State of Florida
Department of Transportation

FDOTConnect

for

OpenBridge Modeler

Florida Slab Beam Workflow

PRODUCTION SUPPORT CADD OFFICE

TALLAHASSEE, FLORIDA

HTTP://WWW.FDOT.GOV/CADD/

[THIS PAGE IS INTENTIONALLY LEFT BLANK.]

FDOTConnectXX.XX OpenBridge Modeler Training: Florida Slab Beam (FSB) Workflow

Bridge Design & Modeling

Description

This training workflow details a 3D bridge modeling Florida Slab Beam (FSB) workflow using Bentley product OpenBridge Modeler (OBM). To be in compliance with Florida Department of Transportation CADD standard (FDOT CADD), this effort must also be accomplished within FDOTConnectXX.XX workspace. The participant is walked through a typical FSB workflow using the tools and features available.

Objectives

This course demonstrates the workflow used to model an FSB bridge superstructure using the OBM tools and the FDOTConnectXX.XX workspace resources.

Prerequisites

This workflow document is a supplement to the *FDOTConnectXX.XX OpenBridge Modeler Training: Introduction to Model-Centric Workflows* training course. This supplemental document will not cover details included in the introductory course; users of this workflow document are expected to understand the basic principles of 3D bridge modeling using OBM.

For information about this and other CADD training courses, publications, videos, and Frequently Asked Questions, visit the Production Support CADD Office of the Florida Department of Transportation on the world-wide web at http://www.fdot.gov/cadd/

[THIS PAGE IS INTENTIONALLY LEFT BLANK.]

Table of Contents

[THIS PAGE IS INTENTIONALLY LEFT BLANK.

1 FLORIDA SLAB BEAM MODELING

OVERVIEW

This workflow document describes the tools and procedures needed to model an example Florida Slab Beam (FSB) bridge superstructure in OBM. It builds on the *FDOTConnectXX.XX OpenBridge Modeler Training: Introduction to Model-Centric Workflows* training course.

The workflow assumes the user knows the OBM workflow for prestressed beams and focuses on the unique characteristics of modeling an FSB bridge superstructure. There is no dataset provided in the workflow document, but an example FSB bridge geometry will be used. The workflow roughly follows the FDOT Developmental Standard Plans d400-324 for a 2-span FSB 15x53 bridge with six FSBs, a normal cross-slope, and an out-to-out CIP topping width of 26'-8". See Appendix A for a copy of d400-324 as a reference. Users should be able to use the workflow presented to model other FSB bridges as needed for the bridge geometry.

The FSB-specific OBM beam and deck templates are provided as a starting point for users. Often, the unique geometry of FSB bridges will require modifications to the base templates to accurately model the geometry. The **Open Cross Section View** tool is the best way to visualize the interaction between the FSB beam templates and FSB deck templates.

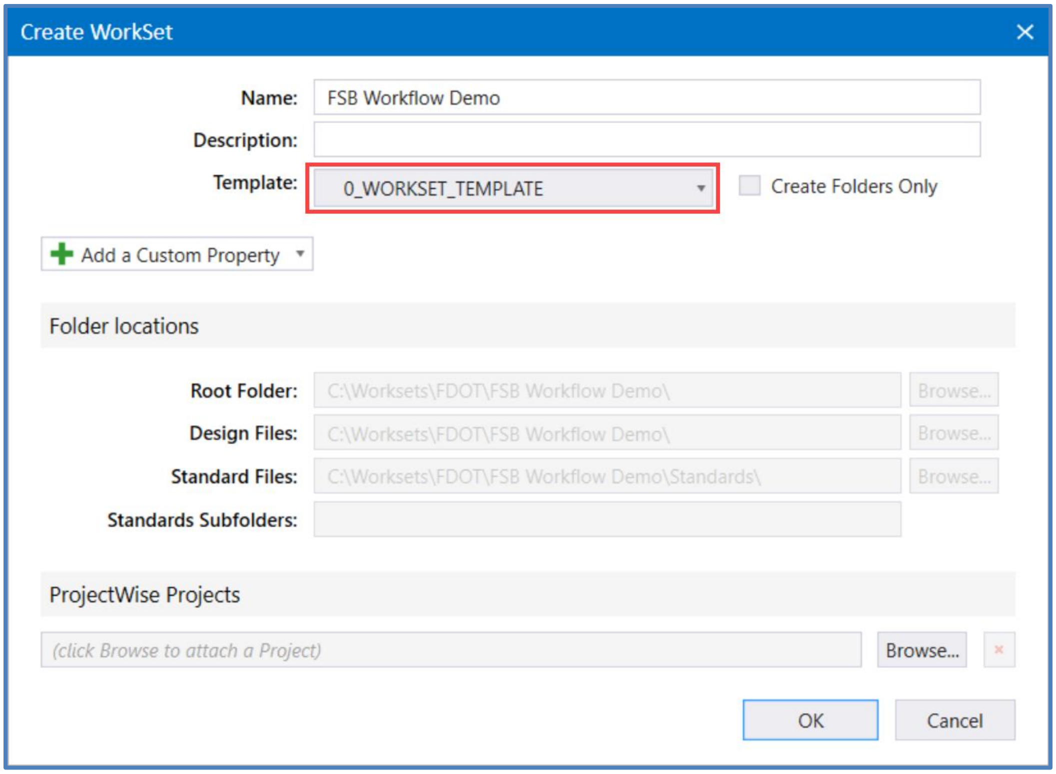
OBJECTIVES

This workflow guide covers the steps to create an FSB bridge superstructure 3D model built around key tools within OBM including:

- Add Bridge
- Place SupportLines
- Place Deck
- Place Barriers
- Place Beam Layout and Beam
- Integral Pockets (Wet Joints)
- Vertical Deck Point Control

SETTING UP THE FSB DESIGN FILE

For this workflow, a new demonstration workset was created using the "0_WORKSET_TEMPLATE" as the template. Users may utilize a test workset or project workset, as needed.

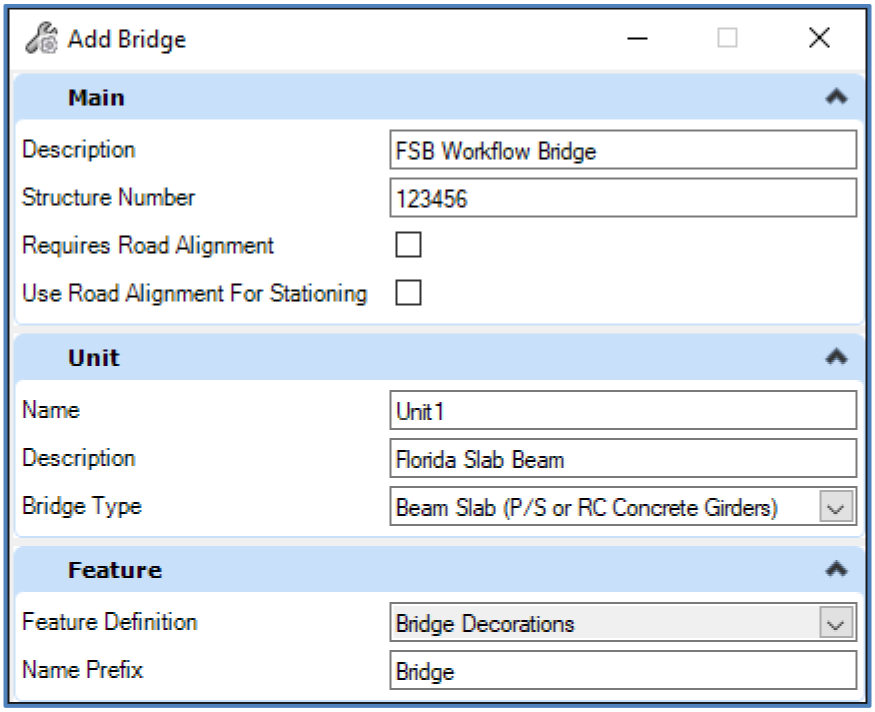


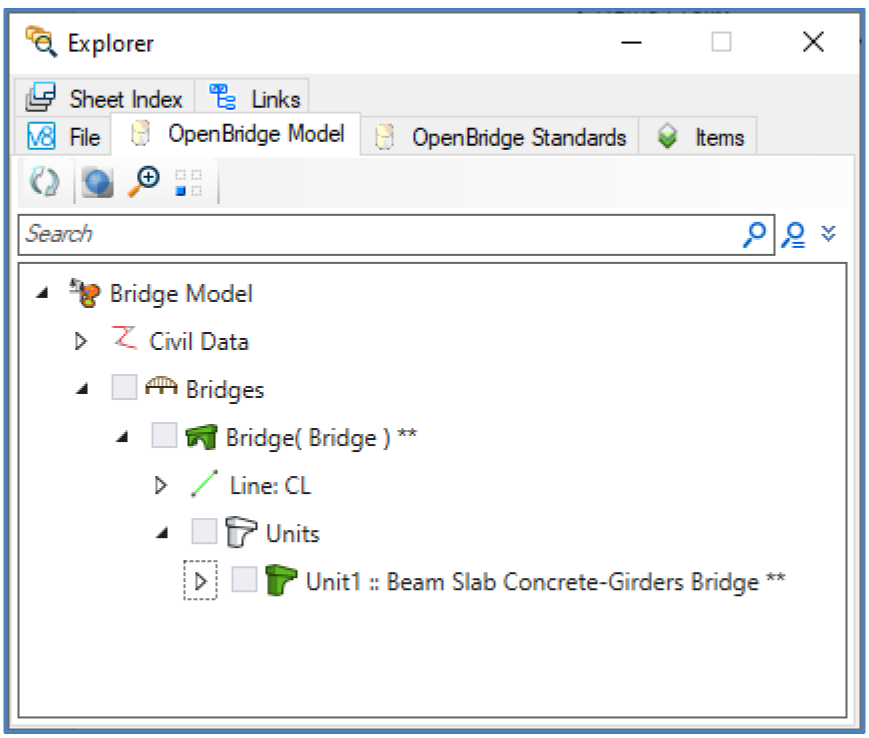
To create a new file, open *_BlankFile.dgn* to access the FDOT **Create File** tool. Create a new Structures design file for a new Bridge 3D Model. In this example, the filename is *B01MODLBR_FSB01.dgn* and the county is **Volusia**.

As with Florida-I Beam or steel girder bridges, the roadway alignment file and terrain files are attached as references. Adjust the *Drawing Scale* (**Reports and Drawings > Drawing Scale**) for the alignment annotations to be legible. Turn off reference display of the terrain file and the *Default-3D* model of the alignment file.

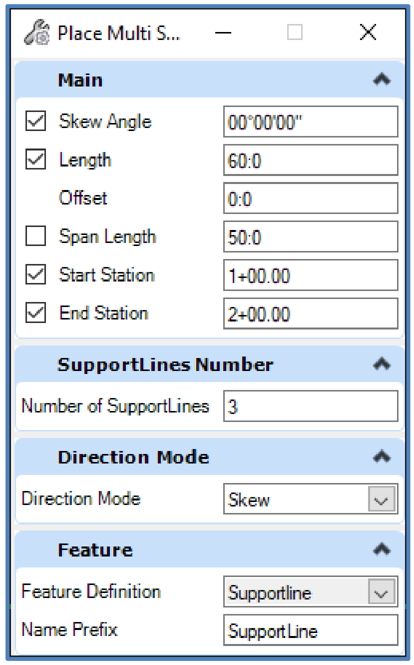
Exercise 1.1 Create a Bridge, Update Templates, and Add a Bridge Deck

1. Create Bridge by selecting **Home > Bridge Setup > Add Bridge**. Note that the Beam Slab (P/S or RC Concrete Girders) bridge type is selected here. Once the bridge "container" is created, we can start adding the bridge components. Note: You will not be able to see anything in the view window, but a bridge will appear in the **Explorer** within the *OpenBridge Modeler* tab.

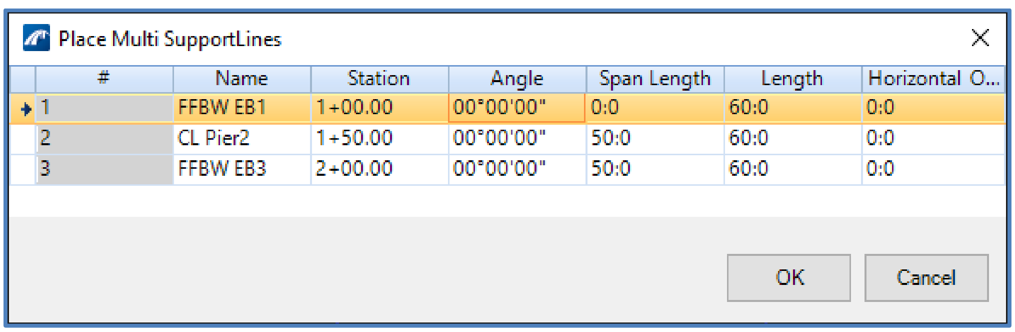




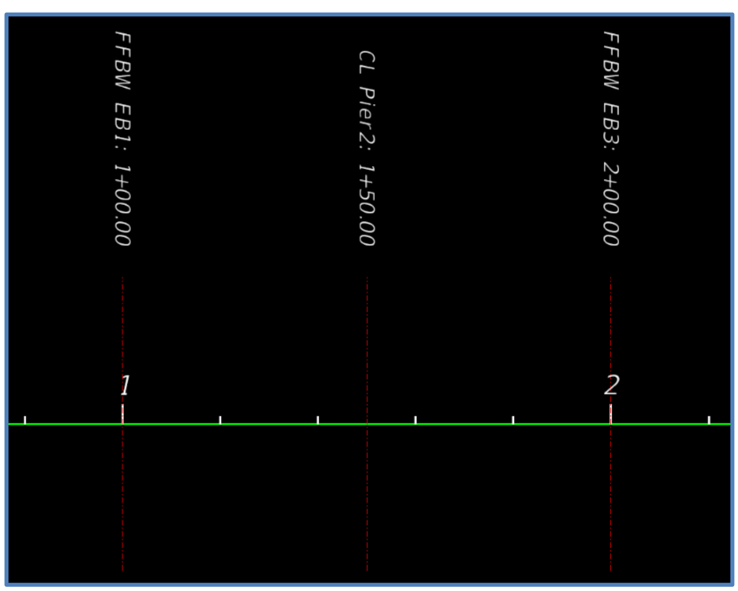
2. Create the Supportines by going to **Home > Supportline > Place (Multi)**. For this example, we will use two 50ft spans with a Supportline length of 60ft, shown below.



3. Rename the Supportlines to match FDOT naming convention as shown below.

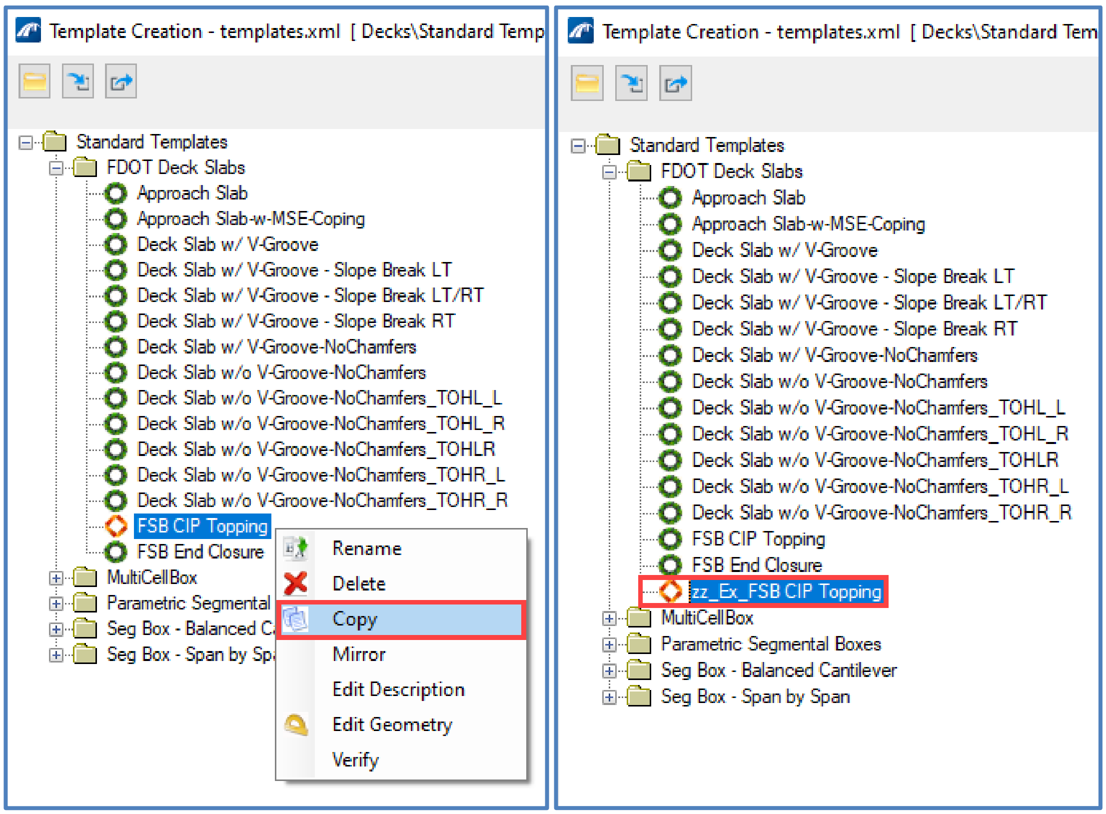


#	Name	Station	Angle	Span Length	Length	Horizontal O...
1	FFBW EB1	1+00.00	00°00'00"	0:0	60:0	0:0
2	CL Pier2	1+50.00	00°00'00"	50:0	60:0	0:0
3	FFBW EB3	2+00.00	00°00'00"	50:0	60:0	0:0



4. Now the deck template for the project-specific CIP Topping will be set-up. Navigate to the Deck library by going to **Utilities > Libraries > Deck**. Within the *FDOT Deck Slabs* folder, right click the *FSB CIP Topping* deck template and select **Copy**. Right click the copied template and select **Rename**. Name the template as desired, in this example it is called **zz_Ex_FSB CIP Topping**.

Note In this example, we will be using the typical (symmetrical) FSBs rather than the edge FSBs as exterior beams. If edge FSBs are used as edge beams, the *Deck Slab w/o V-Groove-NoChamfers* deck template can be copied and used for the CIP Topping.

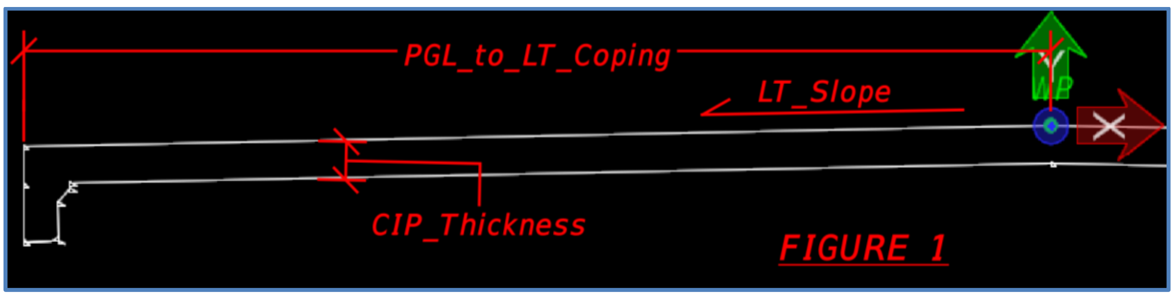


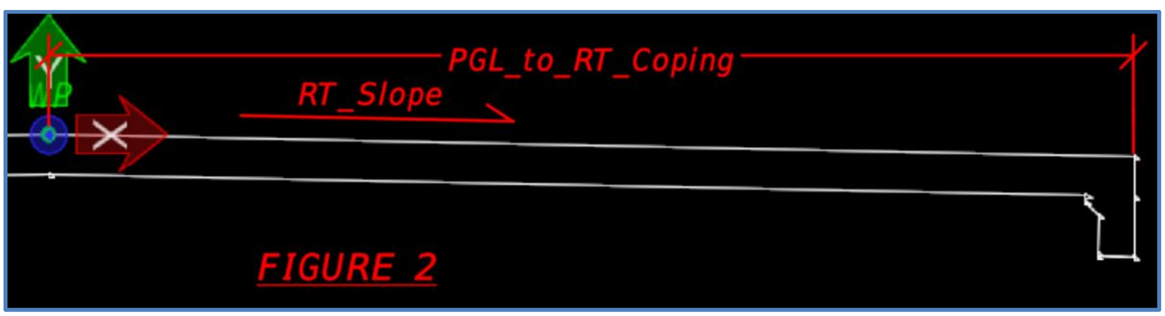
5. In the newly created *zz_Ex_FSB CIP Topping* template, update the variables as needed for the bridge geometry. In this example, **RT_Addl_Thickness** and **LT_Addl_Thickness** variables are both set to **-0:11.5** and **FSB_Stem_No_Chamfer** is set to **0:9**. Click **Close** to close the *Template Creation* window. See table and figures below for what each of the deck variables represent for the default *FSB CIP Topping* template.

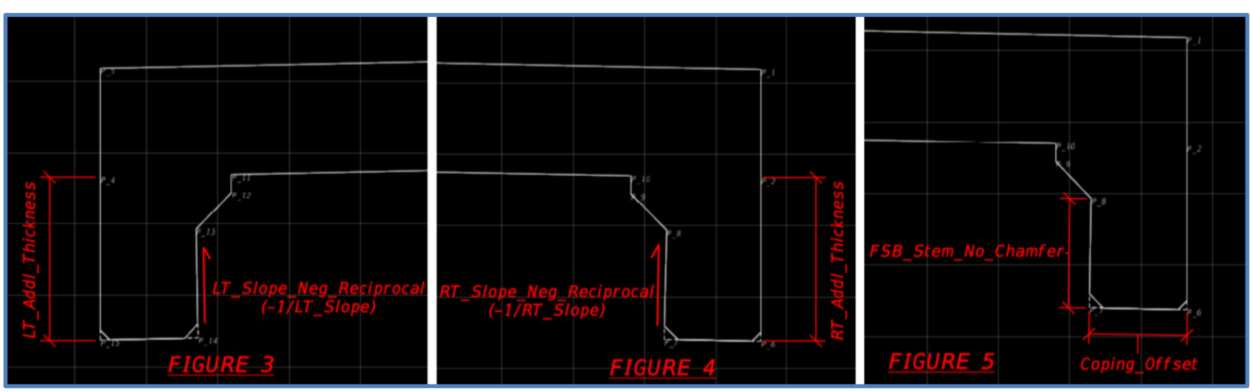
Note The **RT_Addl_Thickness** and **LT_Addl_Thickness** variables include the stem of the FSB as well as an estimate for the portion of the CIP Topping that accounts for beam camber, traditionally considered the build-up for prestressed beams. Due to the generally curved nature of a vertical profile and the assumed vertically chorded nature of the FSBs, these will vary along the span. This variation will be accounted for with a deck point control in a future step of the workflow.

***FSB CIP Topping*: Deck Variable Definitions**		
Variable	**Figure No.**	**Description**
PGL_to_LT_Coping	1	Horizontal Distance from PGL/WP to Left Coping
LT_Slope	1	Slope from PGL/WP to Right Coping (Positive as Shown)
CIP_Thickness	1	Thickness of CIP Topping (generally 6" or 6.5")
PGL_to_RT_Coping	2	Horizontal Distance from PGL/WP to Right Coping
RT_Slope	2	Slope from PGL/WP to Right Coping (Negative as Shown)
LT_Slope_Neg_Reciprocal	3	Negative Reciprocal of LT_Slope (i.e. - 1/LT_Slope)
LT_Addl_Thickness	3	Additional Thickness at LT Coping (Includes Build-up)
RT_Slope_Neg_Reciprocal	4	Negative Reciprocal of RT_Slope (i.e. - 1/RT_Slope)
RT_Addl_Thickness	4	Additional Thickness at RT Coping (Includes Build-up)
Coping_Offset	5	Width of Additional Thickness at bottom of RT/LT Copings
FSB_Stem_No_Chamfer	5	Depth of the FSB Stem minus the 2" Chamfer

Note **Coping_Offset** is set to **5.5"** for no cross-slope since the coping is a uniform width. If there is a non-zero cross-slope, the **Coping_Offset** should be adjusted. For a 2% cross-slope, the **Coping_Offset** would be 5.5" – 0.02*5.5", which to the nearest 1/8" is **5.375"**.





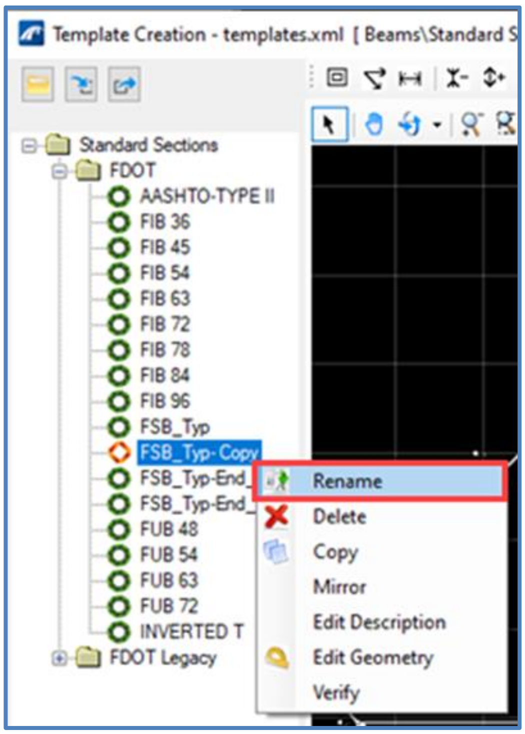


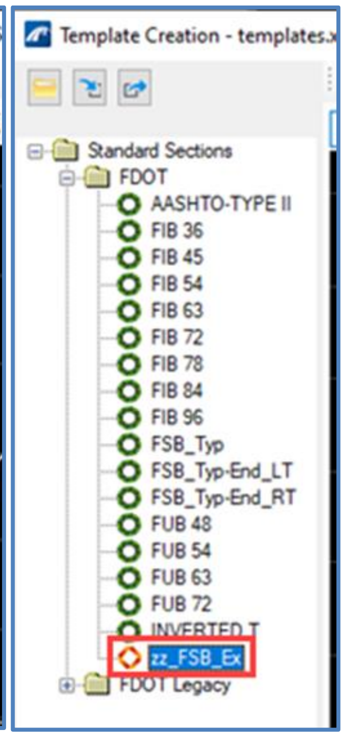
6. For the CIP end closure, a different deck template will be used. Navigate to the Deck library by going to **Utilities > Libraries > Deck**. Within the *FDOT Deck Slabs* folder, right click the *FSB End Closure* deck template and select **Copy**. Right click the copied template and select **Rename**. Name the template as desired, in this example it is called **zz_Ex_FSB End Closure**.

7. In the newly created *zz_Ex_FSB End Closure* template, update the variables as needed for the bridge geometry. In this example, **FSB_and_CIP_Depth** is set to **1:9.5**. Click **Close**.

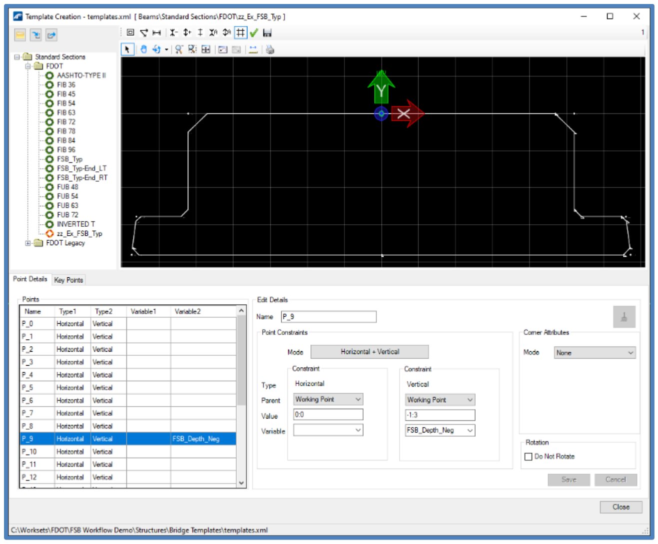
Note The **FSB_and_CIP_Depth** variable will need to be adjusted based on the build-up required at the ends of the FSB. It may be necessary to estimate a value and refine it later.

8. Next, the project-specific FSB templates will be created. Navigate to the Beams library by going to **Utilities > Libraries > Beams**. Within the *FDOT* folder, right click the *FSB_Typ* beam template and select **Copy**. Right click the copied template and select **Rename**. Name the template as desired – in this example it is called **zz_FSB_Ex**.

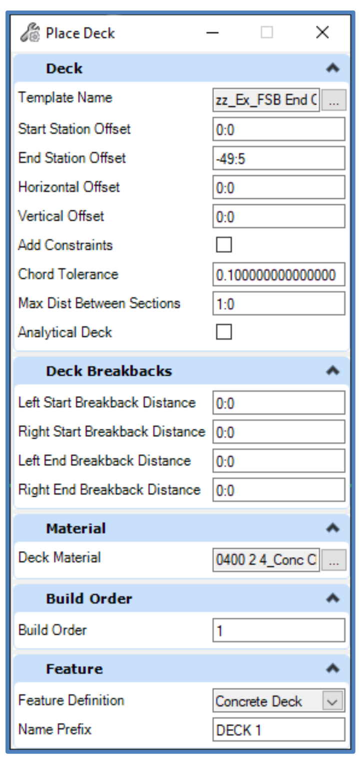




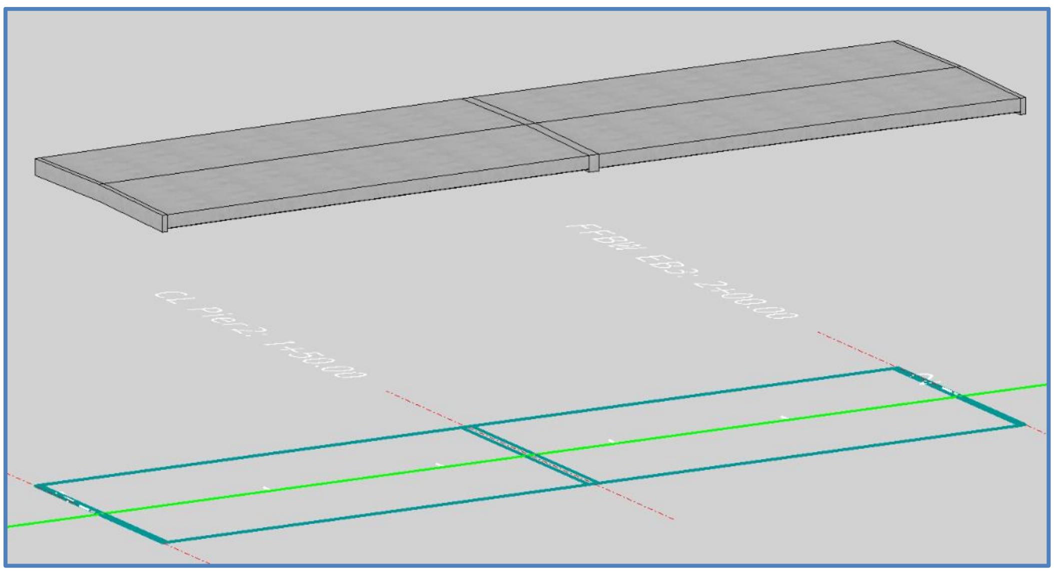
9. In the newly created *zz_FSB_Ex* template, update the variables as needed for the FSB spacing. In this example, the FBSs are FSB 15x53s (spaced at 4'-5$^{5}/_{8}$"), so the **FSB_Depth_Neg** variable is updated to **-1:3**, **FSB_Depth_Pos** to **1:3**, **Half_Width_Pos** to **2:2.5**, and **Half_Width_Neg** to **-2:2.5**.



10. Now that the superstructure templates are established, the deck segments can be placed. In this example, there are two FSB spans, so there will be five deck segments: two main segments using the **zz_Ex_FSB CIP Topping** template and three closure segments using the **zz_Ex_FSB End Closure** template. Create the first deck by selecting: **Home > Superstructure > Place Deck**. Select the end closure template created in Step 6, in this case **zz_Ex_FSB End Closure** with the parameters shown below. Ensure **Concrete Deck** is selected as the Feature Definition. Set the Deck Material to **0400 2 4_Conc Class II, Bridge Super**.



11. Select **FFBW EB1** as the first deck boundary and **CL Pier2** as the second deck boundary. Left click to accept. The first small segment of deck will be created.
12. Next, within the *Place Deck* dialog box, select the CIP topping created in Step 4, in this case **zz_Ex_FSB CIP Topping** with a *Start Station Offset* value of **0:7** and an *End Station Offset* value of **-0:7**. Again, select **FFBW EB1** as the first deck boundary and **CL Pier2** as the second deck boundary. Left click to accept. Another segment of deck will be created.
13. For the third segment of deck, select the end closure template **zz_Ex_FSB End Closure** again but with a *Start Station Offset* value of **49:5** and an *End Station Offset* value of **0:7**. Again, select **FFBW EB1** as the first deck boundary and **CL Pier2** as the second deck boundary. Left click to accept. Another segment of deck will be created.
14. For the fourth segment of deck, select the CIP topping template **zz_Ex_FSB CIP Topping** again but with a *Start Station Offset* value of **0:7** and an *End Station Offset* value of **-0:7**. This time, select **CL Pier2** as the first deck boundary and **FFBW EB3** as the second deck boundary. Left click to accept. Another segment of deck will be created.
15. For the final segment of deck, select the end closure template **zz_Ex_FSB End Closure** again but with a *Start Station Offset* value of **49:5** and an *End Station Offset* value of **0:0**. Again, select **CL Pier2** as the first deck boundary and **FFBW EB3** as the second deck boundary. Left click to accept. The last segment of deck will be created. Alternating the deck templates with appropriate station offsets will result in a continuous deck as shown below.

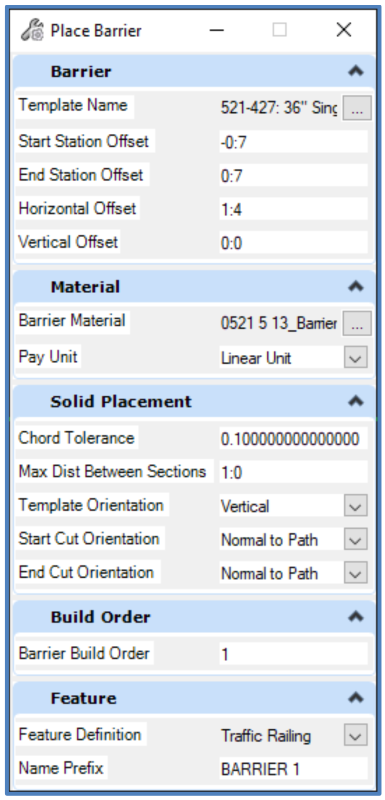


Note In this example, the gaps for the expansion joints are not modeled. If desired, gaps can be included in the model using Start Station Offset and End Station Offset parameters during deck placement.

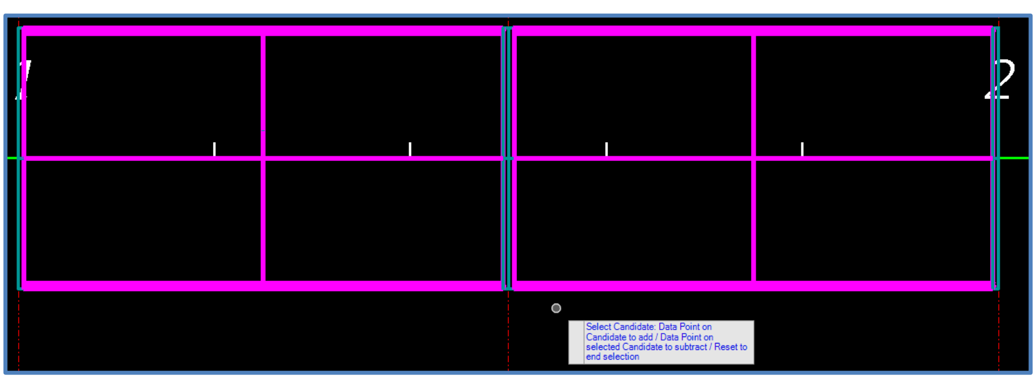
Exercise 1.2 Add Barriers to Bridge Deck

1. Add the bridge barriers by navigating to **Home > Accessory > Place Barrier**.

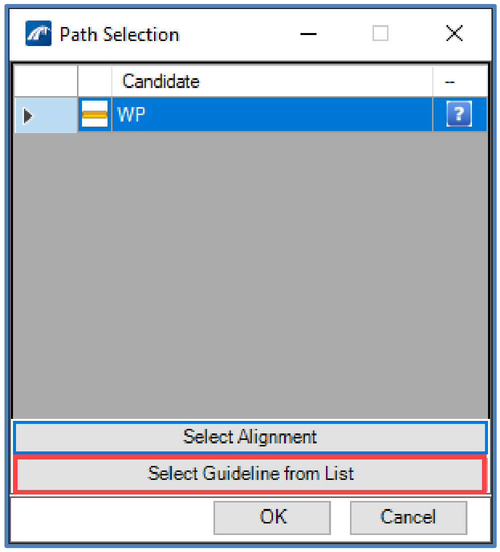
2. Fill out the *Place Barrier* dialog box as shown below. In this example, the bridge uses 36" SS barriers, so the **521-427: 36" Single Slope L** template is selected under the *FDOT* folder. Note that the WP for the barrier is at the gutterline, which is why there is a Horizontal offset value. There are also start and end station offsets to allow the barriers to extend into the end closure portions of the deck. Alternatively, a separate segment of barrier could be placed for each of the segments of deck.



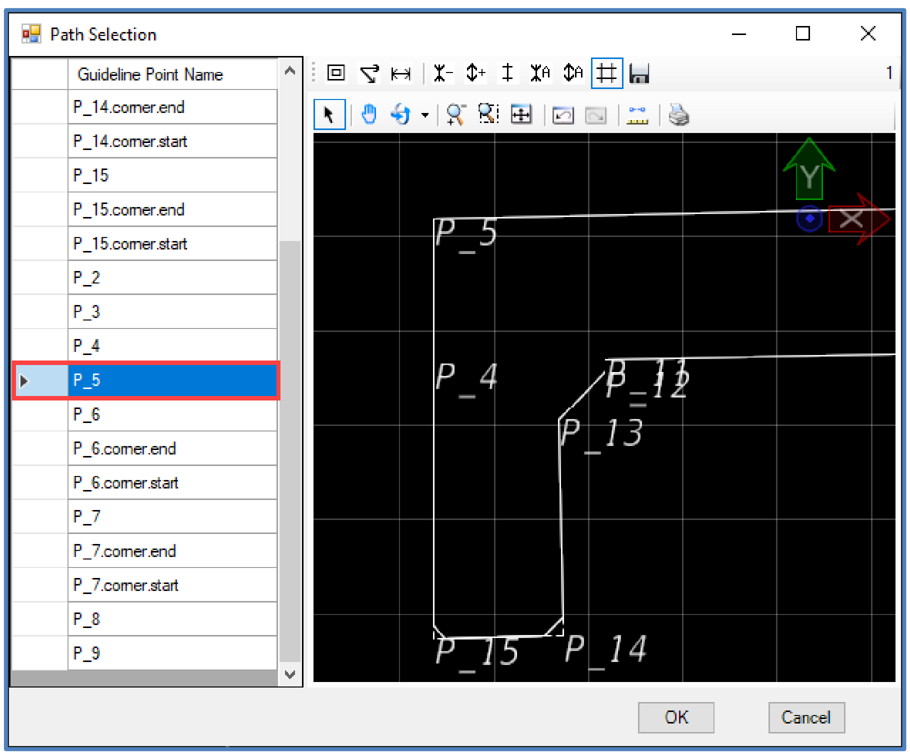
3. Next select both of CIP topping deck segments as the candidates (they will all be highlighted pink to indicate they are selected). End the candidate selection by right-clicking and then left-clicking in open space. This will open the *Path Selection* window.



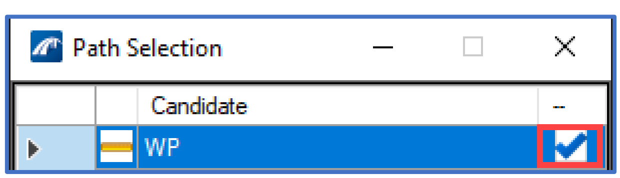
4. Click on **Select Guideline from List** to open the selection window.



5. Select **P_5** from the list, which corresponds to the left coping, and click **OK**.

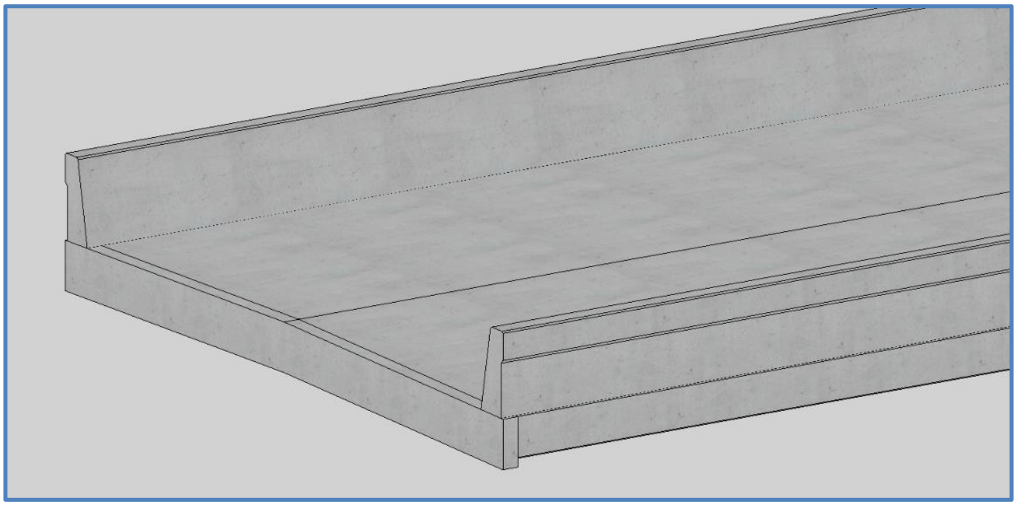


6. Verify that the blue check mark is showing and hit **OK**.



7. The barrier will be displayed on top of the deck.

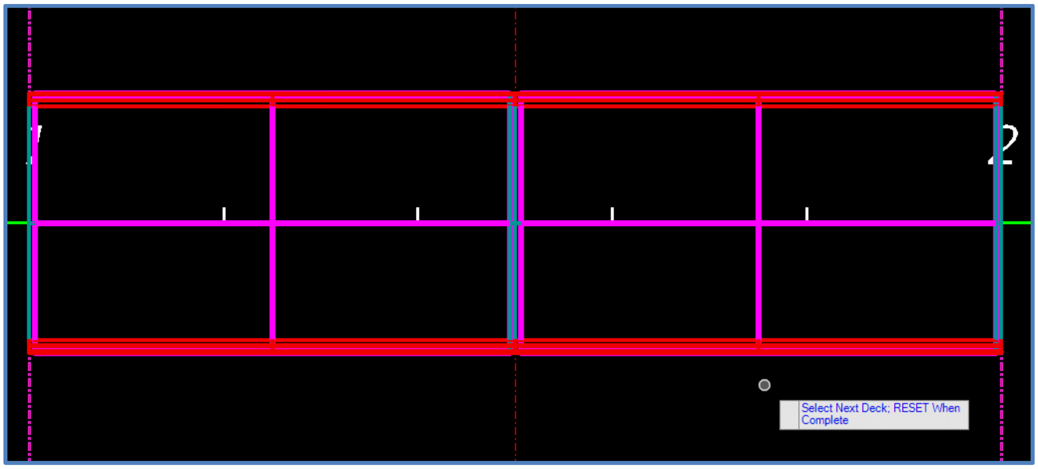
8. Repeat Step 1 – 7 to place the right barrier. In Step 2 change the selected template to **521-427: 36" Single Slope R** and change the *Horizontal Offset* to **-1:4**. In Step 5 select **P_1** as the Guideline Point.



Exercise 1.3 Create a Beam Layout and Model Beams

1. Create Beam Layout by navigating to and selecting **Home > Superstructure > Beam Layout**.

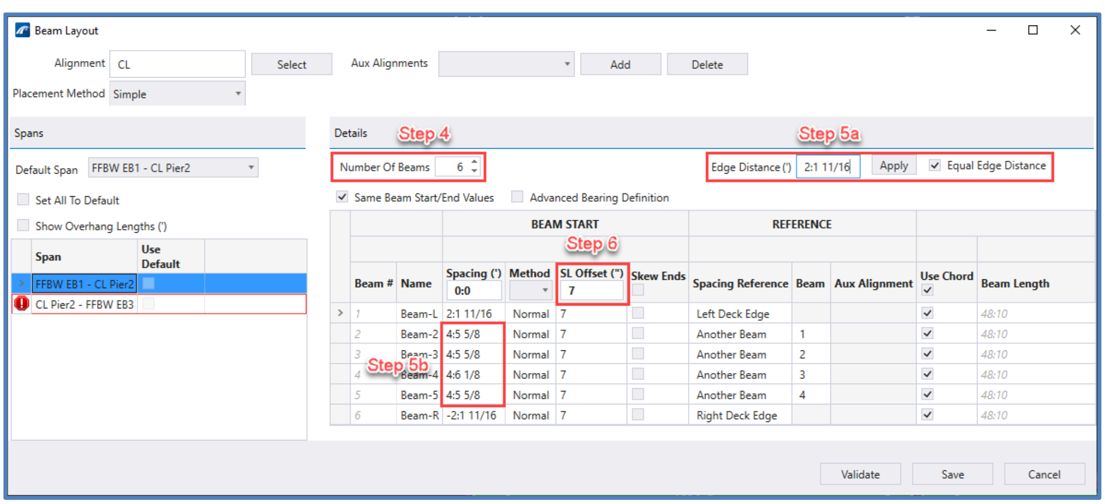
2. Select "FFBW EB1" and "FFBW EB3" as the **Start Limit Line** and **End Limit Line** respectively. Similarly to the barrier placement, select the two CIP topping segments of deck in order from begin bridge to end bridge. The two segments of deck will be highlighted pink. Right-click to reset once all deck segments are selected.

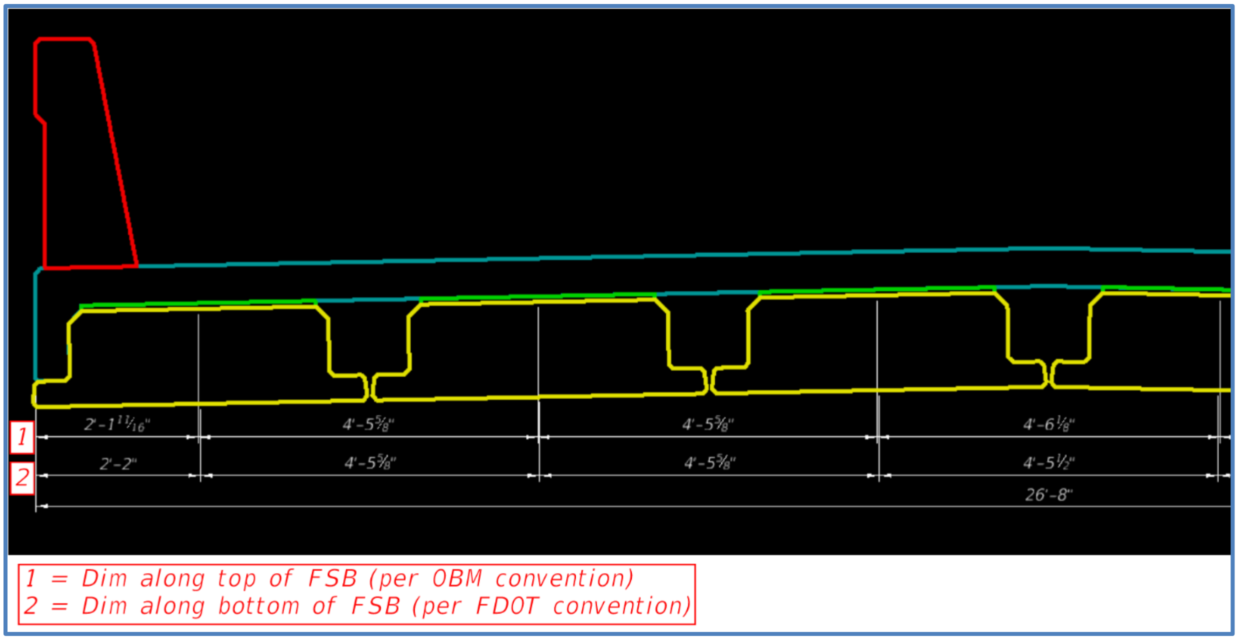


3. Data Point to **Accept** the limit lines and open the *Beam Layout* window.

4. In the *Beam Layout* window change the *Number of Beams* to **6** since there are six FSBs in this example.

5. Notice that there are errors shown in the table of beams. In the *Edge Distance* field enter the distance from the coping to the CL of the FSB, which in this example is **2:1 11/16**. Ensure the E*qual Edge Distance* box is checked and click **Apply**. Note that the Beam-L and Beam-R now have a Spacing of **2:1 11/16** and **-2:1 11/16** respectively and the interior beams have a spacing of **4:5 3/4**. Adjust the beam spacing as shown in the graphic below. This will result in beam spacing that matches the layout in FDOT Developmental Standard Plans d400-324.

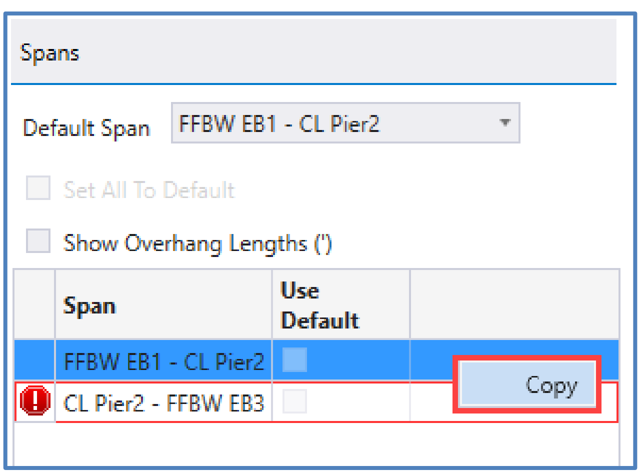


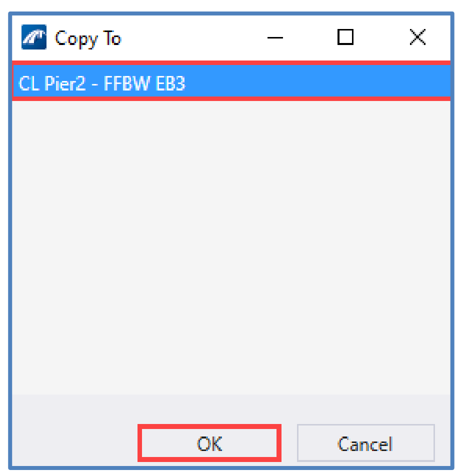


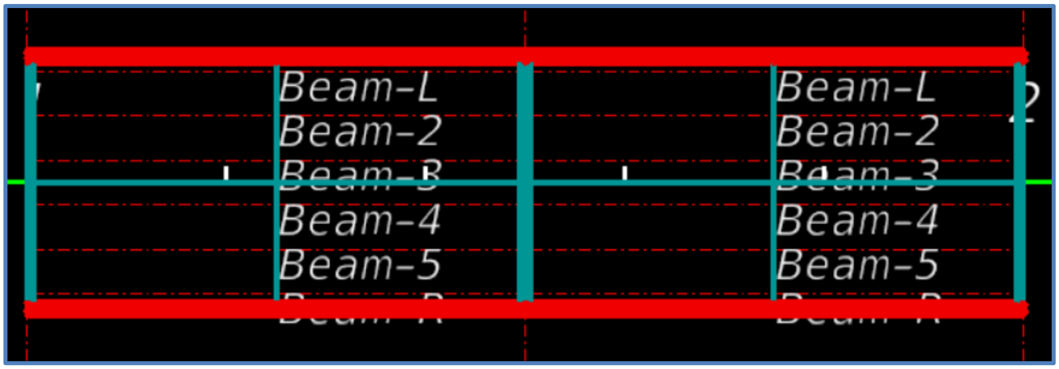
Note Since OBM uses a top of beam convention for rotated beams and FDOT uses a bottom of beam convention for dimensioning, adjustments must be made when entering beam spacing. For the example with a 2% slope and an FSB depth of 15", rather than 2:2 edge distance, use 2:2 – 0.02*15" which to the nearest 1/16 inch is **2:1 11/16**. For *Beam-4* spacing, since the crown is in the middle, the convention also affects this spacing, which can be set to the remainder of the out-to-out deck width: 26:8 – 2*(2:1 11/16) – 4*(4:5 5/8) = **4:6 1/8**.

6. Set the *SL Offset* value to **7** and press **Tab** or **Enter** on the keyboard. SL Offset values for each beam will be set to 7".

7. On the left side of the *Beam Layout* window, right click on the **FFBW EB1 – CL Pier2** span and click **Copy**. In the *Copy To* window, click **OK** to copy the beam layout from Span 1 to Span 2 since the FSB lengths are identical between spans. Click save on the *Beam Layout* window. The beam layout linework will appear at elevation zero (2D lines).

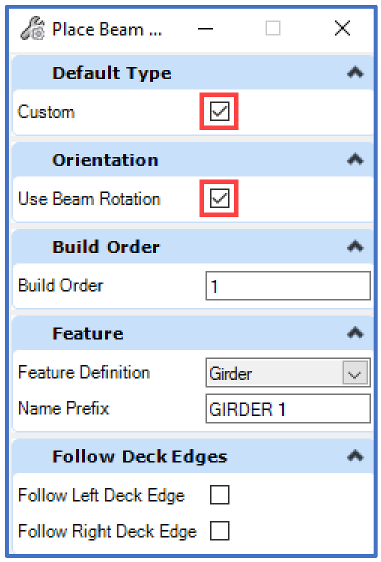






8. Next, add the physical beams to the bridge. Navigate to and select **Home > Superstructure > Place Beam.**

9. In the *Place Beam* dialog box, check the boxes for *Custom* and *Use Beam Rotation*.



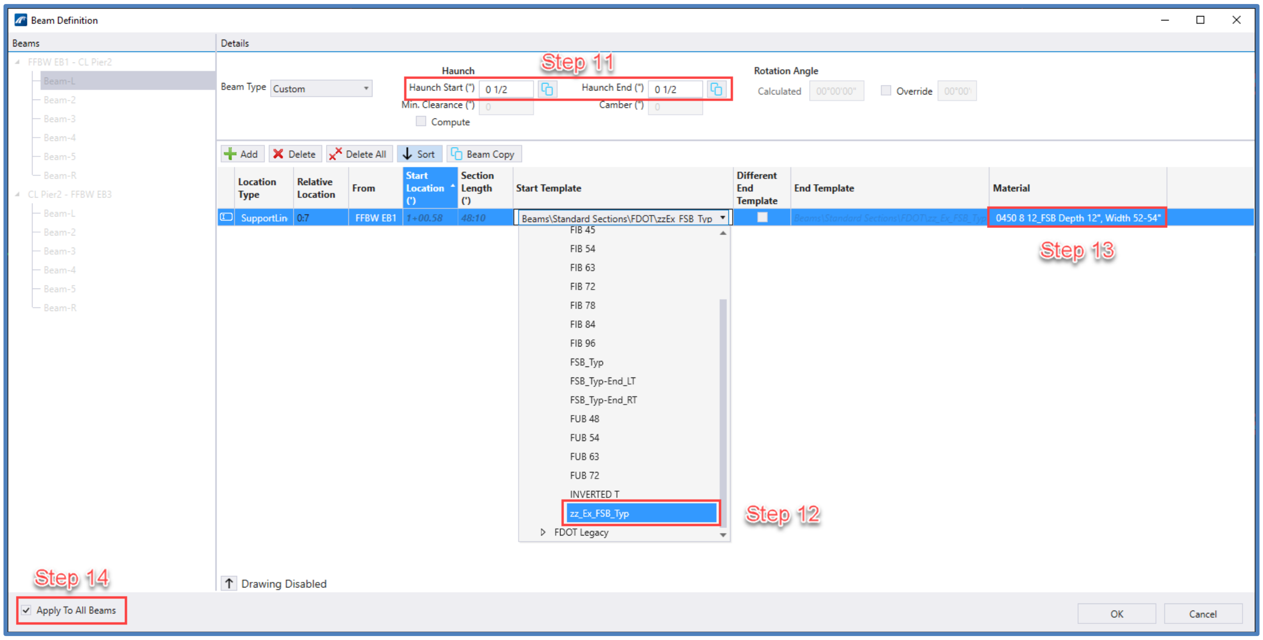
10. Select the beam layout created in Step 7. Left click to accept the beam layout. The *Beam Definition* window will open to allow the user to modify the beam properties.

11. Enter either haunch information or minimum clearance and camber values. In this example, the *Haunch Start* and *Haunch End* values to **0.5”**.

12. Change the *Start Template* to **FSB_Typ**.

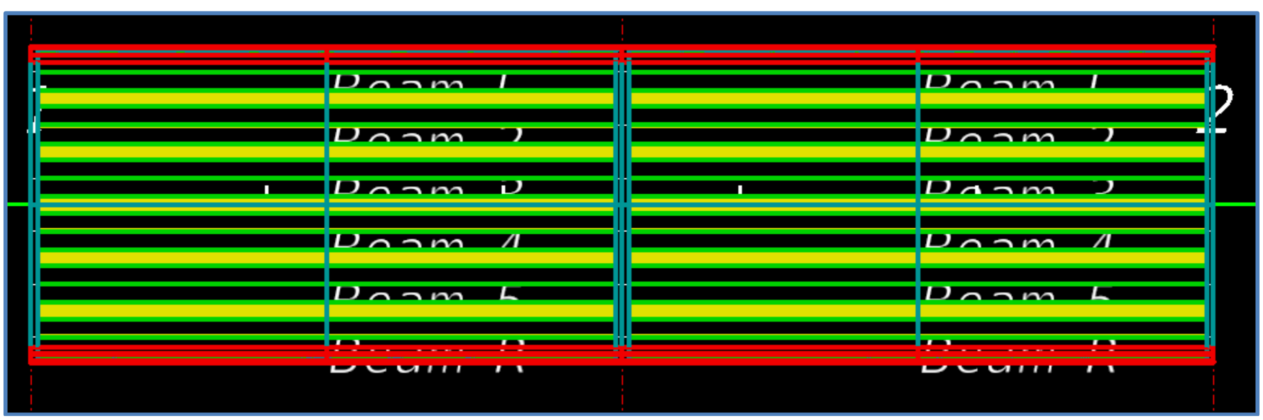
13. Change the *Material* to **0450 8 22_FSB Depth 15”, Width 52-54”**.

14. At the bottom left of the window, verify that the *Apply to All Beams* box is checked.



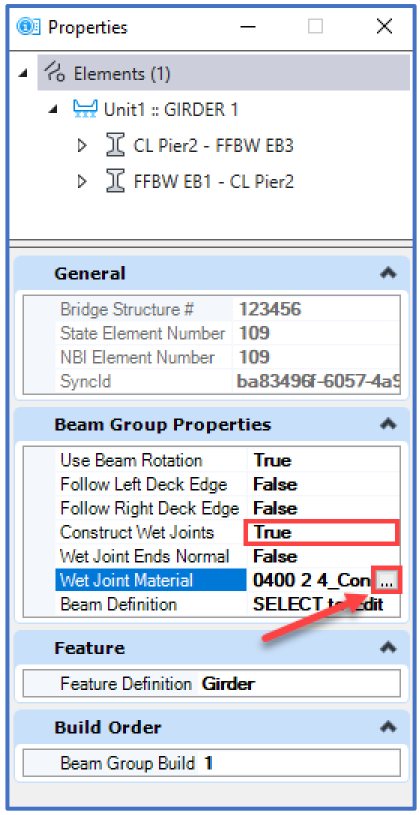
Note If needed, users can override the internally calculated beam rotation by checking the **Override** box in the top right corner and hard-entering a beam rotation.

15. Select **OK** and see the beam group that was just created.

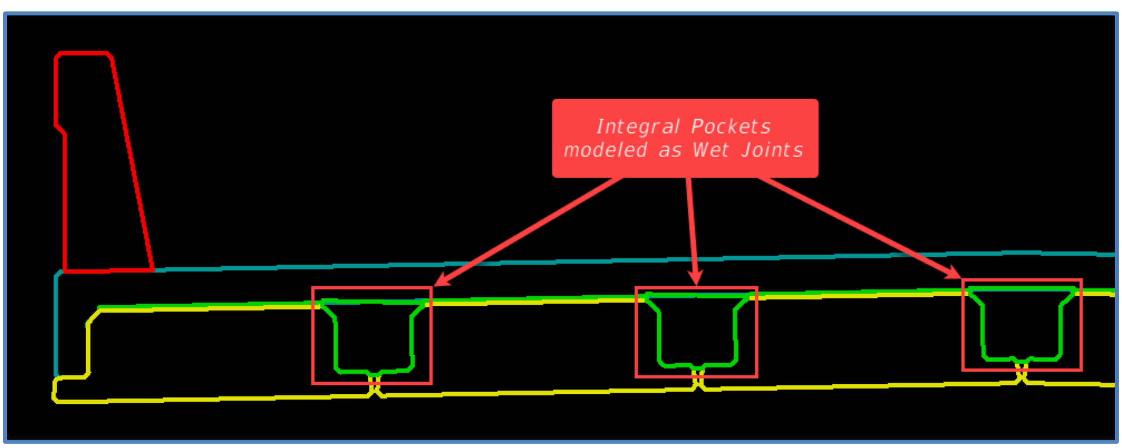


Exercise 1.4 Add Integral Pockets and Point Control for CIP Topping

1. After beams are placed, the integral pockets between the FSBs can be modeled as wet joints. To do this, select the beam group and open the *Properties* dialog box. Under the *Beam Group Properties* section, toggle *Construct Wet Joints* to **True**. Then for *Wet Joint Material*, select the integral pocket material, in this example **0400 2 4_Conc Class II, Bridge Super.**

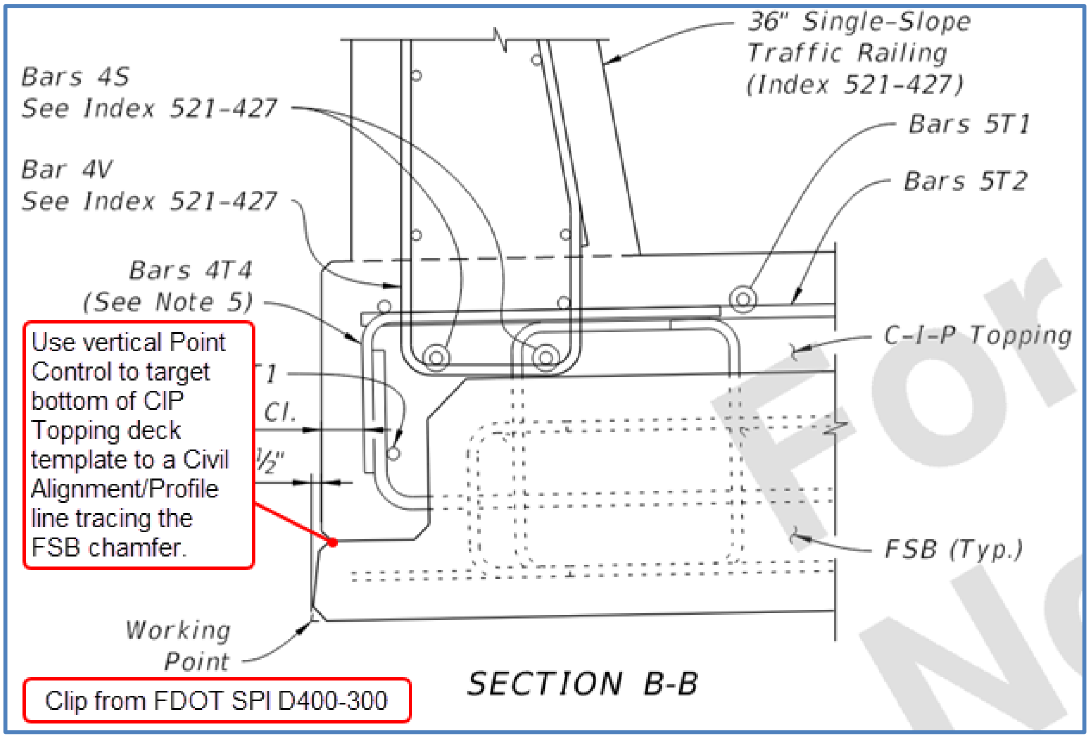


Wet joints are now visible between the FSBs, which can be viewed within a cross-section.

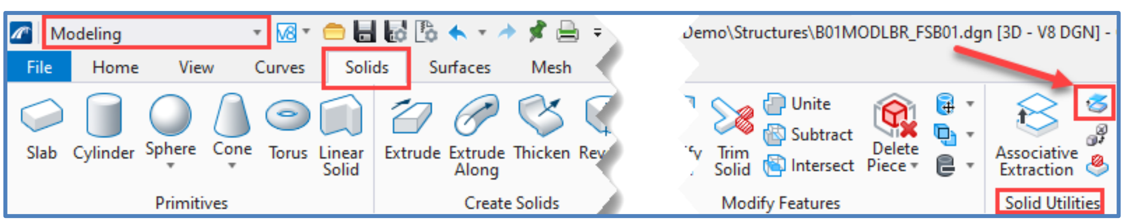


Note In the current version of OBM, there is a bug where wet joints placed in conjunction with rotated beams causes the wet joint area to be warped. While there is no issue for quantities, for model-centric plans production the wet joint level can be turned off and a live linework used if needed.

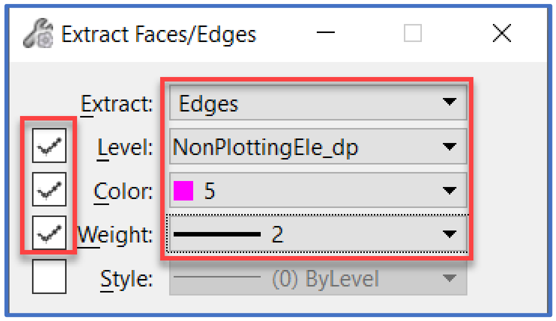
2. **OPTIONAL:** Depending on the level of detail required for the bridge model, it may be necessary to use vertical point controls to set the bottom of the CIP Topping on the outside of the exterior beam to follow along the top of the FSB flange. As discussed previously, due to the generally curved nature of a vertical profile and the assumed vertically chorded nature of the FSBs, the depth of the coping of the CIP topping will vary along the span.

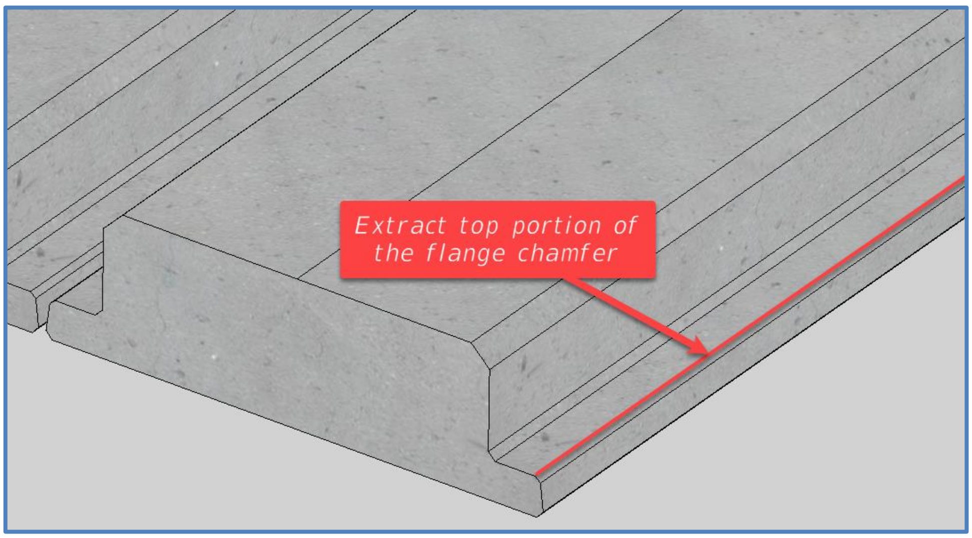


3. In the Isometric View (View 2), turn off all levels except the **BeamConc_pm** level. To extract the edges of the four exterior FSBs, navigate to **Modeling (workflow) > Solids > Solid Utilities > Extract Faces/Edges**.

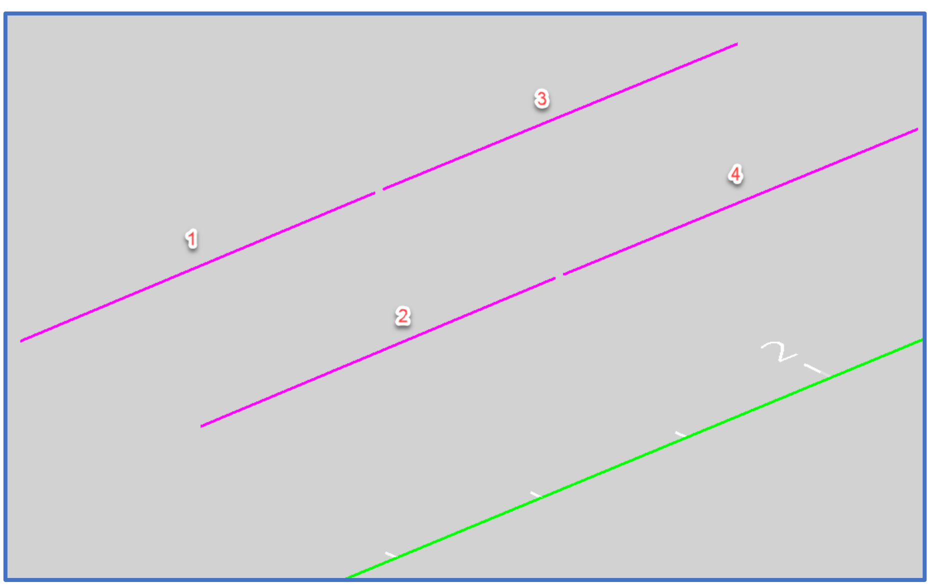


4. In the Extract Face/Edges window, set *Extract* to **Edges**, toggle the *Level, Color,* and *Weight* options on and set the level to **NonPlottingEle_dp**, with a more visible color/weight. Select one of the exterior FSBs and then select the top portion of the chamfer of the flange. When highlighted, it can be difficult to isolate the chamfer edge, so take care to properly locate it.

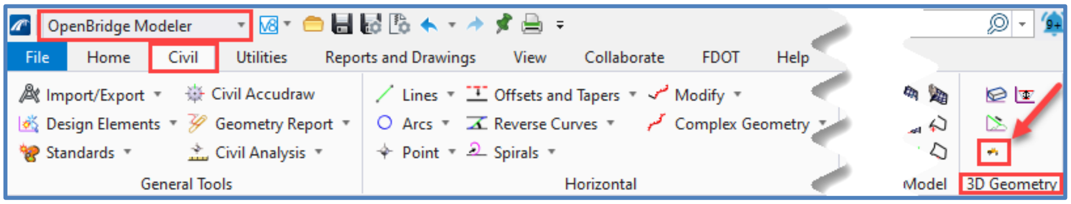




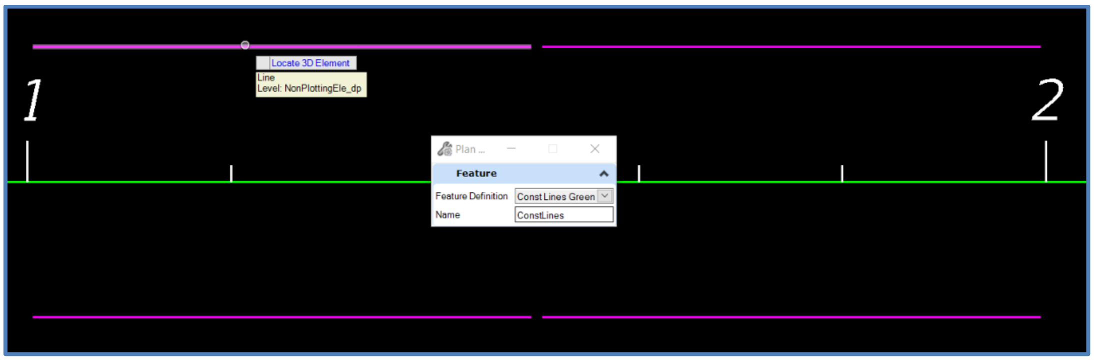
5. Repeat Step 4 for the exterior FSBs in both Span 1 and Span 2, for four total extracted edges. There should be four lines on the **NonPlottingEle_dp** level, visible on top of the FSB and more clearly visible if the **BeamConc_pm** level is turned off.

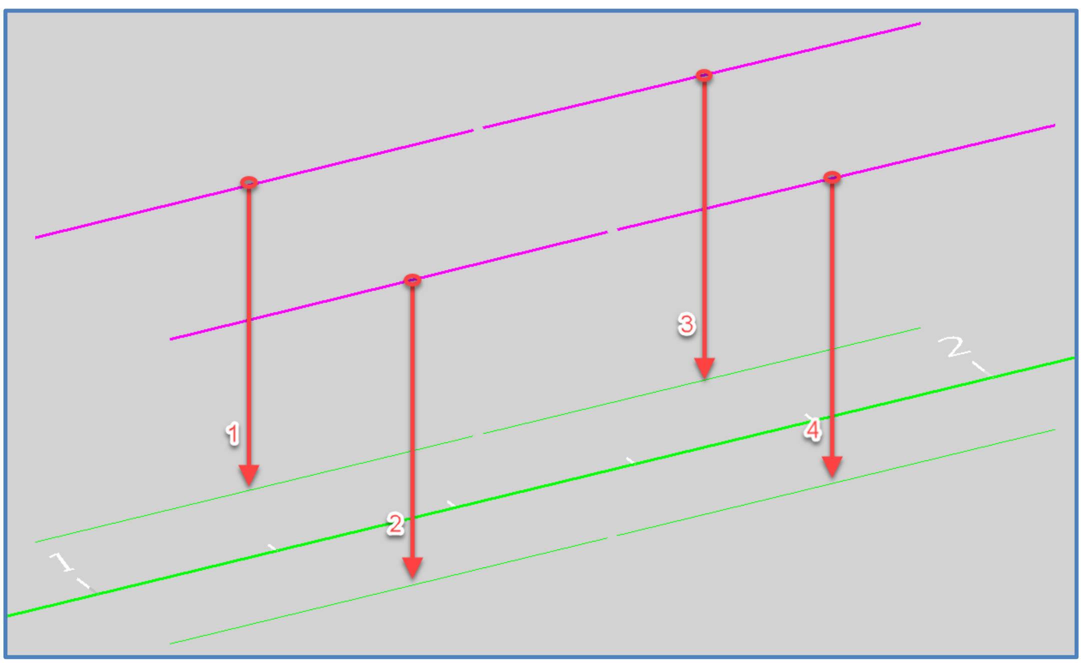


6. Point controls must use Civil geometry rather than Microstation linework, so Civil tools will need to be used to convert the Microstation lines to Civil geometry. Navigate to **OpenBridge Modeler (workflow) > Civil > 3D Geometry > Plan By 3D Element**.

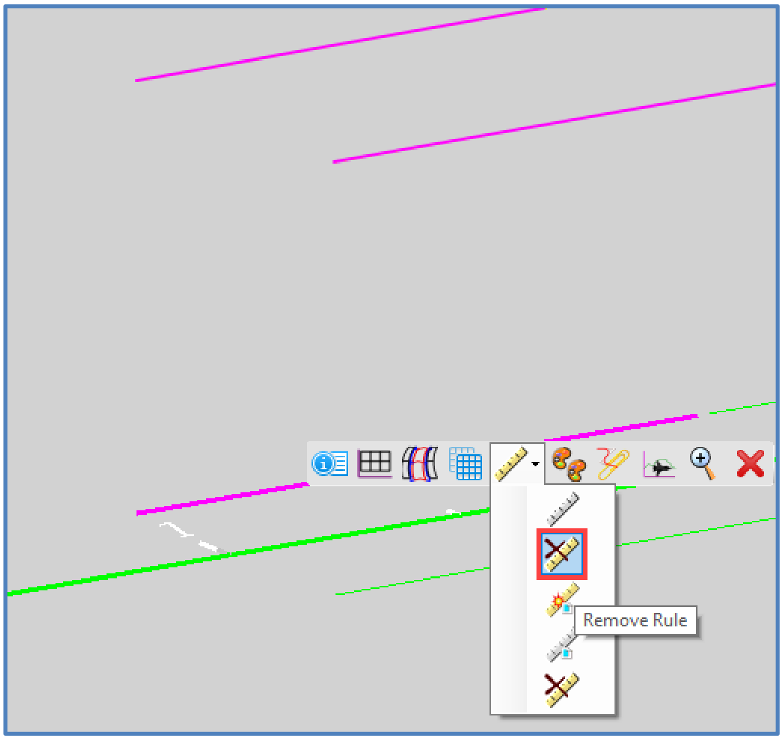


7. Set the **Feature Definition** to a construction feature and select each of the four scratch lines generated in Step 3 through Step 5. Corresponding 2D horizontal linework will be generated.

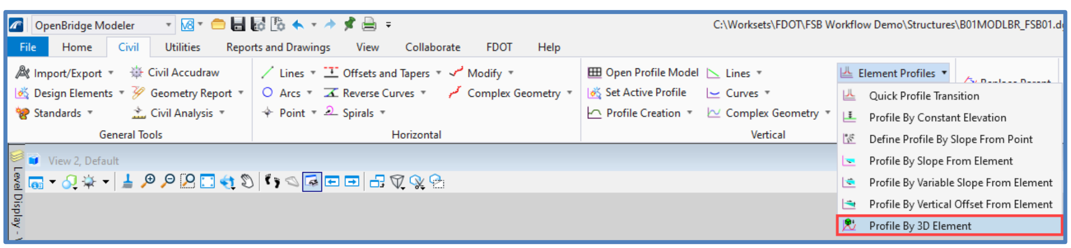




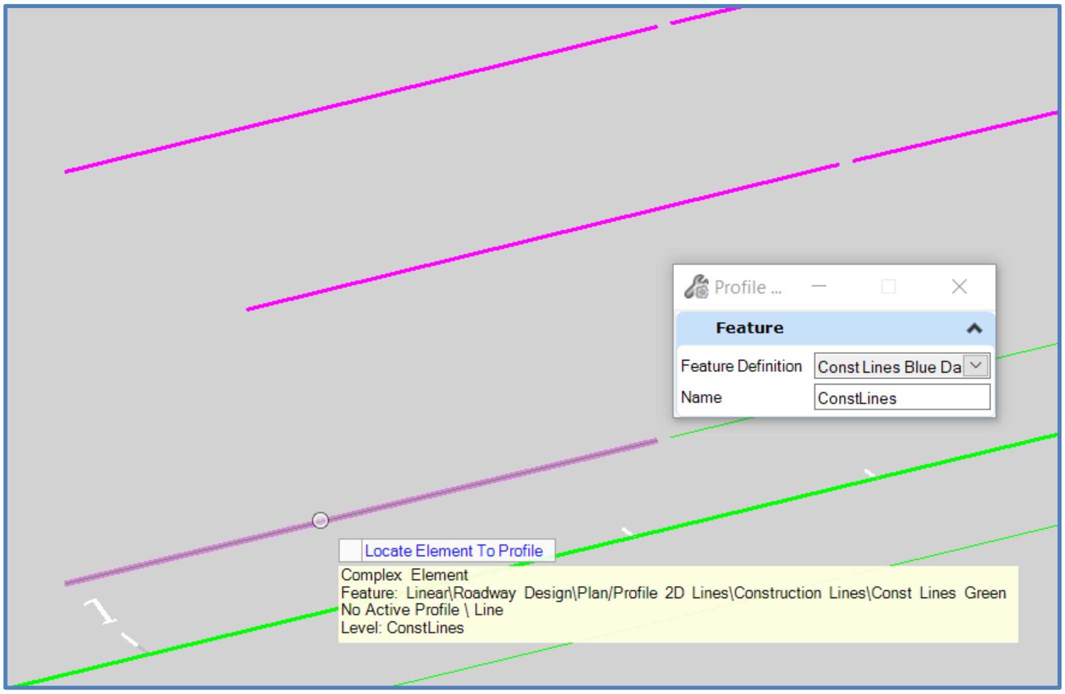
8. Remove the rule from each of the newly created horizontal geometry lines by left clicking each element, hovering over it, clicking the ruler symbol and selecting **Remove Rule**. This should be done for all four horizontal geometry lines so they can be profiled.

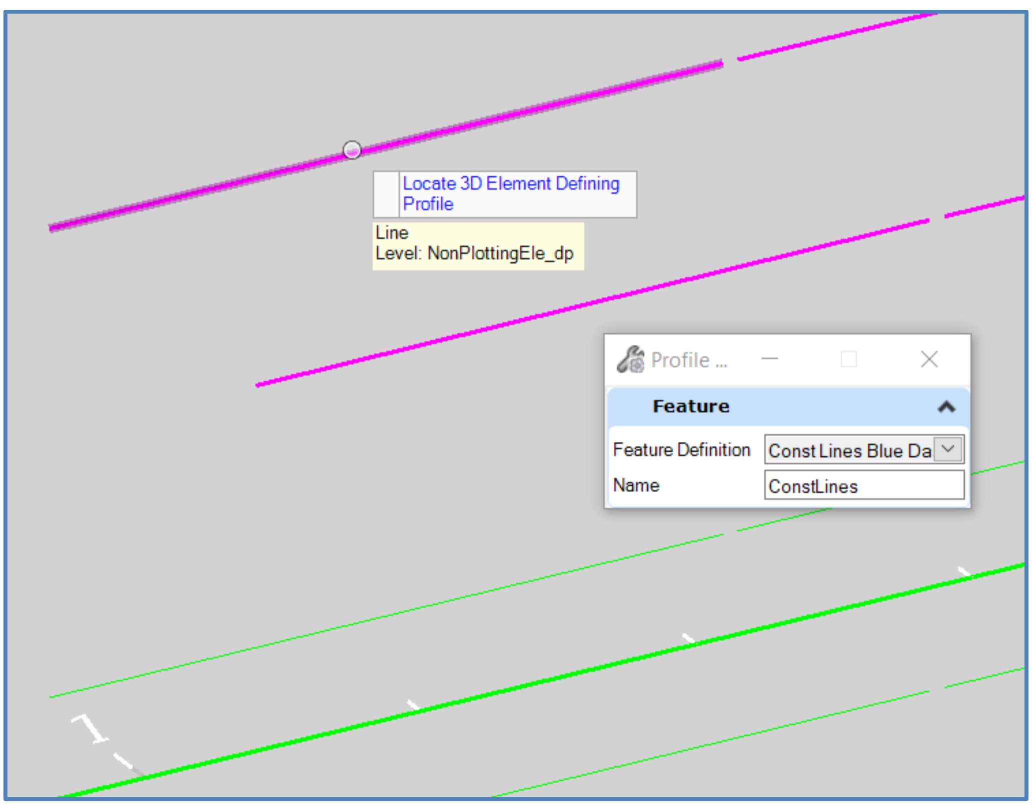


9. Next, create the profile for each of the lines by navigating to **Civil > Vertical > Element Profiles > Profile by 3D Element**.

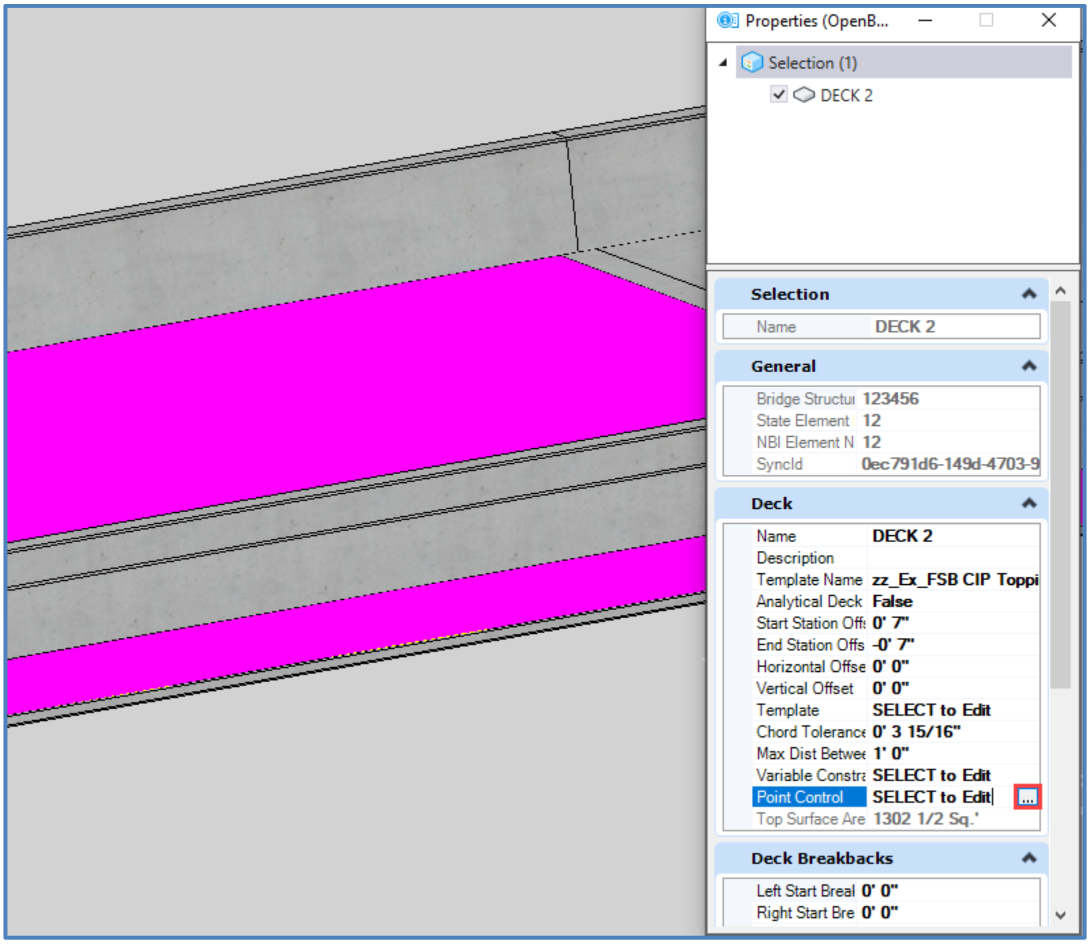


10. Set the **Feature Definition** to a construction feature (in this example a different one than the horizontal geometry was used), select one of the horizontal geometry lines, and then select the corresponding 3D linework that was extracted from the FSB edge in Step 3 through Step 5. Repeat this process for all four sets of horizontal geometry and corresponding 3D extracted edges.

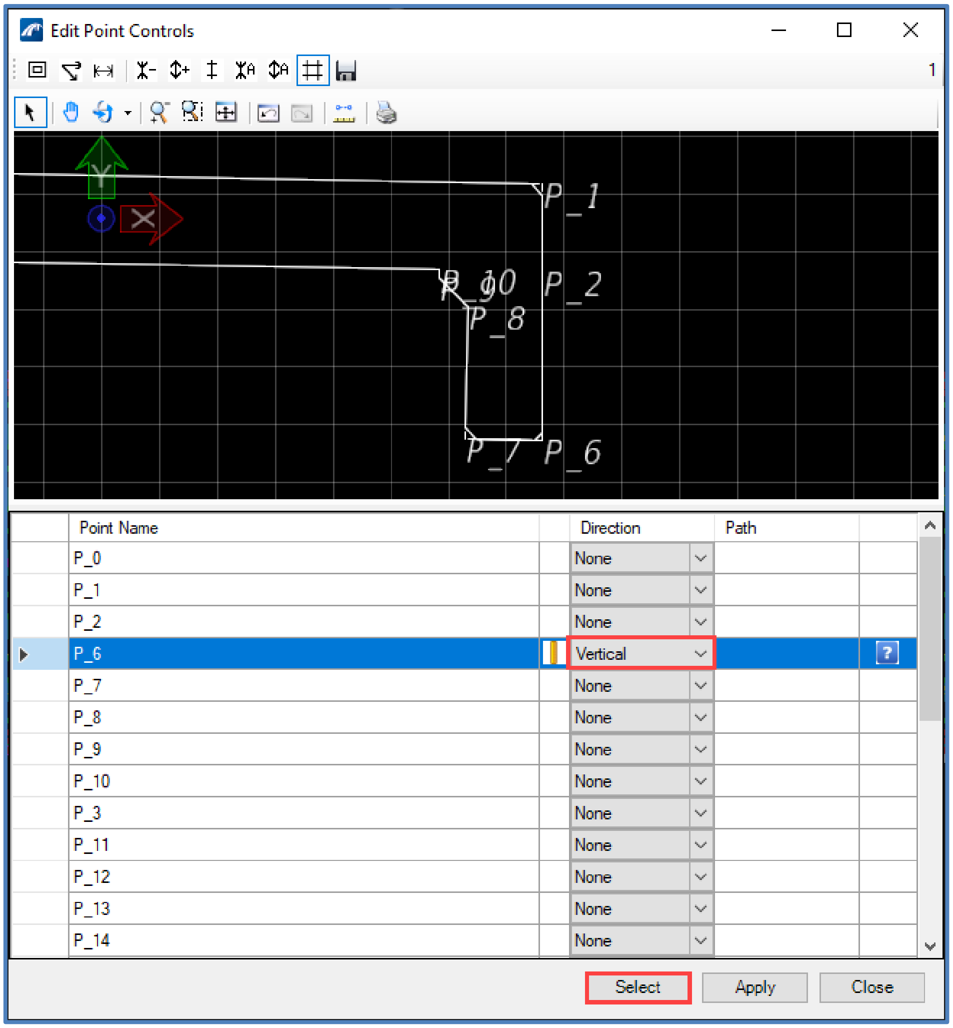


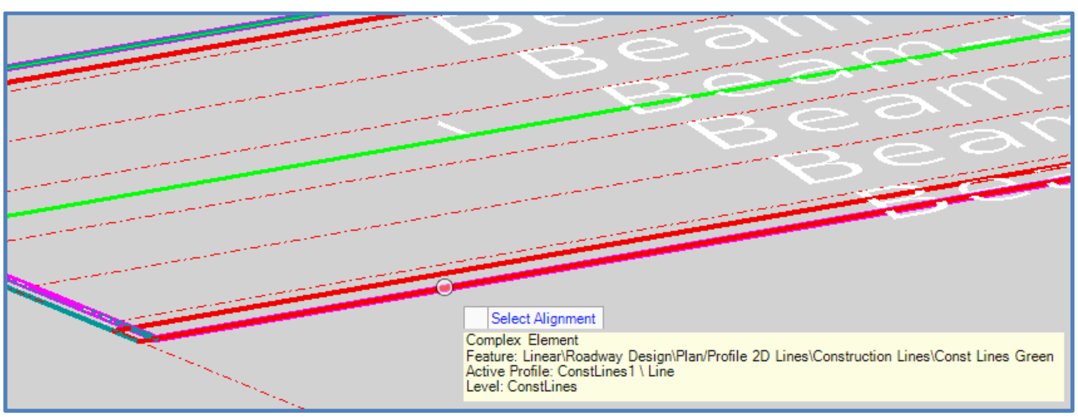


11. Now that the horizontal and vertical geometry is established, vertical point controls will be used to set the bottom of the CIP topping coping to follow the top of the FSB flange. Turn on the display of all the bridge elements again. Select the Span 1 CIP topping deck segment and open the *Properties* dialog box. Under *Deck*, click on **Point Control** and select the ellipses.

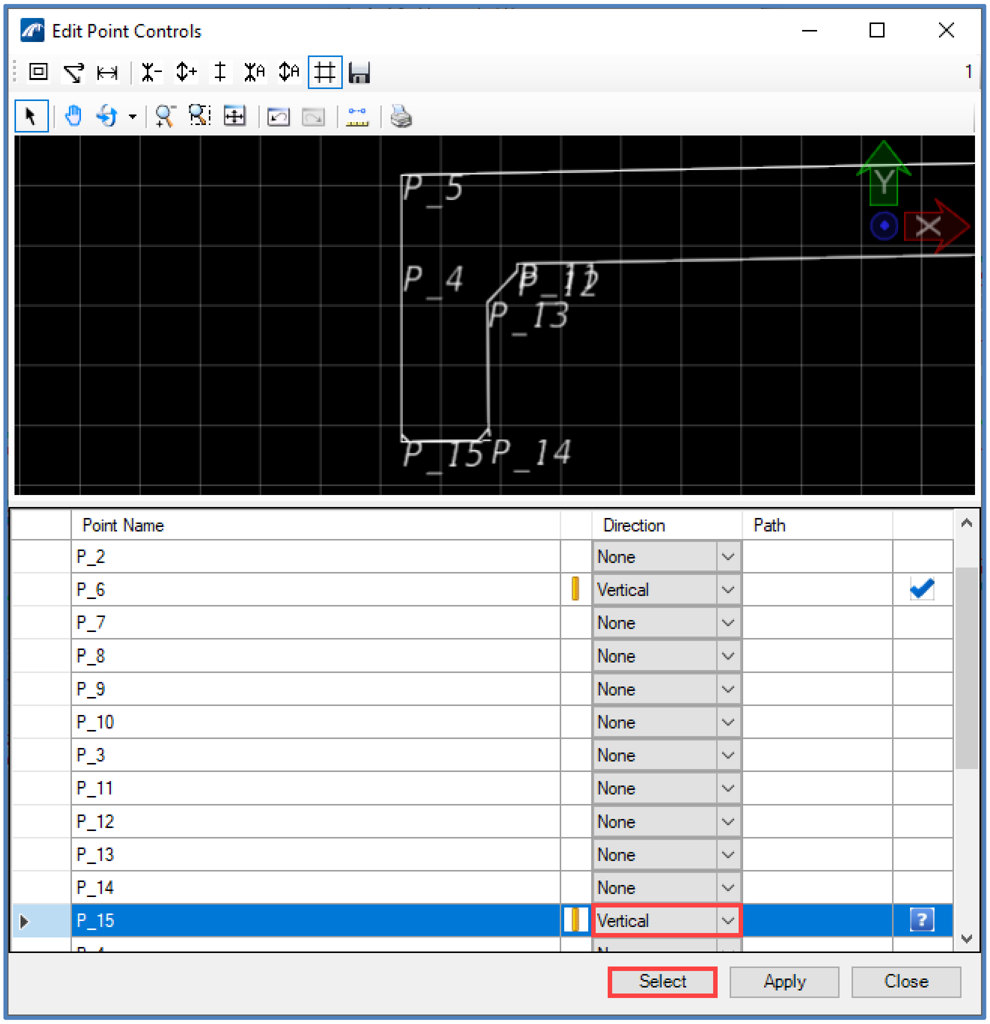


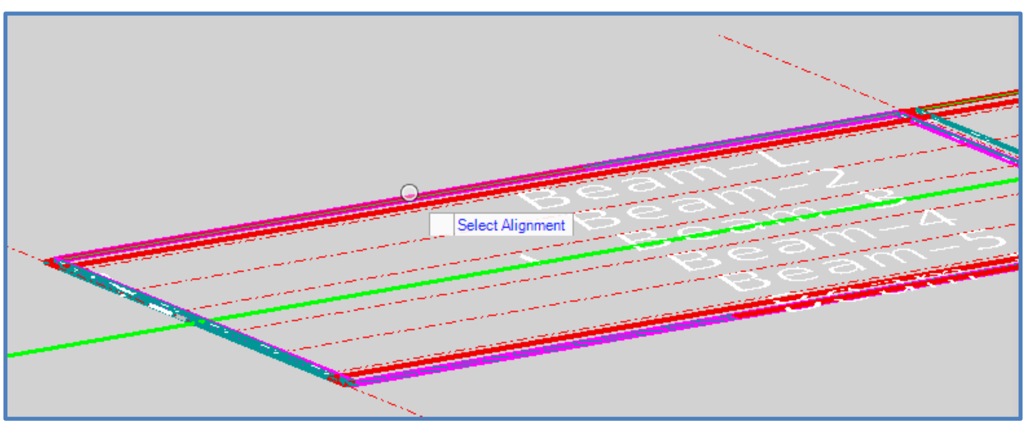
12. An *Edit Point Controls* window will open. For **P_6**, select **Vertical** for direction, and click **Select** on the bottom of the window. In the model view window, select the 2D alignment geometry in the corresponding span and on the corresponding side of the bridge. In this example, it is span one on the right side of the bridge. A blue check will appear on the P_6 line in the right-most column.



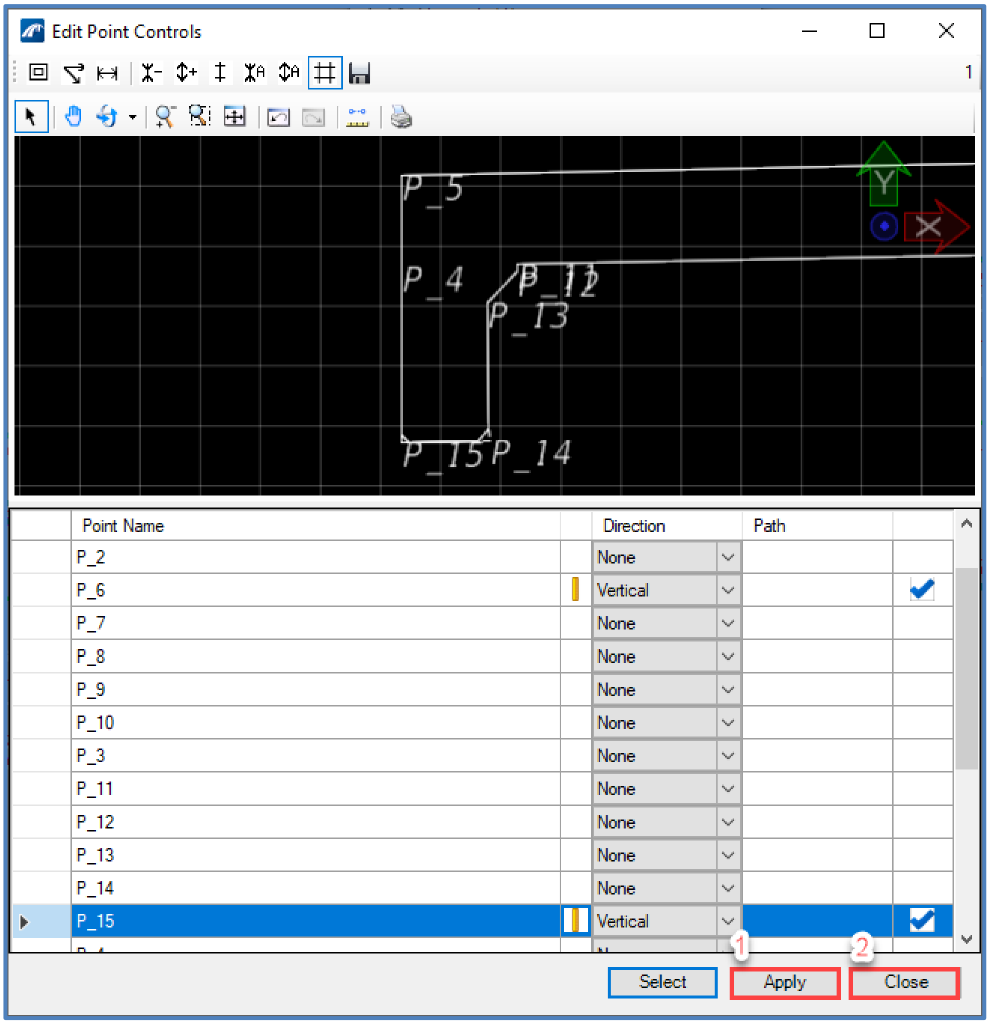


13. In the *Edit Point Controls* window, for **P_15**, select **Vertical** for direction, and click **Select** on the bottom of the window. In the model view window, select the 2D alignment geometry in the corresponding span and on the corresponding side of the bridge. In this example, it is span one on the left side of the bridge.



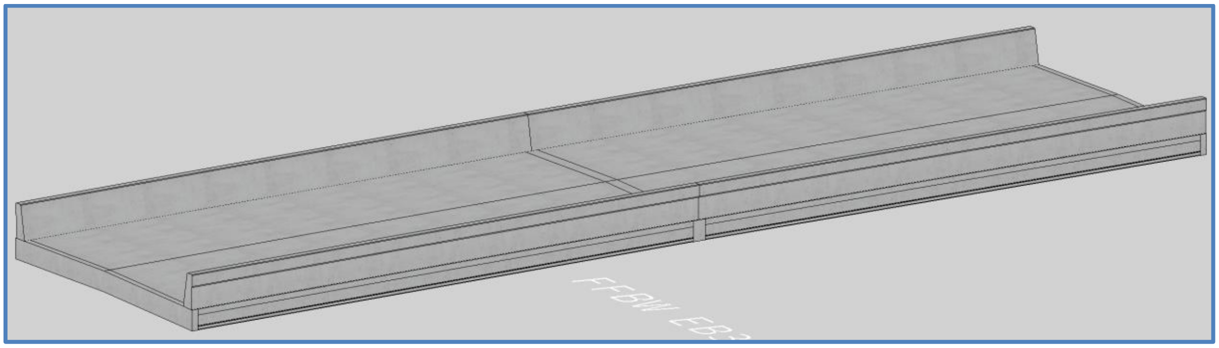


14. In the *Edit Point Controls* window, click **Apply** and then click **Close**. The deck unit selected now follows the top of the FSB flange.



15. Repeat Step 11 through Step 14 for the second span.

Note The extracted edges are not dynamically associated with the FSBs. Therefore, if the bridge geometry changes, the Civil profile will need to be adjusted. It is recommended that this optional step be completed after profile and bridge geometry are sufficiently progressed. FDOT is currently working with Bentley to allow the vertical point controls to be more dynamically linked to OBM elements, in this case the FSBs. The workflow document will be updated with any improvements to the tools available from Bentley.



SUBSTRUCTURE AND BEARINGS FOR FSB MODELS

The procedure for modeling substructure and bearings for FSB bridge models is similar to that of traditional prestressed Florida-I beam bridges. The unique geometry of FSB bridges will need to be considered, including but not limited to:

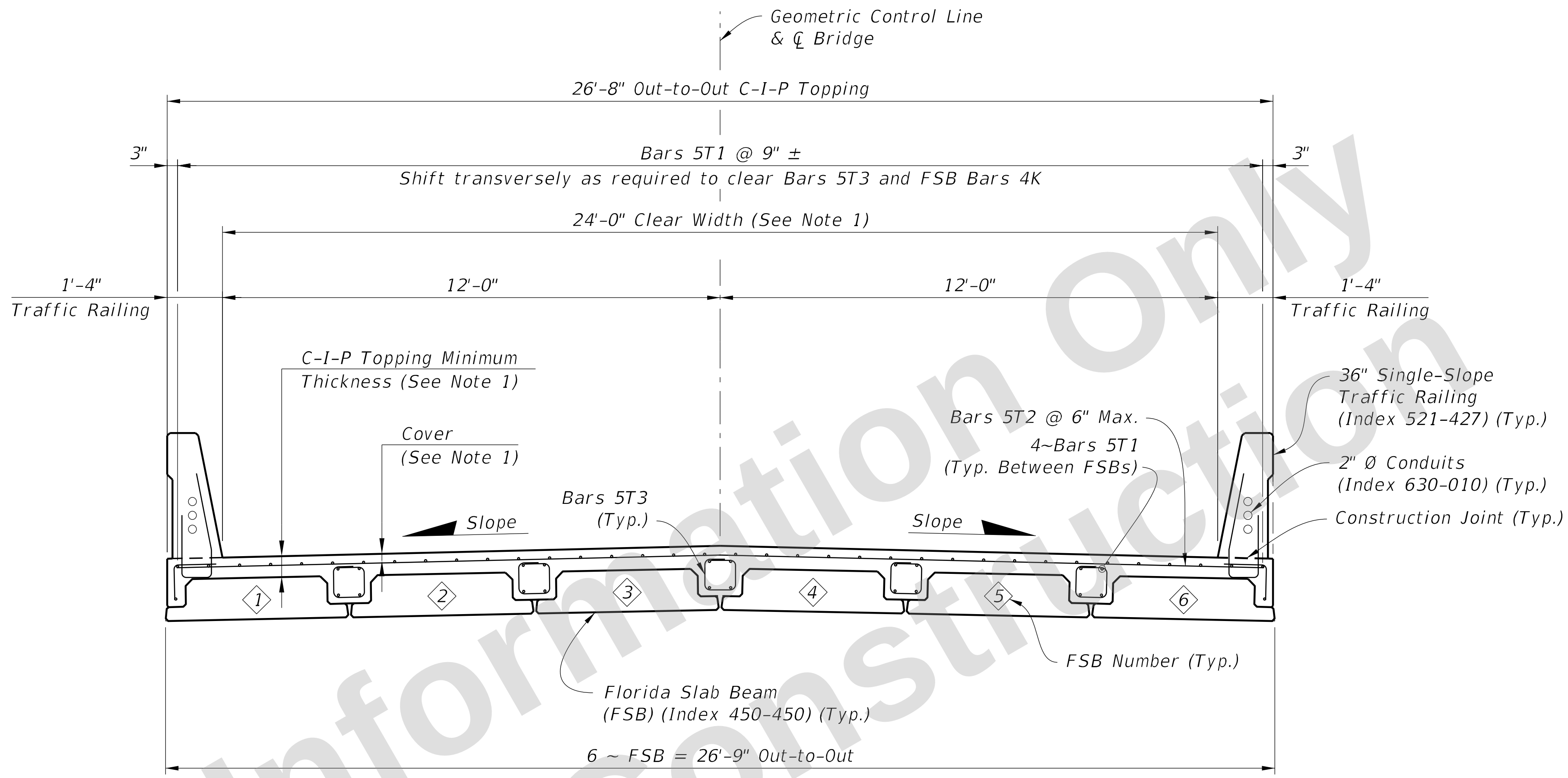
- Bent caps that will be sloped to follow the crown of the FSBs
  - Can utilize *Elevation Constraints* during pier or abutment placement
- If required, substructure transverse keeper blocks may be required
  - Can utilize cheekwalls to model keeper blocks
- Unique bearing offsets for FSB superstructure
  - See FSB Standard Plans Instructions for guidance
- Unique sizing for bearing pads and bearing line offset
  - Can utilize *Cube* type for bearings for required pad geometry
- GRS abutments may be used with FSB bridges
  - Modeling of GRS abutments within OBM to be researched further

FSB BRIDGE QUANTITIES

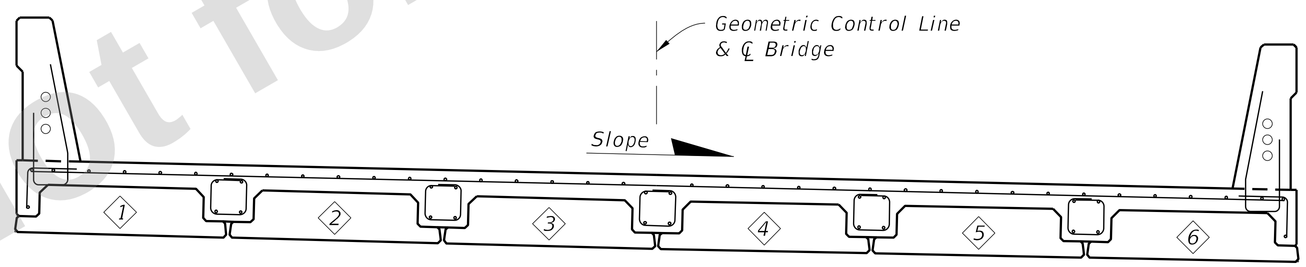
As is always the case with modeling bridges in OpenBridge Modeler, users must be aware of the level of detail to which they are modeling. This is especially important when it comes to utilizing the bridge model for structural design, geometry, or quantities. The following items are generally omitted when modeling an FSB bridge, and must be accounted for outside of OBM for quantity purposes:

- Transverse deck expansion joints (no native OBM tool at this time)
  - Deck gaps can be modeled if desired, but if no gaps are modeled then concrete quantity will be an overestimate.
- Longitudinal backer rod between FSBs

APPENDIX A:
FDOT Developmental Standard Plans
d400-324



TYPICAL SECTION THRU SUPERSTRUCTURE WITH CROWN



TYPICAL SECTION THRU SUPERSTRUCTURE WITH CONSTANT CROSS SLOPE

(SEE SECTION WITH CROWN ABOVE FOR ALL INFORMATION NOT SHOWN IN THIS SECTION)

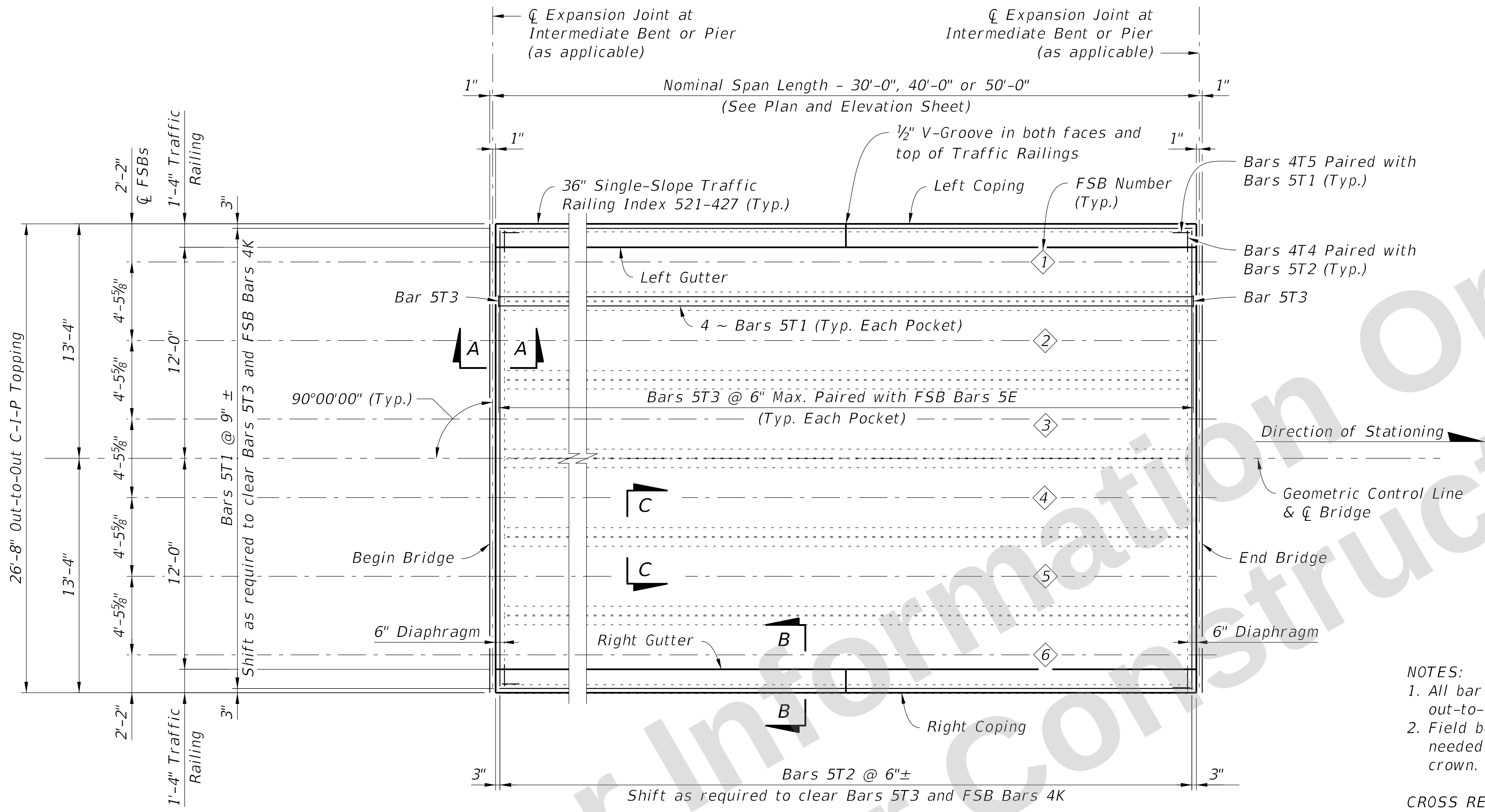
NOTES:

1. See Structure Plans General Notes for Topping minimum thickness and cover.
2. Work this Index with Developmental Index D400-300.

SUPERSTRUCTURE TYPICAL SECTION

LAST REVISION 11/01/20	REVISION	DESCRIPTION:	FDOT DEVELOPMENTAL STANDARD PLANS	FSB SUPERSTRUCTURE PACKAGE 24 FT. CLEAR WIDTH	INDEX D400-324	SHEET 1 of 4

STIMES
SDATES



SUPERSTRUCTURE PLAN
(ONE SPAN SHOWN)

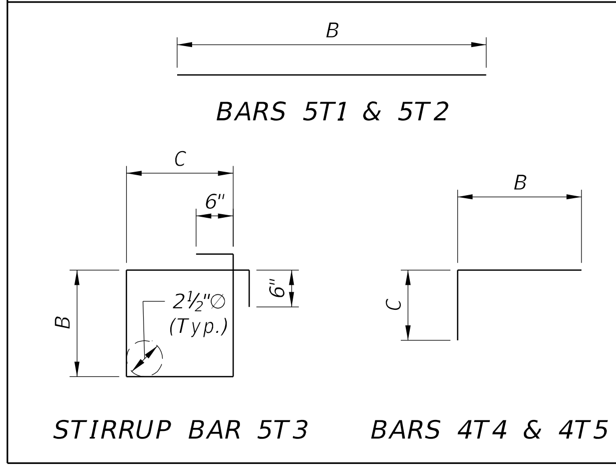
NOTES:
1. All bar dimensions are out-to-out.
2. Field bend Bars 5T2 as needed to accommodate crown.

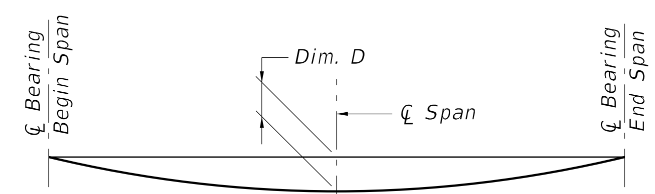
CROSS REFERENCE:
See Index D400-300, Sheet 2 for Sections A-A, B-B and C-C.

BILL OF REINFORCING STEEL FOR ONE SPAN ONLY

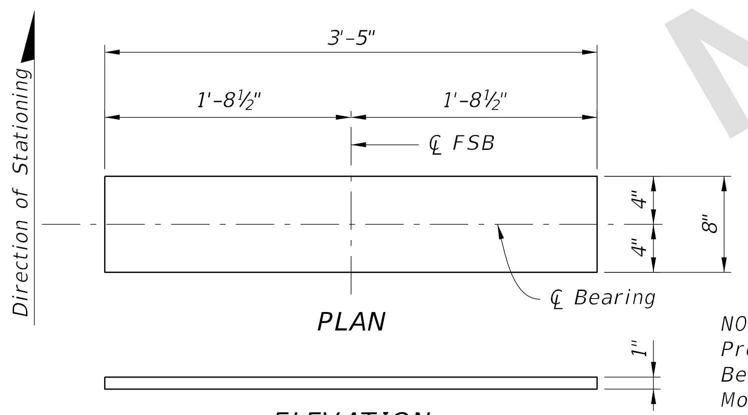
NOMINAL SPAN LENGTH	MARK SIZE	MARK DES	LENGTH	NO. OF BARS	B	C
30'-0"	5	T1	29'-6"	58	29'-6"	
	5	T2	26'-4"	62	26'-4"	
	5	T3	4'-2"	300	9½"	9½"
	4	T4	2'-2"	120	1'-6"	8"
	4	T5	2'-6"	72	1'-6"	1'-0"
40'-0"	5	T1	39'-6"	58	39'-6"	
	5	T2	26'-4"	82	26'-4"	
	5	T3	4'-2"	400	9½"	9½"
	4	T4	2'-2"	160	1'-6"	8"
	4	T5	2'-6"	72	1'-6"	1'-0"
50'-0"	5	T1	49'-6"	58	49'-6"	
	5	T2	26'-4"	102	26'-4"	
	5	T3	4'-7"	500	1'-0"	9½"
	4	T4	2'-5"	200	1'-6"	11"
	4	T5	2'-9"	72	1'-6"	1'-3"

BENDING DIAGRAMS





DEAD LOAD DEFLECTION DIAGRAM



BEARING PAD DETAIL

NOTE:
Provide plain elastomeric Bearing Pads with a Shear Modulus G = 110psi and in accordance with Specification Section 932.

FLORIDA SLAB BEAM - CAMBER AND DEFLECTION DATA TABLE

SPAN LENGTH (ft.)	BEAM NO.	NET BEAM CAMBER (PRESTRESS - DEAD LOAD OF BEAM) @ 120 DAYS (in.)	DIM D DEAD LOAD DEFLECTION DUE TO TOPPING POUR @ 120 DAYS (in.)
30	1-6	⅜"	⅛"
40	1-6	⅞"	⅝"
50	1-6	1⅛"	⅞"

CAMBER NOTE:

The values given in the table are based on theoretical beam cambers. The Contractor shall monitor beam cambers for the purpose of predicting camber values at the time of the topping casting. If the predicted cambers based on field measurements differ more than ± ½" from the theoretical "Net Beam Camber @ 120 Days" shown in the table, propose modified dimensions as required and submit to the Engineer for approval a minimum of 21 days prior to casting topping concrete.

SUPERSTRUCTURE PLAN

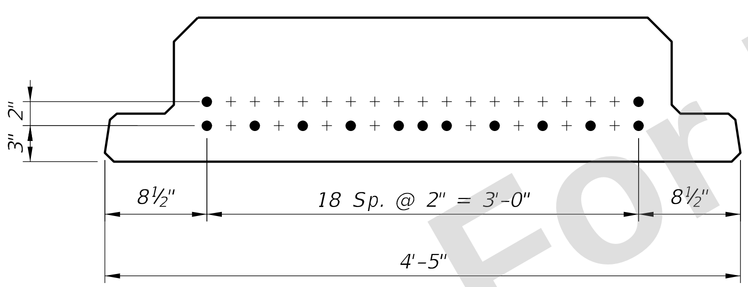
FLORIDA SLAB BEAM - TABLE OF VARIABLES

NOMINAL SPAN LENGTH	LOCATION	BEAM TYPE	CONCRETE PROPERTIES			STND. PTRN.	PLAN VIEW CASE		ANGLE Ø		BEAM DIMENSIONS*			REINFORCING STEEL																
	BEAM NO.		CLASS	STRENGTHS (psi)										3C		4D1	4D2	4D3		5E1		5E2		6Y1	6Y2	4K	NO. OF BAR SPACES		BAR SPACING*	
				28 Day	Release	TYPE	END 1	END 2	END 1	END 2	DIM W	DIM L	DIM R	NO.	DIM C	DIM D	DIM D	NO.	DIM D	NO.	DIM E	NO.	DIM E	DIM Y	DIM Y	NO.	S1	S2	V1	V2
30'	1,6	FSB 12x53	VI	8500	6000	1	1	1	90°	90°	4'-5"	28'-10¼"	¼"	31	4'-0½"	2'-2½"	2'-2½"	24	2'-2½"	–	–	57	4'-1½"	3'-0½"	3'-0½"	84	1	8	1'-6"	1'-6"
	2-5	FSB 12x53	VI	8500	6000	1	1	1	90°	90°	4'-5"	28'-10¼"	¼"	31	4'-0½"	2'-2½"	2'-2½"	24	2'-2½"	57	4'-3"	–	–	3'-0½"	3'-0½"	84	1	8	1'-6"	1'-6"
40'	1,6	FSB 12x53	VI	8500	6000	2	1	1	90°	90°	4'-5"	38'-10⅜"	⅜"	41	4'-0½"	2'-2½"	2'-2½"	32	2'-2½"	–	–	77	4'-1½"	3'-0½"	3'-0½"	156	8	10	6"	1'-6"
	2-5	FSB 12x53	VI	8500	6000	2	1	1	90°	90°	4'-5"	38'-10⅜"	⅜"	41	4'-0½"	2'-2½"	2'-2½"	32	2'-2½"	77	4'-3"	–	–	3'-0½"	3'-0½"	156	8	10	6"	1'-6"
50'	1,6	FSB 15x53	VI	8500	6000	3	1	1	90°	90°	4'-5"	48'-10½"	½"	51	4'-0½"	2'-2½"	2'-2½"	44	2'-2½"	–	–	97	4'-1½"	3'-0½"	3'-0½"	148	4	13	1'-0"	1'-6"
	2-5	FSB 15x53	VI	8500	6000	3	1	1	90°	90°	4'-5"	48'-10½"	½"	51	4'-0½"	2'-2½"	2'-2½"	44	2'-2½"	97	4'-3"	–	–	3'-0½"	3'-0½"	148	4	13	1'-0"	1'-6"

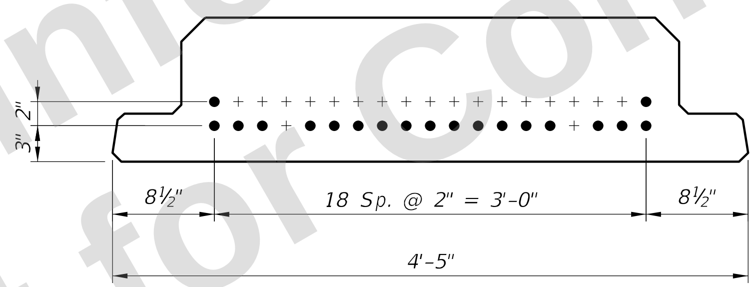
NOTE: Work this sheet with Standard Plans Index Series 450-450.

DIMENSION NOTES

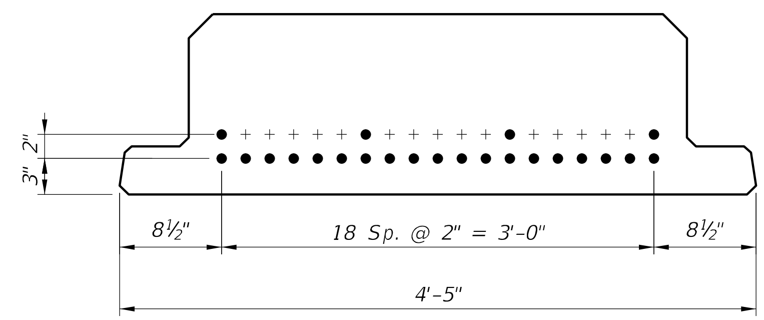
* All longitudinal slab beam dimensions shown on this sheet with a single asterisk (*) are measured along the top of beam at the centerline. Dimension "R" is calculated at mid-height of the slab beam.



TYPE (1) 13 STRANDS



TYPE (2) 19 STRANDS



TYPE (3) 23 STRANDS

STRAND DESCRIPTION: Use 0.60" Diameter, Grade 270, Low Relaxation Carbon Steel Strands stressed at 44.0 kips each. Area per strand equals 0.217 sq. in.

STRAND DEBONDING LEGEND

● - fully bonded strands.

STRAND PATTERNS

SDATES STIMES

Load Rating Summary Details for Prestressed Concrete Bridges (Flat Slab and Deck/Girder)

Table 2 - LRFR

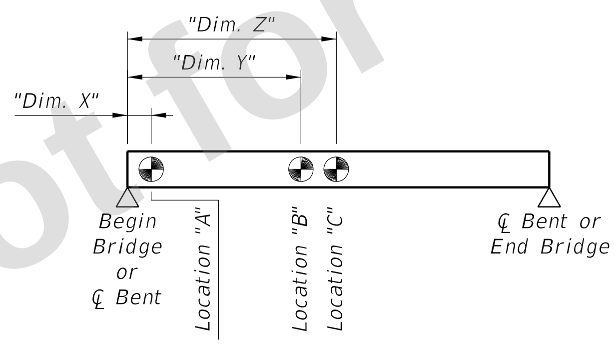
Span Length (Ft)	Level	Limit State	Vehicle	Weight (tons)	Load Factors LL	Load Factors DC	Load Factors DW	Moment (Strength) or Stress (Service) Distribution Factor (DF)	Moment Rating Factor	Moment Tons	Moment Location	Moment Dimension (Ft)	Shear (Strength) Distribution Factor (DF)	Shear Rating Factor	Shear Tons	Shear Location	Shear Dimension (Ft)	Comments: Interior/exterior beam DF method if other than LRFD. Other appropriate comments
30	Design Load Rating	Strength I (Inv)	HL-93	N/A	1.75	1.25	1.50	0.42	1.78	N/A	C	13.32	0.66	4.30	N/A	A	1.39	Exterior Beam
		Strength I (Op)	HL-93	N/A	1.35	1.25	1.50	0.42	2.31	N/A	C	13.32	0.66	5.58	N/A	A	1.39	Exterior Beam
		Service III (Inv)	HL-93	N/A	0.80	1.00	1.00	0.42	1.68	N/A	C	13.32	N/A	N/A	N/A	N/A	N/A	Exterior Beam
	Permit Load Rating	Strength II	FL120	60.0	1.35	1.25	1.50	0.42	1.96	117.54	B	10.54	0.66	3.78	226.82	A	1.39	Exterior Beam
40	Design Load Rating	Strength I (Inv)	HL-93	N/A	1.75	1.25	1.50	0.40	1.57	N/A	C	18.50	0.63	4.54	N/A	A	4.15	Exterior Beam
		Strength I (Op)	HL-93	N/A	1.35	1.25	1.50	0.40	2.04	N/A	C	18.50	0.63	5.88	N/A	A	4.15	Exterior Beam
		Service III (Inv)	HL-93	N/A	0.80	1.00	1.00	0.40	1.21	N/A	C	18.50	N/A	N/A	N/A	N/A	N/A	Exterior Beam
	Permit Load Rating	Strength II	FL120	60.0	1.35	1.25	1.50	0.40	1.53	91.73	B	16.99	0.63	4.05	242.89	A	4.15	Exterior Beam
50	Design Load Rating	Strength I (Inv)	HL-93	N/A	1.75	1.25	1.50	0.38	1.49	N/A	C	22.44	0.62	4.53	N/A	A	1.43	Exterior Beam
		Strength I (Op)	HL-93	N/A	1.35	1.25	1.50	0.38	1.93	N/A	C	22.44	0.62	5.87	N/A	A	1.43	Exterior Beam
		Service III (Inv)	HL-93	N/A	0.80	1.00	1.00	0.38	1.08	N/A	C	22.92	N/A	N/A	N/A	N/A	N/A	Exterior Beam
	Permit Load Rating	Strength II	FL120	60.0	1.35	1.25	1.50	0.38	1.43	85.68	B	21.49	0.62	4.20	251.83	A	1.43	Exterior Beam

NOTES:
1. Permit capacity is determined by using the permit vehicle in all lanes.
2. Service III Design Inventory tensile stress limits = $3\sqrt{f'c}$.
3. Has the AASHTO LRFD Specifications Article 5.8.3.5 longitudinal reinforcement been satisfied? ☒ Yes ☐ No

Abbreviations:

Inv – Inventory

Op – Operating



RATING LOCATIONS

STIMES

SDATES