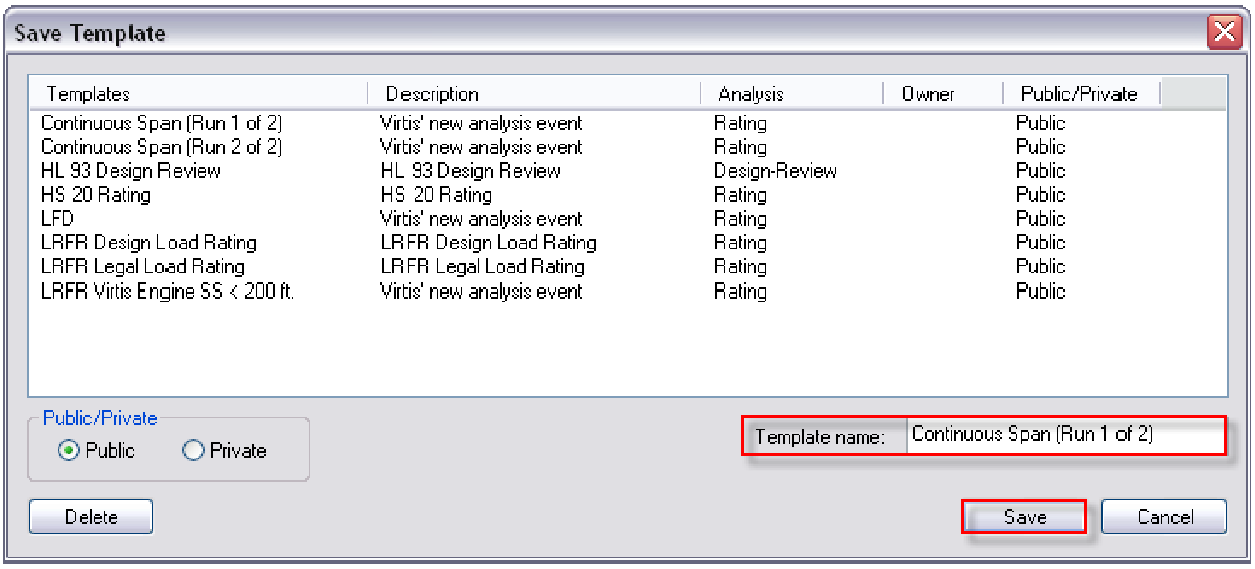
The **Analysis Settings** window will appear. On the **Rating Method** dropdown menu, change the method to **LRFR**.

Add the vehicles shown in the screen shot to the **Vehicle Summary** list.

This is done by first left clicking the destination such as Design Load Rating, Legal Load Rating, and Permit Load Rating in the right column. Then, left click the desired vehicle from the left column and left click the **Add to Rating >>** Button.

Once all vehicles for the LRFR Continuous Span (Run 1 of 2) template have been entered, this can be saved as a Template for future ratings.





Left click the Save Template button.

Template Name: Continuous Span (Run 1 of 2)

Left Click the **Save** button.

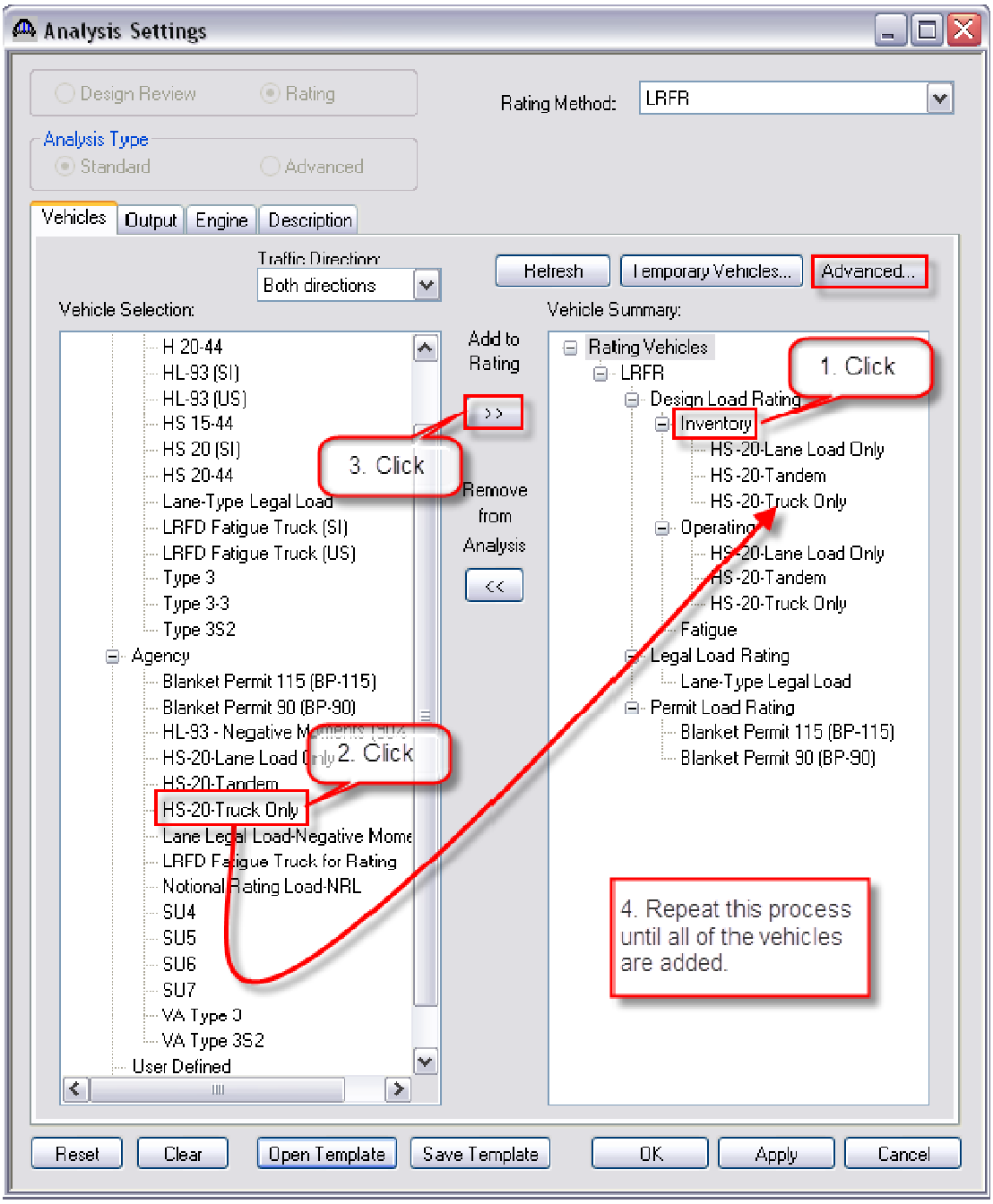
Left click **OK** on the **Analysis Settings** window to accept and close.

NOTE: TO REDUCE THE ANALYSIS TIME AND TO PREVENT ERROR GENERATION DURING THE ANALYSIS, THE LIVE LOAD ANALYSIS FOR CONTINUOUS SPANS IS DIVIDED INTO TWO SEPARATE RUNS.

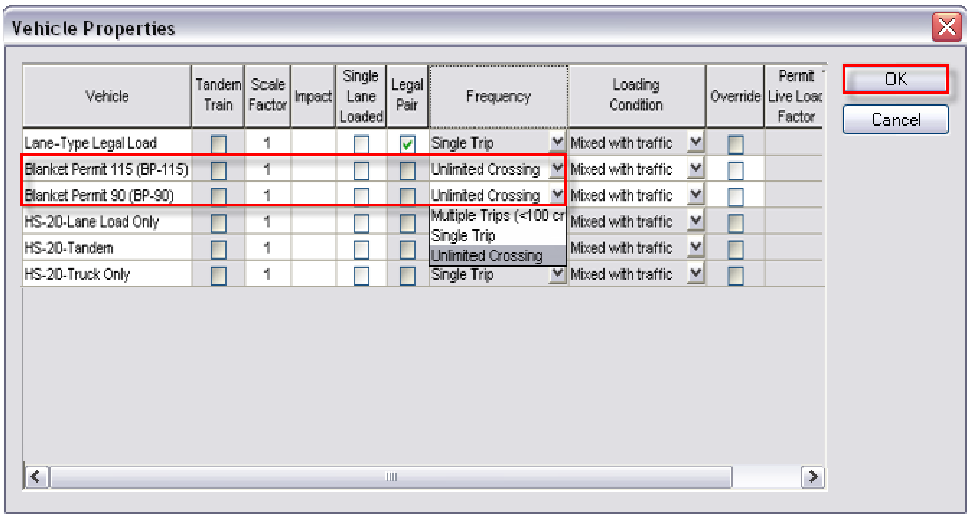
FOLLOW THE DIRECTIONS BELOW TO CREATE THE SECOND RUN.

Add the vehicles shown in the screen shot to the **Vehicle Summary** list.

This is done by first left clicking the destination such as Design Load Rating, Legal Load Rating, and Permit Load Rating in the right column. Then, left click the desired vehicle from the left column and left click the **Add to Rating >>** Button.



Once all vehicles for the LRFR Continuous Span (Run 2 of 2) template have been entered, left click the **Advanced** button above the right column.

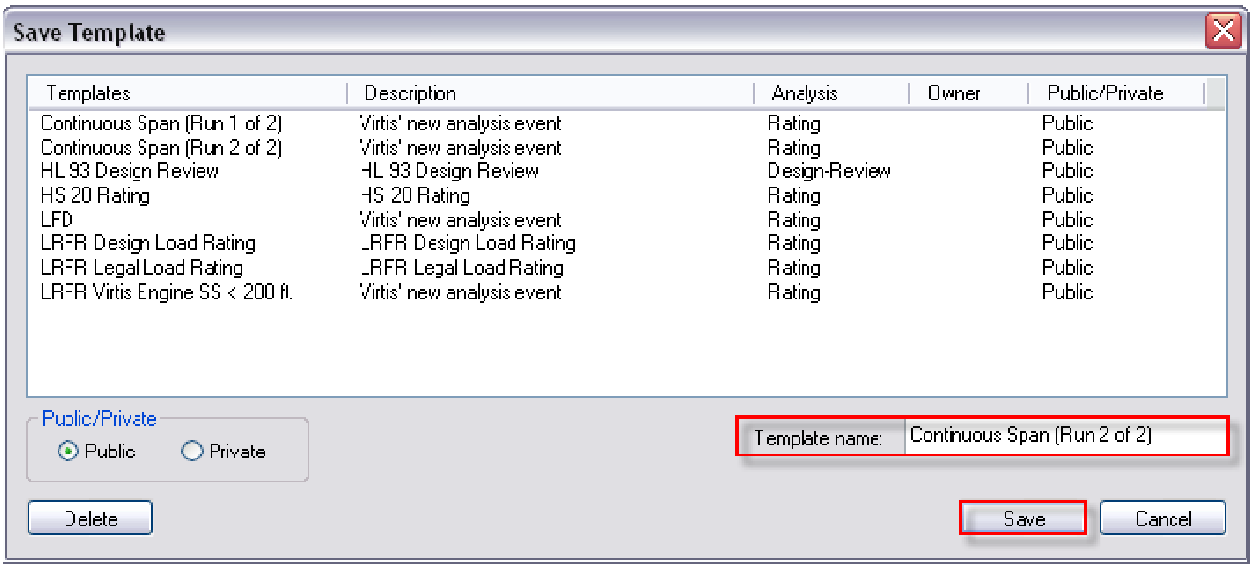


For the Lane-Type Legal Load, left click the Legal Pair box.

For the two Blanket Permit vehicles, change the **Frequency** to **Unlimited Crossings**.

Left click **OK** to accept and close.

Once complete, this can be saved as a Template for future ratings. Left click the **Save Template** button.

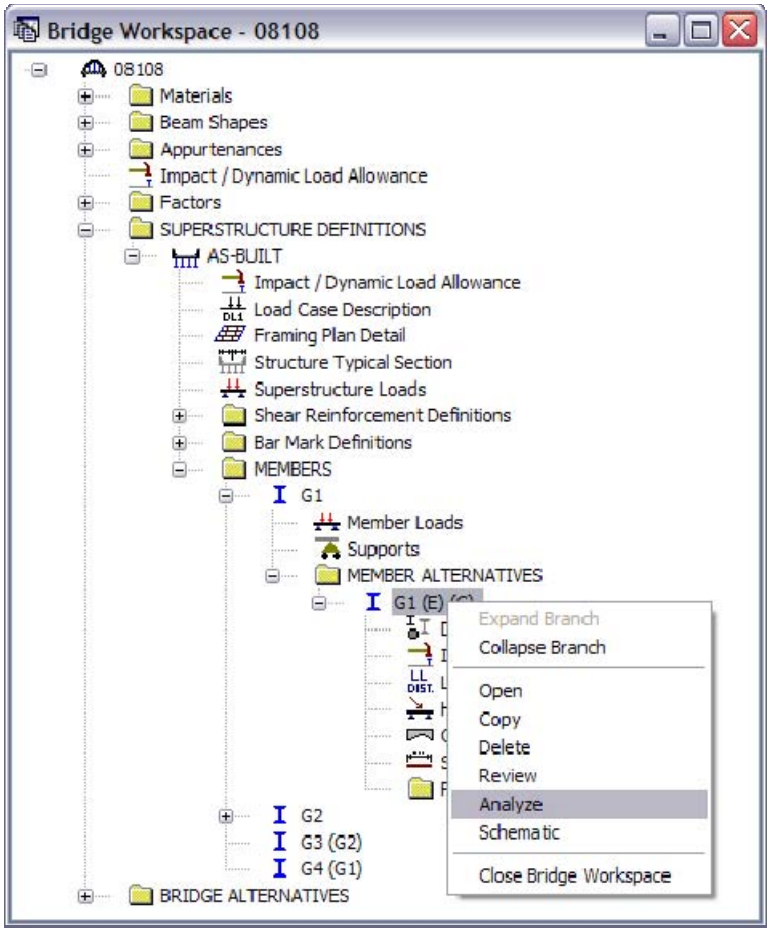


Template Name: Continuous Span (Run 2 of 2)

Left Click the **Save** button.

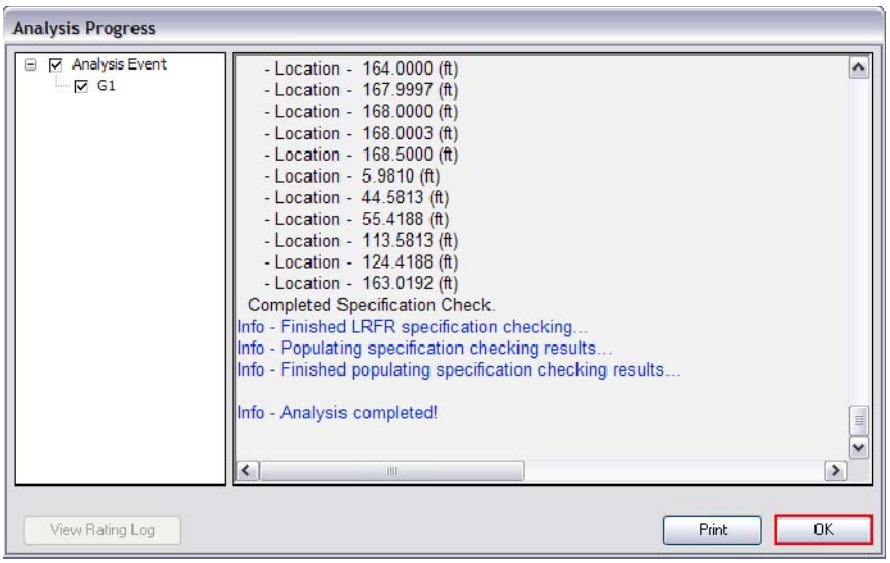
Left click **OK** on the **Analysis Settings** window to accept and close.

ANALYZE MEMBER



Once the Analysis Settings have been set, to analyze a specific member, right click the desired **MEMBER ALTERNATIVE** and select **Analyze**.

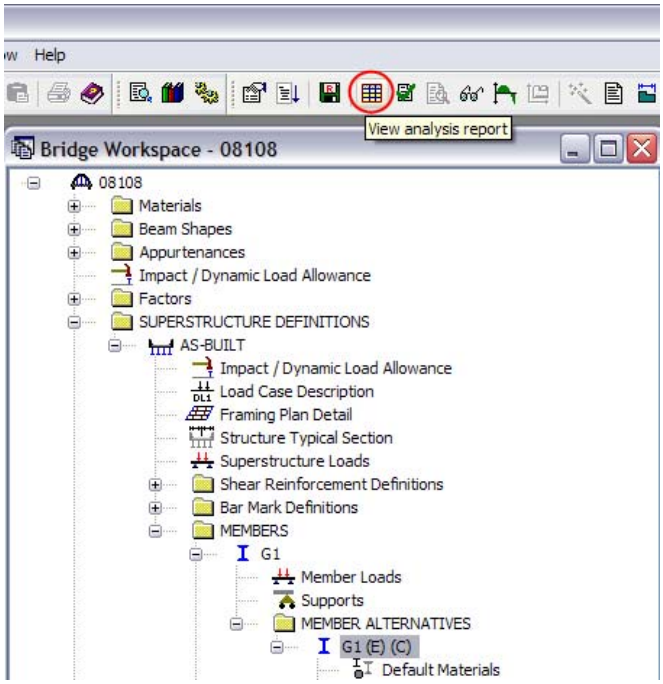
Note: Left click the **View Analysis Settings** icon and open the "Continuous Span (Run 1 of 2)" template prior to running the analysis.



Allow the program to analyze the beam.

After the analysis is completed, the user can read any warnings or errors by scrolling up the **Analysis Progress** window.

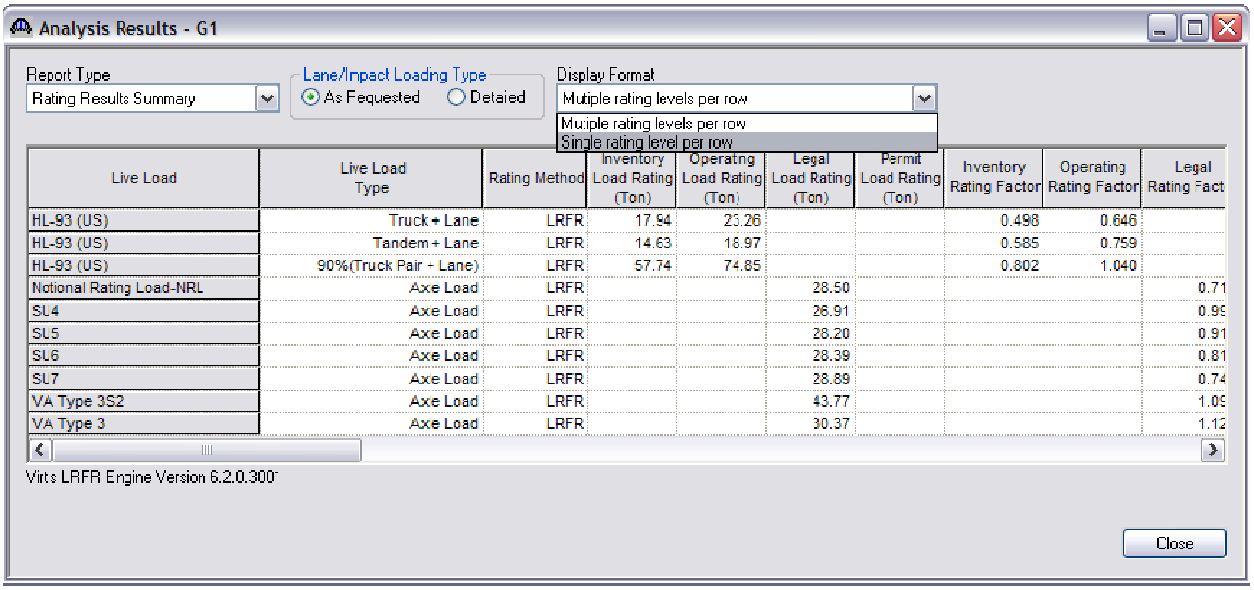
Click **OK** to proceed to view results.

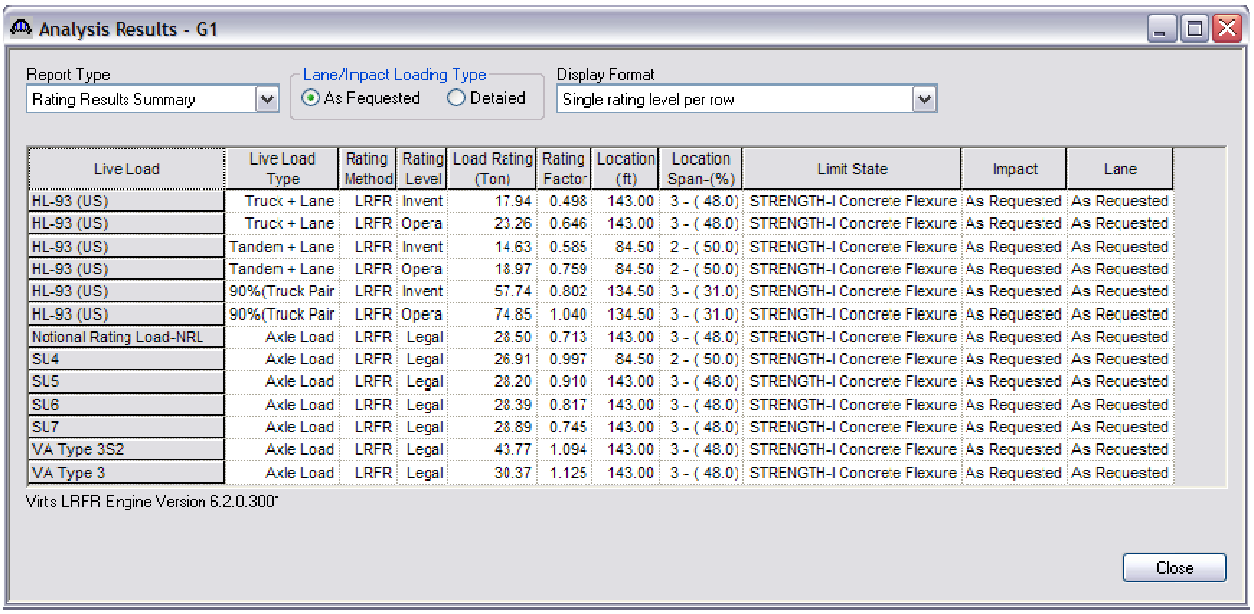


To view the results keep the analyzed **MEMBER ALTERNATIVE** selected.

Left click the **View Analysis Report** icon.

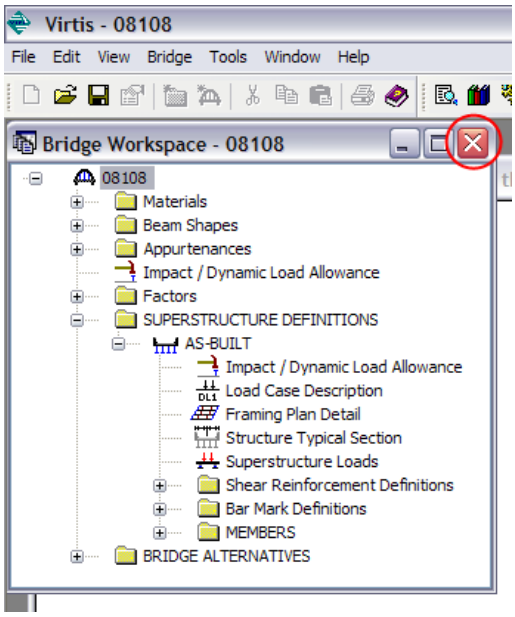
The **Analysis Results** window will appear. To view a more compact version of the results, select **Single rating level per row** under the Display Format Window drop down menu.





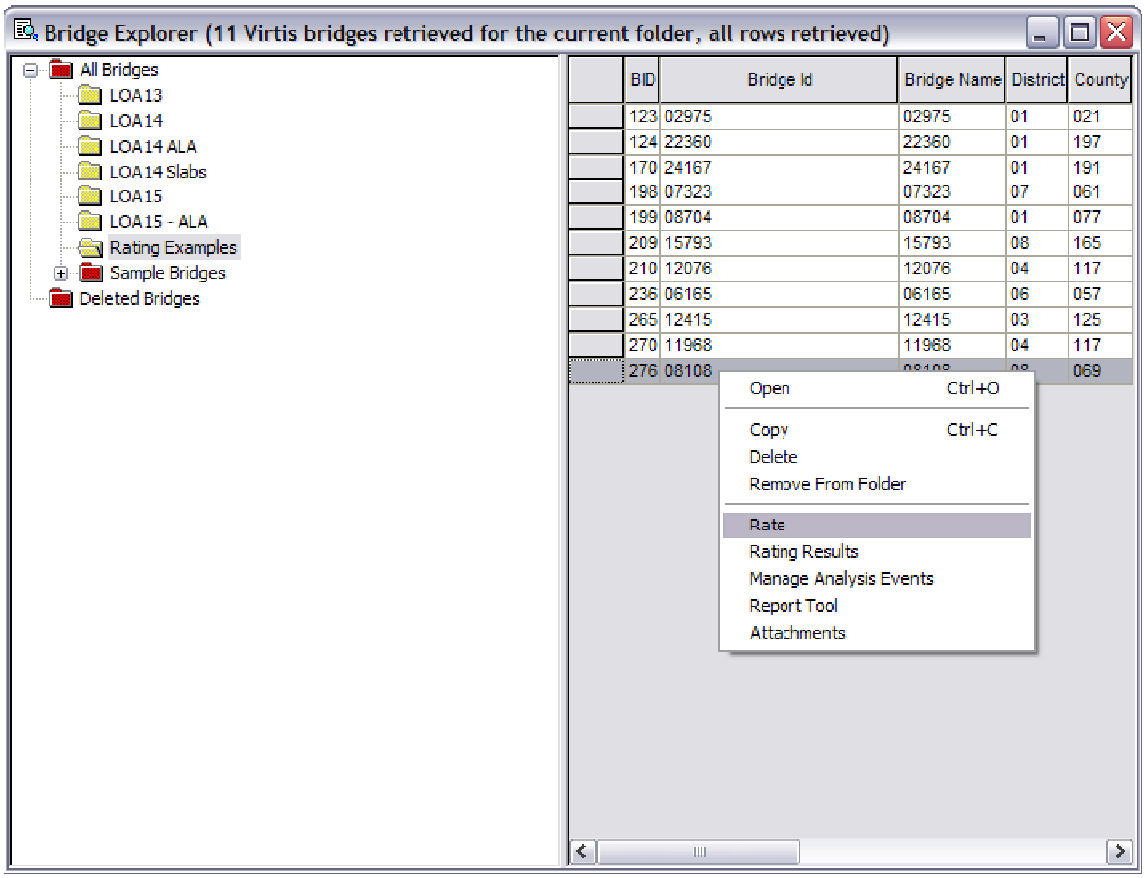
Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Limit State	Impact	Lane
HL-93 (US)	Truck + Lane	LRFR	Invent	17.94	0.498	143.00	3 - (48.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
HL-93 (US)	Truck + Lane	LRFR	Opera	23.26	0.646	143.00	3 - (48.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
HL-93 (US)	Tandem + Lane	LRFR	Invent	14.63	0.585	84.50	2 - (50.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
HL-93 (US)	Tandem + Lane	LRFR	Opera	18.97	0.759	84.50	2 - (50.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
HL-93 (US)	90%(Truck Pair	LRFR	Invent	57.74	0.802	134.50	3 - (31.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
HL-93 (US)	90%(Truck Pair	LRFR	Opera	74.85	1.040	134.50	3 - (31.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
Notional Rating Load-NRL	Axle Load	LRFR	Legal	28.50	0.713	143.00	3 - (48.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
SL4	Axle Load	LRFR	Legal	26.91	0.997	84.50	2 - (50.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
SL5	Axle Load	LRFR	Legal	28.20	0.910	143.00	3 - (48.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
SL6	Axle Load	LRFR	Legal	28.39	0.817	143.00	3 - (48.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
SL7	Axle Load	LRFR	Legal	28.89	0.745	143.00	3 - (48.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
VA Type 3S2	Axle Load	LRFR	Legal	43.77	1.094	143.00	3 - (48.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested
VA Type 3	Axle Load	LRFR	Legal	30.37	1.125	143.00	3 - (48.0)	STRENGTH-I Concrete Flexure	As Requested	As Requested

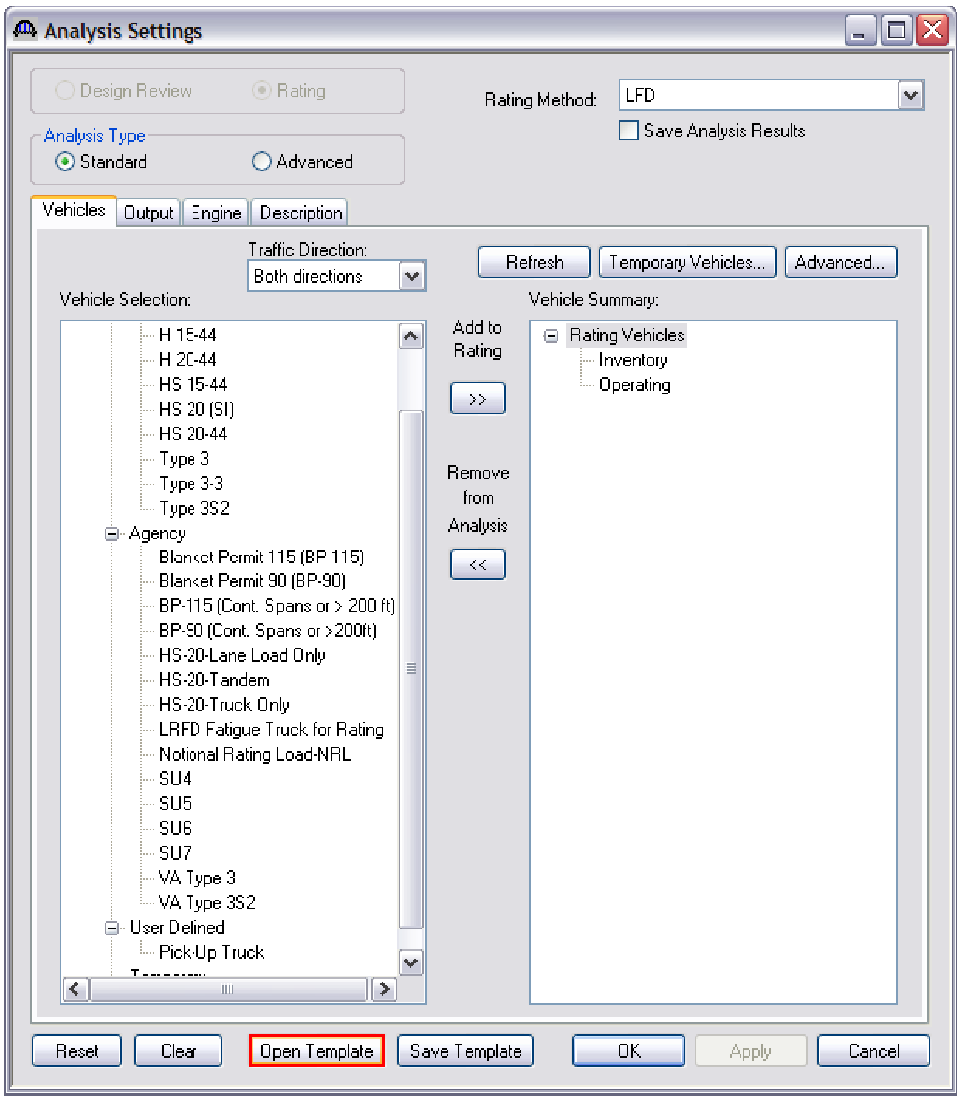
ANALYZE FILE FROM BRIDGE EXPLORER



To analyze the entire file at once, first **Save** and then **Close** the bridge.

In the **Bridge Explorer** window, select the bridge, right click, and select **Rate**.

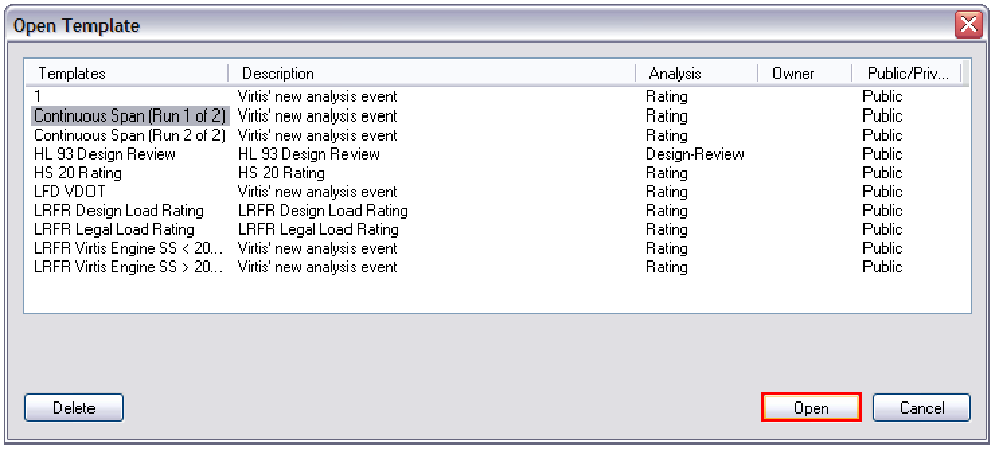




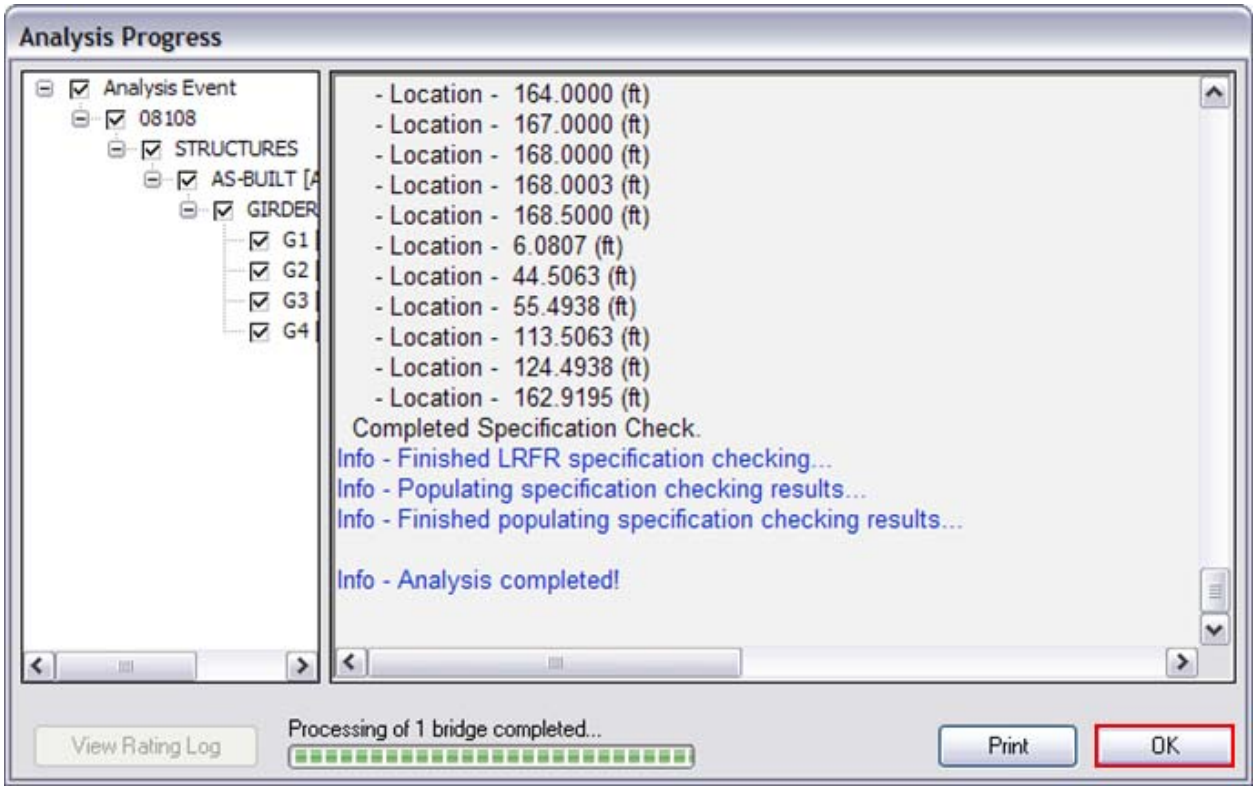
The **Analysis Settings** window will appear.

Left click the **Open Template** button or create the vehicle summary by following the steps previously explained.

Left click **Continuous Span (Run 1 of 2)** and left click the **Open** button.



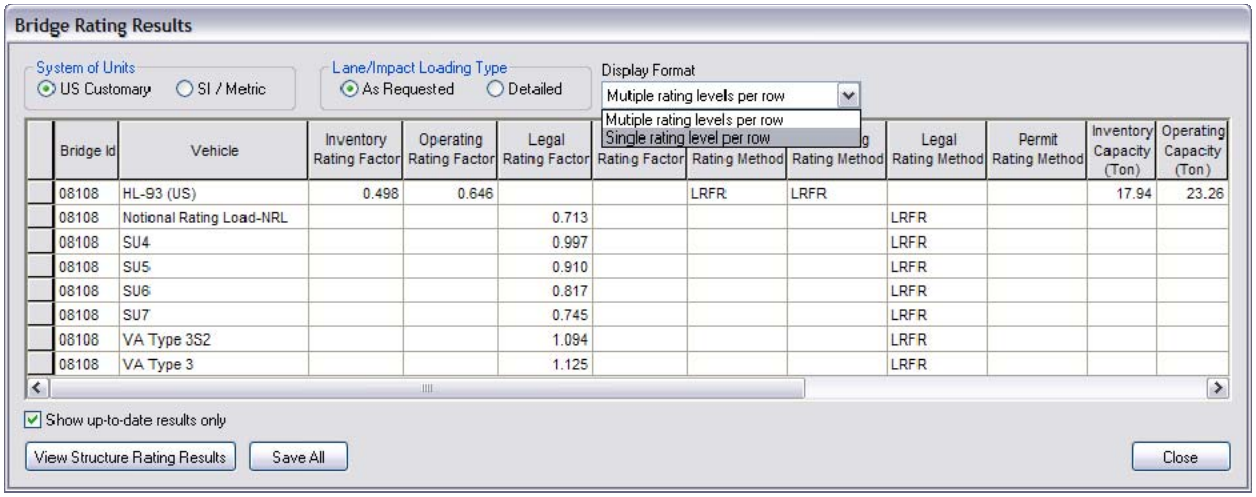
Left click **OK** to accept the template and rate.



Allow the bridge to run. Once the analysis is completed, the user can read any warnings or errors by scrolling up on the **Analysis Progress** window.

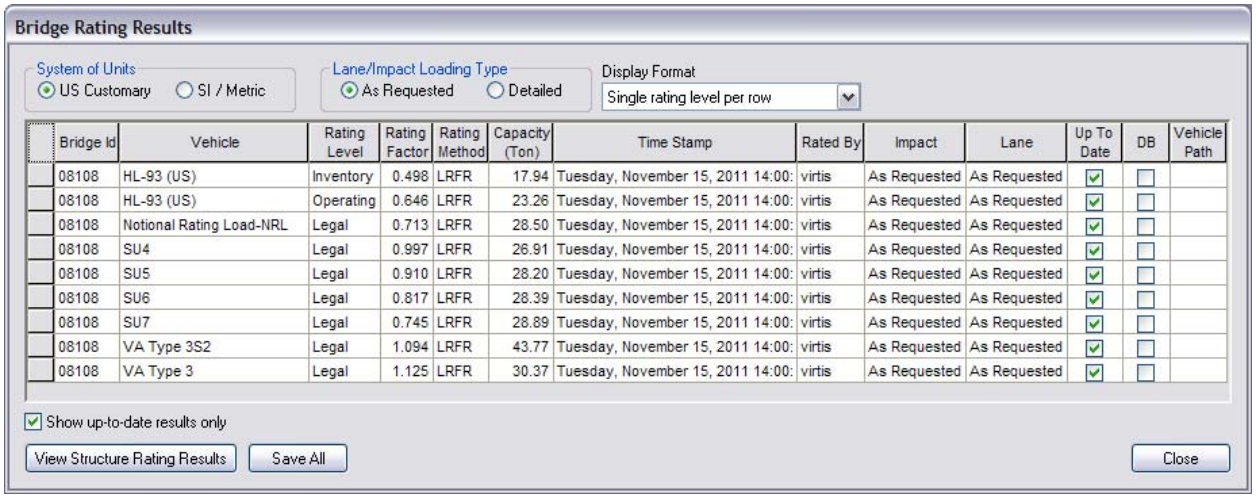
Left click **OK** to view results.

The **Bridge Rating Results** window will appear. To view a more compact set of results, select **Single Rating Level per Row**.



FINAL STRUCTURE RATINGS

Continuous Span (Run 1 of 2)



Bridge Rating Results

System of Units: (•) US Customary ( ) SI / Metric

Lane/Impact Loading Type: (•) As Requested ( ) Detailed

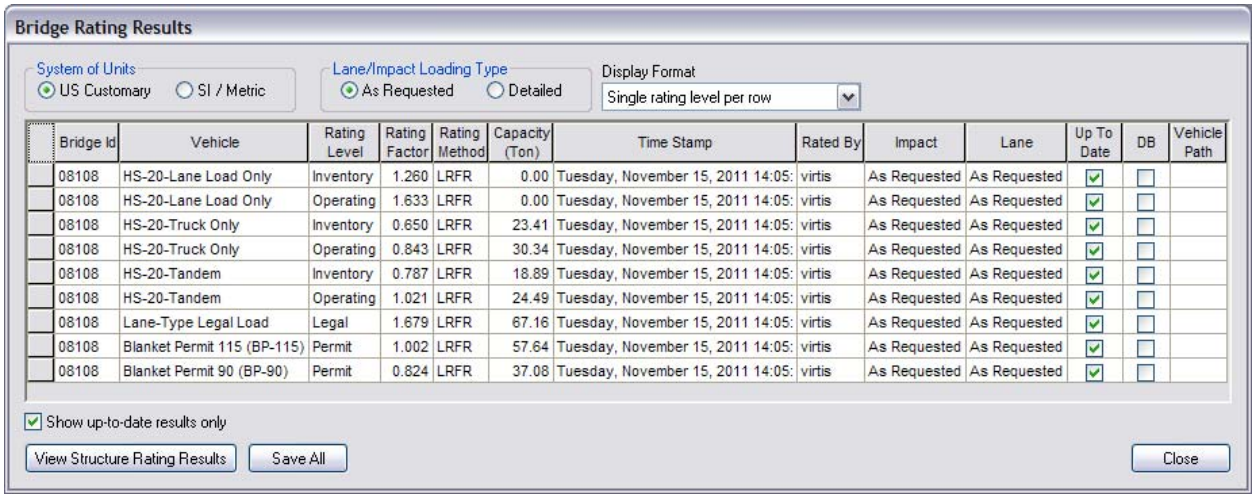
Display Format: Single rating level per row

Bridge Id	Vehicle	Rating Level	Rating Factor	Rating Method	Capacity (Ton)	Time Stamp	Rated By	Impact	Lane	Up To Date	DB	Vehicle Path
08108	HL-93 (US)	Inventory	0.498	LRFR	17.94	Tuesday, November 15, 2011 14:00:	virtis	As Requested	As Requested	☑	☐	
08108	HL-93 (US)	Operating	0.646	LRFR	23.26	Tuesday, November 15, 2011 14:00:	virtis	As Requested	As Requested	☑	☐	
08108	Notional Rating Load-NRL	Legal	0.713	LRFR	28.50	Tuesday, November 15, 2011 14:00:	virtis	As Requested	As Requested	☑	☐	
08108	SU4	Legal	0.997	LRFR	26.91	Tuesday, November 15, 2011 14:00:	virtis	As Requested	As Requested	☑	☐	
08108	SU5	Legal	0.910	LRFR	28.20	Tuesday, November 15, 2011 14:00:	virtis	As Requested	As Requested	☑	☐	
08108	SU6	Legal	0.817	LRFR	28.39	Tuesday, November 15, 2011 14:00:	virtis	As Requested	As Requested	☑	☐	
08108	SU7	Legal	0.745	LRFR	28.89	Tuesday, November 15, 2011 14:00:	virtis	As Requested	As Requested	☑	☐	
08108	VA Type 3S2	Legal	1.094	LRFR	43.77	Tuesday, November 15, 2011 14:00:	virtis	As Requested	As Requested	☑	☐	
08108	VA Type 3	Legal	1.125	LRFR	30.37	Tuesday, November 15, 2011 14:00:	virtis	As Requested	As Requested	☑	☐	

☑ Show up-to-date results only

View Structure Rating Results | Save All | Close

Continuous Span (Run 2 of 2)



Bridge Rating Results

System of Units: (•) US Customary ( ) SI / Metric

Lane/Impact Loading Type: (•) As Requested ( ) Detailed

Display Format: Single rating level per row

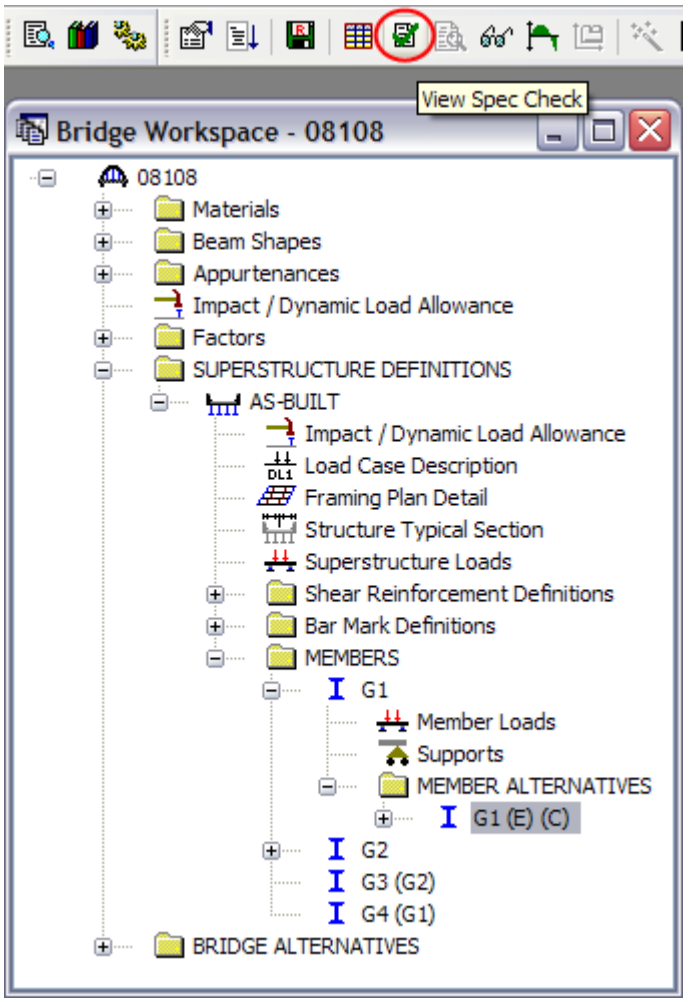
Bridge Id	Vehicle	Rating Level	Rating Factor	Rating Method	Capacity (Ton)	Time Stamp	Rated By	Impact	Lane	Up To Date	DB	Vehicle Path
08108	HS-20-Lane Load Only	Inventory	1.260	LRFR	0.00	Tuesday, November 15, 2011 14:05:	virtis	As Requested	As Requested	☑	☐	
08108	HS-20-Lane Load Only	Operating	1.633	LRFR	0.00	Tuesday, November 15, 2011 14:05:	virtis	As Requested	As Requested	☑	☐	
08108	HS-20-Truck Only	Inventory	0.650	LRFR	23.41	Tuesday, November 15, 2011 14:05:	virtis	As Requested	As Requested	☑	☐	
08108	HS-20-Truck Only	Operating	0.843	LRFR	30.34	Tuesday, November 15, 2011 14:05:	virtis	As Requested	As Requested	☑	☐	
08108	HS-20-Tandem	Inventory	0.787	LRFR	18.89	Tuesday, November 15, 2011 14:05:	virtis	As Requested	As Requested	☑	☐	
08108	HS-20-Tandem	Operating	1.021	LRFR	24.49	Tuesday, November 15, 2011 14:05:	virtis	As Requested	As Requested	☑	☐	
08108	Lane-Type Legal Load	Legal	1.679	LRFR	67.16	Tuesday, November 15, 2011 14:05:	virtis	As Requested	As Requested	☑	☐	
08108	Blanket Permit 115 (BP-115)	Permit	1.002	LRFR	57.64	Tuesday, November 15, 2011 14:05:	virtis	As Requested	As Requested	☑	☐	
08108	Blanket Permit 90 (BP-90)	Permit	0.824	LRFR	37.08	Tuesday, November 15, 2011 14:05:	virtis	As Requested	As Requested	☑	☐	

☑ Show up-to-date results only

View Structure Rating Results | Save All | Close

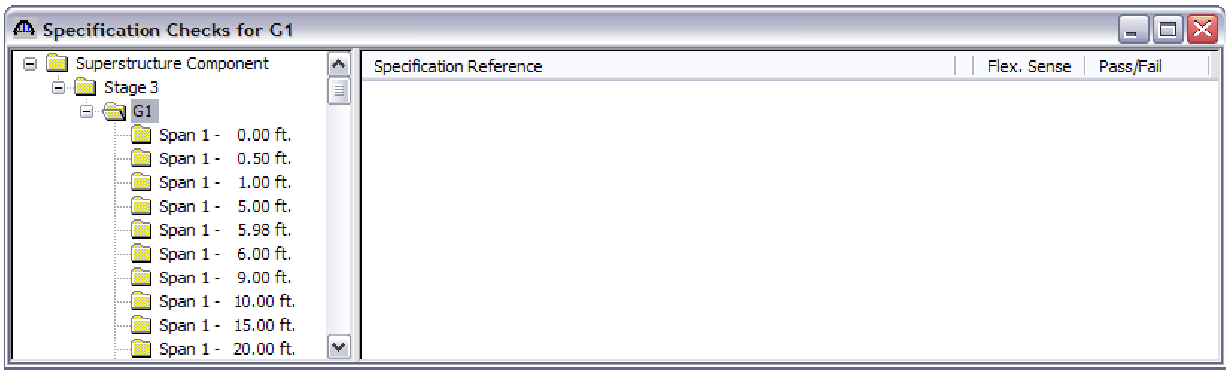
REVIEWING SPECIFICATION CHECKS AND RATING FACTORS

To review the specification checks and to find the rating factors follow these steps:

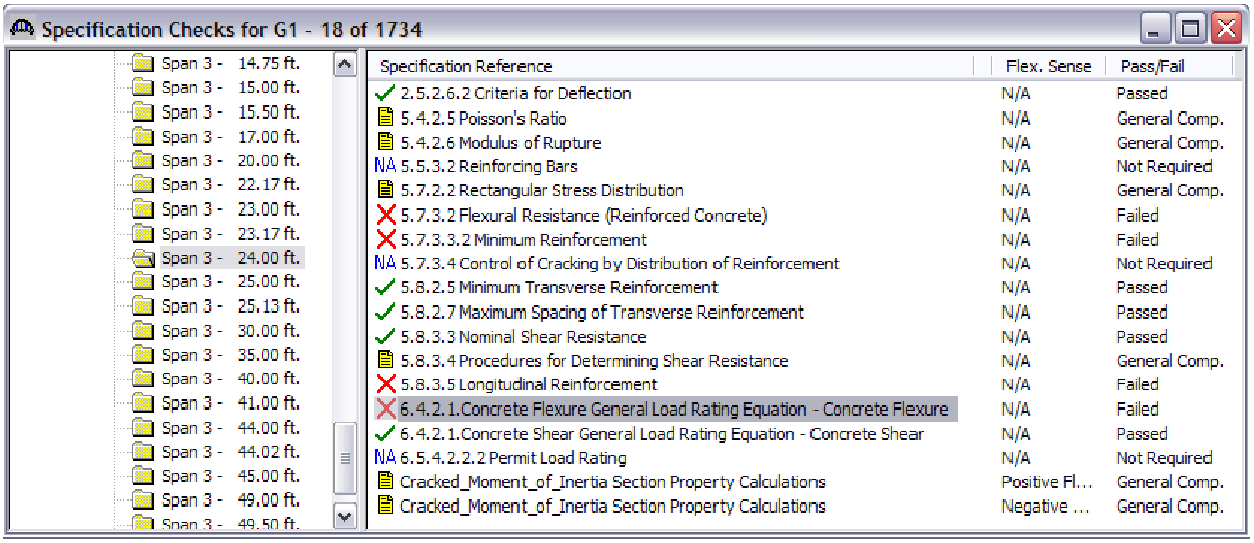


Once the member of interest has been analyzed, highlight the Member Alternative. Left click the **View Spec Check** icon.

Expand the **Superstructure Component** folder. Expand the **Stage 3** folder. Expand the **G1** folder to display the points of analysis for each span.



For this example, the controlling member is G1. One of the controlling locations is in Span 3 at distance 24.00 ft. Scroll down to this location and left click on the associated folder.



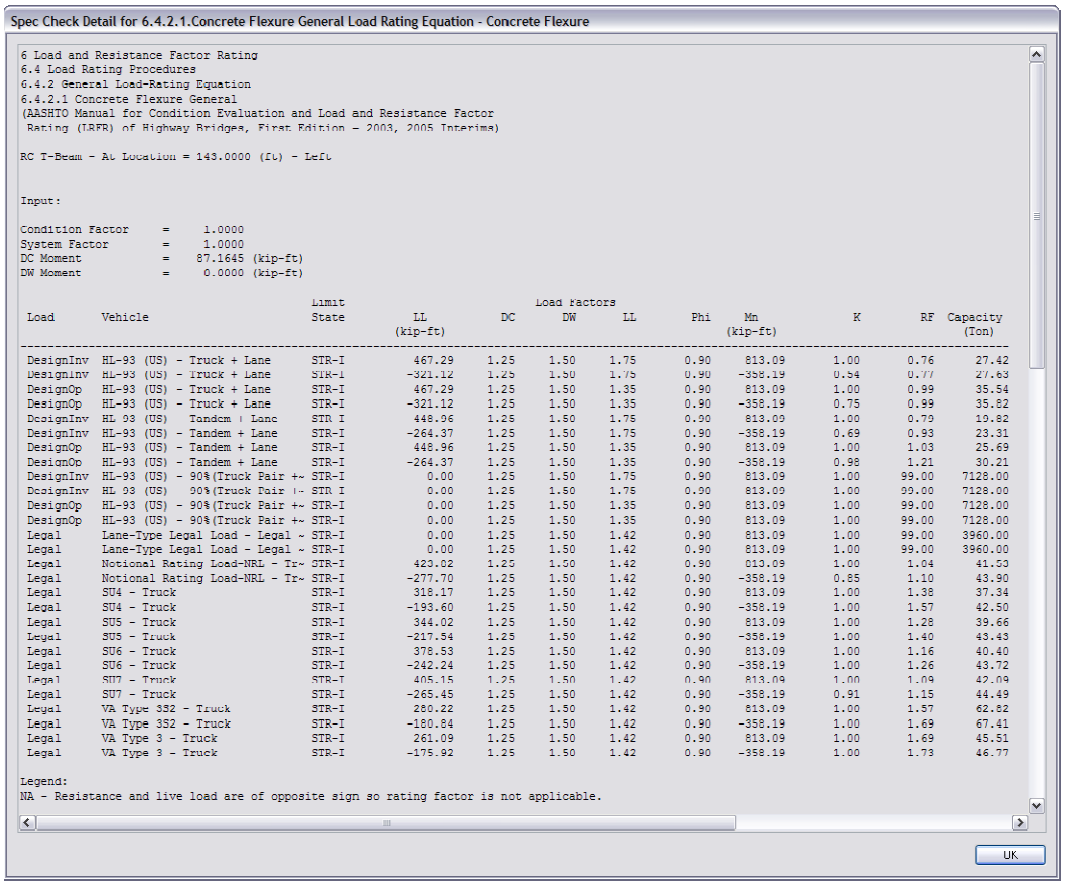
Double click **6.4.2.1 Concrete Flexure General Rating Equation – Concrete Flexure** from the "Specification Reference" column. A new window will appear for this specification check.

The information provided for this specification check looks to the adjacent section to the left and right at this specific location. The ratings for each load and vehicle combination are displayed.

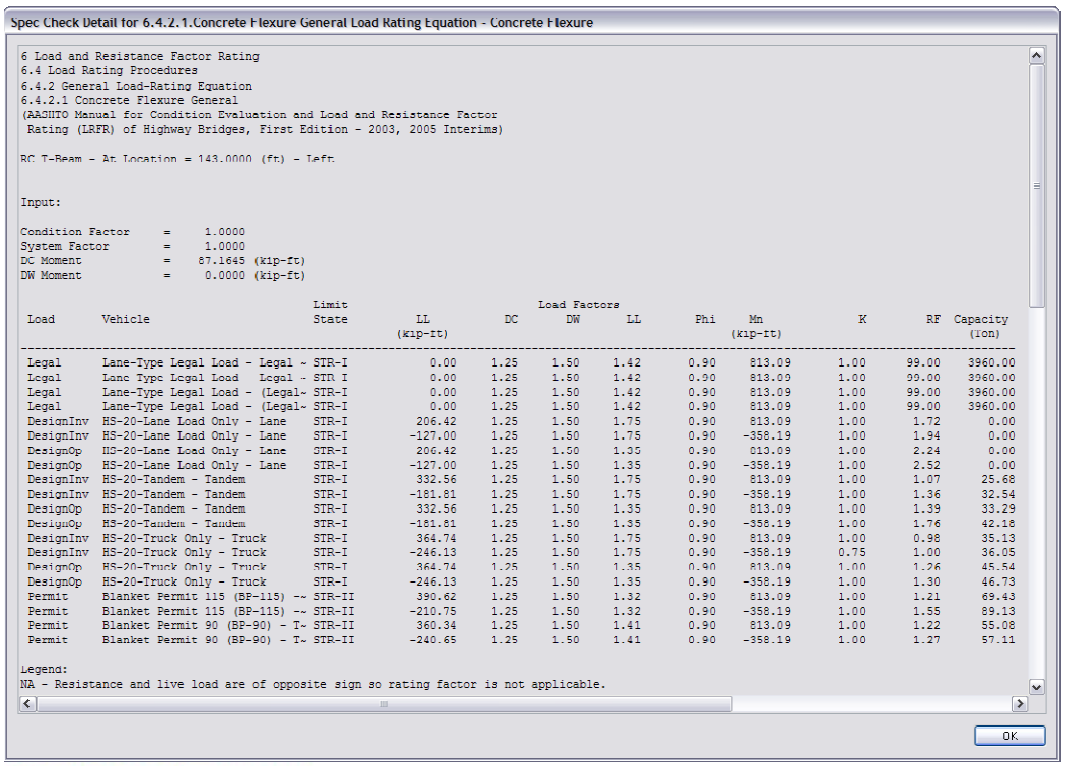
The controlling rating for the section at this specific location is summarized at the bottom for each type of load (Design inventory, Design Operating, Legal Load, Permit Load).

The rating factor and capacity is displayed in the right columns.

Screenshots of this window can be seen below:



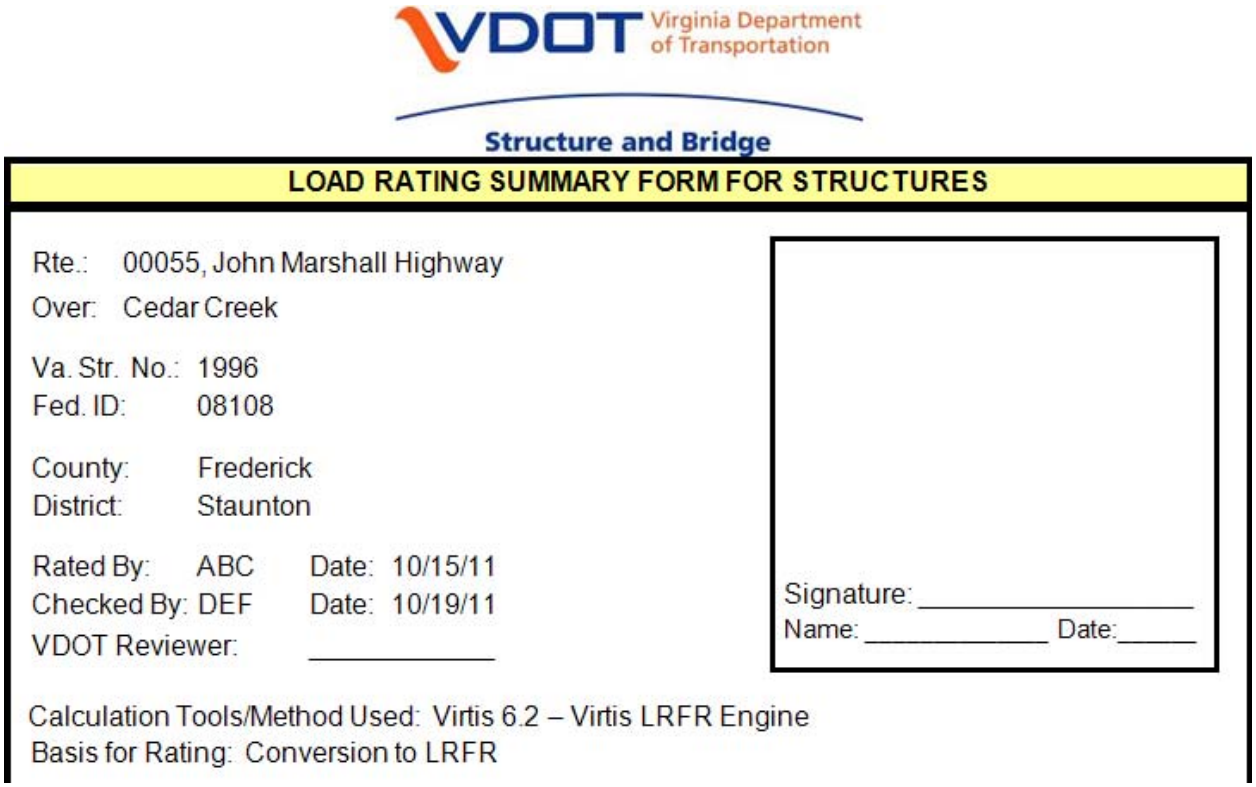
Continuous Span (Run 1 of 2)



Continuous Span (Run 2 of 2)

COMPLETING VDOT LRFR RATING FORM

Complete the information fields at the top portion of rating form. Information can be obtained from the current inspection report for the bridge.



VDOT Virginia Department of Transportation

Structure and Bridge

LOAD RATING SUMMARY FORM FOR STRUCTURES

Rte.: 00055, John Marshall Highway
Over: Cedar Creek

Va. Str. No.: 1996
Fed. ID: 08108

County: Frederick
District: Staunton

Rated By: ABC Date: 10/15/11
Checked By: DEF Date: 10/19/11
VDOT Reviewer: _____

Signature: _____
Name: _____ Date: _____

Calculation Tools/Method Used: Virtis 6.2 – Virtis LRFR Engine
Basis for Rating: Conversion to LRFR

The **VDOT Reviewer** line should be left blank.

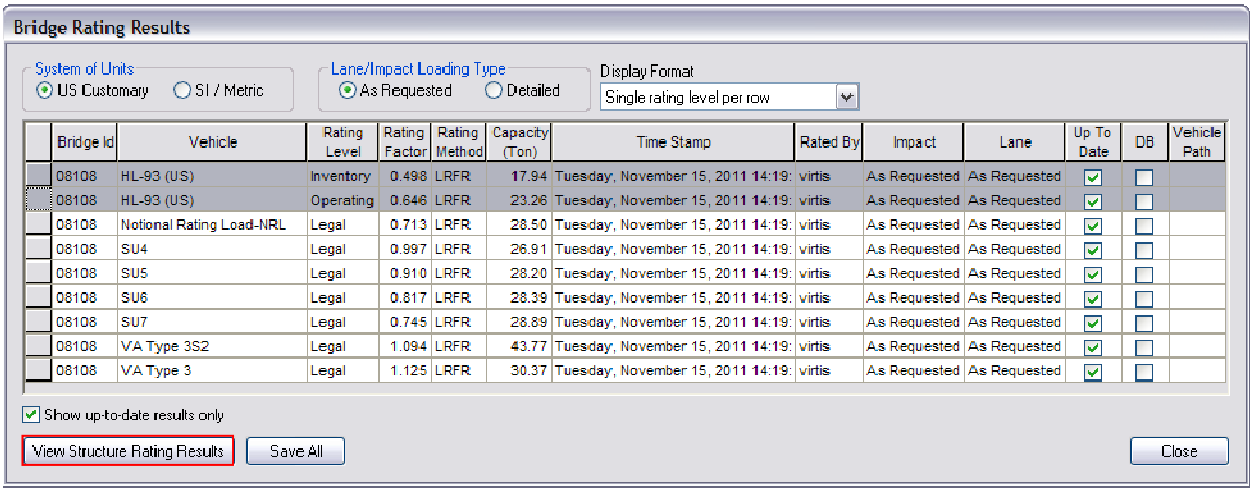
The box in the upper right hand corner of the rating form is for the seal and signature of a professional engineer licensed in the state of Virginia.

DESIGN LOAD: HL-93

Gross Vehicle Weight

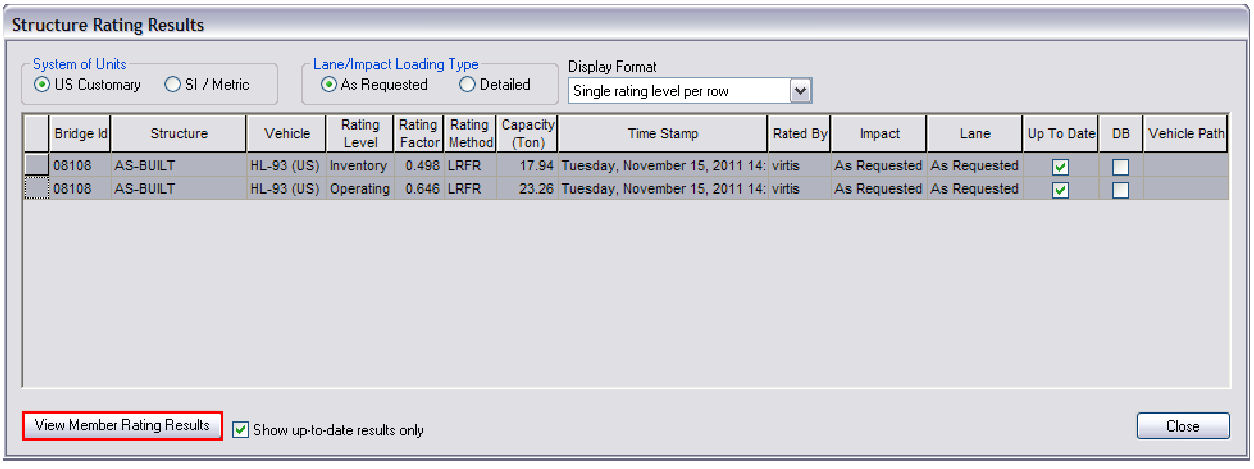
	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
DESIGN LOAD		FACTOR			
***HL-93 (INV)	N/A				
***HL-93 (OPR)	N/A				

To fill out the rating information for the HL-93 vehicle, first highlight the **HL-93 (US) Inventory** and **Operating Rating Level** rows in the **Bridge Rating Results** window.



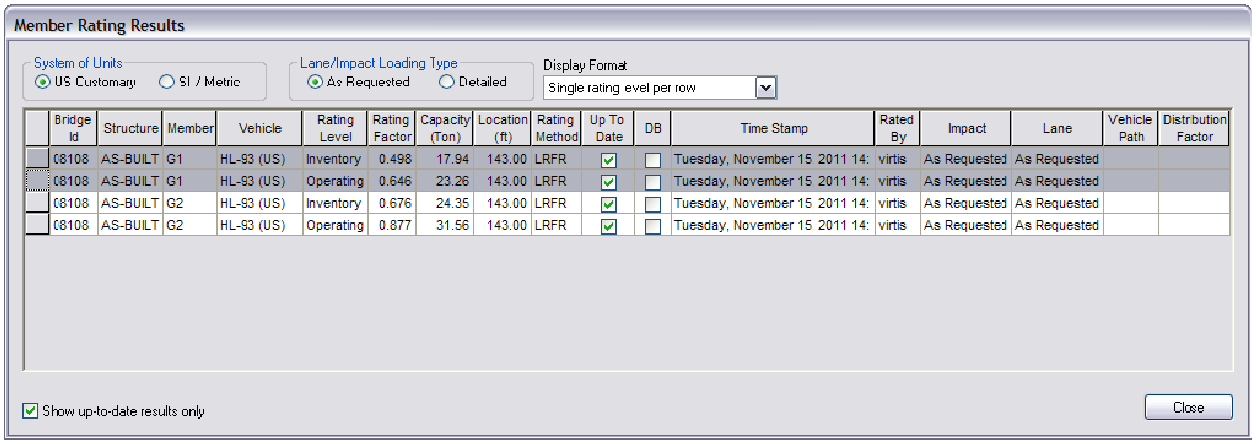
Then, left click the **View Structure Rating Results** button.

The **Structure Rating Results** window will appear. Highlight both the **Inventory** and **Operating Rating Level** rows for **AS-BUILT**.



Left click the **View Member Rating Results** button.

The **Member Rating Results** window will appear.



Since **G1** has lower ratings than **G2**, the rating information for **G1** will be recorded on the rating form. The HL-93 vehicle is the only vehicle without a tonnage since it is a truck load combined with a lane load. The **CONTROLLING FORCE** column will be filled in later.

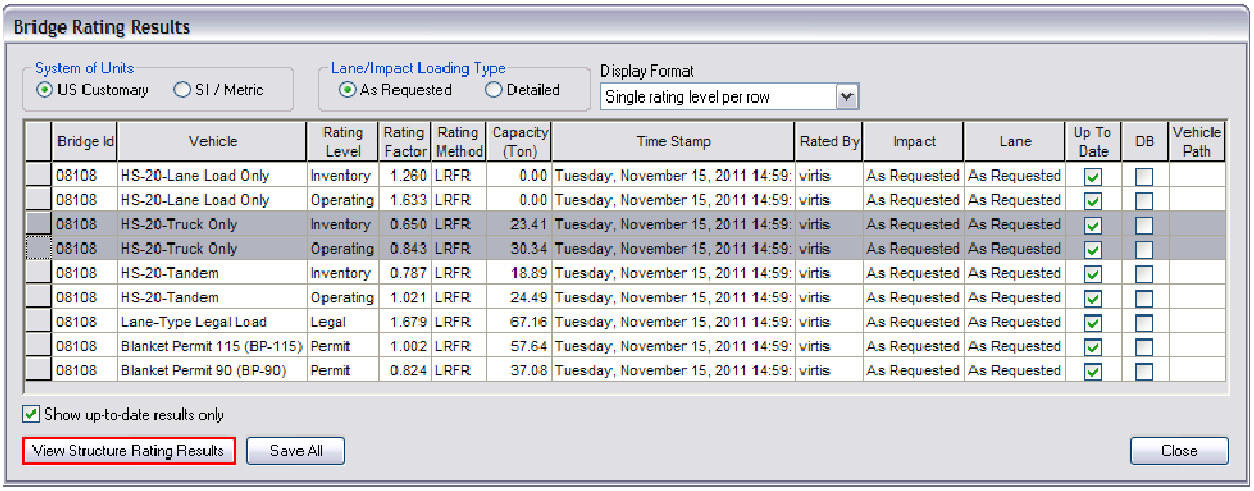
	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
DESIGN LOAD		FACTOR			
***HL-93 (INV)	N/A	0.49	G1	143.00	
***HL-93 (OPR)	N/A	0.64	G1	143.00	

Note: For all results, do not round up. Only record 2 significant digits for the rating factor.

DESIGN LOAD: HS-20

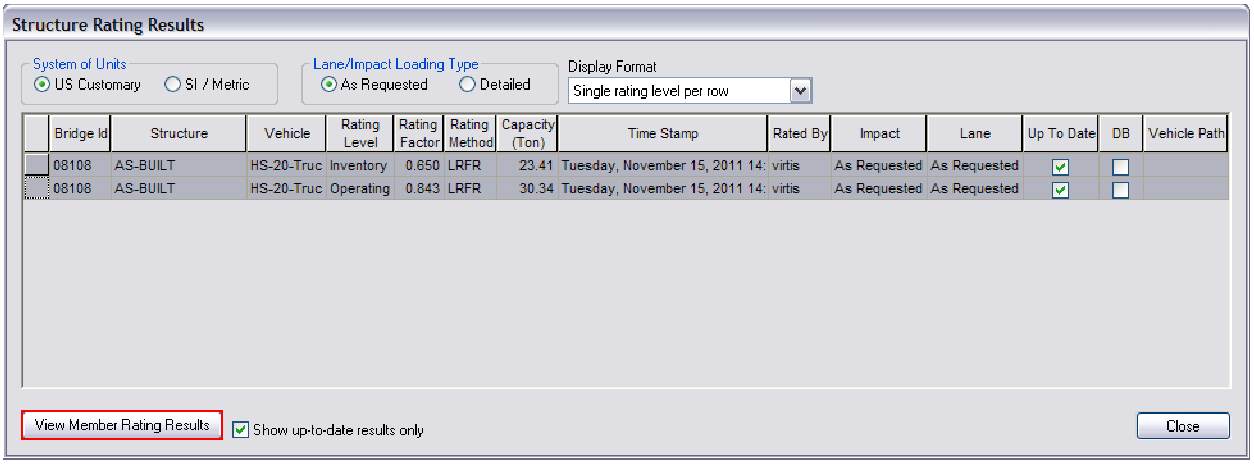
	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
		TONS			
HS-20 (INV)	36				
HS-20 (OPR)	36				

To fill out the rating information for the HS-20 vehicle, first highlight the **HS-20 Truck Only Inventory** and **Operating Rating Level** rows in the **Bridge Rating Results** window. The **HS-20 Lane Load Only** and **HS-20 Tandem** ratings are for informational purposes only and are not included on the rating form.



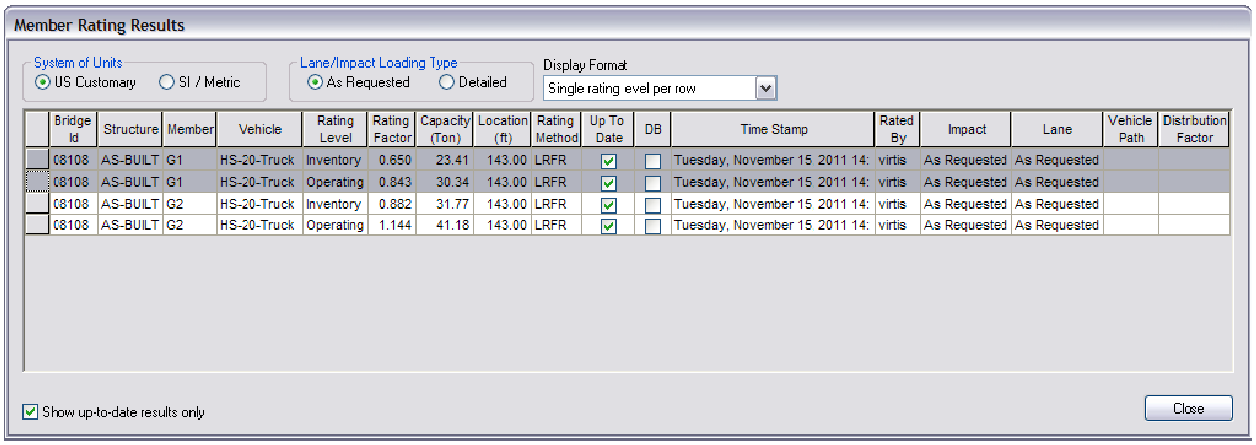
Then, left click the **View Structure Rating Results** button.

The **Structure Rating Results** window will appear. Highlight both the **Inventory** and **Operating Rating Level** rows for **AS-BUILT**.



Left click the **View Member Rating Results** button.

The **Member Rating Results** window will appear.



Since **G1** has lower ratings than **G2**, the rating information for **G1** will be recorded on the rating form. The **CONTROLLING FORCE** column will be filled in later.

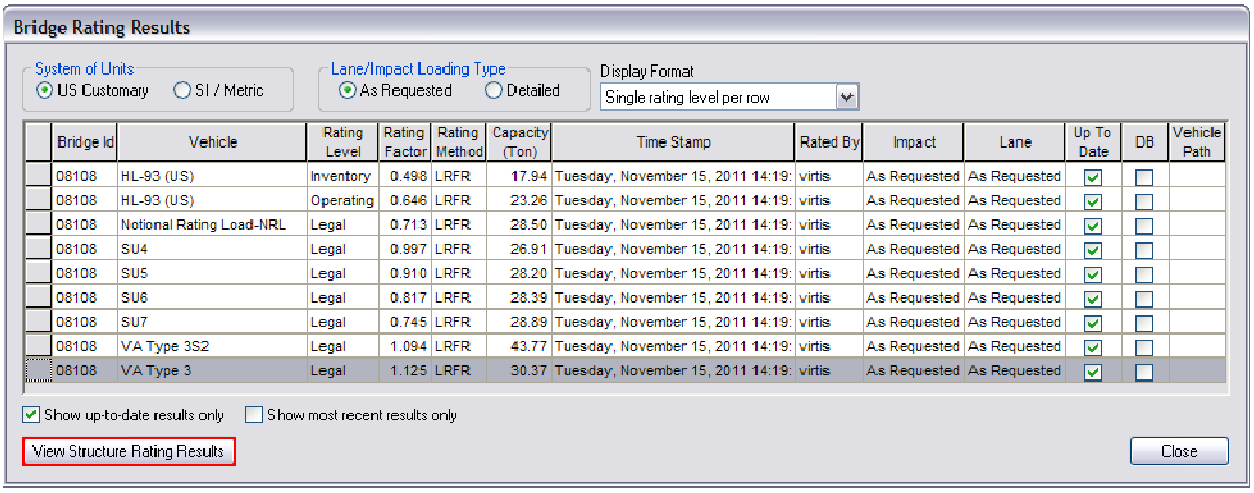
	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
		TONS			
HS-20 (INV)	36	23	G1	143.00	
HS-20 (OPR)	36	30	G1	143.00	

Note: For all tonnages, do not round up. Instead, round down to the nearest ton.

LEGAL LOAD: VA TYPE 3

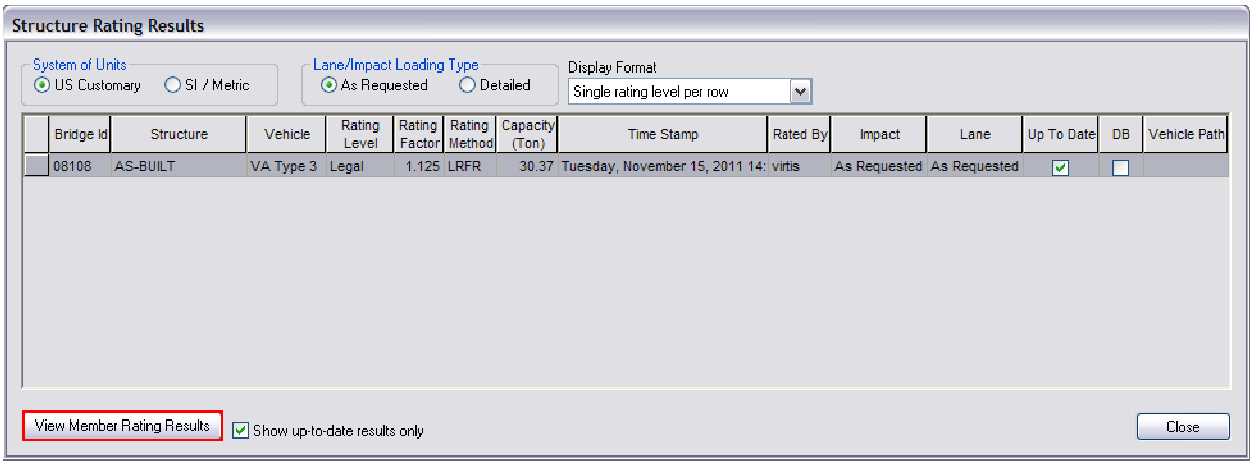
	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
LEGAL LOADS		TONS	**		
VA Type 3	27				
VA Type 3S2	40				
*, ***LANE	40				

To fill out the rating information for the VA-Type 3 vehicle, first highlight the **VA Type 3** row in the **Bridge Rating Results** window.



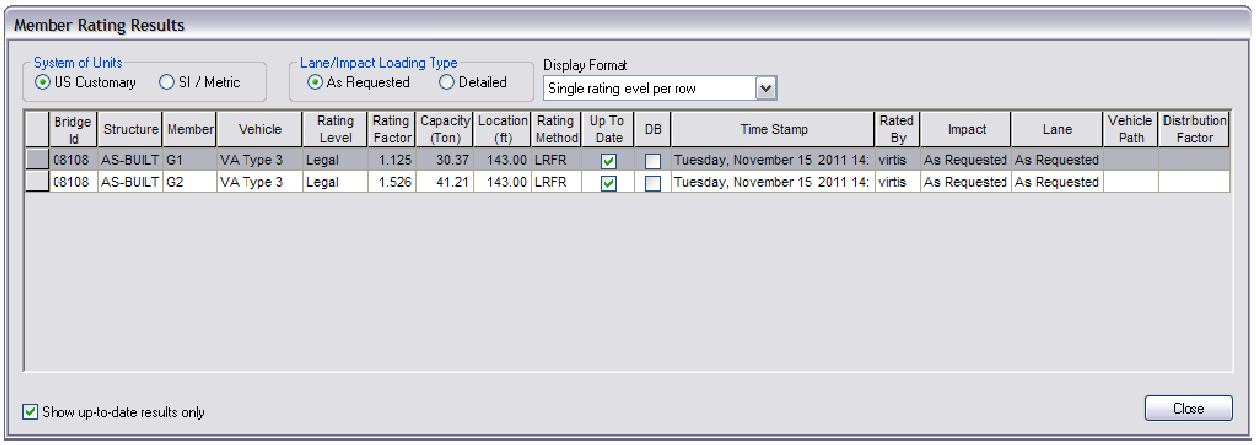
Then, left click the **View Structure Rating Results** button.

The **Structure Rating Results** window will appear. Highlight the row for **AS-BUILT**.



Left click the **View Member Rating Results** button.

The **Member Rating Results** window will appear.



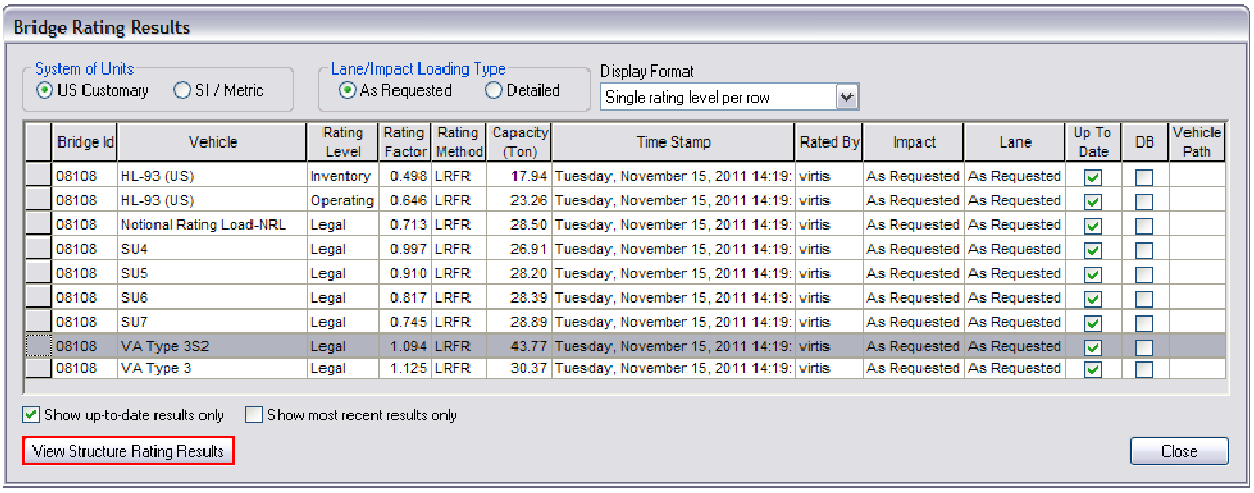
Since **G1** has lower ratings than **G2**, the rating information for **G1** will be recorded on the rating form. The **CONTROLLING FORCE** column will be filled in later.

	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
LEGAL LOADS		TONS	**		
VA Type 3	27	30	G1	143.00	
VA Type 3S2	40				
*, ***LANE	40				

LEGAL LOAD: VA TYPE 3S2

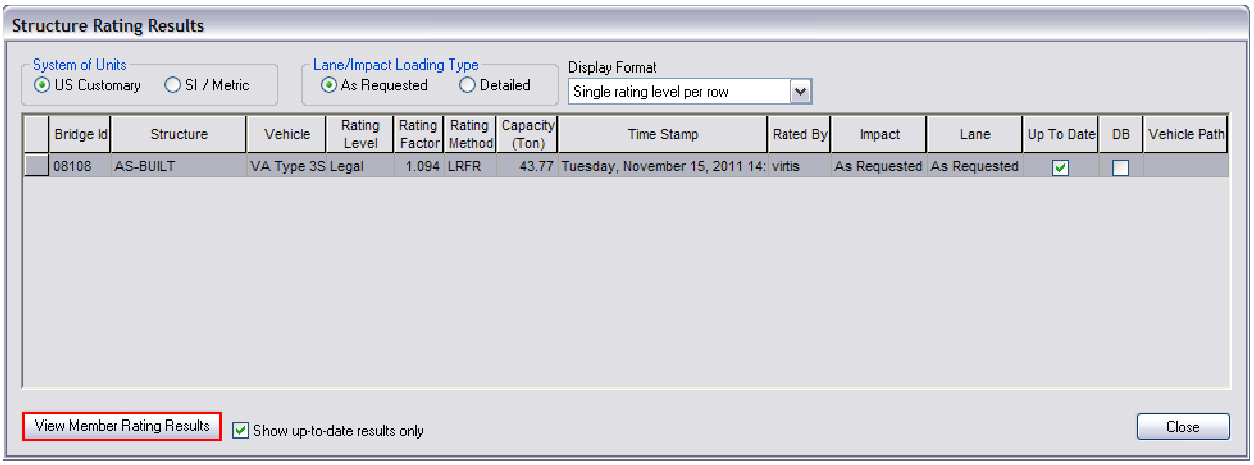
	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
LEGAL LOADS		TONS	**		
VA Type 3	27	30	G1	143.00	
VA Type 3S2	40				
*, ***LANE	40				

To fill out the rating information for the VA-Type 3S2 vehicle, first highlight the **VA Type 3S2** row in the **Bridge Rating Results** window.



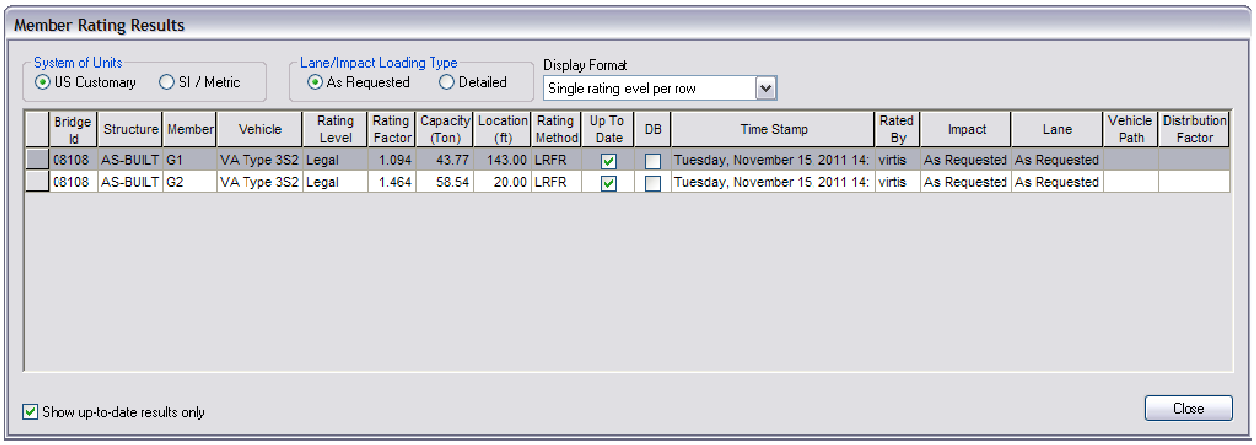
Then, left click the **View Structure Rating Results** button.

The **Structure Rating Results** window will appear. Highlight the row for **AS-BUILT**.



Left click the **View Member Rating Results** button.

The **Member Rating Results** window will appear.



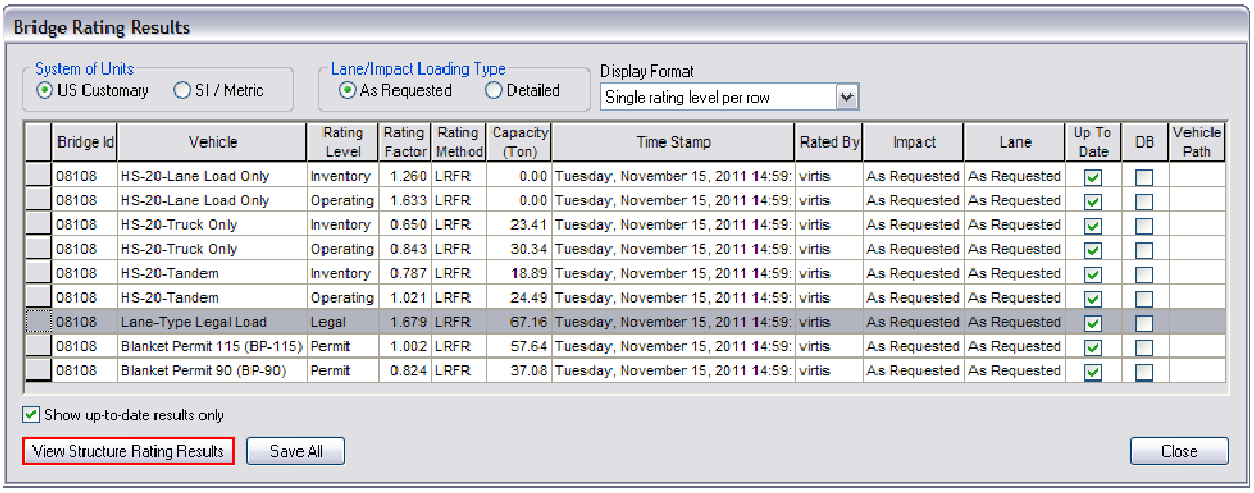
Since **G1** has lower ratings than **G2**, the rating information for **G1** will be recorded on the rating form. The **CONTROLLING FORCE** column will be filled in later.

	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
LEGAL LOADS		TONS	**		
VA Type 3	27	30	G1	143.00	
VA Type 3S2	40	43	G1	143.00	
*, ***LANE	40				

LEGAL LOAD: LANE

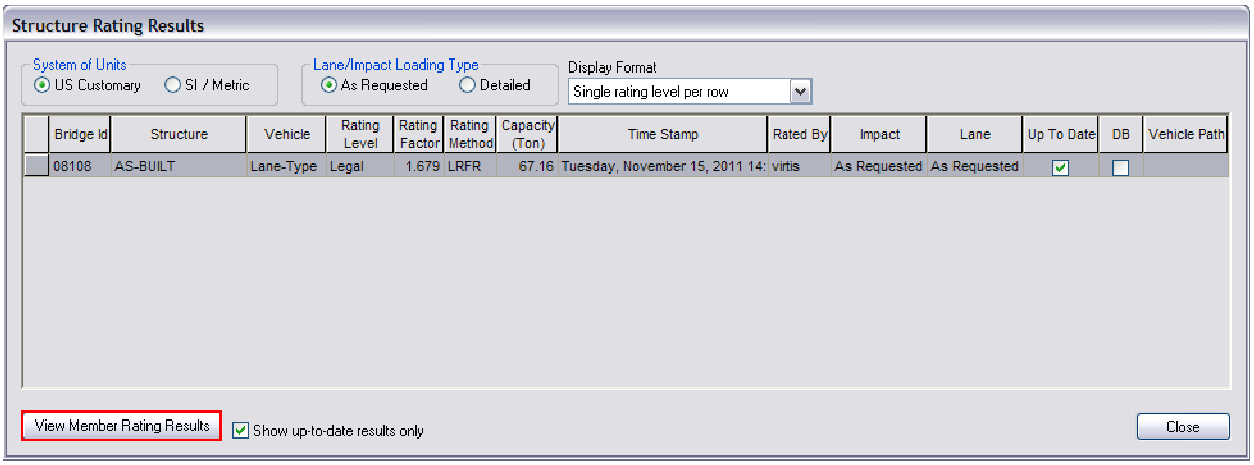
	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
LEGAL LOADS		TONS	**		
VA Type 3	27	30	G1	143.00	
VA Type 3S2	40	43	G1	143.00	
*, ***LANE	40				

To fill out the rating information for the Lane-Type Legal Load vehicle, first highlight the **Lane-Type Legal Load** row in the **Bridge Rating Results** window.



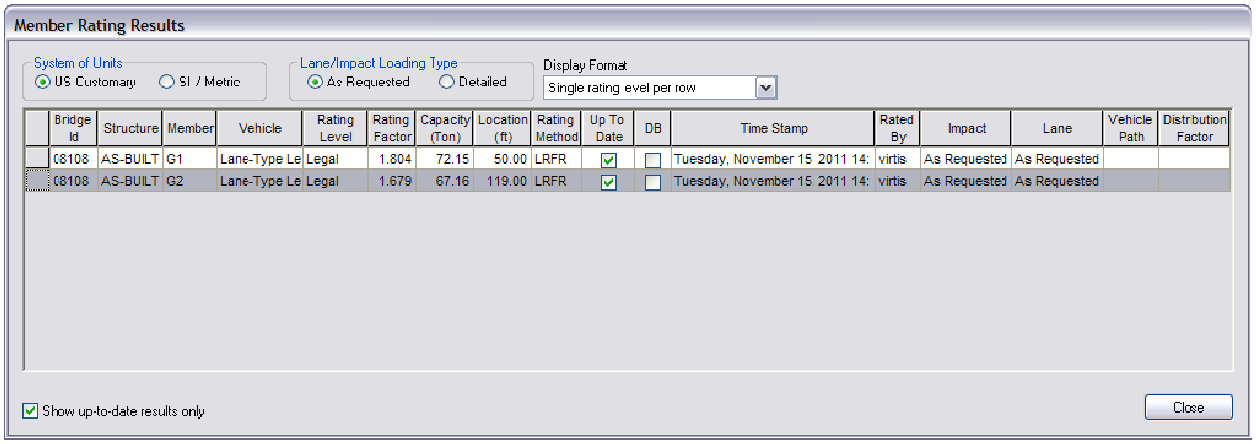
Then, left click the **View Structure Rating Results** button.

The **Structure Rating Results** window will appear. Highlight the row for **AS-BUILT**.



Left click the **View Member Rating Results** button.

The **Member Rating Results** window will appear.



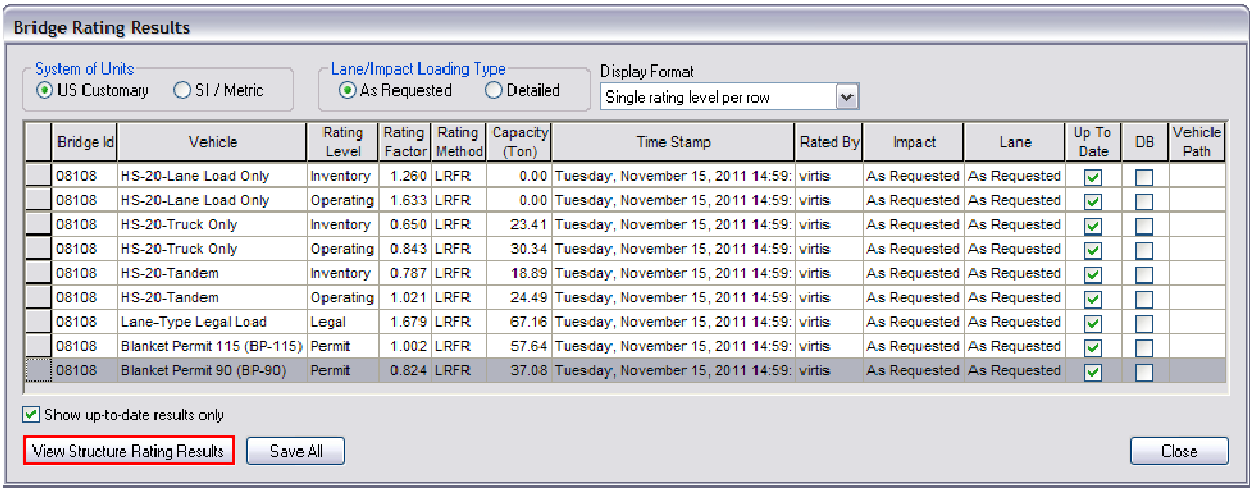
Since **G2** has lower ratings than **G1**, the rating information for **G2** will be recorded on the rating form. The **CONTROLLING FORCE** column will be filled in later.

	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
LEGAL LOADS		TONS	**		
VA Type 3	27	30	G1	143.00	
VA Type 3S2	40	43	G1	143.00	
*, ***LANE	40	67	G2	119.00	

PERMIT LOAD: BP-90

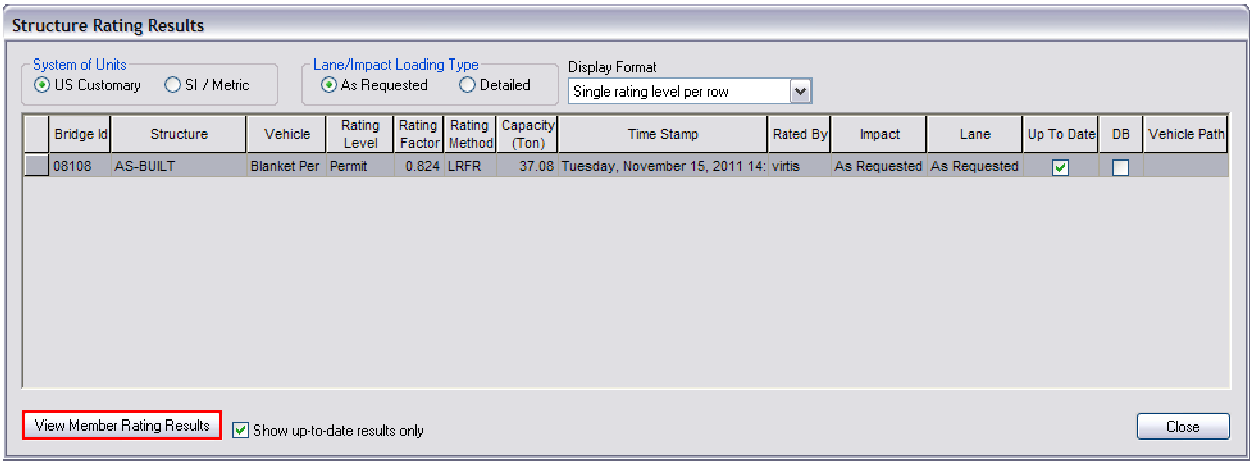
	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
PERMIT LOAD		TONS			
BP-90	45				
BP-115	57.5				

To fill out the rating information for the BP-90 vehicle, first highlight the **Blanket Permit 90 (BP-90)** row in the **Bridge Rating Results** window.



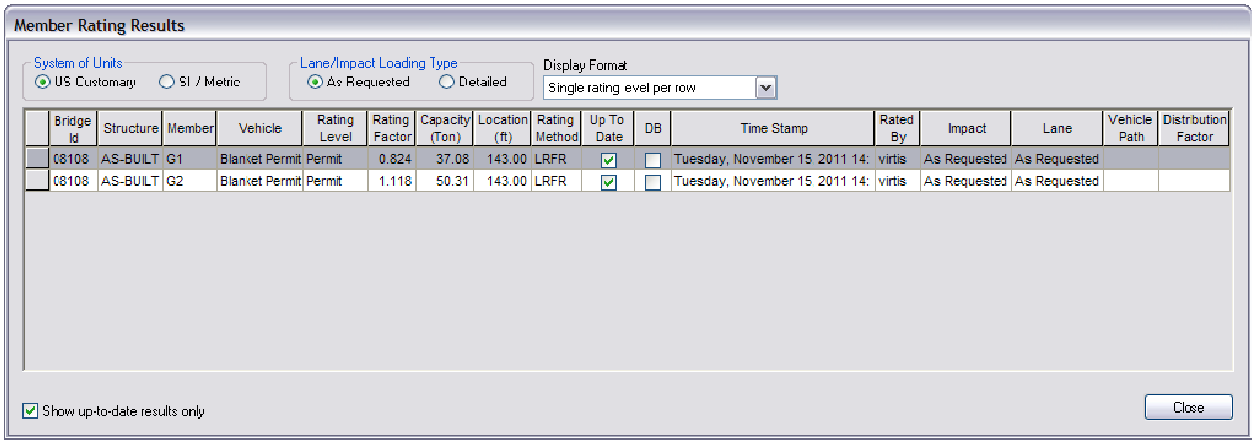
Then, left click the **View Structure Rating Results** button.

The **Structure Rating Results** window will appear. Highlight the row for **AS-BUILT**.



Left click the **View Member Rating Results** button.

The **Member Rating Results** window will appear.



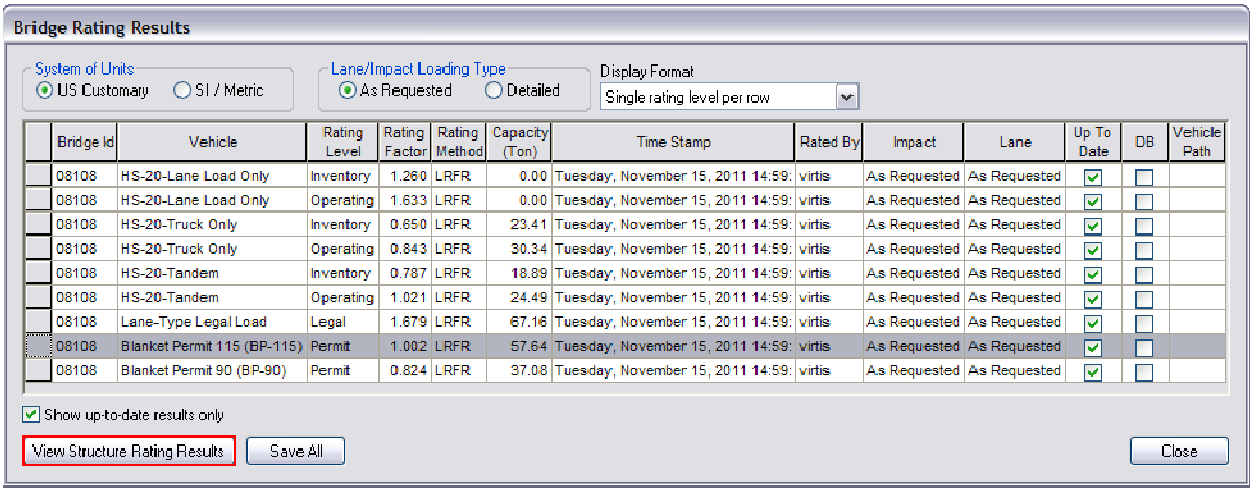
Since **G1** has lower ratings than **G2**, the rating information for **G1** will be recorded on the rating form. The **CONTROLLING FORCE** column will be filled in later.

	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
PERMIT LOAD		TONS			
BP-90	45	37	G1	143.00	
BP-115	57.5				

PERMIT LOAD: BP-115

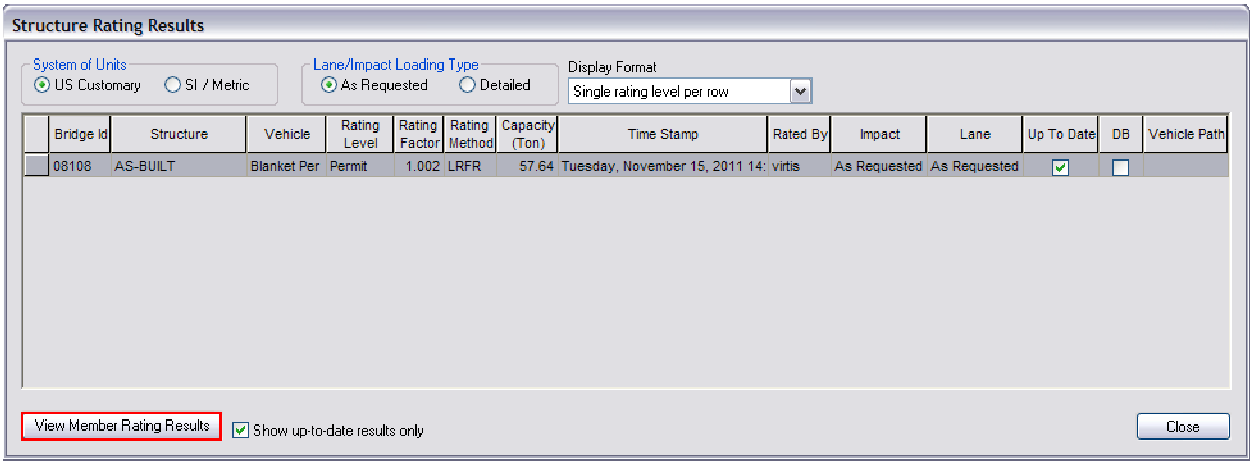
	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
PERMIT LOAD		TONS			
BP-90	45	37	G1	143.00	
DP-115	57.5				

To fill out the rating information for the BP-115 vehicle, first highlight the **Blanket Permit 115 (BP-115)** row in the **Bridge Rating Results** window.



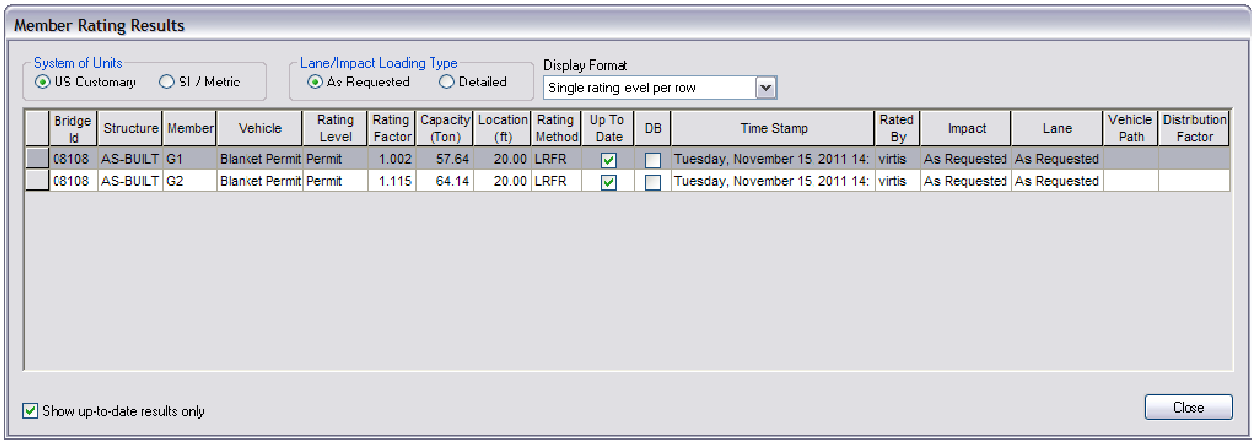
Then, left click the **View Structure Rating Results** button.

The **Structure Rating Results** window will appear. Highlight the row for **AS-BUILT**.



Left click the **View Member Rating Results** button.

The **Member Rating Results** window will appear.



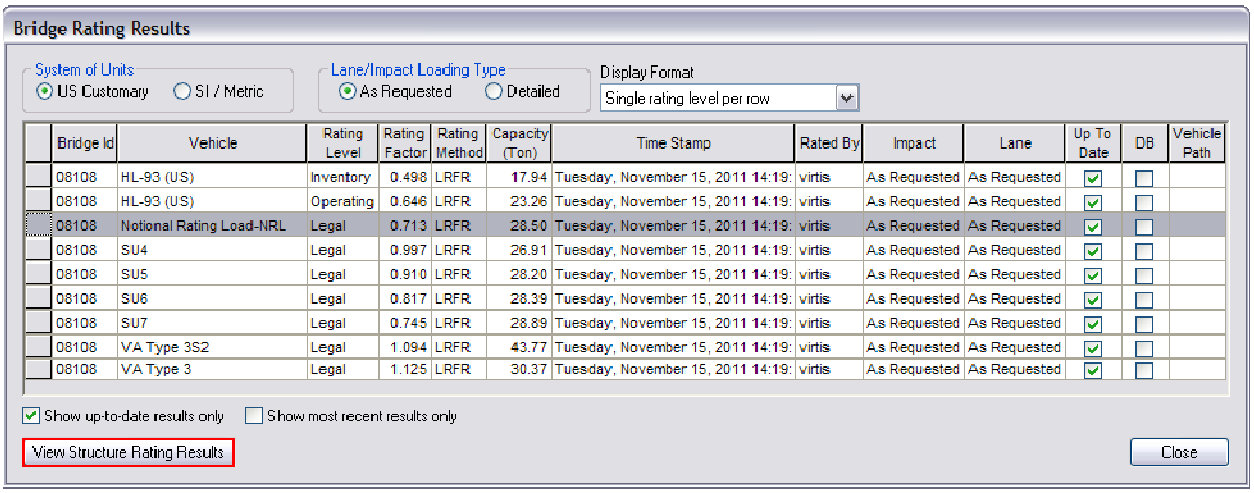
Since **G1** has lower ratings than **G2**, the rating information for **G1** will be recorded on the rating form. The **CONTROLLING FORCE** column will be filled in later.

	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
PERMIT LOAD		TONS			
BP-90	45	37	G1	143.00	
BP-115	57.5	57	G1	20.00	

SH VEHICLE: NRL

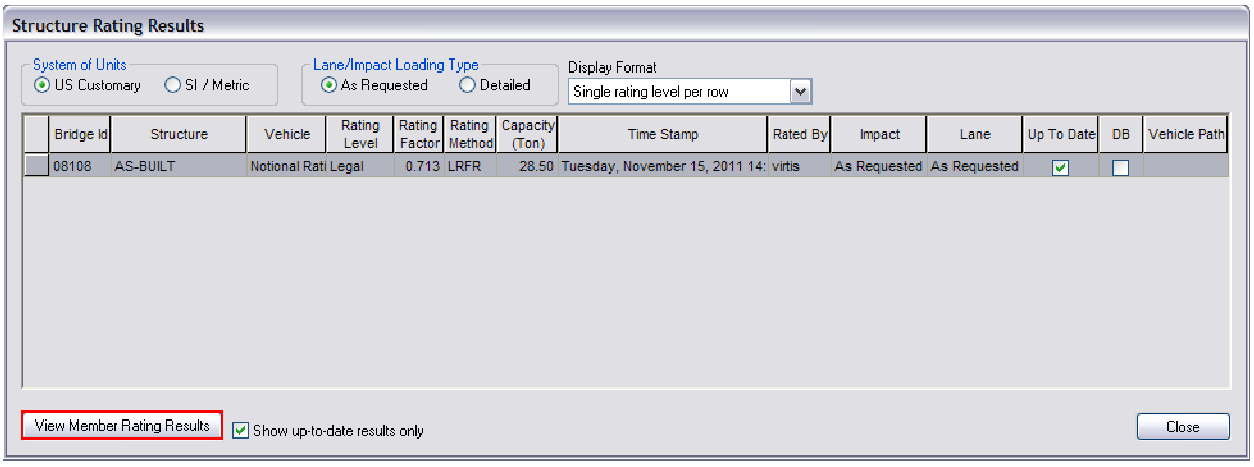
SH VEHICLES	GVW (TONS)	RATING TONS	CONTROLLING MEMBERS **	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
NRL	40				
SU4	27				
SU5	31				
SU6	34.75				
SU7	38.75				

To fill out the rating information for the NRL vehicle, first highlight the **Notional Rating Load-NRL** row in the **Bridge Rating Results** window.



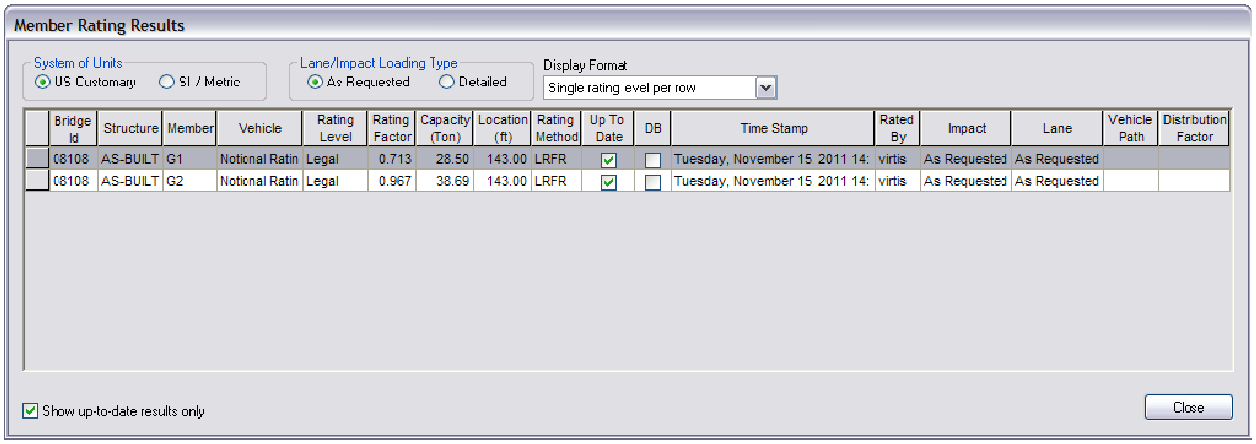
Then, left click the **View Structure Rating Results** button.

The **Structure Rating Results** window will appear. Highlight the row for **AS-BUILT**.



Left click the **View Member Rating Results** button.

The **Member Rating Results** window will appear.



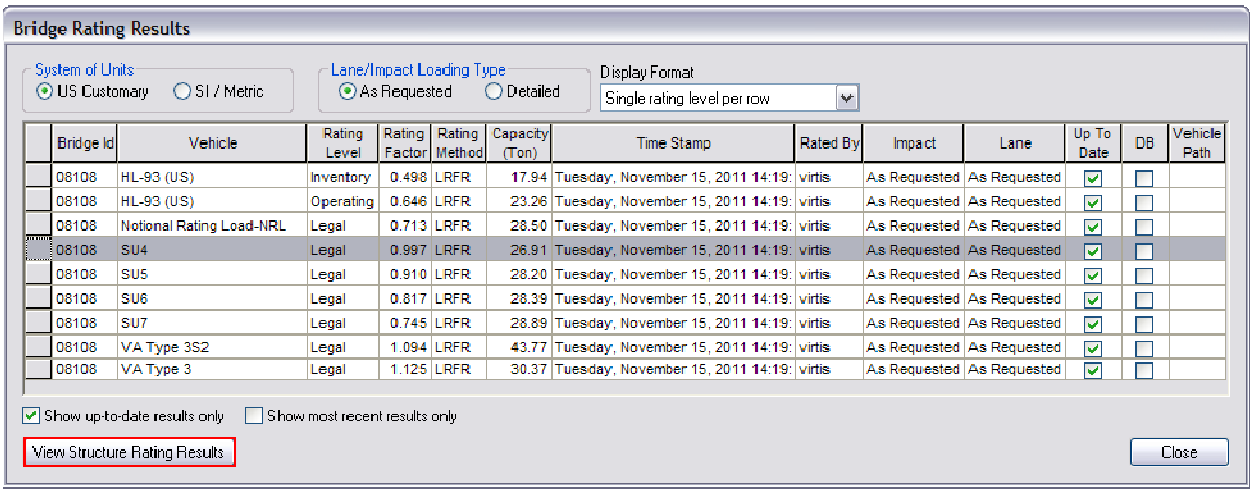
Since **G1** has lower ratings than **G2**, the rating information for **G1** will be recorded on the rating form. The **CONTROLLING FORCE** column will be filled in later.

	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
SH VEHICLES		TONS	**		
NRL	40	28	G1	143.00	
SU4	27				
SU5	31				
SU6	34.75				
SU7	38.75				

SH VEHICLE: SU4

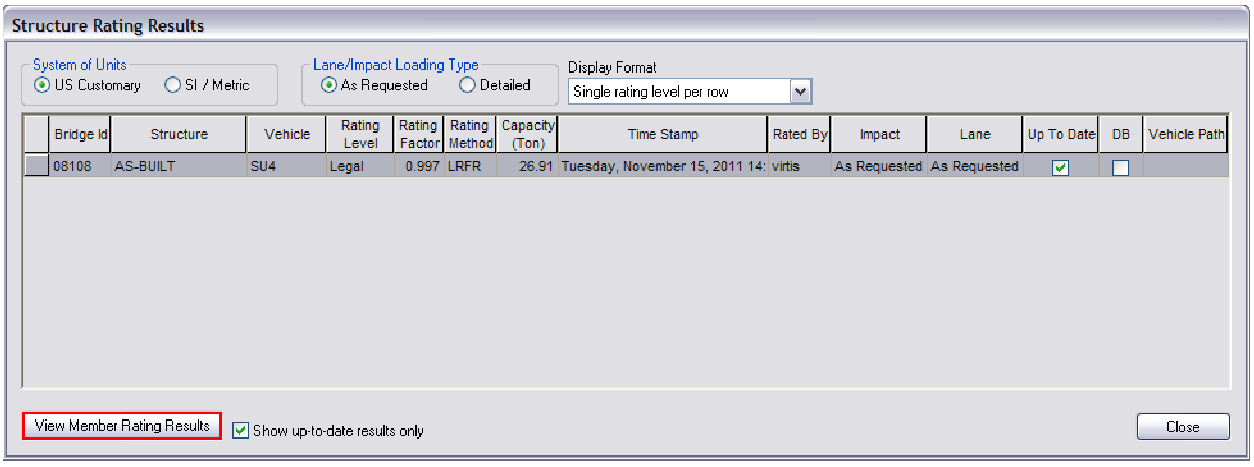
	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
SH VEHICLES		TONS	**		
NRL	40	28	G1	143.00	
SU4	27				
SU5	31				
SU6	34.75				
SU7	38.75				

To fill out the rating information for the SU4 vehicle, first highlight the **SU4** row in the **Bridge Rating Results** window.



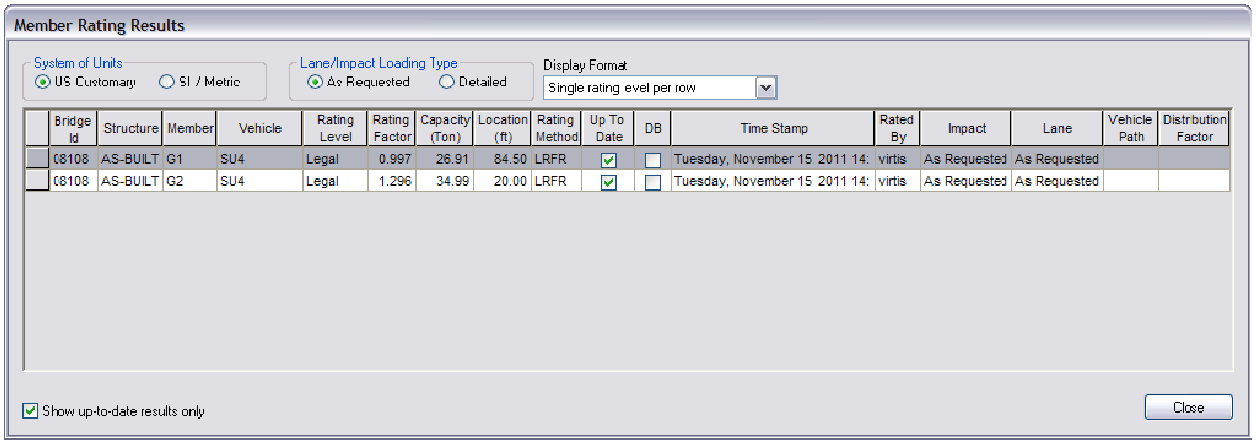
Then, left click the **View Structure Rating Results** button.

The **Structure Rating Results** window will appear. Highlight the row for **AS-BUILT**.



Left click the **View Member Rating Results** button.

The **Member Rating Results** window will appear.



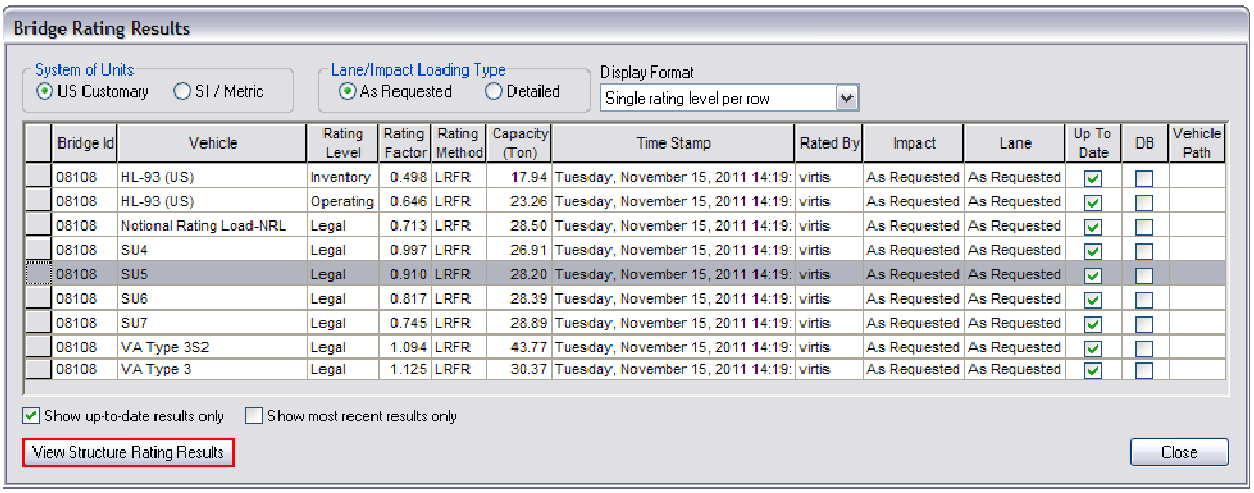
Since **G1** has lower ratings than **G2**, the rating information for **G1** will be recorded on the rating form. The **CONTROLLING FORCE** column will be filled in later.

	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
SH VEHICLES		TONS	**		
NRL	40	28	G1	143.00	
SU4	27	26	G1	84.50	
SU5	31				
SU6	34.75				
SU7	38.75				

SH VEHICLE: SU5

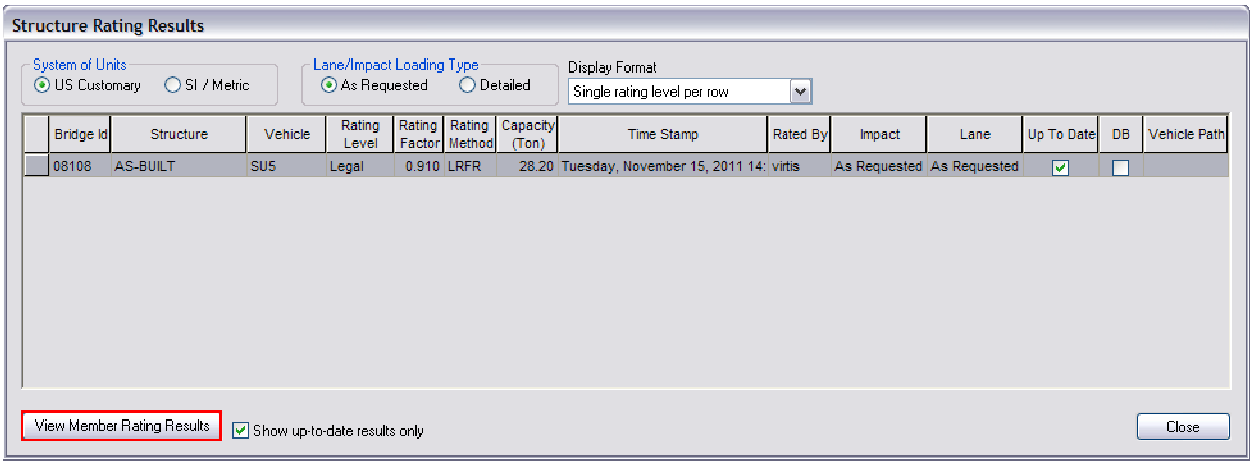
	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
SH VEHICLES		TONS	**		
NRL	40	28	G1	143.00	
SU4	27	26	G1	84.50	
SU5	31				
SU6	34.75				
SU7	38.75				

To fill out the rating information for the SU5 vehicle, first highlight the **SU5** row in the **Bridge Rating Results** window.



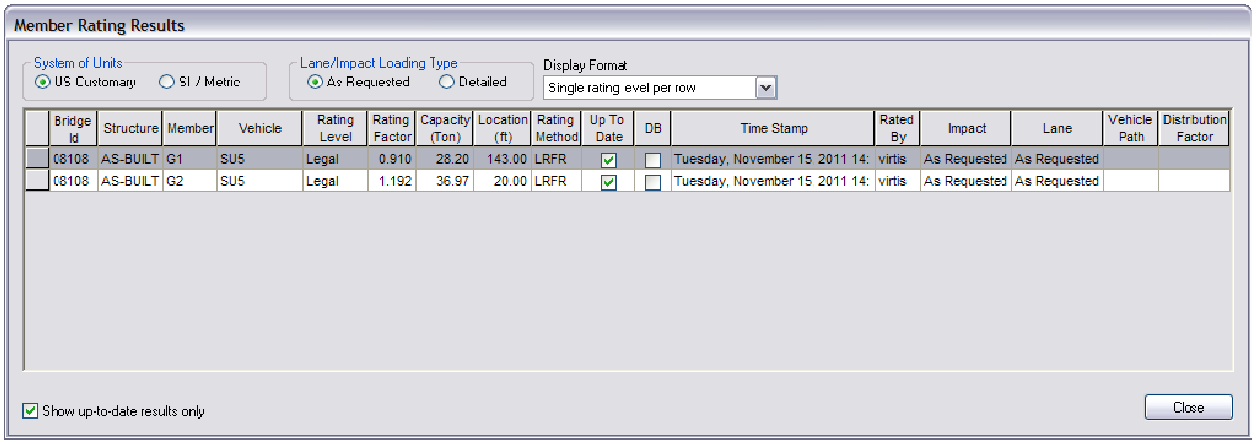
Then, left click the **View Structure Rating Results** button.

The **Structure Rating Results** window will appear. Highlight the row for **AS-BUILT**.



Left click the **View Member Rating Results** button.

The **Member Rating Results** window will appear.



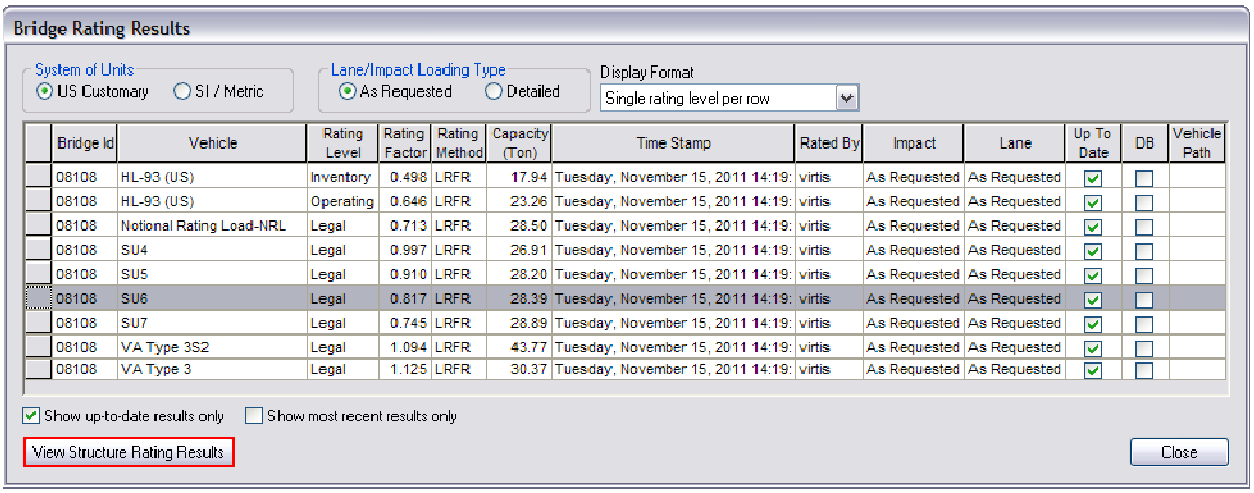
Since **G1** has lower ratings than **G2**, the rating information for **G1** will be recorded on the rating form. The **CONTROLLING FORCE** column will be filled in later.

	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
SH VEHICLES		TONS	**		
NRL	40	28	G1	143.00	
SU4	27	26	G1	84.50	
SU5	31	28	G1	143.00	
SU6	34.75				
SU7	38.75				

SH VEHICLE: SU6

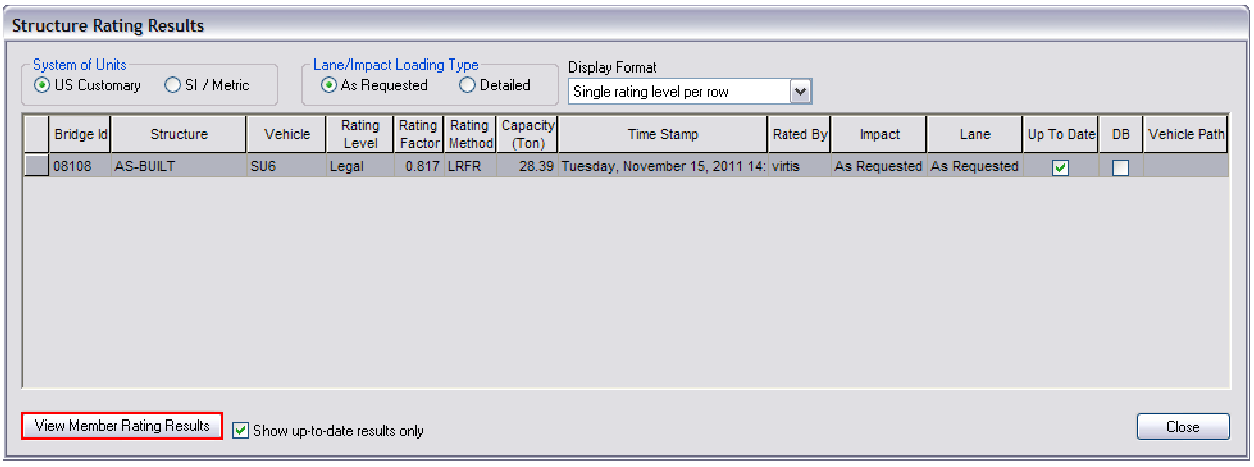
	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
SH VEHICLES		TONS	**		
NRL	40	28	G1	143.00	
SU4	27	26	G1	84.50	
SU5	31	28	G1	143.00	
SU6	34.75				
SU7	38.75				

To fill out the rating information for the SU6 vehicle, first highlight the **SU6** row in the **Bridge Rating Results** window.



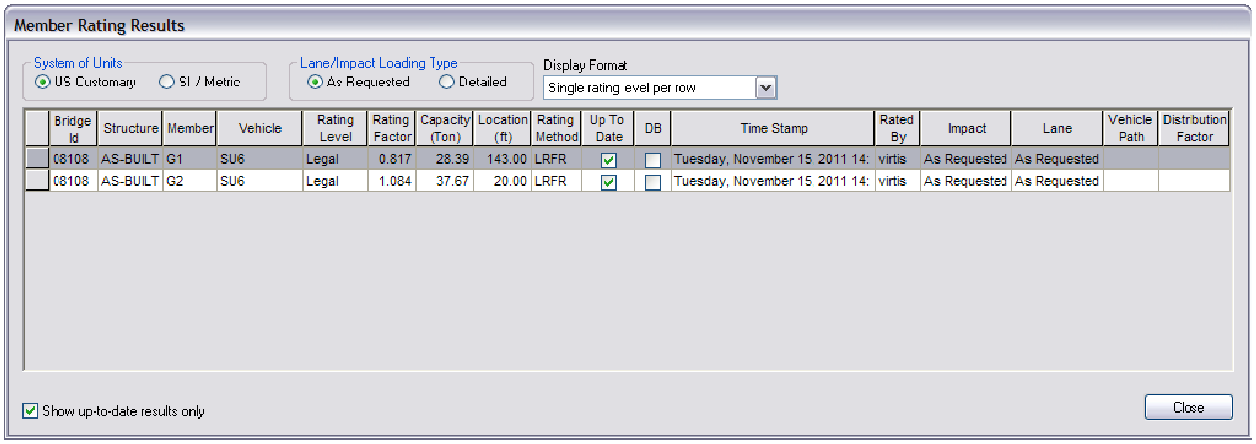
Then, left click the **View Structure Rating Results** button.

The **Structure Rating Results** window will appear. Highlight the row for **AS-BUILT**.



Left click the **View Member Rating Results** button.

The **Member Rating Results** window will appear.



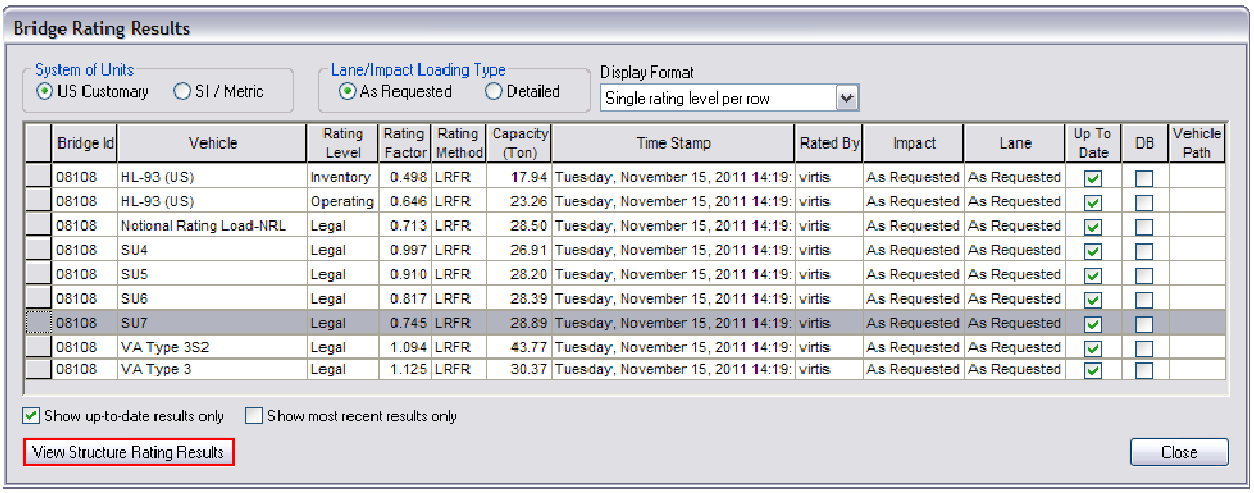
Since **G1** has lower ratings than **G2**, the rating information for **G1** will be recorded on the rating form. The **CONTROLLING FORCE** column will be filled in later.

	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
SH VEHICLES		TONS	**		
NRL	40	28	G1	143.00	
SU4	27	26	G1	84.50	
SU5	31	28	G1	143.00	
SU6	34.75	28	G1	143.00	
SU7	38.75				

SH VEHICLE: SU7

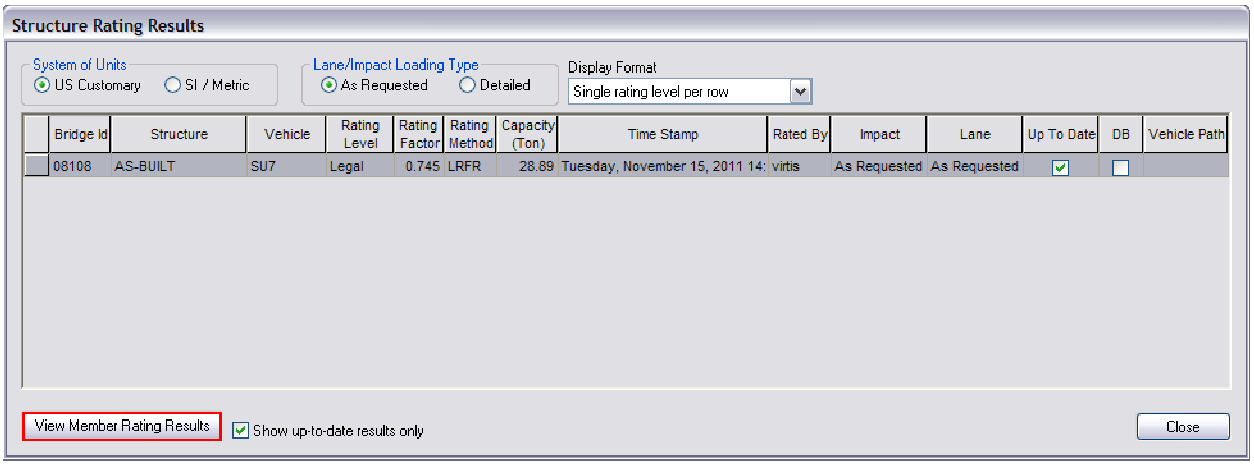
	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
SH VEHICLES		TONS	**		
NRL	40	28	G1	143.00	
SU4	27	26	G1	84.50	
SU5	31	28	G1	143.00	
SU6	34.75	28	G1	143.00	
SU7	38.75				

To fill out the rating information for the SU7 vehicle, first highlight the **SU7** row in the **Bridge Rating Results** window.



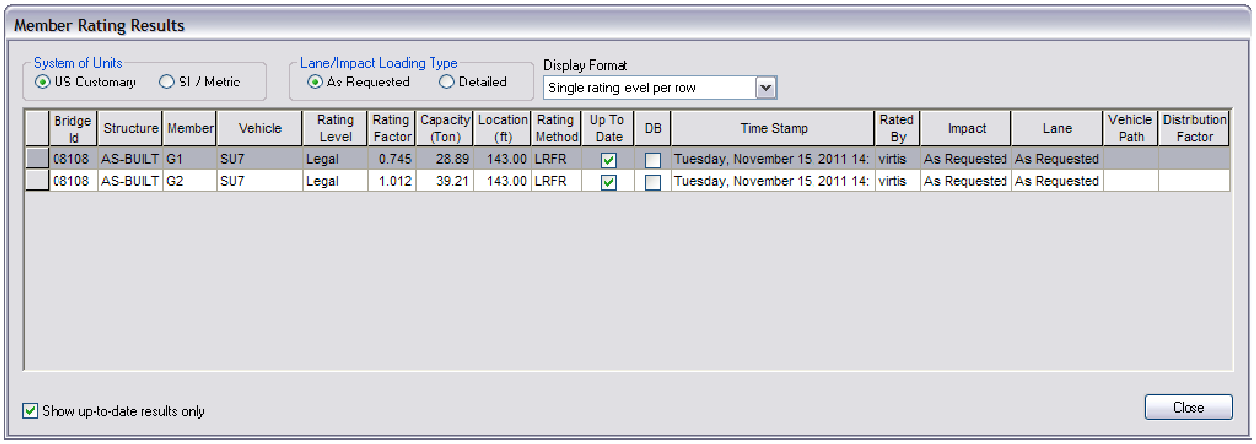
Then, left click the **View Structure Rating Results** button.

The **Structure Rating Results** window will appear. Highlight the row for **AS-BUILT**.



Left click the **View Member Rating Results** button.

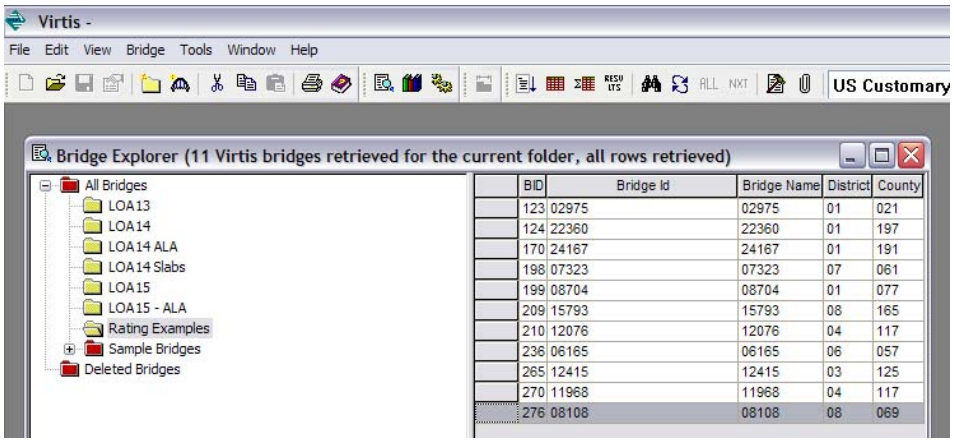
The **Member Rating Results** window will appear.



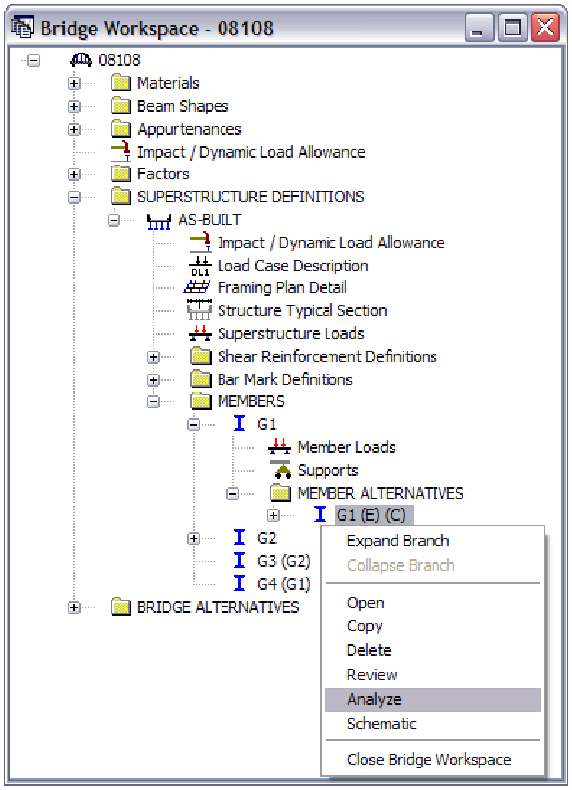
Since **G1** has lower ratings than **G2**, the rating information for **G1** will be recorded on the rating form. The **CONTROLLING FORCE** column will be filled in later.

	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
SH VEHICLES		TONS	**		
NRL	40	28	G1	143.00	
SU4	27	26	G1	84.50	
SU5	31	28	G1	143.00	
SU6	34.75	28	G1	143.00	
SU7	38.75	28	G1	143.00	

COMPLETING THE VDOT RATING FORM: CONTROLLING FORCE

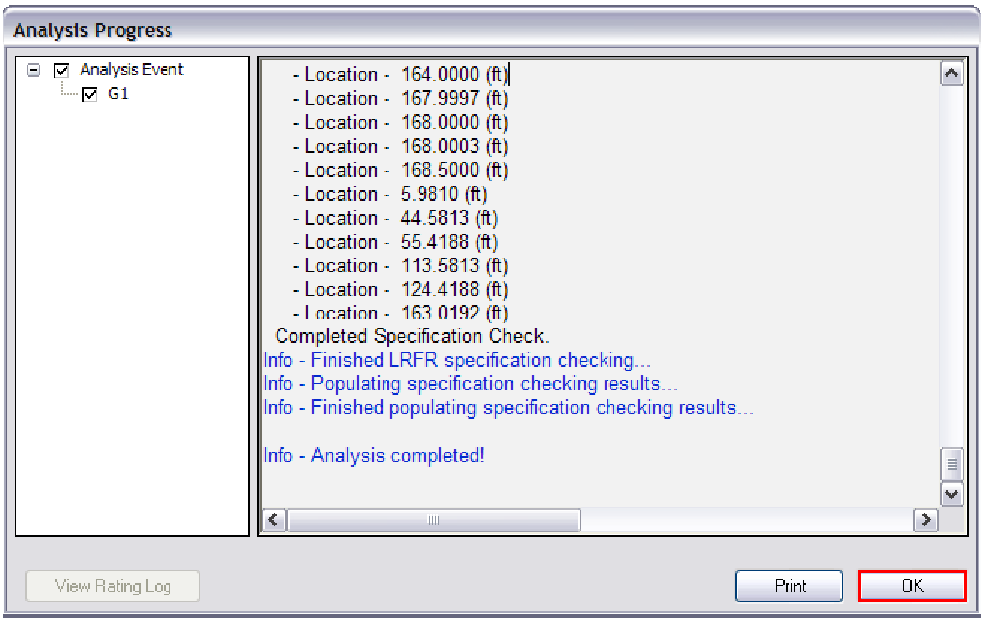


Once the controlling member(s) is known, the user can obtain the controlling force for each vehicle by double clicking the bridge in the Bridge Explorer window to open the file.

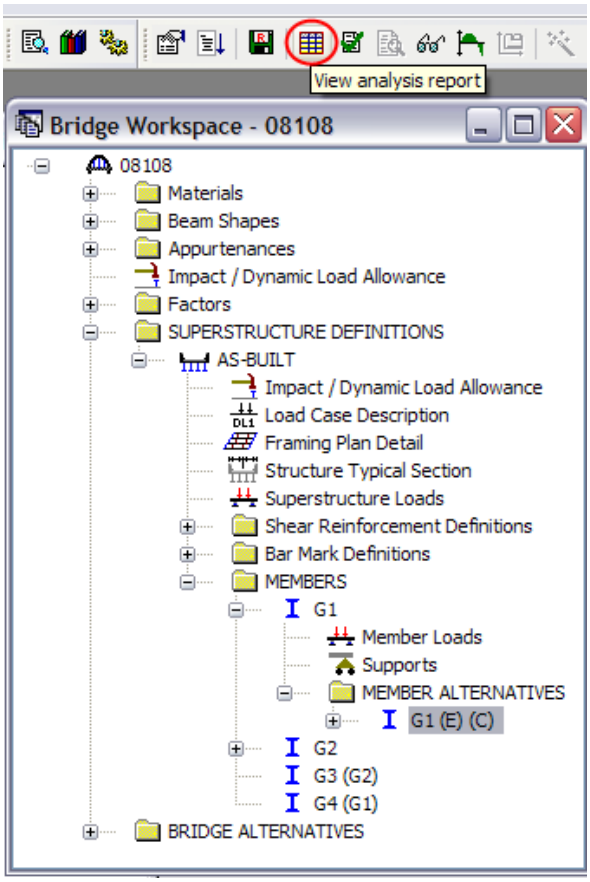


For this example, **G1** is the controlling member for the majority of the vehicles. Expand the folders to get to the controlling **MEMBER ALTERNATIVE**.

Select the **Continuous Span (Run 1 of 2)** template and right click **G1 (E) (C)** and select **Analyze**.

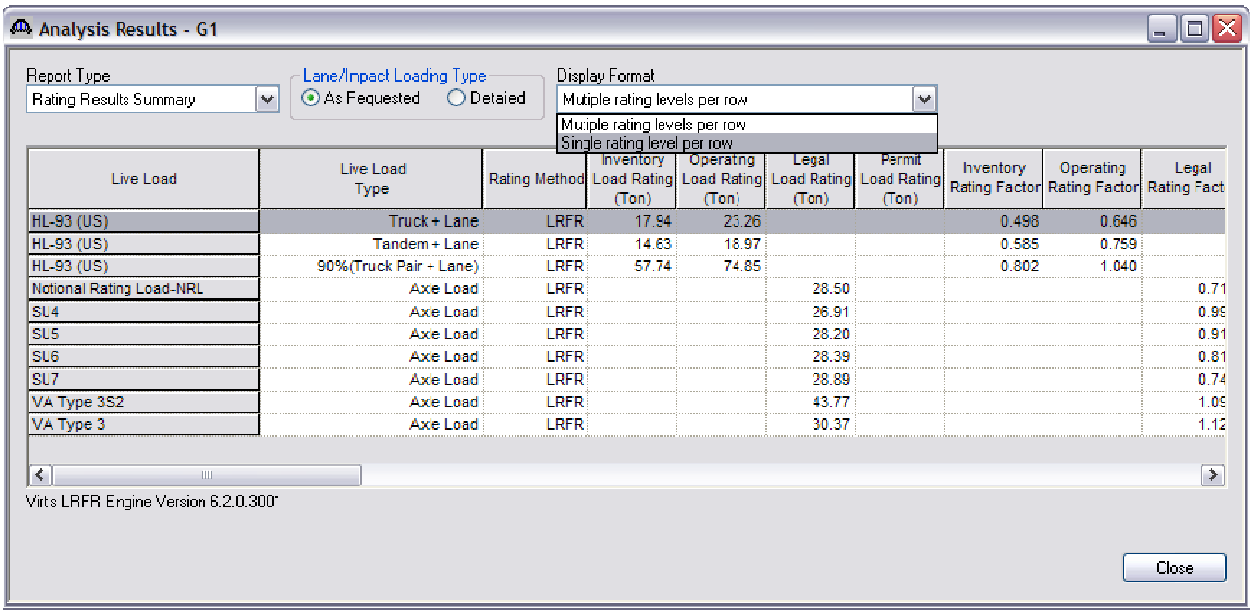


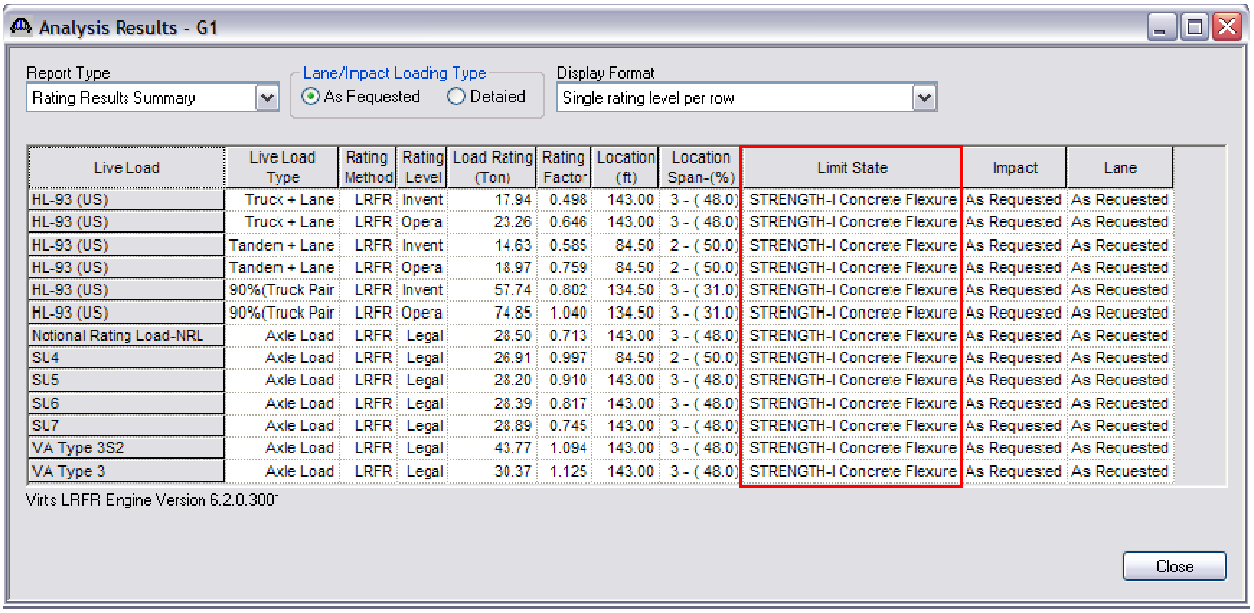
Left click **OK** on the **Analysis Progress** window when the analysis is complete.



Highlight **G1 (E) (C)** and left click the **View analysis report** icon.

The **Analysis Results – G1** window will appear. Select **Single rating level per row** from the **Display Format** drop down menu.



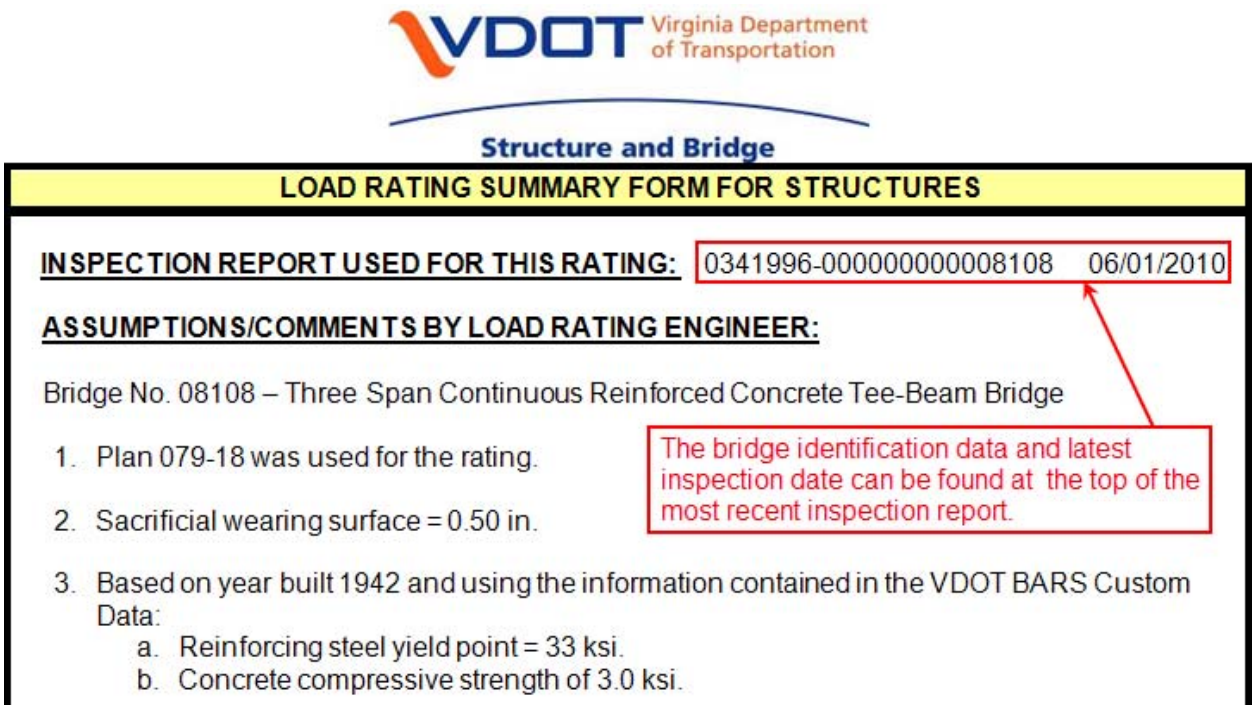


The controlling force can be obtained from the Limit State column. Fill in the rating form as appropriate for each vehicle.

Follow the same process with the **Continuous Span (Run 2 of 2)** vehicle template.

See Appendix D for the completed rating form.

COMPLETING THE RATING FORM: ASSUMPTIONS/COMMENTS



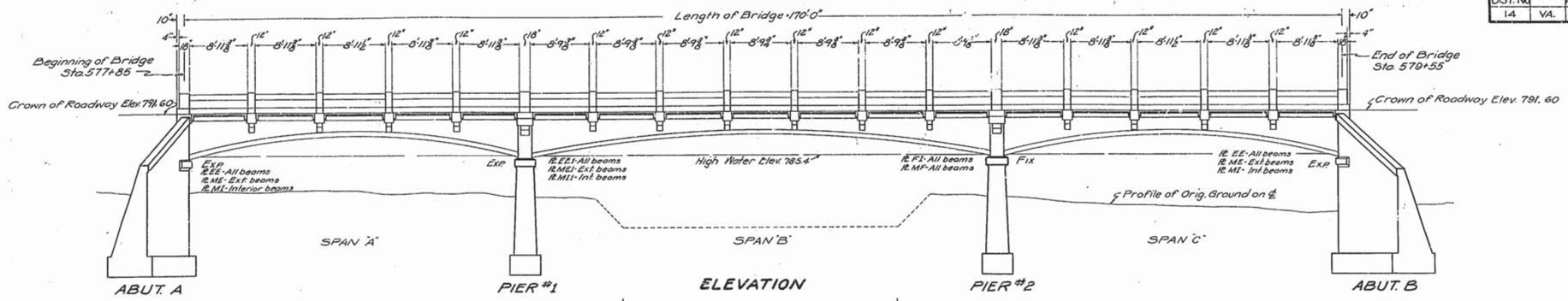
The second page of the rating form provides space for assumption and comments. Some common assumptions and comments are for material strengths, which plan was used, wearing surface thicknesses, and any deterioration or other changes and assumptions applied to the structure.

If the current inspection report indicates that there is deterioration, the user will have to create an IR (inspection report) structure in addition to the AS-BUILT. For continuous span reinforced concrete tee beam bridges, the typical deterioration that warrants an IR structure is section loss to the longitudinal or vertical reinforcement.

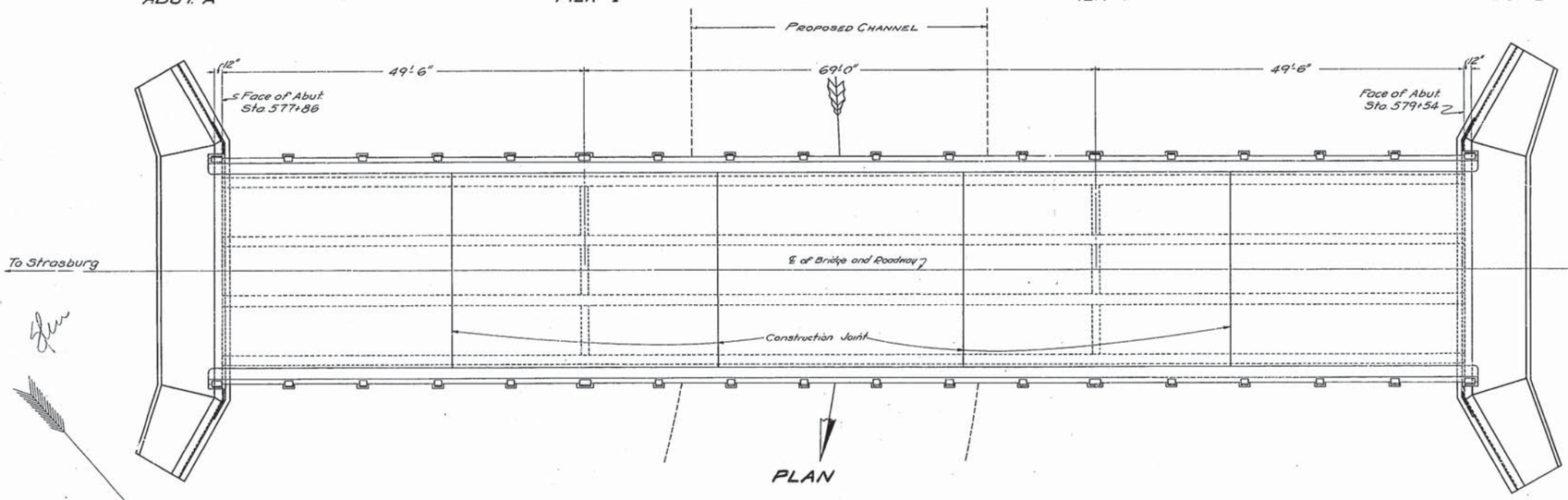
*****RATING FOR THE BRIDGE IS NOW COMPLETE.**

APPENDIX A: DESIGN PLANS

FED. RD. DIST. NO.	STATE	P.R.A. ROUTE NO.	P.R.A. PROJ. NO.	STATE ROUTE NO.	STATE PROJ. NO.	SHEET NO.	TOTAL SHEETS
14	VA.			55	1219 B-1	19	76



ELEVATION



PLAN

ESTIMATED QUANTITIES

	Conc. Cu. Yds. Class "A"	Conc. Cu. Yds. Class "B"	Reinf. Steel Lbs.	Excavation Cu. Yds. "A"	Excavation Cu. Yds. "B"
Superstructure:	286.0 ✓		~~71,340~~ 64,870 **		
Abut. A Neat		139.0 ✓	210 ·	~~80~~ 170	~~39~~ 100
Abut. A Footing		~~265~~ 44.1			
Pier 1 Neat	27.7		955	~~30~~ 53	38 ·
Pier 1 Footing		~~113~~ 15.6			
Pier 2 Neat	27.7 ✓		955 ✓	~~28~~ 48	~~28~~ 30
Pier 2 Footing		~~113~~ 9.9			
Abut. B Neat		145.0 ·	210 ·	~~22~~ 122	~~35~~ 120
Abut. B Footing		~~320~~ 57.3			
Totals	341.4	~~438.6~~ 410.9	~~75,370~~ 67,200	~~132~~ 393	~~156~~ 288

** Cast Iron Bearing Pts. incl in unit price bid for class "A" Conc.
* Includes 6470 # of Cast Iron Bearing Plates (Changed Nov. 24, 1941)

DRAWN BY: R.A.W. & F.F.W.N.
TRACED BY: R.A.W. & F.G.A.
CHECKED BY: H.H.T.

GENERAL NOTE:-
Roadway: 26 Ft. Clear. Capacity, 15 Ton trucks P.R.A.
Specifications: General - Virginia Department of Highways Bridge Specifications, 1932.
Concrete Materials and Construction - Virginia Department of Highways Road Specifications, 1938.
Design - AASHO Specifications for Highway Bridges, 1941, H20 Loading.
Concrete in superstructure and neatwork of piers shall be Class "A", in abutments and pier footings shall be class "B".
Foundations: All foundations shall be solid rock and are to be approved by the Engineer. Foundation elevations shown on these plans are approximate and are given for estimating purposes.
Construction joints in the superstructure shall be located where shown. All of the superstructure, except curbs and railings shall be poured before any falsework is removed.
Bench Mark: Nail & Cap in Base 12" Cedar, 80' Lt. Sta. 575+25. Elev. 796.53

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF HIGHWAYS
PROPOSED BRIDGE
OVER CEDAR CREEK - 9 MI. FROM STRASBURG
STA. 578+70 - RT. 55 - PROJ. 1219 B-1
FREDERICK & SHENANDOAH COUNTIES
2-50'-0" & 1-69'-0" R.C. CONTINUOUS BEAM SPANS
RICHMOND, VIRGINIA.

RECOMMENDED for APPROVAL: W. R. Gilchrist
BRIDGE ENGINEER

APPROVED: C. S. Mullen
CHIEF ENGINEER

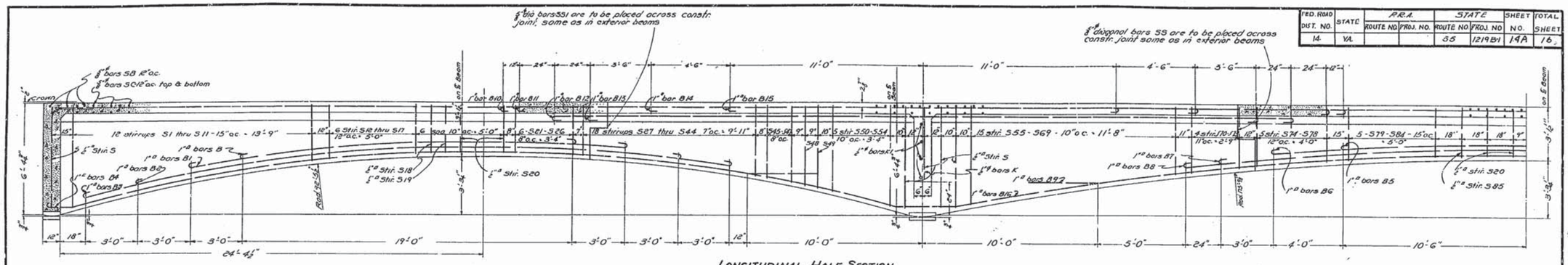
Revised Nov. 24, 1941
DATE: Nov. 14, 1941
SCALE: 1/8" - 1'-0"
Finals Posted Nov. 23, 1942

LXXIX-18
SHEET 1 of 5

1 - 8 1 - 6 7

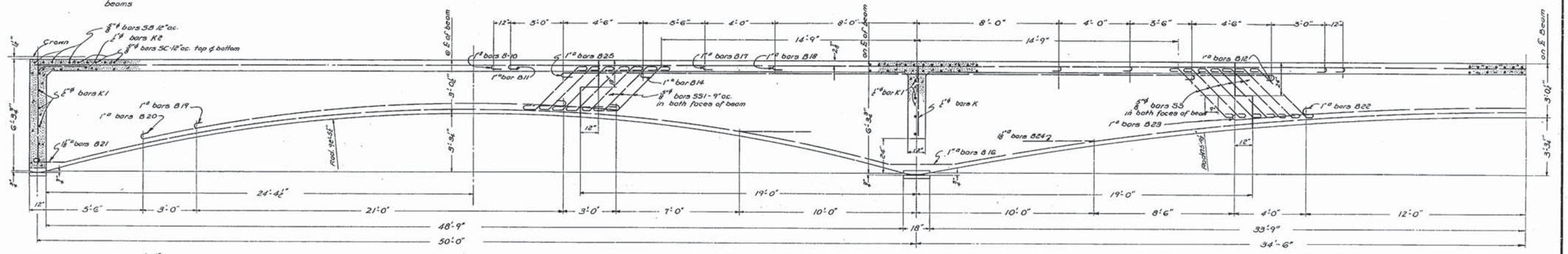
120

FED. ROAD DIST. NO.	STATE	P.R.A. ROUTE NO.	P.R.A. PROJ. NO.	STATE ROUTE NO.	STATE PROJ. NO.	SHEET NO.	TOTAL SHEET
14	VA.			55	1219B1	19A	16

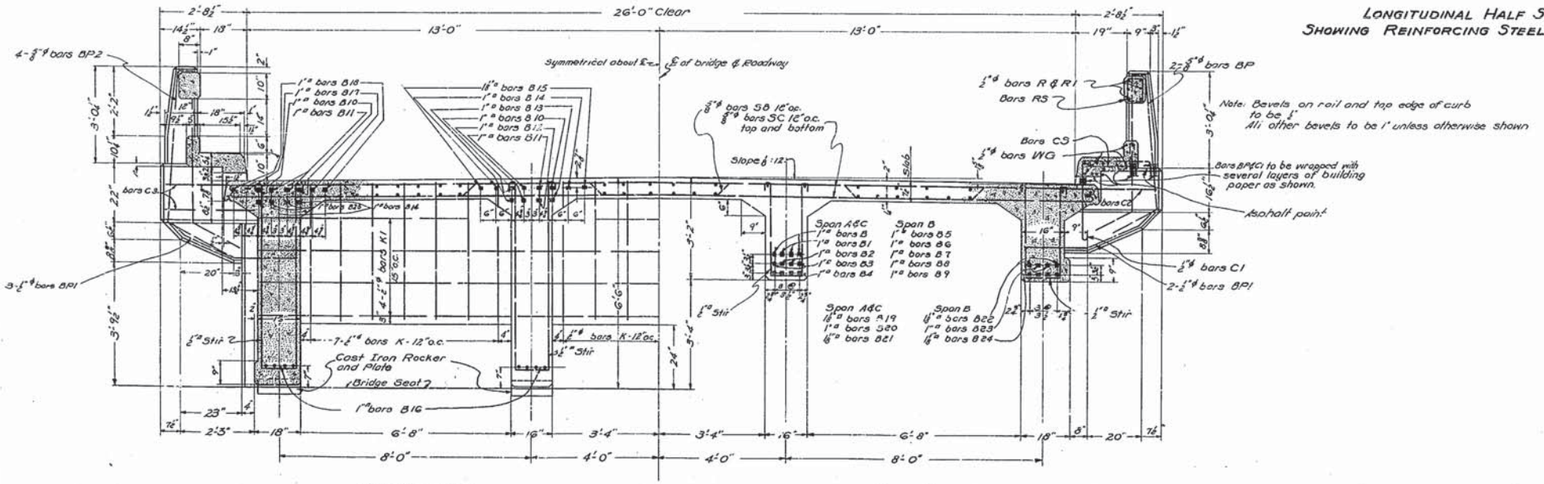


LONGITUDINAL HALF SECTION
SHOWING REINFORCING STEEL IN INTERIOR BEAMS

Note: Stirrup spacing in exterior beams is same as in interior beams and the bar marks of corresponding stirrups have identical numerals. For instance the stirrups marked S62 are to be placed in the exterior beams directly opposite the stirrups marked S6 in the interior beams



LONGITUDINAL HALF SECTION
SHOWING REINFORCING STEEL IN EXTERIOR BEAMS



HALF SECTION
NEAR ℄ PIERS

HALF SECTION
AT MIDSPAN

CEDAR CREEK BRIDGE

SUPERSTRUCTURE DETAILS

VIRGINIA DEPARTMENT OF HIGHWAYS
OFFICE OF THE BRIDGE ENGINEER
RICHMOND, VA. NOV. 1941

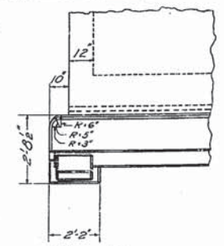
LXXIX-18

DRAWN BY: [illegible]
TRACED BY: F.S.R.
CHECKED BY: [illegible]

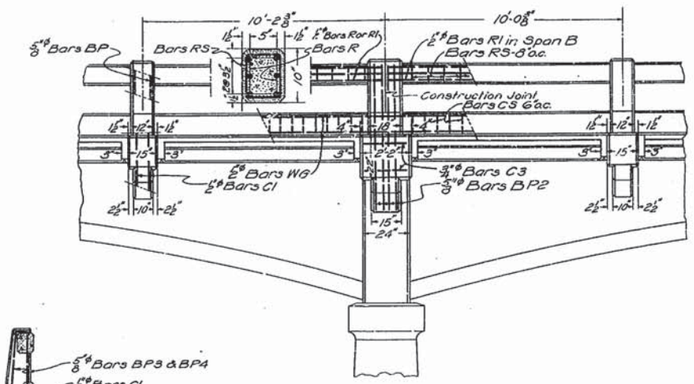
Scale ½"=1', 1"=1'-0"

Sheet 2 of 5

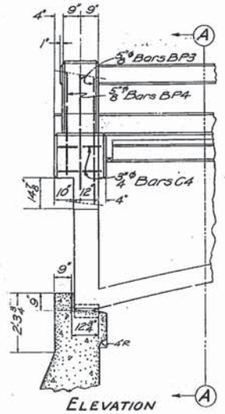
Fed. Road Dist. No.	State	PRA Route No.	PRA Proj. No.	State Route No.	State Proj. No.	Sheet No.	Total Sheets
14	VA			55	1219B1	19B	16



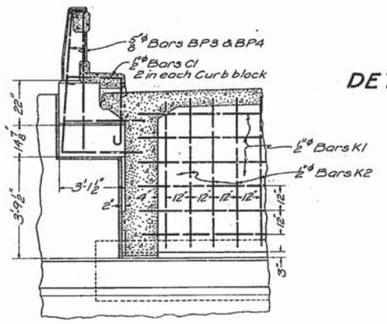
PART PLAN



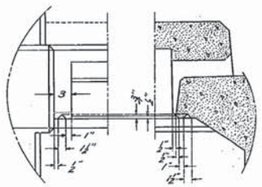
DETAILS AT PIERS



ELEVATION

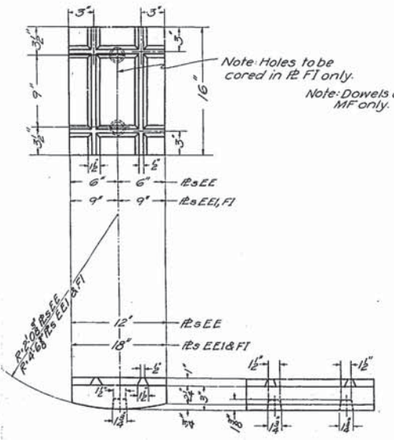


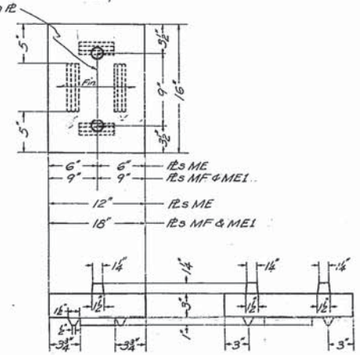
SECTION A-A

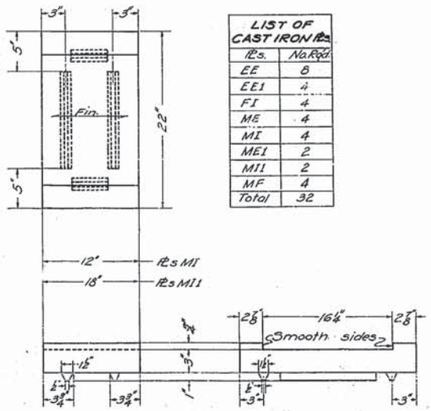


DRIP BEAD

DETAILS AT ABUTS.







LIST OF CAST IRON Rs	
Rs.	No. Req'd
EE	8
EE1	4
FI	4
ME	4
MI	4
ME1	2
MI1	2
MF	4
Total	32

DETAILS OF BEARING Rs

NOTE:- The cost of Cast Iron Plates shall be paid for at the unit price bid for Reinforcing Steel.

Changed Nov. 24, 1941 to Note:- The cost of Cast Iron Plates shall be included in the unit price bid for Class A Concrete

Note: Cost of Cast Iron Rs incl. in unit price bid for Class "A" Conc.

Drawn By: R.A.W.
Traced By: R.A.W. & F.S.A.
Checked By: C.M.H.

Scale: ⅜" & 1½" = 1'-0"

Revised Nov. 24, 1941

SCHEDULE OF ½"ø STIRRUPS

Interior Beams				Bending Diagram	Exterior Beams			
Mark	No	'a'	Length		Mark	No.	'a'	Length
S	20	5'-8½"	13'-5"	6" 13" a	5E	20	5'-7½"	13'-3"
S1	4	5'-5½"	12'-11"		S1E	4	5'-4½"	12'-9"
S2	4	5'-1⅜"	12'-3½"		S2E	4	5'-0⅜"	12'-1½"
S3	4	4'-10½"	11'-9"		S3E	4	4'-9½"	11'-7"
S4	4	4'-7½"	11'-2½"		S4E	4	4'-6½"	11'-0½"
S5	4	4'-4½"	10'-8½"		S5E	4	4'-3½"	10'-6½"
S6	4	4'-1⅝"	10'-3"		S6E	4	4'-0⅝"	10'-1"
S7	4	3'-11"	9'-10"		S7E	4	3'-10"	9'-8"
S8	4	3'-8½"	9'-5"		S8E	4	3'-7½"	9'-3"
S9	4	3'-6½"	9'-1"		S9E	4	3'-5½"	8'-11"
S10	4	3'-4½"	8'-9"		S10E	4	3'-3½"	8'-7"
S11	4	3'-2⅛"	8'-5½"		S11E	4	3'-1⅛"	8'-3½"
S12	4	3'-1⅜"	8'-3"		S12E	4	3'-0⅜"	8'-1"
S13	4	2'-11½"	8'-1"		S13E	4	2'-11½"	7'-11"
S14	4	2'-11⅛"	7'-11"		S14E	4	2'-10⅝"	7'-9"
S15	4	2'-10⅝"	7'-9⅝"		S15E	4	2'-9⅝"	7'-7½"
S16	4	2'-10"	7'-8"		S16E	4	2'-9"	7'-6"
S17	4	2'-9⅝"	7'-7"		S17E	4	2'-8⅝"	7'-5"
S18	4	2'-9"	7'-6"		S18E	4	2'-8"	7'-4"
S19	4	2'-8⅞"	7'-5½"		S19E	4	2'-7⅞"	7'-3½"
S20	24	2'-8⅝"	7'-5"		S20E	24	2'-7⅝"	7'-3"
S21	4	2'-8⅜"	7'-5⅛"		S21E	4	2'-7⅜"	7'-3⅛"
S22	4	2'-9"	7'-6"		S22E	4	2'-8"	7'-4"
S23	4	2'-9⅛"	7'-6⅛"		S23E	4	2'-8⅛"	7'-4⅛"
S24	4	2'-9⅛"	7'-7"		S24E	4	2'-8⅛"	7'-5"
S25	4	2'-9⅜"	7'-7⅛"		S25E	4	2'-8⅜"	7'-5⅛"
S26	4	2'-10⅛"	7'-8⅛"		S26E	4	2'-9⅛"	7'-6⅛"
S27	4	2'-10⅝"	7'-9⅛"		S27E	4	2'-9⅝"	7'-7⅛"
S28	4	2'-11⅛"	7'-10⅛"		S28E	4	2'-10⅛"	7'-8⅛"
S29	4	2'-11⅝"	7'-11⅛"		S29E	4	2'-10⅝"	7'-9⅛"
S30	4	3'-0⅜"	8'-0⅛"		S30E	4	2'-11⅛"	7'-10⅛"
S31	4	3'-1"	8'-2"		S31E	4	3'-0"	8'-0"
S32	4	3'-1⅝"	8'-3⅛"		S32E	4	3'-0⅝"	8'-1⅛"
S33	4	3'-2⅛"	8'-4⅛"		S33E	4	3'-1⅛"	8'-2⅛"
S34	4	3'-2⅝"	8'-5"		S34E	4	3'-1⅝"	8'-2"
S35	4	3'-3⅛"	8'-5⅛"		S35E	4	3'-2⅛"	8'-3⅛"
S36	4	3'-3⅝"	8'-6⅛"		S36E	4	3'-2⅝"	8'-4⅛"
S37	4	3'-4⅛"	8'-7⅛"		S37E	4	3'-3⅛"	8'-5⅛"
S38	4	3'-4⅝"	8'-8⅛"		S38E	4	3'-3⅝"	8'-6⅛"
S39	4	3'-5⅛"	8'-9⅛"		S39E	4	3'-4⅛"	8'-7⅛"
S40	4	3'-5⅝"	8'-10⅛"		S40E	4	3'-4⅝"	8'-8⅛"
S41	4	3'-6⅛"	8'-11⅛"		S41E	4	3'-5⅛"	8'-9⅛"
S42	4	3'-6⅝"	9'-0⅛"		S42E	4	3'-5⅝"	8'-10⅛"
S43	4	3'-7⅛"	9'-1⅛"		S43E	4	3'-6⅛"	8'-11⅛"
S44	4	3'-7⅝"	9'-2⅛"		S44E	4	3'-6⅝"	9'-0⅛"
S45	4	3'-8⅛"	9'-3⅛"		S45E	4	3'-7⅛"	9'-1⅛"
S46	4	3'-8⅝"	9'-4⅛"		S46E	4	3'-7⅝"	9'-2⅛"
S47	4	3'-9⅛"	9'-5⅛"		S47E	4	3'-8⅛"	9'-3⅛"
S48	4	3'-9⅝"	9'-6⅛"		S48E	4	3'-8⅝"	9'-4⅛"
S49	4	3'-10⅛"	9'-7⅛"		S49E	4	3'-9⅛"	9'-5⅛"
S50	4	3'-10⅝"	9'-8⅛"		S50E	4	3'-9⅝"	9'-6⅛"
S51	4	3'-11"	9'-9"		S51E	4	3'-10"	9'-7"
S52	4	3'-11⅝"	9'-10⅛"		S52E	4	3'-10⅝"	9'-8⅛"
S53	4	4'-0⅝"	10'-0⅛"		S53E	4	3'-11⅝"	9'-9⅛"
S54	4	4'-1⅜"	10'-1⅛"		S54E	4	4'-0⅜"	9'-10⅛"
S55	4	4'-2⅛"	10'-2⅛"		S55E	4	4'-1⅛"	10'-0⅛"
S56	4	4'-2⅝"	10'-3⅛"		S56E	4	4'-1⅝"	10'-1⅛"
S57	4	4'-3⅛"	10'-4⅛"		S57E	4	4'-2⅛"	10'-2⅛"
S58	4	4'-3⅝"	10'-5⅛"		S58E	4	4'-2⅝"	10'-3⅛"
S59	4	4'-4⅛"	10'-6⅛"		S59E	4	4'-3⅛"	10'-4⅛"
S60	4	4'-4⅝"	10'-7⅛"		S60E	4	4'-3⅝"	10'-5⅛"
S61	4	4'-5⅛"	10'-8⅛"		S61E	4	4'-4⅛"	10'-6⅛"
S62	4	4'-5⅝"	10'-9⅛"		S62E	4	4'-4⅝"	10'-7⅛"
S63	4	4'-6⅛"	10'-10⅛"		S63E	4	4'-5⅛"	10'-8⅛"
S64	4	4'-6⅝"	10'-11⅛"		S64E	4	4'-5⅝"	10'-9⅛"
S65	4	4'-7⅛"	11'-0⅛"		S65E	4	4'-6⅛"	10'-10⅛"
S66	4	4'-7⅝"	11'-1⅛"		S66E	4	4'-6⅝"	10'-11⅛"
S67	4	4'-8⅛"	11'-2⅛"		S67E	4	4'-7⅛"	11'-0⅛"
S68	4	4'-8⅝"	11'-3⅛"		S68E	4	4'-7⅝"	11'-1⅛"
S69	4	4'-9⅛"	11'-4⅛"		S69E	4	4'-8⅛"	11'-2⅛"
S70	4	4'-9⅝"	11'-5⅛"		S70E	4	4'-8⅝"	11'-3⅛"
S71	4	4'-10⅛"	11'-6⅛"		S71E	4	4'-9⅛"	11'-4⅛"
S72	4	4'-10⅝"	11'-7⅛"		S72E	4	4'-9⅝"	11'-5⅛"
S73	4	4'-11⅛"	11'-8⅛"		S73E	4	4'-10⅛"	11'-6⅛"
S74	4	4'-11⅝"	11'-9⅛"		S74E	4	4'-10⅝"	11'-7⅛"
S75	4	5'-0⅛"	11'-10⅛"		S75E	4	4'-11⅛"	11'-8⅛"
S76	4	5'-0⅝"	11'-11⅛"		S76E	4	4'-11⅝"	11'-9⅛"
S77	4	5'-1⅛"	12'-0⅛"		S77E	4	5'-0⅛"	11'-10⅛"
S78	4	5'-1⅝"	12'-1⅛"		S78E	4	5'-0⅝"	11'-11⅛"
S79	4	5'-2⅛"	12'-2⅛"		S79E	4	5'-1⅛"	12'-0⅛"
S80	4	5'-2⅝"	12'-3⅛"		S80E	4	5'-1⅝"	12'-1⅛"
S81	4	5'-3⅛"	12'-4⅛"		S81E	4	5'-2⅛"	12'-2⅛"
S82	4	5'-3⅝"	12'-5⅛"		S82E	4	5'-2⅝"	12'-3⅛"
S83	4	5'-4⅛"	12'-6⅛"		S83E	4	5'-3⅛"	12'-4⅛"
S84	4	5'-4⅝"	12'-7⅛"		S84E	4	5'-3⅝"	12'-5⅛"
S85	4	5'-5"	12'-8"		S85E	4	5'-4"	12'-6"

CEDAR CREEK BRIDGE
DETAILS OF SUPERSTRUCTURE

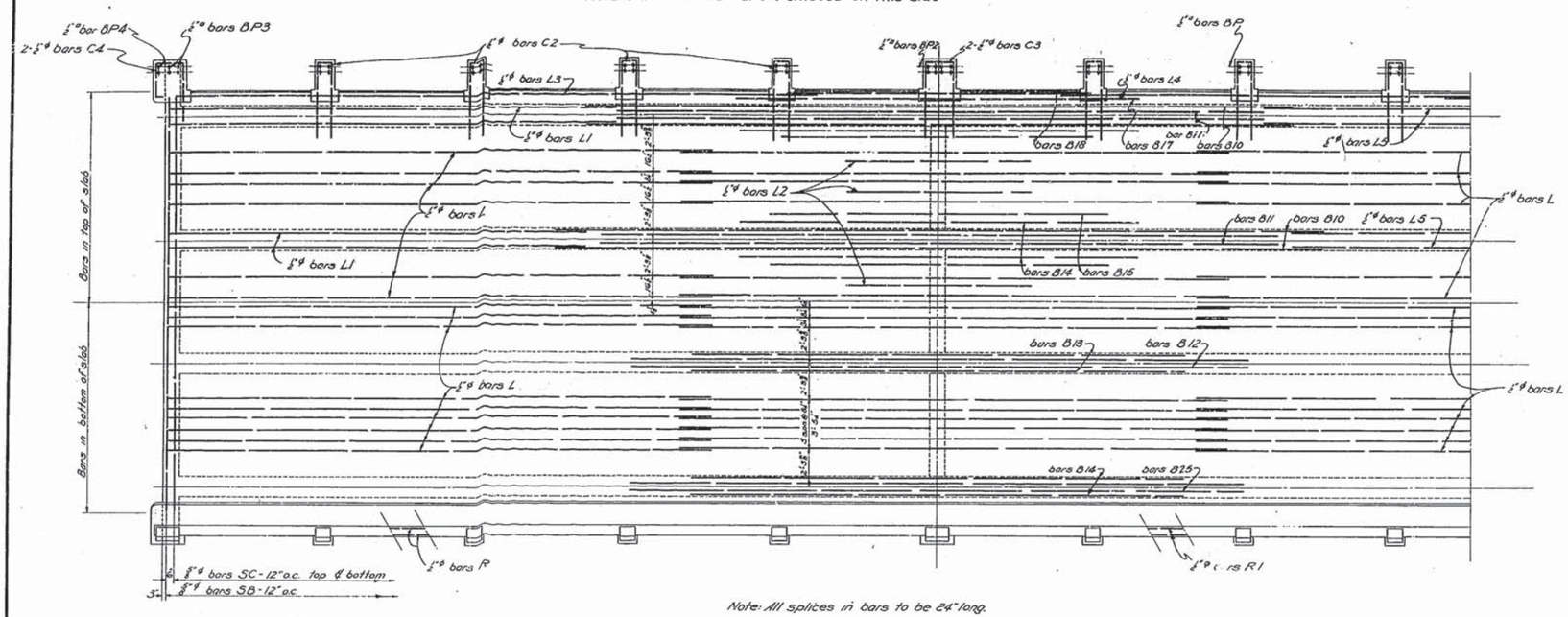
VIRGINIA DEPARTMENT OF HIGHWAYS
OFFICE OF THE BRIDGE ENGINEER
RICHMOND, VIRGINIA NOV. 1941

LXXIX-18
Sheet 3 of 5

3-9-18-7

FED. ROAD DIST. NO.	STATE	P.R.A. ROUTE NO.	P.R.A. PROJ. NO.	STATE RT. NO.	STATE PROJ. NO.	SHEET NO.	TOTAL SHEETS
14	VA.			55	12198-1	14C	16

Note: Handrail and curb removed on this side



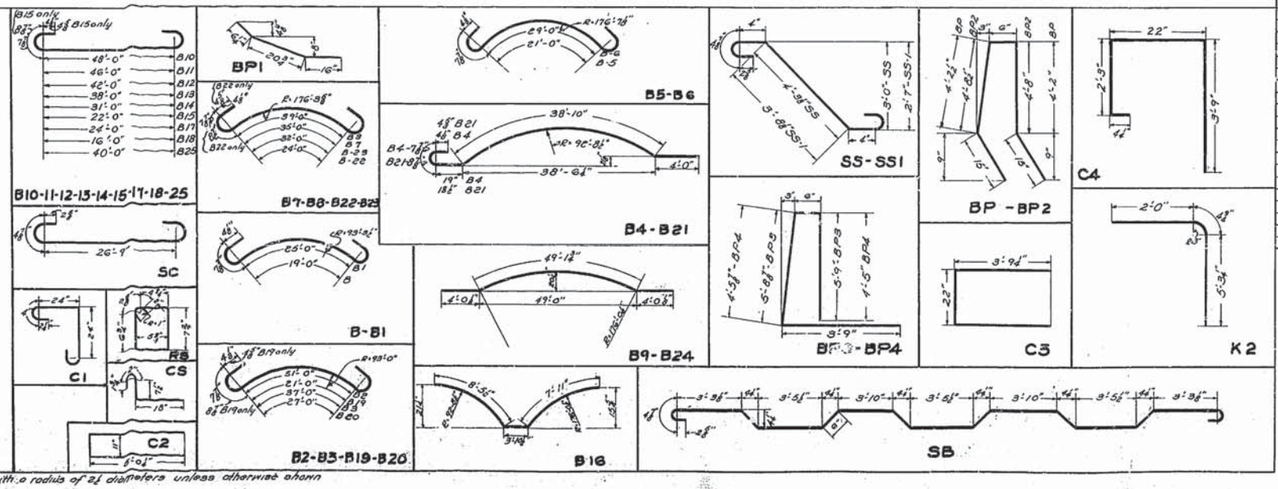
Note: All splices in bars to be 24" long.

HALF PLAN
SHOWING SPACING OF REINFORCING STEEL IN SLAB

BILL OF STEEL—SUPERSTRUCTURE

Mark	Size	No.	Length	Shape	Location
B	1" □	8	21'-0"	Bent	Int. Beam Span "A" & "C"
B1	1" □	8	27'-0"	"	" " " " " "
B2	1" □	8	33'-0"	"	" " " " " "
B3	1" □	8	39'-0"	"	" " " " " "
B4	1" □	16	45'-5"	"	" " " " " "
B5	1" □	4	23'-0"	"	Int. Beam Span "B"
B6	1" □	4	31'-0"	"	" " " "
B7	1" □	4	37'-0"	"	" " " "
B8	1" □	4	41'-0"	"	" " " "
B9	1" □	8	51'-2"	"	" " " "
B10	1" □	16	50'-0"	"	All Beam over support
B11	1" □	16	48'-0"	"	" " " "
B12	1" □	8	44'-0"	"	Int. Beams over support
B13	1" □	8	40'-0"	"	" " " "
B14	1" □	16	35'-0"	"	All " " "
B15	⅝" □	8	24'-3"	"	Int " " "
B16	1" □	32	20'-3"	"	All " " "
B17	1" □	8	26'-0"	"	Ext. " " "
B18	1" □	8	18'-0"	"	" " " "
B19	1⅛" □	8	23'-3	"	Ext. Beam spans "A" & "C"
B20	1" □	8	29'-0"	"	Ext. Beam Spans "A" & "C"
B21	⅝" □	16	45'-6"	"	" " " " " "
B22	⅛" □	4	26'-3"	"	" " Span "B"
B23	1" □	4	34'-0"	"	" " " " "
B24	⅝" □	8	57'-2"	"	" " " " "
B25	1" □	8	42'-0"	"	Ext. Beam over support
SS	⅝" ø	112	6'-2"	Bent	All beam span. "B"
SS1	⅝" ø	112	5'-7"	"	" " " " "A" & "C"
K	½" ø	42	4'-0"	Str.	Strut over pier
K1	½" ø	20	24'-0"	"	Strut and endwalls
K2	½" ø	42	7'-8"	Bent	End walls
SC	⅝" ø	340	28'-0"	Bent	Slab.
SB	⅝" ø	170	28'-9"	"	"
R	1" ø	48	26'-5"	Str.	Rail spans "A" & "C"
R1	1" ø	24	35'-5"	"	" span "B"
R5	#4qq.	462	2'-9"	Bent	"
CS	#4qq.	598	2'-5"	Bent	Curb
WG	½" ø	80	35'-11"	Str.	"
C1	1" ø	72	5'-0"	Bent	Curb blocks
C2	½" ø	28	10'-10"	"	Interm. brack.
C3	½" ø	8	9'-3"	"	Brack. over Piers
C4	½" ø	8	8'-0"	"	" " Abut.
BP	⅝" ø	56	11'-3"	Bent	Inter. Post.
BP1	½" ø	68	3'-7"	"	Brackets
BP2	⅝" ø	16	12'-8"	"	Post at Piers
BP3	⅝" ø	8	15'-7	"	" " Abut.
BP4	⅝" ø	4	13'-0"	"	" " "
L	1" ø	150	35'-6"	Str.	Slab
L1	1" ø	16	28'-4"	"	"
L2	1" ø	12	12'-0"	"	"
L3	1" ø	4	44'-2"	"	"
L4	1" ø	4	29'-6"	"	"
L5	1" ø	8	25'-0"	"	"

Note: See sheet No. 3 for schedule of stirrups.



DRAWN BY: J.T.T.
TRACED BY: F.I.A.
CHECKED BY: E.K.H.

Note: All bends to be with a radius of 2½ diameters unless otherwise shown

CEDAR CREEK BRIDGE
DETAILS OF REINFORCING STEEL

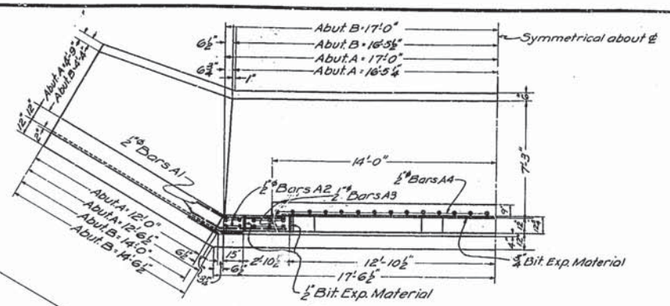
VIRGINIA DEPARTMENT OF HIGHWAYS
OFFICE OF THE BRIDGE ENGINEER
RICHMOND, VA. NOV. 1941

LXXIX-18

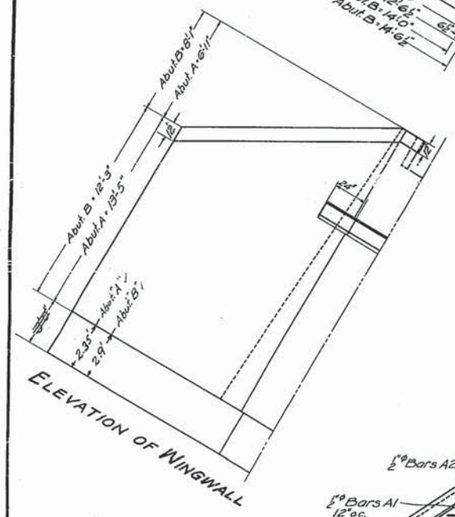
Scale ½" = 1'-0"

SHEET 4 of 5

Fed. Road Dist. No.	State	P.R.A. Route No.	P.R.A. Proj. No.	State Route No.	State Proj. No.	Sheet No.	Total Sheets
14	VA			55	121981	14D	16

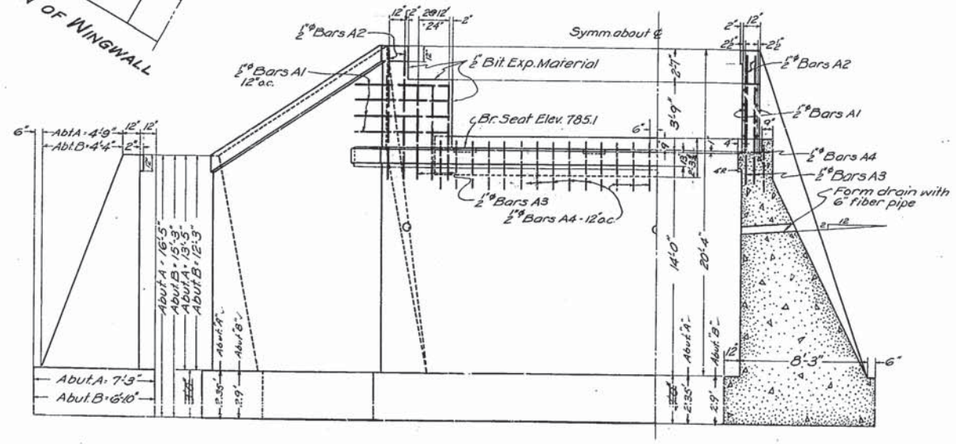


HALF PLAN



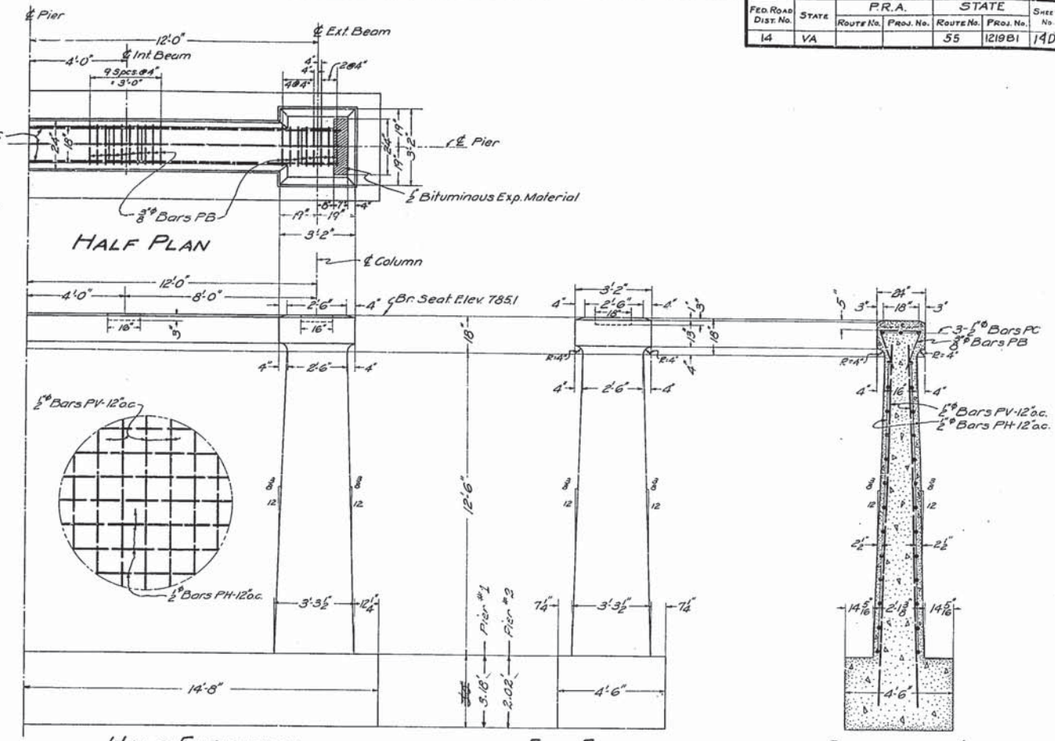
ELEVATION OF WINGWALL

NOTE:-
Bituminous expansion material on main bridge seats shall be set flush with the surface of the concrete.
Pockets, 5" deep for masonry plates shall be left in the bridge seats. The plates shall be set flush with the bridge seats in grout. The bearing plates shall be set to true position in the form and care shall be exercised to prevent concrete accumulating beneath them.



END ELEVATION — HALF FRONT ELEVATION — SECTION ON ℄

DETAILS OF ABUTMENTS



HALF ELEVATION — END ELEVATION — SECTION ON ℄

DETAILS OF PIERS

SCHEDULE OF REINFORCING STEEL

Mark	No.	Size	Length		Location	Bending Diagram
ABUTMENTS						A1
A1	32	⅝	5'-10"	Bent	Walls	
A2	16	⅝	8'-0"	Str.	"	
A3	24	⅝	6'-0"	"	"	
A4	56	⅝	3'-0"	"	Backwalls	
PIERS						
PC	6	⅝	26'-0"	Str.	Caps	
PH	52	½	24'-0"	"	Stems	
PV	84	½	15'-0"	"	"	
PB	72	⅝	4'-10"	Bent	Caps	

Note: All bends to be made with a radius of 2½ diameters unless otherwise noted.

CEDAR CREEK BRIDGE
DETAILS OF SUBSTRUCTURE

VIRGINIA DEPARTMENT OF HIGHWAYS
OFFICE OF THE BRIDGE ENGINEER
RICHMOND, VIRGINIA 1941

Drawn By: R.A.W.
Traced By: R.A.W.
Checked By: H.L.H.

Scales: ½ & ⅜" = 1'-0"

5f of 5 Sheets — LXXIX-18

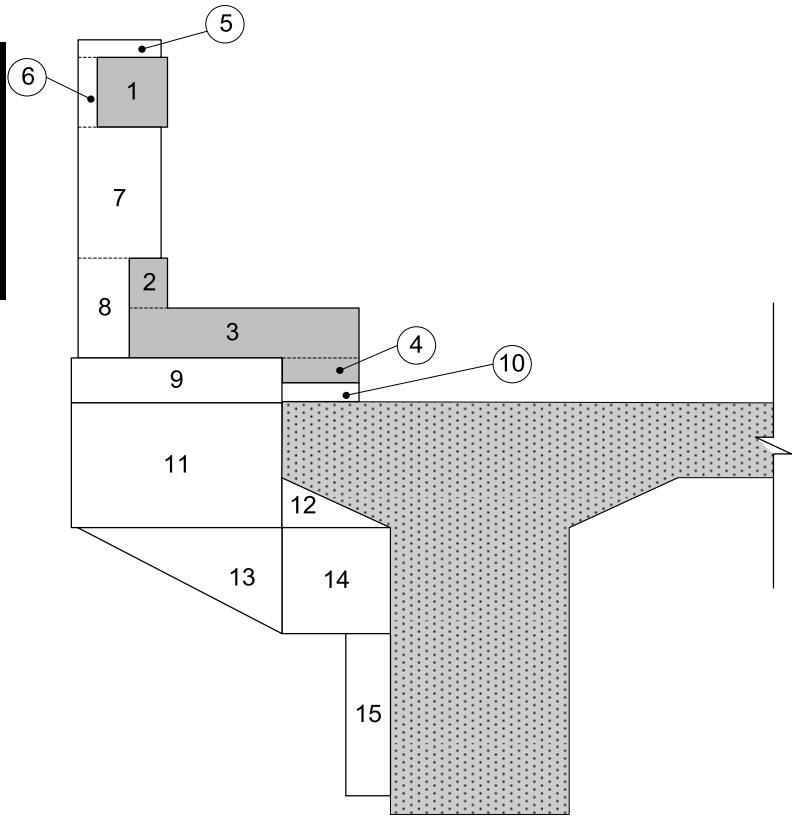
APPENDIX B: BARRIER WEIGHT CALCULATION

Concrete Rail and Post Load

Note: Shaded areas denote railing.
Non-shaded areas denote post.

γ_{conc} =	150	pcf
Length of Bridge =	169.00	ft
No.of Posts at Pier =	2	posts
No.of Int. Posts =	14	posts

Rail			
Shape ----------	Base in	Height in	Weight lb/ft
1	8.00	10.00	83.33
2	5.00	6.00	31.25
3	22.00	5.25	120.31
4	8.75	2.00	18.23



Post at Pier					
Shape ----------	Base in	Height in	Width in	Weight lb/ft	Weight lb
5	9.00	2.00	18	18.75	28.13
6	3.00	10.00	18	31.25	46.88
7	12.00	14.00	18	175.00	262.50
8	8.00	10.25	18	85.42	128.13
9	23.00	5.13	26	122.79	266.04
10	8.75	3.13	26	28.48	61.71
11	23.00	15.88	26	380.34	824.07
12	13.50	8.50	26	119.53	258.98
13	23.00	14.88	15	356.38	445.48
14	13.50	14.88	15	209.18	261.47
15	4.38	45.50	24	207.36	414.71

Intermediate Post					
Shape ----------	Base in	Height in	Width in	Weight lb/ft	Weight lb
5	9.00	2.00	12	18.75	18.75
6	3.00	10.00	12	31.25	31.25
7	12.00	14.00	12	175.00	175.00
8	8.00	10.25	12	85.42	85.42
9	23.00	5.13	15	122.79	153.48
10	8.75	3.13	15	28.48	35.60
11	24.50	11.38	15	290.30	362.87
12	0.00	0.00	0	0.00	0.00
13	27.50	14.88	10	426.11	355.09
14	10.00	14.88	10	154.95	129.12
15	0.00	0.00	0	0.00	0.00

Summary

Weight of Rail as Distributed Load =		253.13	lb/ft
Weight of Posts at Pier as Distributed Load =		35.48	lb/ft
Weight of Intermediate Posts as Distributed Load =	+	111.55	lb/ft

Weight of Rail and Post as Distributed Load =	**0.400**	**kip/ft**

APPENDIX C: LFD EFFECTIVE FLANGE WIDTH

LFD Effective Flange Width (AASHTO 8.10)

	Span 1 & 3		Span 2		
GIRDERS	G1	G2	G1	G2	
EFFECTIVE SPAN LENGTH, S_{EFF}	50.00	50.00	69.00	69.00	FT
EFFECTIVE SLAB THICKNESS, T_{EFF}	7.00	7.00	7.00	7.00	IN
WEB THICKNESS, T_{WEB}	16.00	16.00	16.00	16.00	IN
AVG BEAM SPACING	8.00	8.00	8.00	8.00	FT
$W_{OVERHANG}$	1.79		1.79		FT

INTERIOR BEAM EFFECTIVE FLANGE WIDTH; THE LEAST OF:

1/4 (S_{EFF}) =		150.00		207.00	IN
12 (T_{EFF}) + MAX T_{WEB} =		100.00		100.00	IN
AVG BEAM SPACING =		96.00		96.00	IN
B_{INTEFF} =		**96.00**		**96.00**	IN

EXTERIOR BEAM EFFECTIVE FLANGE WIDTH; THE LEAST OF:

1/4 (S_{EFF}) =	150.00		207.00		IN
12 (T_{EFF}) + MAX T_{WEB} =	100.00		100.00		IN
$W_{OVERHANG}$ + AVG BM SPACING/2 =	69.50		69.50		IN
B_{EXTEFF} =	**69.50**		**69.50**		IN

APPENDIX D: LRFR RATING FORM

VDOT Virginia Department of Transportation

Structure and Bridge

LOAD RATING SUMMARY FORM FOR STRUCTURES

Rte.: 00055, John Marshall Highway
Over: Cedar Creek

Va. Str. No.: 1996
Fed. ID: 08108

County: Frederick
District: Staunton

Rated By: ABC Date: 10/15/11
Checked By: DEF Date: 10/19/11
VDOT Reviewer: _____

Signature: _____
Name: _____ Date:_____

Calculation Tools/Method Used: Virtis 6.2 – Virtis LRFR Engine
Basis for Rating: Conversion to LRFR

	GVW (TONS)	RATING	CONTROLLING MEMBERS	CONTROLLING LOCATION (FT)	CONTROLLING FORCE
DESIGN LOAD		FACTOR			
***HL-93 (INV)	N/A	0.49****	G1	143.00	STR-I Concrete Flexure
***HL-93 (OPR)	N/A	0.64****	G1	143.00	STR-I Concrete Flexure
		TONS			
HS-20 (INV)	36	23****	G1	143.00	STR-I Concrete Flexure
HS-20 (OPR)	36	30****	G1	143.00	STR-I Concrete Flexure
LEGAL LOADS		TONS	**		
VA Type 3	27	30	G1	143.00	STR-I Concrete Flexure
VA Type 3S2	40	43	G1	143.00	STR-I Concrete Flexure
*, ***LANE	40	67	G2	119.00	STR-I Concrete Flexure
PERMIT LOAD		TONS			
BP-90	45	37****	G1	143.00	STR-II Concrete Flexure
BP-115	57.5	57****	G1	20.00	STR-II Concrete Flexure
SH VEHICLES		TONS	**		
NRL	40	28****	G1	143.00	STR-I Concrete Flexure
SU4	27	26****	G1	84.50	STR-I Concrete Flexure
SU5	31	28****	G1	143.00	STR-I Concrete Flexure
SU6	34.75	28****	G1	143.00	STR-I Concrete Flexure
SU7	38.75	28****	G1	143.00	STR-I Concrete Flexure

* Not applicable for single spans less than and equal to 200 feet.
** FOR LFR or ASD: Denote if it is a mid range or operating level for posting and provide the safe posting load.
*** Not applicable for LF/AS rating methods.
**** Denotes does not meet the rating requirements.

Baker

Virginia Department of Transportation

Structure and Bridge

LOAD RATING SUMMARY FORM FOR STRUCTURES

INSPECTION REPORT USED FOR THIS RATING: 0341996-000000000008108 06/01/2010

ASSUMPTIONS/COMMENTS BY LOAD RATING ENGINEER:

Bridge No. 08108 – Three Span Continuous Reinforced Concrete Tee-Beam Bridge

1. Plan 079-18 was used for the rating.

2. Sacrificial wearing surface = 0.50 in.

3. Based on year built 1942 and using the information contained in the VDOT BARS Custom Data:
    a. Reinforcing steel yield point = 33 ksi.
    b. Concrete compressive strength of 3.0 ksi.

Latest version of this form is SB502 and is available on the VDOT Structure and Bridge web site under “Useful Information.”