

AASHTOWare BrDR 7.5.0

Multi-Cell Box Tutorial

MCB1 – Post-Tensioned Multi-Cell Box Example

MCB1 – Post-Tensioned Multi-Cell Box Example

Topics Covered

- Analysis Methods
- Post-tensioned concrete Multi-Cell Box Data Entry
- Integral with substructure
- LRFR analysis and results

This example describes entering a post-tensioned multicell box superstructure into AASHTOWare BrDR. The superstructure is modeled as integral with the pier.

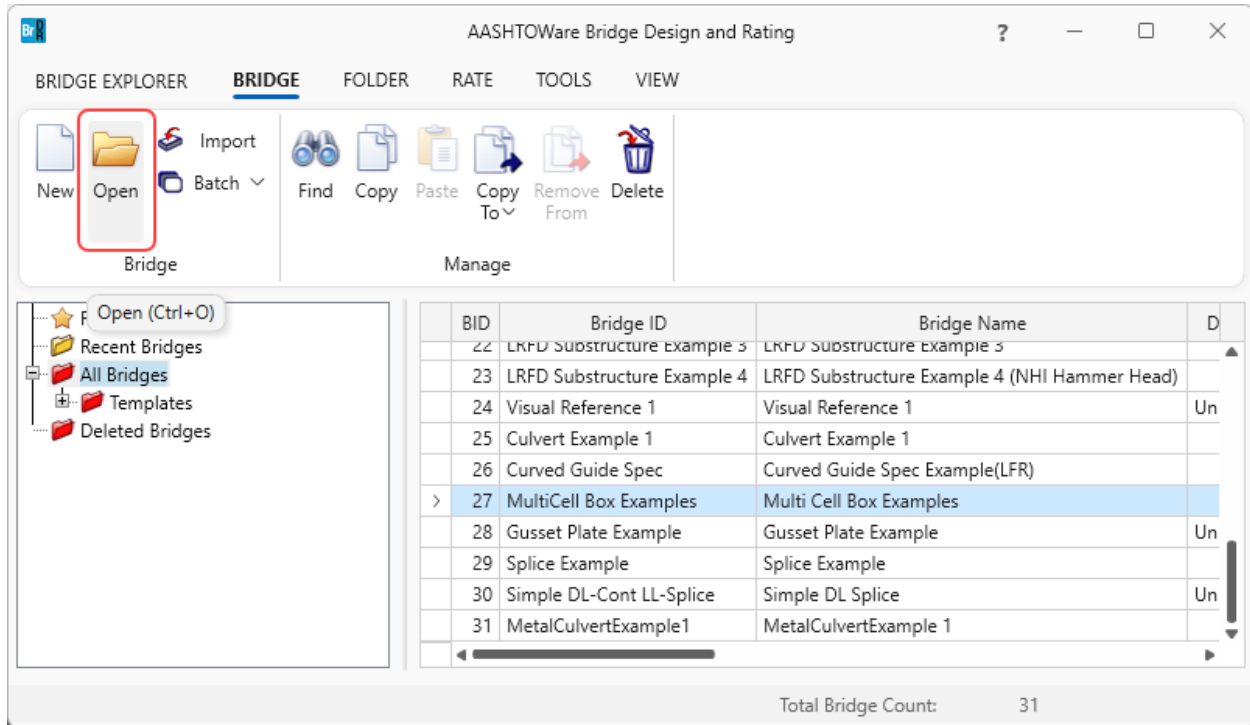
Analysis Methods

Post-tensioned concrete multi-cell box (MCB) superstructures can be analyzed in the following ways:

- LFR
- LRFR
- Full box section including each individual weblane

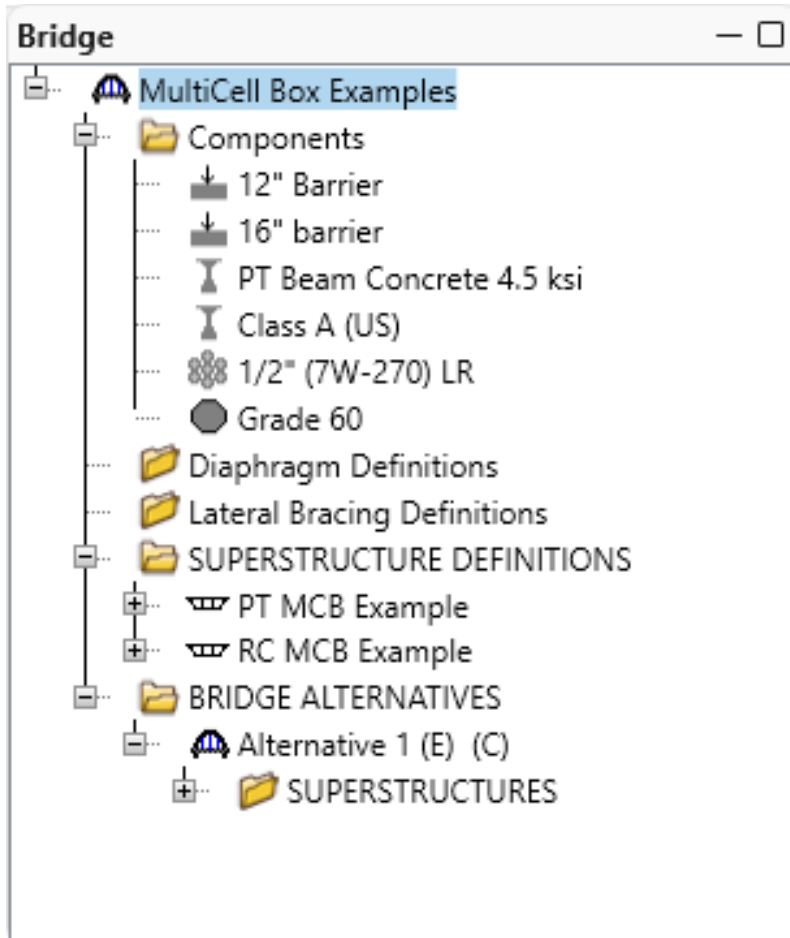
Post-tensioned concrete Multi-Cell Box Data Entry

From the Bridge Explorer, click on the bridge **BID 27 MultiCell Box Examples** in the sample database and select **Open** from the **Bridge** group of the **BRIDGE** ribbon to open this bridge as shown below.



MCB1 – Post-Tensioned Multi-Cell Box Example

The partially expanded **Bridge Workspace (BWS)** tree is shown below.



MCB1 – Post-Tensioned Multi-Cell Box Example

Open the **Bridge** window and check **Substructures** in the **Bridge Workspace View**.

MultiCell Box Examples

Bridge ID: MultiCell Box Examples NBI structure ID (8): MCB Examples

Template Superstructures

Bridge completely defined Culverts

Substructures

Description Description (cont'd) Alternatives Global reference point Traffic Custom agency fields

Name: Multi Cell Box Examples Year built: 2014

Description:

Location: Length: ft

Facility carried (7): Route number: 100

Feat. intersected (6): Mi. post:

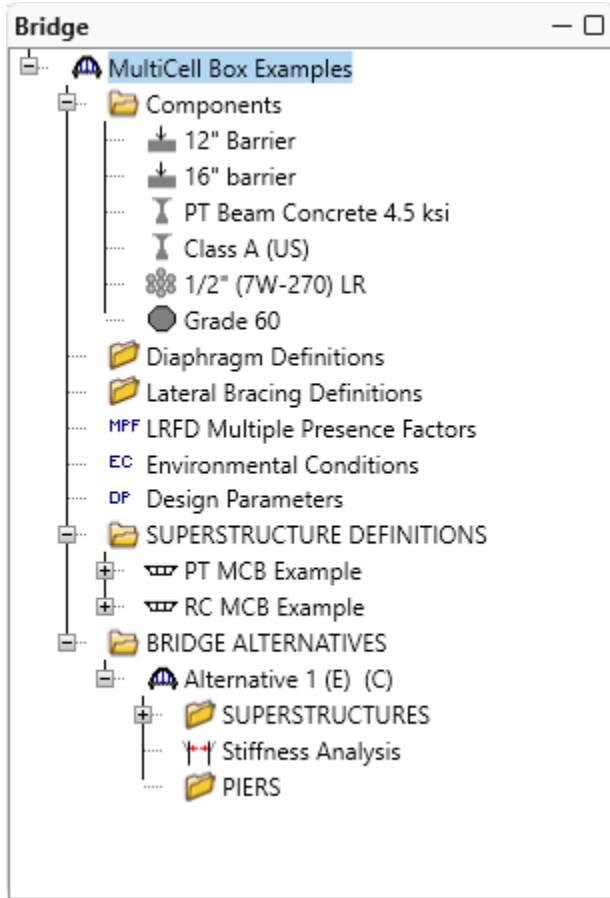
Default units: US Customary

Bridge association... BrR BrD BrM

OK Apply Cancel

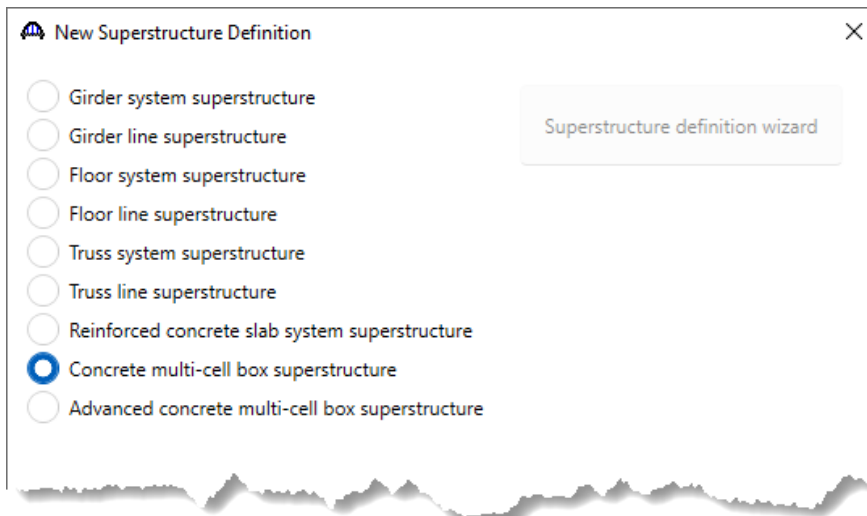
MCB1 – Post-Tensioned Multi-Cell Box Example

The current **Bridge Workspace** tree is shown below.



Superstructure Definitions

Double click on the **SUPERSTRUCTURE DEFINITIONS** folder in the **BWS** tree to start creating a new MCB (Multi-Cell box) superstructure definition. Select **Concrete multi-cell box superstructure** and click **OK**.



MCB1 – Post-Tensioned Multi-Cell Box Example

Enter the following data for the superstructure definition. Select **Integral with substructure** and mark **Support 2** as being integral. Also be sure to select the **Post-tensioned** checkbox. This will display the **PT** windows in the **BWS** tree.

Concrete Multi-Cell Box Superstructure Definition

Definition Analysis Specs Factors Engine Control options

Name: PT MCB

Description: *See Below*

Default units: US Customary

Number of spans: 2

Number of cells: 2

Span lengths: **Integral piers**

Enter span lengths along the reference line:

Span	Length (ft)
> 1	111.5
2	111.5

End projections
Left: 12 in
Right: 12 in

Average humidity: %

Structure type
 Frame structure simplified definition
 Integral with substructure
 Consider substructure skew in FE section proper
 Not integral with pier

Structure model for LLDF computation
 Standalone
 Left side connected to adjacent structure
 Right side connected to adjacent structure

Post-tensioned
 Analyze webs only

OK Apply Cancel

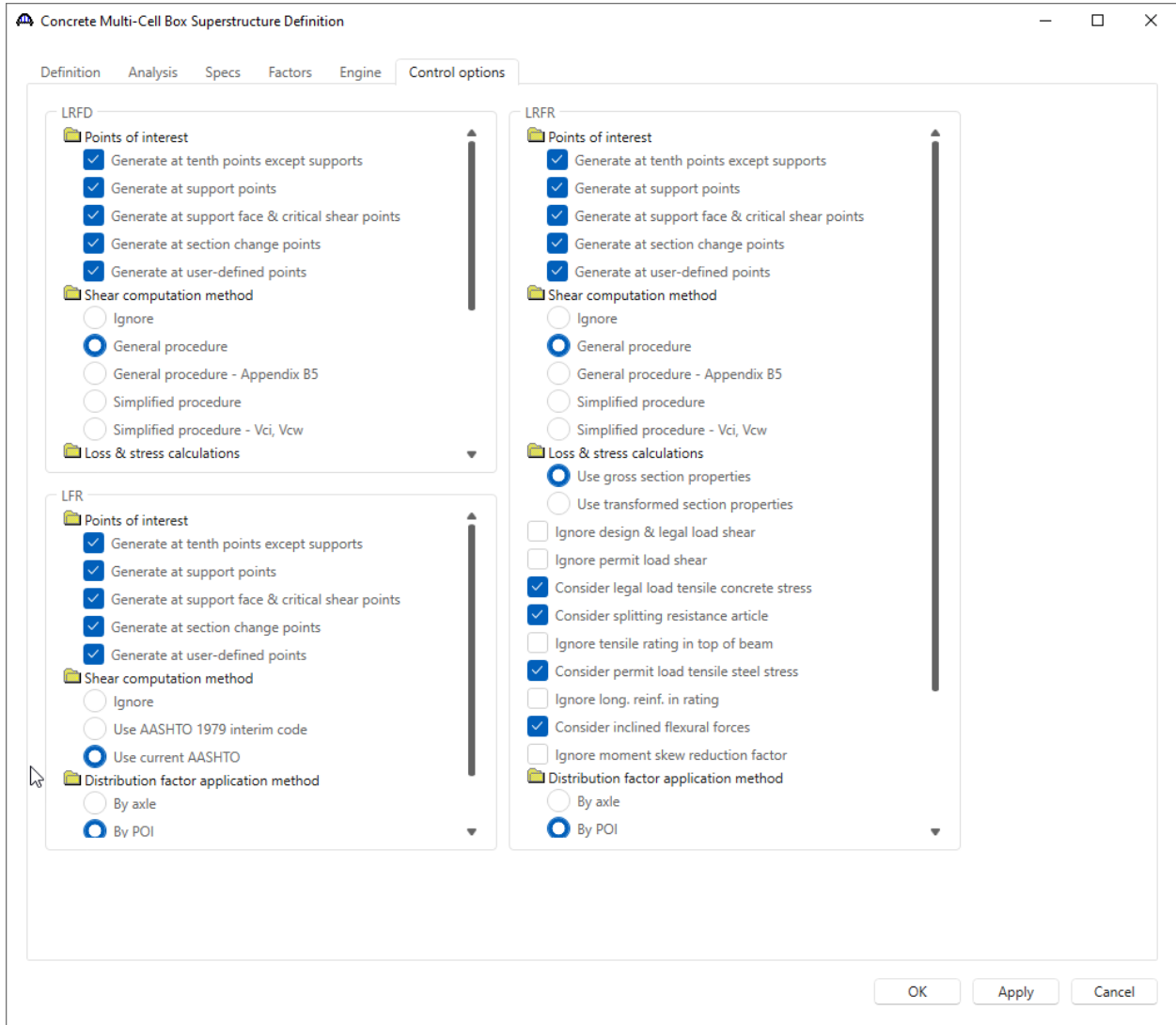
Span lengths **Integral piers**

Frame connections:

	Support	Integral
	1	<input type="checkbox"/>
>	2	<input checked="" type="checkbox"/>
	3	<input type="checkbox"/>

MCB1 – Post-Tensioned Multi-Cell Box Example

Navigate to the **Control options** tab and select the following **LRFR** options.

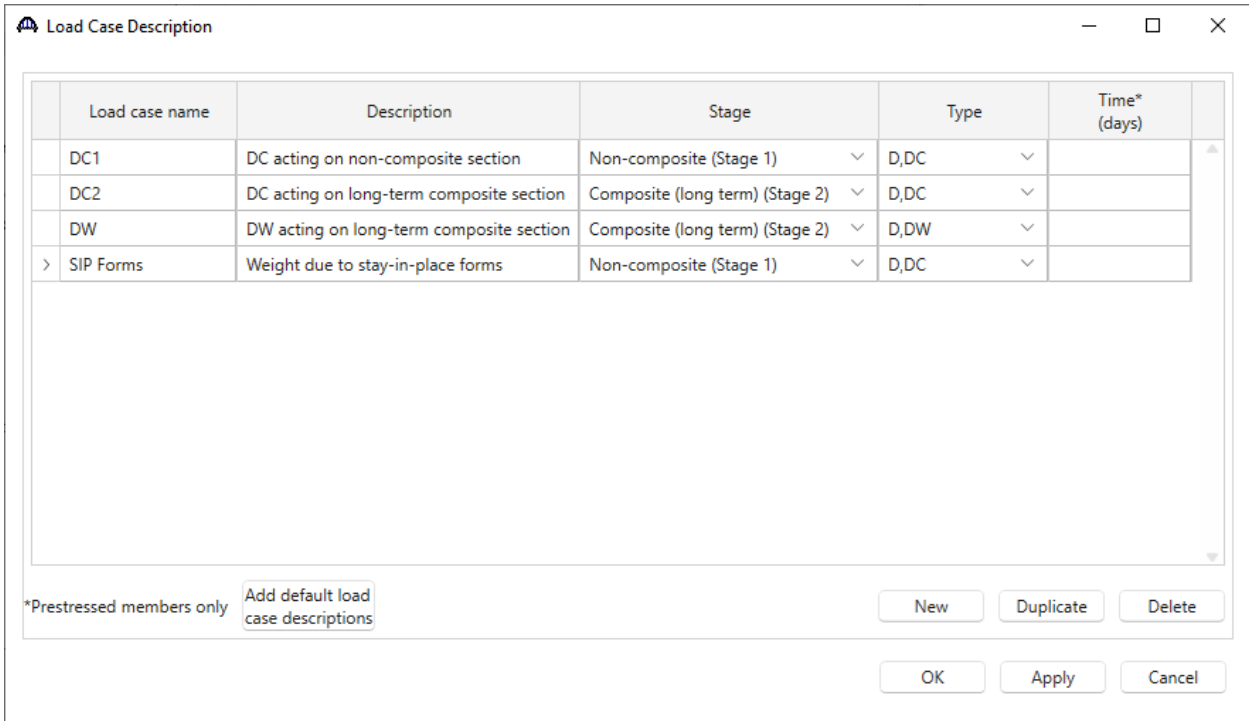
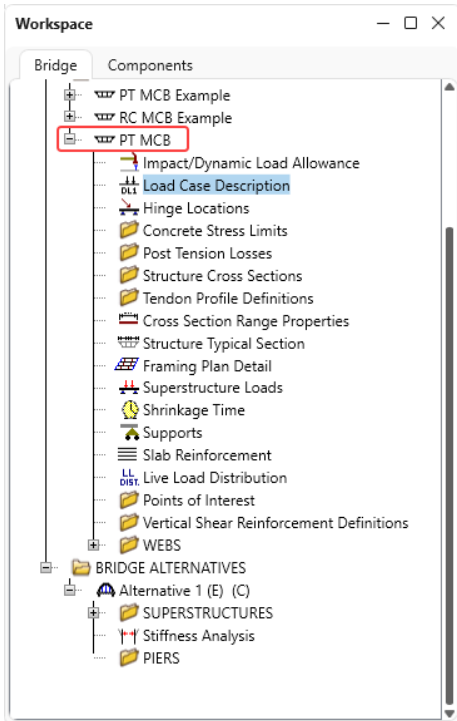


Click **OK** to create the superstructure definition and close the window.

MCB1 – Post-Tensioned Multi-Cell Box Example

Load Case Description

Expand the newly added superstructure definition **PT MCB** folder in the **BWS** tree and double click on the **Load Case Description** node. Use the **Add default load case descriptions** button to create the following load cases.



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

MCB1 – Post-Tensioned Multi-Cell Box Example

Concrete Stress Limits

Double click on the **Concrete Stress Limits** folder in the **BWS** tree and enter a **Name**, **Concrete material** and click the **Compute** button to fill the stress limit data for the beam concrete.

	LFD	LRFD
Initial allowable compression:	2.4 ksi	2.6 ksi
Initial allowable tension:	0.1897367 ksi	0.1896 ksi
Final allowable compression:	2.7 ksi	2.7 ksi
Final allowable tension:	0.4030509 ksi	0.4030509 ksi
Final allowable DL compression:	1.8 ksi	2.025 ksi
Final allowable slab compression:	ksi	ksi
Final allowable compression: (LL+1/2(Pe+DL))	1.8 ksi	1.8 ksi

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

MCB1 – Post-Tensioned Multi-Cell Box Example

Post Tension Losses

Double click on the **Post Tension Losses** folder in the **BWS** tree and select the **Lump Sum** Loss method.

The screenshot shows a software dialog box titled "Post Tension Losses". At the top, there is a "Name:" field containing "Lump Sum Losses". Below this is a "Loss method:" dropdown menu with "Lump Sum" selected; this dropdown is enclosed in a red rectangular box. To the right of the dropdown is a sub-panel titled "Lump sum losses" containing two input fields: "Initial loss:" with the value "20" and "ksi" unit, and "Final loss:" with the value "45" and "ksi" unit. Below these are several other input fields: "Anchor set:" (empty), "Coefficient of friction:" (empty), "Wobble coefficient:" (empty), "P/S transfer stress ratio:" (disabled), "Transfer time:" (disabled), "Age at deck placement:" (disabled), and "Final age:" (disabled). At the bottom right, there are three buttons: "OK" (dashed border), "Apply", and "Cancel".

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

MCB1 – Post-Tensioned Multi-Cell Box Example

Structure Cross Sections

Double click on the **Structure Cross Sections** folder in the **BWS** tree and enter the following data.

Structure Cross Sections

Name: Section 1 Number of cells: 2

Input method: Simple Advanced Top slab concrete: PT Beam Concrete 4.5 ksi Other parts concrete: PT Beam Concrete 4.5 ksi

Entry method: Width Slope Top slab stress limit: Beam Stress Limit Other parts stress limit: Beam Stress Limit

Overall Cells Fillets

	(ft)
D	4
CJ	0.667
LW1	3
LW2	3
RW1	3
RW2	3
LV	1
> RV	1

	(in)
> LT1	8
LT2	12
RT1	8
RT2	12

W2: 24 ft

Properties

Compute properties

Area: ft²

Ixx: ft⁴

Iyy: ft⁴

J: ft⁴

OK Apply Cancel

Overall **Cells** Fillets

Top left web thickness: 14 in W2: 24 ft

Bottom left web thickness: 14 in

Cell	S (ft)	Top right web thickness (in)	Bottom right web thickness (in)	Top slab thickness (in)
> 1	12	14	14	8
2	12	14	14	8

MCB1 – Post-Tensioned Multi-Cell Box Example

Overall Cells **Fillets**

	Location in cells	Exterior web fillet	Interior web fillet	Horiz (in)	Vert (in)
>	Top	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	4	4
	Bottom	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	4	4

Now that all the dimensions are entered, click the **Compute properties** button.

Structure Cross Sections

Name: Section 1 Number of cells: 2

Input method: Simple Advanced
 Top slab concrete: PT Beam Concrete 4.5 ksi Other parts concrete: PT Beam Concrete 4.5 ksi

Entry method: Width Slope
 Top slab stress limit: Beam Stress Limit Other parts stress limit: Beam Stress Limit

Overall Cells Fillets

	(ft)
D	4
CJ	0.667
LW1	3
LW2	3
RW1	3
> RW2	3
LV	1
RV	1

	(in)
> LT1	8
LT2	12
RT1	8
RT2	12

W2: 24 ft

Properties

Compute properties

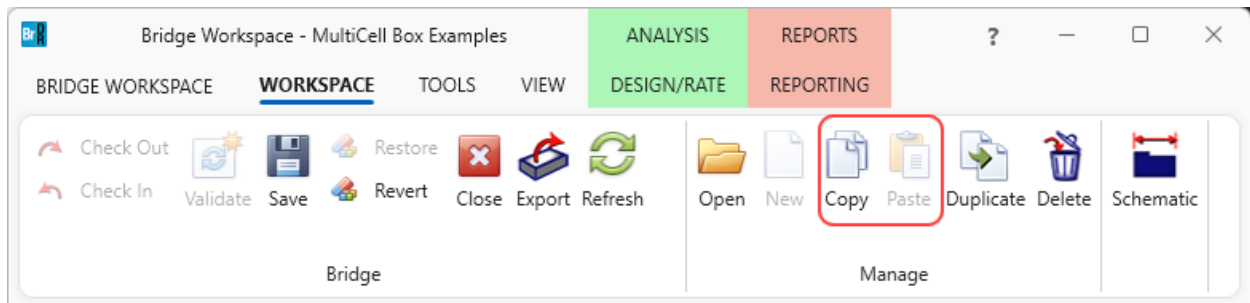
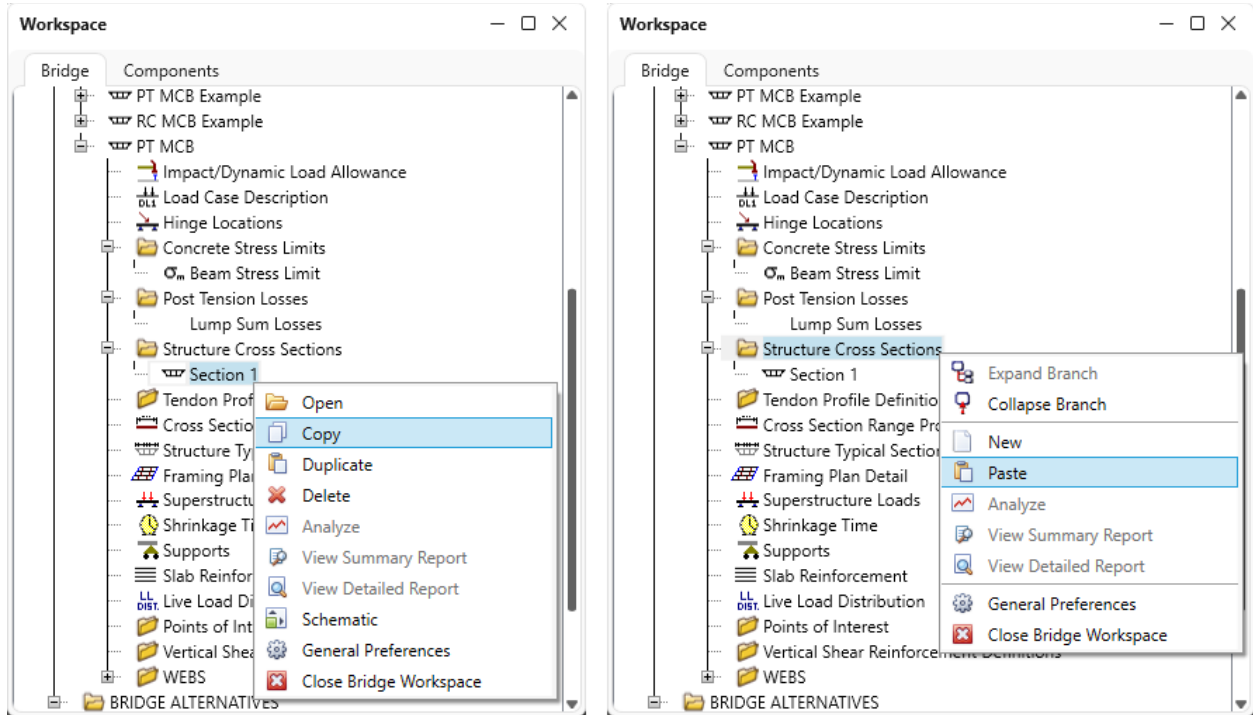
Area: 46.777778 ft²
 Ixx: 107.700434 ft⁴
 Iyy: 3275.222730 ft⁴
 J: 312.225668 ft⁴

OK Apply Cancel

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

MCB1 – Post-Tensioned Multi-Cell Box Example

Create another cross section by copying **Section 1** and making edits to it. To copy, select **Section 1**, right-click and select **Copy** (or click on the **Copy** button from the **Manage** group of the **WORKSPACE** ribbon). Now select **Structure Cross Sections** folder, right-click and select **Paste** (or click on the **Paste** button from the **Manage** group of the **WORKSPACE** ribbon).



MCB1 – Post-Tensioned Multi-Cell Box Example

Now double click on the copied cross section to open its window. Rename the new cross section to **Section 2**, revise the depth to 8' and click on the **Compute properties** button as shown below.

Structure Cross Sections

Name: **Section 2** Number of cells: 2

Input method: Simple Advanced Top slab concrete: PT Beam Concrete 4.5 ksi Other parts concrete: PT Beam Concrete 4.5 ksi

Entry method: Width Slope Top slab stress limit: Beam Stress Limit Other parts stress limit: Beam Stress Limit

30 ft

LT1, LT2, CJ, RT1, RT2, D, WT-T, LW1, WT-B, LV, RV, RW1, RW2, S1, S2, S3, W2

Overall (ft)	
> D	8
CJ	0.667
LW1	3
LW2	3
RW1	3
RW2	3
LV	1
RV	1

Cells (in)	
> LT1	8
LT2	12
RT1	8
RT2	12

W2: 24 ft

Properties

Compute properties

Area: 60.777778 ft²
 Ixx: 581.493973 ft⁴
 Iyy: 4493.319951 ft⁴
 J: 1383.35502 ft⁴

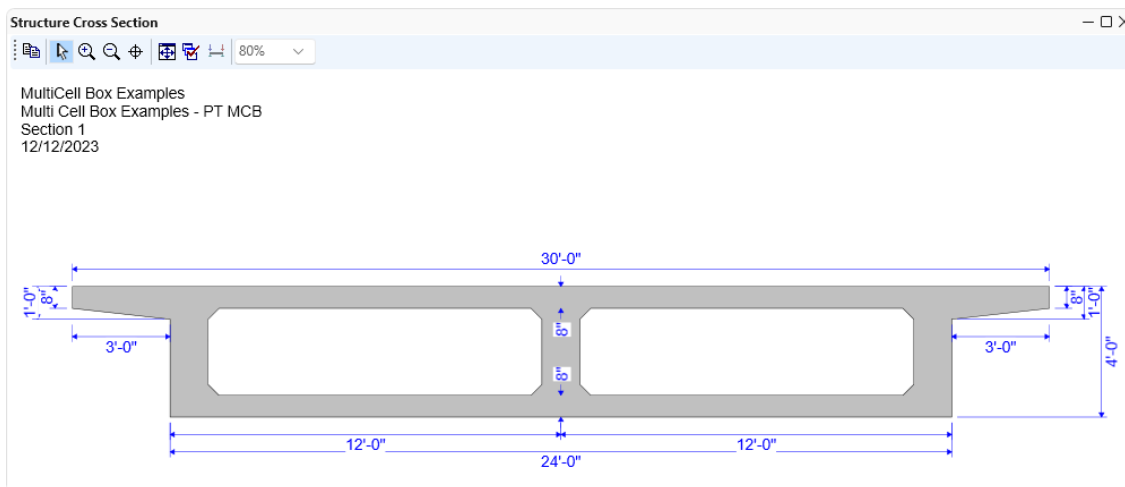
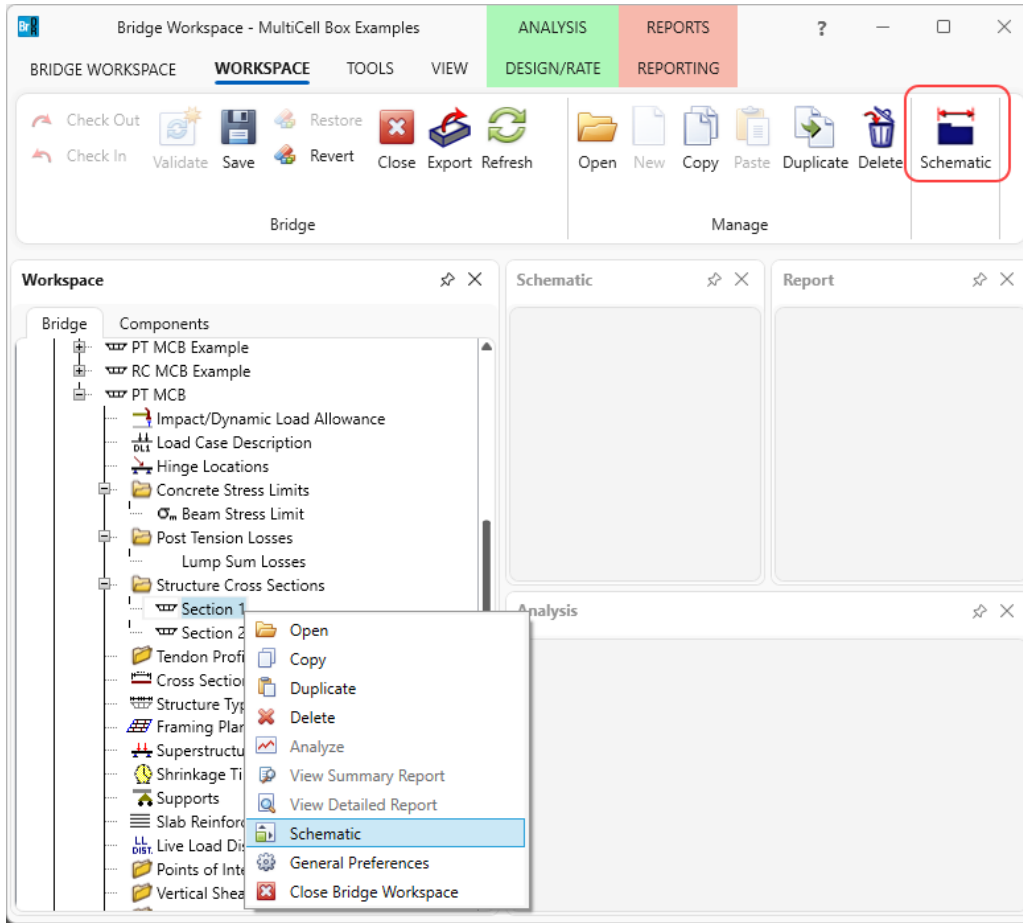
OK Apply Cancel

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

MCB1 – Post-Tensioned Multi-Cell Box Example

Schematic – Section 1

With **Section 1** selected in the **BWS** tree, click on the **Schematic** button from the **WORKSPACE** ribbon (or right click and select **Schematic**) to view the cross section as shown below.



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Tendon Profile Definition

Double click on the **Tendon Profile Definition** folder in the **BWS** tree and create the following tendon profile. Enter the data shown below for the 3 tabs.

Tendon Profile Definition
— □ ×

Profile name: Starting span: Ending span:

Start distance into start span: ft End distance from end span: ft

Profile Post tensioning Stress limits

Inflection point entry method: Percentage Distance Assigned to:

Span	Profile type	Inflection points			Vertical offset					
		Left (%)	Low (%)	Right (%)	Left end (in)	Measured from	Low (in)	Measured from	Right end (in)	Measured from
1	Type 3		40	15	28	Top	48	Bottom	10	Top
> 2	Type 4	15	60		10	Top	48	Bottom	28	Top

MCB1 – Post-Tensioned Multi-Cell Box Example

Tendon Profile Definition

Profile name: Tendon Starting span: 1 Ending span: 2 Start distance into start span: 0 End distance from end span: 0

Profile Post tensioning Stress limits

Prestress material: 1/2" (7W-270) LR Duct grouting: Grouted

Jacking end: Left End Duct diameter: 2 in

Post tensioning

Input method
 Jacking force Strands Jacking stress ratio: 0.75

Total jacking force: 9758.5 kip Number of ducts per web: 0

Distribute equally

Web	Percentage (%)	Duct	Strands per duct
WEB1	33.333333		
WEB2	33.333333		
WEB3	33.333333		

OK Apply Cancel

Tendon Profile Definition

Profile name: Tendon Starting span: 1 Ending span: 2 Start distance into start span: 0 End distance from end span: 0

Profile Post tensioning Stress limits

	LRFD	ksi	LFD	ksi
Prior to seating:	218.7	ksi	218.7	ksi
At anchorages and couplers immediately after anchor set:	189	ksi	189	ksi
Elsewhere along length of member immediately after anchor set:	199.8	ksi	201.69	ksi
At service limit state after losses:	194.4	ksi	194.4	ksi

Compute Values

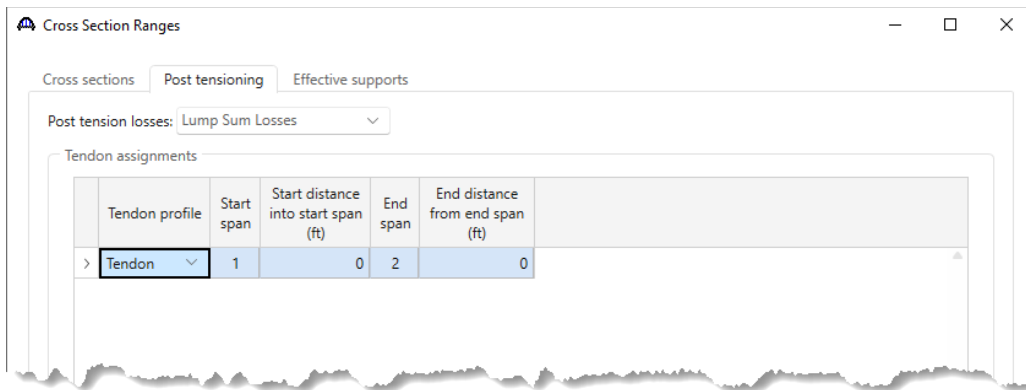
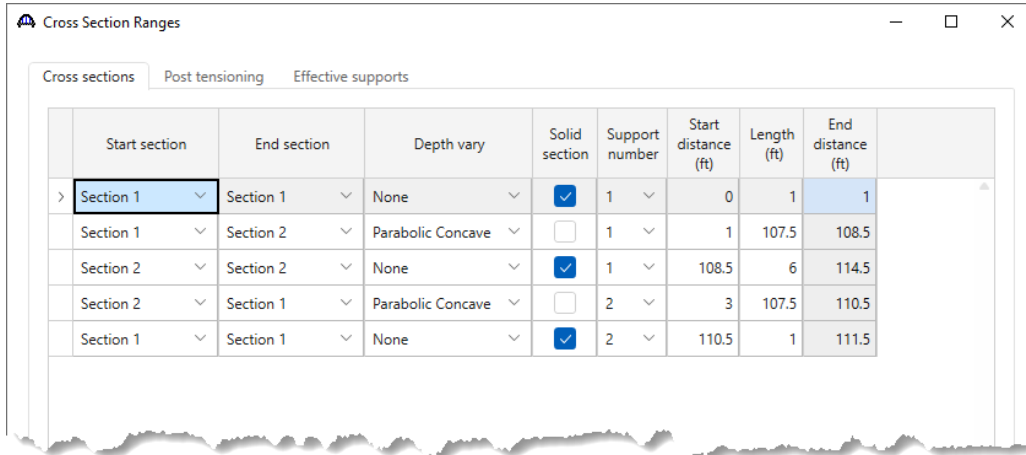
OK Apply Cancel

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

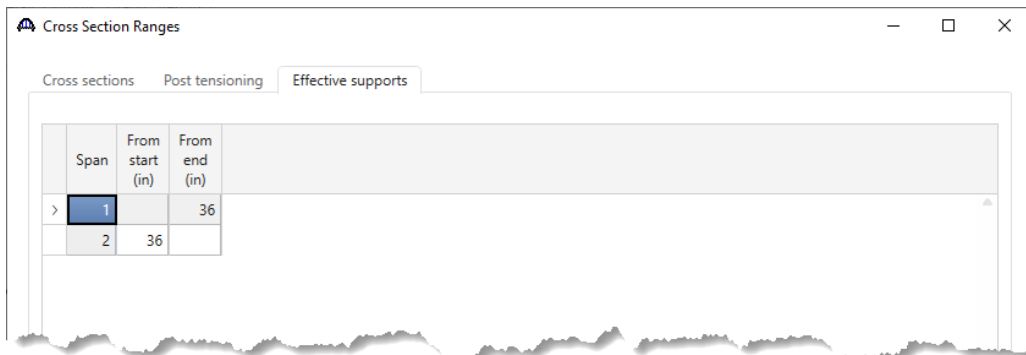
MCB1 – Post-Tensioned Multi-Cell Box Example

Cross Section Ranges

Double click on the **Cross Section Range Properties** node in the **BWS** tree and assign the cross sections as follows visiting both the **Cross sections** and **Post tensioning** tabs.



The **Effective supports** tab allows to shift the specification check point at the centerline of the support to the location entered below. Shear will be checked at a distance d_v from the location entered below.

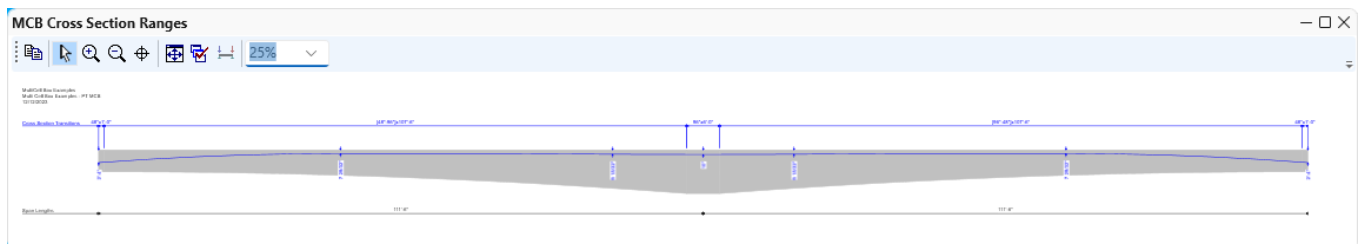
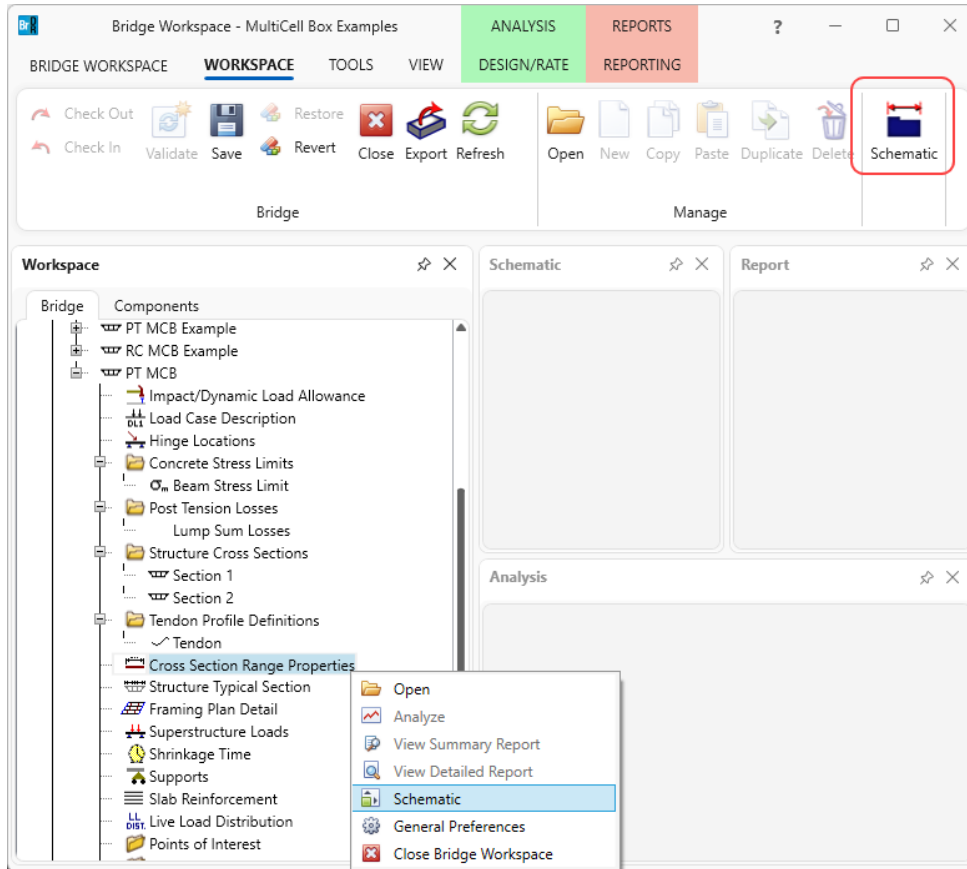


Click **OK** to apply the data and close the window.

MCB1 – Post-Tensioned Multi-Cell Box Example

Schematic – Cross Section Range Properties

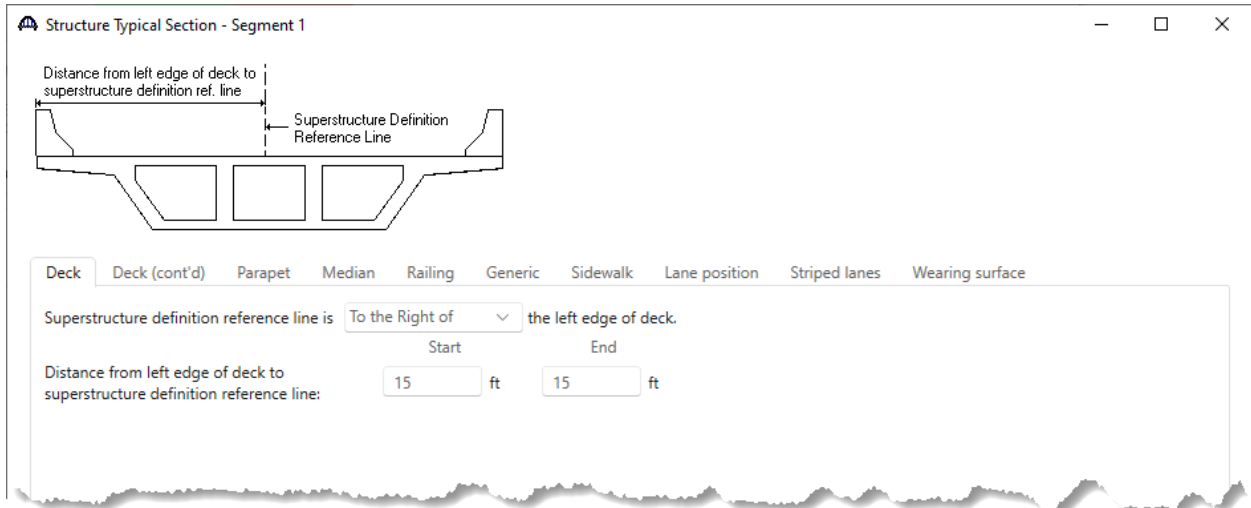
Select the **Cross Section Range Properties** node in the **BWS** tree and click the **Schematic** button from the **WORKSPACE** ribbon (or right click and select **Schematic**) as shown below.



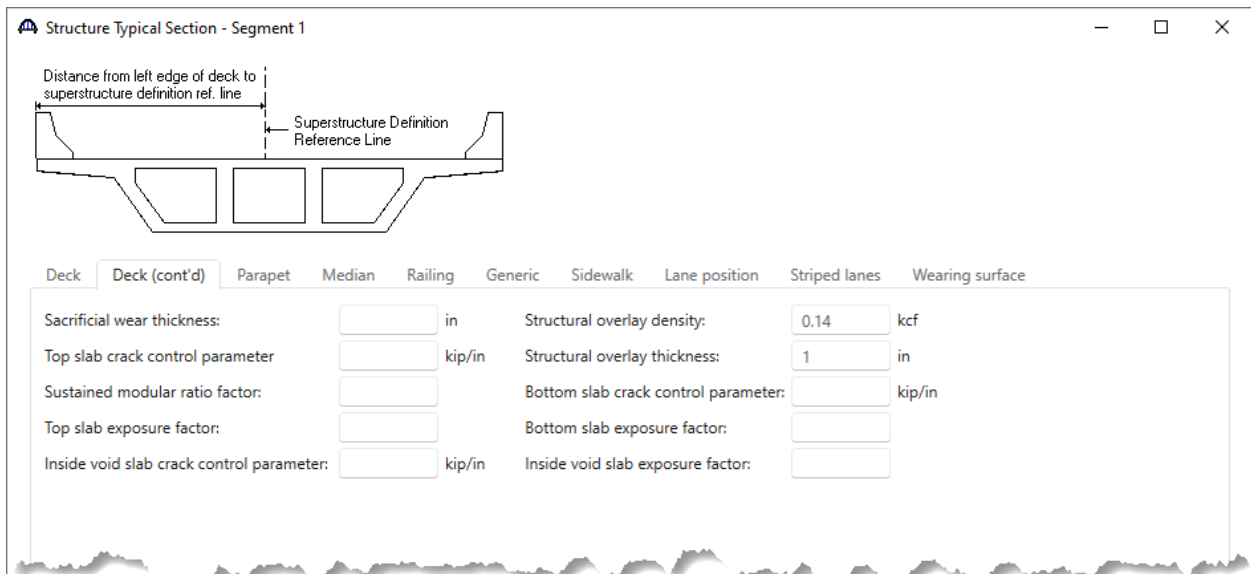
MCB1 – Post-Tensioned Multi-Cell Box Example

Structure Typical Section

Double click on the **Structure Typical Section** node in the **BWS** tree and locate the superstructure definition reference line as follows.

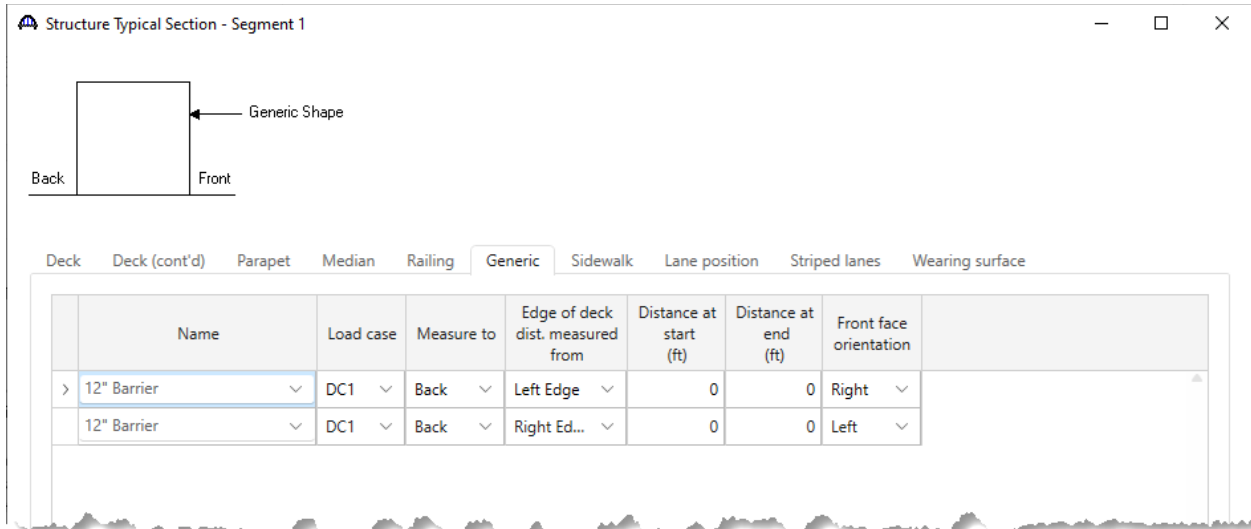


Navigate to the **Deck (cont'd)** tab and enter the following data for the structural overlay. The overlay is applied in the self load DC load case.

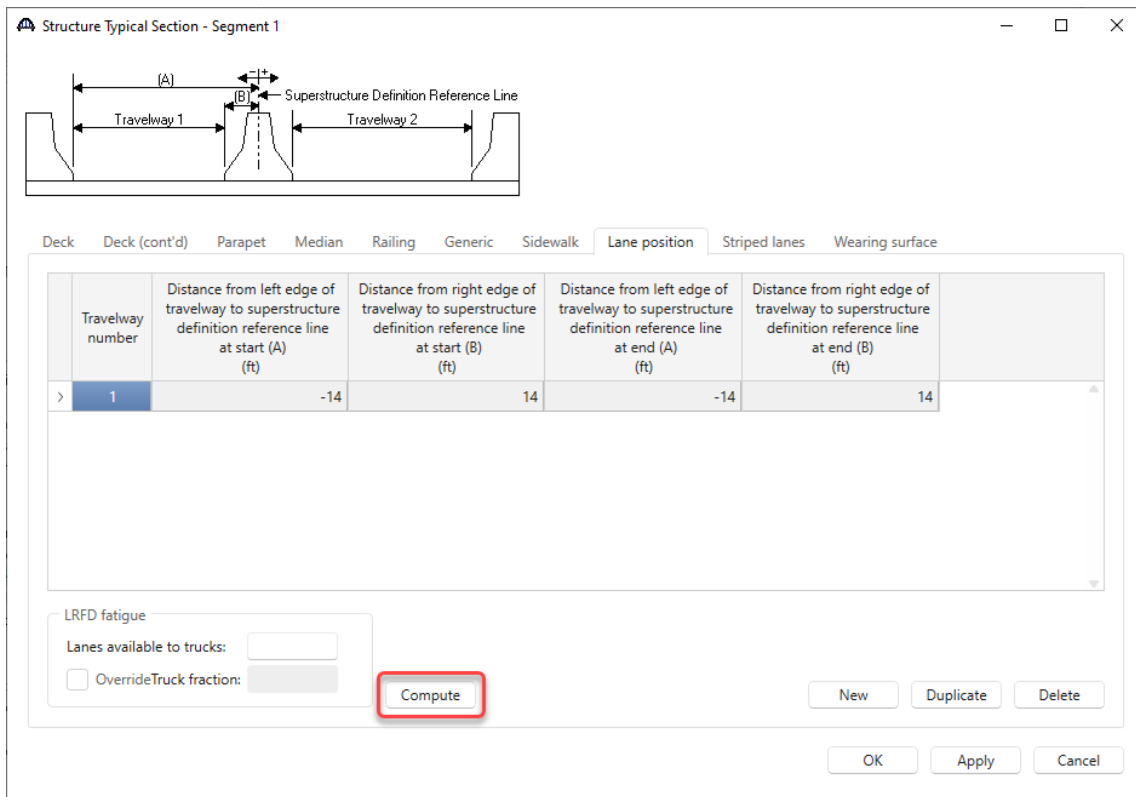


MCB1 – Post-Tensioned Multi-Cell Box Example

Navigate to the **Generic** tab and enter the barriers.



In the **Lane position** tab, use the **Compute** button to enter the lane positions.

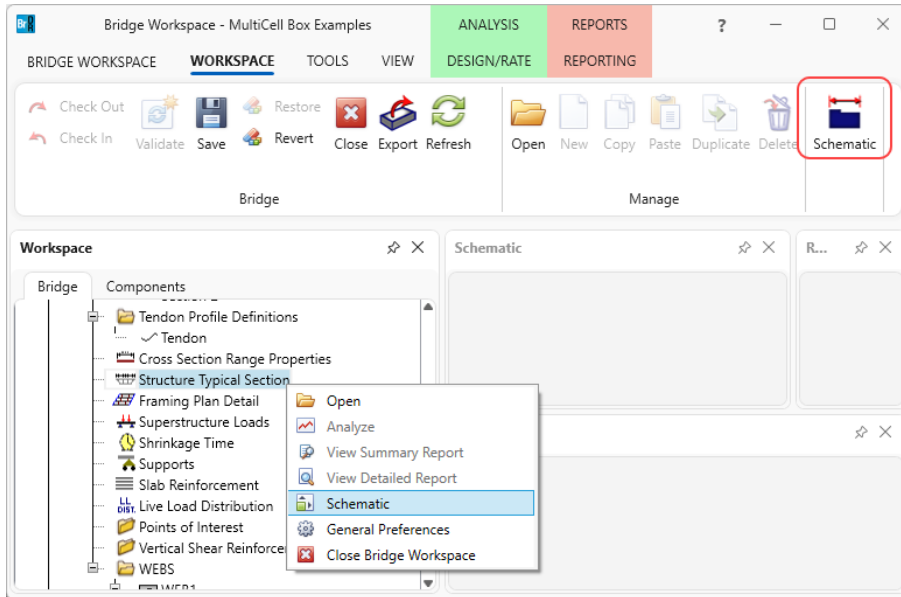


Click **OK** to apply the data and close the window.

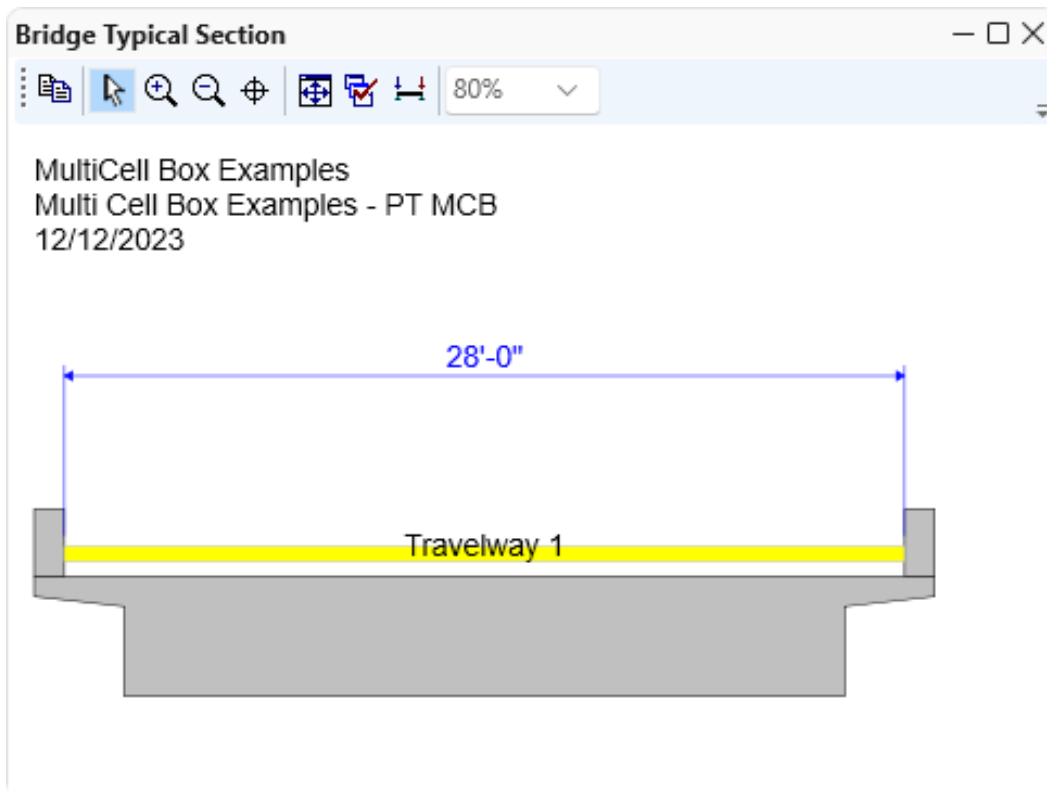
MCB1 – Post-Tensioned Multi-Cell Box Example

Schematic – Structure Typical Section

With the **Structure Typical Section** node selected in the **BWS** tree, click on the **Schematic** button from the **WORKSPACE** ribbon (or right click and select **Schematic**) to view the structure typical section.



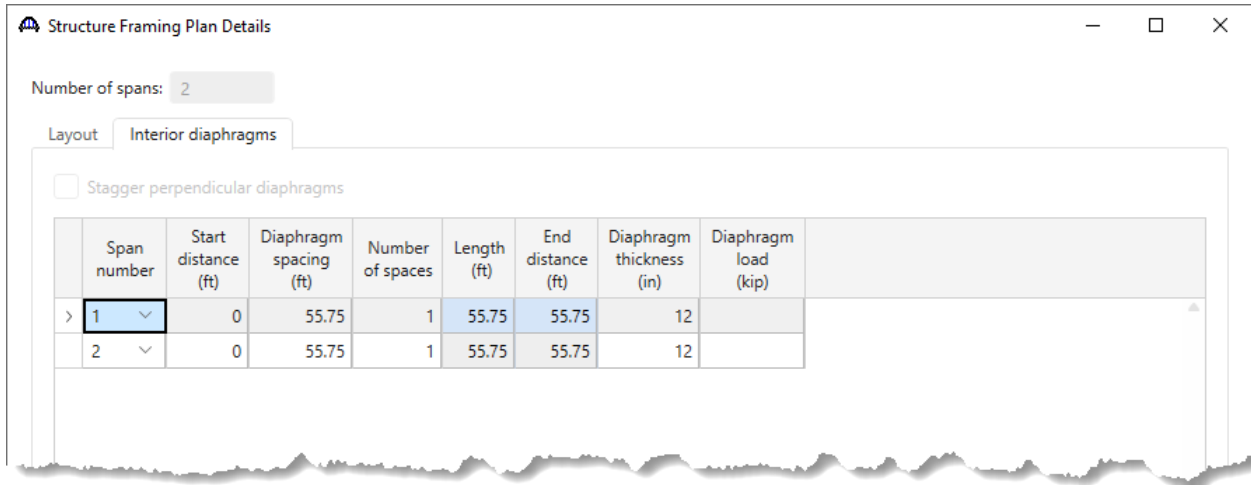
The webs are not visible in the schematic because the cross section at the start of the structure was marked as solid.



MCB1 – Post-Tensioned Multi-Cell Box Example

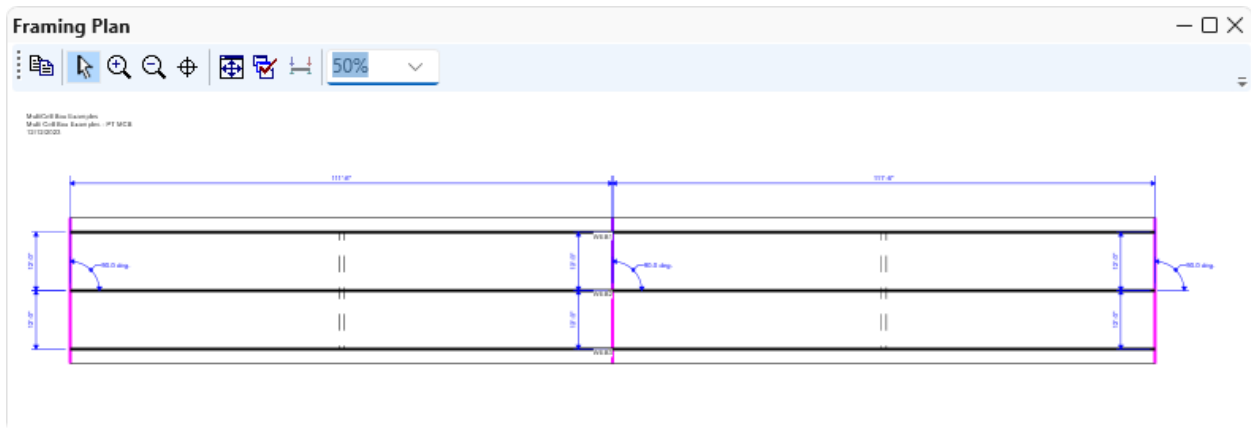
Framing Plan Detail

Double click on the **Framing Plan Detail** node in the **BWS** tree and enter the following diaphragm locations on the **Interior diaphragms** tab. The diaphragms only contribute to the dead load on the structure. They do not provide a structural role in the box analysis. Enter the diaphragm thickness and the AASHTO engine will compute the diaphragm load based on the box cross section properties and diaphragm thickness.



Schematic – Framing Plan Details

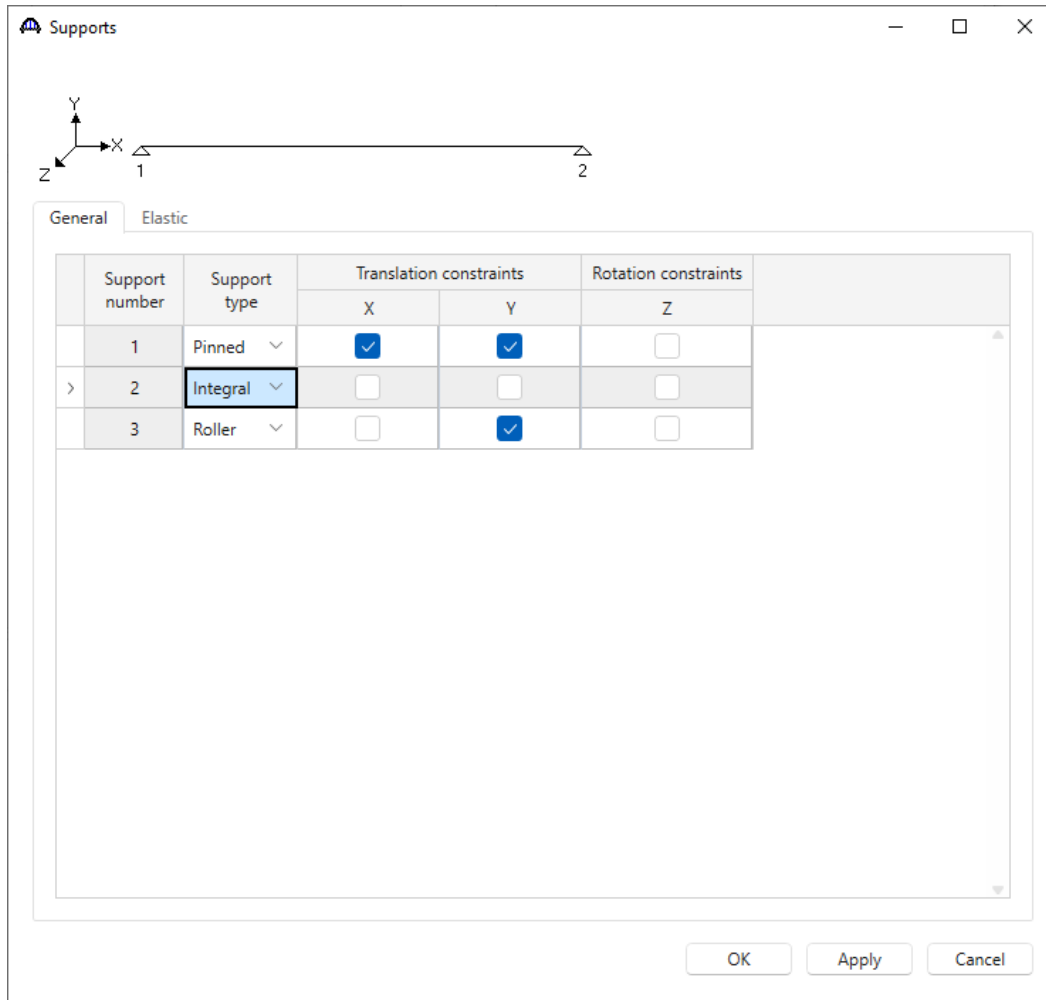
With **Framing Plan Details** node selected in the **BWS** tree, click on the **Schematic** button from the **WORKSPACE** ribbon (or right click and select **Schematic**) to view the framing plan.



MCB1 – Post-Tensioned Multi-Cell Box Example

Supports

Open the **Supports** window to view the following. **Support 2** is marked as **Integral** since this was specified on the **Superstructure Definition** window. There is no data to change here.

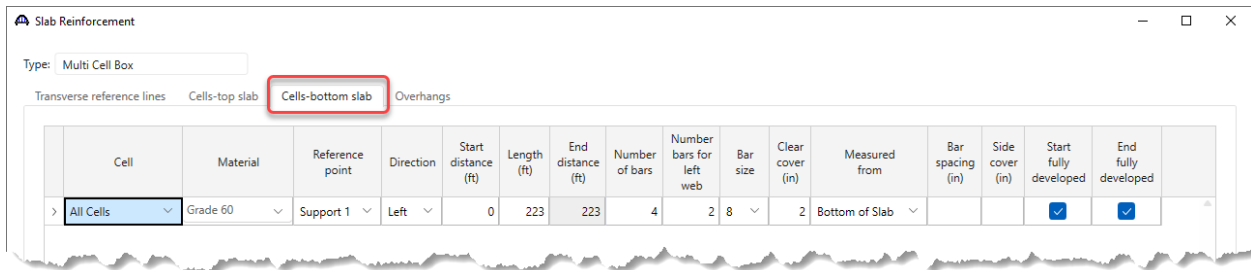
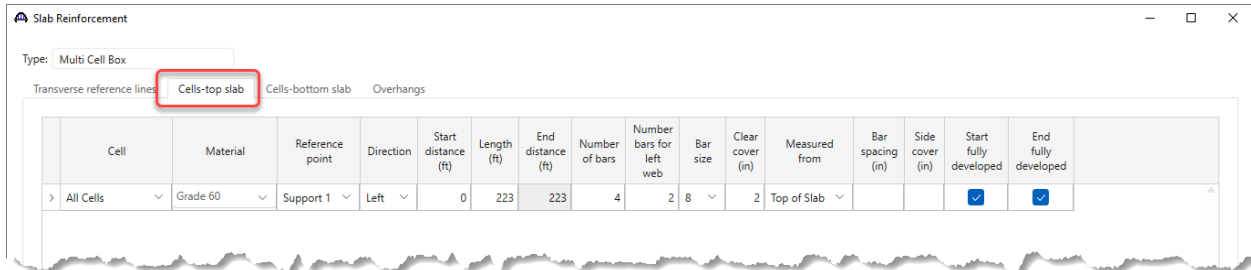


Click **Cancel** to close the window.

MCB1 – Post-Tensioned Multi-Cell Box Example

Slab Reinforcement

Open the **Slab Reinforcement** window and enter the following reinforcement in the **Cells-top slab** and **Cells-bottom slab** of the box.

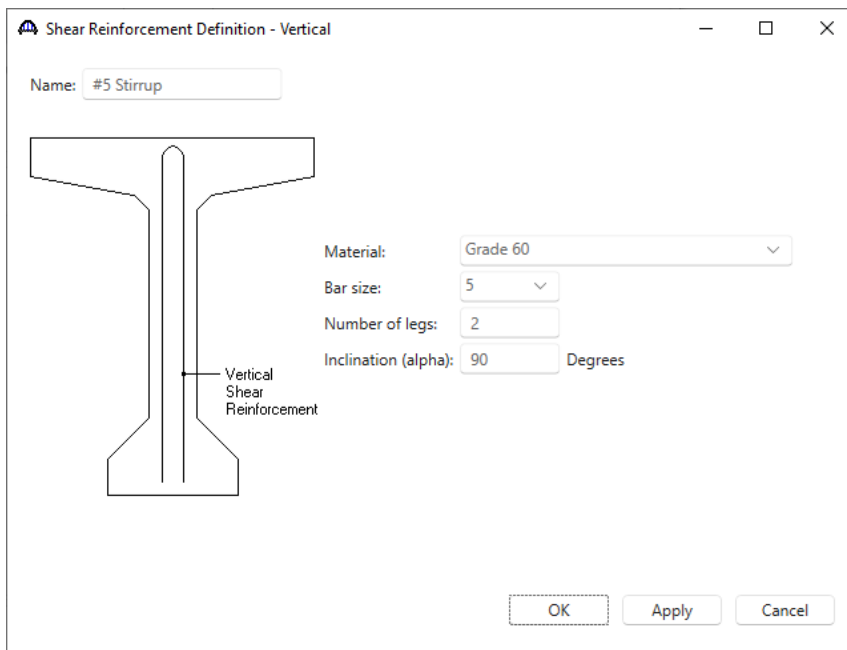


Click **OK** to apply the data and close the window.

Leave the **Live Load Distribution** factors blank so they will be computed by the AASHTO engine at runtime.

Vertical Shear Reinforcement Definitions

Open the **Vertical Shear Reinforcement Definitions** window and create the following stirrup definition.



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

MCB1 – Post-Tensioned Multi-Cell Box Example

WEB1 - Shear Reinforcement Ranges

Expand the **WEBS** folder -> **WEB1** and double click on the **Shear Reinforcement Ranges** node. Select the input reference type as **Centerline bearings**. Click the **Stirrup wizard** button and enter the following data.

Stirrup Wizard

Input reference type
 Voids Centerline bearings

Span: 1 Maximum interior spacing: 18 in

Measured from left end of span
Start distance: 15 in

Name	Number of spaces	Spacing (in)
> #5 Stirrup	12	6
#5 Stirrup	12	9
#5 Stirrup	12	14

Measured from right end of span
Start distance: 39 in

Name	Number of spaces	Spacing (in)
> #5 Stirrup	18	5
#5 Stirrup	18	7
#5 Stirrup	24	9

Buttons: New Duplicate Delete Apply all Apply span Cancel Help

Select **Span 2** in the Wizard and enter similar data for Span 2.

Stirrup Wizard

Input reference type
 Voids Centerline bearings

Span: 2 Maximum interior spacing: 18 in

Measured from left end of span
Start distance: 39 in

Name	Number of spaces	Spacing (in)
#5 Stirrup	18	5
#5 Stirrup	18	7
#5 Stirrup	24	9

Measured from right end of span
Start distance: in

Name	Number of spaces	Spacing (in)
#5 Stirrup	12	6
#5 Stirrup	12	9
#5 Stirrup	12	14

Buttons: New Duplicate Delete Apply all Apply span Cancel Help

MCB1 – Post-Tensioned Multi-Cell Box Example

Click the **Apply all** button to create the stirrup ranges for each span.

Span 1 will show the following data.

Web Shear Reinforcement Ranges - WEB1

Input reference type: Voids Centerline bearings

Linked with: None

Span ranges

Span: 1

Name	Start distance (ft)	Number of spaces	Spacing (in)	Length (ft)	End distance (ft)
#5 Stirrup	1.25	1	0	0	1.25
#5 Stirrup	1.25	12	6	6	7.25
#5 Stirrup	7.25	12	9	9	16.25
#5 Stirrup	16.25	12	14	14	30.25
#5 Stirrup	30.25	13	18	19.5	49.75
#5 Stirrup	49.75	1	18	1.5	51.25
#5 Stirrup	51.25	14	18	21	72.25
#5 Stirrup	72.25	24	9	18	90.25
#5 Stirrup	90.25	18	7	10.5	100.75
#5 Stirrup	100.75	18	5	7.5	108.25

Buttons: Copy... Stirrup wizard... New Duplicate Delete OK Apply Cancel

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

MCB1 – Post-Tensioned Multi-Cell Box Example

WEB2 - Shear Reinforcement Ranges

Expand the **WEB2** folder and double click on the **Shear Reinforcement Ranges** node. Select **WEB1** in the **Linked with** field. The data from **WEB1** will appear in this window as read only. If data is changed in the **WEB1 Shear Reinforcement Ranges** window in the future, those changes will be reflected in this window. Do the same for **WEB3**, linking it to **WEB1**.

Web Shear Reinforcement Ranges - WEB2

Input reference type

Voids Centerline bearings

Linked with: WEB1

Span ranges

Span: 1

	Name	Start distance (ft)	Number of spaces	Spacing (in)	Length (ft)	End distance (ft)
>	#5 Stirrup	0.25	1	0	0	0.25
	#5 Stirrup	0.25	12	6	6	6.25
	#5 Stirrup	6.25	12	9	9	15.25
	#5 Stirrup	15.25	12	14	14	29.25
	#5 Stirrup	29.25	13	18	19.5	48.75
	#5 Stirrup	48.75	1	18	1.5	50.25
	#5 Stirrup	50.25	14	18	21	71.25
	#5 Stirrup	71.25	24	9	18	89.25
	#5 Stirrup	89.25	18	7	10.5	99.75
	#5 Stirrup	99.75	18	5	7.5	107.25

Copy... Stirrup wizard... New Duplicate Delete

OK Apply Cancel

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

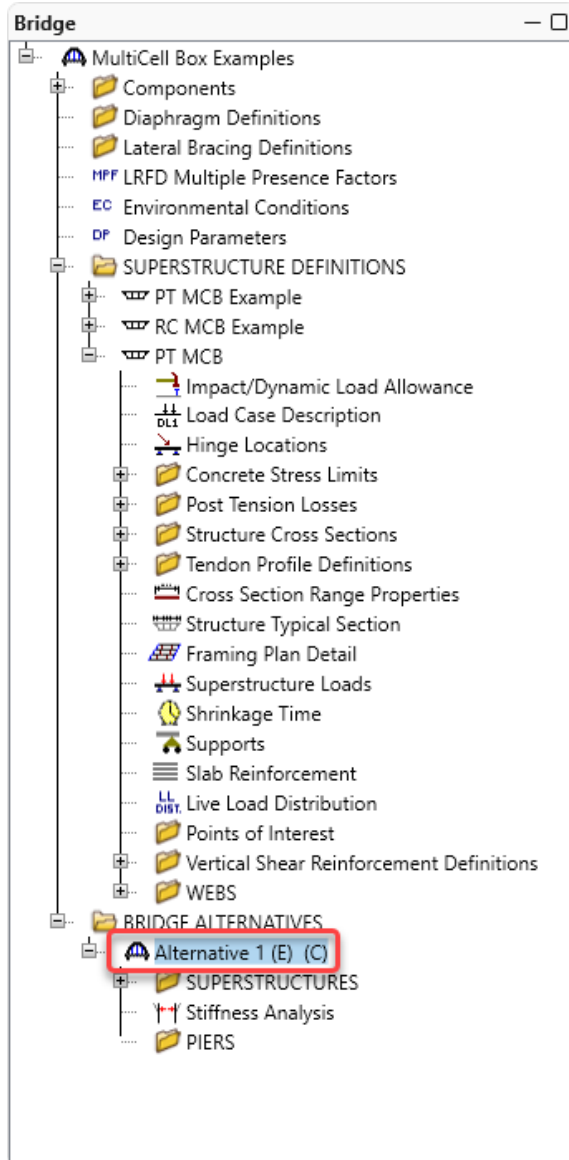
MCB1 – Post-Tensioned Multi-Cell Box Example

Integral with substructure

Now that the **Superstructure Definition** has been defined, a pier that is integral with the superstructure will be created.

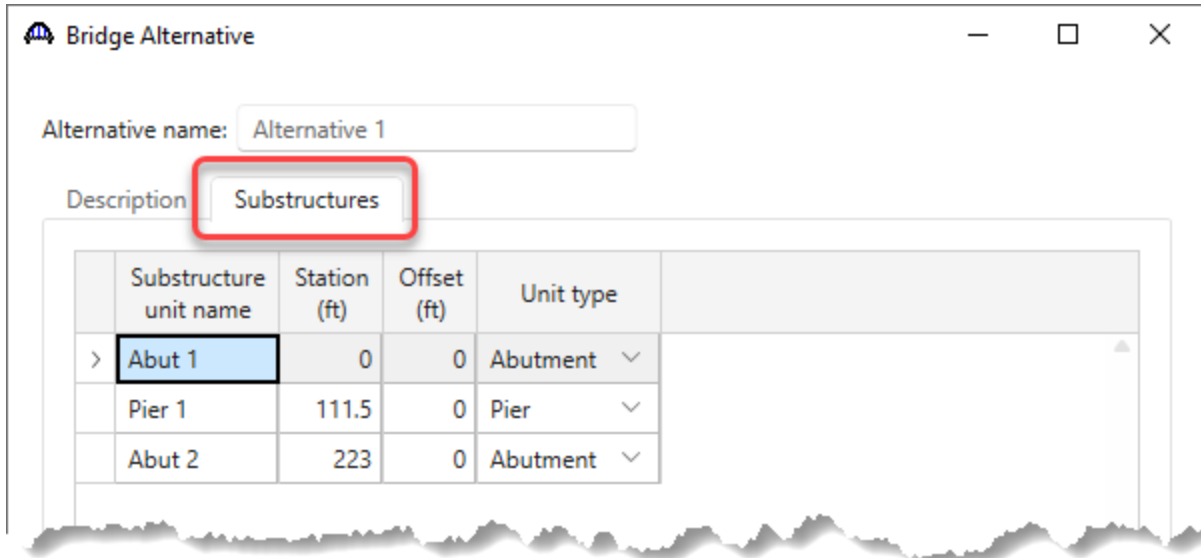
Bridge Alternative

Double click on the **Alternative 1** bridge alternative in the **BWS** tree and navigate to the **Substructures** tab of this window.



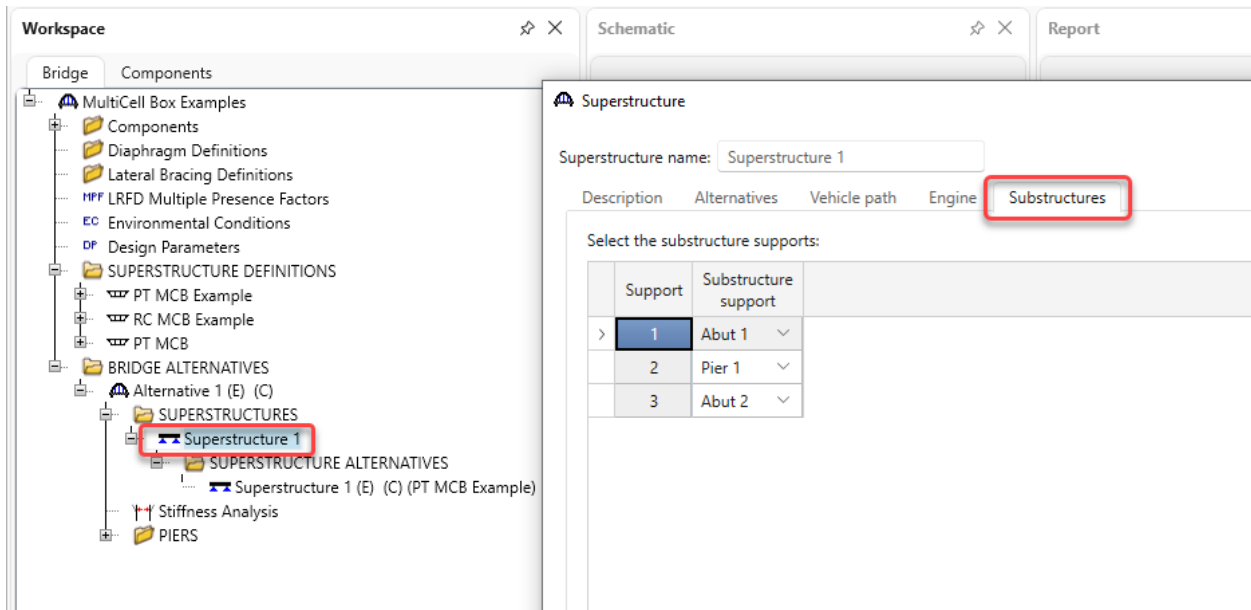
MCB1 – Post-Tensioned Multi-Cell Box Example

Enter the following substructure locations and click **OK**.



Superstructure

Expand the **SUPERSTRUCTURE** folder and double click on the **Superstructure 1** node to open the **Superstructure** window. Navigate to the **Substructures** tab on this window and select the following supports. This is necessary because a Bridge can contain multiple Superstructures and Substructures. This tab identifies which substructure units support which superstructures.



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

MCB1 – Post-Tensioned Multi-Cell Box Example

Superstructure Alternative

Double click on the **Superstructure 1** superstructure alternative node in the **BWS** tree and select the **Superstructure definition** that was just created and click **OK**.

Superstructure Alternative

Alternative name: Superstructure 1

Description:

Superstructure definition: PT MCB

Superstructure type: Multi Cell Box

Number of cells: 2

	Span	Length (ft)	
	1	111.5	▲
	2	111.5	

OK Apply Cancel

MCB1 – Post-Tensioned Multi-Cell Box Example

Pier

Double click on the **Pier 1** window and review the data. No changes are required in this window.

The screenshot shows a software window titled "Pier" with a close button (X) in the top right corner. The window contains the following elements:

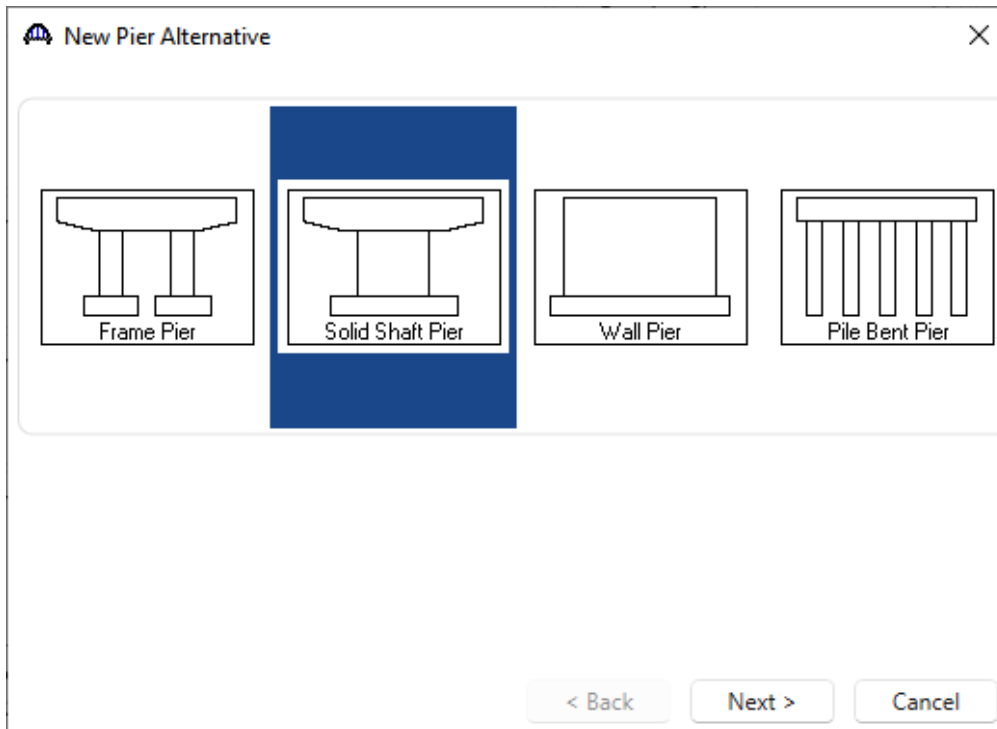
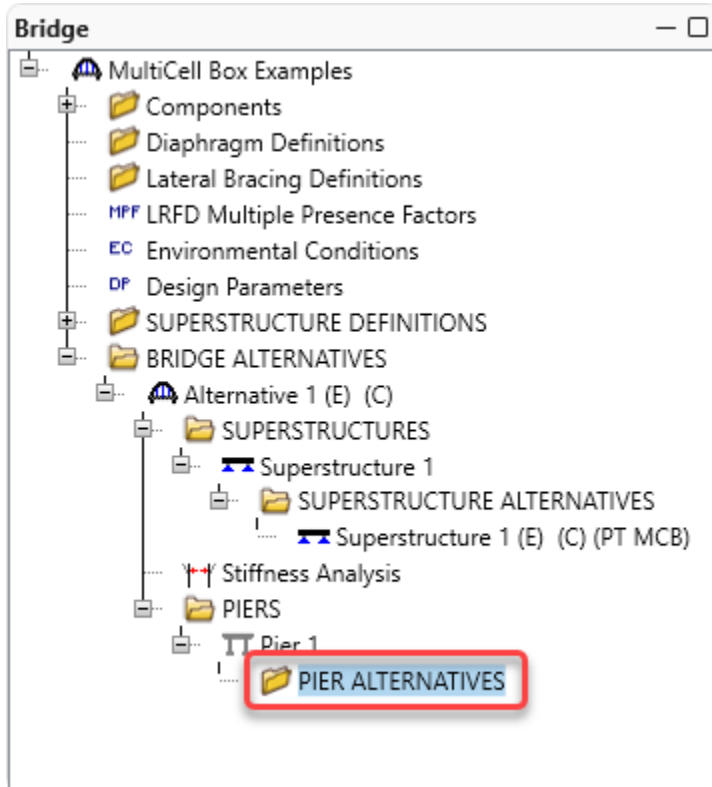
- Pier name:** A text field containing "Pier 1".
- Description:** A tabbed interface with "Stream flow" selected. It includes a "Description:" text area.
- Pier skew angle:** A group box containing two radio buttons: "Input skew angle" (selected) and "Input bearing angle". The "Skew angle:" field is set to "0" Degrees.
- Finished groundline elevation:** A text field with "ft" units. A checked checkbox "Superstructure defined in BrDR" is to its right.
- Soil density:** A text field with "kcf" units.
- Superstructure longitudinal direction:** A group box with two radio buttons: "Consider as fixed" and "Consider as expansion" (selected).
- Pier location relative to bridge alternative:** A group box with "Station:" set to "111.5" ft and "Offset:" set to "0" ft.
- Computed pier location relative to structure:** A group box with "Station:" set to "111.5" ft and "Offset:" set to "0" ft.
- Computed pier coordinates:** A group box with "X:" set to "111.5" ft and "Y:" set to "0" ft.
- Table:** A table with columns: Existing, Current, Pier alternative name, and Description. The table is currently empty.
- Buttons:** "OK", "Apply", and "Cancel" buttons at the bottom right.

Click **Cancel** to close the window.

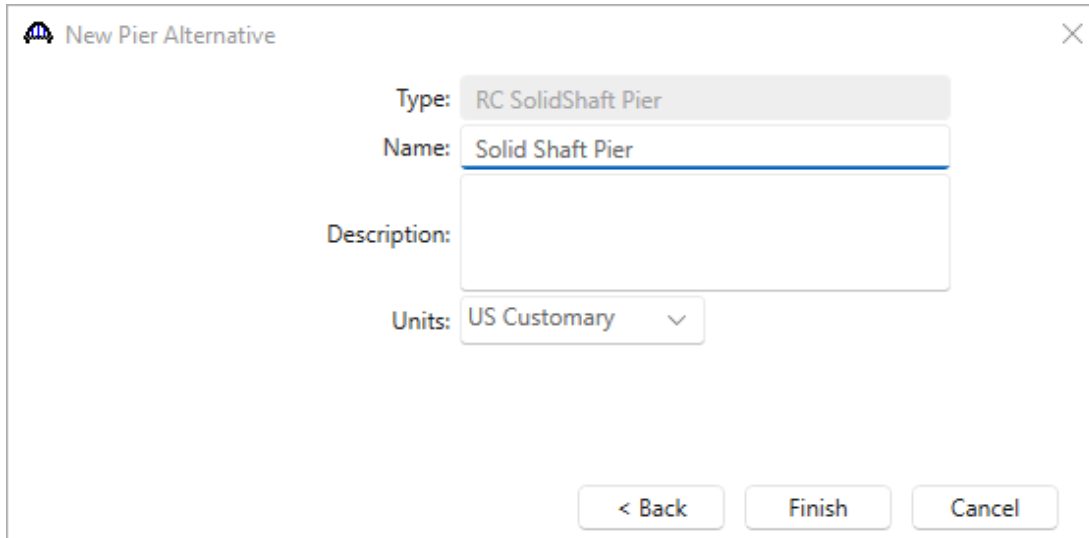
MCB1 – Post-Tensioned Multi-Cell Box Example

Pier Alternatives

Open the **Pier Alternatives** window and select the **Solid Shaft Pier** then click **Next**.



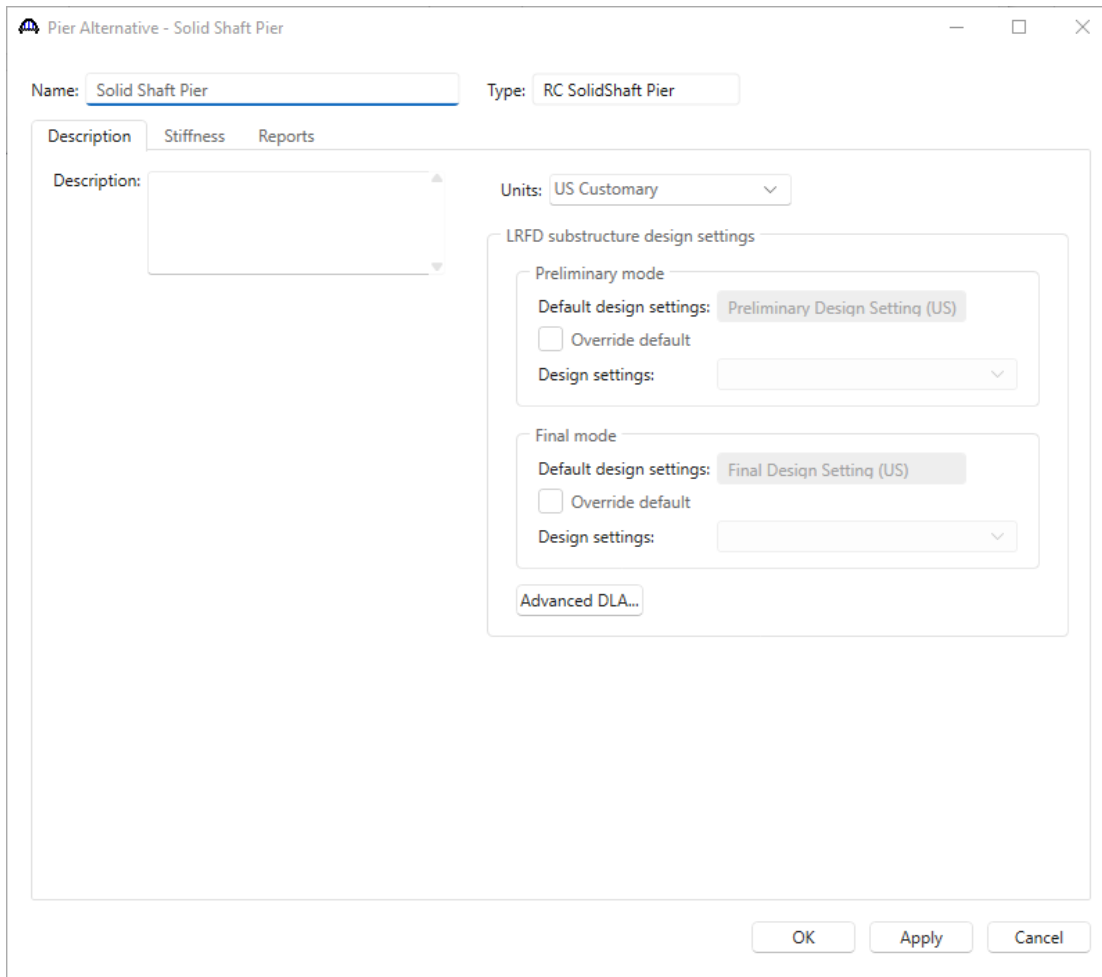
MCB1 – Post-Tensioned Multi-Cell Box Example



The screenshot shows a dialog box titled "New Pier Alternative" with a close button (X) in the top right corner. The dialog contains the following fields and controls:

- Type:** A dropdown menu with "RC SolidShaft Pier" selected.
- Name:** A text input field containing "Solid Shaft Pier".
- Description:** An empty text area.
- Units:** A dropdown menu with "US Customary" selected.
- At the bottom, there are three buttons: "< Back", "Finish", and "Cancel".

Enter the **Name** as shown above, no data needs to be changed on the **New Pier Alternative** window so click **Finish** to close it. The window shown below will appear.



The screenshot shows a dialog box titled "Pier Alternative - Solid Shaft Pier" with standard window controls (minimize, maximize, close) in the top right corner. The dialog contains the following fields and controls:

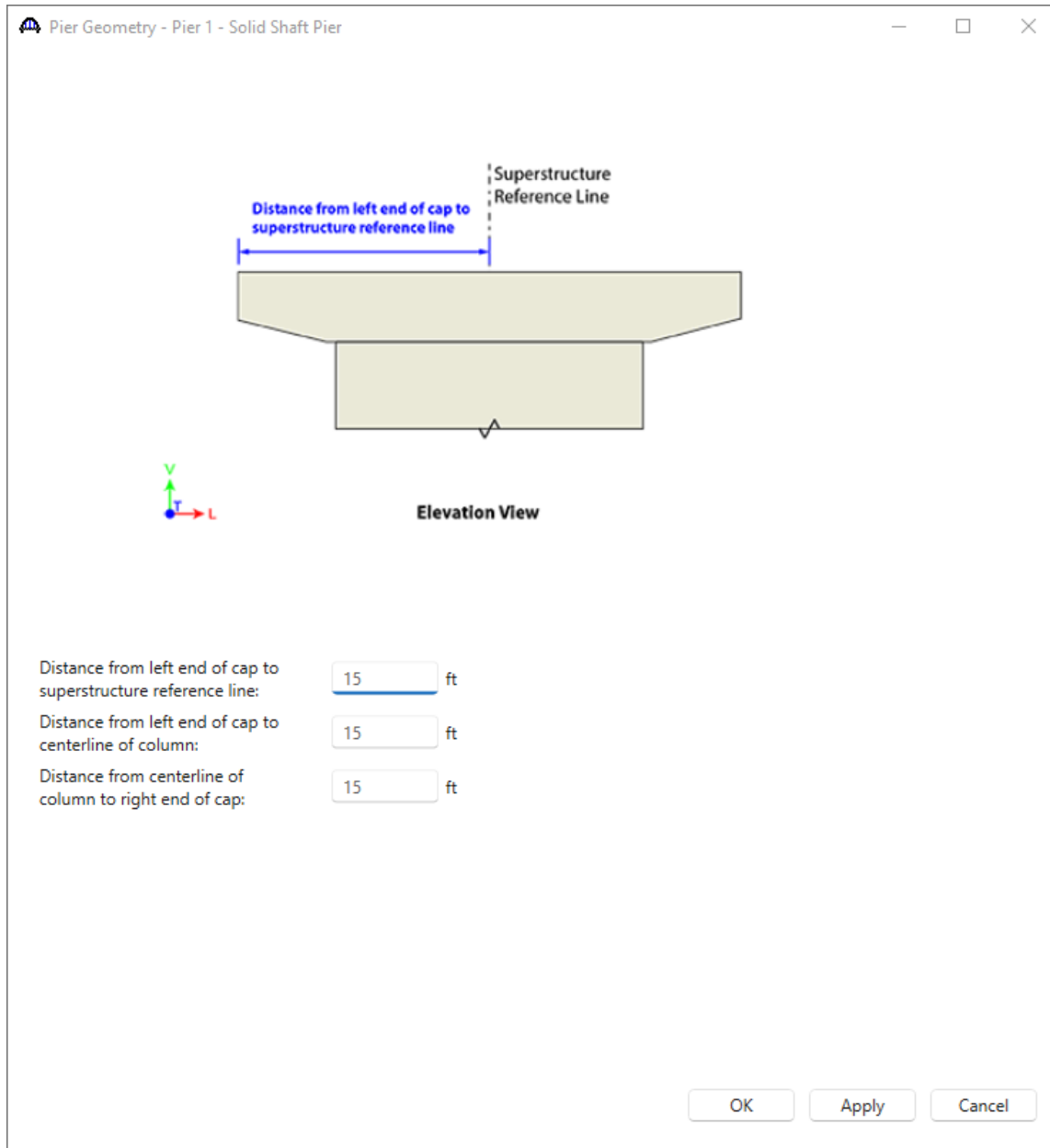
- Name:** A text input field containing "Solid Shaft Pier".
- Type:** A dropdown menu with "RC SolidShaft Pier" selected.
- Description:** A tabbed interface with "Description" selected, showing an empty text area.
- Units:** A dropdown menu with "US Customary" selected.
- LRFD substructure design settings:** A section containing:
 - Preliminary mode:** "Default design settings:" with "Preliminary Design Setting (US)" selected, an "Override default" checkbox, and a "Design settings:" dropdown.
 - Final mode:** "Default design settings:" with "Final Design Setting (US)" selected, an "Override default" checkbox, and a "Design settings:" dropdown.
 - An "Advanced DLA..." button.
- At the bottom, there are three buttons: "OK", "Apply", and "Cancel".

No data needs to be changed so click **OK** on the above window to continue.

MCB1 – Post-Tensioned Multi-Cell Box Example

Pier Geometry

This training focuses on modeling the pier geometry so its stiffness can be included in the superstructure analysis. Therefore, no reinforcement details will be entered for the pier. Expand the **Solid Shaft Pier** folder, double click on the **Geometry** node and enter the geometry for the pier as shown below.



Pier Geometry - Pier 1 - Solid Shaft Pier

Distance from left end of cap to superstructure reference line

Superstructure Reference Line

Elevation View

Distance from left end of cap to superstructure reference line: ft

Distance from left end of cap to centerline of column: ft

Distance from centerline of column to right end of cap: ft

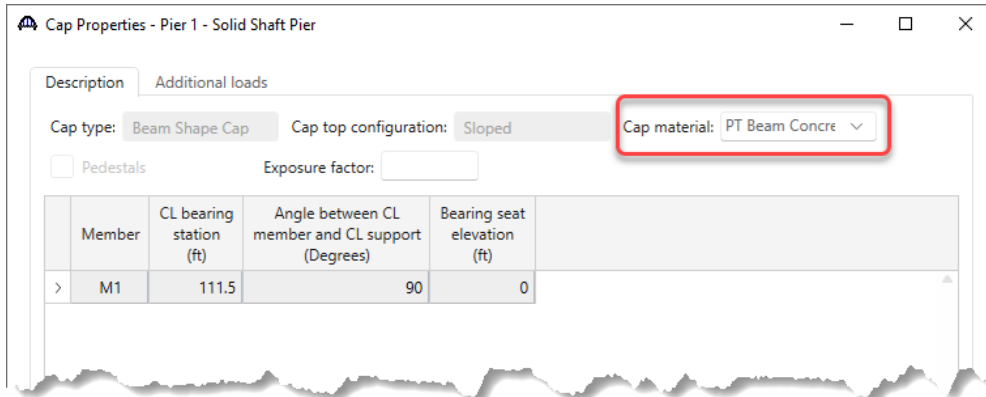
OK Apply Cancel

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

MCB1 – Post-Tensioned Multi-Cell Box Example

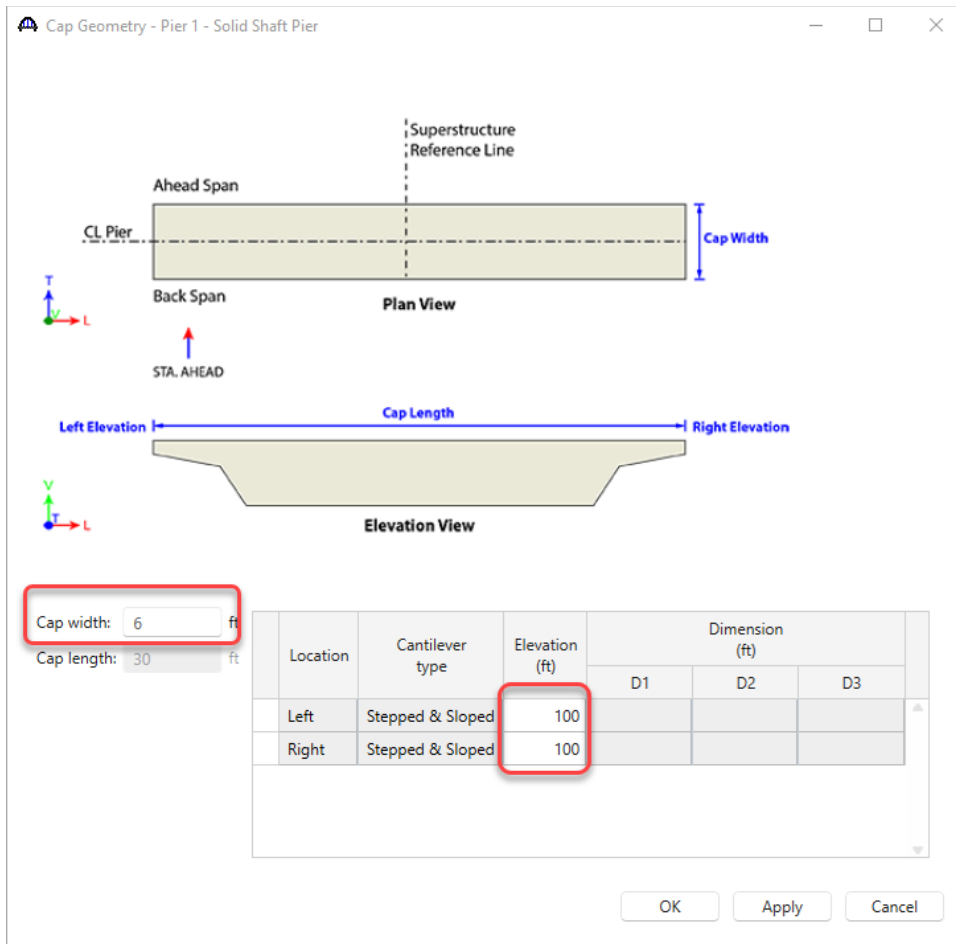
Cap Properties

Double click on **Cap** node in the **BWS** tree to open the **Cap Properties** window. Verify that the following cap concrete material is selected.



Cap Geometry

Expand the **Cap** node and double click on **Geometry**. Enter the following for the pier cap **Geometry**.

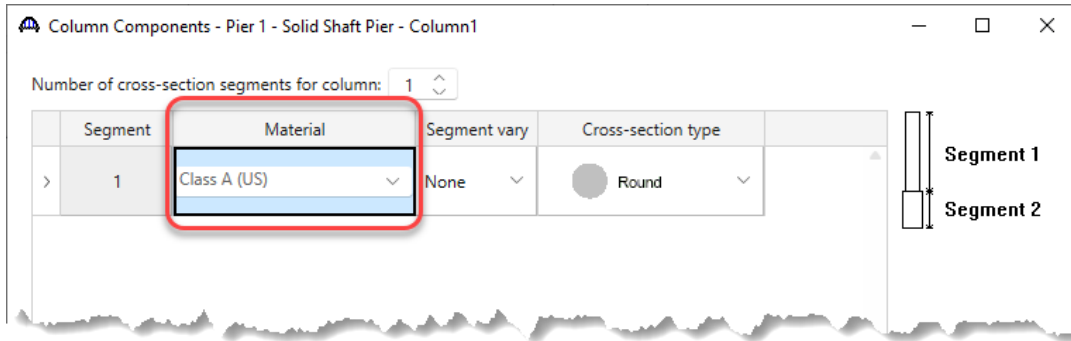


Click **OK** to apply the data and close the window.

MCB1 – Post-Tensioned Multi-Cell Box Example

Column Components

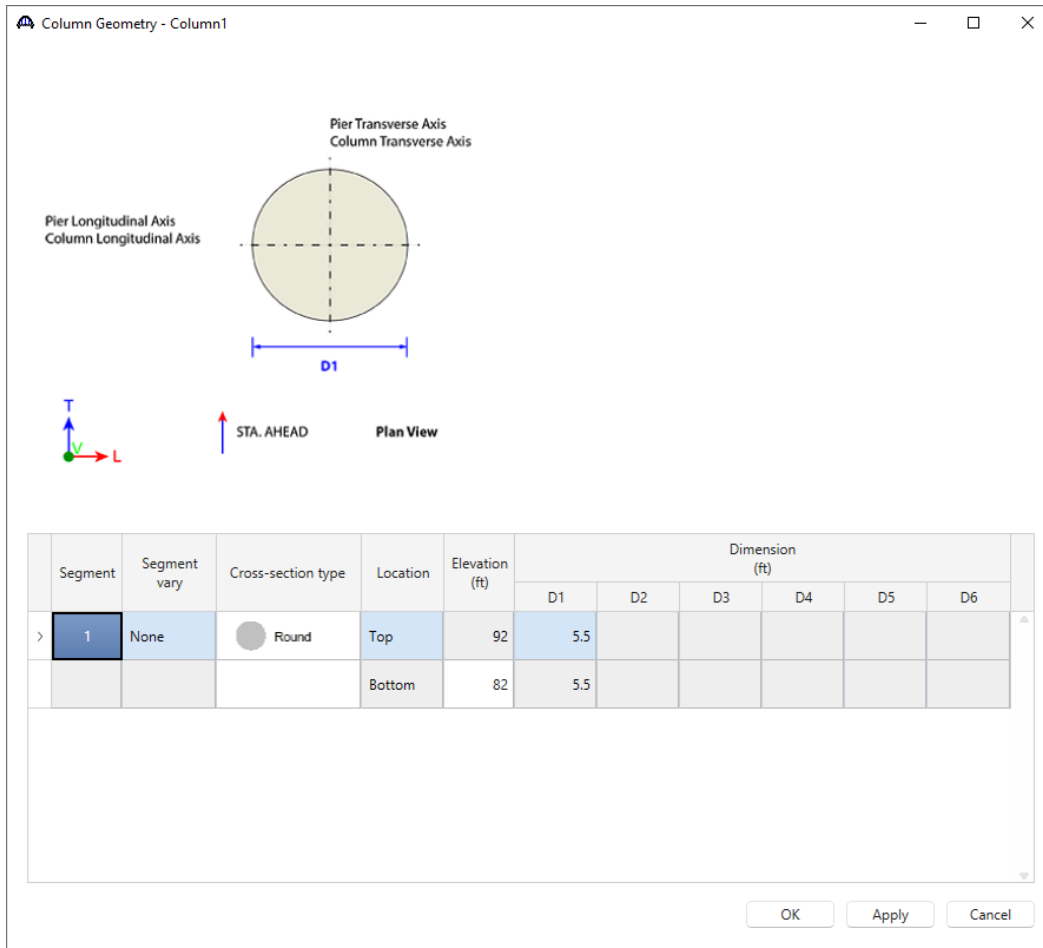
Expand the **Column1** node and double click on **Components**. Select the following concrete material.



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

Column Geometry

Double click on the **Geometry** node and enter the following data.



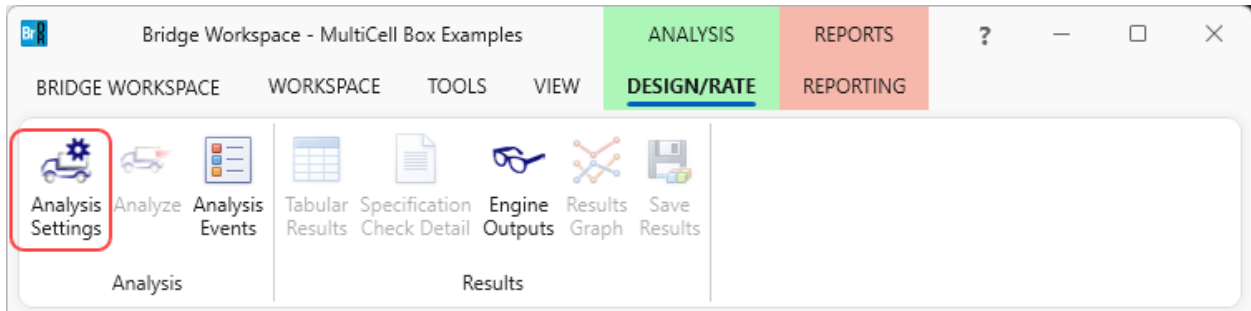
Click **OK** to apply the data and close the window.

MCB1 – Post-Tensioned Multi-Cell Box Example

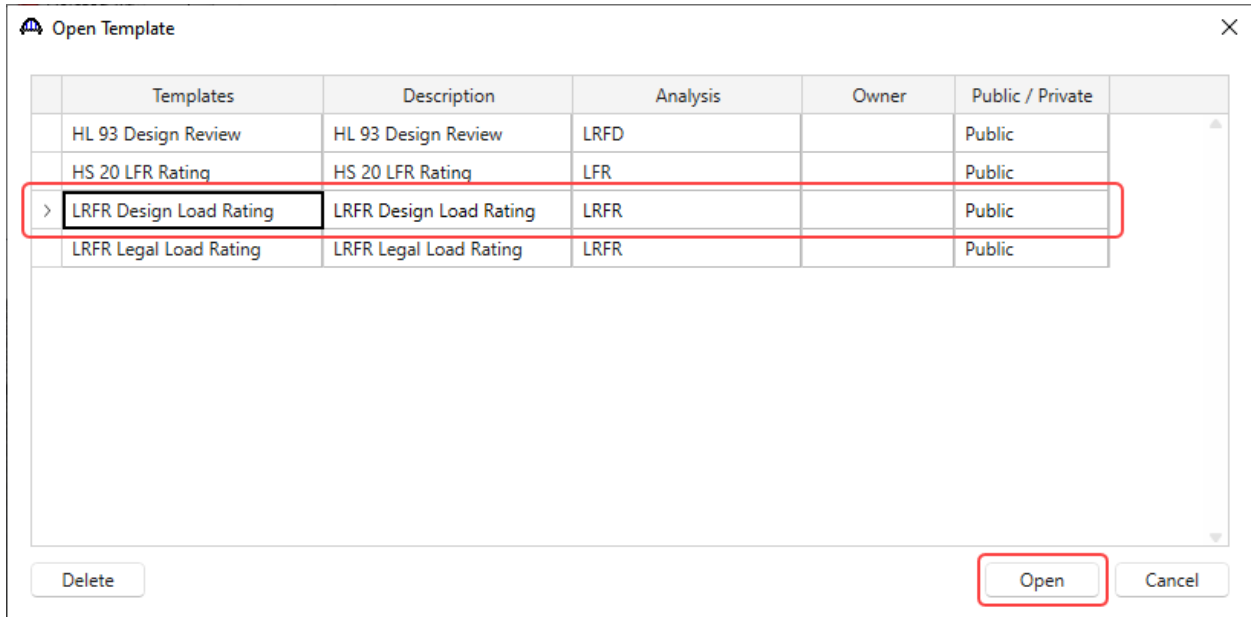
The pier is now sufficiently defined to be considered in the superstructure analysis. The column will be considered fixed at the base of the column. This percent fixity can be adjusted on the Pier Model Settings window if desired. The FE model created during the superstructure analysis will include an element modeling the column length and stiffness.

LRFR analysis and results

To run an LRFR analysis on the **PT MCB** superstructure definition, click on the **Analysis Settings** window from the **Analysis** group of the **DESIGN/RATE** ribbon.

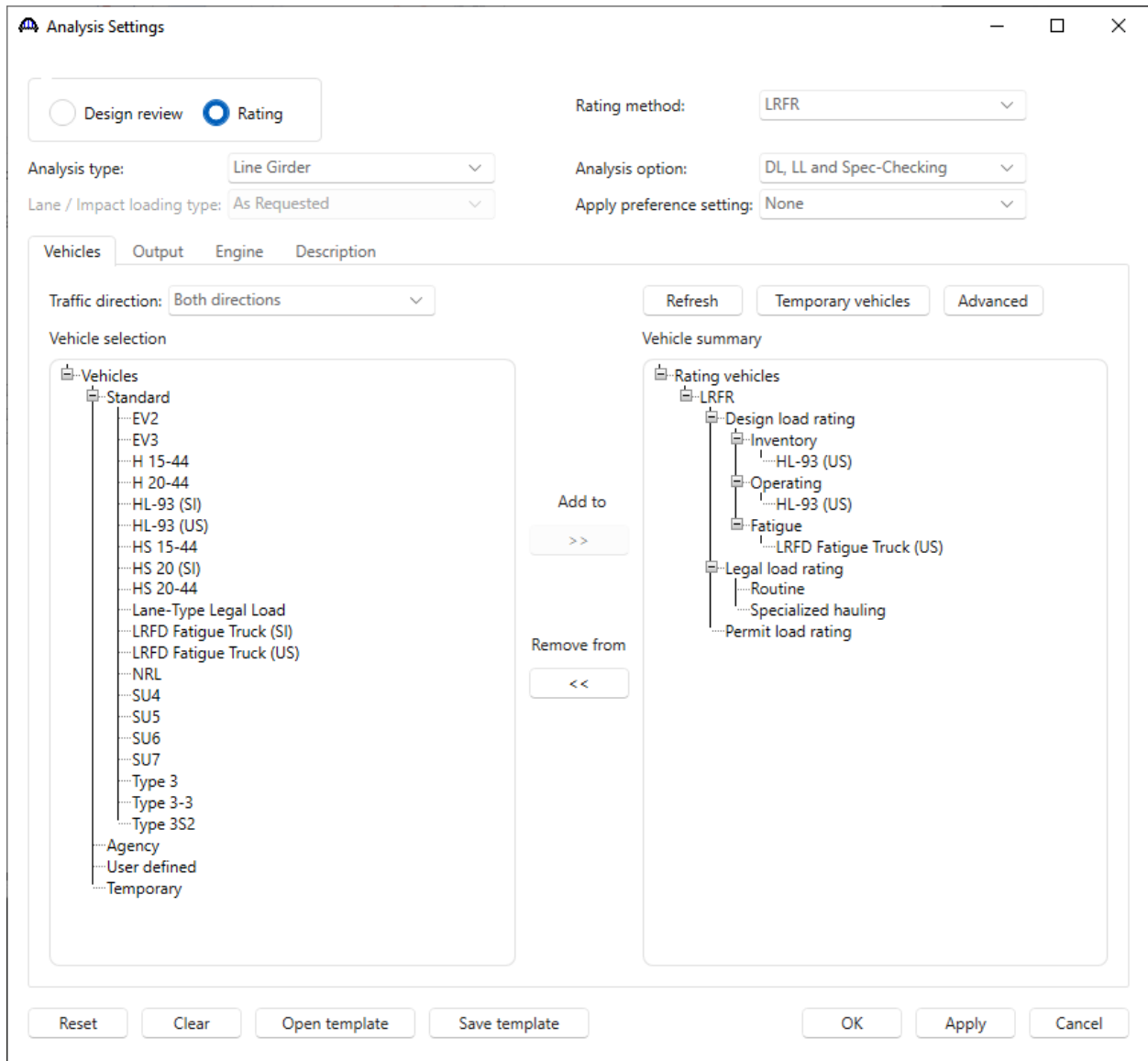


Click on the **Open template** button in the **Analysis Settings** window, select the **LRFR Design Load Rating** from the analysis templates and click **Open**. The full multi-cell box width is analyzed for flexure and shear and then each webline is analyzed for shear.



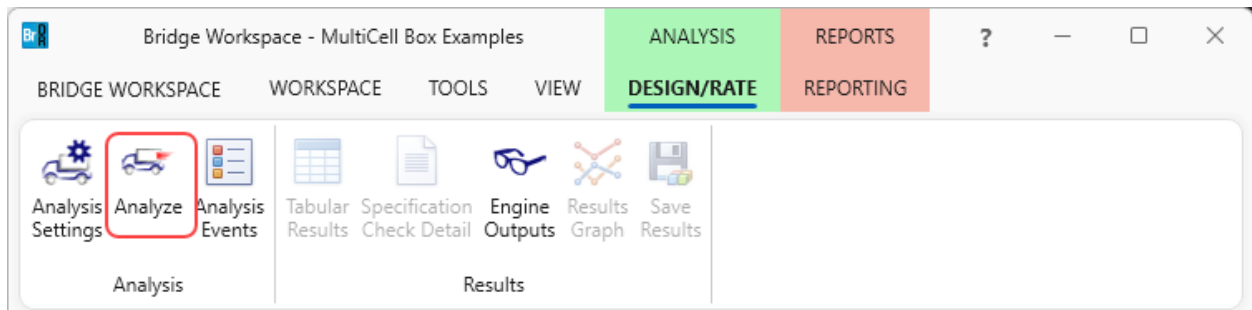
MCB1 – Post-Tensioned Multi-Cell Box Example

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



Click OK to apply the settings and close the window.

With **PT MCB** superstructure selected in the **BWS** tree, click on the **Analyze** button from the **Analysis** group of the **DESIGN/RATE** ribbon.



MCB1 – Post-Tensioned Multi-Cell Box Example

Tabular Results

Once the analysis is complete, click on the **Tabular Results** button from the **Results** group of the **DESIGN/RATE** ribbon. The **Analysis Results** window shows the critical rating factors considering the full box and each weblane.

Bridge Workspace - MultiCell Box Examples

ANALYSIS REPORTS

BRIDGE WORKSPACE WORKSPACE TOOLS VIEW DESIGN/RATE REPORTING

Analysis Analyze Analysis Events **Tabular Results** Specification Check Detail Engine Outputs Results Graph Save Results

Analysis Results

Analysis Results - PT MCB

Print

Report type: Rating Results Summary Lane/Impact loading type: As requested Detailed Display Format: Single rating level per row

Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Element Name	Limit State	Impact	Lane
> HL-93 (US)	Truck + Lane	LRFR	Inventory	0.00	0.000	11.15	1 - (10.0)	WEB1	STRENGTH-I Concrete Shear Eval	As Requested	As Requested
HL-93 (US)	Truck + Lane	LRFR	Operating	0.00	0.000	11.15	1 - (10.0)	WEB1	STRENGTH-I Concrete Shear Eval	As Requested	As Requested
HL-93 (US)	90%(Truck Pair + Lane)	LRFR	Inventory	61.93	1.720	101.62	1 - (91.1)	WEB2	STRENGTH-I Concrete Shear Eval	As Requested	As Requested
HL-93 (US)	90%(Truck Pair + Lane)	LRFR	Operating	78.46	2.179	101.62	1 - (91.1)	WEB2	STRENGTH-I Concrete Shear Eval	As Requested	As Requested
HL-93 (US)	Tandem + Lane	LRFR	Inventory	0.00	0.000	11.15	1 - (10.0)	WEB1	STRENGTH-I Concrete Shear Eval	As Requested	As Requested
HL-93 (US)	Tandem + Lane	LRFR	Operating	0.00	0.000	11.15	1 - (10.0)	WEB1	STRENGTH-I Concrete Shear Eval	As Requested	As Requested

AASHTO LRFR Engine Version 7.5.0.3001
Analysis preference setting: None

Close

Specification Check Detail

Select the **Specification Check Detail** button from the **Results** group of the **DESIGN/RATE** ribbon for the full box and each weblane Spec check details.

Bridge Workspace - MultiCell Box Examples

ANALYSIS REPORTS

BRIDGE WORKSPACE WORKSPACE TOOLS VIEW DESIGN/RATE REPORTING

Analysis Analyze Analysis Events Tabular Results **Specification Check Detail** Engine Outputs Results Graph Save Results

Analysis Results

MCB1 – Post-Tensioned Multi-Cell Box Example

Specification Checks for PT MCB - 706 of 1751

Properties | Generate | Articles: All articles | Format: Bullet list | Report

Specification filter

- Superstructure Component
 - Prestress Calculations
 - Stage 1
 - Stage 2
 - Stage 3
 - PT MCB
 - WEB1
 - WEB2
 - WEB3

Specification reference	Limit State	Flex. Sense	Pass/Fail
✓ 5.4.2.1 Compressive Strength		N/A	Passed
5.4.2.5 Poisson's Ratio		N/A	General Comp.
5.4.2.6 Modulus of Rupture		N/A	General Comp.
5.4.2.8 Concrete Density Modification Factor		N/A	General Comp.
NA 5.5.3.2 Reinforcing Bars and Welded Wire Reinforcement		N/A	Not Required
5.5.4.2 PS Strength Limit State - Resistance Factors		N/A	General Comp.
5.6.2.2 Rectangular Stress Distribution		N/A	General Comp.
✓ 5.6.3.2 PS Flexural Resistance (Prestressed Concrete)		N/A	Passed
✓ 5.6.3.3 Minimum Reinforcement		N/A	Passed
5.7.2.1 Torsion - General		N/A	None
5.7.3 Effective Shear		N/A	General Comp.
✓ 5.9.2.3.2b Tensile Stresses		N/A	Passed