AASHTOWare BrDR 7.5.0

Prestress Tutorial 4 PS4 – Prestressed Concrete I Beam Using BrDR LRFD Engine



**Structure Typical Section** 



Span Elevation







### **BrDR** Training

### PS4 – Prestressed Concrete I Beam Using BrDR LRFD Engine

### **Topics** Covered

- Prestressed concrete I beam with debonded strands input as girder system.
- Prestressed loss calculation methods
  - AASHTO Refined, AASHTO Approximate, Pre-2005 Interim methods.
- Prestressed multi-span modeling options.
  - Multi-span continuous
  - Multi-span continuous and simple span
- Export of prestressed concrete beams to the BrDR LRFD analysis engine
- BrDR LRFD specification checking

Prestressed concrete I beam with debonded strands input as girder system.

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



| 234                    |                   |               |                     |              |                        |               | -        |                   |    |
|------------------------|-------------------|---------------|---------------------|--------------|------------------------|---------------|----------|-------------------|----|
| ridge ID: PS4          |                   | NBI structure | ID (8): PS4         |              | Template Bridge comple | etely defined | Super    | structure:<br>rts | s  |
| Description Descr      | vinsion (constat) | Alternatives  | Clabel astronom     | -:           | Curtan anan Erl        | 4-            | ✓ Substi | ructures          |    |
| Description Desc       | ription (cont d)  | Alternatives  | Global reference po | oint Traffic | Custom agency fiel     | as            | _        |                   |    |
| Name:                  | NHI Example       |               |                     |              | Year built:            |               |          |                   |    |
| Description:           |                   |               |                     |              |                        |               |          |                   |    |
| Location:              |                   |               |                     |              | Length:                |               | ft       |                   |    |
| Facility carried (7):  |                   |               |                     |              | Route number:          |               | 1        |                   |    |
| Feat. intersected (6): |                   |               |                     |              | Mi. post:              |               | 1        |                   |    |
| Default units:         | US Customary      | ~             |                     |              |                        |               |          |                   |    |
| Default units:         | US Customary      | ~             |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
|                        |                   |               |                     |              |                        |               |          |                   |    |
| Bridge associa         | tion 🗹 f          | BrR 🗹 BrD 🗌   | BrM Sync with Bi    | rM           |                        |               |          |                   |    |
| Bridge associa         | tion 🗹 🛙          | 3rR ⊻ BrD 🗌 I | BrM Sync with Bi    | rM           |                        |               |          |                   |    |
| Bridge associa         | tion 🗹 f          | 3rR 🗹 BrD 🗌 1 | BrM Sync with B     | rM           |                        |               |          |                   |    |
| Bridge associa         | tion 🗹 f          | 3rR 🗹 BrD 🗌 I | BrM Sync with Bi    | rM           | 0                      | Α             | ppły     | Cance             | el |

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

### Bridge Materials

To enter the materials to be used by members of the bridge, open the **Components** tab, and click on the  $\textcircled{\pm}$  button to expand the tree for **Materials**. The tree with the expanded **Materials** branch is shown below.



To add a new concrete material, in the **Components** tab of the **Bridge Workspace**, click on **Materials**, **Concrete**, and select **New** from the **Manage** group of the **WORKSPACE** ribbon (or right mouse click on **Concrete** and select **New**). The window shown below will open.



Enter the values shown above the **Compute** button and click the **Compute** button to compute the remaining values below them.

| A Bridge Materials - Concrete |                            |                 | _                   |     | ×     |   |
|-------------------------------|----------------------------|-----------------|---------------------|-----|-------|---|
| Name:                         | Beam Concrete              |                 |                     |     |       |   |
| Description:                  | 7 Ksi Concrete             |                 |                     |     |       |   |
| Compressive                   | strength at 28 days (f'c): | 7               | ksi                 |     |       |   |
| Initial compre                | essive strength (f'ci):    | 5.5             | ksi                 |     |       |   |
| Composition                   | of concrete:               | Normal 🗸 🗸      |                     |     |       |   |
| Density (for d                | dead loads):               | 0.15            | kcf                 |     |       |   |
| Density (for n                | modulus of elasticity):    | 0.15            | kcf                 |     |       |   |
| Poisson's rati                | 0:                         | 0.2             | ]                   |     |       |   |
| Coefficient of                | f thermal expansion (α):   | 0.000006        | 1/F                 |     |       |   |
| Splitting tens                | ile strength (fct):        |                 | ksi                 |     |       |   |
| LRFD Maximu                   | um aggregate size:         |                 | in                  |     |       |   |
|                               | Compute                    |                 |                     |     |       |   |
| Std modulus                   | of elasticity (Ec):        | 5072.240629     | ksi                 |     |       |   |
| LRFD modulu                   | us of elasticity (Ec):     | 5131.521081     | ksi                 |     |       |   |
| Std initial mo                | odulus of elasticity:      | 4496.060776     | ksi                 |     |       |   |
| LRFD initial m                | nodulus of elasticity:     | 4738.96446      | ksi                 |     |       |   |
| Std modulus                   | of rupture:                | 0.627495        | ksi                 |     |       |   |
| LRFD modulu                   | us of rupture:             | 0.63498         | ksi                 |     |       |   |
| Shear factor:                 |                            | 1               | ]                   |     |       |   |
|                               | Copy 1                     | to library Copy | from library OK App | y ( | Cance | I |

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

| Bridge Mate     | erials - Concrete          |             |     | - | × |
|-----------------|----------------------------|-------------|-----|---|---|
| Name:           | Deck Concrete              |             |     |   |   |
| Description:    | 4.5 Ksi Concrete           |             |     |   |   |
| Compressive :   | strength at 28 days (f'c): | 4.5         | ksi |   |   |
| Initial compre  | ssive strength (f'ci):     |             | ksi |   |   |
| Composition     | of concrete:               | Normal ~    |     |   |   |
| Density (for d  | ead loads):                | 0.15        | kcf |   |   |
| Density (for m  | nodulus of elasticity):    | 0.145       | kcf |   |   |
| Poisson's ratio | <b>)</b> :                 | 0.2         |     |   |   |
| Coefficient of  | thermal expansion (α):     | 0.000006    | 1/F |   |   |
| Splitting tensi | ile strength (fct):        |             | ksi |   |   |
| LRFD Maximu     | ım aggregate size:         |             | in  |   |   |
|                 | Compute                    |             |     |   |   |
| Std modulus (   | of elasticity (Ec):        | 3865.20204  | ksi |   |   |
| LRFD modulu     | s of elasticity (Ec):      | 4144.549969 | ksi |   |   |
| Std initial mod | dulus of elasticity:       |             | ksi |   |   |
| LRFD initial m  | odulus of elasticity:      |             | ksi |   |   |
| Std modulus o   | of rupture:                | 0.503115    | ksi |   |   |
| LRFD modulu     | s of rupture:              | 0.509117    | ksi |   |   |
| Shear factor:   |                            | 1           |     |   |   |

Add concrete material for the deck, using the same techniques. Enter the data for deck concrete as shown below.

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

To add a new reinforcement material, in the **Components** tab of the **Bridge Workspace**, click on **Materials**, **Reinforcing Steel**, and select **New** from the **Manage** group of the **WORKSPACE** ribbon (or right mouse click on **Reinforcing Steel** and select **New**). The window shown below will open.



Add the reinforcing steel material by clicking the Copy from library... button. The following window opens.

| Grade 300         300 MPa reinforcing steel         Standard         SI / Metric         300.00         500.00         11           Grade 350         350 MPa reinforcing steel (rail-steel)         Standard         SI / Metric         350.00         550.00         19           Grade 40         40 ksi reinforcing steel         Standard         SI / Metric         40.00         70.000         19           Grade 400         400 MPa reinforcing steel         Standard         SI / Metric         40.000         600.00         19           Grade 50         50 ksi reinforcing steel (rail-steel)         Standard         SI / Metric         50.00         80.000         80.000         80.000         19           Grade 50         50 ksi reinforcing steel (rail-steel)         Standard         SI / Metric         50.00         80.000                           |
|--|
| Grade 350         350 MPa reinforcing steel (rail-steel)         Standard         SI / Metric         350.00         550.00         19           Grade 40         40 ksi reinforcing steel         Standard         US Customary         40.000         70.000         13           Grade 400         400 MPa reinforcing steel         Standard         US Customary         40.000         600.00         14           Grade 50         50 ksi reinforcing steel (rail-steel)         Standard         US Customary         50.00         80.000         60.000         14           Grade 50         500 MPA reinforcing steel         Standard         Standard |
| Grade 40         40 ksi reinforcing steel         Standard         US Customary         40.000         70.                               |
| Grade 400         400 MPa reinforcing steel         Standard         SI / Metric         400.00         600.00         19           Grade 50         50 ksi reinforcing steel (rail-steel)         Standard         US Customary         50.000         80.000         20           Grade 500         500 MBa reinforcing steel         Standard         SL / Metric         500.000         700.00         10   |
| Grade 50         50 ksi reinforcing steel (rail-steel)         Standard         US Customary         50.000         80.000         20           Grade 500         500 MPa reinforcing steel         Standard         SI / Metric         500 00         700.00         10  |
| Grade 500 500 MPa reinforcing steel Standard SL/Metric 500.00 700.00 11  |
| Standard Sty Metric Stores 1   |
| Grade 60 60 ksi reinforcing steel Standard US Customary 60.000 90.000  |
| Grade 75 75 ksi reinforcing steel Standard US Customary 75.000 100.000   |
| Structural or unknown grade prior 1954 Structural or unknown grade prior to 1954 Standard US Customary 33.000 60.000   |

Select the Grade 60 material and click OK. The selected material properties are copied to the Bridge Materials -

Reinforcing Steel window as shown below.

| 💁 Bridge Mat                 | terials - Reinforc | ing Steel    |                  |    | _     |     | ×   |
|------------------------------|--------------------|--------------|------------------|----|-------|-----|-----|
| Name:                        | Grade 60           |              |                  |    |       |     |     |
| Description:                 | 60 ksi reinforci   | ng steel     |                  |    |       |     |     |
| Material prop                | perties            |              |                  |    |       |     |     |
| Specified yie                | ld strength (fy):  | 60.000087    | ksi              |    |       |     |     |
| Modulus of e                 | elasticity (Es):   | 29000.004206 | ksi              |    |       |     |     |
| Ultimate stre                | ngth (Fu):         | 90.0000131   | ksi              |    |       |     |     |
| Type<br>Plain<br>Epo<br>Galv | n<br>xy<br>vanized |              |                  |    |       |     |     |
|                              | Copy t             | o library Co | opy from library | OK | Apply | Car | cel |

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

Add the prestress strand 1/2" (7W-270) LR using the same technique as above. The window is populated as shown below.

| 🗛 Bridge Mat  | erials - PS Strand |                      |        | _  |       | ×        |
|---------------|--------------------|----------------------|--------|----|-------|----------|
| Name:         | 1/2" (7W-270) Li   | R                    |        |    |       |          |
| Description:  | Low relaxation 1   | /2"/Seven Wire/fpu = | 270    |    |       |          |
| Strand diame  | ter:               | 0.5000               | in     |    |       |          |
| Strand area:  |                    | 0.153                | in^2   |    |       |          |
| Strand type:  |                    | Low Relaxation       | >      |    |       |          |
| Ultimate tens | ile strength (Fu): | 270.000              | ksi    |    |       |          |
| Yield strengt | h (fy):            | 243.000              | ksi    |    |       |          |
| Modulus of e  | lasticity (E):     | 28500.00             | ksi    |    |       |          |
|               | Com                | pute                 |        |    |       |          |
| Transfer leng | th (Std):          | 25.0000              | in     |    |       |          |
| Transfer leng | th (LRFD):         | 30.0000              | in     |    |       |          |
| Unit load per | length:            | 0.520                | lb/ft  |    |       |          |
|               |                    | Epoxy coated         |        |    |       |          |
|               |                    |                      |        |    |       |          |
|               |                    |                      |        |    |       |          |
| Copy          | to library         | Copy from library    | ОК Арр | ly | Cance | <u>!</u> |

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

#### Beam Shapes

To enter a prestress beam shape to be used in this bridge expand the **Beam Shapes** node and **Prestress Shapes** node

in the Componenets tree as shown below.



Click on the **I Beams** node in the **Components** tree and select **New** from the **Manage** group of the **WORKSPACE** ribbon (or right mouse click on **I Beams** and select **New** or double click on **I Beams** in the **Components** tree). The window shown below will open.



Select the **Top flange type** as **Wide** and click the **Copy from library...** button. Select **AASHTO Type VI** and click **OK**.

| ф | Library Data: Prestress I | Beam Shapes               |          |              |         |                         |                     | - 0                        | ×  |
|---|---------------------------|---------------------------|----------|--------------|---------|-------------------------|---------------------|----------------------------|----|
|   | Name                      | Description               | Library  | Units        | Depth   | Top flange<br>thickness | Top flange<br>width | Bottom flange<br>thickness |    |
|   | AASHTO TYPE V             | AASHTO TYPE V             | Standard | US Customary | 63.0000 | 5.0000                  | 42.0000             | 8.0000                     |    |
| Þ | AASHTO TYPE VI            | AASHTO TYPE VI            | Standard | US Customary | 72.0000 | 5.0000                  | 42.0000             | 8.0000                     |    |
|   | BT-54                     | AASHTO-PCI Bulb-Tee BT-54 | Standard | US Customary | 54.0000 | 3.5000                  | 42.0000             | 6.0000                     |    |
|   | BT-63                     | AASHTO-PCI Bulb-Tee BT-63 | Standard | US Customary | 63.0000 | 3.5000                  | 42.0000             | 6.0000                     |    |
|   | BT-72                     | AASHTO-PCI Bulb-Tee BT-72 | Standard | US Customary | 72.0000 | 3.5000                  | 42.0000             | 6.0000                     | -  |
|   | 4                         |                           |          |              |         |                         |                     |                            |    |
|   |                           |                           |          |              |         | OK                      | Apply               | / Cance                    | el |

The beam properties are copied to the **Prestress I Beam** window as shown below.



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

### Bridge - Appurtenances

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

| B   | Bridge Workspace - PS4  | Д           | ANALYSIS  | REPORTS      |                | ? –     |       | × |
|---|---|-------------|-----------|--------------|----------------|---------|-------|---|
| BRIDGE WORKSPACE  | WORKSPACE TOOLS   | VIEW DE     | SIGN/RATE | REPORTING    |                |         |       | ^ |
| Check Out<br>Check In<br>Validate   | e Save & Restore Close Expo   | ort Refresh | Open New  | Copy Paste   | Duplicate Dele | te Sche | matic |   |
|   | Bridge  |             |           | Manage       |                |         |       |   |
| Workspace Bridge Components   | <i></i>   | Schematio   | С         | <b>4</b> × F | Report         |         | д     | × |
| - Components - Co | n New Analyze   |             |           |              |                |         |       |   |
| In International Internationa | <ul> <li>View Summary Report</li> <li>View Detailed Report</li> </ul>   | vsis        |           |              |                |         | 4     | × |
| ⊞- 🥟 Materials  | <ul> <li>General Preferences</li> <li>Close Bridge Workspace</li> </ul> |             |           |              |                |         |       |   |

Enter the parapet details as shown below.

| 🕰 Bridge Ap  | purtenances - Parapet  |                               |                    | – 🗆   | ×    |
|--------------|--|-------------------------------|--------------------|---|------|
| Name:        | Jersey Barrier   |                               |                    |   |      |
| Description: | Standard New Jersey Barrier  |                               |                    |   |      |
|              | All dimensions are in inches   |                               |                    |   |      |
| <br> <br>    | Additional load:<br>2.0000<br>12.0000<br>eference<br>Line<br>Back<br>Front | 0.0000 19.0000 10.0000 3.0000 | Roadway<br>Surface | Parapet unit load:<br>0.150 kcf<br>Calculated properties<br>Net centroid (from<br>reference line):<br>7.880 in<br>Total load:<br>0.505 kip/ft |      |
|              |  | C                             | opy from library   | OK Apply Can  | ncel |

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

The default dynamic load allowance and default LRFD factors will be used.

The partially expanded Bridge Workspace is shown below.

| Works  | space – 🗆 ×   |
|--------|---|
| Bridge | Components  |
|        | PS4<br>Components<br>Jersey Barrier<br>AASHTO TYPE VI<br>Beam Concrete<br>Deck Concrete<br>Structure<br>Crade 60<br>Component of the second second<br>Component of the second |

#### Superstructure Definition

Returning to the **Bridge** tab of the **Bridge Workspace**, double click on **SUPERSTRUCTURE DEFINITIONS** (or click on **SUPERSTRUCTURE DEFINITIONS** and select **New** from the **Manage** group of the **WORKSPACE** ribbon or right mouse click on **SUPERSTRUCTURE DEFINITIONS** and select **New** from the popup menu) to create a new structure definition. The window shown below will appear.

| A New Superstructure Definition                            |                                  | × |
|--|----------------------------------|---|
| Girder system superstructure                               |                                  | ] |
| ◯ Girder line superstructure                               | Superstructure definition wizard |   |
| Floor system superstructure                                |                                  | ] |
| Floor line superstructure                                  |                                  |   |
| <ul> <li>Truss system superstructure</li> </ul>            |                                  |   |
| <ul> <li>Truss line superstructure</li> </ul>              |                                  |   |
| Reinforced concrete slab system superstructure             |                                  |   |
| <ul> <li>Concrete multi-cell box superstructure</li> </ul> |                                  |   |
| Advanced concrete multi-cell box superstructure            |                                  |   |
|  |                                  |   |
|  |                                  |   |
|  |                                  |   |
|  |                                  |   |
|  |                                  |   |
|  |                                  |   |
|  | OK Cancel                        |   |

Select Girder system superstructure, click OK and the Girder System Superstructure Definition window will open.

#### Enter the data as shown below.

| Girder System Superstructure Defin   | Finding   |        | - 🗆 X  |
|--|---|--------|--|
| Name: PS I Beam  | engine  |        | Modeling<br>Multi-girder system   MCB  |
| Description:   |   |        | With frame structure simplified definition Deck type: Concrete Deck  |
| Default units: US Customan<br>Number of spans: 2 3<br>Number of girders: 6 5 | Image: constraint of the second se |        | For PS/PT only<br>Average humidity:<br>70.000 %<br>Member alt. types<br>Steel<br>Ø P/S<br>R/C<br>Timber<br>Ø P/T |
| Horizontal curvature along refer   | ence line   |        |  |
| Horizontal curvature   | Distance from PC to first support line:   | ft     |  |
| Superstructure alignment   | Start tangent length:   | ft     |  |
| Tangent, curved, tangent   | Radius:   | ft     |  |
| <ul> <li>Tangent, curved</li> </ul>  | Direction:  | Left V |  |
| <ul> <li>Curved, tangent</li> </ul>  | End tangent length:   | ft     |  |
|  | Distance from last support line to PT:  | ft     |  |
|  | Design speed:   | mph    |  |
|  | Superelevation:   | %      |  |
|  |   |        | OK Apply Cancel  |

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

#### Load Case Description

Double-click on the **Load Case Description** node in the **Bridge Workspace** tree to open the **Load Case Description** window. Click on the **Add default load case descriptions** button to create the following load cases.

| Load case name | Description                              | Stage                             |      | Туре | Time'<br>(days | ) |  |
|----------------|--|-----------------------------------|------|------|----------------|---|--|
| DC1            | DC acting on non-composite section       | Non-composite (Stage 1) *         | D,DC |      | *              |   |  |
| DC2            | DC acting on long-term composite section | Composite (long term) (Stage 2) * | D,DC |      | *              |   |  |
| DW             | DW acting on long-term composite section | Composite (long term) (Stage 2) * | D,DW |      | -              |   |  |
| SIP Forms      | Weight due to stay-in-place forms        | Non-composite (Stage 1) *         | D,DC |      | *              |   |  |
|                |  |                                   |      |      |                |   |  |
|                |  |                                   |      |      |                |   |  |

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

### Structure Framing Plan Detail – Layout

Double-click on **Framing Plan Detail** in the **Bridge Workspace** tree to describe the framing plan in the **Structure Framing Plan Details** window. Enter the data as shown below. In this example, enter all data to 4 significant digits. For example, enter the girder spacing of **9'-8"** as **9.6667.** 

| A Structure Framing Plan Details   |      |                 |                            |                  |   |       | -   |       | × |
|------------------------------------|------|-----------------|----------------------------|------------------|---|-------|-----|-------|---|
| Number of spans: 2 Number of girde | ers: | 6               |                            |                  |   |       |     |       |   |
| Layout Diaphragms                  |      |                 |                            |                  |   |       |     |       |   |
|                                    | - Gi | rder spaci      | ng orientatio              | 1                |   |       |     |       |   |
| Support Skew<br>(degrees)          |      | Perper<br>Along | dicular to gire<br>support | der              |   |       |     |       |   |
| > 1 0                              |      |                 |                            |                  |   |       |     |       |   |
| 2 0                                |      | Girder          | Girder s<br>(fi            | pacing<br>:)     |   |       |     |       |   |
|                                    |      | bay             | Start of girder            | End of<br>girder |   |       |     |       |   |
|                                    | >    | 1               | 9.6667                     | 9.6667           | ^ | 6     |     |       |   |
|                                    |      | 2               | 9.6667                     | 9.6667           |   |       |     |       |   |
|                                    |      | 3               | 9.6667                     | 9.6667           |   |       |     |       |   |
|                                    |      | 4               | 9.6667                     | 9.6667           |   |       |     |       |   |
|                                    |      | 5               | 9.6667                     | 9.6667           |   |       |     |       |   |
|                                    |      |                 |                            |                  |   |       |     |       |   |
|                                    |      |                 |                            |                  |   |       |     |       |   |
|                                    |      |                 |                            |                  |   | ,     |     |       |   |
|                                    |      |                 |                            |                  |   | ОК Ар | bly | Cance | 2 |

### Structure Framing Plan Detail – Diaphragms

Switch to the **Diaphragms** tab to enter diaphragm spacing. Click the **Diaphragm wizard...** button to add diaphragms for the entire structure. **Select the desired framing plan system** and click the **Next** button. Enter the following data on the window shown below.

| 🕰 Diaphragm Wizard  | ×  |
|---|----|
| Select the desired framing plan system:   |    |
|   |    |
|   |    |
|   |    |
|   |    |
|   |    |
|   |    |
|   |    |
|   |    |
|   |    |
|   |    |
|   |    |
|   |    |
| < Back Next > Cance   | el |
| Diaphram Wizard   |    |
|   | ×  |
|   | ×  |
| Diaphragm spacing   | ×  |
| Diaphragm spacing     Diaphragm spacing     Enter number of equal spaces per span     Enter equal spacing per span  | ×  |
| Diaphragm spacing     Diaphragm spacing     Enter number of equal spaces per span     Enter equal spacing per span     Enter groups of equal spacing  | ×  |
| Diaphragm spacing         Image: Diaphragm | ×  |
| Diaphragm spacing         Image: Diaphragm | ×  |
| Diaphragm spacing         Image: Diaphragm spacent spacent         Image: D | ×  |
| Diaphragm spacing         Image: Diaphragm spaces         Image: Diaphragm  | ×  |
| Diaphragm spacing         Image: Diaphragm | ×  |
| Diaphragm spacing         Image: Diaphragm | ×  |
| Diaphragm spacing         Enter number of equal spaces per span         Enter equal spacing per span         Enter groups of equal spacing         Support diaphragm load:         5.0000         kip         Interior diaphragm load:         5.0000         kip         Interior diaphragm load:         5.0000         kip         Interior diaphragm load:         5.0000         kip         1         110.00         2         110.00   | ×  |
| Diaphragm spacing         Image: Diaphragm spaces         Image: Diaphragm  | ×  |
| Diaphragm spacing         Enter number of equal spaces per span         Enter equal spacing per span         Enter groups of equal spacing         Support diaphragm load:         5.0000         kip         Interior diaphragm load:         5.0000         kip         1         1         1         1         1         2   | ×  |
| Diaphragm spacing         Enter number of equal spaces per span         Enter equal spacing per span         Enter groups of equal spacing         Support diaphragm load:         5.0000         kip         Interior diaphragm load:         5.0000         kip         1         10.00         2         110.00         2         110.00         2   | ×  |

Click the **Finish** button to add the diaphragms. The **Diaphragm Wizard** will create diaphragms for all the girder bays in the structure.

| der b | ay: 1          |             | >                     | Copy bay             | to                  | Dia<br>w       | phragm<br>vizard |                     |               |                |  |
|-------|----------------|-------------|-----------------------|----------------------|---------------------|----------------|------------------|---------------------|---------------|----------------|--|
| Su    | pport<br>imber | S<br>dis    | tart<br>tance<br>(ft) | Diaphragm<br>spacing | Number<br>of spaces | Length<br>(ft) | E<br>dist<br>(   | nd<br>tance<br>(ft) | Load<br>(kip) | Diaphragm      |  |
|       |                | Left girder | Right girder          | (ft)                 |                     |                | Left girder      | Right girder        |               |                |  |
| 1     | *              | 0.00        | 0.00                  | 0.00                 | 1                   | 0.00           | 0.00             | 0.00                | 5.0000        | Not Assigned 🔻 |  |
| 1     | *              | 0.00        | 0.00                  | 55.00                | 1                   | 55.00          | 55.00            | 55.00               | 5.0000        | Not Assigned 🔹 |  |
| 2     | *              | 0.00        | 0.00                  | 0.00                 | 1                   | 0.00           | 0.00             | 0.00                | 5.0000        | Not Assigned 🔹 |  |
| 2     | *              | 0.00        | 0.00                  | 55.00                | 1                   | 55.00          | 55.00            | 55.00               | 5.0000        | Not Assigned 🔹 |  |
| 2     | -              | 110.00      | 110.00                | 0.00                 | 1                   | 0.00           | 110.00           | 110.00              | 5.0000        | Not Assigned 🔹 |  |
|       |                |             |                       |                      |                     |                |                  |                     |               |                |  |

The diaphragms created for **Girder bay 1** are shown below.

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

#### Schematic - Framing Plan Detail

While the **Framing Plan Detail** is selected in the **Bridge Workspace** tree, open the schematic for the framing plan by selecting the **Schematic** button on the **WORKSPACE** ribbon (or right click on **Framing Plan Detail** in the Bridge Workspace and select **Schematic** from the menu).



The following schematic will be displayed.

| Schem                          | atic              |   |      | _ 🗆 ×    |
|--------------------------------|-------------------|---|------|----------|
| Framing p                      | olan              |   |      | ▼ X      |
|                                | © ⊙ ⊕ 🖶 🗟 🛏 80% 🔽 |   |      | +        |
| PS4<br>NHI Example<br>2/8/2023 | -PS I Beam        |   |      |          |
|                                | 50.0 deg. 119-2*  |   |      |          |
| 9.4L                           | (.1 )t-2          | 01<br>17<br>0   | 3    | 4<br>20  |
| 1.4                            | 2.1 2.2           | 9<br>2  | 3 24 | 9<br>20  |
| .B.45                          | 34 342            | 63,<br>19<br>20   | 3 34 | 9<br>8   |
| 9.E                            | 4-1 4-2           | Ge<br>ly<br>b   | 3 44 | 4.6<br>8 |
| 9.4                            | 51 5-2            | in a contract of the contract | 3 54 | 50       |
| -                              |                   | 66  |      |          |
|                                |                   |   |      |          |

### Structure Typical Section - Deck

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

| A Structure Typical Section  |                |                    |                              |            |               |               |                 | -     |       | $\times$ |
|--|----------------|--------------------|------------------------------|------------|---------------|---------------|-----------------|-------|-------|----------|
| Distance from left edge of deck to<br>superstructure definition ref. line        | Distance from  | right e<br>definit | dge of deck<br>ion ref. line | to         |               |               |                 |       |       |          |
| Deck<br>thickness  | Reference      | ture De<br>Line    | efinition                    | 4          |               |               |                 |       |       |          |
| Left overhang  |                |                    | Ţ                            | Bight ov   | erhang        |               |                 |       |       |          |
| Deck Deck (cont'd) Parapet Me  | edian Railin   | g (                | Generic                      | Sidewalk   | Lane position | Striped lanes | Wearing surface |       |       |          |
| Superstructure definition reference line is                                      | within         |                    | ✓ the br                     | idge deck. |               |               |                 |       |       |          |
| Distance from left edge of deck to<br>superstructure definition reference line:  | Start<br>27.75 | ft                 | 27.75                        | ind ft     |               |               |                 |       |       |          |
| Distance from right edge of deck to<br>superstructure definition reference line: | 27.75          | ft                 | 27.75                        | ft         |               |               |                 |       |       |          |
| Left overhang:   | 3.5833         | ft                 | 3.5833                       | ft         |               |               |                 |       |       |          |
| Computed right overhang:   | 3.5832         | ft                 | 3.5832                       | ft         |               |               |                 |       |       |          |
|  |                |                    |                              |            |               |               |                 |       |       |          |
|  |                |                    |                              |            |               |               |                 |       |       |          |
|  |                |                    |                              |            |               |               |                 |       |       |          |
|  |                |                    |                              |            |               |               |                 |       |       |          |
|  |                |                    |                              |            |               |               |                 |       |       |          |
|  |                |                    |                              |            |               |               | ОК              | Apply | Cance | 2        |

#### Structure Typical Section – Deck (cont'd)

The **Deck (cont'd)** tab is used to enter information about the **Deck concrete** and the **Total deck thickness**. The material to be used for the deck concrete is selected from the list of bridge materials. Enter the data as shown below.

| A Structure Typical Section  | -   |       | ×    |
|--|-----|-------|------|
| Distance from left edge of deck to Distance from right edge of deck to<br>superstructure definition ref. linesuperstructure definition ref. line |     |       |      |
| Deck ↓ thickness Feference Line  |     |       |      |
| Left overhang  |     |       |      |
| Deck Deck (cont'd) Parapet Median Railing Generic Sidewalk Lane position Striped lanes Wearing surface   |     |       |      |
| Deck concrete:   |     |       |      |
| Total deck thickness: 8.0000 in  |     |       |      |
| Load case: rigine Assigned   |     |       |      |
| Deck crack control parameter: kip/in   |     |       |      |
| Sustained modular ratio factor: 2.000  |     |       |      |
| Deck exposure factor: 1.000  |     |       |      |
|  |     |       |      |
|  |     |       |      |
|  |     |       |      |
|  |     |       |      |
|  |     |       |      |
|  |     |       |      |
|  |     |       |      |
|  |     |       |      |
|  |     |       |      |
| ОК Арі   | oly | Cance | el 🛛 |
|  |     |       |      |

### Structure Typical Section – Parapets

| tru | cture Typical Sectior | י   |        |           |         |       |  |                              |                            |                           |                |          | _ |        |
|-----|-----------------------|-----|--------|-----------|---------|-------|--|------------------------------|----------------------------|---------------------------|----------------|----------|---|--------|
| k   | Fre                   | ont |        |           |         |       |  |                              |                            |                           |                |          |   |        |
| ecl | k Deck (cont'd)       | Pa  | arapet | Median    | Railing | Gene  | ric Sidewalk                           | Lane posit                   | on Stripe                  | d lanes 🛛 W               | earing surface |          |   |        |
|     | Name                  |     | L      | .oad case | Measu   | re to | Edge of deck<br>dist. measured<br>from | Distance at<br>start<br>(ft) | Distance at<br>end<br>(ft) | Front face<br>orientation |                |          |   |        |
| Þ   | Jersey Barrier        | •   | DC2    |           | Back    | -     | eft Edge 🔹 👻                           | 0.00                         | 0.00                       | Right                     | -              |          |   |        |
|     | Jersey Barrier        | Ŧ   | DC2    |           | Back    | - 1   | light Edge 🛛 *                         | 0.00                         | 0.00                       | Left '                    | -              |          |   |        |
|     |                       |     |        |           |         |       |  |                              |                            |                           |                |          |   |        |
|     |                       |     |        |           |         |       |  |                              |                            |                           | New D          | uplicate | [ | Delete |
|     |                       |     |        |           |         |       |  |                              |                            |                           |                |          |   |        |

### Structure Typical Section – Lane Positions

Select the **Lane position** tab and use the **Compute...** button to compute the lane positions. A window showing the results of the computation opens. Click **Apply** to apply the computed values.

| 4 | D, | Compute La          | ne Positions   |   |  |   | ×    |
|---|----|---------------------|--|---|--|---|------|
|   |    | Travelway<br>number | Distance from left edge of<br>travelway to superstructure<br>definition reference line<br>at start (A)<br>(ft) | Distance from right edge of<br>travelway to superstructure<br>definition reference line<br>at start (B)<br>(ft) | Distance from left edge of<br>travelway to superstructure<br>definition reference line<br>at end (A)<br>(ft) | Distance from right edge of<br>travelway to superstructure<br>definition reference line<br>at end (B)<br>(ft) |      |
|   | Þ. | 1                   | -26.00   | 26.00   | -26.00   | 26.00   | -    |
|   |    |                     |  |   |  |   | Ŧ    |
|   |    |                     |  |   |  | Apply Ca  | ncel |

The **Lane Position** tab is populated as shown below. These lane positions are used by BrDR to compute the LRFD live load distribution factors.

| A Structure | Typical Sec                            | tion   |   |  |   | -      |        | ×  |
|-------------|--|--|---|--|---|--------|--------|----|
|             | (A)<br>Travelway                       | B A Superstructure   | ure Definition Reference Line<br>ravelway 2   |  |   |        |        |    |
| Deck [      | Deck (cont'                            | d) Parapet Median  | Railing Generic Sidewa  | alk Lane position Striped  | l lanes Wearing surface   |        |        |    |
| Trav        | velway<br>umber                        | Distance from left edge of<br>travelway to superstructure<br>definition reference line<br>at start (A)<br>(ft) | Distance from right edge of<br>travelway to superstructure<br>definition reference line<br>at start (B)<br>(ft) | Distance from left edge of<br>travelway to superstructure<br>definition reference line<br>at end (A)<br>(ft) | Distance from right edge of<br>travelway to superstructure<br>definition reference line<br>at end (B)<br>(ft) |        |        |    |
| Þ           | 1                                      | -26.00   | 26.00   | -26.00   | 26.00   |        | -      |    |
|             |  |  |   |  |   |        |        |    |
| LRFD        | fatigue<br>anes availal<br>werride Tru | ble to trucks:   | Compute   |  | New Dup   | licate | Delete |    |
|             |  |  |   |  | ОК  | Apply  | Canc   | el |

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

#### Schematic – Structure Typical Section

While the **Structure Typical Section** is selected in the **Bridge Workspace** tree, open the schematic for the structure typical section by selecting the **Schematic** button on the **WORKSPACE** ribbon (or right click on **Structure Typical Section** in the **Bridge Workspace** and select **Schematic** from the menu).

| Bridge Workspace - F  | PS4                 | ANALYS          | IS REPORT    | S                 |           | ? – | □ × |
|---|---------------------|-----------------|--------------|-------------------|-----------|-----|-----|
| BRIDGE WORKSPACE WORKSPACE  | TOOLS VIE           | W DESIGN/R      | ATE REPORTIN | NG                | $\frown$  |     | ^   |
| Check Out<br>Check In<br>Validate Save  | Close Export        | Refresh Oper    | New Copy F   | aste Duplicate De | Schematic |     |     |
| Bridge  |                     |                 | Mar          | lage              |           |     |     |
| Workspace   |                     | ч×              | Schematic    | ₽ ×               | Report    |     | ά×  |
| Bridge Components   |                     |                 |              |                   |           |     |     |
| Components     Sersey Barrier     ASHTO TYPE VI     East Concrete     If the Concrete     Seast Deck Conconcrete     Seast Deck Concrete     Seast Deck Conconcrete     S | 5                   | -               |              |                   |           |     |     |
| B- H PS I Beam  | *5                  |                 | Analysis     |                   |           |     | ά×  |
| Impact/Dynamic Load /     dt Load Case Description     df Framing Plan Detail     Ø     Pracing Spec Check Set     Stracing Spec Check Set     ft Structure Typical Sectio  | Allowance<br>ection |                 |              |                   |           |     |     |
| H Superstructure Loads  | 🗁 Open              |                 |              |                   |           |     |     |
| Concrete Stress Limits     Prestress Properties   | M Analyze           |                 |              |                   |           |     |     |
| Shear Reinforcement D   | 🕼 View Sum          | mary Report     |              |                   |           |     |     |
| MEMBERS   | View Deta           | iled Report     |              |                   |           |     |     |
| BRIDGE ALTERNATIVES   | General D           | -<br>references |              |                   |           |     |     |
|   | ogo Cenerare        | renerences      |              |                   |           |     |     |

The schematic of the Structure Typical Section is shown below.

| Schematic                                  | _ 🗆 ×      |
|--|------------|
| Typical section                            | <b>▼</b> × |
|  | ÷          |
| PS4<br>NHI Example - PS I Beam<br>2/8/2023 |            |
| 55'-6"                                     | -          |
|  |            |
| 52'-0"                                     | -          |
| Deck Thickness 8"                          |            |
| Travelway 1                                |            |
|  |            |
| 3'-6 15/16" 5@9'-8" = 48'-4" 3'-           | 7 1/16"    |
|  |            |

#### Superstructure Loads

Double click on the **Superstructure Loads** node in the **Bridge Workspace** tree to open the **Superstructure Loads** window. Navigate to the **DL distribution** tab in this window. Select options in this window as shown below. The BrDR LRFD engine does not support the transverse continuous beam analysis option.

| Jniform                                      | temperat  | ure Gradient t  | temperature             | Wind | DL distrib | ution |  |  |
|--|---|---|-------------------------|------|------------|-------|--|--|
| Stan   | e 1 dead I  | oad distribution  |                         |      |            |       |  |  |
|  | v tributan  |   |                         |      |            |       |  |  |
|  | y transver  | raica   | maherin                 |      |            |       |  |  |
|  | y transver  | se sontinuous-be  | am analysis             |      |            |       |  |  |
|  | y nercent:  | se continuous-be  | ann anaiysis            |      |            |       |  |  |
|  | y percenta  | Jgc   |                         |      |            |       |  |  |
|  | Girder  | Percentage<br>(%)   |                         |      |            |       |  |  |
|  |   |   |                         |      |            |       |  |  |
|  |   |   |                         |      |            |       |  |  |
|  |   |   |                         |      |            |       |  |  |
|  |   |   |                         |      |            |       |  |  |
|  |   |   |                         |      |            |       |  |  |
|  |   |   |                         |      |            |       |  |  |
|  | Ser Genne   |   |                         |      |            |       |  |  |
| Stag   | e 2 dead l<br>Iniformly t   | oad distribution<br>o all girders   |                         |      |            |       |  |  |
|  | e 2 dead I<br>Iniformly t<br>y tributary<br>y transver<br>y transver  | oad distribution<br>o all girders<br>r area<br>se simple-beam a<br>se continuous-be   | analysis<br>am analysis |      |            |       |  |  |
| Stag   | e 2 dead I<br>Iniformly t<br>y tributary<br>y transver<br>y transver<br>y percenta  | oad distribution<br>o all girders<br>r area<br>se simple-beam a<br>se continuous-be<br>age                                      | analysis<br>am analysis |      |            |       |  |  |
| Stag<br>U<br>B<br>B<br>B<br>B<br>B<br>B<br>B | e 2 dead I<br>Iniformly t<br>y tributary<br>y transver<br>y transver<br>y percenta<br>Girder  | oad distribution<br>o all girders<br>v area<br>se simple-beam a<br>se continuous-be<br>age<br>Percentage<br>(%)                 | analysis<br>am analysis |      |            |       |  |  |
| Stag U B B B B B B B B B B B B B B B B B B   | e 2 dead I<br>Iniformly t<br>y tributany<br>y transver<br>y transver<br>y percenta<br>Girder  | oad distribution<br>o all girders<br>v area<br>se simple-beam a<br>se continuous-be<br>age<br>Percentage<br>(%)                 | analysis<br>am analysis |      |            |       |  |  |
|  | e 2 dead l<br>Iniformly t<br>y tributary<br>y transver<br>y transver<br>y percenta<br>Girder<br>1<br>2                              | oad distribution<br>o all girders<br>r area<br>se simple-beam a<br>se continuous-be<br>age<br>Percentage<br>(%)                 | analysis<br>am analysis |      |            |       |  |  |
| Stag<br>U<br>B<br>B<br>B<br>B<br>B           | e 2 dead l<br>Iniformly t<br>y tributary<br>y transver<br>y transver<br>y percenta<br>Girder<br>1<br>2<br>3                         | oad distribution<br>o all girders<br>v area<br>se simple-beam a<br>se continuous-be<br>age<br>Percentage<br>(%)                 | analysis<br>am analysis |      |            |       |  |  |
| Stag   | e 2 dead l<br>Iniformly t<br>y tributany<br>y transver<br>y percenta<br>Girder<br>1<br>2<br>3<br>4                                  | oad distribution<br>o all girders<br>v area<br>se simple-beam a<br>se continuous-be<br>age<br>Percentage<br>(%)                 | analysis<br>am analysis |      |            |       |  |  |
| Stag   | e 2 dead l<br>Iniformly t<br>y tributany<br>y transver<br>y percenta<br>Girder<br>1<br>2<br>3<br>4<br>5                             | oad distribution<br>o all girders<br>a rea<br>se simple-beam a<br>se continuous-be<br>ge<br>Percentage<br>(%)                   | analysis<br>am analysis |      |            |       |  |  |
|  | e 2 dead l<br>Iniformly t<br>y tributary<br>y transver<br>y transver<br>y percenta<br>Girder<br>1<br>2<br>3<br>4<br>5<br>ser-define | oad distribution<br>o all girders<br>r area<br>se simple-beam a<br>se continuous-be<br>sge<br>Percentage<br>(%)                 | analysis<br>am analysis |      |            |       |  |  |
|  | e 2 dead l<br>Iniformly t<br>y tributary<br>y transver<br>y transver<br>y percenta<br>Girder<br>1<br>2<br>3<br>4<br>5<br>ser-define | oad distribution<br>o all girders<br>area<br>se simple-beam a<br>se continuous-be<br>age<br>Percentage<br>(%)                   | analysis<br>am analysis |      |            |       |  |  |
|  | e 2 dead l<br>Iniformly t<br>y tributary<br>y transver<br>y percenta<br>Girder<br>1<br>2<br>3<br>4<br>5<br>ser-define               | oad distribution<br>o all girders<br>r area<br>se simple-beam a<br>se continuous-be<br>gge<br>Percentage<br>(%)<br>ad dead load | analysis<br>am analysis |      |            |       |  |  |
|  | e 2 dead l<br>Iniformly t<br>y tributary<br>y transver<br>y percenta<br>Girder<br>1<br>2<br>3<br>4<br>5<br>ser-define               | oad distribution<br>o all girders<br>rarea<br>es eximple-beam as<br>es continuous-be<br>ge<br>(%)<br>(%)<br>ed dead load        | analysis<br>am analysis |      |            |       |  |  |

#### Concrete Stress Limits

A Stress Limit defines the allowable concrete stresses for a given concrete material. Double click on the **Concrete Stress Limits** node in the **Bridge Workspace** tree to open the **Stress Limit Sets – Concrete** window. Enter the data shown above the **Compute** button and select the **Beam Concrete** material from the drop-down menu of the **Concrete material**. Click the **Compute** button. Default values for the allowable stresses will be computed based on the **Concrete material** selected and the AASHTO Specifications. A default value for the **Final allowable slab compression** is not computed since the deck concrete is typically different from the concrete used in the beam.

| A Stress Limit Sets -                   | Concrete      |                 |              |           |     |       | _ |       | ×  |
|---|---------------|-----------------|--------------|-----------|-----|-------|---|-------|----|
| Name:                                   | Girder Stre   | ss Limit        |              |           |     |       |   |       |    |
| Description:                            |               |                 |              |           |     |       |   |       |    |
| Corrosion condition:                    | Moderate      |                 | $\sim$       |           |     |       |   |       |    |
| Final allowable te                      | ension stress | limit coef. (US | 6) override: |           |     |       |   |       |    |
| Concrete material:                      | Beam Concr    | ete             | ~            |           |     |       |   |       |    |
|   | Compute       |                 |              |           |     |       |   |       |    |
|   |               | LFD             |              | LRFD      |     |       |   |       |    |
| Initial allowable comp                  | pression:     | 3.3             | ksi          | 3.575     | ksi |       |   |       |    |
| Initial allowable tensi                 | on:           | 0.2             | ksi          | 0.2       | ksi |       |   |       |    |
| Final allowable comp                    | ression:      | 4.2             | ksi          | 4.2       | ksi |       |   |       |    |
| Final allowable tensio                  | on:           | 0.5026927       | ksi          | 0.5026927 | ksi |       |   |       |    |
| Final allowable DL co                   | mpression:    | 2.8             | ksi          | 3.15      | ksi |       |   |       |    |
| Final allowable slab c                  | ompression:   |                 | ksi          |           | ksi |       |   |       |    |
| Final allowable comp<br>(LL+1/2(Pe+DL)) | ression:      | 2.8             | ksi          | 2.8       | ksi |       |   |       |    |
|   |               |                 |              | C         | К   | Apply |   | Cance | el |

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

#### **Prestress Properties**

Double click on the **Prestress Properties** node in the **Bridge Workspace** tree to open the **Prestress Properties** window. Select the loss method as **Pre-2005 AASHTO Refined**. The losses will be computed by the BrDR LRFD engine using the refined method in the **Third edition**, **2004 without interims**. Define the prestress properties as shown below.

| Prestress Properties     |                                    |                            |       | _     |       | ×  |
|--------------------------|------------------------------------|----------------------------|-------|-------|-------|----|
| Name: 3rd Edition Losses | 5                                  |                            |       |       |       |    |
| General P/S data Los     | ss data - lump sum Loss data - PCI |                            |       |       |       |    |
| P/S strand material:     | 1/2" (7W-270) LR                   | Jacking stress ratio:      | 0.750 | ]     |       |    |
| Loss method:             | Pre-2005 AASHTO Refined            | P/S transfer stress ratio: |       | ]     |       |    |
|                          |                                    | Transfer time:             | 24.0  | Hours |       |    |
|                          |                                    | Age at deck placement:     |       | Days  |       |    |
|                          |                                    | Final age:                 |       | Days  |       |    |
| Include elastic gains    |                                    |                            |       |       |       |    |
|                          |                                    |                            | ОК    | Apply | Cance | el |

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

#### Prestressed loss calculation methods

The following loss methods are available in the BrDR LRFD engine.

- AASHTO Approximate
- AASHTO Refined
- Lump Sum
- PCI
- Pre-2005 AASHTO Refined (AASHTO Refined, Third edition, 2004 without interims)

The AASHTO Approximate and refined loss methods correspond to the AASHTO LRFD Specifications, Ninth edition, by default in BrDR 7.5.0. Another feature for prestress loss calculations in the BrDR LRFD engine is the ability to include elastic gains and losses due to dead load application.

#### Shear Reinforcement

Define shear reinforcement to be used by the girders. Expand the **Shear Reinforcement Definitions** on the **Bridge Workspace** tree, select the **Vertical** node and click on **New** from the **Manage** group of the **WORKSPACE** ribbon (or double click on **Vertical**).



Define the stirrup as shown below. Click **OK** to apply the data and close the window.

| A Shear Reinforcement Definition - Vertical  | -    |       | Х |
|--|------|-------|---|
| Name: #4 Stirrup   |      |       |   |
| Material: Grade 60<br>Bar size: 4<br>Number of legs: 2.00<br>Inclination (alpha): 90.0 Degrees<br>Shear<br>Reinforcement |      |       |   |
| OK Ap  | oply | Cance | I |

#### Defining a Member Alternative

Double-click on **MEMBER ALTERNATIVES** in the **Bridge Workspace** tree for member **G2** to create a new member alternative. The **New Member Alternative** window shown below will open. Select **Prestressed** (pretensioned) concrete for the **Material type** and **PS Precast I** for the **Girder Type**.

| laterial type:                      | Girder type:   |
|-------------------------------------|----------------|
| Post tensioned concrete             | PS Precast Box |
| Prestressed (pretensioned) concrete | PS Precast I   |
| Reinforced concrete                 | PS Precast Tee |
| Steel                               | PS Precast U   |
| Timber                              |                |
|                                     |                |
|                                     |                |

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

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

| ember alterna | tive: I Bea | am Alt     |        |           |                     |                      |        |  |  |
|---------------|-------------|------------|--------|-----------|---------------------|----------------------|--------|--|--|
| Description   | Specs       | Factors    | Engine | Import    | Control options     |                      |        |  |  |
| Description:  |             |            |        |           | Material type:      | Prestressed (Pretens | ioned) |  |  |
|               |             |            |        |           | Girder type:        | PS Precast I         |        |  |  |
|               |             |            |        |           | Modeling type:      | Multi Girder System  |        |  |  |
|               |             |            |        |           | Default units:      | US Customary         | ~      |  |  |
| Girder pro    | perty input | t method   |        |           |                     |                      |        |  |  |
| Schedu        | le based    |            |        |           |                     |                      |        |  |  |
| O Cross-s     | ection base | ed         |        |           |                     |                      |        |  |  |
| Self load     |             |            |        |           | Default rating meth | od:                  |        |  |  |
| Load case:    |             | Engine Ass | igned  | ~         | LFR                 | ~                    |        |  |  |
| Additional    | self load:  |            | kip/ft |           |                     |                      |        |  |  |
| Additional    | self load:  |            | %      |           |                     |                      |        |  |  |
| Crack cont    | rol parame  | eter (Z)   |        | Exposure  | factor              |                      |        |  |  |
| Top of bea    | m:          |            | kip/in | Top of be | am: 1.000           | Use creep            | )      |  |  |
| Bottom of     | beam:       |            | kip/in | Bottom o  | of beam: 1.000      |                      |        |  |  |
|               |             |            |        |           |                     |                      |        |  |  |
|               |             |            |        |           |                     |                      |        |  |  |
|               |             |            |        |           |                     |                      |        |  |  |
|               |             |            |        |           |                     |                      |        |  |  |
|               |             |            |        |           |                     |                      |        |  |  |
|               |             |            |        |           |                     |                      |        |  |  |
|               |             |            |        |           |                     |                      |        |  |  |
|               |             |            |        |           |                     |                      |        |  |  |
|               |             |            |        |           |                     |                      |        |  |  |
|               |             |            |        |           |                     |                      |        |  |  |

Navigate to the **Control options** tab in this window. The BrDR LRFD engine allows the selection of either gross or transformed section properties to be used in the loss and stress calculations. Note that the gross section properties are always used in structural analysis. Under LRFD section, select the **Use gross section properties** option for **Loss & stress calculations**, and the **Continuous** option for the **Multi-span analysis** as shown below.



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

#### Prestressed multi-span modeling options

The BrDR LRFD engine allows the user to model prestress beams made continuous for live load in two ways:

- The **Continuous** analysis method considers multi-span structures to be simply supported for beam selfweight and uncured deck and continuously supported for composite dead and live loads. This method takes advantage of the continuity connection to reduce the maximum positive moment at mid-spans.
- The **Continuous** and **Simple** method analyzes the structure as simply supported for beam self-weight and uncured deck and both continuously and simply supported for composite dead and live loads. The maximum effects from the two analyses are then used in the specification checking. This method accounts for the condition where full continuity is not provided at the interior supports and does not reduce the maximum positive moment at mid-spans.

### Beam Details

Next describe the beam by double clicking on the **Beam Details** node in the **Bridge Workspace** tree. Enter the data in each tab of the **Beam Details** window as shown below.

| Span detail   | Continuous sup  | port det   | ail Stress limit ranges                                   | Slab interface | Continuity dia | aphragm | Web end          | d block           |       |    |
|---|---|--|---|----------------|----------------|---------|------------------|-------------------|-------|----|
| - Same  |   |  | Girder  | Dree           |                |         | Beam p           | projection        |       |    |
| number  | Beam shap   | be   | material  | proj           | perties        | n       | Left end<br>(in) | Right end<br>(in) |       |    |
| ▶ 1   | AASHTO TYPE   | VI - E   | Beam Concrete   | 3rd Edition Lo | sses -         |         | 9.0000           | 9.0000            |       |    |
| 2   | AASHTO TYPE   | VI - E   | eam Concrete 🔹  | 3rd Edition Lo | sses *         |         | 9.0000           | 9.0000            |       |    |
|   |   |  |   |                |                |         |                  |                   |       |    |
|   |   |  |   |                |                |         |                  |                   |       | ~  |
|   |   |  |   |                |                | OI      | K                | Apply             | Cance | el |
|   |   |  |   |                |                |         |                  |                   |       |    |
| Beam Details  |   |  |   |                |                |         |                  |                   |       | >  |
| Beam Details<br>Span detail                             | Continuous sup  | oport det  | ail Stress limit ranges                                   | Slab interface | Continuity dia | aphragm | Web end          | -<br>d block      |       | >  |
| Beam Details<br>Span detail                             | Continuous sup  | oport det  | ail Stress limit ranges                                   | Slab interface | Continuity dia | aphragm | Web end          | -<br>d block      |       | ;  |
| Beam Details<br>Span detail<br>CL of Bearing<br>on Left | Continuous sup  | pport det  | ail Stress limit ranges                                   | Slab interface | Continuity dia | aphragm | Web end          | d block           |       | ;  |
| Beam Details<br>Span detail<br>CL of Bearing<br>on Left | Continuous sup  | pport det  | ail Stress limit ranges                                   | Slab interface | Continuity dia | aphragm | Web end          | -                 |       | ;  |
| Beam Details<br>Span detail<br>CL of Bearing<br>on Left | Continuous sup<br>SL SR<br>K—CL ol<br>Support<br>distance on<br>left, SL                    | pport det  | ail Stress limit ranges<br>,<br>earing<br>t<br>ort<br>s R | Slab interface | Continuity dia | aphragm | Web end          | _                 |       | ,  |
| Beam Details  | Continuous sup<br>SL SR<br>k—CL ol<br>Support<br>distance on<br>left, SL<br>(in)<br>12.0000 | oport det<br>CL of B<br>on Right<br>f Pier<br>Suppo<br>distance<br>right,<br>(in)                        | ail Stress limit ranges<br>earing t<br>on<br>SR 0000      | Slab interface | Continuity dia | aphragm | Web end          | -                 |       |    |
| Beam Details  | Continuous sup<br>Support<br>distance on<br>ieft, SL<br>(in)<br>12.0000                     | sport det  | ail Stress limit ranges earing to an SR 00000             | Slab interface | Continuity dia | aphragm | Web end          | d block           |       |    |
| Beam Details  | Continuous sup<br>Support<br>Support<br>distance on<br>left, SL<br>(in)<br>12.0000          | yport det<br>↓<br>↓ CL of B<br>★ on Righ<br>f Pier<br>support<br>distance<br>distance<br>distance<br>12. | ail Stress limit ranges earing to an SR 00000             | Slab interface | Continuity dia | aphragm | Web end          | d block           |       |    |

|   | Continuous support det   | ail Stres   | s limit ra                    | nges  | Slab interface    | Continuity diaphra | gm 🛛 🛛      | /eb end block          |        |
|---|--|---|-------------------------------|-------|-------------------|--------------------|-------------|------------------------|--------|
|   | 1  |   |                               |       |                   |                    |             |                        |        |
| Span  | Name   | d   | Start<br>listance             | Lengt | h End<br>distance |                    |             |                        |        |
| number  |  |   | (ft)                          | (ft)  | (ft)              |                    |             |                        |        |
| 1 *   | Girder Stress Limit  | -   | 0.00                          | 110.5 | 110.50            |                    |             |                        | -      |
| ▶ 2 ·   | Girder Stress Limit  | *   | 0.00                          | 110.5 | 110.50            |                    |             |                        |        |
|   |  |   |                               |       |                   |                    |             |                        |        |
|   |  |   |                               |       |                   | N                  | ew          | Duplicate              | Delete |
|   |  |   |                               |       |                   |                    |             |                        |        |
|   |  |   |                               |       |                   |                    | OK          | Apply                  | Cance  |
| Beam Details  |  |   |                               |       |                   |                    | OK          | Apply                  | Cance  |
| Beam Details  |  |   |                               |       |                   |                    | OK          | Apply                  | Cance  |
| Beam Details<br>Span detail   | Continuous support det   | ail Stres   | ss limit ra                   | nges  | Slab interface    | Continuity diaphra | OK<br>gm V  | Apply<br>Veb end block | Cance  |
| Beam Details<br>Span detail<br>nterface type  | Continuous support det   | ail Stres   | is limit ra                   | nges  | Slab interface    | Continuity diaphra | OK<br>gm V  | Apply<br>Veb end block | Cance  |
| Beam Details<br>Span detail<br>nterface type<br>Default interf  | Continuous support det<br>::<br>ace width to beam widths:                      | ail Stres<br>Monolithi  | is limit ra                   | nges  | Slab interface    | Continuity diaphra | OK<br>gm V  | Apply<br>Veb end block | Cance  |
| Beam Details<br>Span detail<br>nterface type<br>Default interf<br>nterface widt   | Continuous support det<br>::<br>ace width to beam widths:<br>th:               | ail Stres<br>Monolithi  | is limit ra                   | nges  | Slab interface    | Continuity diaphra | OK<br>Igm V | Apply                  | Cance  |
| Beam Details<br>Span detail<br>nterface type<br>Default interf<br>nterface widt<br>Cohesion fact  | Continuous support det<br>::<br>ace width to beam widths:<br>:h:               | ail Stres<br>Monolithi  | is limit ra<br>ic v<br>in ksi | nges  | Slab interface    | Continuity diaphra | OK<br>gm V  | Veb end block          | Cance  |
| Beam Details<br>Span detail<br>nterface type<br>Default interf<br>nterface widt<br>Cohesion facto   | Continuous support det<br>::<br>ace width to beam widths:<br>:h:<br>:or:<br>:: | il Stres<br>Monolithi   | is limit ra                   | nges  | Slab interface    | Continuity diaphra | OK          | Veb end block          | Cance  |
| Beam Details<br>Span detail<br>nterface type<br>Default interf<br>nterface widt<br>Cohesion facto<br>Criction facto                                   | Continuous support det<br>ace width to beam widths:<br>th:<br>tor:             | ail Stres<br>Monolithi<br>0.400<br>1.400                        | is limit ra                   | nges  | Slab interface    | Continuity diaphra | OK<br>gm V  | Veb end block          | Cance  |
| Beam Details<br>Span detail<br>nterface type<br>Default interf<br>nterface widt<br>Cohesion facto<br>Criction facto<br>(1:                            | Continuous support det<br>ace width to beam widths:<br>th:<br>cor:             | ail Stres<br>Monolithi<br>0.400<br>1.400<br>0.250<br>1.500      | ic V<br>ic ksi                | nges  | Slab interface    | Continuity diaphra | OK<br>gm V  | Veb end block          | Cance  |
| Beam Details<br>Span detail<br>nterface type<br>Default interf<br>nterface widf<br>Cohesion fact<br>Cohesion facto<br>(1:<br>(2:                      | Continuous support det<br>::<br>ace width to beam widths:<br>:or:<br>::        | il Stres<br>Monolithi<br>0.400<br>1.400<br>0.250<br>1.500       | is limit ra                   | nges  | Slab interface    | Continuity diaphra | OK<br>gm V  | Veb end block          | Cance  |
| Beam Details<br>Span detail<br>nterface type<br>Default interf<br>nterface widi<br>Cohesion fact<br>Cohesion fact<br>(1:<br>(2:                       | Continuous support det<br>::<br>ace width to beam widths:<br>:h:<br>:or:<br>:  | iil Stres<br>Monolithi<br>0.400<br>1.400<br>0.250<br>1.500      | ic V<br>in ksi                | nges  | Slab interface    | Continuity diaphra | OK<br>gm V  | Veb end block          | Cance  |
| Beam Details<br>Span detail<br>Interface type<br>Default interf<br>Interface widd<br>Cohesion fact<br>Cohesion facto<br>Ciriction facto<br>C1:<br>C2: | Continuous support det<br>::<br>ace width to beam widths:<br>:b:<br>::<br>::   | il Stres<br>Monolithi<br>2<br>0.400<br>1.400<br>0.250<br>1.500  | ic V<br>ic ksi                | nges  | Slab interface    | Continuity diaphra | OK<br>gm V  | Veb end block          | Cance  |
| Beam Details<br>Span detail<br>nterface type<br>Default interf<br>nterface widt<br>Cohesion fact<br>Cohesion fact<br>Ciriction facto<br>(1:<br>(2:    | Continuous support det<br>::<br>ace width to beam widths:<br>:h:<br>:or:<br>:  | iil Stres<br>Monolithi<br>✓<br>0.400<br>1.400<br>0.250<br>1.500 | ic V<br>ic ksi                | nges  | Slab interface    | Continuity diaphra | OK          | Veb end block          |        |
| Beam Details<br>Span detail<br>nterface type<br>Default interf<br>nterface widt<br>Cohesion fact<br>Cohesion facto<br>Criction facto<br>(1:<br>(2:    | Continuous support det<br>::<br>ace width to beam widths:<br>th:<br>:or:<br>:  | ail Stres<br>Monolithi<br>✓<br>0.400<br>1.400<br>0.250<br>1.500 | ic V                          | nges  | Slab interface    | Continuity diaphra | OK          | Veb end block          |        |
| Beam Details<br>Span detail<br>nterface type<br>Default interf<br>nterface widt<br>Cohesion facto<br>Criction facto<br>(1:<br>(2:                     | Continuous support det<br>::<br>ace width to beam widths:<br>th:<br>:or:<br>:  | ail Stres<br>Monolithi<br>✓<br>0.400<br>1.400<br>0.250<br>1.500 | ic V<br>in ksi                | nges  | Slab interface    | Continuity diaphra | OK          | Veb end block          |        |
| Beam Details<br>Span detail<br>Interface type<br>Default interf<br>Interface widt<br>Cohesion facto<br>Cohesion facto<br>Chesion facto<br>(1:<br>(2:  | Continuous support det<br>ace width to beam widths:<br>th:<br>for:             | il Stres<br>Monolithi<br>0.400<br>1.400<br>0.250<br>1.500       | is limit ra                   | nges  | Slab interface    | Continuity diaphra | OK<br>gm V  | Veb end block          |        |
| Beam Details<br>Span detail<br>nterface type<br>Default interf<br>nterface widt<br>Cohesion facto<br>Cohesion facto<br>(1:<br>(2:                     | Continuous support det<br>::<br>ace width to beam widths:<br>:or:<br>::        | il Stres<br>Monolithi<br>0.400<br>1.400<br>0.250<br>1.500       | is limit ra                   | nges  | Slab interface    | Continuity diaphra | OK<br>gm V  | Veb end block          |        |
| Beam Details<br>Span detail<br>nterface type<br>Default interf<br>nterface widt<br>Cohesion facto<br>Cohesion facto<br>(1:<br>(2:                     | Continuous support det<br>:<br>ace width to beam widths:<br>th:<br>cor:<br>:   | il Stres<br>Monolithi<br>0.400<br>1.400<br>0.250<br>1.500       | ic V<br>in ksi                | nges  | Slab interface    | Continuity diaphra | OK<br>gm V  | Veb end block          |        |
| Beam Details<br>Span detail<br>nterface type<br>Default interf<br>nterface widf<br>Cohesion facto<br>Cohesion facto<br>(1:<br>(2:                     | Continuous support det<br>ace width to beam widths:<br>th:<br>tor:             | ii Stres<br>Monolithi<br>0.400<br>1.400<br>0.250<br>1.500       | ic V<br>ic ksi                | nges  | Slab interface    | Continuity diaphra | OK<br>gm V  | Veb end block          |        |
| Beam Details<br>Span detail<br>nterface type<br>Default interf<br>nterface widd<br>Cohesion fact<br>iriction facto<br>(1:<br>(2:                      | Continuous support det<br>::<br>ace width to beam widths:<br>:h:<br>:or:<br>:: | il Stres<br>Monolithi<br>                                       | ic V                          | nges  | Slab interface    | Continuity diaphra | OK<br>gm V  | Veb end block          |        |

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

### Shrinkage Time

Double-click on the **Shrinkage Time** node in the **Bridge Workspace** tree to open the **Shrinkage/Time** window. Enter the data as shown below.

| A Shrinkage/Time  | _   |      | ×  |
|---|-----|------|----|
| Shrinkage Time  |     |      |    |
| Beam<br>Curing method: Steam-cured                      |     |      |    |
| Deck<br>Curing method: Moist-cured<br>Drying time: Days |     |      |    |
| Consider deck differential shrinkage loads              |     |      |    |
|   |     |      |    |
|   |     |      |    |
| OK App  | oly | Canc | el |

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

#### Strand Layout

Expand the **Strand Layout** node in the **Bridge Workspace** tree and open the **Span 1** window. Use the **Zoom** buttons on the right side of this window to shrink/expand the schematic of the beam shape so that the entire beam is visible. Select the **Description type** as **Strands in rows** and the **Strand configuration type** as **Straight/Debonded**. Define the following strand layout at midspan.



Now select the **Left end** radio button Under the Debonding section, select New to enter a left debonded section location as **273 inches**. This distance is measured from the left end of the precast beam. The strands can be defined at the left end of the span by selecting strand locations in the right hand schematic. Define the following debonded strands at this location.

| A New Location   | × |
|--|---|
| Section location: 273.0000 in                                      |   |
| Measured and debonded from   |   |
| End of beam  |   |
| O Mid-span: Cut strand after release of initial prestressing force |   |
|  |   |
| OK Cancel  |   |

| A Strand Layout - Span 1   | - 🗆 X   |
|--|---|
| Description type   |   |
| P and CGS only   Strands in rows                                       | Notes:  |
| Strand configuration type  | sitian posicing generated by the KervaseD method.<br>Please refer to Help for a description of this method.   |
| Straight/Debonded  |   |
| Harped   |   |
| O Harped and straight debonded   |   |
| Mid span   |   |
|  |   |
|  |   |
|  |   |
|  |   |
|  | $\sim \sim \sim \sim$   |
| Debesties  |   |
| Debonding      Eft Section location (in) Measured and debonded from    |   |
| 273.0000 End of Beam   |   |
|  |   |
|  |   |
| New Modify Delete  | ***   |
| Right         Section location (in)         Measured and debonded from |   |
| ▶ 273.0000 End of Beam   |   |
|  |   |
| ×  |   |
| New Modify Delete  |   |
| OK Apply Cancel  | Number of debonded strands (Total/Here/Other) = 6/6/0   |
|  | CG of strands (measured from bottom of section) = 5.16 in   |
|  | Legend:   |
|  | No strand at this position at the current section location.     No strand at this position at the current location but a strand is harped to this position.             |
|  | A strand occupies this position at the current section location. The strand is debonded from the end of the beam to the current section location.                       |
|  | The strand is debonded from the mid-span to the current section location. The strand is debonded at other section location. Hover over the strand for more information. |
|  | The harped position of a harped strand.<br>The mid-span position of a harped strand.  |
|  | <ul> <li>The mid-span position of one strand and the harped position of another strand.</li> <li>Mild steel.</li> </ul>   |
|  |   |

Similarly, add an additional debonding location of 129 inches and debond the following strands.

| 🕰 New Location  | × |
|---|---|
| Section location: 129.0000 in   |   |
| Measured and debonded from<br>End of beam<br>Mid-span: Cut strand after release of initial prestressing force |   |
| OK Cancel   |   |



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

Repeat the procedure used in Strand Layout – Span 1 section to describe the same strand layout for Span 2.

#### Deck Profile

Next open the **Deck Profile** window by double-clicking the **Deck Profile** node in the **Bridge Workspace** tree and enter the data describing the structural properties of the deck. The window is shown below.

The LRFD effective flange width is computed as follows:

AASHTO LRFD Article 4.6.2.6.1

For interior beams, the effective flange width is taken as :

• average spacing of adjacent beams = 9.67'(12'') = 116''

|           | cast I     |        |                 |                           |                |                         |                                 |  |  |   |   |   |  |  |
|-----------|------------|--------|-----------------|---------------------------|----------------|-------------------------|---------------------------------|--|--|---|---|---|--|--|
| ck concre | rete Reinf | orceme | int             |                           |                |                         |                                 |  |  |   |   |   |  |  |
|           | Material   | Si     | upport<br>umber | Start<br>distance<br>(ft) | Length<br>(ft) | End<br>distance<br>(ft) | Structural<br>thickness<br>(in) | Start effective<br>flange width<br>(Std)<br>(in) | End effective<br>flange width<br>(Std)<br>(in) | Start effective<br>flange width<br>(LRFD)<br>(in) | End effective<br>flange width<br>(LRFD)<br>(in) | n |  |  |
| Beam (    | Concrete   | * 1    | *               | 0.00                      | 220.00         | 220.00                  | 7.5000                          |  |  | 111.0000  | 111.0000  |   |  |  |
|           |            |        |                 |                           |                |                         |                                 |  |  |   |   |   |  |  |
|           |            |        |                 |                           |                |                         |                                 |  |  |   |   |   |  |  |
|           |            |        |                 |                           |                |                         |                                 |  |  |   |   |   |  |  |
|           |            |        |                 |                           |                |                         |                                 |  |  |   |   |   |  |  |

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

| e: | PS Precast I |                   |                           | 1              |                         |                  |                   |          |                  |                  |                        |     |         | -  |        |   |
|----|--------------|-------------------|---------------------------|----------------|-------------------------|------------------|-------------------|----------|------------------|------------------|------------------------|-----|---------|----|--------|---|
| ec | k concrete   | Reinforcem        | ent                       |                |                         |                  |                   |          |                  |                  |                        |     |         |    |        |   |
|    | Material     | Support<br>number | Start<br>distance<br>(ft) | Length<br>(ft) | End<br>distance<br>(ft) | Std<br>bar count | LRFD<br>bar count | Bar size | Distance<br>(in) | Row              | Bar<br>spacing<br>(in) |     |         |    |        |   |
|    | Grade 60 🔹   | 1 -               | 0.00                      | 220.00         | 220.00                  |                  | 21.00             | 6 -      | 3.0000           | Top of Slab 🔹    |                        |     |         |    |        | 4 |
| Þ  | Grade 60 🔻   | 1 -               | 0.00                      | 220.00         | 220.00                  |                  | 14.00             | 6 -      | 3.0000           | Bottom of Slab 👻 |                        |     |         |    |        |   |
|    |              |                   |                           |                |                         |                  |                   |          |                  |                  |                        |     |         |    |        |   |
|    |              |                   |                           |                |                         |                  |                   |          |                  |                  |                        |     |         |    |        |   |
|    |              |                   |                           |                |                         |                  |                   |          |                  |                  |                        |     |         |    |        |   |
|    |              |                   |                           |                |                         |                  |                   |          |                  |                  |                        |     |         |    |        |   |
|    |              |                   |                           |                |                         |                  |                   |          |                  |                  |                        |     |         |    |        |   |
|    |              |                   |                           |                |                         |                  |                   |          |                  |                  |                        |     |         |    |        |   |
|    |              |                   |                           |                |                         |                  |                   |          |                  |                  |                        |     |         |    |        |   |
|    |              |                   |                           |                |                         |                  |                   |          |                  |                  |                        |     |         |    |        |   |
|    |              |                   |                           |                |                         |                  |                   |          |                  |                  |                        |     |         |    |        |   |
|    |              |                   |                           |                |                         |                  |                   |          |                  |                  |                        |     |         |    |        |   |
|    |              |                   |                           |                |                         |                  |                   |          |                  |                  |                        |     |         |    |        |   |
|    |              |                   |                           |                |                         |                  |                   |          |                  |                  |                        |     |         |    |        |   |
|    |              |                   |                           |                |                         |                  |                   |          |                  |                  |                        |     |         |    |        |   |
|    |              |                   |                           |                |                         |                  |                   |          |                  |                  |                        |     |         |    |        |   |
|    |              |                   |                           |                |                         |                  |                   |          |                  |                  |                        |     |         |    |        |   |
|    |              |                   |                           |                |                         |                  |                   |          |                  |                  |                        | New | Duplica | te | Delete |   |
|    |              |                   |                           |                |                         |                  |                   |          |                  |                  |                        | New | Duplica | te | Delete |   |

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

#### Haunch Profile

The haunch profile is defined by double-clicking on the **Haunch Profile** node in the **Bridge Workspace** tree. Enter data as shown below.

| 🕰 PS Haun | ch Pro       | file                      |                |                         |            |            |            |            |     |         | _   |        | ×   |
|-----------|--------------|---------------------------|----------------|-------------------------|------------|------------|------------|------------|-----|---------|-----|--------|-----|
|           |              |                           | 11<br>         |                         |            |            |            |            |     |         |     |        |     |
| Sup       | port<br>nber | Start<br>distance<br>(ft) | Length<br>(ft) | End<br>distance<br>(ft) | Z1<br>(in) | Z2<br>(in) | Y1<br>(in) | Y3<br>(in) |     |         |     |        |     |
| ▶ 1       | -            | 0.00                      | 220.00         | 220.00                  |            |            | 4.0000     |            |     |         |     |        | -   |
|           |              |                           |                |                         |            |            |            |            |     |         |     |        | 4   |
|           |              |                           |                |                         |            |            |            |            | New | Duplica | te  | Delete | •   |
|           |              |                           |                |                         |            |            |            | [          | OK  | Арр     | oly | Can    | cel |

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

#### Shear Reinforcement Ranges

Double-click on the Shear Reinforcement Ranges node in the Bridge Workspace tree to open the PS Shear Reinforcement Ranges window. Use the Stirrup wizard to create the following shear stirrups.



**Beam Elevation Showing Stirrups** 

| Start Distance     Spacing  |
|---|
| Vertical Horizontal   |
| Span: 1 🗸 Copy span to Span: 1 🗸  |
| Extends Start Nur   |
| Name into distance si deck (ft)   |
| 0.7500 <b>ft</b> 109.0000 <b>ft</b> 0.7500 <b>ft</b>  |
| Distance from left end to first   |
| stirrup: 0.2500 ft Distance from left end to last stirrup: 542500   |
| Distance from right end to last 56.2500 ft ✓ All extended into deck   |
| Reinf. Number of Spacing<br>name spaces (in)  |
| #4 Stirrup ~ 18 6.0000  |
| #4 Stimup * 14 18.0000  |
|   |
|   |
|   |
| Stirrup wizard Stirrup design tool  |
| New Duplicate Delete  |
| Symmetry  |
| Even number spaces  |
| Odd number spaces   |
| Apply all Apply span Cance  |
|   |
| → PS Shear Reinforcement Ranges —   |
|   |
|   |
|   |
|   |
| Start Distance  |
|   |
| Vertical Horizontal   |
| Vertical Horizontal Span: 1 V Copy span to  |
| Start Distance     Start Distance     Vertical     Horizontal     Span:     1     Copy span to     Fxtends     Start     Find   |
| Start Distance     Spacing       Vertical     Horizontal       Span:     1       Copy span to       Image: Spacing space sp                               |
| Start Distance       Spacing         Vertical       Horizontal         Span:       1         Vertical       Start         Name       Extends         Start       Start         Name       Extends         Start       Spacing         Length       End         distance       (ft)         deck       (ft)         spaces       0 3000  |
| Start Distance       Spacing         Vertical       Horizontal         Span:       1         Vertical       Start         Name       Extends         Start       Number of spaces         (in)       (ft)         #4 Stirrup       V         0.2500       1         0.2500       18         6 0000       0.2500   |
| Start Distance         Spacing           Vertical         Horizontal           Span:         1         Copy span to           Name         Extends<br>into<br>deck         Start<br>(ft)         Length<br>(ft)         End<br>distance<br>(ft)           #4 Stirrup         V         0.2500         1         0.0000         0.2500           #4 Stirrup         V         0.2500         18         6.0000         9.02500           #4 Stirrup         V         9.2500         14         18.0000         21.0000         30.2500  |
| Start Distance         Spacing           Vertical         Horizontal           Span:         1           Vertical         Copy span to           Image: Start Distance deck         Start distance deck           Mame         Start distance deck           #4 Stirrup *         Image: October of the spaces           #4 Stirrup *         0.2500           #4 Stirrup *         0.2500           #4 Stirrup *         9.2500           #4 Stirrup *         9.2500           #4 Stirrup *         9.2500           #4 Stirrup *         9.2500           #4 Stirrup *         Image: October of spaces           Image: October of spaces         1.0000           0.0000         0.2500           Image: October of spaces         1.0000           Image: October o   |
| Name         Extends<br>into<br>deck         Start<br>distance<br>(ft)         Spacing<br>Length<br>(ft)         End<br>distance<br>(ft)           #4 Stirrup         V         0.2500         1         0.0000         0.2500           #4 Stirrup         V         0.2500         1         0.0000         0.2500           #4 Stirrup         V         0.2500         1         0.0000         0.2500           #4 Stirrup         V         0.2500         14         18.0000         21.0000         30.2500           #4 Stirrup         V         30.2500         25         24.0000         50.0000         80.2500           #4 Stirrup         V         80.2500         14         18.0000         21.0000         101.2500  |
| Name         Extends<br>into<br>deck         Start<br>distance<br>(ft)         Number of<br>spaces         Spacing<br>(in)         Length<br>distance<br>(ft)         End<br>distance<br>(ft)           #4 Stirrup         I         I         0.2500         1         0.0000         0.2500           #4 Stirrup         I         I         0.2500         1         0.0000         0.2500           #4 Stirrup         I         I         0.2500         1         0.0000         0.2500           #4 Stirrup         I         I         9.2500         14         18.0000         21.0000         30.2500           #4 Stirrup         I         I         30.2500         25         24.0000         50.0000         80.2500           #4 Stirrup         I         I         10.2500         18         6.0000         9.0000         110.2500           #4 Stirrup         I         I         I         18.0000         21.0000         110.2500   |
| Image: Start Distance         Spacing           Vertical         Horizontal           Span:         1         Copy span to           Image: Start Distance         Start distance         Spacing           Image: Start Distance         Start         Start   |
| Name         Extends         Start         Mumber of spaces         Spacing           Vertical         Horizontal         Image: Start distance deck         Number of spaces         Spacing (in)         Length distance (ft)         End distance (ft)         Image: Space deck         Image: Space deck         Space deck         Image: Space deck         Im   |
| Image: Start Distance         SDacing           Vertical         Horizontal           Span:         1         Copy span to           Image: Space start Distance         Start distance (ft)         Extends start distance (ft)           #4 Stirrup         V         0.2500         1         0.0000         0.2500           #4 Stirrup         V         0.2500         1         0.0000         0.2500           #4 Stirrup         V         0.2500         14         18.0000         21.0000         30.2500           #4 Stirrup         V         30.2500         25         24.0000         50.0000         80.2500           #4 Stirrup         V         80.2500         14         18.0000         21.0000         101.2500           #4 Stirrup         V         101.2500         18         6.0000         9.0000         110.2500  |
| Image: Start Distance         SDacing           Vertical         Horizontal           Spar:         1         Copy span to           Image: Space start Distance         Start           deck         (ft)         Gistance           deck         (ft)         0.0000         0.0000           #4 Stirrup         Image: Optimized start         0.2500         1           #4 Stirrup         Image: Optimized start         0.2500         1.0000         0.0000           #4 Stirrup         Image: Optimized start         0.2500         1.0000         30.2500           #4 Stirrup         Image: Optimized start         0.2500         1.1         1.0000         30.2500           #4 Stirrup         Image: Optimized start         Image: Optimized start         1.0000         10.2500           #4 Stirrup         Image: Optimized start         Image: Optimized start         1.0000         10.2500           #4 Stirrup         Image: Optimized start         Image: Optimized start         Image: Optimized start         Image: Optimized start           Horizont         Image: Optimized start         Image: Optimized start         Image: Optimized start         Image: Optimized start           Image: Optimized start         Image: Optimized start         Image: Optim  |
| Vertical         Horizontal           Span:         1         Copy span to           Image: Spacing transmission of the space of the s |
| Start Distance         Spacing           Vertical         Horizontal           Span:         1         Copy span to           Image: Space stress into distance (ft)         Space stress (in)         End distance (ft)           #4 Stirrup *         Image: Stress (in)         1         0.0000         0.2500           #4 Stirrup *         Image: Stress (in)         1         1         1         0.2500         1         0.0000         0.2500           #4 Stirrup *         Image: Stress (in)         1   |
| Statt Distance         Spacing           Vertical         Horizontal           Span:         I         Copy span to           Image: Start Distance deck         Start distance (ft)         distance (ft)           #4 Stirrup         Image: Start distance deck         0.2500         1         0.0000         0.2500           #4 Stirrup         Image: Start distance deck         1         1         0.2500         18         6.0000         9.0000         9.2500           #4 Stirrup         Image: Start distance deck         Image: Start distance deck         1   |
| Start Distance         Spacing           Vertical         Horizontal           Spar:         1         Copy span to           Image: Im                                    |
| Name         Extends         Start         Number of spaces         Spacing (n)           Yertical         Horizontal           Spar:         1         Copy span to           Name         Extends         Start         Number of spaces         Spacing (n)           #4 Stirrup         V         0.2500         1         0.0000         0.2500           #4 Stirrup         V         0.2500         18         6.0000         9.02500           #4 Stirrup         V         0.2500         14         18.0000         101.2500           #4 Stirrup         V         0.2500         14         18.0000         101.2500           #4 Stirrup         V         101.2500         18         6.0000         9.0000         110.2500  |
| Start Distance         Spacing           Vertical         Horizontal           Span:         1         Copy span to           Name         Extends         Start           into         distance         (ft)           #4 Stirrup         Ø         0.2500           #4 Stirrup         Ø         0.000           Ø         0.000         0.0000           Ø         0.000         10.2500   |
| Vertical         Horizontal           Span:         1         Copy span to           Name         Extends         Start<br>distance<br>deck         Number of<br>spaces         Spacing<br>(in)         Length<br>(ft)         End<br>distance<br>(ft)           #4 Stirrup         V         0.2500         1         0.0000         0.2500           #4 Stirrup         V         9.2500         14         18.0000         21.0000         30.2500           #4 Stirrup         V         30.2500         25         24.0000         50.0000         80.2500           #4 Stirrup         V         80.2500         14         18.0000         21.0000         101.2500           #4 Stirrup         V         101.2500         18         6.0000         9.0000         110.2500           #4 Stirrup         V         101.2500         18         6.0000         9.0000         110.2500  |
| Image: Start Distance         Spacing           Vertical         Horizontal           Span:              Copy span to            Image: Start Distance         Start           Vertical         Horizontal           Span:         Image: Copy span to           Image: Start Distance         Start           Vertical         Extends           Start Distance         Geck           #4 Stirrup         Image: Opposite Distance           Stirrup         Image: Opposite Distance           Stirrup         Image: Opposite Distance           Stirrup witzard         Stirrup design tool           View calcs         New         Duplicate           OK         Apply         Cancel  |

| A Stat Distance       \$Descing       A         rtical       Horizontal         an:       1       Copy span to         #4 Stirup       Q 0.2500       1       0.0000       0.0000         #4 Stirup       Q 0.2500       A Copy To Span       X         #4 Stirup       Q 0.2500       A Copy To Span       X         #4 Stirup       Q 0.2500       A Copy To Span       X         #4 Stirup       Q 0.2500       A Copy To Span       X         #4 Stirup       Q 0.0000       0.0000       0.0000         #4 Stirup       Q 0.000       Select the new span: 2       X         #4 Stirup       Q 101.2500       A copy To Span       X         #4 Stirup       Q 101.2500       Apply       Cancel         OK       Apply       Cancel       OK         Start Distance       Start pacing       -       -         Start Distance       Start       Number of Spacing       -       -         *       Copy span to       -       -       -       -         Shart Distance       Start       Number of Spacing       End       distance         *       Copy span to       -       -       -  | Start Distance   | Copy s       | pacing   | )  |   |   |   |         |        |        |
|--|--|--------------|--|--|---|---|---|---------|--------|--------|
| trical Horizontal an: 1 Copy span to<br>An: 1 Copy span to<br>An: 1 Copy span to<br>An: 1 Copy span to<br>An: 1 Copy span to<br>A Start Distance<br>Start Distance<br>St | lertical Horizontal<br>pan: 1 v<br>Name  | Copy s       | pan to   | )  |   |   |   |         |        |        |
| an: 1 Copy span to<br>Name Extends Start Number of Spacing Length End<br>distance (ft) distance (ft) distance<br>#4 Stirrup V 0 02500<br>#4 Stirrup V 0 302500<br>#4 Stirrup V 0 302500<br>#4 Stirrup V 0 302500<br>#4 Stirrup V 0 302500<br>#4 Stirrup V 0 302500<br>Select the new span: 2 V<br>Apply Cancel<br>OK Apply Cancel<br>Start Distance + Spacing<br>trical Horizontal<br>an: 2 V Copy span to   | pan: 1 V   | Copy s       | pan to   | )  |   |   |   |         |        |        |
| Extends       Start<br>distance<br>deck       Number of<br>(ft)       Spacing<br>(ft)       Length<br>distance<br>(ft)       End<br>distance<br>(ft)         #4 Stirup       V       0.2500       A Copy To Span       X         #4 Stirup       V       9.2500       A Copy To Span       X         #4 Stirup       V       9.2500       A Copy To Span       X         #4 Stirup       V       9.2500       Select the new span:       Z         #4 Stirup       V       80.2500       Select the new span:       Z         #4 Stirup       V       101.2500       Apply       Cancel         Stirup wizard       Stirup design tool       View calcs       New       Duplicate         OK       Apply       Cancel       OK       Apply       Cancel         Shart Distance       Start       Start       Start       Start       Start         Name       Extends       Start       Number of<br>(n)       Spacing       End<br>distance   | Name   | L. Eveneda   |  |  |   |   |   |         |        |        |
| Name       into       distance       Number of<br>spaces       Spacing<br>(in)       Length<br>(if)       distance<br>(if)         #4 Stirrup       V       0.2500       1       0.0000       0.2500         #4 Stirrup       V       0.2500       A Copy To Span       X         #4 Stirrup       V       0.2500       Select the new span:       Z       X         #4 Stirrup       V       0.2500       Select the new span:       Z       X         #4 Stirrup       V       0.000       0.2500       A pply       Cancel         Stirrup       V       0.12500       Select the new span:       Z       X         #4 Stirrup       V       101.2500       Apply       Cancel       Delete         OK       Apply       Cancel       OK       Apply       Cancel         Stirrup wizard       Stirrup design tool       View calcs       New       Duplicate       Delete         OK       Apply       Cancel       Cancel       OK       Apply       Cancel         Start Distance       Start Distance       Start Distance       Copy span to       Copy span to       End       distance         Name       intod       Start       Number of  | Name   | Extends      | Start  |  | . ·   |   | End   |         |        |        |
| #4 Stirrup       V       0.2500       1       0.0000       0.2500         #4 Stirrup       V       0.2500       A Copy To Span       X         #4 Stirrup       V       0.2500       Select the new span: 2       X         #4 Stirrup       V       0.2500       A Copy To Span       X         #4 Stirrup       V       0.2500       Select the new span: 2       X         #4 Stirrup       V       0.2500       Select the new span: 2       X         #4 Stirrup       V       0.000       0.2500       Apply       Cancel         Stirrup wizard       Stirrup design tool       View calcs       New       Duplicate       Delete         OK       Apply       Cancel       OK       Apply       Cancel         Shear Reinforcement Ranges       -       -       -       -         Statt Distance       Sbacing       -       -       -         Mame       Extends       Start       Number of Spacing       End       distance         Name       Extends       Start       Number of Spacing       End       -       -  |  | into<br>deck | distance<br>(ft)   | spaces   | (in)  | (ft)  | distance<br>(ft)  |         |        |        |
| #4 Stirrup       V       0.2500       A Copy To Span         #4 Stirrup       V       9.2500       Select the new span:       Z         #4 Stirrup       V       80.2500       Select the new span:       Z       Z         #4 Stirrup       V       80.2500       Apply       Cancel       Cancel         Stirrup       V       101.2500       Apply       Cancel       Cancel         Stirrup wizard       Stirrup design tool       View calcs       New       Duplicate       Delete         OK       Apply       Cancel       OK       Apply       Cancel         Shear Reinforcement Ranges       -       -       -       -       -  | ▶ #4 Stirrup *   | <b>V</b>     | 0.2500   | 1  | 0.0000  | 0.0000  | 0.2500  |         |        | -      |
| #4 Stirrup       •       Ø .2500       •       •       Ø .2500         #4 Stirrup       •       Ø .02500       Select the new span: 2       •         #4 Stirrup       •       Ø .02500       Select the new span: 2       •         #4 Stirrup       •       Ø .02500       Select the new span: 2       •         #4 Stirrup       •       Ø .02500       Select the new span: 2       •         #4 Stirrup       •       Ø .02500       Select the new span: 2       •         Stirrup       •       Ø .011.2500       Apply       Cancel         Stirrup wizard       Stirrup design tool       View calcs       New       Duplicate       Delete         OK       Apply       Cancel       OK       Apply       Cancel         Shear Reinforcement Ranges       -       -       -       -         Start Distance       • Spacing       -       -       -         Start Distance       • Spacing       -       -       -         Mame       into       distance       Number of       Spacing       fm   | #4 Stirrup *   | 1            | 0.2500   | Conv   | To Span   | 0.0000  | 0.0500  | ×       |        |        |
| Stirup       Image: Select the new span:       2         Image: Select the new span:       3         Image: Select the   | #4 Stirrup *   | ✓            | 9.2500   |  | io span   |   |   | ~       |        |        |
| #4 Stirrup       I 01.2500         Apply       Cancel         Stirrup wizard       Stirrup design tool         View calcs       New         Duplicate       Delete         OK       Apply         Cancel       OK         Apply       Cancel         Statt Distance       Spacing         Itical       Horizontal         an:       Z       Copy span to         Name       Extends       Start of stance         (into       distance       (fft)   | #4 Stirrup *   | ✓            | 80.2500  | Select the                                       | new span:   | 2   | ~   |         |        |        |
| Stirrup wizard Stirrup design tool View calcs New Duplicate Delete<br>OK Apply Cance<br>OK Apply Cance<br>Shear Reinforcement Ranges – C<br>Shear Reinforcement Ranges – C<br>Shear Reinforcement Ranges – C<br>Stati Distance Spacing<br>rtical Horizontal<br>an: 2 Copy span to  | #4 Stirrup -   | 1            | 101.2500   |  |   |   |   |         |        |        |
| Stirrup wizard Stirrup design tool View calcs New Duplicate Delete<br>OK Apply Cance<br>Shear Reinforcement Ranges –<br>Shear Reinforcement Ranges –<br>Shear Distance Spacing<br>Tical Horizontal<br>an: 2 V Copy span to<br>Name Extends Start, Number of Spacing Length End<br>distance   |  |              |  |  |   | Apply   | Cance   | el      |        |        |
| Stirrup wizard Stirrup design tool View calcs New Duplicate Delete OK Apply Cance Shear Reinforcement Ranges —  Shear  |  |              |  |  |   |   |   |         |        |        |
| Stirrup wizard Stirrup design tool View calcs New Duplicate Delete OK Apply Cance Shear Reinforcement Ranges —  Shear R  |  |              |  |  |   |   |   |         |        |        |
| OK     Apply     Cance       Shear Reinforcement Ranges     -     -       Statt Distance     Spacing     -       Antical     Horizontal       anti     2     V       Copy span to     Copy span to       Name     Extends     Start distance       Name     Extends     Start of spacing (in)  | Stirrup wizard   | Stirrup d    | lesign tool  | View calcs                                       |   |   | New   |         |        |        |
| Shear Reinforcement Ranges –<br>Shear Reinforcement Ranges –<br>Statt Distance Spacing<br>rtical Horizontal<br>an: 2 V Copy span to<br>Name Extends Start Number of Spacing Length distance  |  |              |  |  |   |   | incu .  | Duplica | ite D  | elete  |
| Shear Reinforcement Ranges –<br>Shear Reinforcement Ranges –<br>Statt Distance Spacing<br>rtical Horizontal<br>an: 2 V Copy span to<br>Name Extends Start Number of Spacing Length End<br>distance (int) distance  |  |              |  |  |   |   | 01  | Duplica | ite D  | elete  |
| Shear Reinforcement Ranges –<br>Shear Reinforcement Ranges –<br>Statt Distance Spacing A<br>rtical Horizontal<br>an: 2 V Copy span to<br>Name Extends Start, Number of Spacing Length End<br>distance (into distance spaces (int) (fft) (fft))   |  |              |  |  |   |   | OK  | Ar      | oply   | Cancel |
| Start Distance     Spacing      rtical Horizontal      an: 2 ♥ Copy span to      Name Extends Start Order of Spacing Length (ft) (ft)     (ft)   |  |              |  |  |   |   | OK  | Ap      | oply   | Cancel |
| Start Distance     Spacing       rtical     Horizontal       an:     2       V     Copy span to       Name     Extends       Start     Number of       Spacing     Length       End     distance   | S Shear Reinforceme  | nt Ranges    |  |  |   |   | ОК  | Ap      | oply   | Cancel |
| Start Distance     Spacing     Start     Name     Extends     Start     Number of     Spacing     (in)     (ff)     (ff)     (ff)  | S Shear Reinforceme  | nt Ranges    |  |  |   |   | OK  |         | oply _ | Cancel |
| rtical Horizontal<br>an: 2 V Copy span to<br>Name Extends Start Number of Spacing Length End distance (int) (fft)  | S Shear Reinforceme  | nt Ranges    |  |  |   |   | OK  |         | pply   | Cancel |
| An: 2 V Copy span to           Name         Extends         Start<br>distance         Number of<br>spaces         Spacing<br>(in)         Length<br>(ff)         End<br>distance   | S Shear Reinforcemer   | nt Ranges    | pacing   |  |   |   | OK  |         | pply   | Cance  |
| an: 2 V Copy span to<br>Name Extends Start distance spaces (in) (ff) End distance  | S Shear Reinforceme  | nt Ranges    | pacing   |  |   |   | OK  |         | oply - | Cancel |
| Extends         Start         Number of         Spacing         Length         End           Name         into         distance         spaces         (in)         (ff)         distance  | S Shear Reinforceme<br>Start Distance<br>ertical Horizontal  | nt Ranges    | pacing   |  |   |   |   |         | pply _ | Cancel |
|  | S Shear Reinforcemer<br>Start Distance<br>ertical Horizontal<br>pan: 2   | nt Ranges    | pan to   |  |   |   | OK  |         | -      | Cancel |
| deck         (ft)         (m)         (ft)           #4 Stimute         0.2500         1         0.0000         0.2500   | S Shear Reinforcement<br>Start Distance<br>ertical Horizontal<br>pan: 2 V<br>Name  | nt Ranges    | pan to   | Number of spares                                 | Spacing (in)  | Length  | OK<br>OK<br>End<br>distance   |         | pply [ | Cancel |
| #4 Stirrup * V 0.2500 18 6.0000 9.0000 9.2500  | S Shear Reinforceme<br>Start Distance<br>ertical Horizontal<br>pan: 2 V<br>Name  | nt Ranges    | pan to<br>Start<br>distance<br>(ft)  | Number of<br>spaces                              | Spacing<br>(in)   | Length<br>(ft)  | End<br>distance<br>(ft)   | Ap      | pply   | Cancel |
| #4 Stirrup V 9.2500 14 18.0000 21.0000 30.2500   | S Shear Reinforceme  Start Distance  ertical Horizontal  pan: 2 V  Name #4 Stirrup #4 Stirrup #4 Stirrup   | nt Ranges    | pan to<br>Start<br>distance<br>(ft)<br>0.2500<br>0.2500                                    | Number of<br>spaces                              | Spacing<br>(in)<br>0.0000<br>6.0000   | Length<br>(ft)<br>0.0000<br>9.0000                                  | End<br>distance<br>(ft)<br>0.2500   |         | pply [ | Cancel |
|  | S Shear Reinforceme<br>Start Distance<br>ertical Horizontal<br>pan: 2 v<br>Name<br>#4 Stirrup *<br>#4 Stirrup *  | nt Ranges    | pan to<br>Start<br>distance<br>(0.2500<br>0.2500<br>9.2500                                 | Number of<br>spaces<br>1<br>18<br>14             | Spacing<br>(in)<br>0.0000<br>6.0000<br>18.0000                                  | Length<br>(ft)<br>0.0000<br>9.0000<br>21.0000                       | End<br>distance<br>(ft)<br>0.2500<br>9.2500<br>30.2500                        |         | oply [ | Cance  |
| #4 Stirrup V 30.2500 25 24.0000 50.0000 80.2500  | S Shear Reinforceme Start Distance ertical Horizontal pan: 2 V Name #4 Stirrup #5 Stirru | nt Ranges    | pan to<br>Start<br>distance<br>(0.2500<br>0.2500<br>9.2500<br>30.2500                      | Number of<br>spaces<br>1<br>18<br>14<br>25       | Spacing<br>(in)<br>0.0000<br>6.0000<br>18.0000<br>24.0000                       | Length<br>(ft)<br>0.0000<br>9.0000<br>21.0000<br>50.0000            | End<br>distance<br>(ft)<br>0.2500<br>9.2500<br>30.2500<br>80.2500             |         | pply [ |        |
| #4 Stirrup         Image: Constraint of the state o   | S Shear Reinforceme Start Distance ertical Horizontal pan: 2 V Name #4 Stirrup #4 Stirru | nt Ranges    | pan to<br>Start<br>distance<br>0.2500<br>0.2500<br>9.2500<br>30.2500<br>80.2500<br>80.2500 | Number of<br>spaces                              | Spacing<br>(in)<br>0.0000<br>6.0000<br>18.0000<br>24.0000<br>18.0000<br>24.0000 | Length<br>(ft)<br>0.0000<br>9.0000<br>21.0000<br>50.0000<br>21.0000 | End<br>distance<br>(ft)<br>0.2500<br>9.2500<br>30.2500<br>80.2500<br>101.2500 |         | pply   |        |
| ** SUITAD 1 1 2.63001 14 10.0000 21.0000 30.6300   | S Shear Reinforceme<br>Start Distance<br>ertical Horizontal<br>ban: 2 V<br>Name<br>#4 Stirrup *<br>#4 Stirrup *  | nt Ranges    | pan to<br>Start<br>distance<br>(ft)<br>0.2500<br>0.2500                                    | Number of<br>spaces<br>1<br>18                   | Spacing<br>(in)<br>0.0000<br>6.0000   | Length<br>(ft)<br>9.0000<br>9.0000                                  | CK<br>CK<br>CK<br>CK<br>CK<br>CK<br>CK<br>CK<br>CK<br>CK                      |         | pply [ | Cance  |
| #4 Stirrup V 30.2500 25 24.0000 50.0000 80.2500  | S Shear Reinforceme<br>Start Distance<br>ertical Horizontal<br>ban: 2 V<br>Name<br>#4 Stirrup *<br>#4 Stirrup *<br>#4 Stirrup *  | nt Ranges    | pan to<br>Start<br>distance<br>(ft)<br>0.2500<br>9.2500<br>30.2500                         | Number of<br>spaces<br>1<br>18<br>14<br>25       | Spacing<br>(in)<br>0.0000<br>18.0000<br>24.0000                                 | Length<br>(ft)<br>0.0000<br>9.0000<br>21.0000<br>50.0000            | End<br>distance<br>(ft)<br>0.2500<br>30.2500<br>80.2500                       |         | pply [ |        |
| #4 Stirrup         V         30.2500         25         24.0000         50.0000         80.2500           #4 Stirrup         V         V         80.2500         14         18.0000         21.0000         101.2500   | S Shear Reinforceme<br>Start Distance<br>ertical Horizontal<br>ban: 2 V<br>Name<br>#4 Stirrup *<br>#4 Stirrup *<br>#4 Stirrup *<br>#4 Stirrup *  | nt Ranges    | parto<br>Start<br>distance<br>(ft)<br>0.2500<br>0.2500<br>9.2500<br>30.2500<br>80.2500     | Number of<br>spaces<br>1<br>18<br>14<br>25<br>14 | Spacing<br>(in)<br>0.0000<br>6.0000<br>18.0000<br>24.0000<br>18.0000            | Length<br>(ft)<br>0.0000<br>9.0000<br>21.0000<br>50.0000<br>21.0000 | End<br>distance<br>(ft)<br>0.2500<br>9.2500<br>80.2500<br>101.2500            |         | pply [ |        |

Then use the **Copy to span** button to copy the stirrups to **Span 2**.

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

#### Live Load Distribution

BrDR will compute the live load distribution factors during analysis. No changes are required in this window.

#### Schematic – I Beam Alt

While the member alternative **I Beam Alt (E) (C)** is selected in the **Bridge Workspace** tree, open the schematic for the member alternative by selecting the **Schematic** button on the **WORKSPACE** ribbon (or right click on **I Beam Alt (E) (C)** in the **Bridge Workspace** and select **Schematic** from the menu).



The member alternative schematic is shown below.

| Schematic  | _ 🗆 ×      |
|--|------------|
| PS profile   | <b>→</b> × |
|  | ÷          |
| HI Hanne 23<br>Millione 23<br>MINT   |            |
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| Kan<br>- Ya kunka ngi kungata na kula.<br>- Ya kunka ngi maga kunka.   |            |
|  |            |
|  |            |
|  |            |

## LRFD Design Review

The member alternative can now be analyzed. To perform an **LRFD Design Review**, select the **Analysis Settings** button on the **Analysis** group of the **DESIGN/RATE** ribbon. The window shown below opens.

| Br                         | Bridg                 | ge Worksp          | ace - PS4                     |                   |                  | ANALYSI         | S   | REPORTS   | ? | - | × |
|----------------------------|-----------------------|--------------------|-------------------------------|-------------------|------------------|-----------------|-----|-----------|---|---|---|
| BRIDGE WOR                 | KSPACE                | WORKSPA            | CE TOOL                       | S VIE             | w                | DESIGN/R        | ATE | REPORTING |   |   | ^ |
| <b>*</b>                   |                       |                    |                               | S-                | ${\sim}$         | P.              |     |           |   |   |   |
| Analysis Analy<br>Settings | ze Analysis<br>Events | Tabular<br>Results | Specification<br>Check Detail | Engine<br>Outputs | Results<br>Graph | Save<br>Results |     |           |   |   |   |
| Anal                       | /sis                  |                    | R                             | esults            |                  |                 |     |           |   |   |   |

Click the **Open Template** button and select the **HL-93 Design Review** template to be used in the design review and click **Open**.

| Templates               | Description             | Analysis | Owner | Public / Private |  |
|-------------------------|-------------------------|----------|-------|------------------|--|
| HL 93 Design Review     | HL 93 Design Review     | LRFD     |       | Public           |  |
| HS 20 LFR Rating        | HS 20 LFR Rating        | LFR      |       | Public           |  |
| LRFR Design Load Rating | LRFR Design Load Rating | LRFR     |       | Public           |  |
| LRFR Legal Load Rating  | LRFR Legal Load Rating  | LRFR     |       | Public           |  |
|                         |                         |          |       |                  |  |
|                         |                         |          |       |                  |  |

The Analysis Settings window will be populated as shown below.

Navigate to the **Output** tab of this window and click on the **Select All** button under the **AASHTO engine reports** and click **OK**.

| • Design review         • Rating        Design method:           IRFD          Analysis type:          Line Girder           Apply preference setting:         None           Apply preference setting:         None          Analysis type:          Line Girder           Apply preference setting:         None           Apply preference setting:             Analysis type:           Line Girder           Apply preference setting:           None             Analysis type:           Line Girder           Apply preference setting:           None             Analysis type:           Line Girder           Apply preference setting:           None             Analysis type:           Apply preference setting:           None           Apply preference setting:             Apply preference setting:           Cupacity design review           MASHTO engine reports             Line Counce terminis state summary report           Capacity design computations           Capacity design computations             K Eff codel for L analysis           Camber           Camber           Serorice Il stress ranges  |   |   |                                       |   |      |
|---|---|---|---------------------------------------|---|------|
| nalysis type: Line Girder   ane / Impact loading type: As Requested     Vehicles Output   Engine Description     Tabular results   Obeal load action report   Ocnocrete limit state summary report   Ocnocrete limit state summary report   ItsPD specification check report   Steel limit state summary report   Rc service stress report   Steel limit state summary report   Steel limit state summary report   Listib. factor summary   Rc service stress report   Steel limit state summary report   Listib. factor summary   Steel limit state summary report   Listib. factor summary   Steel limit state summary report   Listib. factor summary   P Encode for LL analysis   Listib. factor summary   R Camber   Fatigue stress regort   Select all   Clear all     Select all   | Design review     Rating  | Design method:  | LRFD                                  | ~ |      |
| ane / Impact loading type:       As Requested       Apply preference setting:       None         Vehicles       Output       Engine       Description             Tabular results       Miscellaneous reports         Is bead load action report       Miscellaneous reports:       Summary influence line loading         Is LRFD critical loads report       Summary influence line loading       Detailed influence line loading         Is LRFD specification check report       Capacity summary       Capacity detailed computations         Is Requested       FE model for LL analysis       FE model for LL analysis         Is the summary report       Is factor summary       Regression data         Is the summary report       Is distrib. factor summary       Regression data         Is capacity detailed store uputations       Is list state summary report       Is distrib. factor summary         Is the summary report       Is distrib. factor summary       Regression data         Is capacity detailed store uputations       Is list state summary       Regression data         Is capacity can all       Is RFD/LRFR conc article detailed       Is RFD/LRFR conc article detailed   | nalysis type: Line Girder 🗸   |   |                                       |   |      |
| Veticles       Output       Engine       Description         Tabular results       ASSHTO engine reports         ✓ Live load action report       Girder properties         ✓ Concrete limit state summary report       Summary influence line loading         ✓ LRFD specification check report       ✓ Capacity detailed computations         ✓ RC service stress report       ✓ Capacity detailed computations         ✓ Steel limit state summary report       ✓ Eff model for LL analysis         ✓ Steel limit state summary report       ✓ Li Influence lines FE model         ✓ LL distrib. factor computations       ✓ LL distrib. factor summary         ✓ Steel limit state summary report       ✓ Service II stress ranges         ✓ Steel all       Clear all   | ne / Impact loading type: As Requested  | Apply preference setting  | p: None                               | ~ |      |
| Tabular results       AASHTO engine reports         Live load action report       Miscellaneous reports         Concrete limit state summary report       Girder properties         LRFD critical loads report       Summary influence line loading         RFD specification check report       Capacity summary         PS concrete stress report       Capacity detailed computations         R c service stress report       FE model for DL analysis         Steel limit state summary report       IL influence lines FE model         LL influence lines FE model       LL influence lines FE model         LL isfuence lines FE model       LL influence lines FE model         M is table summary report       Regression data         Camber       Fatigue stress ranges         Sericic all       Clear all  | Vehicles Output Engine Description  |   |                                       |   | <br> |
| ✓ Live load action report         ✓ Concrete limit state summary report         ✓ LRFD critical loads report         ✓ LRFD specification check report         ✓ P S concrete stress report         ✓ Steel limit state summary report         ✓ Capacity detailed computations         ✓ LL distrib. factor summary         ✓ Regression data         ✓ Camber         ✓ Service II stress ranges  | Tabular results<br>✓ Dead load action report  | AASHTO engine re<br>Miscellaneous r                             | ports<br>eports:                      |   |      |
| LRFD critical loads report         LRFD specification check report         PS concrete stress report         RC service stress report         Steel limit state summary report         LL influence lines FE model         LL influence lines FE actions         LL influence lines FE actions         LL influence lines FE actions         LL distrib. factor summary         Regression data         Service II stress ranges         Service II stress ranges         Service II stress ranges         Select all         Clear all   | <ul> <li>Live load action report</li> <li>Concrete limit state summary report</li> </ul>    | Girder prope  | erties<br>fluence line loading        |   |      |
| Image: PS concrete stress report       Image: Capacity detailed computations         Image: PS concrete stress report       Image: PE model for DL analysis         Image: PS concrete stress report       Image: PE model for DL analysis         Image: PS concrete stress report       Image: PE model for DL analysis         Image: PS concrete stress report       Image: PE model for DL analysis         Image: PS concrete stress report       Image: PE model for DL analysis         Image: PS concrete stress report       Image: PE model for DL analysis         Image: PS concrete stress report       Image: PE model for DL analysis         Image: PS concrete stress report       Image: PE model for DL analysis         Image: PS concrete stress report       Image: PE model for DL analysis         Image: PS concrete stress report       Image: PE model for DL analysis         Image: PS concrete stress report       Image: PE model for DL analysis         Image: PS concrete stress report       Image: PE model for DL analysis         Image: PS concrete stress report       Image: PE model for DL analysis         Image: PS concrete stress report       Image: PE model for DL analysis         Image: PS concrete stress report       Image: PE model for DL analysis         Image: PS concrete stress report       Image: PE model for DL analysis         Image: PS concrept stress report       Image: PE model for DL  | <ul> <li>✓ LRFD critical loads report</li> <li>✓ LRFD specification check report</li> </ul> | <ul> <li>Detailed influence</li> <li>Capacity surrow</li> </ul> | uence line loading<br>nmary           |   |      |
| Steel limit state summary report               FE model for LL analysis          LL influence lines FE model              LL influence lines FE model          LL distrib. factor computations              LL distrib. factor summary          Regression data              Camber          Sevice II stress ranges              Sevice II stress ranges          Select all              Clear all  | <ul> <li>✓ PS concrete stress report</li> <li>✓ RC service stress report</li> </ul>         | Capacity det     FE model for                                   | ailed computations<br>r DL analysis   |   |      |
| Image: Clear all       Clear all  | Steel limit state summary report  | FE model for  | r LL analysis<br>lines FE model       |   |      |
| Image: Light of L |   | LL influence  | lines FE actions<br>ctor computations |   |      |
| Camber         Camber         Camber         Fatigue stress ranges         Service II stress ranges         Specification output:         LRFD/LRFR conc article detailed         Select all         Clear all  |   | LL distrib. fa  | ctor summary                          |   |      |
| Select all       Clear all  |   | Camber  | 1010                                  |   |      |
| Select all Clear all Clear all  |   | ✓ Fatigue stres ✓ Service II stres                              | is ranges<br>ess ranges               |   |      |
| Select all Clear all Clear all  |   | Specification ou<br>LRFD/LRFR of                                | itput:<br>conc article detailed       |   |      |
| Select all Clear all Clear all  |   |   |                                       |   |      |
| Select all Clear all Clear all  |   |   |                                       |   |      |
|   | Select all Clear all  | Select all C  | lear all                              |   |      |

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

Next click the **Analyze** button on the **Analysis** group of the **DESIGN/RATE** ribbon to perform the design review. The **Analysis** window should be reviewed for any warning messages.





#### Export of prestressed concrete beams to the BrDR LRFD analysis engine

The following steps are performed during a design review of a multi-span prestressed beam using the BrDR LRFD analysis engine:

1. Finite element models are generated for the dead load and live load analyses. A Stage 1 FE model is generated for the dead loads on the non-composite simple span prestressed concrete beam.

For Continuous method of analysis:

A Stage 2 FE model is generated for the continuous final span condition for composite dead load analysis.

A Stage 3 FE model is generated for the continuous final span condition for the live load analysis.

For Continuous and Simple method of analysis:

Two Stage 2 FE models are generated:

Continuous final span condition

Simple span condition

Two Stage3 FE models are generated:

Continuous final span condition

Simple span condition

Stage 2 models contain section properties corresponding to the sustained modular ratio factor entered in BrDR (e.g., 2n). Stage 3 models contain section properties corresponding to the modular ratio (n).

The model generated by the export to the BrDR LRFD analysis engine will always contain node points at the middle of each simple span, at simple support locations, at harp points, at debond locations and at prestress strand transfer length locations so that the prestress force distribution can be computed.

- 2. The Stage 1 and 2 FE models are analyzed for the dead load. The prestress loss calculations are then performed along with determining the prestress forces at transfer and the restraint effects for the creep and shrinkage analysis for multi-span structures.
- The final analysis then takes place. The prestress forces at transfer are applied to the Stage 1 FE model to determine the prestress camber in the beam. They are not included in the load combination generation. Creep and shrinkage forces are applied to the Stage 2 FE model.

The Stage 1 and 2 FE models are analyzed for the dead load. The Stage 3 FE model is loaded with unit loads at each node to generate influence lines for the beam. The influence loads are then loaded with the selected vehicles to find the maximum live load effects.

4. Load combinations are generated for the loadings and specification checks are performed at each of the nodes in the finite element model. For the Continuous and Simple method of analysis, the maximum force effects between the 2 sets of models are used to generate the load combinations.

### **Engine Outputs**

Click the **Engine Outputs** button from the **Results** group of the **DESIGN/RATE** ribbon to open the following window.



The window shown below will open. A summary and a detailed report of the computed live load distribution factors are available.



Double click on the Live Load Distribution Factors Calculation Summary option under the AASHTO\_LRFD

branch in this window.

The following file opens.

| LRFD Dist Fact                               | or Summary - Notepad                   |                      |                      |      | - | × |
|--|--|----------------------|----------------------|------|---|---|
| File Edit Forma                              | at View Help                           |                      |                      |      |   |   |
| ** N-+- ++                                   | *****************                      | *****                | ******************   | **** |   | ^ |
| ** Note that<br>** computed k                | this tile contain<br>withe BrD wittend | has the distribut    | idge description     | **   |   |   |
| ** in BrD on                                 | the date and tim                       | e below. These       | computed values      | **   |   |   |
| ** may not ma                                | atch those shown                       | in BrD if the us     | ser has changed      | **   |   |   |
| ** the BrD br                                | ridge description                      | after these dis      | stribution           | **   |   |   |
| ** factors we                                | ere computed.                          |                      |                      | **   |   |   |
| ********                                     | ******                                 | ******               | *************        | **** |   |   |
| Bridge: NHI E<br>Bridge ID: PS<br>BID: 0     | Example<br>54 NBI S                    | tructure ID: PS4     | l                    |      |   |   |
| Superstructur<br>Member: G2<br>Member Alterr | re Def: PS I Beam<br>native: I Beam Al | t                    |                      |      |   |   |
| Date: 2/8/20                                 | 023 Time: 2:13:3                       | 1 PM                 |                      |      |   |   |
| AASHTO LRFD E                                | Bridge Design Spe                      | cifications, Edi     | ition 9, Interim (   | 0    |   |   |
| Ν  | Noment Distributi                      | on Factor Schedu     | ıle                  |      |   |   |
| Start  | End                                    | Single Lane          | Multi Lane           |      |   |   |
| Distance                                     | Distance                               | DF                   | DF                   |      |   |   |
| (ft)   | (ft)                                   | (Lanes)              | (Lanes)              |      |   |   |
| 0.00   | <br>مر مد                              | 0 E49(A)             | 0 90E(A)             |      |   |   |
| 82.36  | 137.64                                 | 0.548(A)             | 0.805(A)             |      |   |   |
| 137.64                                       | 220.00                                 | 0.548(A)             | 0.805(A)             |      |   |   |
| <u>c</u>                                     | Shear Distributio                      | n Factor Schedul     | Le                   |      |   |   |
| Start  | End                                    | Single Lane          | Multi Lane           |      |   |   |
| Distance                                     | Distance                               | DF                   | DF                   |      |   |   |
| (ft)   | (ft)                                   | (Lanes)              | (Lanes)              |      |   |   |
| 0.00<br>110.00                               | 110.00<br>220.00                       | 0.747(A)<br>0.747(A) | 0.929(A)<br>0.929(A) |      |   |   |
|  |  |                      |                      |      |   | ~ |
| <  |  |                      |                      |      |   | > |

#### BrDR LRFD Specification checking

A summary report of the specification check results is also available. This summary report lists the design ratios for each spec article at each spec check location point. The design ratio is the ratio of capacity to demand. A design ratio less than one indicates the demand is greater than the capacity and the spec article fails. A design ratio equal to 99.0 indicates the section is subject to zero demand.

Double click on the Stage 3 Spec Check Results option under the AASHTO\_LRFD branch in this window.



Bridge ID : PS4 Bridge : NHI Example Superstructure Def : PS I Beam Member : G2 Analysis Preference Setting : NBI Structure ID : PS4 Bridge Alt : Member Alt : I Beam Alt ^

AASHTO LRFD Specification, Edition 9, Interim 0

#### Specification Check Summary

| Article  | Status |
|--|--------|
| Initial Stress at Transfer (5.9.2.3.1a, 5.9.2.3.1b)                        | Fail   |
| Splitting Resistance in Anchorage Zones (5.9.4.4.1)                        | Pass   |
| Final Stress due to Permanent and Transient Loads (5.9.2.3.2a, 5.9.2.3.2b) | Pass   |
| Flexure (5.6.3.2, 5.6.3.3)   | Pass   |
| Shear (5.7.3.3, 5.7.2.5, 5.7.2.6, 5.7.3.5)                                 | Pass   |
| Deflection (5.6.3.5.2)   | Pass   |

#### **Initial Compression Stress At Transfer of Prestress**

| Location<br>(ft) | Allowable Stress<br>(ksi) | Actual Stress Top of Beam<br>(ksi) | Actual Stress Bot of Beam<br>(ksi) | Design Ratio | Code |
|------------------|---------------------------|------------------------------------|------------------------------------|--------------|------|
| 0.000            | -3.575                    | 0.160                              | -0.668                             | 5.350        | Pass |
| 1.750            | -3.575                    | 0.470                              | -2.164                             | 1.652        | Pass |
| 6.457            | -3.575                    | 0.319                              | -2.010                             | 1.779        | Pass |
| 10.000           | -3.575                    | 0.215                              | -1.904                             | 1.878        | Pass |
| 11.000           | -3.575                    | 0.228                              | -2.047                             | 1.746        | Pass |
| 12.500           | -3.575                    | 0.249                              | -2.264                             | 1.579        | Pass |
| 22.000           | -3.575                    | 0.023                              | -2.034                             | 1.758        | Pass |
| 24.500           | -3.575                    | 0.078                              | -2.415                             | 1.480        | Pass |
| 33.000           | -3.575                    | -0.066                             | -2.268                             | 1.576        | Pass |

The specification checks can be viewed by selecting the **Specification Check Detail** button from the **Results** group of the **DESIGN/RATE** ribbon.

| Br Bridge Worksp                                 | ace - PS4 ANALYSIS                                     | REPORTS ? - C     | ×           |               |
|--|--|-------------------|-------------|---------------|
|  |  | EPORTING          |             |               |
|  |  |                   |             |               |
| a 😤 🖙 📰 🔳  | i 🖻 🌾 🔆 📙  |                   |             |               |
| Analysis Analyze Analysis Tabular                | Specification Engine Results Save                      |                   |             |               |
| Settings Events Results                          | Check Detail Outputs Graph Results                     |                   |             |               |
| Analysis   | Results  |                   |             |               |
|  |  |                   |             |               |
| A Specification Checks for I Beam Alt - 2        | of 2117  |                   |             | – 🗆 X         |
| Properties<br>Properties<br>Specification filter | Loss calcs,<br>creep/shrinkage o                       | calcs             |             |               |
| Superstructure Component                         | Specification reference                                | Limit State       | Flex, Sense | Pass/Fail     |
| Prestress Calculations                           | <ul> <li>2.5.2.6.2 Criteria for Deflection</li> </ul>  |                   | N/A         | Passed        |
| Stage 1  | ✓ 5.4.2.1 Compressive Strength                         |                   | N/A         | Passed        |
| Stage 2  | 5.4.2.5 Poisson's Ratio                                |                   | N/A         | General Comp. |
| 🕨 🚞 Stage 3                                      | 5.4.2.6 Modulus of Rupture                             |                   | N/A         | General Comp. |
| Stage 1  | 5.4.2.8 Concrete Density Modification Factor           |                   | N/A         | General Comp. |
| Stage 2  | ✓ 5.5.3.1 Fatigue Limit State - General                |                   | N/A         | Passed        |
| 🔺 🚞 Stage 3                                      | NA 5.5.3.2 Reinforcing Bars and Welded Wire Reinforce  | ment              | N/A         | Not Required  |
| 🔺 🛄 l Beam Alt                                   | 5.5.4.2 PS Strength Limit State - Resistance Factors   |                   | N/A         | General Comp. |
| Span 1 - 0.00 ft.                                | 5.6.2.2 Rectangular Stress Distribution                |                   | N/A         | General Comp. |
| Span 1 - 1.75 ft.                                | ✓ 5.6.3.2 PS Flexural Resistance (Prestressed Concrete | )                 | N/A         | Passed        |
| Span 1 - 6.45 ft.                                | ✓ 5.6.3.3 Minimum Reinforcement                        |                   | N/A         | Passed        |
| Span 1 - 10.00 ft.                               | ✓ 5.7.2.5 Minimum Transverse Reinforcement             |                   | N/A         | Passed        |
| Span 1 - 11.00 ft.                               | 5.7.2.6 Maximum Spacing of Transverse Reinforcem       | ent               | N/A         | Passed        |
| Span 1 - 12.50 ft.                               | ✓ 5.7.3.3 Nominal Shear Resistance                     |                   | N/A         | Passed        |
| Span 1 - 22.00 ft.                               | 5.7.3.4 Procedures for Determining Shear Resistance    | e                 | N/A         | General Comp. |
| Span 1 - 22,00 ft                                | <ul> <li>5.7.3.5 Longitudinal Reinforcement</li> </ul> |                   | N/A         | Passed        |
| Span 1 - 44.00 ft                                | ✓ 5.7.4 Interface Shear Transfer                       |                   | N/A         | Passed        |
| Span 1 - 54.50 ft.                               | ✓ 5.7.4.2 Minimum Area of Interface Shear Reinforcen   | nent              | N/A         | Passed        |
| Span 1 - 55.00 ft.                               | ✓ 5.9.2.3.2a Compressive Stresses                      |                   | N/A         | Passed        |
| Span 1 - 66.00 ft.                               | ✓ 5.9.2.3.2b Tensile Stresses                          |                   | N/A         | Passed        |
| Span 1 - 77.00 ft.                               | 5.9.4.3.2 Bonded Strand                                |                   | N/A         | General Comp. |
| i Span 1 - 84.50 ft.                             | Computation of Vp                                      |                   | N/A         | General Comp. |
| ing Span 1 - 87.00 ft.                           | Cracked_Moment_of_Inertia Section Property Calcu       | lations           | N/A         | General Comp. |
| 🚞 Span 1 - 88.00 ft.                             | PS_Basic_Properties Calculation                        |                   | N/A         | General Comp. |
| 🚞 Span 1 - 96.50 ft.                             | PS_Gross_Composite_Section_Properties PS Gross C       | Composite Section | N/A         | General Comp. |
| 🚞 Span 1 - 99.00 ft. 🔍                           |  |                   |             |               |

Open the spec check detail window for the flexural resistance at the middle of simple span 1. The following is noted for this window, other spec articles are similar:

- 1. For each spec check location, both the left and right sides of the point are evaluated. The Deflection article is an exception to this since deflection must be the same between the left and right sides of a point.
- 2. The design ratio is printed out for the article. The design ratio is the ratio of capacity to demand. A design ratio less than one indicates the demand is greater than the capacity and the spec article fails. A design ratio equal to 99.0 indicates the section is subject to zero demand.
- 3. The Strength-I, Service-I, Service III, and Fatigue limit states are the only limit states investigated. For each limit state, the max and min force effect is checked. Thus, each limit state shows two rows of data.

4. The LL load combination is shown in this column. If the location is not at a node in the FE model (e.g., the node is at a point where the rebar is fully developed), this column will list two load combinations separated by a comma. The first load combination is the combination considered at the left end and the second load combination is the combination considered at the right end of the FE element that contains this location. The resulting load displayed is a linear interpolation between the two displayed load cases.

| Spec Check Detail for 5.6.3.2 PS Flexural Resistance (Prestressed Concrete)  | _ |                | ×              |
|--|---|----------------|----------------|
| 5.6 Design for Flexural and Axial Effects - B Regions<br>5.6.3 Flexural Members<br>5.6.3.2 Flexural Resistance<br>(AASHTO LRFD Bridge Design Specifications, Ninth Edition)  |   |                | Î              |
| PS I Wide - At Location = 54.5000 (ft) - Left Stage 3  |   |                |                |
| Cross Section Properties   |   |                |                |
| Name: AASHTO TYPE VI<br>Girder f'c = 7.00(ksi) Girder f'ci = 5.50(ksi)<br>Slab f'c = 7.00(ksi)   |   |                |                |
| Effective Slab Width=111.00(in)Effective Slab Thickness=7.50(in)Haunch Width=42.00(in)Haunch Thickness=4.00(in)Beam Height=72.00(in)   |   |                | I              |
| Total Aps = 6.58(in^2)<br>Total CGS = 4.93(in)   |   |                |                |
| Eff Aps = 6.58 (in^2)<br>Eff CGS = 4.93 (in)   |   |                |                |
| Flexural Reinforcement<br>   |   |                |                |
| Allow Moment Redistribution Control Option: No<br>Moment Redistribution Qualified: No, redistribution did not occur.   |   |                |                |
| Note: If the capacity has been overridden, the Resistance is computed as override phi*override capacity.<br>Otherwise the Resistance is computed as per the Specification.   |   |                |                |
| Limit State Load Mu DeltaMu Phi Mn Phi Mn Phi Mn Phi Mn Mr/Mu<br>Combination kip-ft kip-ft kip-ft kip-ft kip-ft  |   | Depth<br>in    |                |
| STR-I         1         S114.11          1.000         11296.04          1.1296.04         1.392           STR-I         1         2257.52          1.000         11296.04          11296.04         5.004           STR-I         2         7586.59          1.000         11296.04          11296.04         1.489 |   | 3.<br>3.<br>3. | 71<br>71<br>71 |
| STR-I 2 2450.55 1.000 11296.04 11296.04 4.610  |   | 3.             | 71             |
|  |   | ОК             |                |

The loads making up the Mu = 8114.1 k-ft for the maximum Strength-I limit state can be tracked down in **Moment** Summary report.

#### Report Tool – Moment Summary

The **Moment Summary** report can be viewed by selecting the **Report Tool** button from the **Bridge** group of the **TOOLS** ribbon as shown below.

| Br Br                               | idge Workspace - | PS4                  | ANALYSIS | REPORTS                 | ?              | - | × |   |
|-------------------------------------|------------------|----------------------|----------|-------------------------|----------------|---|---|---|
| BRIDGE WORKSPACE                    | WORKSPACE        | TOOLS                | VIEW     | DESIGN/RATE             | REPORTING      |   |   | ^ |
| Multimedia<br>Attachments<br>Bridge | Report<br>Tool   | Culvert<br>Design To | ol Desig | port<br>n Tool PS Desig | t to<br>n Tool |   |   |   |

Select the LRFD analysis output as the Report type. Select the Moment summary checkbox and click on the

Generate button to populate the moment summary report as shown below.

| A PS4 - Report Tool   | – 🗆 ×   |
|---|---|
| PS4 - Report Tool      Report type: LRFD analysis output      Advanced Begin each topic on a new page when printed      Report     New Open Merge Save Save As Generate      Reactions      Moment summary     Shear summary     Shear analysis summary     Initial stresses at transfer of prestress     Final stresses under dead load and prestress     Final stresses - design loads     Final stresses - design loads     Final stresses in slab     Camber summary PS | -       -       ×         Template <ul> <li>Bws report (all superstructure definitions)</li> <li>Girderline system struct def</li> <li>Floor system GFS system struct def</li> <li>Floor system GF struct def</li> <li>Floor system GF struct def</li> <li>Floorline GFS struct def</li> <li>Floorline GFS struct def</li> <li>Floorline GF struct def</li> <li>Floorline GF struct def</li> <li>Truss system TF struct def</li> <li>Truss system TF struct def</li> <li>Trussine TFS struct def</li> <li>Slab system struct def</li> <li>Multicellbox system struct def</li> <li>Culvert definition</li> </ul> |
| Select all Delete   | Close   |

| Bridge Name<br>NBI Structure<br>Bridge ID: PS                  | : NHI Example<br>e <b>ID:</b> PS4<br>54                    |                                      |                                    |                |                            |  |                          |                     |                          | ^ |
|--|--|--------------------------------------|------------------------------------|----------------|----------------------------|--|--------------------------|---------------------|--------------------------|---|
| Diluge ID. I.  |  |                                      |                                    |                |                            |  |                          |                     |                          |   |
| Analyzed By:<br>Analyze Date<br>Analysis Engi<br>Analysis Pref | Bridge<br>: Wednesday, F<br>ne: AASHTO I<br>erence Setting | ebruary 8, 2<br>LRFD Engir<br>: None | 2023 14:13:29<br>ie Version 7.5.0. | 1              |                            |  |                          |                     |                          |   |
| Report By: B<br>Report Date:                                   | ridge<br>Wednesday, Fe                                     | ebruary 8, 2                         | 023 14:38:35                       |                |                            |  |                          |                     |                          |   |
| Structure Def<br>Member Nan                                    | inition Name:<br>ne: G2                                    | PS I Beam                            |                                    |                |                            |  |                          |                     |                          |   |
| Member Alte  | rnative Name:  | I Beam Alt                           |                                    |                |                            |  |                          |                     |                          |   |
|  |  |                                      |                                    | Moment S       | ummary (Sim                | nle snan model                               |                          |                     |                          |   |
|  |  |                                      |                                    | Li             | ve Load: HL-<br>Impact = 9 | 93 (US)<br>%                                 | ,                        |                     |                          |   |
| Span 1   |  |                                      |                                    |                | •                          |  |                          |                     |                          |   |
|  |  |                                      |                                    |                |                            |  |                          |                     |                          |   |
|  | Loca   | tion                                 | (                                  | DC<br>kip-ft)  | DW<br>(kip-ft)             | +(LL+I)<br>(kip-ft)                          | Controlling<br>Live Load | -(LL+I)<br>(kip-ft) | Controlling<br>Live Load |   |
|  | (f   | t) I                                 | Percent                            | 0.00           | <b>N</b> T/A               | **   |                          | **                  |                          |   |
|  | 0.00   | )(K)<br>5(B)                         | 0.0                                | 0.00           | N/A<br>N/A                 | **   |                          | **                  |                          |   |
|  | 10.0   | 0(B)                                 | 91 1                               | 149 35         | N/A                        | **   |                          | **                  |                          |   |
|  | 11.0   | 0(B)                                 | 10.0 1                             | 251.79         | N/A                        | **   |                          | **                  |                          |   |
|  | 12.5   | 0(B)                                 | 11.4 1                             | 401.19         | N/A                        | **   |                          | **                  |                          |   |
|  | 22.0   | 0(B)                                 | 20.0 2                             | 228.68         | N/A                        | **   |                          | **                  |                          |   |
|  | 24.5   | 0(B)                                 | 22.3 2                             | 412.37         | N/A                        | **   |                          | **                  |                          |   |
|  | 33.0   | 0(B)                                 | 30.0 2                             | 930.68         | N/A                        | **   |                          | **                  |                          |   |
|  | 44.0   | 0(B)                                 | 40.0 3                             | 357.78         | N/A<br>N/A                 | **   |                          | **                  |                          |   |
|  | 55.0   | од)<br>ОД)                           | 49.5 3<br>50.0 3                   | 509.02         | N/A<br>N/A                 | **   |                          | **                  |                          |   |
|  | 55.0   | 0(R)                                 | 50.0 3                             | 509.98         | N/A                        | **   |                          | **                  |                          | ~ |
|  |  |                                      |                                    |                |                            |  |                          |                     |                          |   |
| (L) Left   |  |                                      |                                    |                |                            |  |                          |                     |                          |   |
| (R) Right  |  |                                      |                                    | Manuaut Sum    |                            |  | -D                       |                     |                          |   |
|  |  |                                      |                                    | Li             | ve Load: HL-9              | uous span mou<br>93 (US)                     | lei)                     |                     |                          |   |
|  |  |                                      |                                    |                | Impact = **                | %  |                          |                     |                          |   |
| Span 1   |  |                                      |                                    |                |                            |  |                          |                     |                          |   |
| •  |  |                                      |                                    |                |                            |  |                          |                     |                          |   |
|  | Location   | <b>D</b> (                           | DC<br>(kip-ft)                     | DW<br>(kip-ft) | +(LL-<br>(kip-i            | ⊦I)<br>ft) Contro<br>Live L                  | olling<br>.oad           | (LL+I)<br>(kip-ft)  | Controlling<br>Live Load |   |
|  | (ff)   | Percent                              | 0.00                               | NI/A           | 0.00                       | ) Tandama                                    | + I ana                  | 0.00                | Tondom + Lono            |   |
|  | 1.75(B)  | 1.6                                  | 11 90                              | N/A<br>N/A     | 160 4                      | i9 Truck +                                   | Lane                     | -18.65              | Truck + Lane             |   |
|  | 10.00(B)   | 9.1                                  | 61.05                              | N/A            | 825.3                      | 4 Truck +                                    | Lane -                   | 106.55              | Truck + Lane             |   |
|  | 11.00(B)   | 10.0                                 | 66.22                              | N/A            | 895.6                      | 6 Truck +                                    | Lane -                   | 117.21              | Truck + Lane             |   |
|  | 12.50(B)   | 11.4                                 | 73.68                              | N/A            | 997.0                      | )4 Truck +                                   | Lane -                   | 133.19              | Truck + Lane             |   |
|  | 22.00(B)   | 20.0                                 | 112.07                             | N/A            | 1525.                      | 54 Truck +                                   | Lane -                   | 234.41              | Truck + Lane             |   |
|  | 24.50(B)   | 22.3                                 | 119.65                             | N/A            | 1632.                      | 62 Truck +                                   | Lane -                   | 261.05              | Truck + Lane             |   |
|  | 33.00(B)   | 30.0                                 | 137.54                             | N/A            | 1903.                      | 2.5 Truck +                                  | Lane -                   | 351.62              | Truck + Lane             |   |
|  | 44.00(B)   | 40.0                                 | 142.04                             | N/A            | 2070.                      | <ol> <li>Truck +</li> <li>Truck +</li> </ol> | Lane -                   | -408.85             | Truck + Lane             |   |
|  | 55 00(L)   | 50.0                                 | 128.49                             | N/A            | 2038.                      | 41 Truck +                                   | Lane -                   | 586.04              | Truck + Lane             |   |
|  | 55.00(R)   | 50.0                                 | 127.35                             | N/A            | 2033.                      | 41 Truck +                                   | Lane -                   | 586.04              | Truck + Lane             |   |
|  | 66.00(B)   | 60.0                                 | 91.70                              | N/A            | 1814.                      | 66 Truck +                                   | Lane -                   | 703.24              | Truck + Lane             |   |
|  | 77.00(B)   | 70.0                                 | 35.66                              | N/A            | 1406.                      | 07 Truck +                                   | Lane -                   | 820.45              | Truck + Lane             |   |
|  | 84.50(B)   | 76.8                                 | -14.23                             | N/A            | 1034.                      | 44 Truck +                                   | Lane -                   | 900.36              | Truck + Lane             |   |
|  | 87.00(B)   | 79.1                                 | -32.96                             | N/A            | 896.1                      | 1 Truck +                                    | Lane -                   | 927.00              | Truck + Lane             |   |
|  | 88.00(B)   | 80.0                                 | -40.75                             | N/A            | 838.2                      | 23 Truck +                                   | Lane -                   | 937.66              | Truck + Lane             |   |
|  | 96.50(B)   | 87.7                                 | -113.76                            | N/A            | 394.4                      | D Tandem                                     | +Lane -                  | 1104.60             | 90% (Iruck Pair + Lane)  |   |
|  | 99.00(B)<br>107.25/B)                                      | 90.0                                 | -15/.04                            | IN/A<br>N/A    | 300.2<br>40 7              | o iandem.<br>6 Touck⊥                        | ⊤∟anë -<br>Lane          | 1299.89<br>1885.07  | 90%(Truck Pair + Lane)   |   |
|  | 109.00(L)  | 99.1                                 | -243.22                            | N/A            | 17.4                       | 6 Truck +                                    | Lane -                   | 2022.18             | 90%(Truck Pair + Lane)   |   |
|  | 109.00(R)  | 99.1                                 | -243.22                            | N/A            | 17.4                       | 6 Truck +                                    | Lane -                   | 2022.18             | 90%(Truck Pair + Lane)   |   |
|  | 110.00(L)  | 100.0                                | -254.71                            | N/A            | 0.00                       | ) Tandem                                     | +Lane -:                 | 2104.99             | 90%(Truck Pair + Lane)   |   |
|  |  |                                      |                                    |                |                            |  |                          |                     |                          | ~ |

The resulting maximum moment for Strength-I at the midspan is equal to (1.25 \* (3509.02 + 128.49)) + (1.75 \* 2038.41) = 8114.1 kft.

### Tabular Results

To review the dead load and live load analysis results, click on the **Tabular Results** button from the **Results** group of the **DESIGN/RATE** ribbon as shown below.



The Analysis Results window will open as shown below.

| <b>,</b> | Analy              | sis Kesults               | - I Bear             | n Alt             |                    |                |                |                   |                     |      | _                    |          | ~     |
|----------|--------------------|---------------------------|----------------------|-------------------|--------------------|----------------|----------------|-------------------|---------------------|------|----------------------|----------|-------|
| Re       | port typ           | be:                       |                      |                   | Stage              |                |                |                   | Dead                | l Lo | ad Case              |          |       |
| D        | ead Loa            | ad Actions                |                      | $\sim$            | Non-co             | mposite        | (Stage         | 1)                | ✓ Loa               | d Ca | ase 1 - Self Lo      | ad(Stage | 1:1 🗸 |
|          |                    |                           |                      |                   |                    |                |                |                   |                     |      |                      |          |       |
|          | Span               | Location<br>(ft)          | %<br>Span            | Side              | Moment<br>(kip-ft) | Shear<br>(kip) | Axial<br>(kip) | Reaction<br>(kip) | X Deflectio<br>(in) | on   | Y Deflection<br>(in) |          |       |
| Þ        | 1                  | 0.00                      | 0.0                  | Right             | 0.00               | 61.60          | 0.00           | 61.60             | 0.00                | 00   | 0.0000               |          |       |
|          | 1                  | 1.75                      | 1.6                  | Both              | 106.06             | 59.62          | 0.00           |                   | 0.00                | 00   | -0.0490              |          |       |
|          | 1                  | 10.00                     | 9.1                  | Both              | 559.45             | 50.29          | 0.00           |                   | 0.00                | 00   | -0.2755              |          |       |
|          | 1                  | 11.00                     | 10.0                 | Both              | 609.18             | 49.16          | 0.00           |                   | 0.00                | 00   | -0.3021              |          |       |
|          | 1                  | 12.50                     | 11.4                 | Both              | 681.66             | 47.47          | 0.00           |                   | 0.00                | 00   | -0.3414              |          |       |
|          | 1                  | 22.00                     | 20.0                 | Both              | 1081.61            | 36.73          | 0.00           |                   | 0.00                | 00   | -0.5710              |          |       |
|          | 1                  | 24.50                     | 22.3                 | Both              | 1169.91            | 33.91          | 0.00           |                   | 0.00                | 00   | -0.6246              |          |       |
|          | 1                  | 33.00                     | 30.0                 | Both              | 1417.28            | 24.30          | 0.00           |                   | 0.00                | 00   | -0.7804              |          |       |
|          | 1                  | 44.00                     | 40.0                 | Both              | 1616.20            | 11.87          | 0.00           |                   | 0.000               | 00   | -0.9117              |          |       |
|          | 1                  | 54.50                     | 49.5                 | Both              | 1678.50            | 0.00           | 0.00           |                   | 0.00                | 00   | -0.9539              |          |       |
|          | 1                  | 55.00                     | 50.0                 | Left              | 16/8.36            | -0.57          | 0.00           |                   | 0.00                | 00   | -0.9538              |          |       |
|          |                    | 55.00                     | 50.0                 | Right             | 1602.77            | -0.57          | 0.00           |                   | 0.000               | 00   | -0.9538              |          | =     |
|          | - 1                | 77.00                     | 70.0                 | Both              | 1202.42            | -15.00         | 0.00           |                   | 0.000               | 00   | -0.9055              |          |       |
|          | 1                  | 94.50                     | 76.0                 | Both              | 1392.42            | -23,45         | 0.00           |                   | 0.00                | 00   | -0.7044              |          |       |
|          | 1                  | 87.00                     | 79.1                 | Both              | 1081.61            | -36.73         | 0.00           |                   | 0.00                | 00   | -0.5710              |          |       |
|          | 1                  | 88.00                     | 80.0                 | Both              | 1044.31            | -37.86         | 0.00           |                   | 0.00                | 00   | -0.5486              |          |       |
|          | 1                  | 96.50                     | 87.7                 | Both              | 681.66             | -47.47         | 0.00           |                   | 0.00                | 00   | -0.3414              |          |       |
|          | 1                  | 99.00                     | 90.0                 | Both              | 559.45             | -50.29         | 0.00           |                   | 0.00                | 00   | -0.2755              |          |       |
|          | 1                  | 107.25                    | 97.5                 | Both              | 106.06             | -59.62         | 0.00           |                   | 0.00                | 00   | -0.0490              |          |       |
|          | 1                  | 109.00                    | 99.1                 | Left              | 0.00               | -61.60         | 0.00           | 62.73             | 0.00                | 00   | 0.0000               |          |       |
|          | 2                  | 1.00                      | 0.9                  | Right             | 0.00               | 61.60          | 0.00           | 62.73             | 0.00                | 00   | 0.0000               |          |       |
|          | 2                  | 2.75                      | 2.5                  | Both              | 106.06             | 59.62          | 0.00           |                   | 0.00                | 00   | -0.0490              |          |       |
|          | 2                  | 11.00                     | 10.0                 | Both              | 559.45             | 50.29          | 0.00           |                   | 0.00                | 00   | -0.2755              |          |       |
|          | 2                  | 13.50                     | 12.3                 | Both              | 681.66             | 47.47          | 0.00           |                   | 0.00                | 00   | -0.3414              |          |       |
|          | 2                  | 22.00                     | 20.0                 | Both              | 1044.31            | 37.86          | 0.00           |                   | 0.00                | 00   | -0.5486              |          |       |
|          | 2                  | 23.00                     | 20.9                 | Both              | 1081.61            | 36.73          | 0.00           |                   | 0.00                | 00   | -0.5710              |          |       |
|          | 2                  | 25.50                     | 23.2                 | Both              | 1169.91            | 33.91          | 0.00           |                   | 0.00                | 00   | -0.6246              |          |       |
|          | 2                  | 33.00                     | 30.0                 | Both              | 1392.42            | 25.43          | 0.00           |                   | 0.00                | 00   | -0.7644              |          |       |
|          | 2                  | 44.00                     | 40.0                 | Both              | 1603.77            | 13.00          | 0.00           |                   | 0.00                | 00   | -0.9033              |          |       |
|          | 2                  | 55.00                     | 50.0                 | Left              | 1678.36            | 0.57           | 0.00           |                   | 0.00                | 00   | -0.9538              |          | w     |
| AA<br>An | SHTO l<br>alysis p | .RFD Engin<br>reference : | e Versio<br>setting: | on 7.5.0.<br>None | 3001               |                |                |                   |                     |      |                      |          | Close |

| An                | alysis Re           | sults -         | - I Bear            | n Alt               |                    |                |                |                |                |          |          |         |            |                     |       |          |              |                          | -             |                   | ×  |
|-------------------|---------------------|-----------------|---------------------|---------------------|--------------------|----------------|----------------|----------------|----------------|----------|----------|---------|------------|---------------------|-------|----------|--------------|--------------------------|---------------|-------------------|----|
| Pri               | nt                  |                 |                     |                     |                    |                |                |                |                |          |          |         |            |                     |       |          |              |                          |               |                   |    |
| Pri               | nt .                |                 |                     |                     |                    |                |                |                |                |          |          |         |            |                     |       |          |              |                          |               |                   |    |
| Livele            | type:<br>ad Actio   |                 |                     |                     | tage<br>Composito  | (rhort tor     | m) (Stage 3    |                | LIVE LOAD      |          |          | V       | Live       | Load Type           | ~     |          |              |                          |               |                   |    |
| Live Lo           | au Actio            | 115             |                     |                     | composite          | (short ter     | iii) (stage s  | <i>)</i>       | 112-55 (03)    |          |          |         | Lan        | ne                  |       |          |              |                          |               |                   |    |
|                   |                     |                 |                     | Positive            | Negative           | Positiva       | Negative       | Positiva       | Negative       | Positiva | Negative | Pori    | Axl        | le Load             | in a  |          | Negative     |                          |               |                   |    |
| Spa               | n Locat             | tion<br>)       | %<br>Span           | Moment<br>(kin-ft)  | Moment<br>(kin-ft) | Shear<br>(kin) | Shear<br>(kin) | Axial<br>(kin) | Axial<br>(kin) | Reaction | Reaction | X Defle | Tan<br>Tru | ndem<br>Ick Pair    | cti   | on       | Y Deflection | % Impact<br>Pos Reaction | % In<br>Neg R | npact<br>leaction |    |
|                   | 1 0                 | 0.00            | 0.0                 | 0.00                | 0.00               | 79.62          | -8.24          | 0.00           | 0.00           | 79.62    | -8.24    | 0       | Tru        | ick + Lane          | 00    | 00       | 0.0000       | 33.000                   |               | 33.000            |    |
|                   | 1 1                 | .75             | 1.6                 | 117.98              | -12.49             | 77.87          | -8.24          | 0.00           | 0.00           |          |          | 0       | Tan        | ndem + Lane         | 00    | 27       | -0.0085      |                          |               |                   |    |
|                   | 1 10                | 0.00            | 9.1                 | 603.06              | -71.38             | 69.66          | -8.24          | 0.00           | 0.00           |          |          | 0       | 909        | %(Truck Pair + Lane | ≘) 01 | 54       | -0.0476      |                          |               |                   |    |
|                   | 1 11                | .00             | 10.0                | 653.98              | -78.52             | 68.67          | -8.24          | 0.00           | 0.00           |          |          | 0       | .000       | 0000.0              | 0.01  | 69       | -0.0522      |                          |               |                   |    |
|                   | 1 12                | .50             | 11.4                | 727.23              | -89.23             | 67.20          | -8.24          | 0.00           | 0.00           |          |          | 0       | .000       | 0000.0 00           | 0.01  | 92       | -0.0590      |                          |               |                   |    |
|                   | 1 22                | 2.00            | 20.0                | 1104.49             | -157.04            | 57.99          | -13.40         | 0.00           | 0.00           |          |          | 0       | .000       | 0000.0              | 0.03  | 29       | -0.0985      |                          |               |                   |    |
|                   | 1 24                | .50             | 22.3                | 1179.50             | -174.88            | 55.61          | -15.61         | 0.00           | 0.00           |          |          | 0       | .000       | 0.0000              | 0.03  | 62       | -0.1076      |                          |               |                   |    |
|                   | 1 33                | 8.00            | 30.0                | 1365.11             | -235.56            | 47.67          | -23.61         | 0.00           | 0.00           |          |          | 0       | .000       | 0.0000              | 0.04  | 67       | -0.1340      |                          |               |                   |    |
|                   | 1 44                | .00             | 40.0                | 14/7.87             | -314.08            | 37.87          | -34.20         | 0.00           | 0.00           |          |          | 0       | .000       | 0.0000              | 0.05  | /5       | -0.1547      |                          |               |                   |    |
|                   | 1 54                | .50             | 49.5                | 1451.30             | -389.03            | 29.11          | -43.92         | 0.00           | 0.00           |          |          | 0       | .000       | 0.0000              | 0.06  | 40       | -0.1582      |                          |               |                   |    |
|                   | 1 66                | 00.00           | 60.0                | 1200.15             | -592.39            | 20.71          | -44.57         | 0.00           | 0.00           |          |          | 0       | .000       | 0.0000              | 0.00  | 42<br>57 | -0.1360      |                          |               |                   |    |
|                   | 1 77                | 200             | 70.0                | 1022.71             | -549.63            | 12.87          | -62.92         | 0.00           | 0.00           |          |          | 0       | 000        | 0.0000              | 0.00  | 11       | -0.1440      |                          |               |                   |    |
|                   | 1 84                | 150             | 76.8                | 776.89              | -603.17            | 8.44           | -68.54         | 0.00           | 0.00           |          |          | 0       | .000       | 0.0000              | 0.05  | 39       | -0.0920      |                          |               |                   |    |
|                   | 1 87                | .00             | 79.1                | 686.94              | -621.01            | 7.18           | -70.32         | 0.00           | 0.00           |          |          | 0       | .000       | 0.0000 00           | 0.05  | 07       | -0.0830      |                          |               |                   |    |
|                   | 1 88                | 8.00            | 80.0                | 649.31              | -628.15            | 6.69           | -71.03         | 0.00           | 0.00           |          |          | 0       | .000       | 0000.0 00           | 0.04  | 93       | -0.0794      |                          |               |                   |    |
|                   | 1 96                | 5.50            | 87.7                | 315.86              | -688.82            | 2.86           | -76.67         | 0.00           | 0.00           |          |          | 0       | .000       | 0.0000 00           | 0.03  | 46       | -0.0475      |                          |               |                   |    |
|                   | 1 99                | 0.00            | 90.0                | 221.44              | -706.67            | 2.26           | -78.22         | 0.00           | 0.00           |          |          | 0       | .000       | 0.0000 00           | 0.02  | 93       | -0.0382      |                          |               |                   |    |
|                   | 1 107               | .25             | 97.5                | 47.61               | -765.56            | 0.51           | -82.86         | 0.00           | 0.00           |          |          | 0       | .000       | 0.0000 00           | 0.00  | 82       | -0.0089      |                          |               |                   |    |
|                   | 1 109               | 0.00            | 99.1                | 17.20               | -778.05            | 0.18           | -83.78         | 0.00           | 0.00           |          |          | 0       | .000       | 0000.0 00           | 0.00  | 31       | -0.0032      |                          |               |                   |    |
|                   | 1 110               | 0.00            | 100.0               | 0.00                | -785.19            | 0.00           | -84.30         | 0.00           | 0.00           | 88.00    | 0.00     | 0       | .000       | 0.0000 00           | 0.00  | 00       | 0.0000       | 33.000                   |               | 0.000             |    |
|                   | 2 0                 | 0.00            | 0.0                 | 0.00                | -785.19            | 84.30          | 0.00           | 0.00           | 0.00           | 88.00    | 0.00     | 0       | .000       | 0000.0 00           | 0.00  | 00       | 0.0000       | 33.000                   |               | 0.000             |    |
|                   | 2 1                 | .00             | 0.9                 | 17.20               | -778.05            | 83.78          | -0.18          | 0.00           | 0.00           |          |          | 0       | .000       | 0000.0 00           | 0.00  | 31       | -0.0032      |                          |               |                   |    |
|                   | 2 2                 | .75             | 2.5                 | 47.61               | -765.56            | 82.86          | -0.51          | 0.00           | 0.00           |          |          | 0       | .000       | 0000.0 00           | 0.00  | 82       | -0.0089      |                          |               |                   |    |
| _                 | 2 11                | .00             | 10.0                | 221.44              | -706.67            | 78.22          | -2.26          | 0.00           | 0.00           |          |          | 0       | .000       | 0000.0              | 0.02  | 93       | -0.0382      |                          |               |                   |    |
|                   | 2 13                | .50             | 12.3                | 315.86              | -688.82            | 76.67          | -2.86          | 0.00           | 0.00           |          |          | 0       | .000       | 0.0000              | 0.03  | 46       | -0.0475      |                          |               |                   |    |
| _                 | 2 22                | .00             | 20.0                | 649.31              | -628.15            | 71.03          | -6.69          | 0.00           | 0.00           |          |          | 0       | .000       | 0000.000            | 0.04  | .93      | -0.0794      |                          |               |                   |    |
| -                 | 2 23                | 5.00            | 20.9                | 585.94              | -621.01            | /0.32          | -7.18          | 0.00           | 0.00           |          |          | 0       | .000       | 0.0000              | 0.05  | 20       | -0.0830      |                          |               |                   |    |
|                   | 2 23                | 00              | 23.2                | 1022.71             | -003.17            | 62.02          | -8.44          | 0.00           | 0.00           |          |          | 0       | .000       | 0.0000              | 0.05  | 59<br>11 | -0.0920      |                          |               |                   |    |
|                   | 2 33                |                 | 50.0                | 1022.71             | -049.03            | 02.92          | -12.67         | 0.00           | 0.00           |          |          | 0       |            | 0.0000              | 0.06  |          | -0.1109      |                          |               |                   | T  |
| AASHT(<br>Analysi | D LRFD E<br>prefere | ngine<br>nce se | e Versio<br>etting: | on 7.5.0.30<br>None | 01                 |                |                |                |                |          |          |         |            |                     |       |          |              |                          |               |                   |    |
|                   |                     |                 |                     |                     |                    |                |                |                |                |          |          |         |            |                     |       |          |              |                          |               | Clo               | se |

*Note:* These values include dynamic load allowance, distribution factors and any live load scale factor entered on the *Analysis Settings* window.

### Method of solution

A copy of the AASHTO LRFD engine **Method of Solution** manual is available for reference. To access this manual, click on the **Bridge Workspace** ribbon to open the **Support** window as shown below.



From the leftmost column, click on the **Help** button. Select the **AASHTO LRFD** option from the **Engine Help** column. The **Engine Help** and **Method of Solution** for the selected analysis engine will be displayed in the **Engine Help Configuration** column. Double-click on the **Method of Solution** option to open the **AASHTO LRFD/LRFR Superstructure Method of Solution** as shown below.

| $\bigcirc$ | Bridge Workspace - PS4   | – 🗆 × |
|------------|--|-------|
| E          |  |       |
| 🖶 Print    | Support  |       |
| Help       | Melp Topics  |       |
|            | Getting help using the software  |       |
| 🔀 Close    | Frequently Asked Questions<br>Find questions that are frequently asked |       |
|            | Support<br>Find more information on technical support                  |       |
|            | Engine   |       |
|            | Engine Help Engine Help Configuration                                  |       |
|            | AASHTO ASR   |       |
|            | AASHTO Culvert LFR Method of Solution                                  |       |
|            | AASHTO Culvert LRFD  |       |
|            | AASHTO Culvert LRFR  |       |
|            | AASHTO LFR   |       |
|            | AASHTO LRFD Default Engine Help  |       |
|            | AASHTO LRFD Substructure (BrD)   |       |
|            | AASHTO LRFR  |       |
|            | AASHTO Metal Culvert LFR   |       |
|            | AASHTO Metal Culvert LRFR 🗸  |       |
|            | Set As Main Engine Help  |       |