

AASHTOWare BrD 6.8

BrR and BrD Tutorial

CNVRT1 – Converting Girder Line to Girder System Example

BrR and BrD Training

CNVRT1 – Converting Girder Line to Girder System Example

This example illustrates how to convert a girder line superstructure definition to a girder system superstructure definition.

You will need to consult the design plans for the bridge to obtain the following types of items to convert a girder line to a girder system:

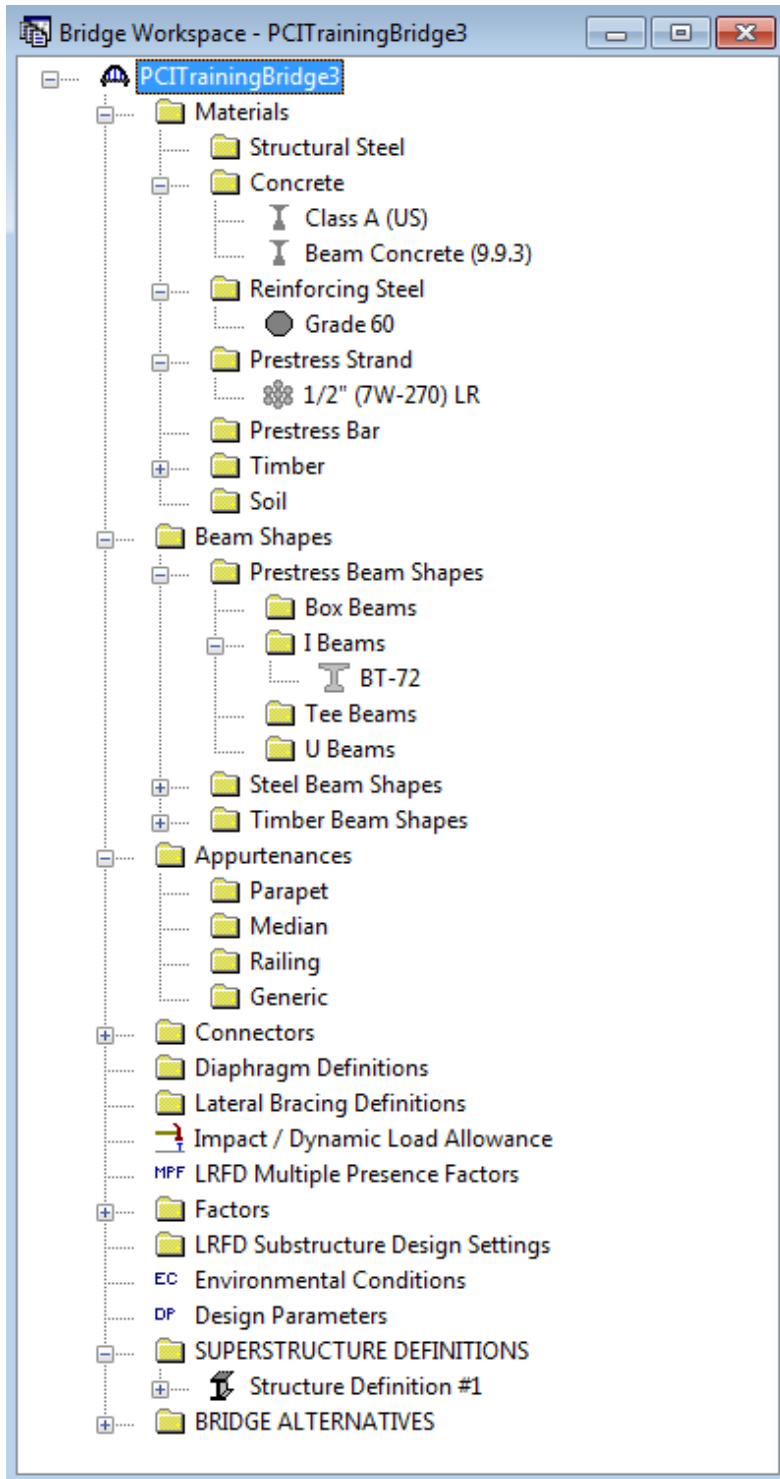
- Overall width of deck, location of travelway lanes, etc.
- Appurtenance dimensions
- Number of girders
- Framing plan skews

In this example we will convert PCITrainingBridge3 from a girder line to a girder system structure definition. PCITrainingBridge3 is a single span prestressed I beam. Select PCITrainingBridge3 on the right portion of the Bridge Explorer and open its Bridge Workspace tree.

| BID | Bridge ID | Bridge Name | District | County |
|-----|--------------------------|-----------------------------------|----------|-------------|
| 1 | TrainingBridge1 | Training Bridge 1(LRFD) | | |
| 2 | TrainingBridge2 | Training Bridge 2(LRFD) | Unknown | Unknown (P) |
| 3 | TrainingBridge3 | Training Bridge 3(LRFD) | | |
| 4 | PCITrainingBridge1 | PCI TrainingBridge1(LFD) | | |
| 5 | PCITrainingBridge2 | PCITrainingBridge2(LRFD) | | |
| 6 | PCITrainingBridge3 | PCI TrainingBridge3(LFD) | | |
| 7 | PCITrainingBridge4 | PCITrainingBridge4(LRFD) | | |
| 8 | PCITrainingBridge5 | PCI TrainingBridge5(LFD) | | |
| 9 | PCITrainingBridge6 | PCITrainingBridge6(LRFD) | | |
| 10 | Example7 | Example 7 PS (LFD) | | |
| 11 | RCTrainingBridge1 | RC Training Bridge1(LFD) | | |
| 12 | TimberTrainingBridge1 | Timber Tr. Bridge1 (ASD) | | |
| 13 | FSys GFS TrainingBridge1 | FloorSystem GFS Training Bridge 1 | | |
| 14 | FSys FS TrainingBridge2 | FloorSystem FS Training Bridge 2 | | |

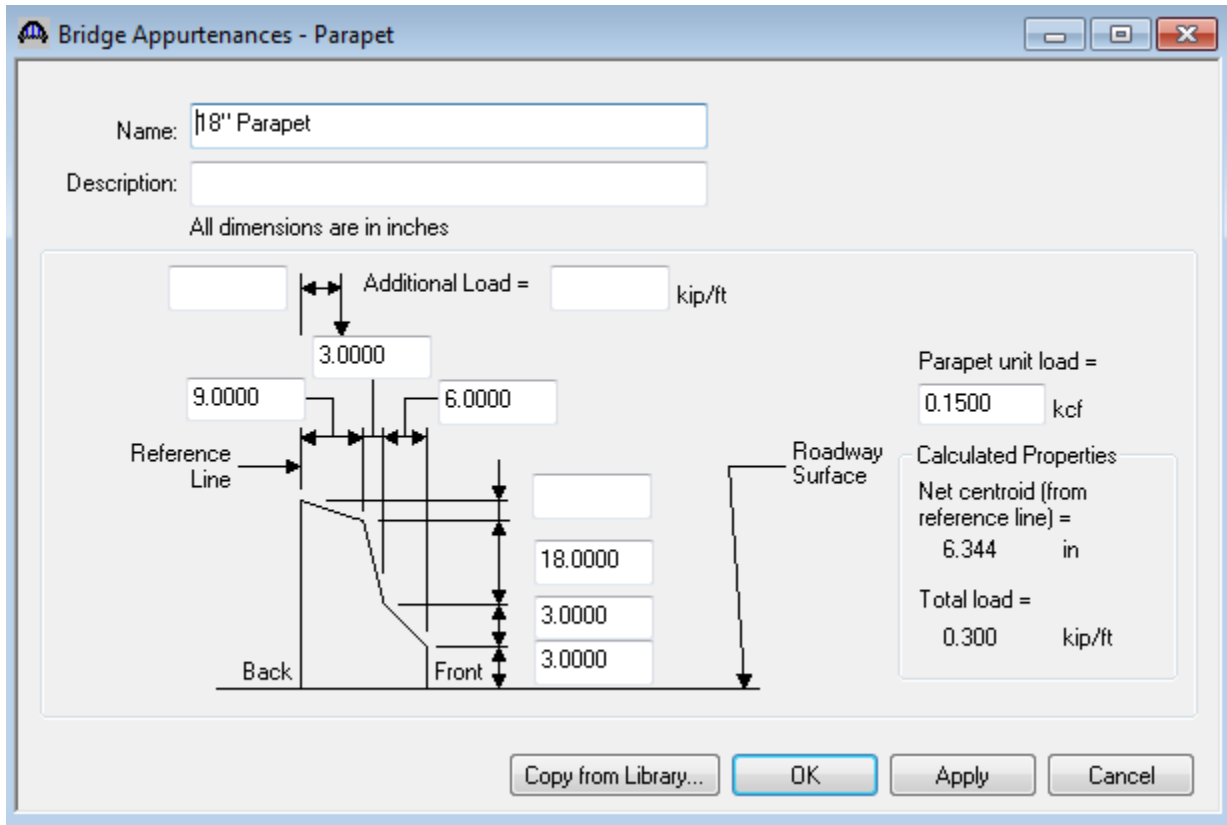
CNVRT1 – Converting Girder Line to Girder System Example

The following view of the expanded Bridge Workspace tree shows the materials and beam shapes that currently exist for this bridge. Any superstructure definitions that belong to this bridge will have access to these materials and beam shapes so we do not need to add any materials or beam shapes to the bridge to convert this girder line structure definition.



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Add a parapet to this bridge by selecting “Parapet” in the Bridge Workspace tree and selecting New. Enter the following data to describe the parapet:



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Now create a new girder system superstructure definition and enter the following data:

Girder System Superstructure Definition

Definition | Analysis | Specs | Engine

Name: 6 Girder System

Description:

Default Units: US Customary

Number of spans: 1

Number of girders: 6

Enter Span Lengths Along the Reference Line:

| Span | Length (ft) |
|------|-------------|
| 1 | 120.00 |

Frame Structure Simplified Definition:

Deck type: Concrete

For PS only

Average humidity: %

Member Alt. Types

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

Horizontal Curvature Along Reference Line

Horizontal curvature

Superstructure Alignment

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

Distance from PC to first support line: ft

Start tangent length: ft

Radius: ft

Direction: Left

End tangent length: ft

Distance from last support line to PT: ft

Design speed: mph

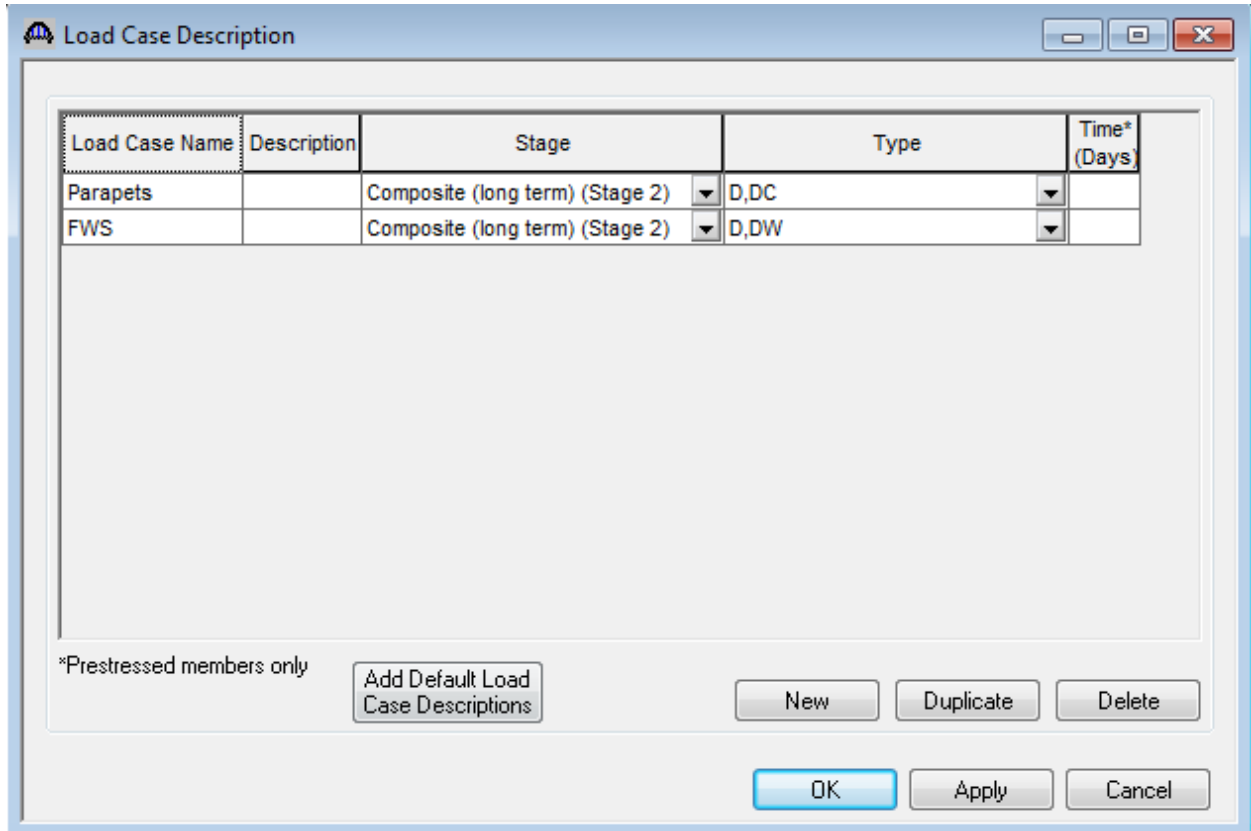
Superelevation: %

OK Apply Cancel

As we enter data for the new girder system superstructure definition, we will need to open windows for the original girder line superstructure definition to determine if there is data that needs to be copied from the original girder line superstructure. The Average Humidity on the superstructure definition window is an example of such data. Open the “Structure Definition #1” girder line window to determine that the original superstructure does not have any data for that item. If it did, we would need to copy that data to the new girder system superstructure definition.

CNVRT1 – Converting Girder Line to Girder System Example

Now add Load Case Descriptions to the new superstructure definition. Open the Load Case Description for the original girder line “Structure Definition #1” and you will see the following window:



Enter these same load cases for the new “6 Girder System” superstructure definition. Open the Load Case Description window belonging to the new “6 Girder System” superstructure definition and enter these same load cases. Click the OK button to save these load cases to the new superstructure definition and close the window.

CNVRT1 – Converting Girder Line to Girder System Example

Open the Structure Framing Plan Details window for the “6 Girder System” and enter the following data:

Structure Framing Plan Details

Number of spans = 1 Number of girders = 6

Layout Diaphragms

| Support | Skew (Degrees) |
|---------|----------------|
| 1 | 0.0000 |
| 2 | 0.0000 |

Girder Spacing Orientation

Perpendicular to girder

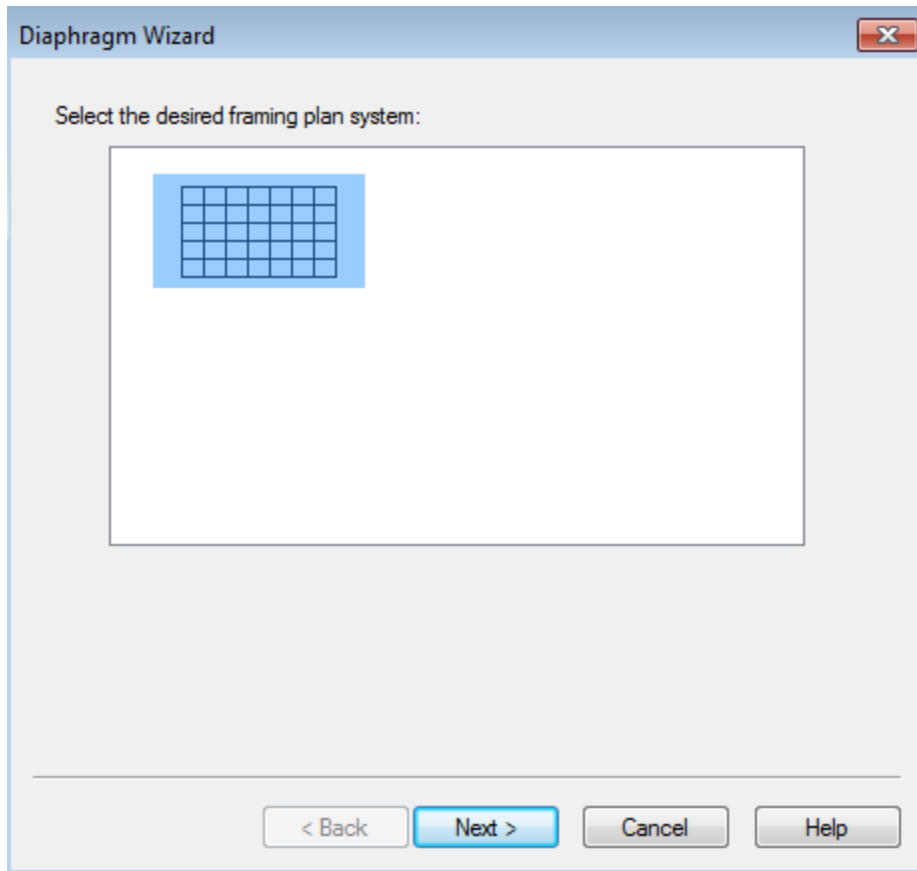
Along support

| Girder Bay | Girder Spacing (ft) | |
|------------|---------------------|---------------|
| | Start of Girder | End of Girder |
| 1 | 9.00 | 9.00 |
| 2 | 9.00 | 9.00 |
| 3 | 9.00 | 9.00 |
| 4 | 9.00 | 9.00 |
| 5 | 9.00 | 9.00 |

OK Apply Cancel

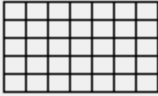
CNVRT1 – Converting Girder Line to Girder System Example

Select the Diaphragms tab and use the Diaphragm Wizard as follows to create the diaphragms:



CNVRT1 – Converting Girder Line to Girder System Example

Diaphragm Wizard



Diaphragm Spacing

Enter number of equal spaces per span

Enter equal spacing per span

Enter groups of equal spacing

Support diaphragm load: kip

Interior diaphragm load: kip

| Span | Length (ft) | Number of Equal Spaces |
|------|-------------|------------------------|
| 1 | 120.00 | 2 |

< Back Finish Cancel Help

Structure Framing Plan Details

Number of spans = Number of girders =

Layout Diaphragms

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

| Support Number | Start Distance (ft) | | Diaphragm Spacing (ft) | Number of Spaces | Length (ft) | End Distance (ft) | | Load (kip) | Diaphragm |
|----------------|---------------------|--------------|------------------------|------------------|-------------|-------------------|--------------|--------------------|-----------|
| | Left Girder | Right Girder | | | | Left Girder | Right Girder | | |
| 1 | 0.00 | 0.00 | 0.00 | 1 | 0.00 | 0.00 | 0.00 | -- Not Assigned -- | |
| 1 | 60.00 | 60.00 | 0.00 | 1 | 0.00 | 60.00 | 60.00 | -- Not Assigned -- | |
| 1 | 60.00 | 60.00 | 60.00 | 1 | 60.00 | 120.00 | 120.00 | -- Not Assigned -- | |

New Duplicate Delete

OK Apply Cancel

CNVRT1 – Converting Girder Line to Girder System Example

(Note: PCITrainingBridge3 as delivered in your sample database does not have any diaphragms entered in the Bracing Ranges window for Member Alternative “Member Alternative #1 (9.9.3)”. That is in error, it should have diaphragms.)

Open the Structure Typical Section window for “6 Girder System” and enter the following on the Deck tab:

Structure Typical Section

Distance from left edge of deck to superstructure definition ref. line | Distance from right edge of deck to superstructure definition ref. line

Deck thickness | Superstructure Definition Reference Line

Left overhang | Right overhang

Deck | Deck (Cont'd) | Parapet | Median | Railing | Generic | Sidewalk | Lane Position | Striped Lanes | Wearing Surface

Superstructure definition reference line is within the bridge deck.

| | Start | End |
|--|----------|----------|
| Distance from left edge of deck to superstructure definition reference line = | 25.50 ft | 25.50 ft |
| Distance from right edge of deck to superstructure definition reference line = | 25.50 ft | 25.50 ft |
| Left overhang = | 3.00 ft | 3.00 ft |
| Computed right overhang = | 3.00 ft | 3.00 ft |

OK Apply Cancel

CNVRT1 – Converting Girder Line to Girder System Example

Next, select the Deck (Cont'd) tab and enter the following:

Structure Typical Section

Distance from left edge of deck to superstructure definition ref. line

Distance from right edge of deck to superstructure definition ref. line

Deck thickness

Superstructure Definition Reference Line

Left overhang

Right overhang

Deck Deck (Cont'd) Parapet Median Railing Generic Sidewalk Lane Position Striped Lanes Wearing Surface

Deck concrete: Class A (US)

Total deck thickness: 8.0000 in

Load case: Engine Assigned

Deck crack control parameter: kip/in

Sustained modular ratio factor: 2.000

Deck exposure factor:

OK Apply Cancel

CNVRT1 – Converting Girder Line to Girder System Example

The parapet locations are entered as follows on the Parapet tab:

The screenshot shows the 'Structure Typical Section' window with the 'Parapet' tab selected. At the top, a diagram of a parapet cross-section is shown with 'Back' and 'Front' labels. Below the diagram is a table with columns for Name, Load Case, Measure To, Edge of Deck Dist. Measured From, Distance At Start (ft), Distance At End (ft), and Front Face Orientation. Two rows are present in the table, both for '18" Parapet' with 'Parapets' as the load case. The first row is measured to the 'Back' 'Left Edge' with 0.00 ft at both start and end, and a 'Right' orientation. The second row is measured to the 'Back' 'Right Edge' with 0.00 ft at both start and end, and a 'Left' orientation. At the bottom of the window are buttons for 'New', 'Duplicate', 'Delete', 'OK', 'Apply', and 'Cancel'.

| Name | Load Case | Measure To | Edge of Deck Dist. Measured From | Distance At Start (ft) | Distance At End (ft) | Front Face Orientation |
|-------------|-----------|------------|----------------------------------|------------------------|----------------------|------------------------|
| 18" Parapet | Parapets | Back | Left Edge | 0.00 | 0.00 | Right |
| 18" Parapet | Parapets | Back | Right Edge | 0.00 | 0.00 | Left |

CNVRT1 – Converting Girder Line to Girder System Example

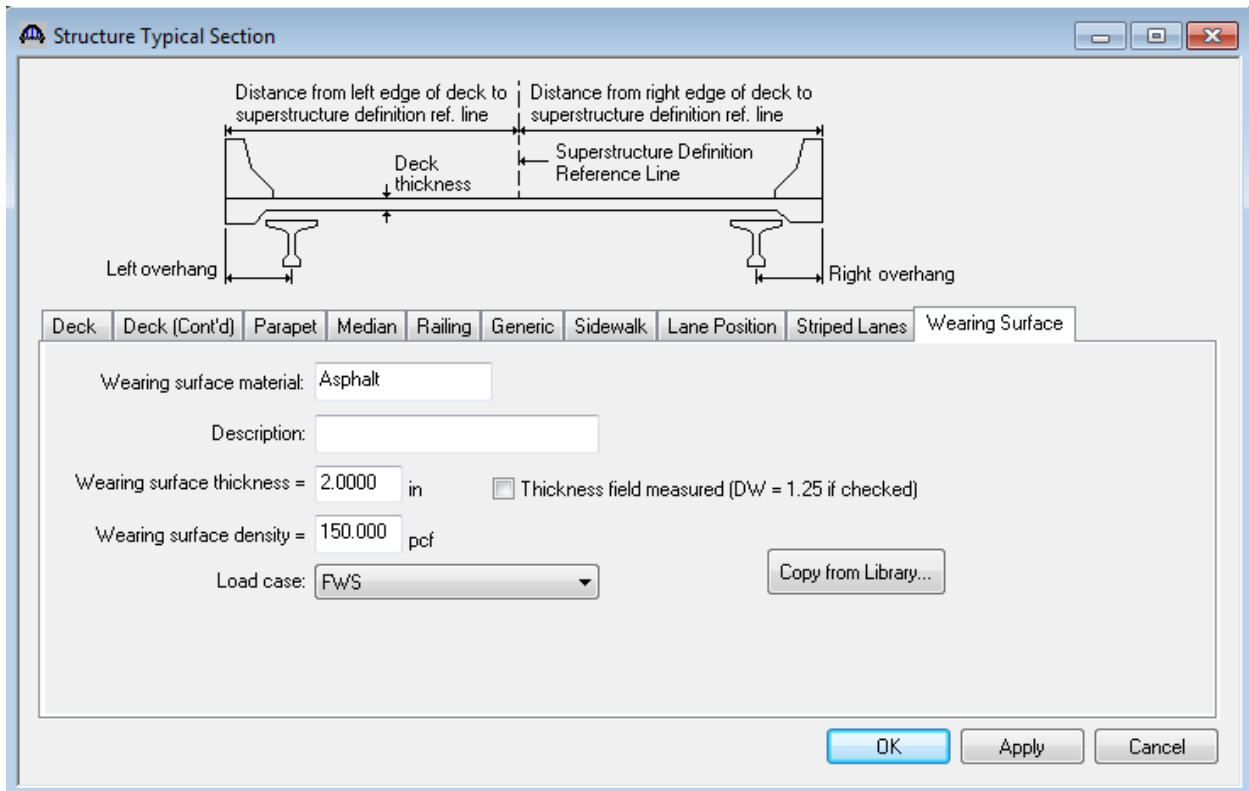
Open the Lane Position tab and use the Compute button to compute the travelway locations.

| Travelway Number | Distance From Left Edge of Travelway to Superstructure Definition Reference Line At Start (A) (ft) | Distance From Right Edge of Travelway to Superstructure Definition Reference Line At Start (B) (ft) | Distance From Left Edge of Travelway to Superstructure Definition Reference Line At End (A) (ft) | Distance From Right Edge of Travelway to Superstructure Definition Reference Line At End (B) (ft) |
|------------------|--|---|--|---|
| 1 | -24.00 | 24.00 | -24.00 | 24.00 |

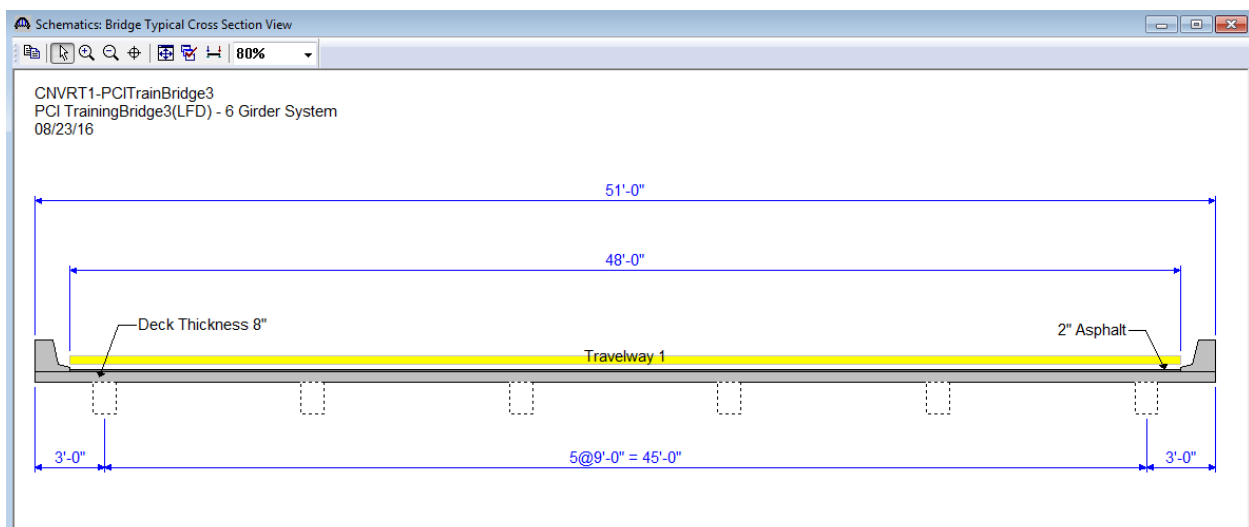
LRFD Fatigue
 Lanes available to trucks:
 Override Truck fraction:

CNVRT1 – Converting Girder Line to Girder System Example

Enter the wearing surface data as follows on the Wearing Surface tab:

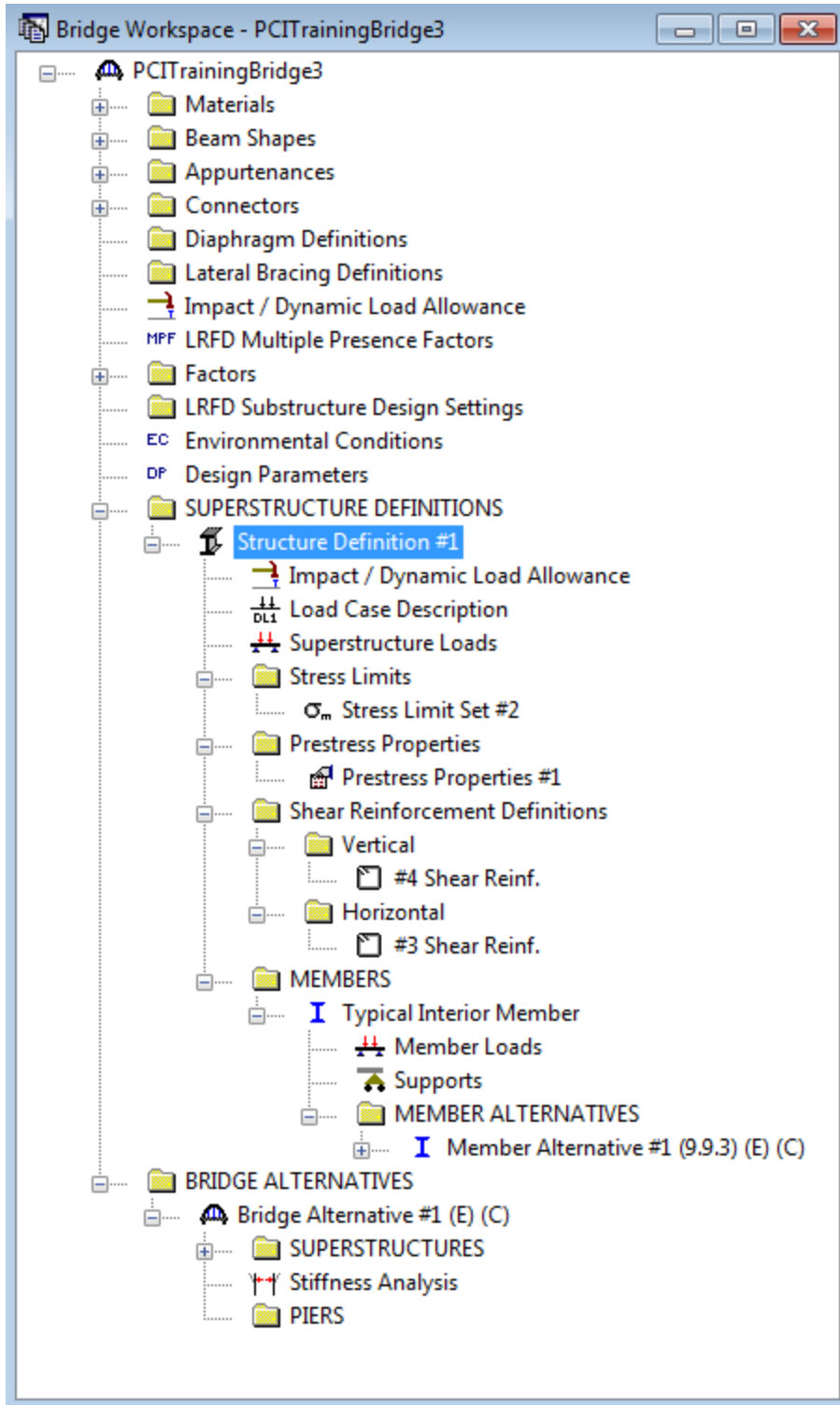


Now view the schematic for the Structure Typical Section for “6 Girder System”.



CNVRT1 – Converting Girder Line to Girder System Example

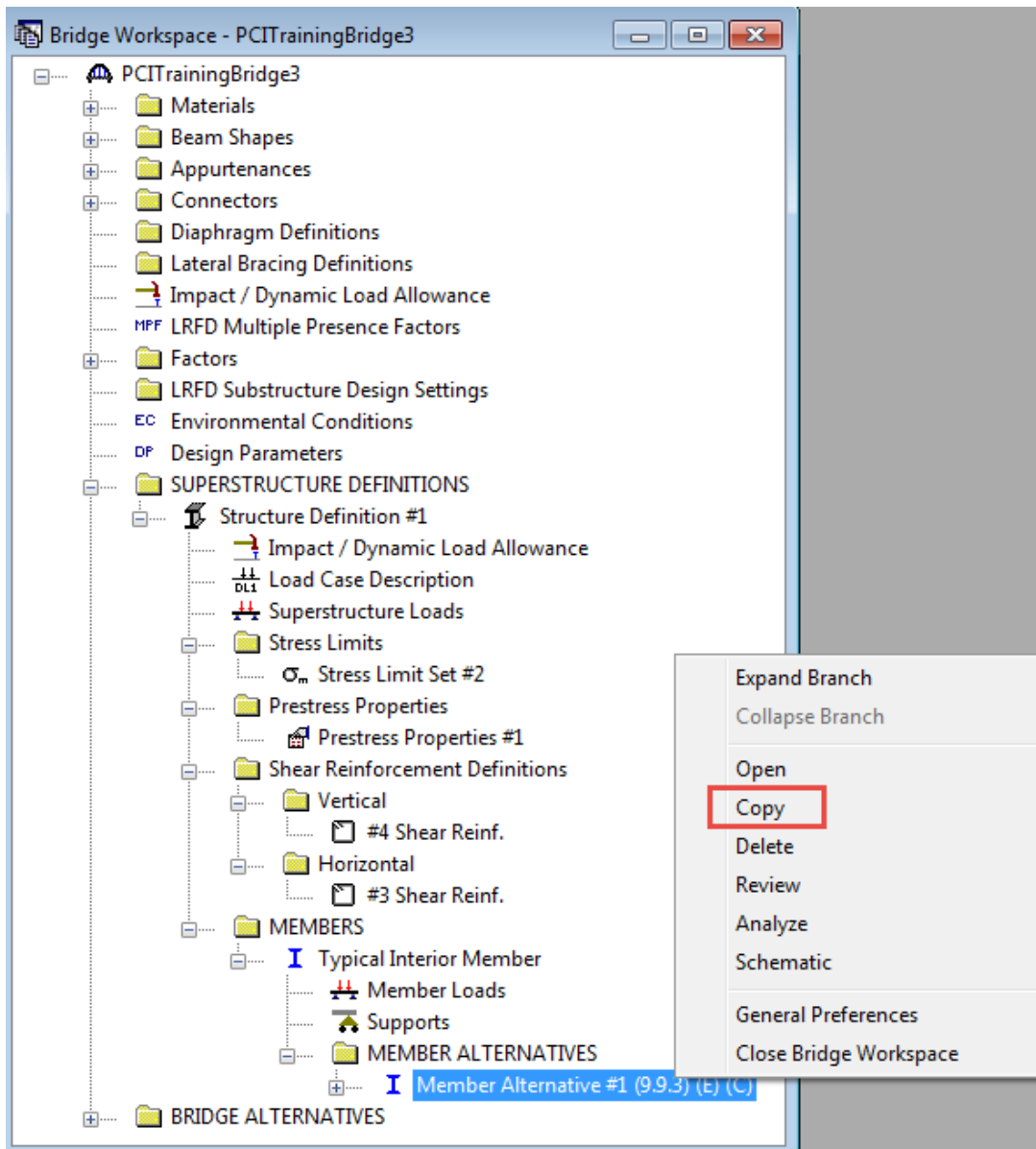
Expand the BWS tree for the original girder line “Structure Definition #1”.



CNVRT1 – Converting Girder Line to Girder System Example

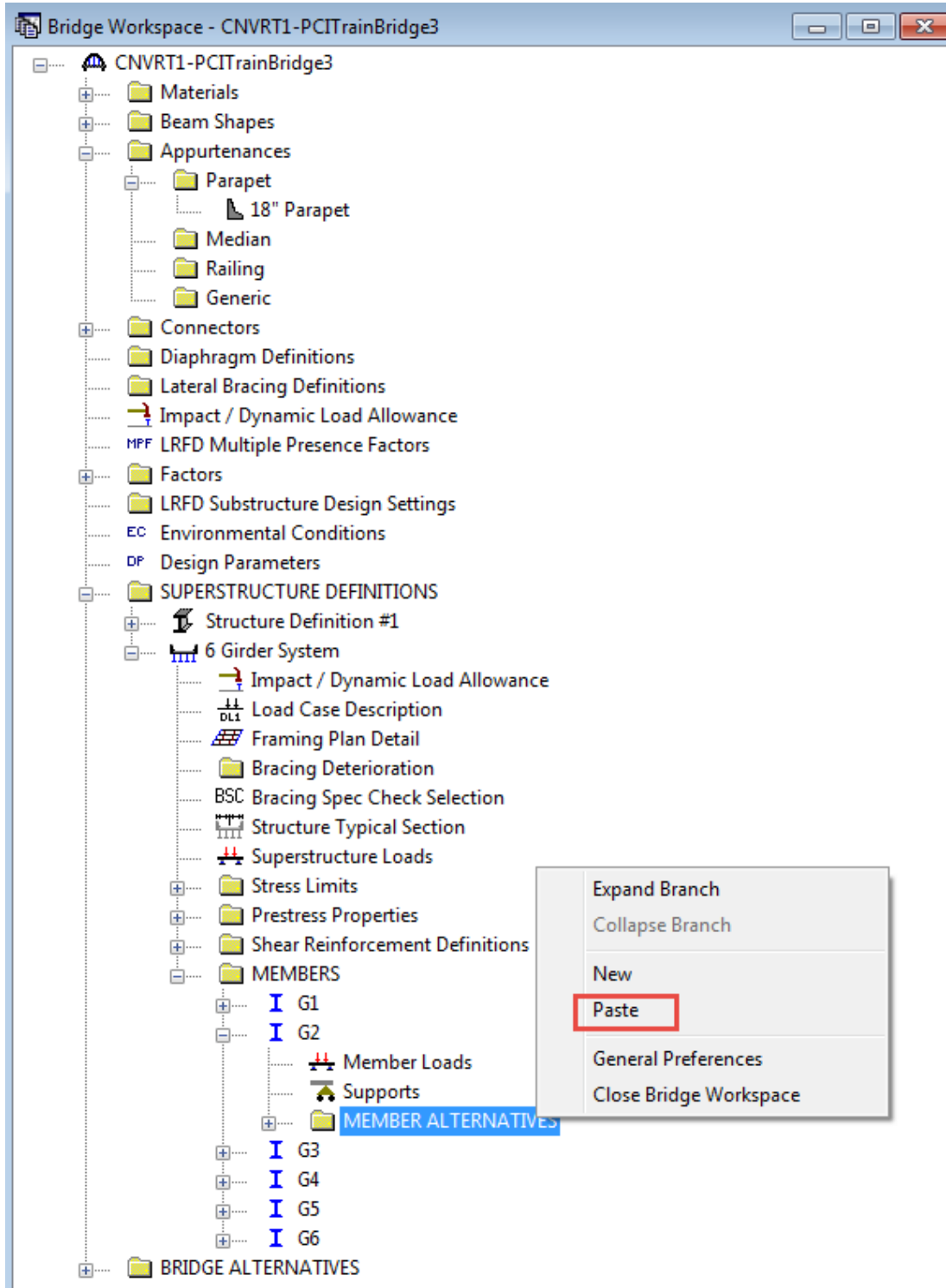
This structure already has data defined for the Stress Limits, Prestress Properties and Shear Reinforcement Definitions. It also has a Member Alternative for an interior member. The Member Alternative can be copied from this original superstructure definition to the new “6 Girder System” superstructure definition. When the Member Alternative is copied, the Stress Limits, Prestress Properties and Shear Reinforcement definitions belonging to the girder line superstructure will also be copied.

Select “Member Alternative #1 (9.9.3)” in the tree and right click the mouse. Select “Copy” from the menu that appears.



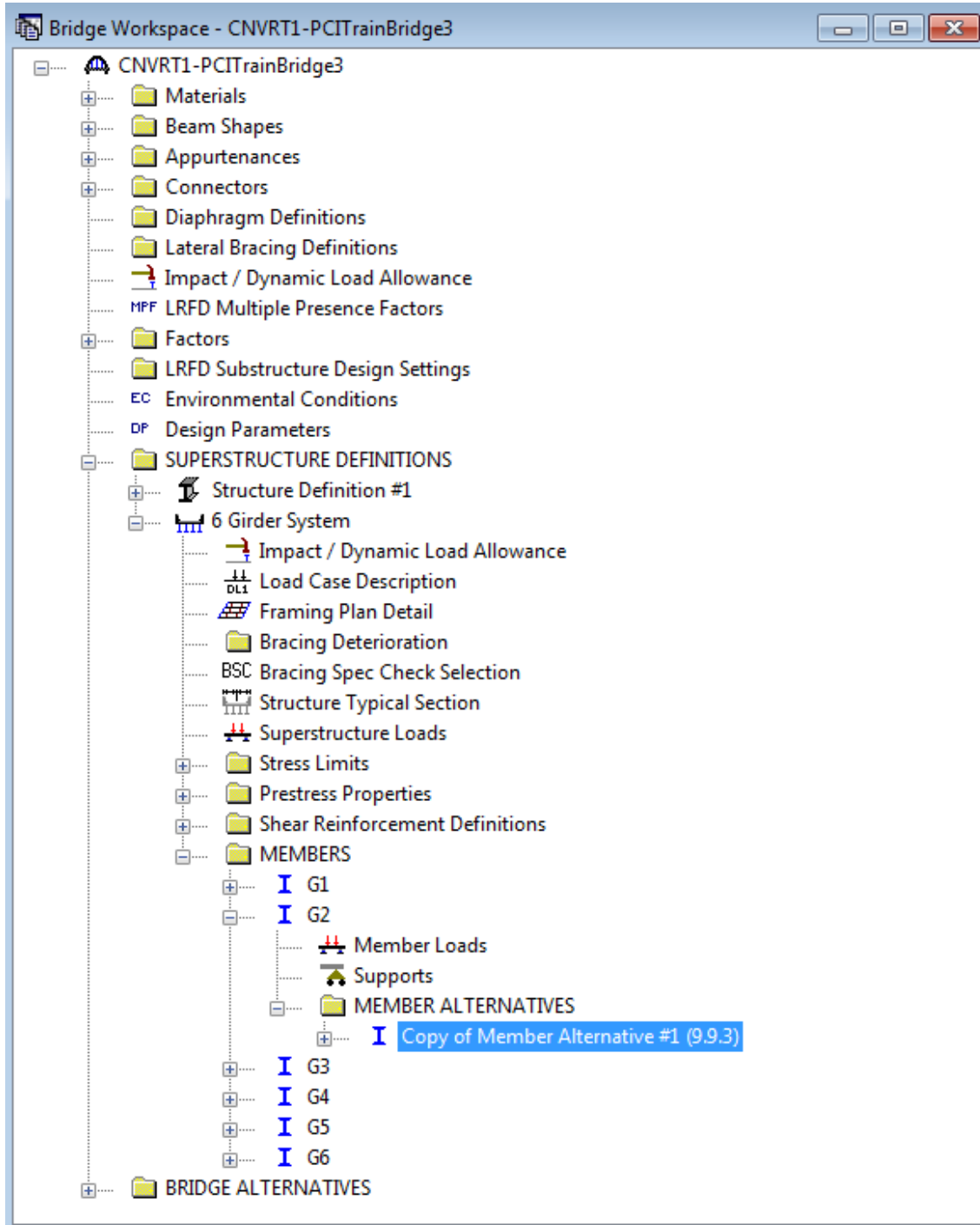
CNVRT1 – Converting Girder Line to Girder System Example

Now select “MEMBER ALTERNATIVES” under the Member G2 in the “6 Girder System” superstructure definition, right click the mouse and select Paste.



CNVRT1 – Converting Girder Line to Girder System Example

“Copy of Member Alternative #1 (9.9.3)” will now appear under Member G2 in the “6 Girder System” Bridge Workspace tree. The Stress Limit, Prestress Properties, and Shear Reinforcement Definitions will also now appear under the “6 Girder System” BWS tree.



CNVRT1 – Converting Girder Line to Girder System Example

We should now check for differences between the original girder line member and the new girder system member. Open the “Typical Interior Member” window and review the data on it to determine if any data such as the “Pedestrian Load” should be entered for the new “G2” member. You will need to compare such data in many locations. You can open each window or you can use the Report Tool to compare the data.

You have two choices as to how the dead loads will be entered and distributed in the new girder system superstructure definition. The method you choose will depend on the original girder line member’s Member Load data and the amount of calculations you wish to perform.

- Method 1: You can let BrR compute and distribute the superstructure load. You will need to compute any additional loads that should be applied to the members (stay-in-place forms, e.g.). Some of these loads may already be entered for the original girder line member lumped together with parapet loads, etc. It may take some computations to determine what portion of the original girder line member loads is due to loads that can be computed and distributed by BrR.
- Method 2: You can tell BrR not to compute and distribute the deck load. You can copy the original girder line Member Loads to the new girder system member. You will need to compute dead load due to the deck slab that acts on that particular girder and enter that as a member load for the new girder system member.

CNVRT1 – Converting Girder Line to Girder System Example

We will follow Method 1 first in this example.

Method 1: In a girder system superstructure, BrR will determine the dead load due to the deck slab and appurtenances located on the deck. BrR uses the data on the Superstructure Loads window to determine how to distribute this dead load.

The screenshot shows the 'Superstructure Loads' dialog box with the 'DL Distribution' tab selected. The dialog is divided into two sections: 'Stage 1 Dead Load Distribution' and 'Stage 2 Dead Load Distribution'. Each section has four radio button options: 'By tributary area', 'By transverse simple-beam analysis', 'By transverse continuous-beam analysis', and 'By percentage'. Below the 'By percentage' options in both sections is a table with columns 'Girder' and 'Percentage (%)'. The 'By percentage' option is selected in both sections. At the bottom of the dialog are 'OK', 'Apply', and 'Cancel' buttons.

Superstructure Loads

Uniform Temperature Gradient Temperature Wind DL Distribution

Stage 1 Dead Load Distribution

By tributary area
 By transverse simple-beam analysis
 By transverse continuous-beam analysis
 By percentage

| Girder | Percentage (%) |
|--------|----------------|
| 1 | |
| 2 | |
| 3 | |

User-defined dead load

Stage 2 Dead Load Distribution

Uniformly to all girders
 By tributary area
 By transverse simple-beam analysis
 By transverse continuous-beam analysis
 By percentage

| Girder | Percentage (%) |
|--------|----------------|
| 1 | |
| 2 | |
| 3 | |

User-defined dead load

OK Apply Cancel

CNVRT1 – Converting Girder Line to Girder System Example

Open the “Member Loads” window for the original girder line member and review the data on that window. This original member has two uniform load cases, one for the “FWS” load case and one for the “Parapets” load case. For this example, these loads are easily verifiable with the data we have entered on the Structure Typical Section window.

$$\text{FWS(Future Wearing Surface): } 0.2k / ft = \frac{\left(\frac{2''}{12}\right)(48')(0.150kcf)}{6 \text{ girders}}$$

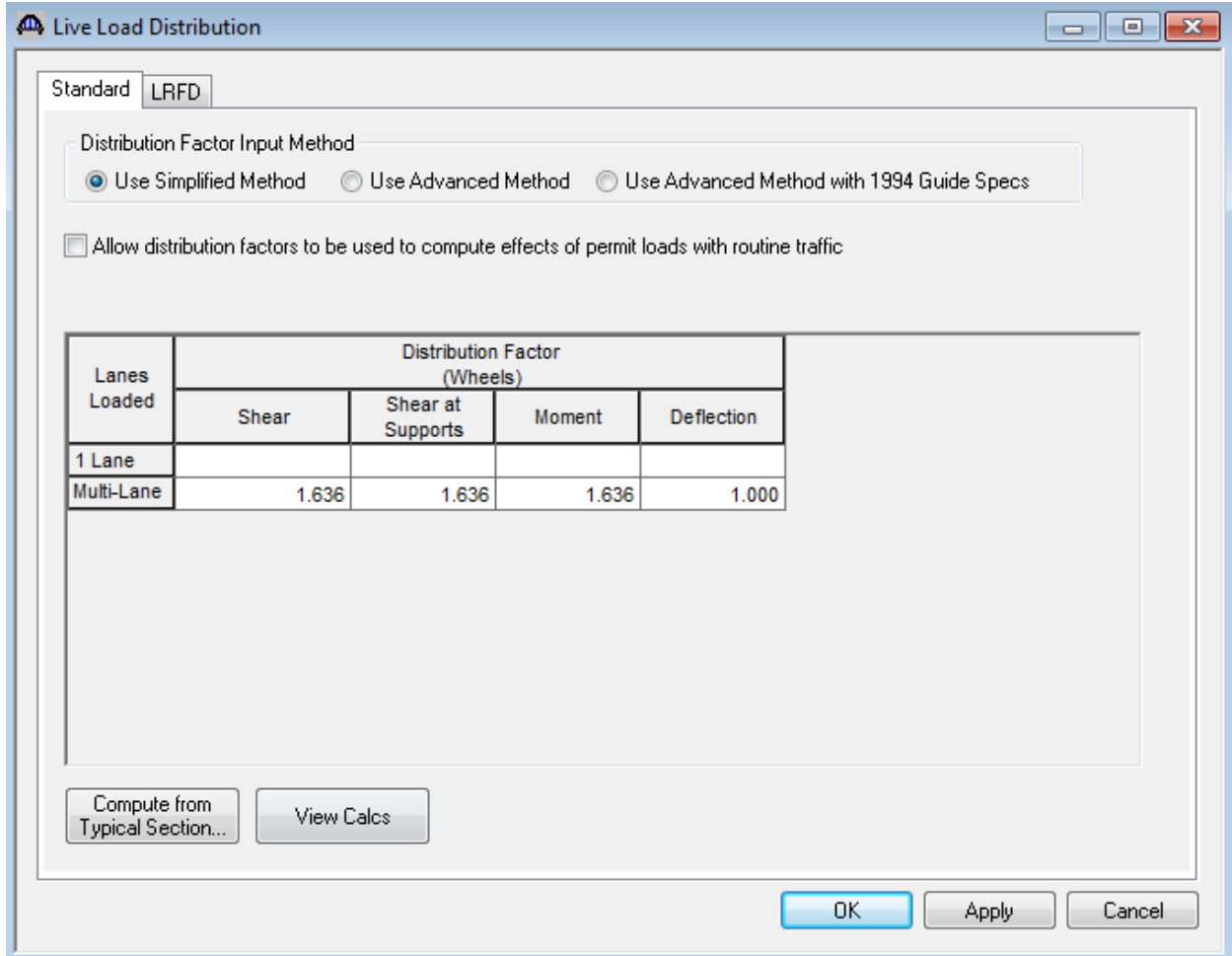
$$\text{Parapets: } 0.1k / ft = \frac{2 * 0.3klf}{6 \text{ girders}}$$

For our girder system superstructure, the future wearing surface load and parapet load applied to each member will be computed by BrR based on the data entered in the Structure Typical Section window. Therefore we do not need to enter any Member Loads for the new girder system members. For this example, determining the source of the original girder line Member Loads was easy. If the original girder line member was imported from BARS, it may not be as easy to determine what portion of the Member Load is due to the deck slab, appurtenances and wearing surface. You will need to do some investigation and calculations to determine what member loads you should enter into BrR for new girder system members when you are converting existing girder line members.

We should also open the Supports window for the original girder line member to see if any data should be copied to the new girder system members.

The Live Load Distribution window for the new girder system member alternative contains the following data based on being copied from the original girder line member alternative. This data can remain or you can use the “Compute from Typical Section” to update these values now that we know where the travelways are in relation to the girder member location.

CNVRT1 – Converting Girder Line to Girder System Example



The data in the remaining windows under the girder member alternative should be acceptable based on being copied from the girder line member alternative. The following two windows show a comparison of the rating factors obtained for the original girder line and the new girder system member alternatives.

CNVRT1 – Converting Girder Line to Girder System Example

Original girder line member alternative:

Analysis Results - Member Alternative #1 (9.9.3)

Report Type: Rating Results Summary | Lane/Impact Loading Type: As Requested Detailed | Display Format: Single rating level per row

| Live Load | Live Load Type | Rating Method | Rating Level | Load Rating (Ton) | Rating Factor | Location (ft) | Location Span-(%) | Limit State | Impact | Lane |
|-----------|----------------|---------------|--------------|-------------------|---------------|---------------|-------------------|-------------------------|--------------|--------------|
| HS 20-44 | Lane | LFD | Inventory | 23.04 | 0.640 | 120.00 | 1 - (100.0) | Design Shear - Concrete | As Requested | As Requested |
| HS 20-44 | Lane | LFD | Operating | 38.48 | 1.069 | 120.00 | 1 - (100.0) | Design Shear - Concrete | As Requested | As Requested |
| HS 20-44 | Axle Load | LFD | Inventory | 22.06 | 0.613 | 120.00 | 1 - (100.0) | Design Shear - Concrete | As Requested | As Requested |
| HS 20-44 | Axle Load | LFD | Operating | 36.84 | 1.023 | 120.00 | 1 - (100.0) | Design Shear - Concrete | As Requested | As Requested |

AASHTO LFR Engine Version 6.8.0.3001
Analysis Preference Setting: None

Close

Newly copied girder system member alternative:

Analysis Results - Copy of Member Alternative #1 (9.9.3)

Report Type: Rating Results Summary | Lane/Impact Loading Type: As Requested Detailed | Display Format: Single rating level per row

| Live Load | Live Load Type | Rating Method | Rating Level | Load Rating (Ton) | Rating Factor | Location (ft) | Location Span-(%) | Limit State | Impact | Lane |
|-----------|----------------|---------------|--------------|-------------------|---------------|---------------|-------------------|-------------------------|--------------|--------------|
| HS 20-44 | Lane | LFD | Inventory | 23.04 | 0.640 | 120.00 | 1 - (100.0) | Design Shear - Concrete | As Requested | As Requested |
| HS 20-44 | Lane | LFD | Operating | 38.48 | 1.069 | 120.00 | 1 - (100.0) | Design Shear - Concrete | As Requested | As Requested |
| HS 20-44 | Axle Load | LFD | Inventory | 22.06 | 0.613 | 120.00 | 1 - (100.0) | Design Shear - Concrete | As Requested | As Requested |
| HS 20-44 | Axle Load | LFD | Operating | 36.84 | 1.023 | 120.00 | 1 - (100.0) | Design Shear - Concrete | As Requested | As Requested |

AASHTO LFR Engine Version 6.8.0.3001
Analysis Preference Setting: None

Close

The newly created member alternative for Member G2 can now be copied to or linked with the other members in the “6 Girder System” superstructure definition. After copying this interior member alternative to one of the exterior members, you should visit the Live Load Distribution Factors and Haunch windows to enter the correct data for an exterior member.

CNVRT1 – Converting Girder Line to Girder System Example

We will now use Method 2 to enter the loads in BrR.

Method 2: We can tell BrR not to distribute the superstructure loads for us on the Superstructure Loads window.

The screenshot shows the 'Superstructure Loads' dialog box with the 'DL Distribution' tab selected. The dialog is divided into two sections: 'Stage 1 Dead Load Distribution' and 'Stage 2 Dead Load Distribution'. Each section contains radio buttons for different distribution methods: 'By tributary area', 'By transverse simple-beam analysis', 'By transverse continuous-beam analysis', and 'By percentage'. Below the 'By percentage' options, there are two tables for defining percentages for girders 1, 2, and 3. The 'User-defined dead load' option is selected in both sections. At the bottom of the dialog are 'OK', 'Apply', and 'Cancel' buttons.

Uniform Temperature Gradient Temperature Wind **DL Distribution**

Stage 1 Dead Load Distribution

- By tributary area
- By transverse simple-beam analysis
- By transverse continuous-beam analysis
- By percentage

| Girder | Percentage (%) |
|--------|----------------|
| 1 | |
| 2 | |
| 3 | |

User-defined dead load

Stage 2 Dead Load Distribution

- Uniformly to all girders
- By tributary area
- By transverse simple-beam analysis
- By transverse continuous-beam analysis
- By percentage

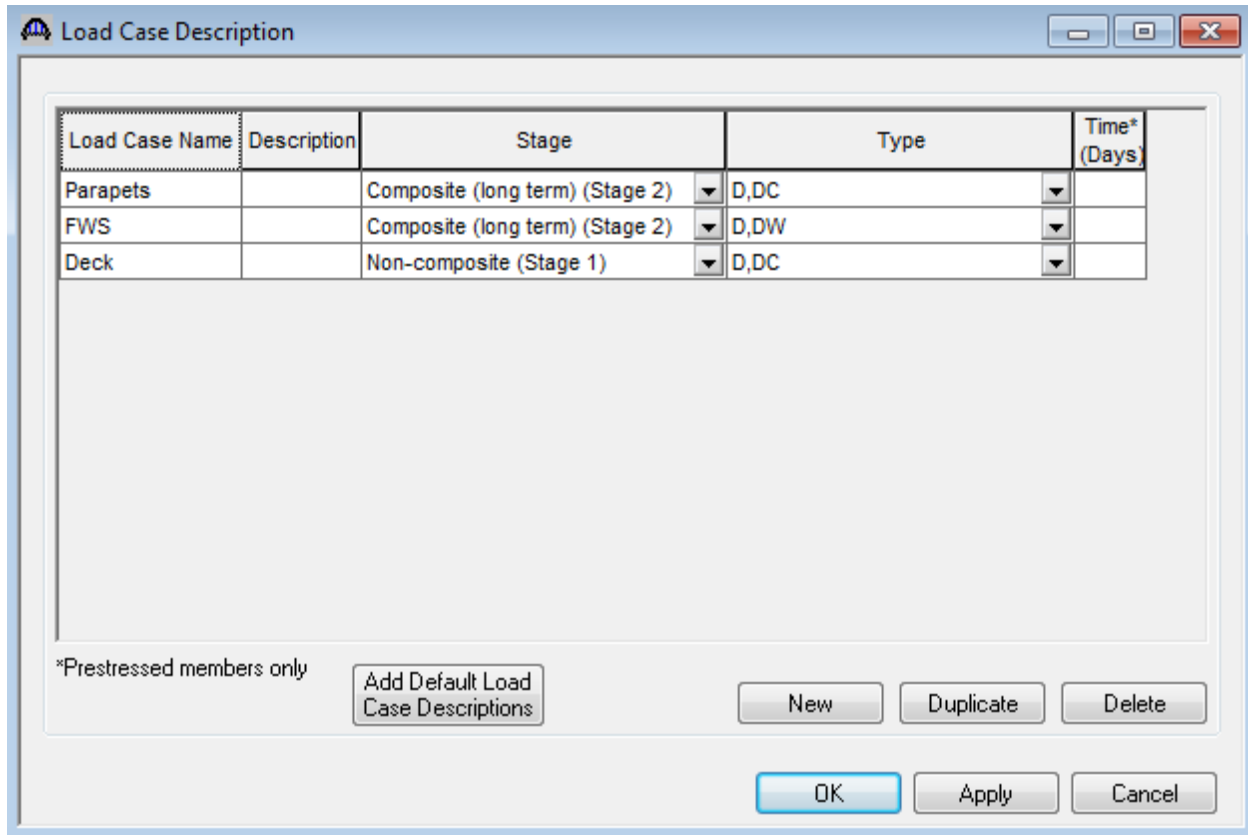
| Girder | Percentage (%) |
|--------|----------------|
| 1 | |
| 2 | |
| 3 | |

User-defined dead load

OK Apply Cancel

CNVRT1 – Converting Girder Line to Girder System Example

We need to compute the dead load on each girder system member due to the deck slab since it will not be computed by BrR now. We first need to create an additional Load Case Description for the deck slab. Open the Load Case Description window and add the following load case:

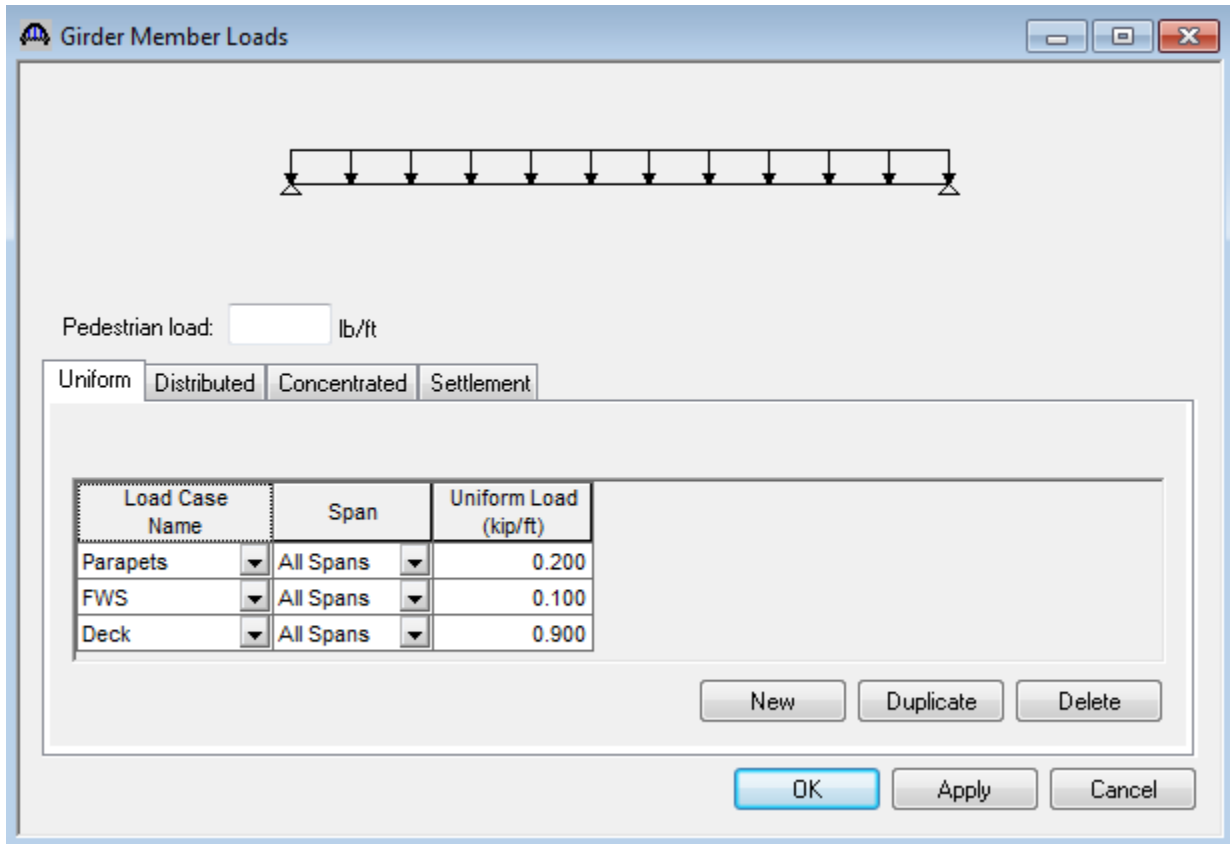


The deck slab dead load acting on Member G2 is:

$$0.9k / ft = \left(\frac{8''}{12} \right) (9') (0.150kcf)$$

CNVRT1 – Converting Girder Line to Girder System Example

Open the Member Loads window and enter each of the following three load cases. The first two load cases are those that exist in the original girder line member.



We can now analyze Member G2 and we will get the same rating results as we did following Method 1.

