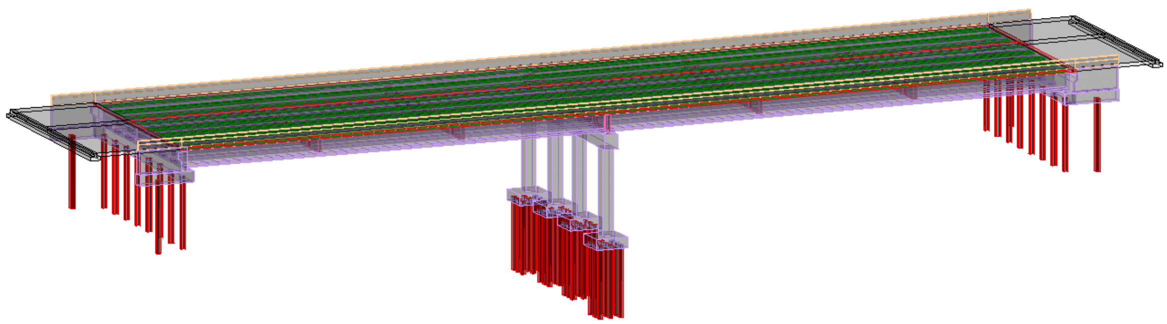
3D BRIDGE MODELING I

OpenBridge Modeler

CONNECT Edition



TDOT

Structures Division

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TN TDOT Department of Transportation

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Preface

Purpose & Need

The ***3D BRIDGE MODELING I*** OpenBridge Modeler (OBM) Manual is the first document in a series of training manuals to be released by the Tennessee Department of Transportation (TDOT). Bentley's OBM software is being adopted and implemented statewide by TDOT as the new **3D modeling** design software, which will ultimately replace MicroStation V8i. This manual provides introductory exercises using the OBM **3D modeling** workflow. Analysis and structural design are performed outside of OBM and, therefore, are not covered in this manual. Additional documentation on advanced topics such as steel bridges, skewed substructure, and plans production will be released in the future. Development is ongoing for workspace customization, standards, and naming conventions.

Disclaimer

The ***3D BRIDGE MODELING I*** Manual is developed based on OpenBridge Designer CONNECT Edition 2021 Release 2, Version **10.10.20.34** (OpenBridge Modeler CONNECT Edition 2021 Release 2, Version **10.10.20.92**). The combined TDOT OpenRoads Designer (ORD)/OpenBridge Modeler (OBM) workspace (**10.10.20.34**) should be used in conjunction with this manual, but the workspace is not yet fully configured for OBM. If you have any technical issues or recommendations for this manual, please contact TDOT CADD Support at TDOT.ORD@tn.gov.

When new versions of OpenBridge Modeler are released, there may or may not be a schema change. For example, when going from 10.10 to 10.11, there is a schema change. However, when going from 10.10 R1 to 10.10 R2, there is no schema change. When attempting to open an older file in a newer version of the program, the file will automatically be upgraded to the latest file format. A back-up file with an extension of .bak will be automatically created to preserve the file in the previous version.

Starting with 2021 Release 1, OpenBridge Modeler now supports side-by-side installation. This means you could have a previous version of OBM on the same machine, and without uninstalling it, you could install the new version on the same machine. You simply choose the version you wish to run. Note that there are separate install folders for each new version

Chapter 1. Course Overview

Course Description and Objectives:

This course introduces users to the **modeling** functionality of the OpenBridge Modeler (OBM) CONNECT software, which is Bentley's current drafting and design platform that has been adopted for use by TDOT. This course was designed to be an exercise-only manual, without a lecture component. While tips and notes are present throughout, users who are not familiar with Bentley CONNECT software (MicroStation, OpenRoads Designer, etc.), may find it helpful to review TDOT's Fundamentals (ORD) Manual since many of the non-bridge concepts and workspace setup are identical.

At the conclusion of this course, participants will be able to:

1. Create an OBD file, a WorkSet, an OBM file, and add references.
2. Model a Bridge Deck and Barriers.
3. Create a Beam Layout, Model Beams, and Add Diaphragms.
4. Model Abutments, Wingwalls, Piers, and Bearings.
5. Create Approach Slabs and Sleeper Slabs

Target Audience:

This course is designed for Project Development staff, or anyone using the modeling tools for highway and bridge design.

Pre-Requisites:

- Familiarity with TDOT's design policies, procedures, and standards.
- A working knowledge of Windows 10.
- While not required, a review of the Fundamentals (ORD) Manual may be helpful.

Chapter 2. OpenBridge Modeler (OBM) Exercises

The exercises in this chapter are intended to give users a basic understanding of the process for creating a 3D bridge model. The goal is to create a bridge model that will integrate with the ORD models developed by other disciplines on a project.

In this case, we will access **OpenBridge Modeler (OBM)** within **OpenBridge Designer (OBD)**. However, the process would be similar if accessing OBM separately.

In general, the **Explorer** can be opened within the **Primary** tools, if needed. Refer to the Fundamentals (ORD) Manual for more insight on the **Explorer**. Feature Definitions are contained within a library and are part of the overall workspace managed by TDOT CADD support and cannot be edited.

Take Note!

*Any data entered within a tool can be edited after placement using **Properties** (**OpenBridge Modeler >> Primary >> Properties**). You can also isolate and select different bridge elements using the OpenBridge Model tab of the **Explorer** (**OpenBridge Modeler >> Primary >> Properties**) and expanding the elements. See Bentley Help (**OpenBridge Modeler >> Help >> Help Contents**) for more information on the tools used in this manual.*

2.1 Objectives

At the conclusion of this chapter, participants will be able to:

1. Create a new workset, a new OBD file, a new OBM file, and reference Roadway Geometry and Terrain files.
2. Model a bridge deck and add barriers.
3. Place a beam layout, beams, and add intermediate/end diaphragms.
4. Model abutments with wingwalls, pier, and bearing elements.
5. Create approach slabs (Reinforced Concrete Pavement at Bridge Ends) with barriers and sleeper slabs.

2.2: WorkSet/File Creation and References

In the following exercises, we will create a workset and OBD file both named **123456.00_OBM_TR** and a bridge model named **TDOT_TR_OBM_Model.dgn**, which will then be used for the upcoming exercises. We will then attach the Roadway references required to begin modeling a bridge.

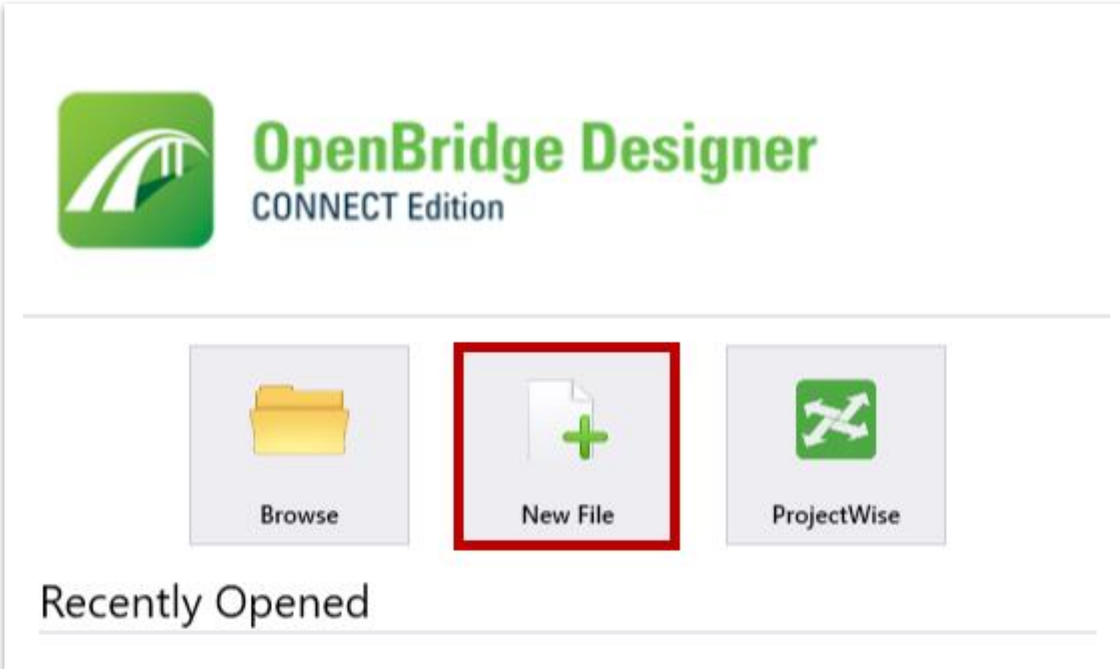
Take Note!

The file names used in this manual serve as general guidance for training purposes only. The procedures are intended to teach the necessary tools and TDOT's OBM workspace.

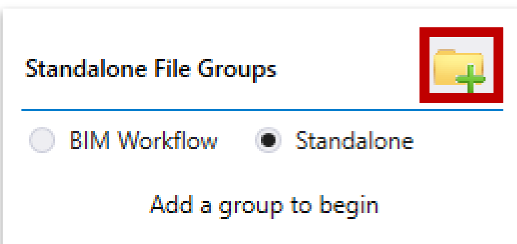
2.2.1 Exercise: OpenBridge Designer (OBD) File and WorkSet Creation

In this exercise, we will create an OBD file that will be used to access OBM and can also be used to access other Bentley analysis software: LEAP Bridge Steel, LEAP Bridge Concrete, and RM Bridge. We will then create a new workset.

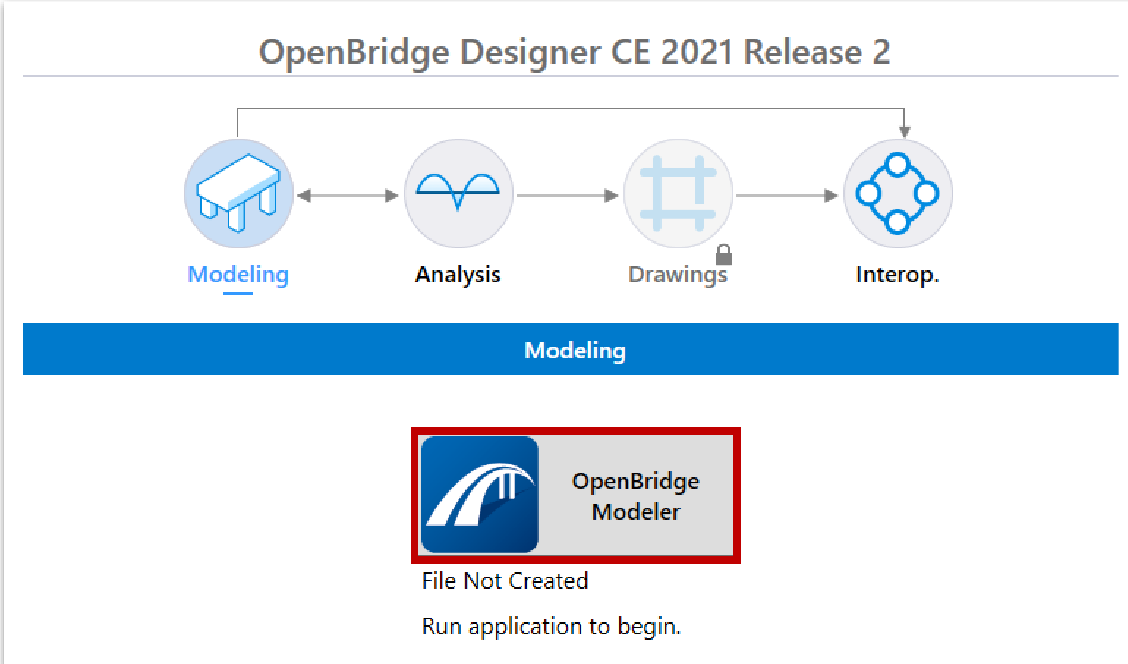
1. Launch OBD from your desktop or Windows menu. Select **New File** and enter the name of the OBD file: **123456.00_OBM_TR.obdx**. Save the file to your desktop.



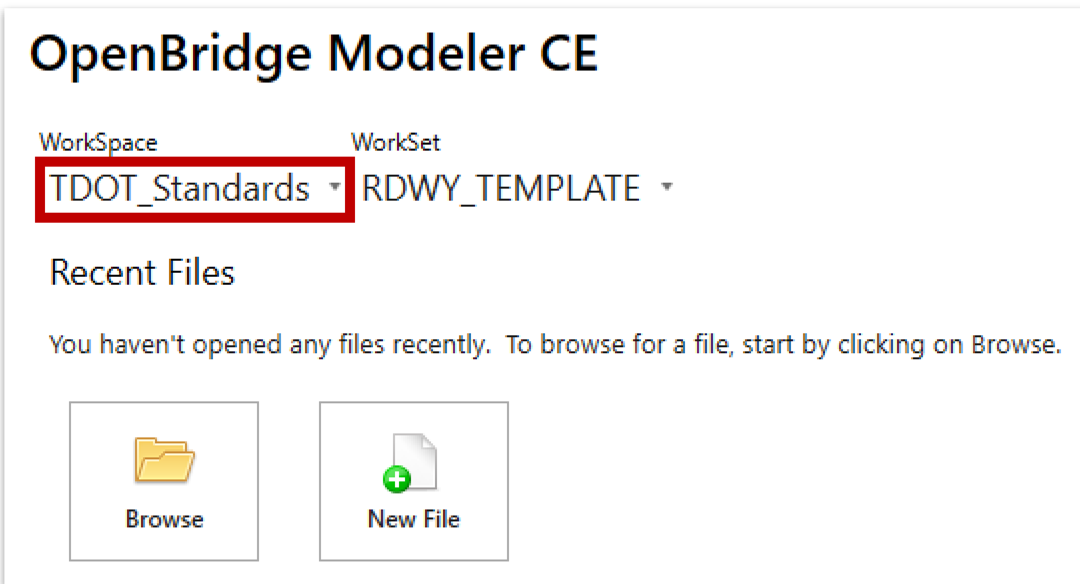
2. Select **Standalone** in the left panel and then select the **Add Standalone Group** button. Name the group **TDOT_OBM_TR** and click **OK**.



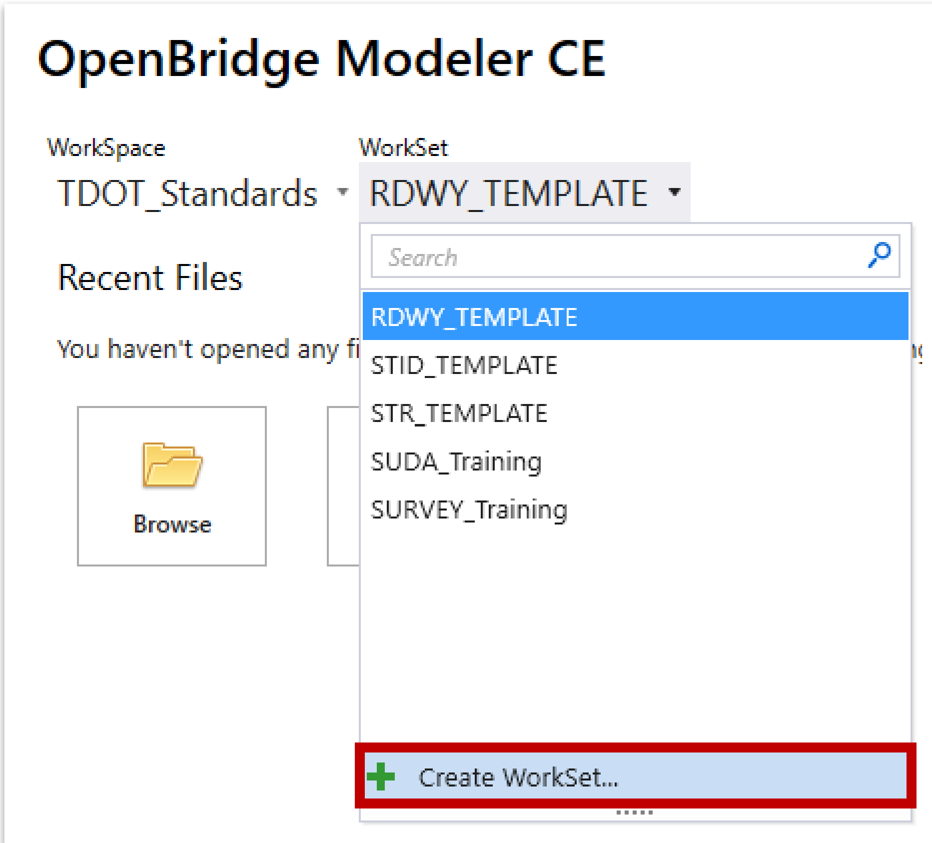
3. Select the **OpenBridge Modeler** button and OBM will launch in another window. If not using OBD, simply select the OBM icon from your desktop or Windows menu.



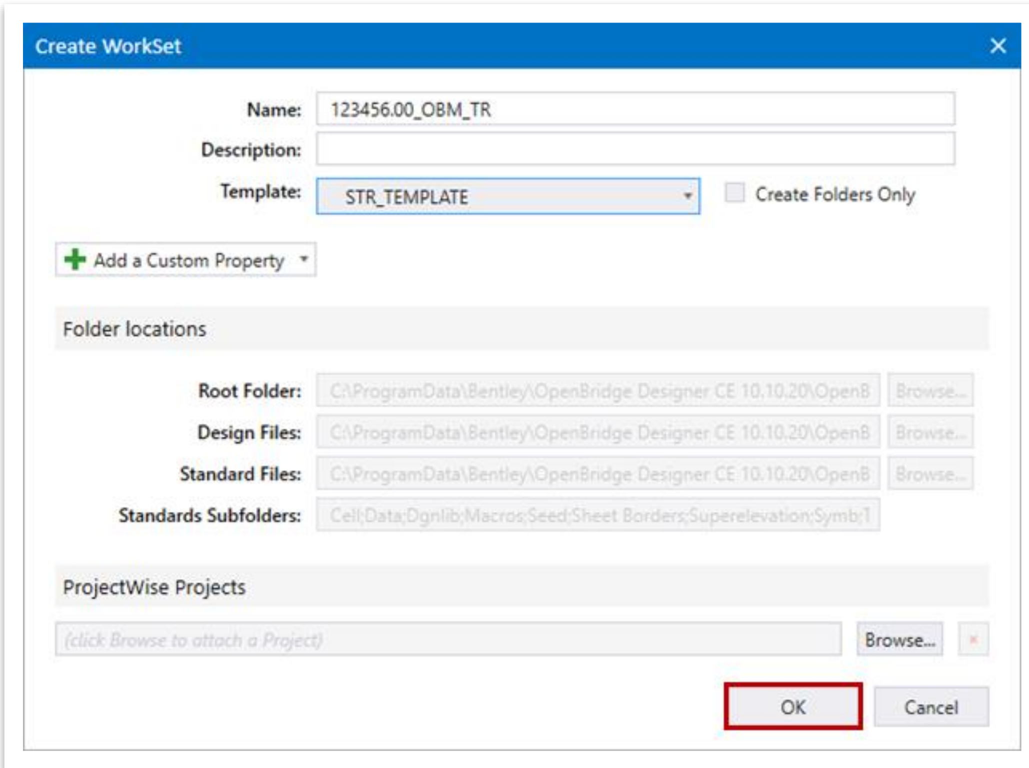
4. Select the **TDOT_Standards** Workspace from the drop-down menu. The first time you open OBM, it will show No WorkSpace by default. Each time thereafter, it should remember the TDOT_Standards Workspace and have it prepopulated. Notice that after selecting the workspace, by default it populates the WorkSet with **RDWY_TEMPLATE** (alphabetical order).



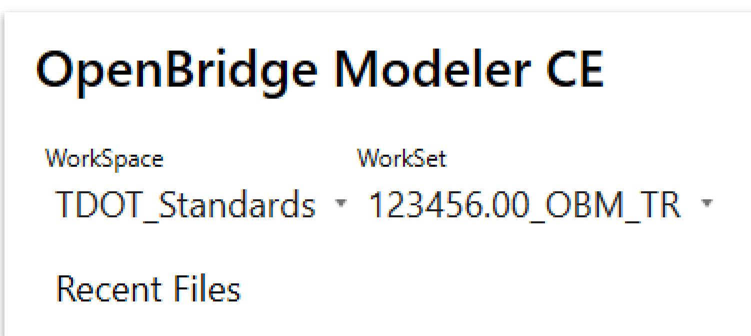
5. Before we create a new file, we need to create a new project **WorkSet**. Select **Create WorkSet** from the workset drop-down menu.



6. The **Create WorkSet** dialog will appear.
    a. Type the name **123456.00_OBM_TR**.
    b. Select the **STR_TEMPLATE** as the template. Plans production will be covered in a future OBM manual.
    c. Leave the **Create Folders Only** option in the top right section unchecked and click **OK**.



7. Notice your new project **WorkSet** is now populated.



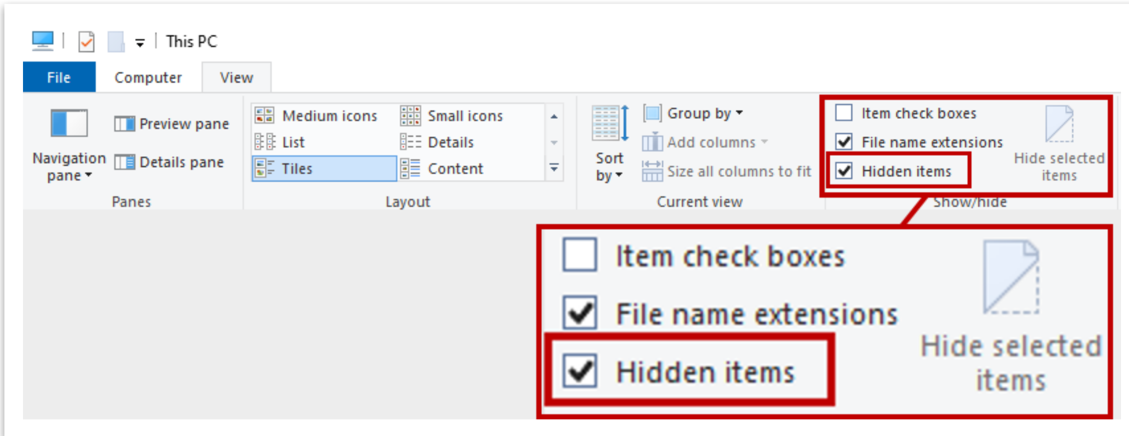
Take Note!

When using OBM for plans production, WorkSet properties will be used for sheet information. This topic will be covered in later OBM manuals, but the concepts can be found in the Fundamentals (ORD) Manual.

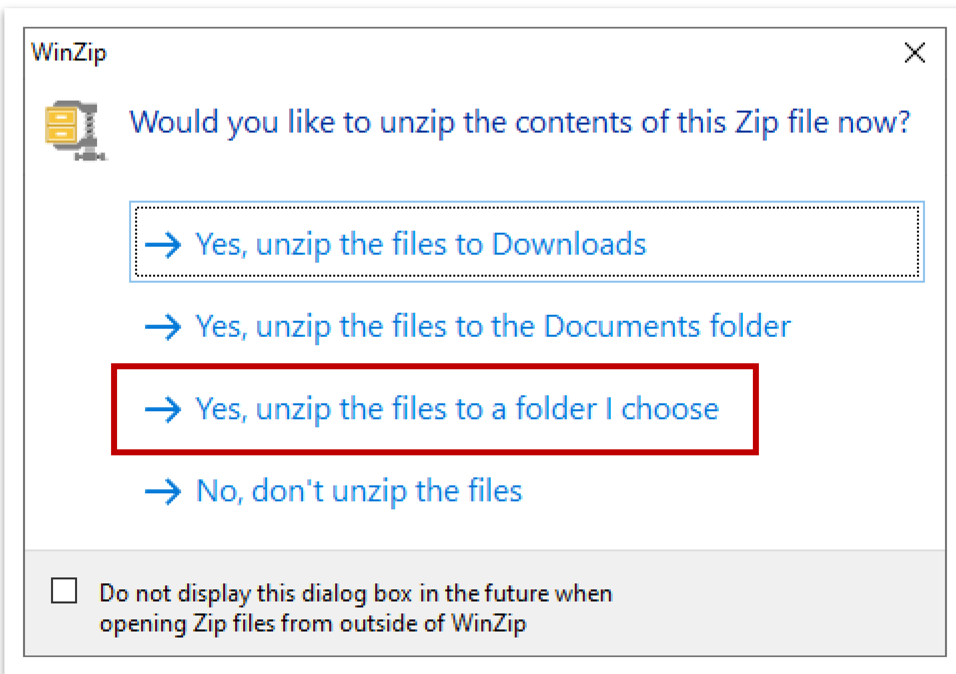
8. Now that we have created a workset, the applicable project folders have been created on the **C** drive. Go ahead and download the provided **class zip file** and set **Hidden Items** to be shown within **File Explorer**.

Take Note!

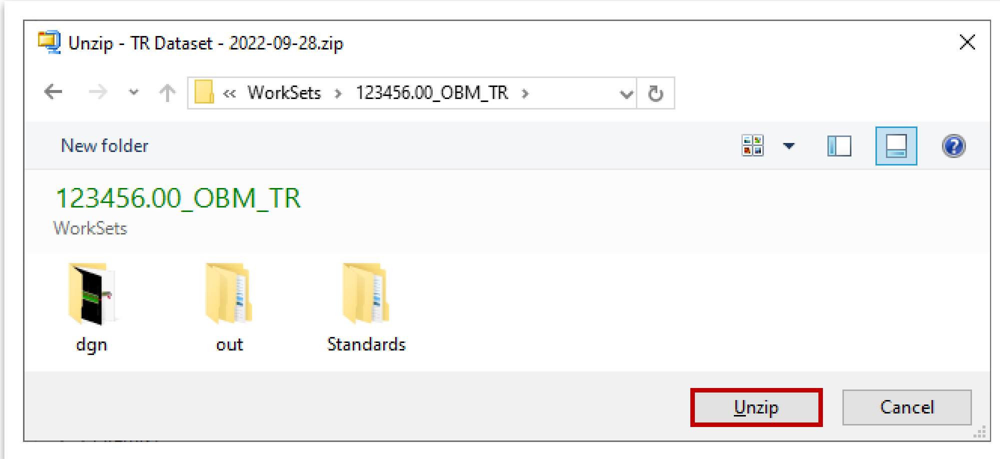
*The **Program Data** folder where the **WorkSets** are located is a hidden folder by default. In your C drive folder, make sure that **Hidden Items** is checked under **View >> Show / Hide,** as shown below.*



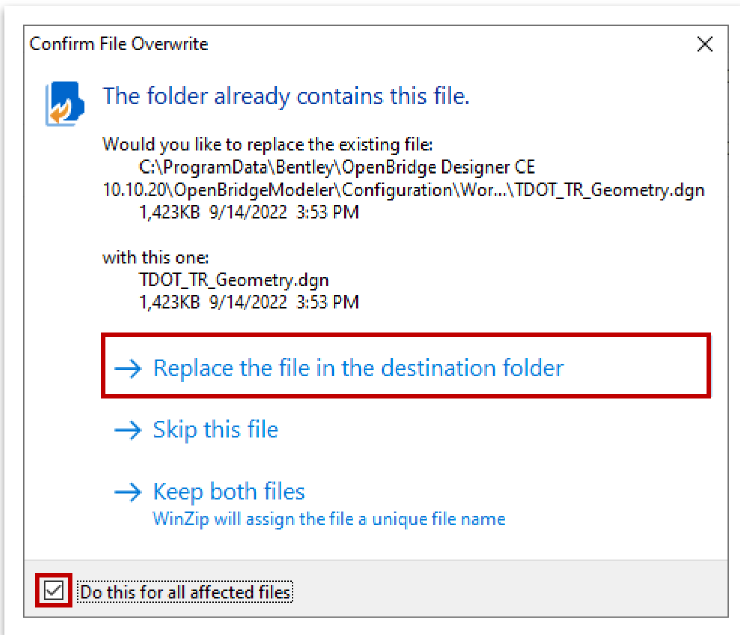
9. Unzip the training files. Select the option to choose the folder they are unzipped to. This option must be selected to place the files in the correct location.



10. Unzip the files to the newly created project folder (**C:\ProgramData\Bentley\OpenBridge Designer CE 10.10.20\OpenBridge Modeler\Configuration\WorkSpaces\TDOT_Standards\WorkSets\123456.00_OBM_TR**).



11. Check the **Do this for all affected files** option at the bottom and then select **Replace the file in the destination folder**. **Note:** Your options may look slightly different if using a different application to unzip the class files.



12. The files have been updated and you are ready to begin

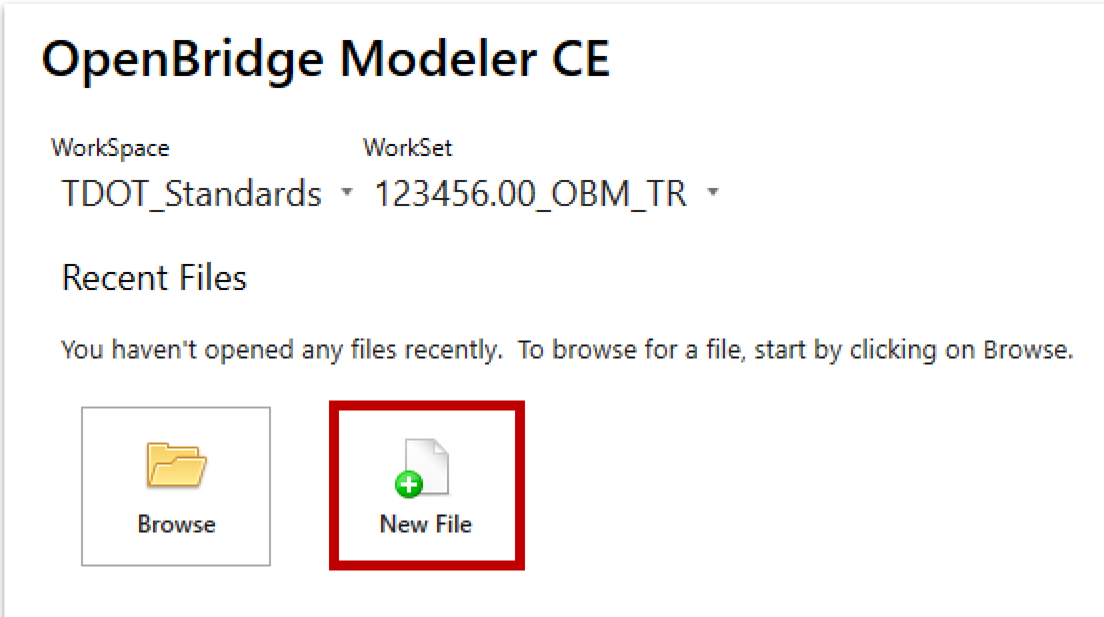
Take Note!

*Any pre-created class file that is opened in this manual will likely yield an alert about not belonging to a workset. Always select your **123456.00_OBM_TR** workset and then click **Open**.*

2.2.2 Exercise: OBM File Creation

In this exercise, we will create a new OBM file that we will use to begin modeling our bridge. After creation, it should be accessed through the OBD interface.

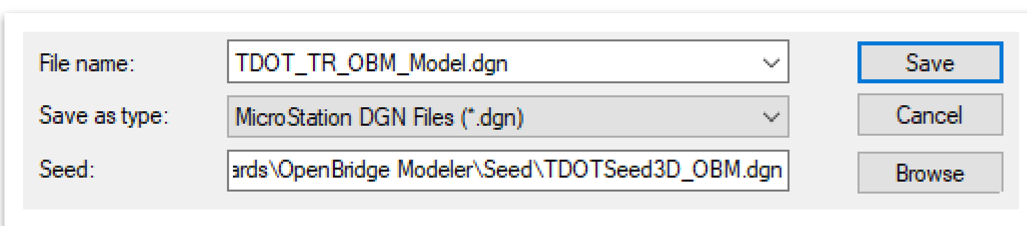
1. Let's now create a **New File** to use for the remaining exercises.



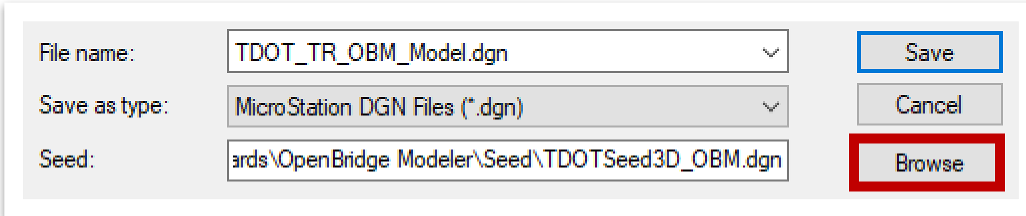
Take Note!

*To open a previously created file, select the appropriate WorkSpace and WorkSet, and select the **Browse** button.*

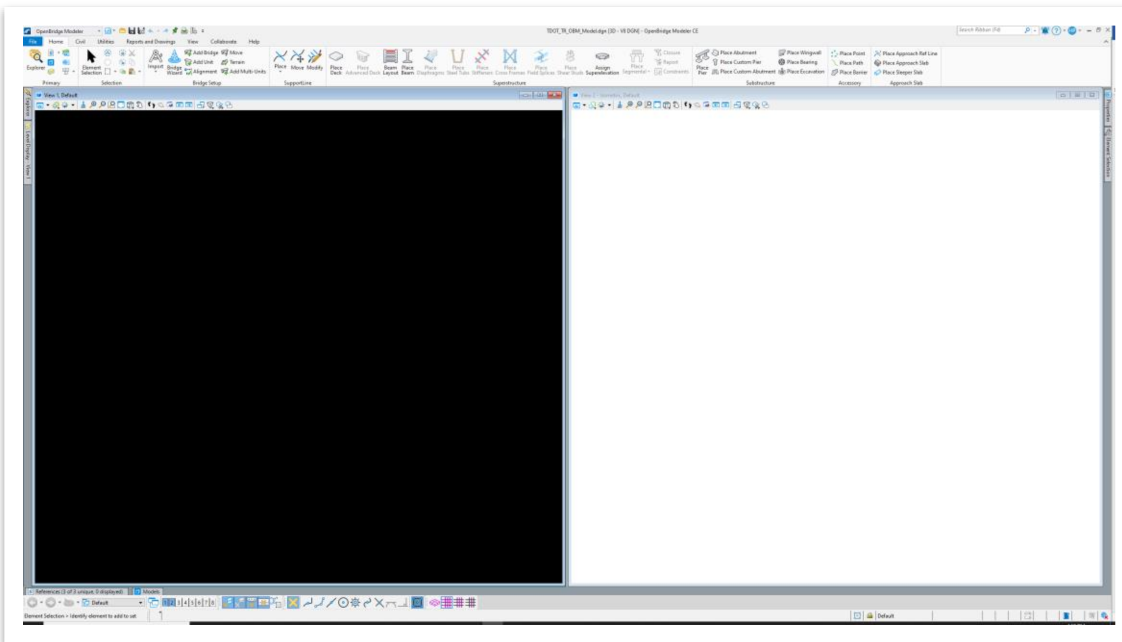
2. Notice that the default folder location is the dgn folder within the **123456.00_OBM_TR** workset that was just created. **C:\ProgramData\Bentley\OpenBridge Designer CE 10.10.20\OpenBridgeModeler\Configuration\WorkSpaces\TDOT_Standards\WorkSets\123456.00_OBM_TR\dgn**.
3. In the **File name** field, type in **TDOT_TR_OBM_Model**.



4. To select the seed, click **Browse**. This will open another window. Navigate to **C:\ProgramData\Bentley\OpenBridge Designer CE 10.10.20\OpenBridge Modeler\Configuration\ Organization-Civil\TDOT_Standards\OpenBridge Modeler\Seed**. This is where the OBM seed files are located.



5. Select the **TDOTSeed3D_OBM.dgn** seed file and click **Open**.
6. Notice that by default, the **TDOT_TR_OBM_Model** file that you just created will be saved in the DGN folder under the **123456.00_OBM_TR** workset.
7. Click **Save** and the file will open.



Take Note!

In this manual, we will not discuss interface setup. Refer to the Fundamentals (ORD) Manual for information.

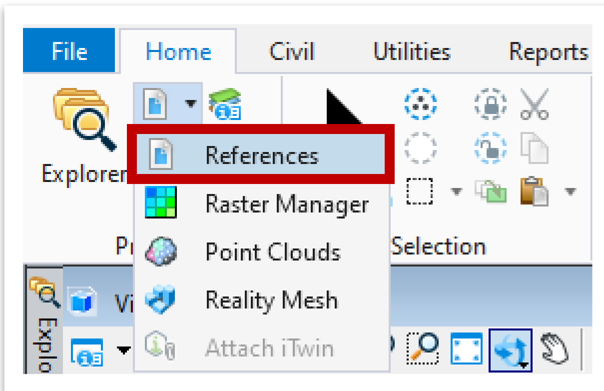
2.2.3 Exercise: Reference Roadway Geometry and Terrain Files

In this exercise, we will attach multiple models of a roadway geometry file, as well as a terrain file that we will later use to set footing elevations. We will continue to utilize the same **TDOT_TR_OBM_Model.dgn** file.

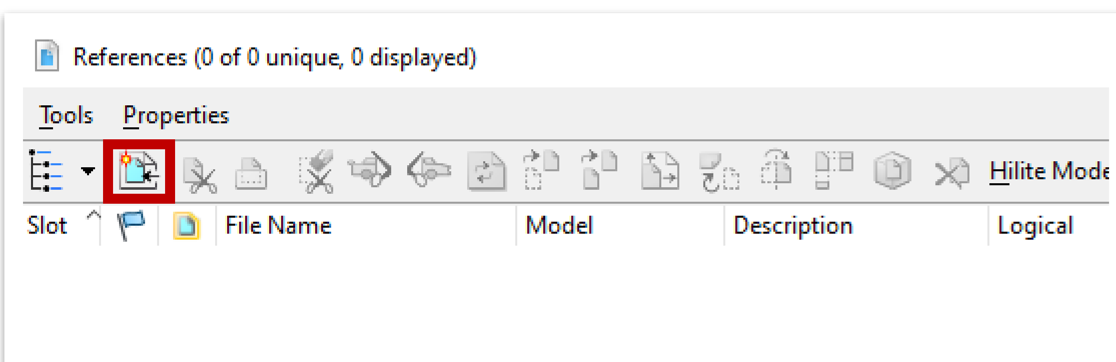
Take Note!

*You can change the units that are displayed by going to **File >> Settings >> File >> Design File Settings >> Working Units**.*

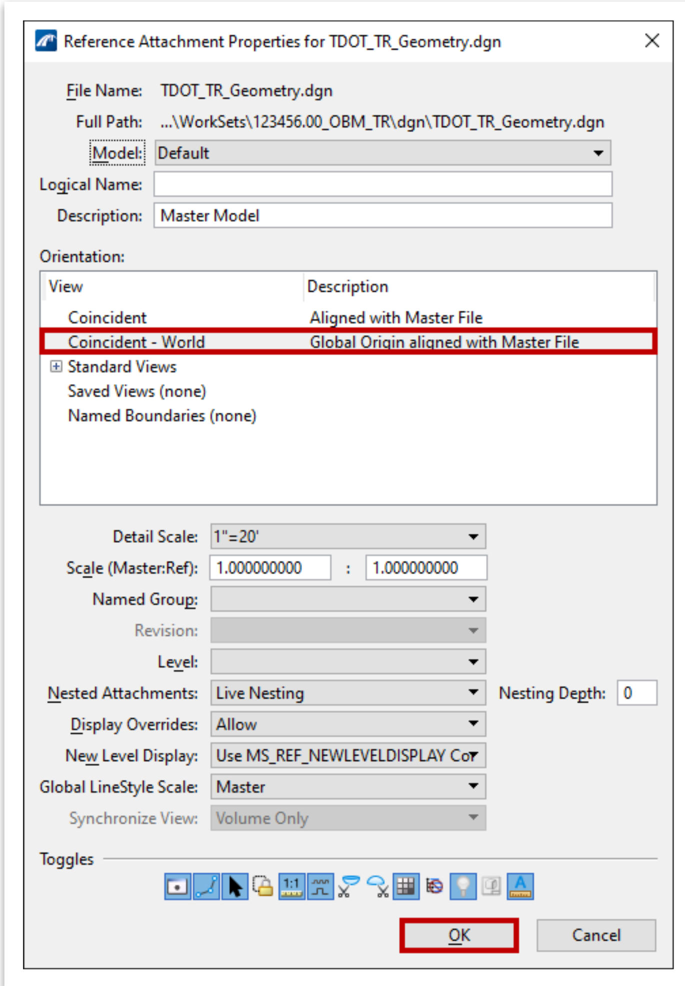
1. First, make sure the **OpenBridge Modeler** workflow is selected in the upper left corner. Then, click the **References** button to open the Reference window. **Note:** The References can be found in the **Home** ribbon tab of any workflow, within the **Primary** group.



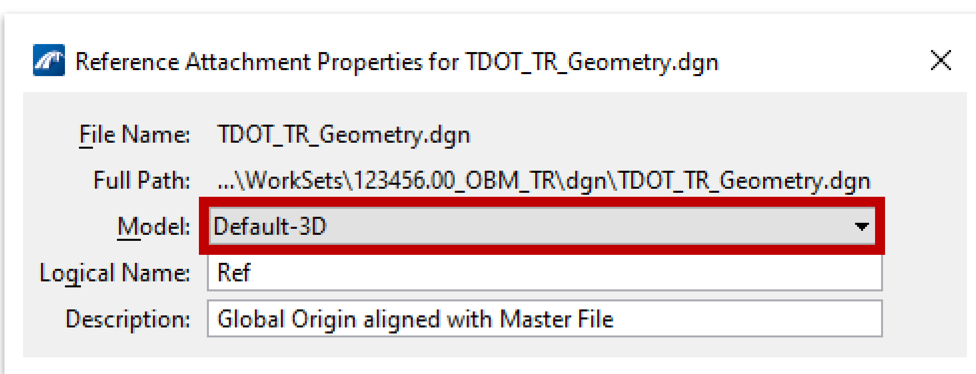
2. Click the **Attach Reference** button and browse to the **TDOT_TR_Geometry.dgn** file located here: **C:\ProgramData\Bentley\OpenBridge Designer CE 10.10.20\OpenBridgeModeler\Configuration\WorkSpaces\TDOT_Standards\WorkSets\123456.00_OBM_TR\dgn**. It should open to this folder by default. After selecting the dgn, click **Open**. Click **OK** in the pop-up alert about the file not belonging to the active workset.



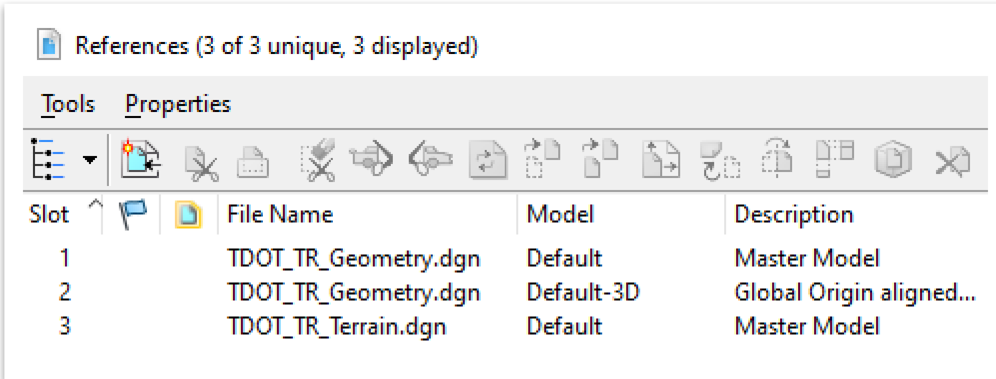
3. In the **Reference Attachment Properties** dialog box, confirm that the **Attachment Method** is set to **Coincident - World**. Click **OK**.



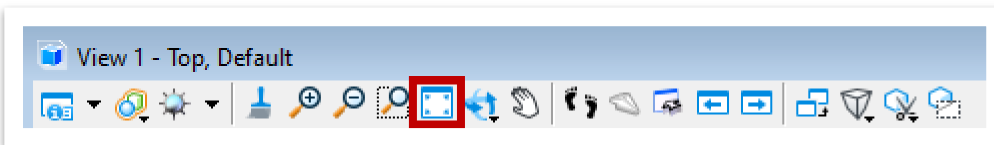
4. The **TDOT_TR_Geometry.dgn** should now be attached. ORD geometry files generally have at least two models. Attach the same **TDOT_TR_Geometry.dgn** again but select the **Default-3D** model. In geometry files with superelevations, there will be additional models. However, our geometry does not contain superelevation information.



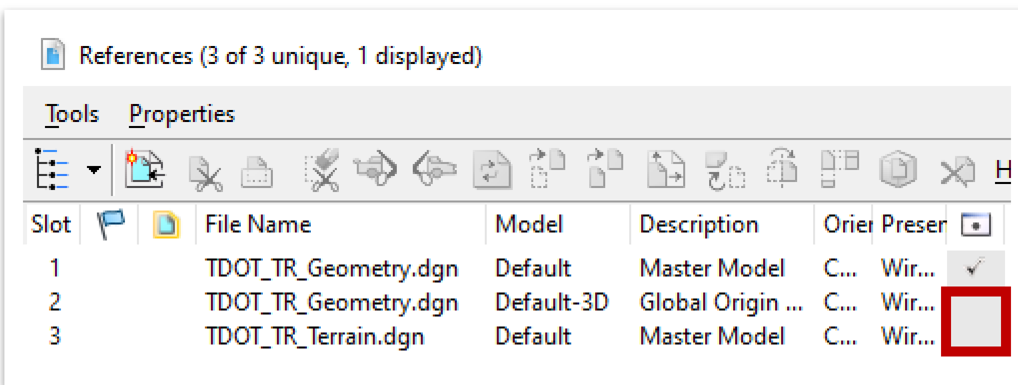
5. Click the **Attach Reference** button one more time and select **TDOT_TR_Terrain .dgn**. This is the ground elevation file and can be used to set footing elevations.



6. Select the **Fit View** button at the top of the view windows for both **View 1 - Top** and **View 2 - Isometric**. The newly referenced files will now be visible.



7. For the purposes of modeling our bridge, the **Default-3D** model of the **TDOT_TR_Geometry.dgn** reference and the **TDOT_TR_Terrain.dgn** reference should be set to not display. This will make navigating the model easier. Close the **References** dialog box.



Take Note!

Annotation scale can be used to adjust the text size if desired. By default, the seed file will have a 1”=20’ scale for design models.

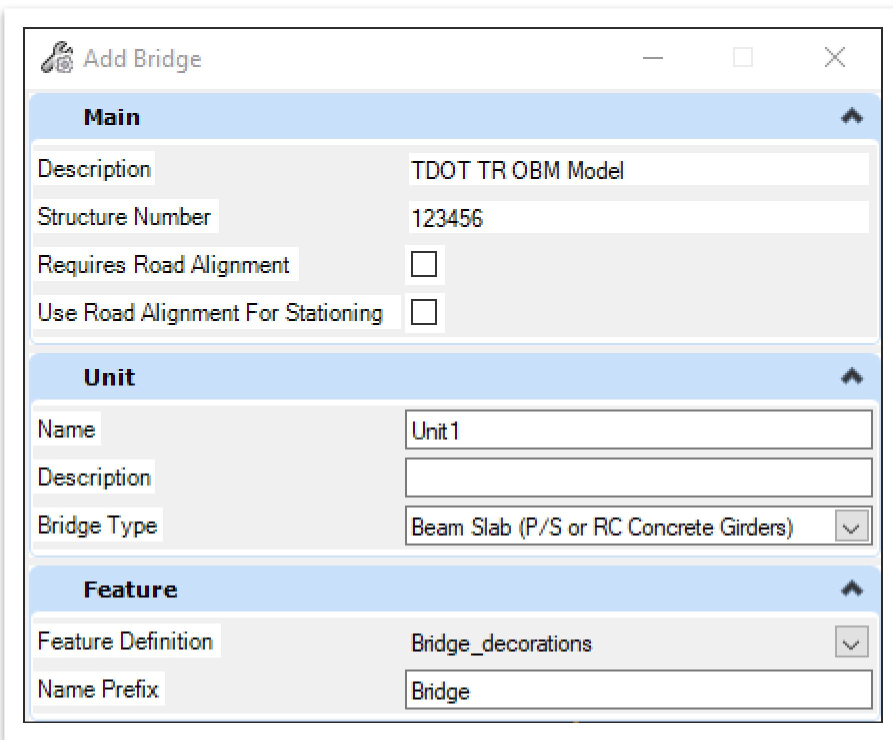
2.3: Model a Bridge Deck and Barriers

In the following exercises, we will add a bridge to the dgn created in the previous exercise. Once the bridge is added, we will set up SupportLines, a bridge deck, and traffic barriers along the deck. For this training we will create a deck template for the deck modeling, but we will be using a pre-generated barrier template.

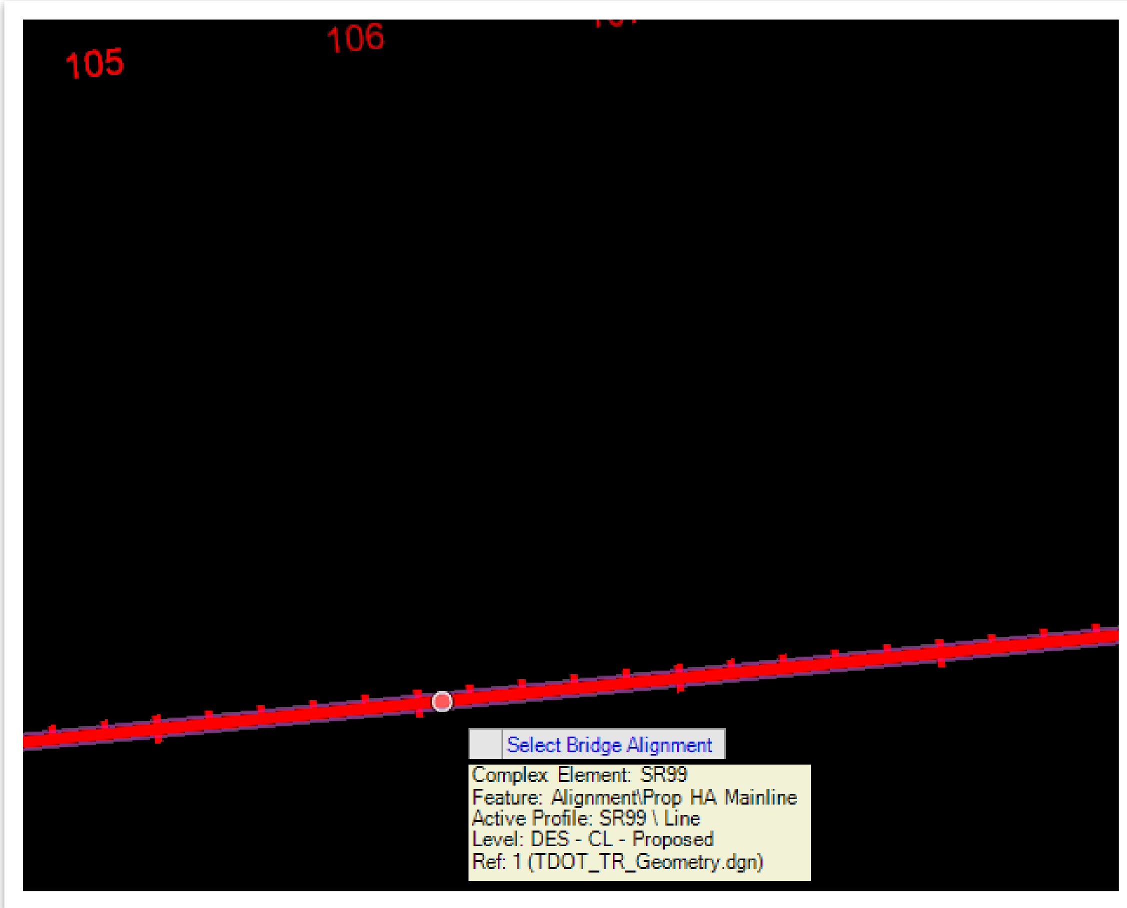
2.3.1 Exercise: Set up Bridge, Add SupportLines, and Rotate View

In this exercise, we will add a bridge to the dgn and set up the SupportLines that will represent the location of each substructure element. Once the SupportLines are set up, we will rotate the view of the dgn to provide a cleaner look. We will continue to utilize the same **TDOT_TR_OBM_Model.dgn** file. **Note:** In the workset dgn folder, there is a dgn file with **Begin** in the name for each overall section. If necessary, you can access the applicable file (**TDOT_TR_OBM_Model_2.3_Begin.dgn**) from the dataset and then proceed with the exercises.

1. First, open the **Add Bridge** tool (**OpenBridge Modeler >> Home >> Bridge Setup**). In the **Add Bridge** dialog box, select the following settings:
    a. **Main >> Description:** TDOT TR OBM Model
    b. **Main >> Structure Number:** 123456
    c. **Unit >> Name:** Unit1
    d. **Unit >> Bridge Type:** Beam Slab (P/S or RC Concrete Girders)
    e. All settings not explicitly listed can be kept as default. **Note:** Do NOT click **X**.



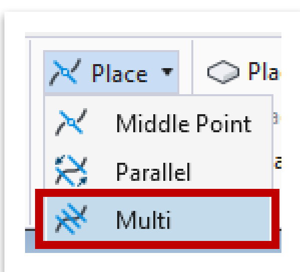
2. Notice the cursor prompt: **Select Bridge Alignment**. Select the **SR99** alignment as shown below. **Data Point** (left click) to accept the selection and then the new bridge will be created.



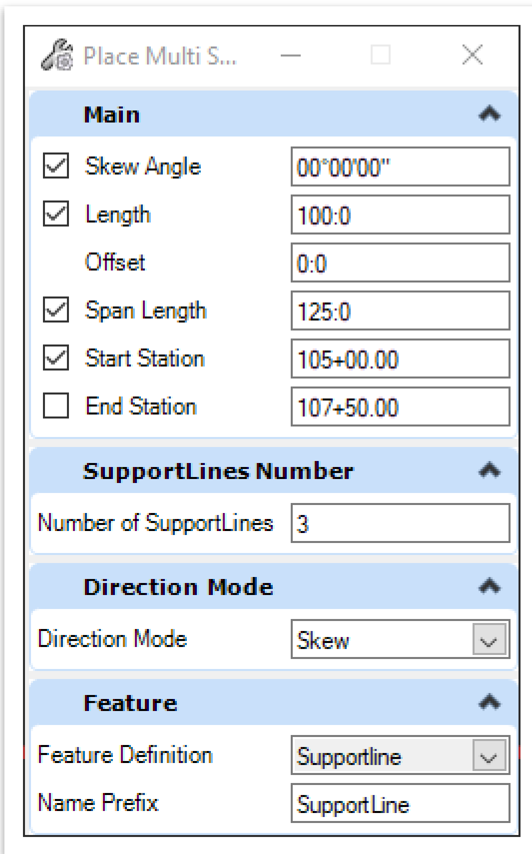
Take Note!

If you move your cursor into space while using a tool, there will be instructions as to what input/clicks the program is expecting. This message will also be in the lower left corner of the screen.

3. Now we need to create the SupportLines. Open the **Place (Multi)** tool (**OpenBridge Modeler >> Home >> SupportLine >> Place**).



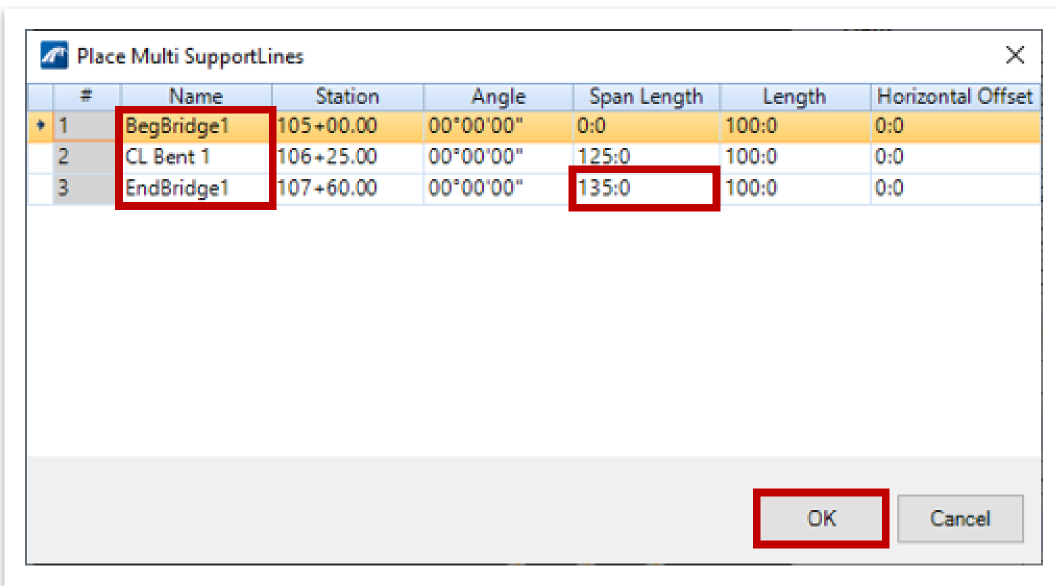
4. In the **Place Multi SupportLines** dialog box, select the following settings. **Note:** You could also follow the cursor prompts to select the settings before accepting each one.
    a. **Skew Angle:** Checkmark (**00°00'00"**).
    b. **Length:** Checkmark (**100:0**), keep **Offset** set to **0:0**. **Note:** This is the length of the SupportLine itself. The SupportLine should be long enough to extend beyond the limits of the proposed deck.
    c. **Span Length:** Checkmark (**125:0**).
    d. **Start Station:** Checkmark (**105+00.00**).
    e. **End Station:** The value should remain unchecked.
    f. **Number of SupportLines:** 3
    g. All settings not explicitly listed can be kept as default.



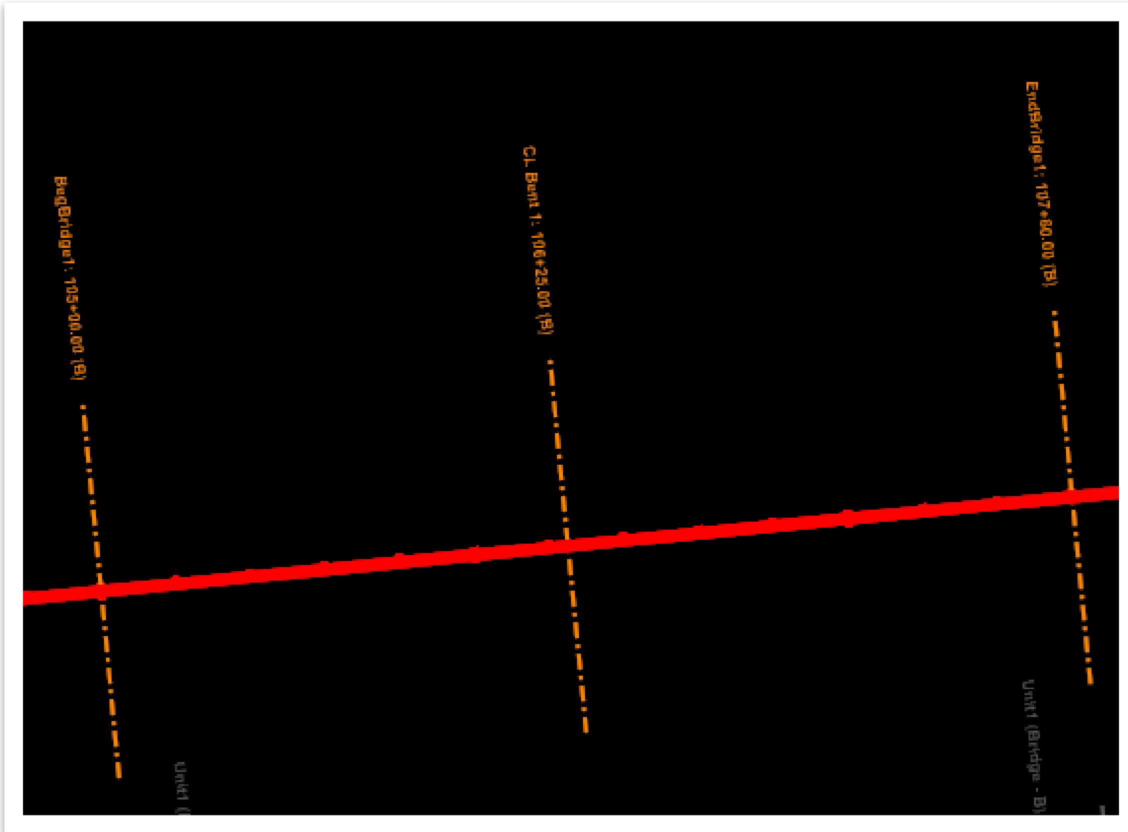
Take Note!

*In this exercise, the **End Station** does not need to be checkmarked as the end station will be calculated by the program using the **Start Station** and **Span Length** values we provided. Various combinations of values may be checked and unchecked to arrive at the same conclusion in the future. For example, we could instead provide the **Start Station** and **End Station** but leave the **Span Length** unchecked; in which case, the program will use those checked values and the number of SupportLines to calculate the **Span Length**.*

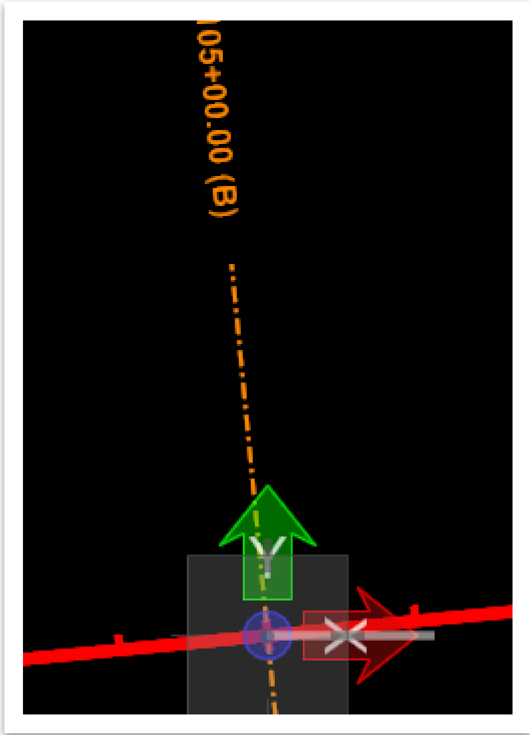
5. After this information is entered, the user can **Data Point** in space to confirm the **Start Location**.
6. Then, **Data Point** again to confirm the **Skew**. **Data Point** again to confirm the **End Location**.
7. The **Place Multi SupportLines** window will then open. Here, the user can modify each characteristic of these **SupportLines**. Update the characteristics as follows to match the image below:
   a. **Name:** Update
      i. "**SupportLine1**" to "**BegBridge1**"
      ii. "**SupportLine2**" to "**CL Bent 1**"
      iii. "**SupportLine3**" to "**EndBridge1**"
   b. **Span Length:** Update for **EndBridge1** from **125:0** to **135:0**. This will automatically update the **Station** for this SupportLine to be **107+60.00**.
   c. Click **OK**.

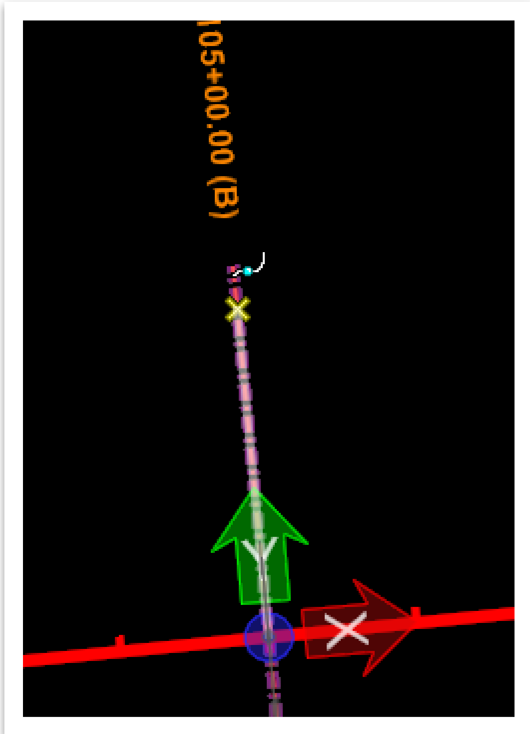


8. The **SupportLines** should now be shown. The **Place Multi SupportLines** tool will automatically allow you to start the placement of another set of SupportLines, but you can end the placement by right clicking in the view window or by selecting another tool.

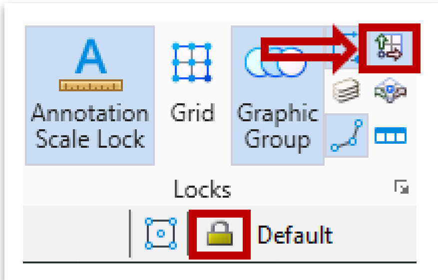


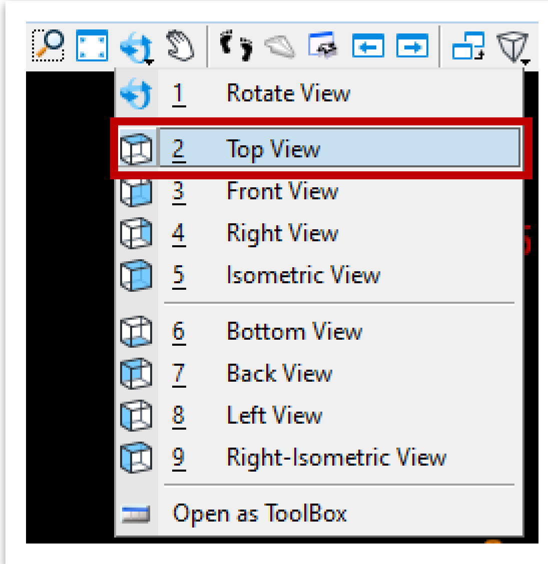
9. Now we need to rotate the orientation of **View 1** to be parallel with the screen. First, we need to set the **Auxiliary Coordinate System (ACS)**. Open the **Define by Points** tool (**OpenBridge Modeler >> Utilities >> ACS >> Define an ACS** or **[Hold Shift] + [type] R + [type] A**) and then place the **ACS** at the intersection of the **BegBridge1** SupportLine and the alignment line. Select a point on the alignment to define the x-axis. Then, select a point on the SupportLine to define the y-axis.



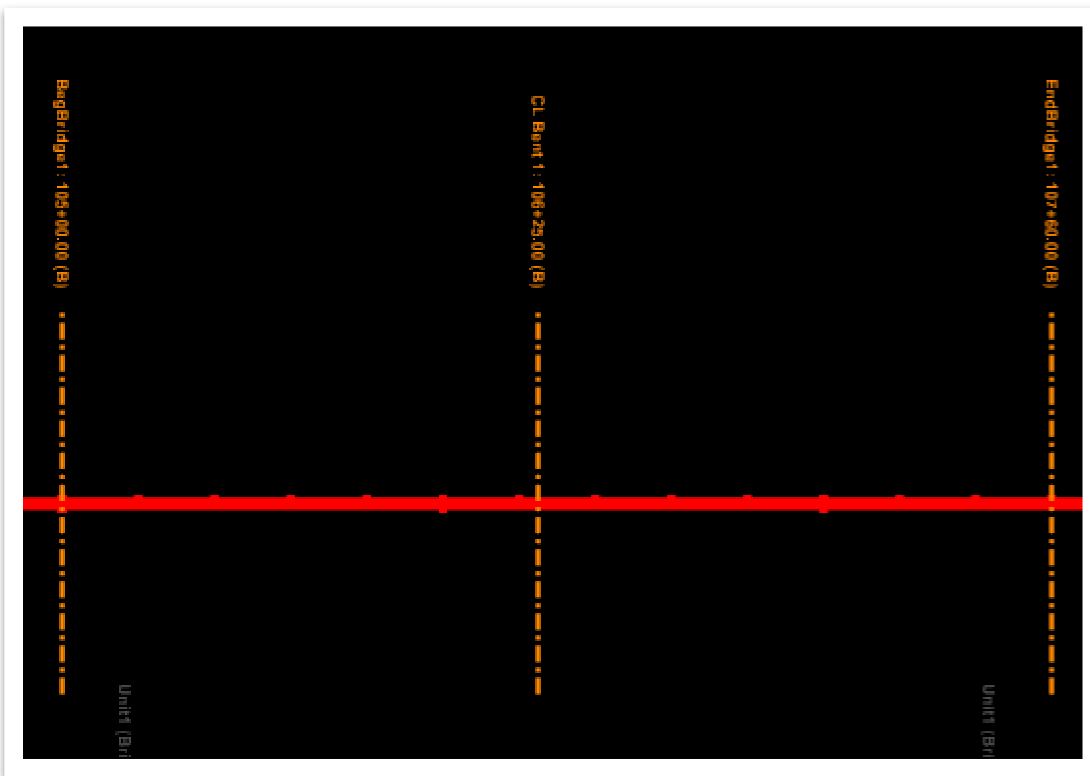


10. Once the **ACS** is defined, click the **Locks** icon at the bottom of the screen and select **ACS Plane Lock**. Once the **ACS Plane Lock** is enabled, in **View 1**, select **View Rotate >> Top View** or **[Hold Shift] + [Right Click] + [type] T**.





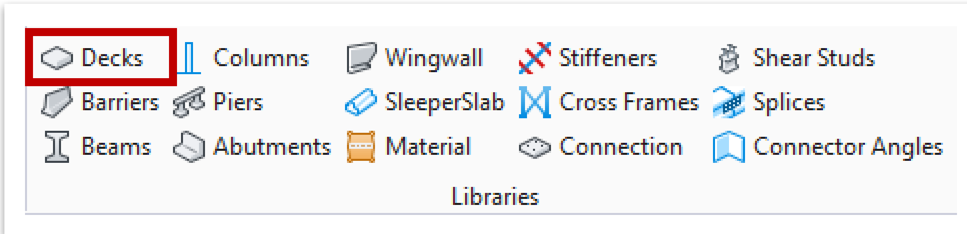
11. **View 1** of the alignment should now be parallel with the screen. Go to **File >> Save Settings** or **[Hold Ctrl] + [type] F** to ensure the **ACS** rotation is saved.



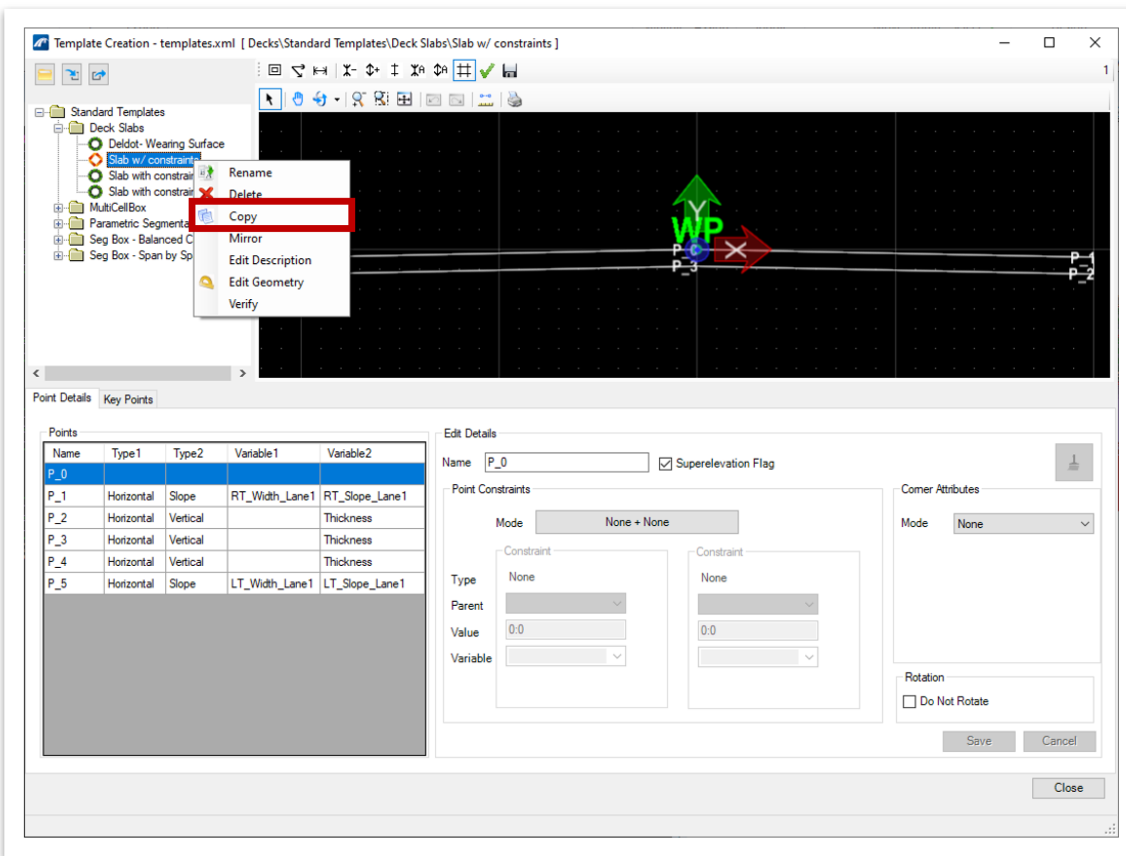
2.3.2 Exercise: Set up a Deck Template and Create a Deck

In this exercise, we will create a new deck template to use specifically for this bridge. Once created, we will model the deck using the SupportLines set up in the previous exercise as the deck limits. However, the begin and end of deck will be offset short of the SupportLines to account for the modeling of integral abutment in upcoming Exercise 2.5.1. We will continue to utilize the same **TDOT_TR_OBM_Model.dgn** file (or **TDOT_TR _OBM_Model_ 2.3_Begin.dgn**) from the previous portion of the exercise.

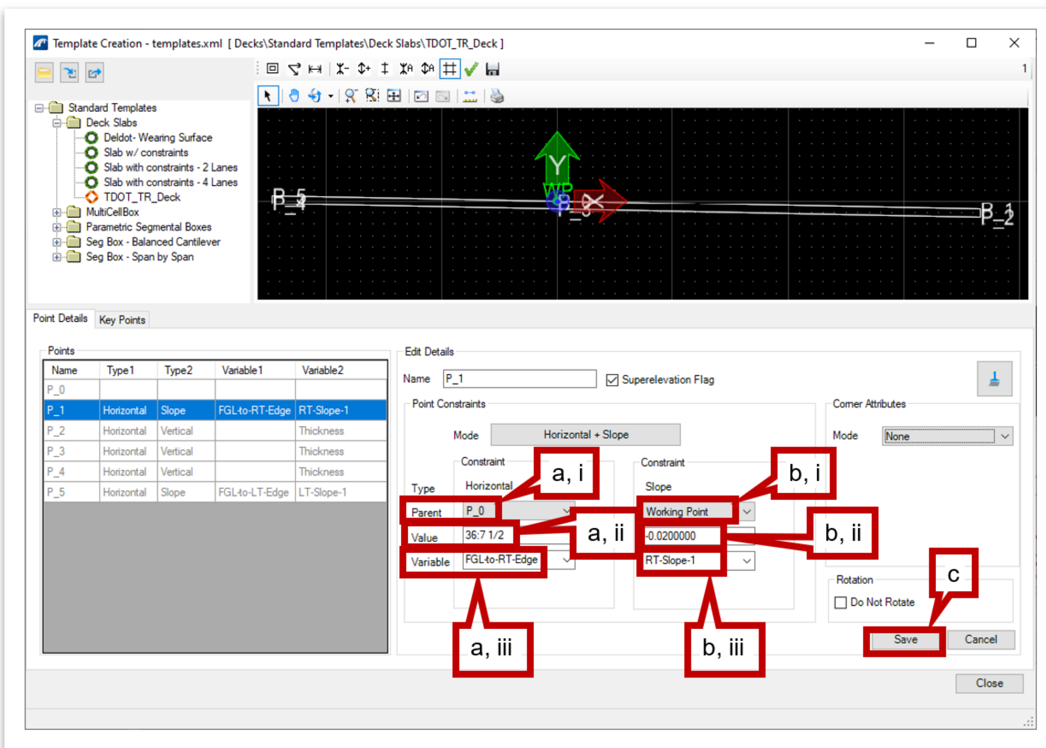
1. First, open the **Decks** tool (**OpenBridge Modeler >> Utilities >> Libraries)**, which will open the deck template library.



2. In the **Template Creation - templates.xml** window, expand the **Standard Templates** and **Deck Slab** folders, and then right click on **Slab w/ constraints** and select **Copy**.



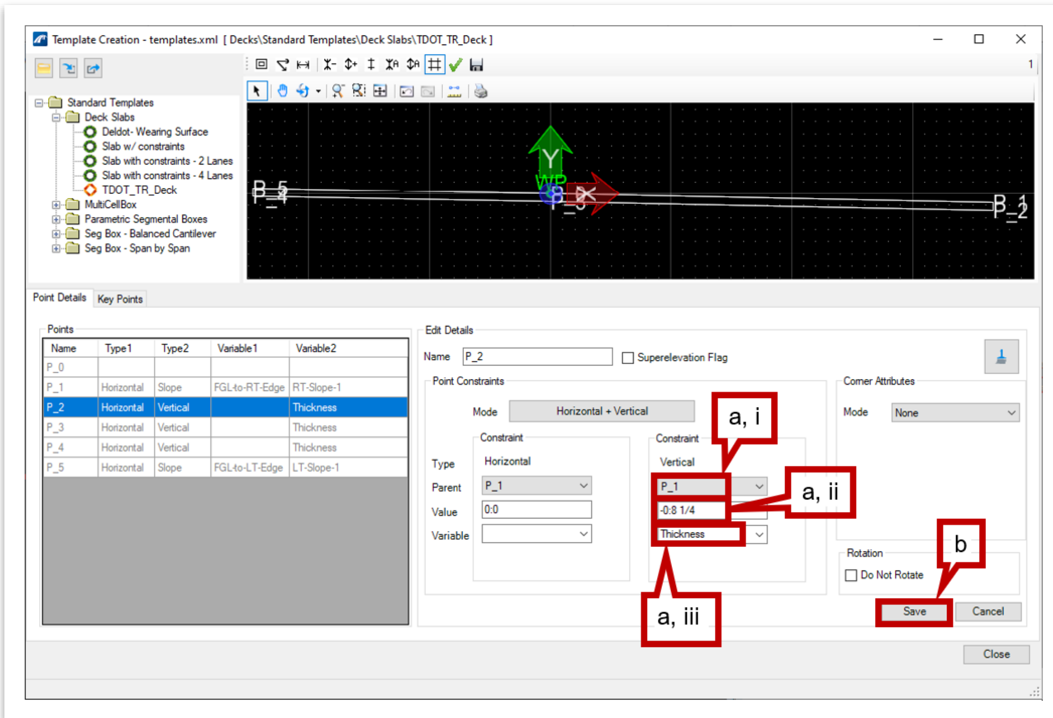
3. Right click the copied template named **Slab w/ constraints-Copy** and select **Rename**. Rename the template to **TDOT_TR_Deck**.
4. Highlight **P_1** in the **Points** section and select the following settings.
   a. Change the **Horizontal** constraint to the following:
      i. **Parent:** P_0
      ii. **Value:** 36:7.5. **Note:** The software converts to a fraction automatically.
      iii. **Variable:** RT_Width_Lane1. **Note:** Once the correct value is selected, rename it by clicking in the **Variable** box and typing **FGL-to-RT-Edge**.
   b. Change the **Slope** constraint to the following:
      i. **Parent:** Working Point
      ii. **Value:** -0.020
      iii. **Variable:** RT_Slope_Lane1. **Note:** Once the correct value is selected, rename it by clicking in the **Variable** box and typing **RT-Slope-1**.
   c. Click **Save** to update the graphical view.



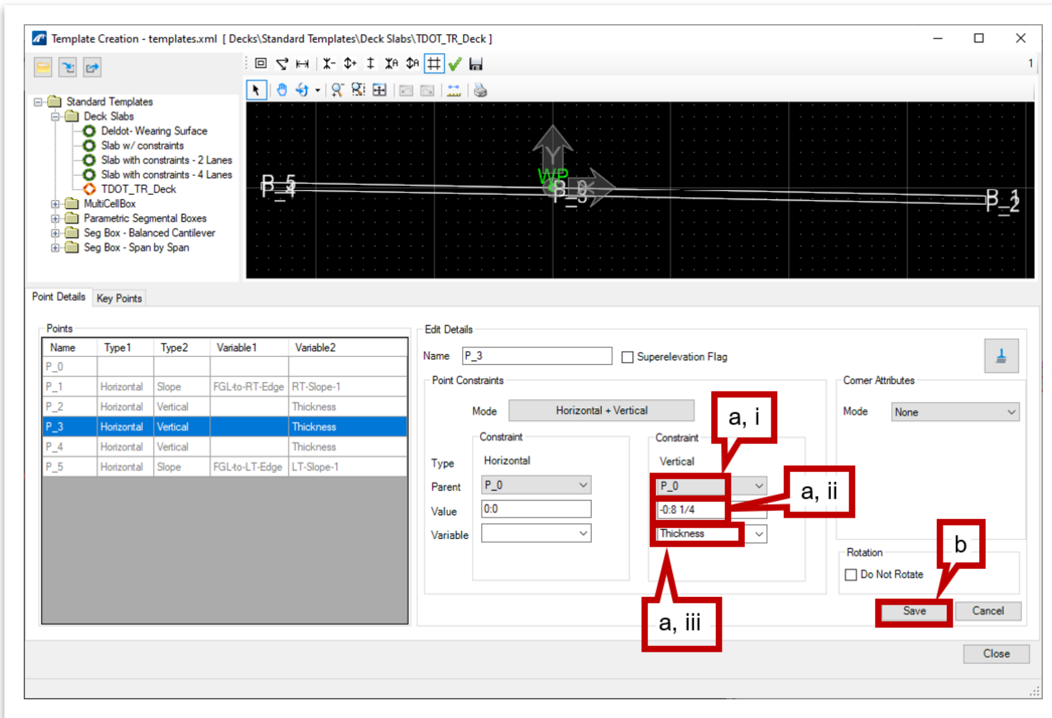
*Checking the **Superelevation Flag** box will allow the program to override the assigned slope to the selected point. If there is a superelevation model within the roadway file, the **Superelevation** tool can be used to automatically model the superelevation transition. We will not use the **Superelevation** tool in this introductory manual.*

Take Note!

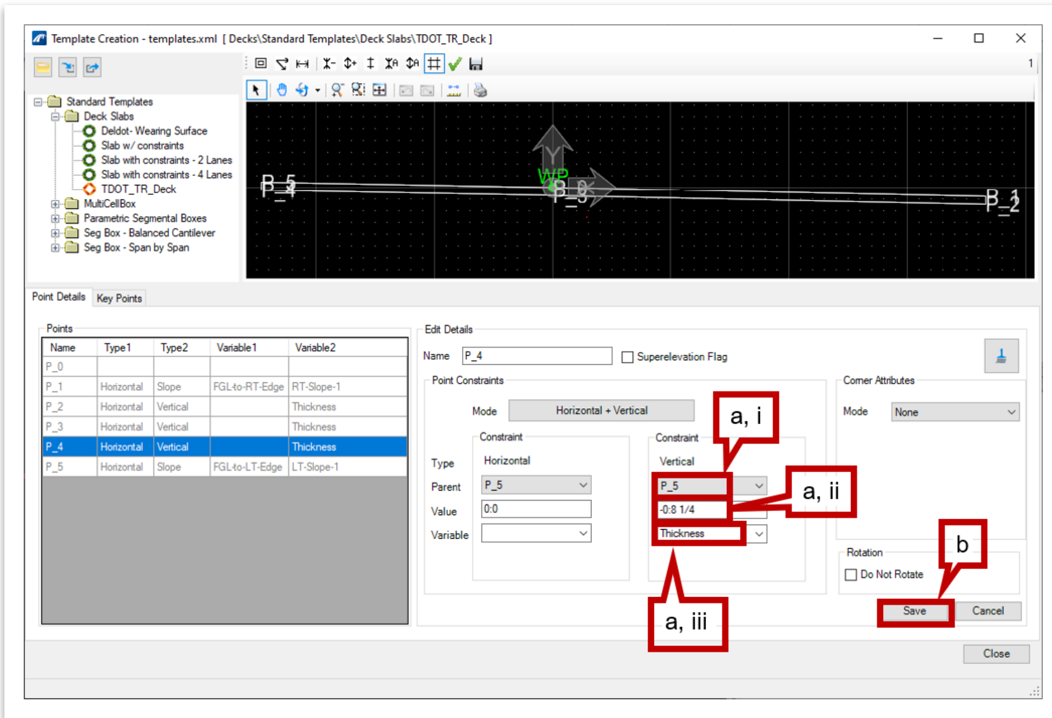
5. Highlight **P_2** in the **Points** section and select the following settings.
   a. Change the **Vertical** constraint to the following:
      i. **Parent:** P_1
      ii. **Value:** -0:8.25
      iii. **Variable:** Thickness
   b. Click **Save** to update the graphical view. **Note:** The **Horizontal** constraint is set to: **Parent >> P_1** and **Value >> 0:0**, so the adjustment made in the previous step resulted in **P_2** also shifting further from the **Working Point**.



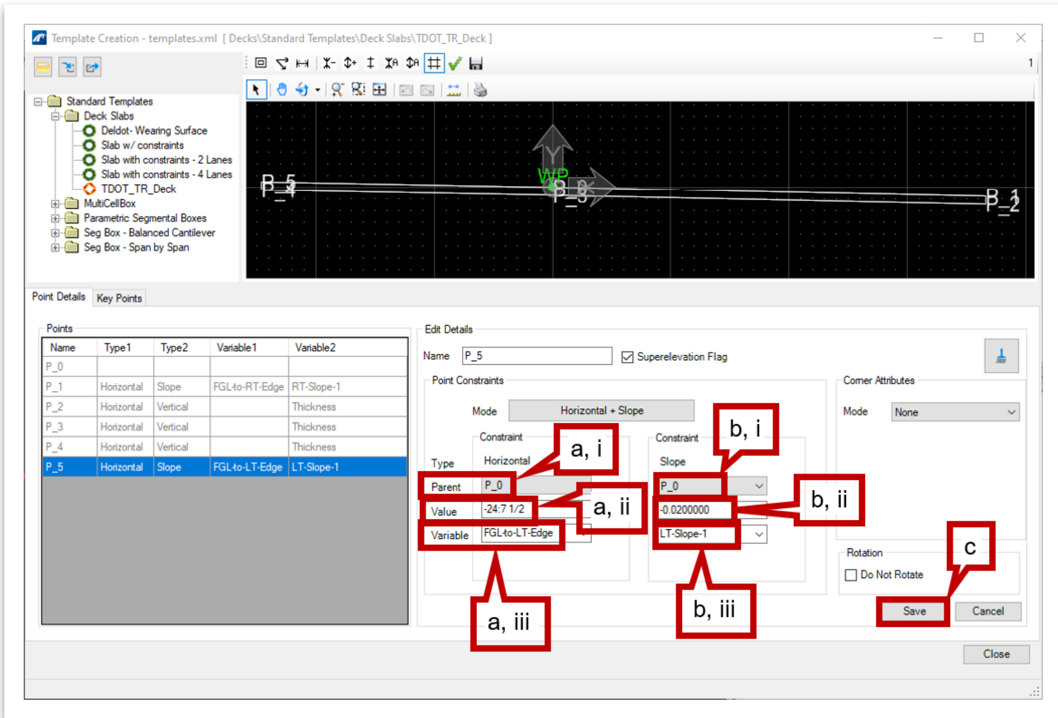
6. Highlight **P_3** in the **Points** section and select the following settings.
   a. Change the **Vertical** constraint to the following:
      i. **Parent:** P_0
      ii. **Value:** -0:8.25
      iii. **Variable:** Thickness
   b. Click **Save** to update the graphical view.



7. Highlight **P_4** in the **Points** section and select the following settings.
    a. Change the **Vertical** constraint to the following:
        i. **Parent:** P_5
        ii. **Value:** -0:8.25
        iii. **Variable:** Thickness
    b. Click **Save** to update the graphical view.

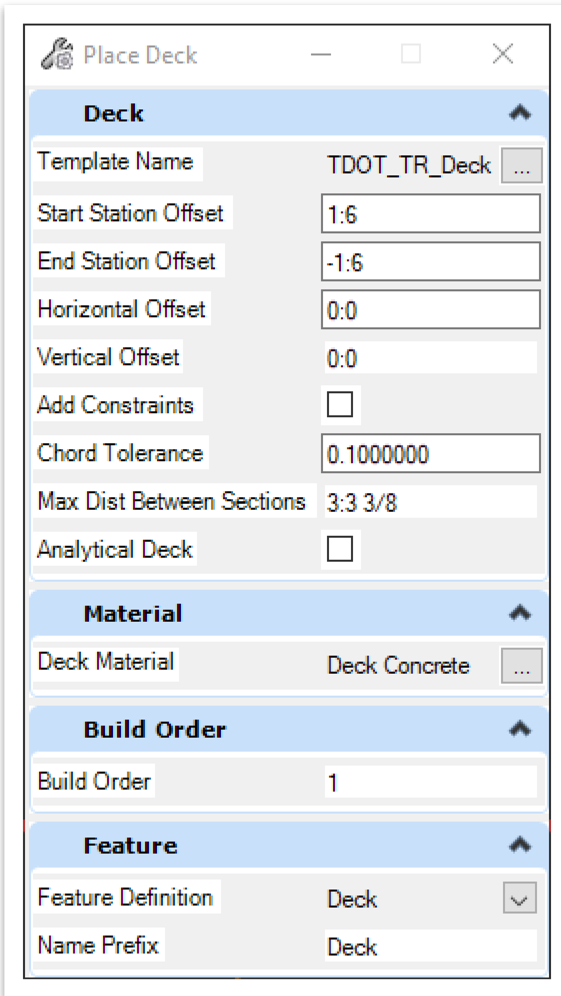


8. Highlight **P_5** in the **Points** section and select the following settings.
    a. Change the **Horizontal** constraint to the following:
        i. **Parent:** P_0
        ii. **Value:** -24:7.5
        iii. **Variable:** LT_Width_Lane1. **Note:** Once the correct value is selected, rename it by clicking in the box and typing "**FGL-to-LT-Edge**".
    b. Change the **Slope** constraint to the following:
        i. **Parent:** P_0
        ii. **Value:** -0.020
        iii. **Variable:** LT_Slope_Lane1. **Note:** Once the correct value is selected, rename it by clicking in the box and typing "**LT-Slope-1**".
    c. Click **Save** to update the graphical view. **Note:** The horizontal offset of P_4 was updated automatically with the change to P_5.



9. Click **Close** to close the **Template Creation** window. The new deck template is now complete and is ready to be used with the **Place Deck** tool.

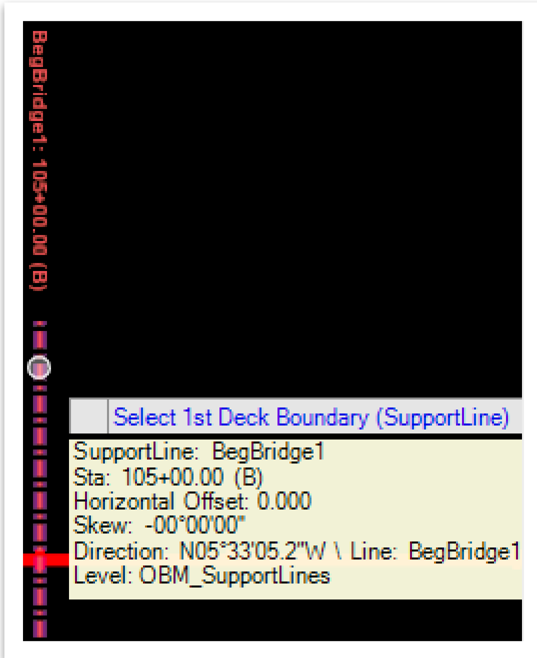
10. Now let's create the deck. Open the **Place Deck** tool (**OpenBridge Modeler >> Home >> Superstructure**). In the **Place Deck** dialog box, select the following settings.
    a. **Template Name:** TDOT_TR_Deck
    b. **Start Station Offset:** 1:6
    c. **End Station Offset:** -1:6
    d. **Deck Material:** Deck Concrete
    e. **Feature Definition:** Deck

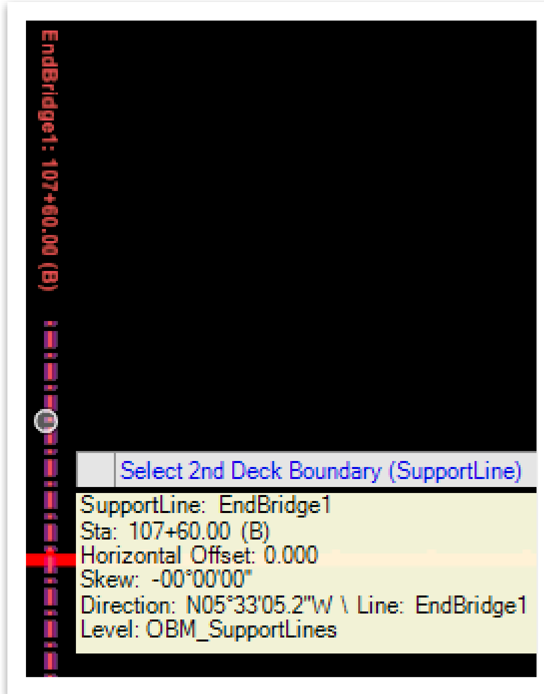


Take Note!

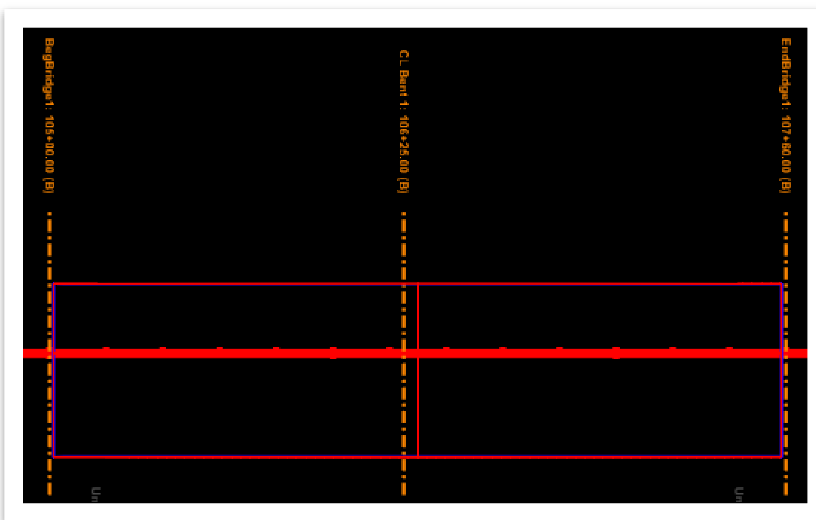
Station offsets are provided at the start and end of the bridge deck to account for the manner in which the integral abutments are being modeled. At these locations, the end wall will align with the top of deck.

11. Notice the cursor prompt: **Select 1st Deck Boundary (SupportLine)**. Select **BegBridge1**. Notice the next cursor prompt: **Select 2nd Deck Boundary (SupportLine)**. Select the **2nd Deck Boundary**.





12. **Data Point** (left click) to accept. The deck will be created as seen below.



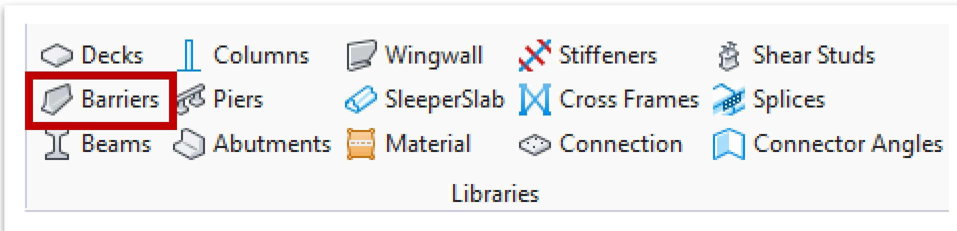
Take Note!

If a superelevation transition is present in the roadway design, a separate superelevation model will be present in the alignment dgn. This superelevation can then be applied to the bridge by selecting ***Open Bridge Modeler*** **>> Home >> Superstructure >> Assign Superelevation**.

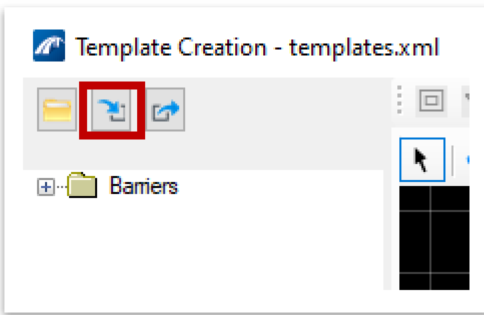
2.3.3 Exercise: Create Barriers

In this exercise, we will learn how to use the provided TDOT templates in the model to create elements. We will import a barrier template that has been pre-modified for the training model and use it to model barriers on either side of the bridge deck. We will continue to utilize the same **TDOT_TR_OBM_Model.dgn** file (or **TDOT_TR_OBM_ Model_ 2.3_Begin.dgn**) from the previous portion of the exercise.

1. First, open the **Barriers** tool (**OpenBridge Modeler >> Utilities >> Libraries**), which will open the barrier template library.

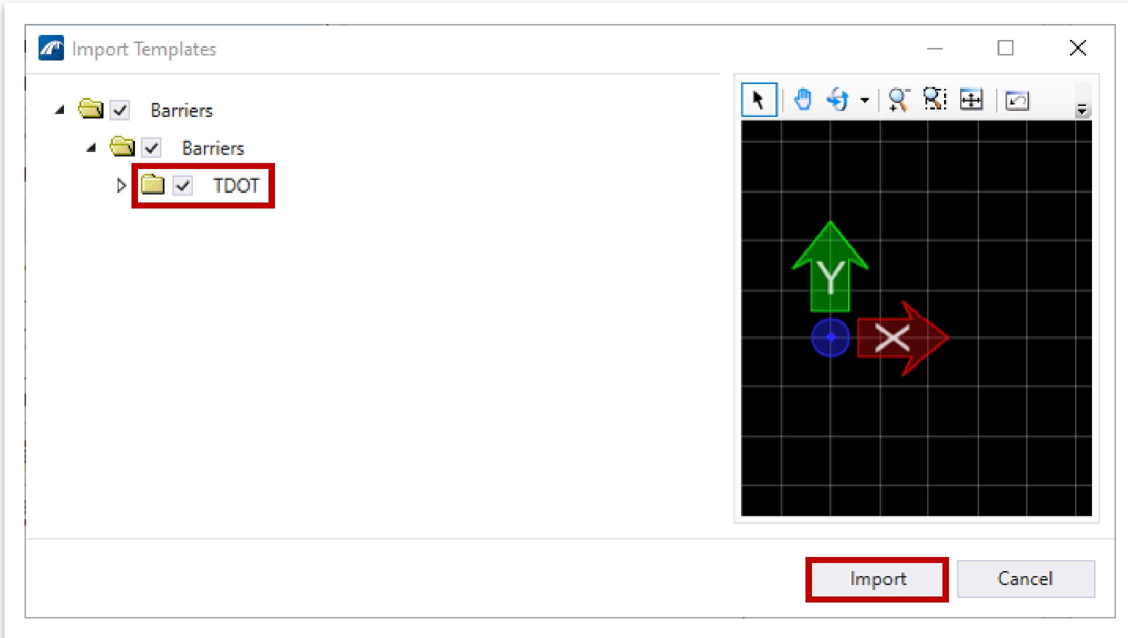


2. In the **Template Creation - templates.xml** window, click on the **Import** tool.



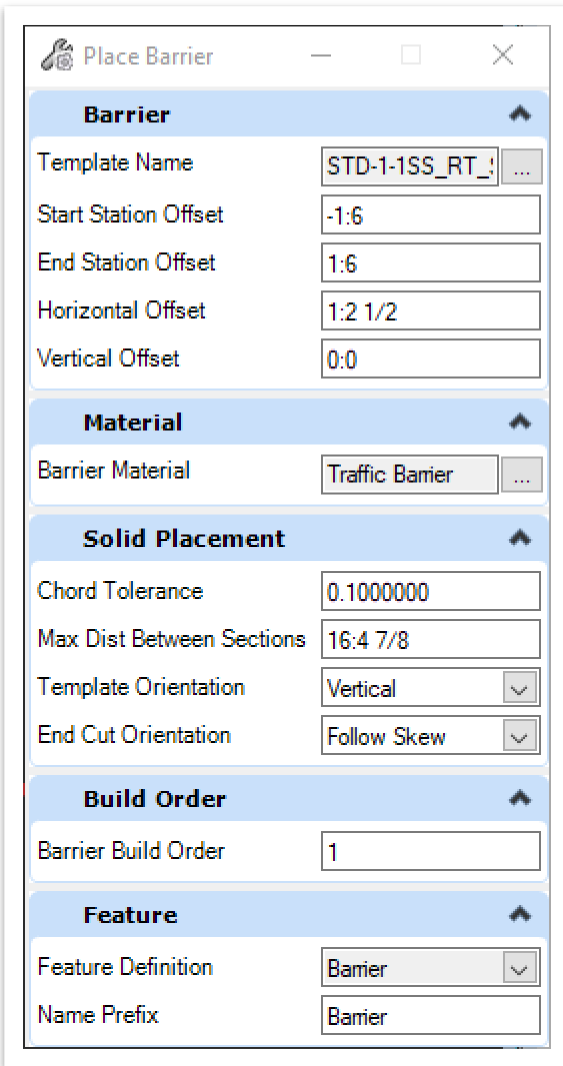
3. The **Import Templates** window should open. Navigate to where the dataset files are located and select the **Deck&Barrier-Templates_TDOT_TR.xml** file, and then click **Open** (**C:\ProgramData\Bentley\OpenBridge Designer CE 10.10.20\ OpenBridge Modeler\Configuration\WorkSpaces\TDOT_Standards\Work Sets\123456.00_OBM_TR\Standards\TemplateLibrary\TR_ OBM_Templates**).

4. Select the desired templates to import by clicking in the empty box next to the **TDOT** template folder. A checkmark will now fill the box. Then click **Import** to add the TDOT barrier templates to the template library. **Note:** Additional barrier types will be added to the workspace in the future.



5. Now we will create the bridge barriers. Open the **Place Barrier** tool (**OpenBridge Modeler >> Home >> Accessory**).

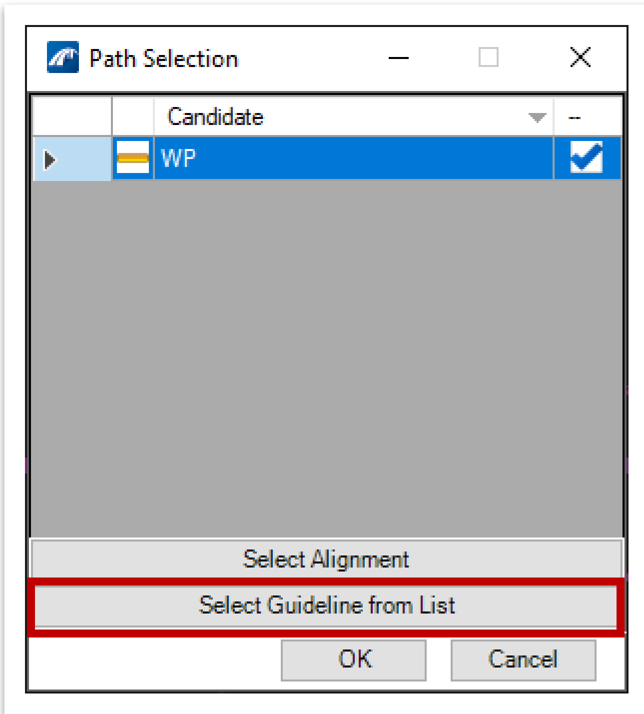
6. We will first setup the left barrier. In the **Place Barrier** dialog box, select the following settings.
    a. **Template Name:** STD-1-1SS_LT_SingleSlopeParapet
    b. **Start Station Offset:** -1:6
    c. **End Station Offset:** 1:6
    d. **Horizontal Offset:** 1:2.5. **Note:** This value denotes the horizontal offset of the barrier template's **Working Point (WP)**, which is typically the inside edge of the barrier to the edge of the deck.
    e. **Barrier Material:** Traffic Barrier. **Note:** This material can be found under the **Miscellaneous** tab within the **Material Library**.
    f. **Feature Definition:** Barrier
    g. All settings not explicitly listed can be kept as default.



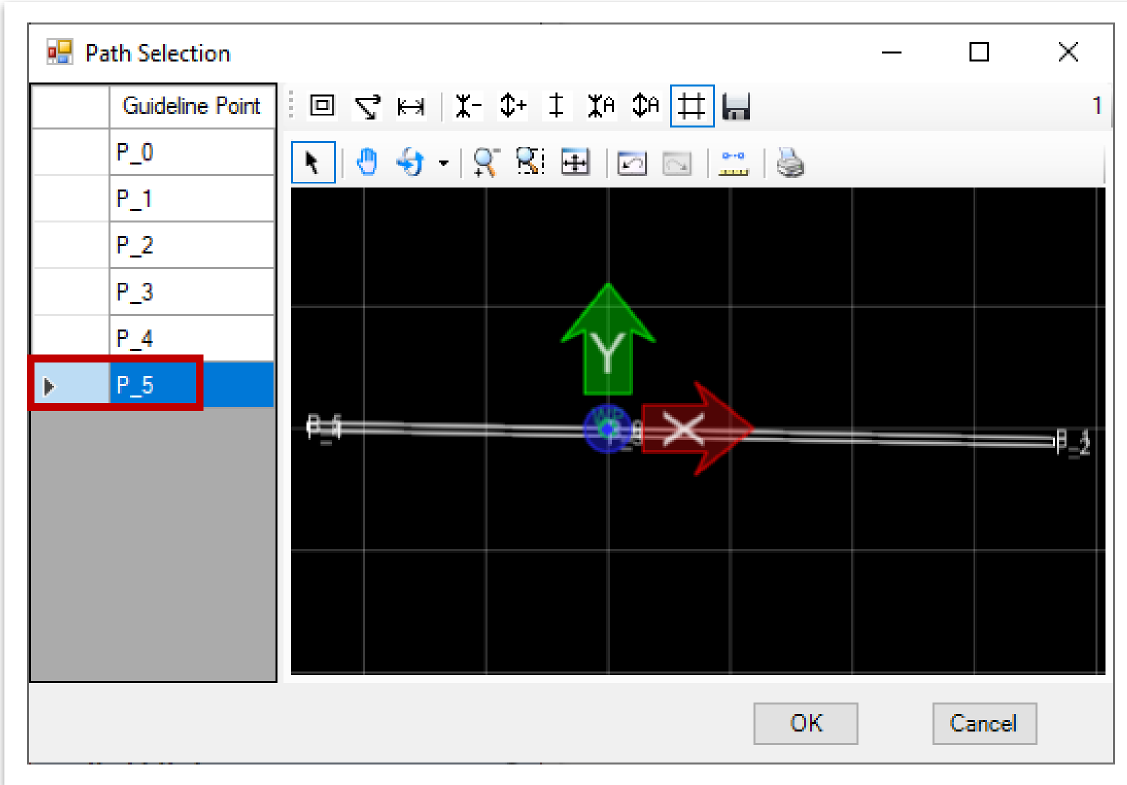
Take Note!

*A barrier's limits are always placed in relation to the start and end of the selected candidate (deck). Because the deck limits were offset from the SupportLines in Exercise 2.3.2 to accommodate the end walls, the barriers will need to be extended beyond the deck at each end by using the **Start Station Offset** and **End Station Offset**. This ensures that the barriers are extended to the SupportLines and present atop of the end walls.*

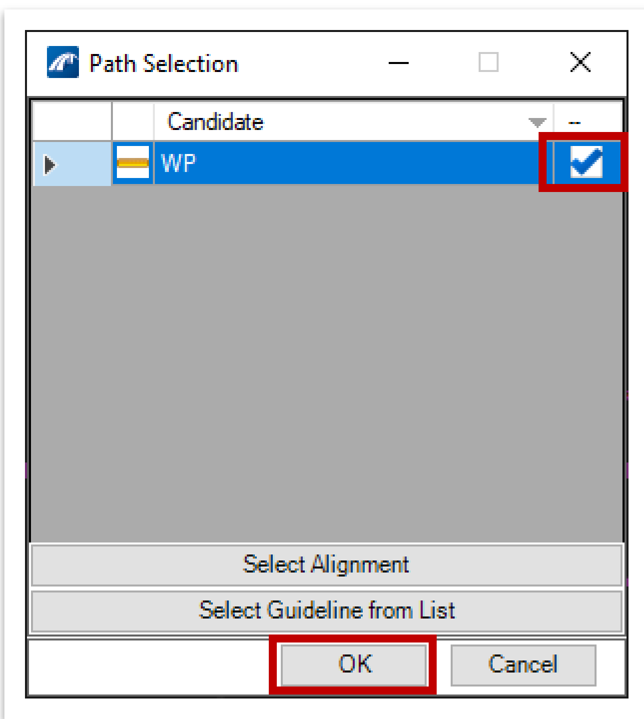
7. Select the deck that was just created as the **Candidate** by left clicking on the deck.
8. **Reset** (right click) to end the candidate selection and then **Data Point** (left click) in space. This will open the **Path Selection** window.
9. Click on **Select Guideline from List** to open the **Path Selection** window.



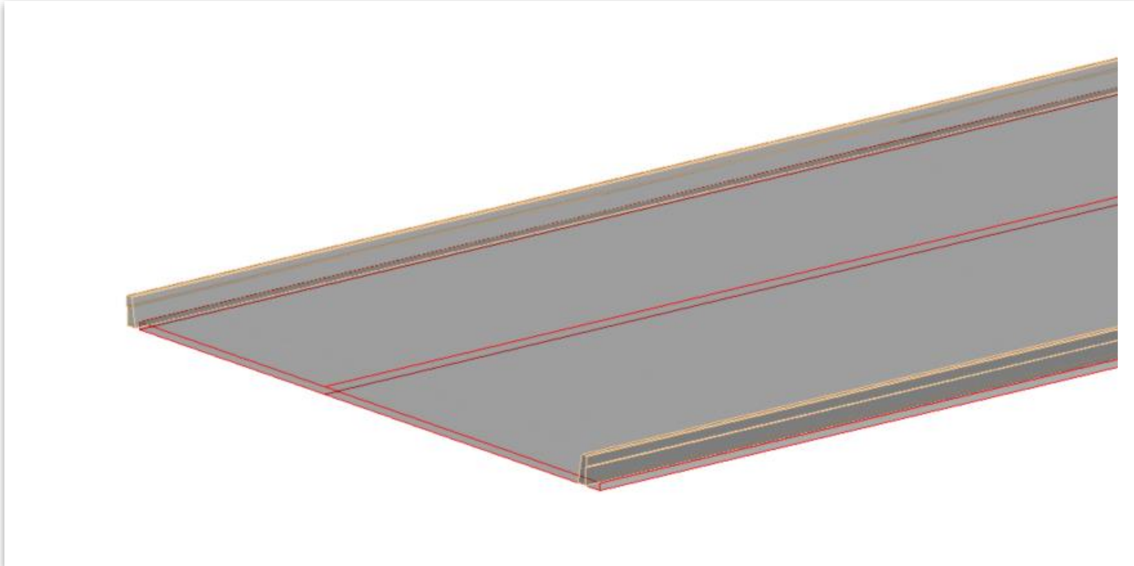
10. Select **P_5** from the list as the **Guideline Point** and click **OK**.



11. Verify that the blue check mark is showing and click **OK**. The barrier should now be displayed on top of the deck.



12. Repeat Steps 5-11 to place the **Right Barrier**. In Step 6 change the selected template to **STD-1-1SS_RT_SingleSlopeParapet** and change the horizontal offset to **-1:2.5**. In Step 10 select **P_1** as the **Guideline Point**.



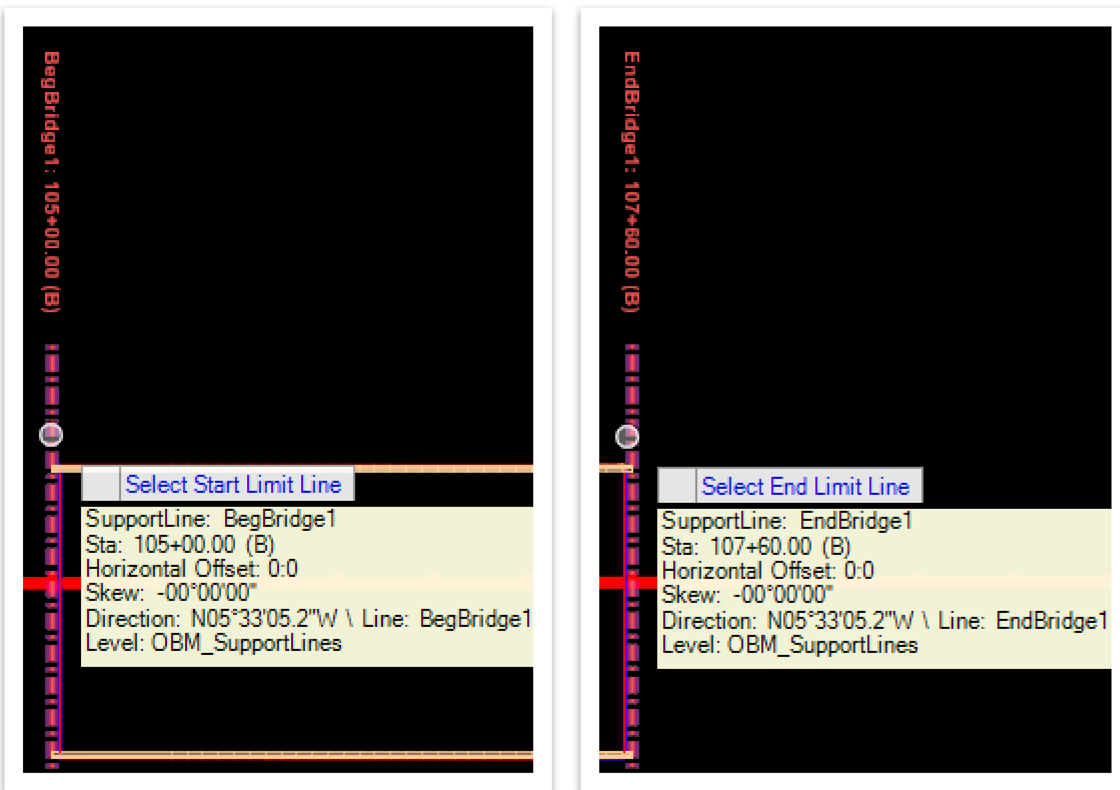
2.4: Create a Beam Layout, Model Beams, and Add Diaphragms

In the following exercises, we will create a beam layout to set the centerlines and beam limits for the bridge. We will then use the beam layout to model the beams using an existing Bulb-Tee section template. Lastly, we will add diaphragms to the bridge based on the span arrangement.

2.4.1 Exercise: Create a Beam Layout

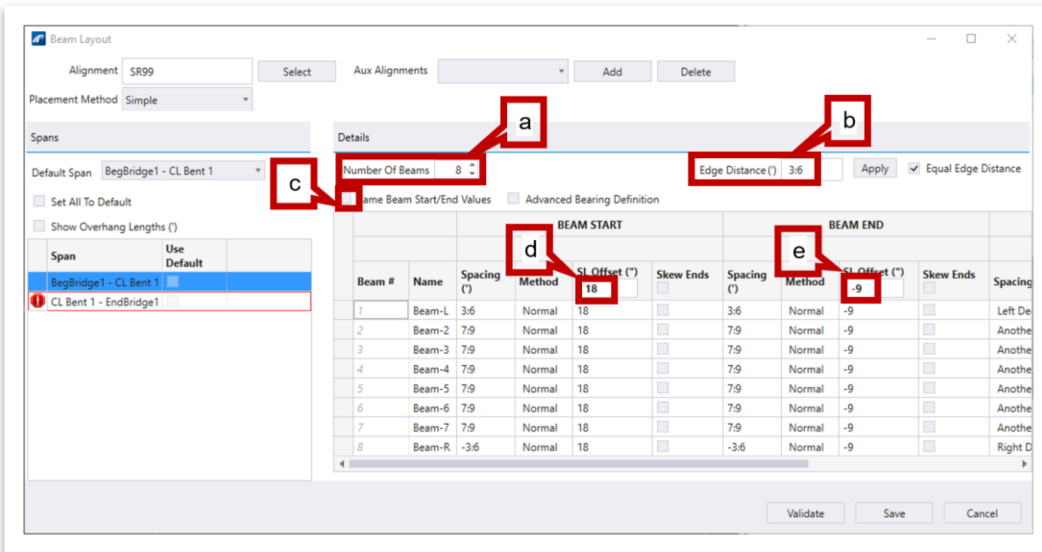
In this exercise, we will create a beam layout that will define the locations of the beam centerlines, as well as, the limits of the beam ends for both spans of the bridge. We will continue to utilize the same **TDOT_TR_OBM_Model.dgn** file (or **TDOT_TR_OBM_ Model_2.4_Begin.dgn**).

1. First, we need to create the beam layout. Open the **Beam Layout** tool (**Open Bridge Modeler >> Home >> Superstructure**). Placing the beam layout is required before the 3D beam elements can be placed.
2. Notice the cursor prompt: **Select Start Limit Line**. Select **BegBridge1**. Notice the next cursor prompt: **Select End Limit Line**. Select **EndBridge1**.



3. **Data Point** (left click) to accept the Limit Lines and then open the **Beam Layout** window.

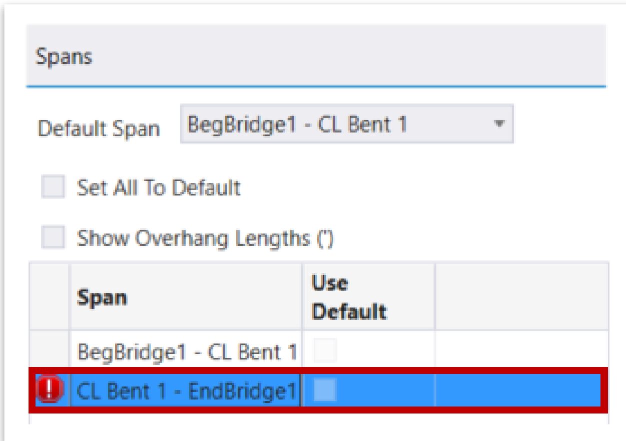
4. In the **Beam Layout** window, you can modify how the beams will be placed in the model. Go ahead and select the following settings.
   a. **Number Of Beams:** 8
   b. **Edge Distance:** 3:6. Then ensure **Equal Edge Distance** is checked and click **Apply**. **Note:** The Beam-L and Beam-R will now have a Spacing of **3:6** and **-3:6**, respectively.
   c. **Same Beam Start/End Values:** Uncheck
   d. **Beam Start >> SL Offset:** 18”
   e. **Beam End >> SL Offset:** -9”
   f. All settings not explicitly listed can be kept as default.



*The **Validate** button in the **Beam Layout** window can be used to see a preview of how the proposed beam layout would look in **2D** prior to fully generating the layout. This can help minimize the need to make edits after the beam layout has been created.*

Take Note!

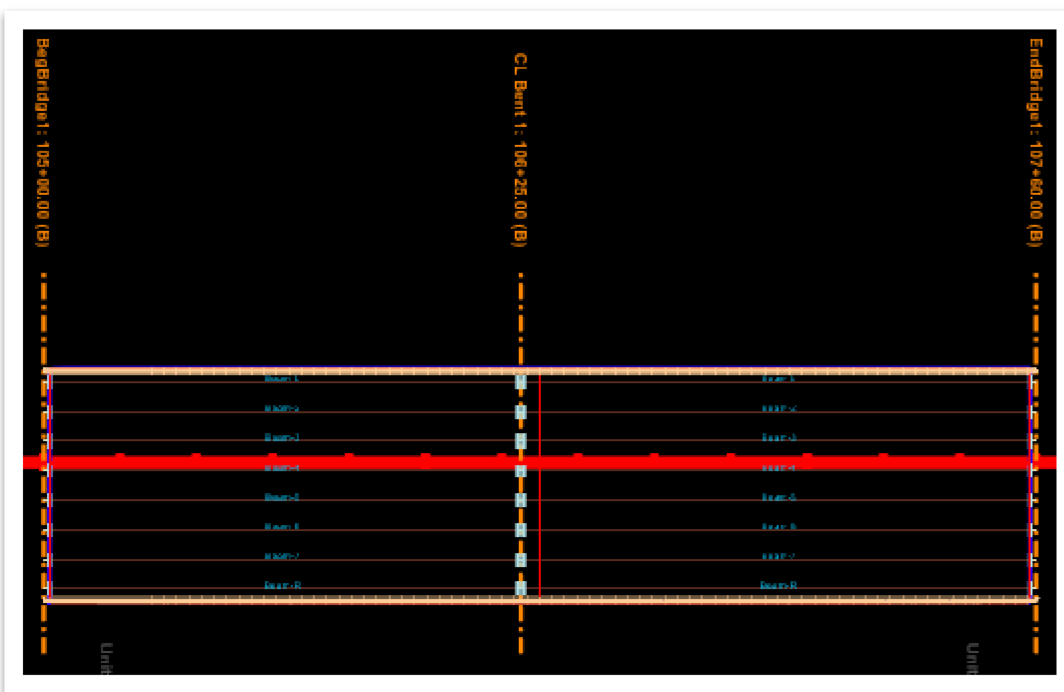
5. Repeat Step 4 for the second span. Select **CL Bent 1 - EndBridge1** in the **Span** section of the **Beam Layout** window by highlighting the span. The **SL** offsets will be different for this span so go ahead and select the following settings.
   a. **Beam Start >> SL Offset:** 9”
   b. **Beam End >> SL Offset:** -18”



Take Note!

*If spans have different numbers of beams, the **Number of Beams** can simply be changed for individual spans. Likewise, this is applicable to any other variable present within the **Beam Layout** window.*

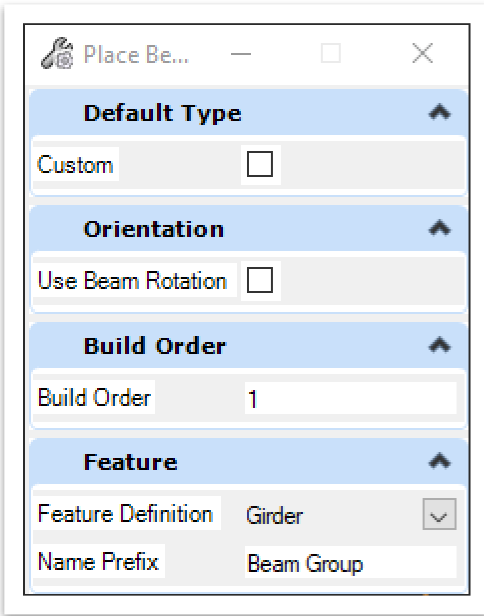
6. Click **Save** at the bottom of the window to place the **Beam Layout** in the model, which is shown below.



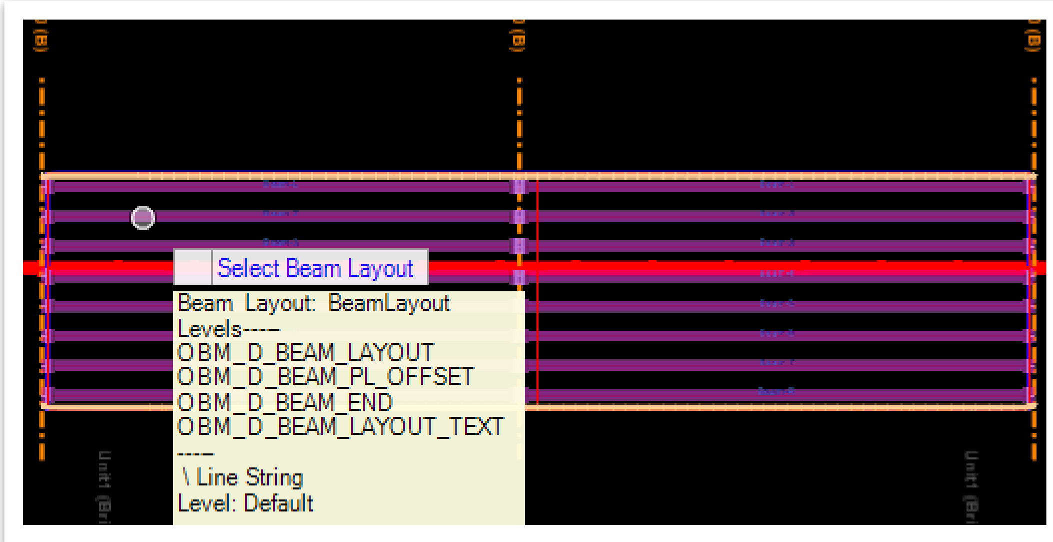
2.4.2 Exercise: Model Beams

In this exercise, we will use the beam layout created in the previous portion of the exercise to model the beams that are used on the bridge. The beam template that will be used is an existing Bulb-Tee template found in the LEAP Concrete templates. We will continue to utilize the same **TDOT_TR_OBM_Model.dgn** file (or **TDOT_TR_OBM_Model_2.4_Begin.dgn**) from the previous portion of the exercise.

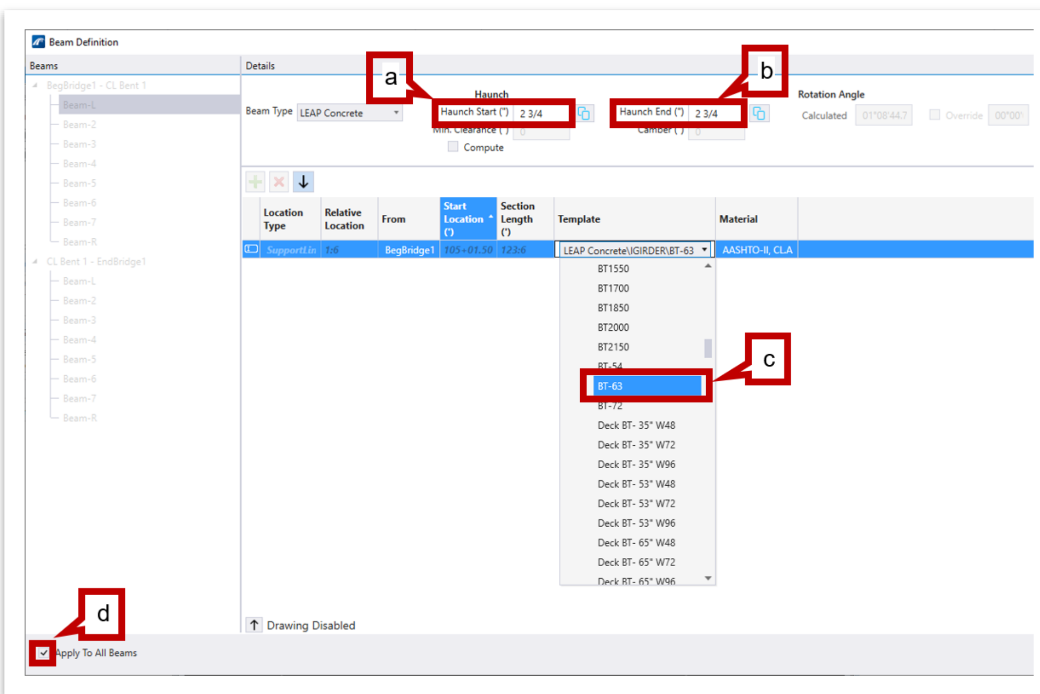
1. First, we need to add the actual beams to the bridge. To begin modeling the beams, open the **Place Beam** tool (**OpenBridge Modeler >> Home >> Super structure**).
2. In the **Place Beam** dialog box, ensure that the **Feature Definition** is set to **Girder**.



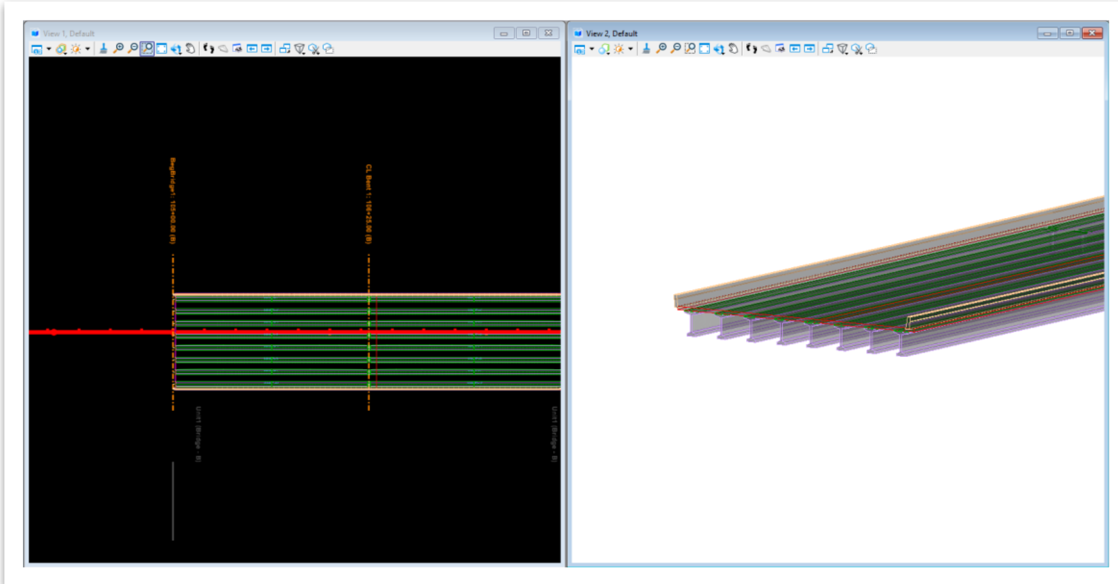
3. Notice the cursor prompt: **Select Beam Layout**. Select the **Beam Layout** by left clicking on it and then data point (left click) to accept the selection. The **Beam Definition** window should open which will allow you to modify the beam properties.



4. In the **Beam Definition** window, select the following settings.
   a. **Haunch >> Haunch Start:** 2.75
   b. **Haunch >> Haunch End:** 2.75
   c. **Template:** I_GIRDER >> BT-63
   d. **Apply To All Beams:** Check
   e. All settings not explicitly listed can be kept as default.



5. Select **OK** and you should see the **Beam Group** that was just created.



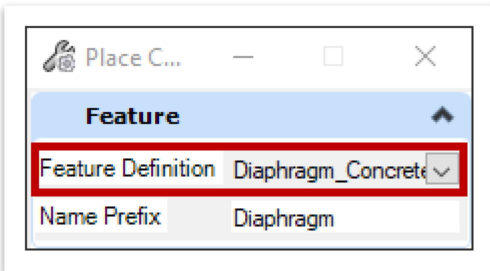
Take Note!

On an actual project, users may not have uniform haunches or beams for all beams on the bridge. In this case, the ***Apply To All Beams*** *option in Step 4 can be toggled off, and each beam's properties can be accessed one at a time by highlighting a specific beam and changing the necessary properties.*

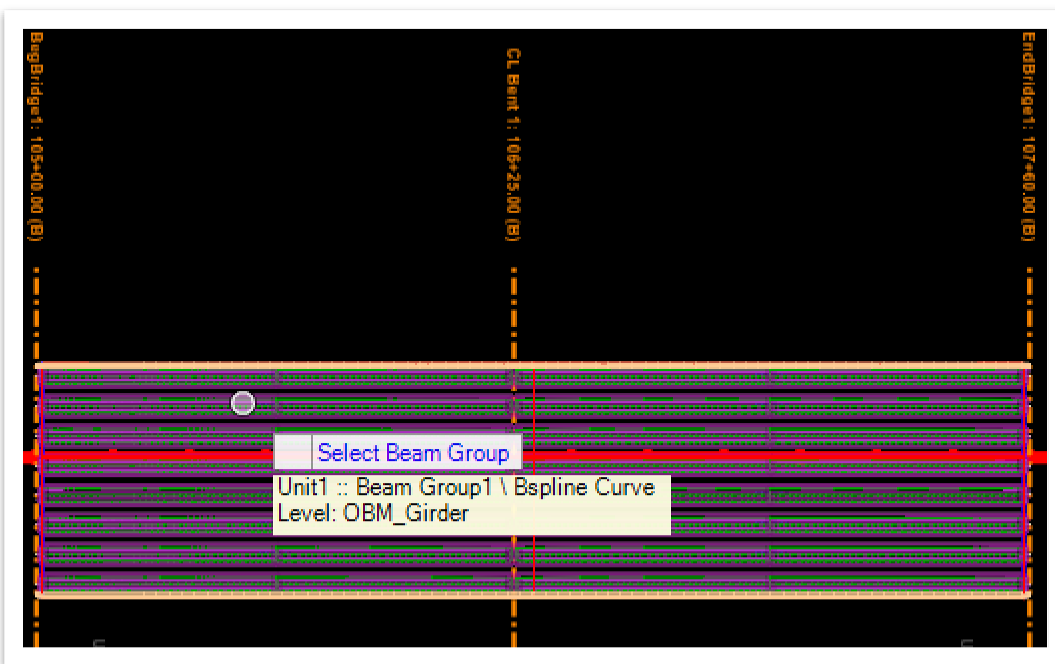
2.4.3 Exercise: Add Diaphragms

In this exercise, we will add diaphragms to the bridge model. Because we will be modeling integral abutments that will have their own backwalls, there is no need to place diaphragms at the abutments. We will model concrete diaphragms at third points in each span. The end diaphragm at the intermediate pier will not be modeled. The current version of OBM (10.10) does not allow for an end diaphragm to be applied if they are located beyond the end of the beams. Future versions of OBM will allow for end diaphragms to be applied. We will continue to utilize the same **TDOT_TR_OBM_Model.dgn** file (or **TDOT_TR_ OBM_Model_2.4_Begin.dgn**) from the previous portion of the exercise.

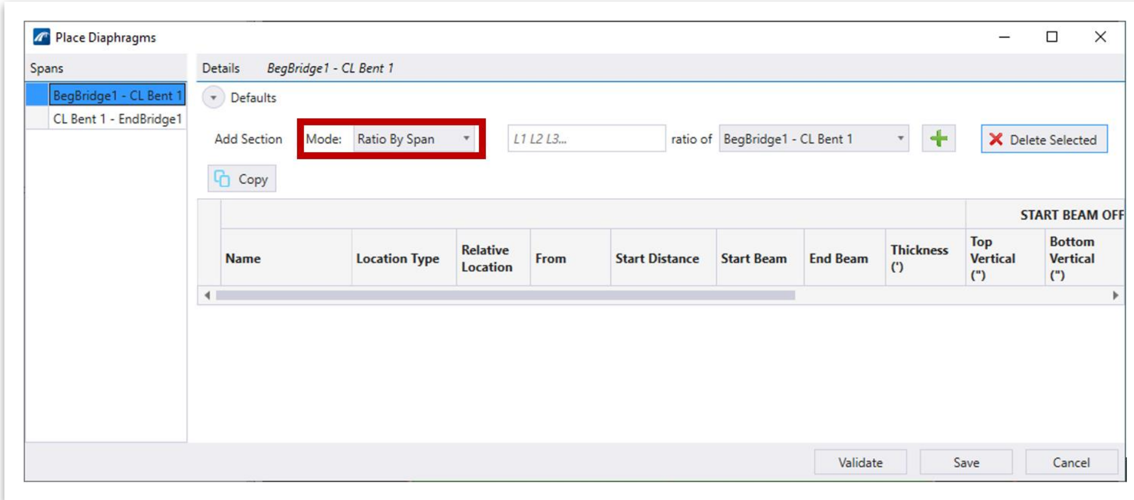
1. First, we need to create the concrete diaphragms. Open the **Place Diaphragms** tool (**OpenBridge Modeler >> Home >> Superstructure**).
2. In the **Place Concrete Diaphragm** dialog box, ensure that the **Feature Definition** is set to **Diaphragm_Concrete**.



3. Notice the cursor prompt: **Select Beam Group**. Left click to select and then data point (left click) to accept the selection. The **Place Diaphragms** window should open which will allow you to modify the diaphragm properties.



4. Before adding a section in the **Place Diaphragms** window, update the **Mode** to **Ratio By Span**.



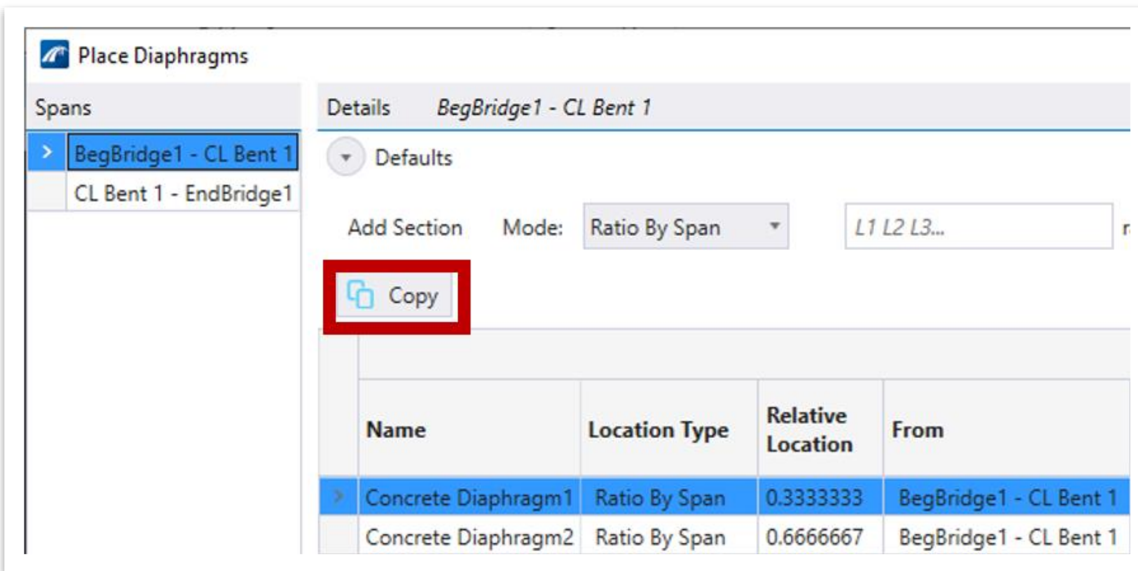
5. Next, add a new section by clicking on the green plus sign  in the **Add Section** area.
6. Then update the following properties of the first intermediate diaphragm.
   a. **Relative Location:** 0.3333333
   b. **Start Beam Offsets:**
      i. **Top Vertical:** -3.125
      ii. **Bottom Vertical:** 10
   c. **End Beam Offsets:**
      i. **Top Vertical:** -3.875
      ii. **Bottom Vertical:** 10
7. Add another section by clicking the green plus sign. Then, update the following properties of the second intermediate diaphragm.
   a. **Relative Location:** 0.6666667. **Note:** You can enter this value before clicking the **+** in the **Add Section** window.
   b. **Start Beam Offsets:**
      i. **Top Vertical:** -3.125
      ii. **Bottom Vertical:** 10
   c. **End Beam Offsets:**
      i. **Top Vertical:** -3.875
      ii. **Bottom Vertical:** 10

8. Now, all diaphragms in **Span 1** have been added. All properties should now match those shown in the following two images.

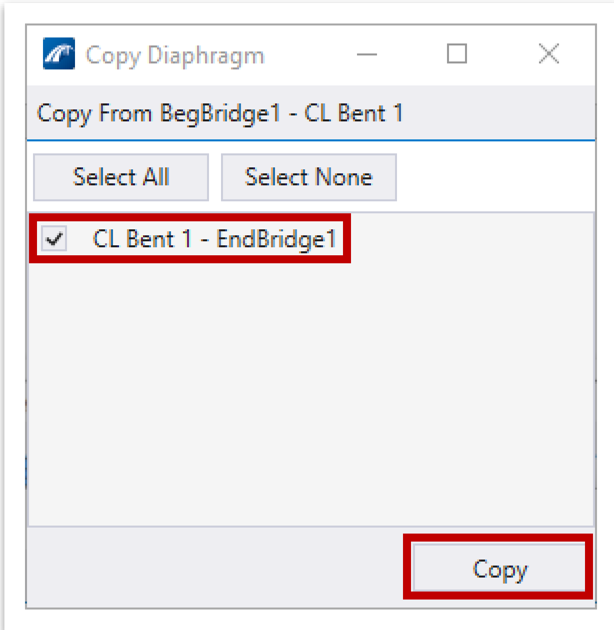
Name	Location Type	Relative Location	From	Start Distance	Start Beam	End Beam	Thickness (')
Concrete Dia	Ratio By Span	0.3333333	BegBridge1 - CL Bent 1	105+41.67	Beam-L	Beam-R	1:0
Concrete Dia	Ratio By Span	0.6666667	BegBridge1 - CL Bent 1	105+83.33	Beam-L	Beam-R	1:0

START BEAM OFFSETS			END BEAM OFFSETS				
Top Vertical (")	Bottom Vertical (")	Horizontal (")	Top Vertical (")	Bottom Vertical (")	Horizontal (")	Angle	Material
-3 1/8	10	0	-3 7/8	10	0	00°00'00"	AASHTO-II, CLA
-3 1/8	10	0	-3 7/8	10	0	00°00'00"	AASHTO-II, CLA

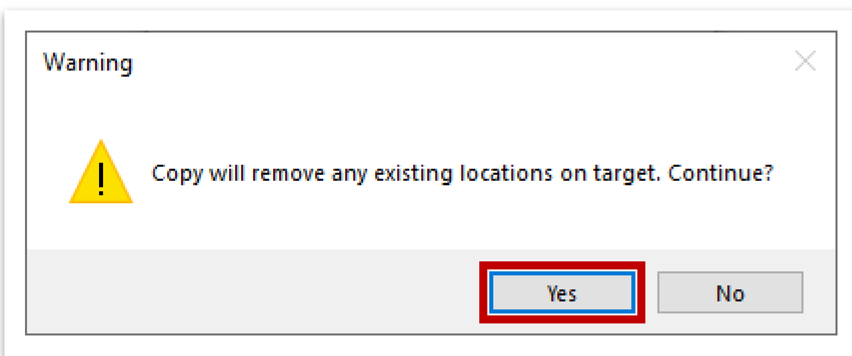
9. Because the two intermediate diaphragms are also present at the third points in **Span 2**, we can copy over these diaphragms by clicking the **Copy** button.



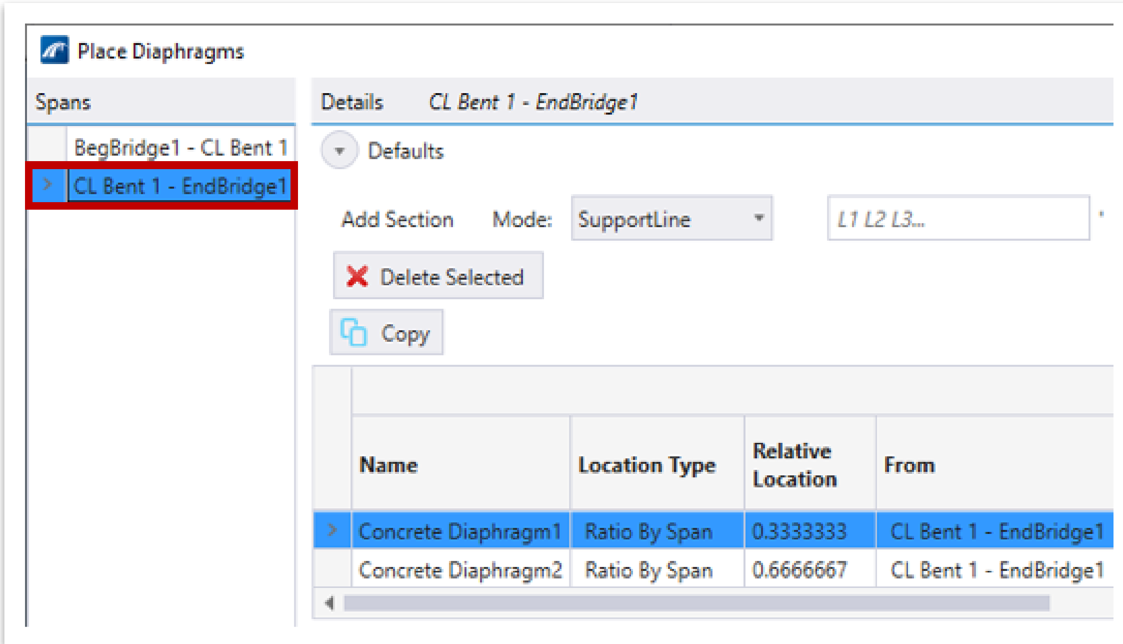
10. This will open the **Copy Diaphragm** dialog box. Here, checkmark the box next to **CL Bent 1 - EndBridge1** to denote the span that the diaphragms will be copied to. Then, click **Copy**.



11. A **Warning** window will open stating that copying diaphragms from Span 1 will remove any existing diaphragms in the target span (Span 2). Go ahead and click **Yes** to continue as there are currently no existing diaphragms present that will be deleted.



12. Once copied over to Span 2, click on the Span **CL Bent 1 - EndBridge1** in the **Spans** area of the **Place Diaphragms** window to see that both diaphragms have been copied to the next span.



Take Note!

*If users would like to change the name of a diaphragm from the default **Concrete Diaphragm#,** highlight the diaphragm, as shown above. Then click the cell with the diaphragm's name and type the new desired name into the cell.*

13. Once all diaphragms are set up in the **Place Diaphragms** window, click **Save** to generate the concrete diaphragms in the model.

2.5: Model Abutments, Wingwalls, Pier, and Bearings

In the following exercises, we will place abutments at the ends of the bridge, add wingwalls, place a pier, and place bearing pads and bearing seats under the beams created in the previous exercise. For this training, we will be using pre-generated substructure templates.

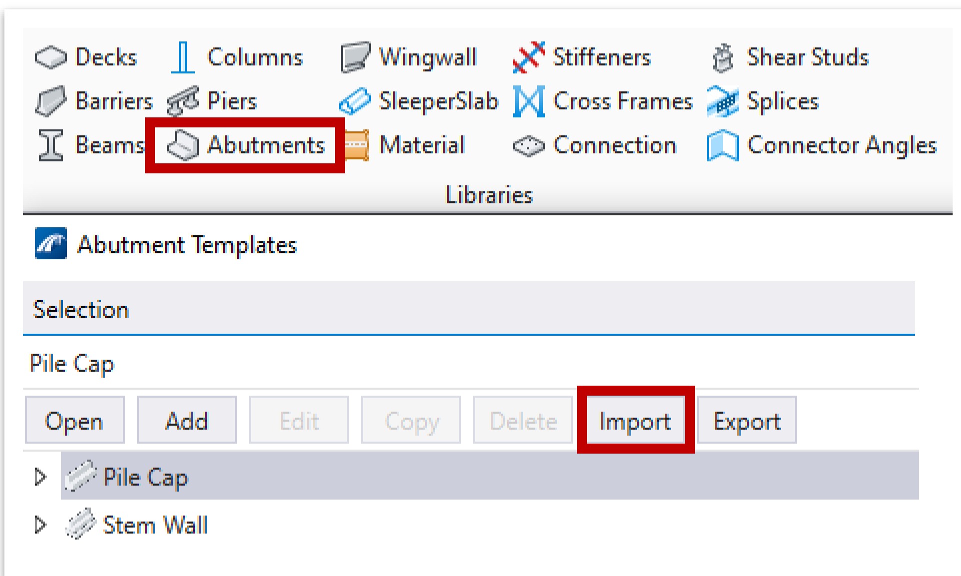
Take Note!

*On an actual project, users will have to create project-specific abutment and pier templates within the corresponding template libraries **(OpenBridge Modeler >> Utilities >> Libraries >> Abutments** [or] **Piers)**. Template creation will be covered in additional OBM manuals. There are various provided templates to use as a starting point.*

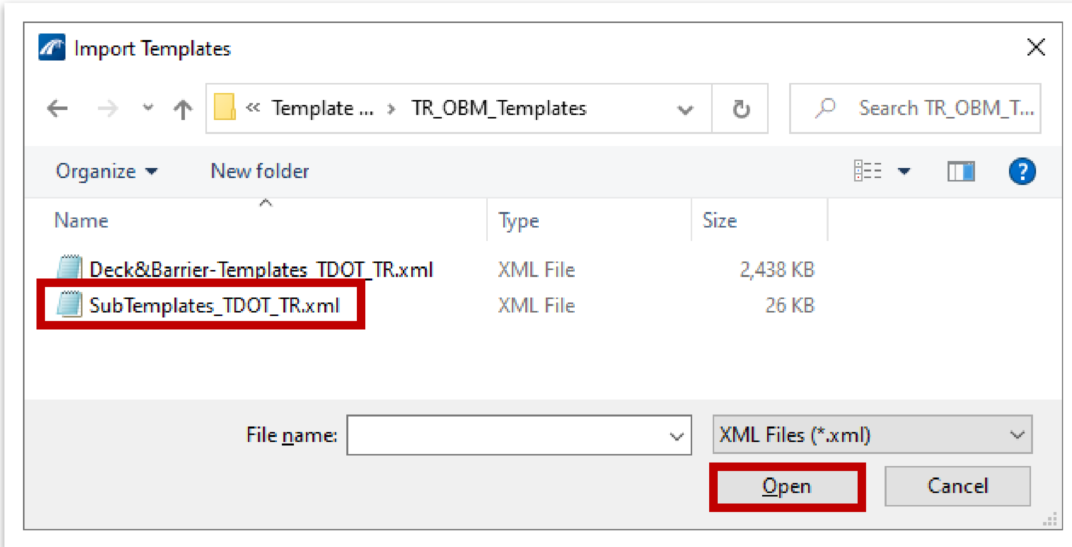
2.5.1 Exercise: Model Abutments

In this exercise, we will use a previously generated abutment template with a corbel (roadway bracket) to place an abutment at each end of the bridge. Although the abutment is structurally integral, we will not select integral as a placement option since in OBM integral is equivalent to embedded. **Note:** Wingwalls and wingbeams will be added to the abutments separately in the next exercise. We will continue to utilize the same **TDOT_TR_OBM_Model.dgn** file (or **TDOT_TR_OBM_Model_2.5_Begin.dgn**).

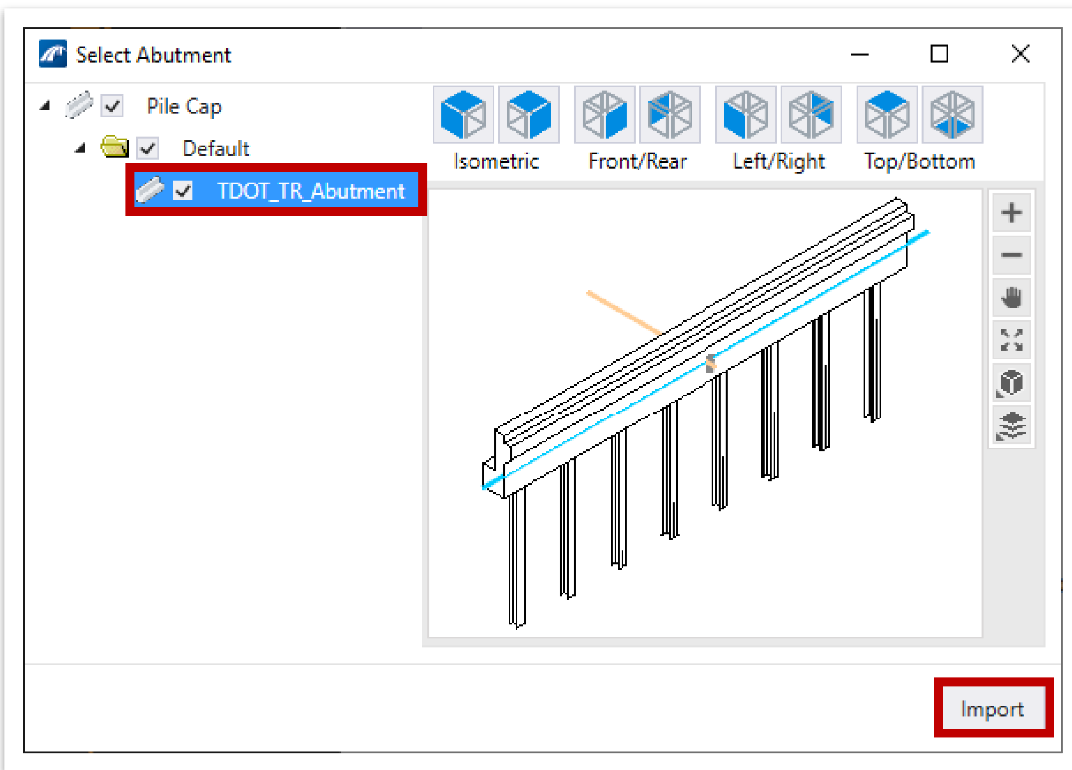
1. First, we will import an abutment template that has been pre-modified for the training model. Open the **Abutments** tool (**OpenBridge Modeler >> Utilities >> Libraries**). In the **Abutment Templates** window, click **Import**.



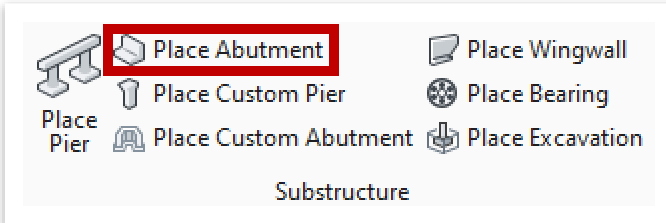
2. The **Import Templates** window should open. Navigate to where the dataset files are located and select the **SubTemplates_TDOT_TR.xml** file and then click **Open** (**C:\ProgramData\Bentley\OpenBridge Designer CE 10.10.20\OpenBridge Modeler\Configuration\WorkSpaces\TDOT_Standards\WorkSets\123456.00_OBM_TR\Standards\Template Library\TR_OBM_Templates**).



3. The **Select Abutment** window should automatically open. Select the **TDOT_TR_Abutment** checkbox and click **Import**. The template is now available for use. Close the **Abutment Templates** window.



4. To begin abutment placement, open the **Place Abutment** tool (**OpenBridge Modeler >> Home >> Substructure**).

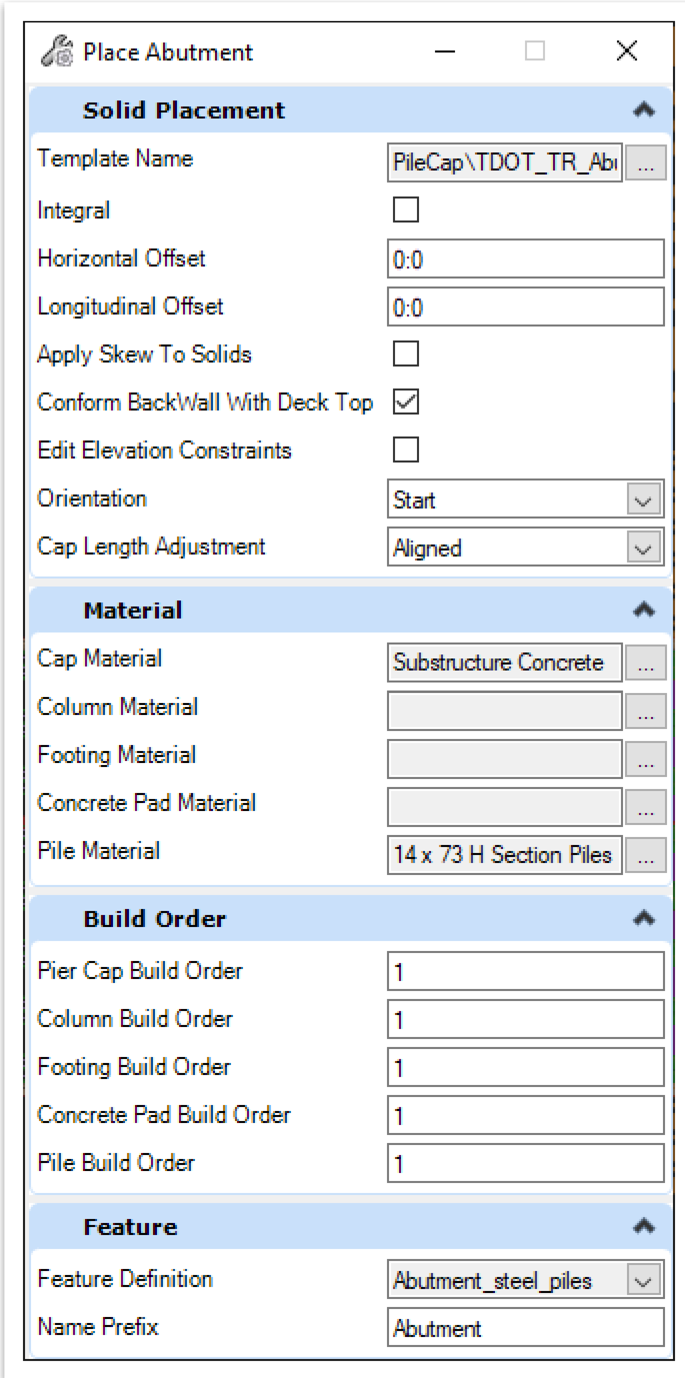


5. In the **Place Abutment** dialog box (see figure on next page), select the following settings.
    a. **Template Name:** TDOT_TR_Abutment (**Pile Cap >> Default**). **Note:** This is the imported template.
    b. **Conform BackWall With Deck Top:** Checkmark. This will adjust the height of the backwall to keep it aligned with the top of the deck.
    c. **Orientation:** Start. This controls which direction the abutment faces.
    d. **Cap Length Adjustment:** Aligned. This setting will automatically center the abutment cap on the deck.

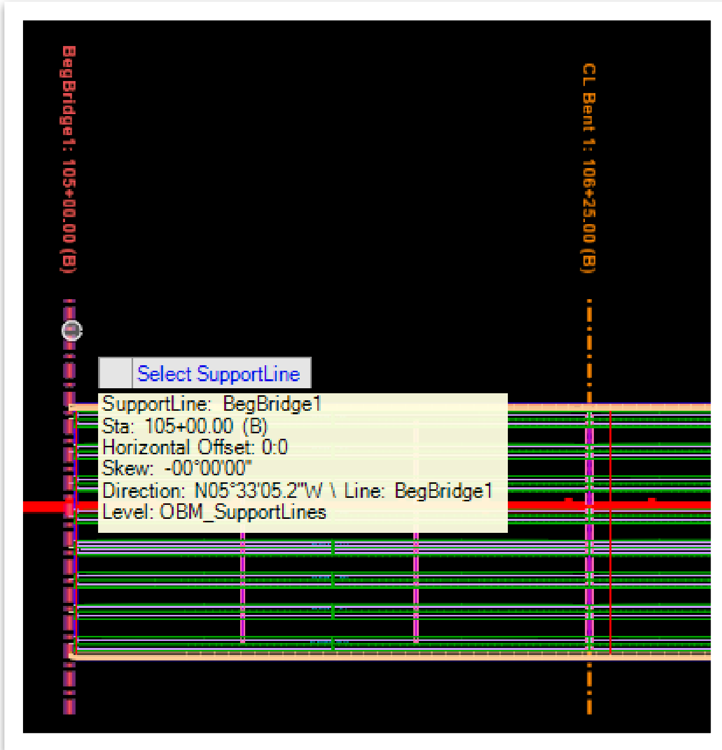
Take Note!

*If the abutment cap is not centered on the deck, you can keep the **Cap Length Adjustment** as **None** and instead use the **Horizontal Offset** to manually set the horizontal offset from the alignment to the geometric center of the abutment cap.*

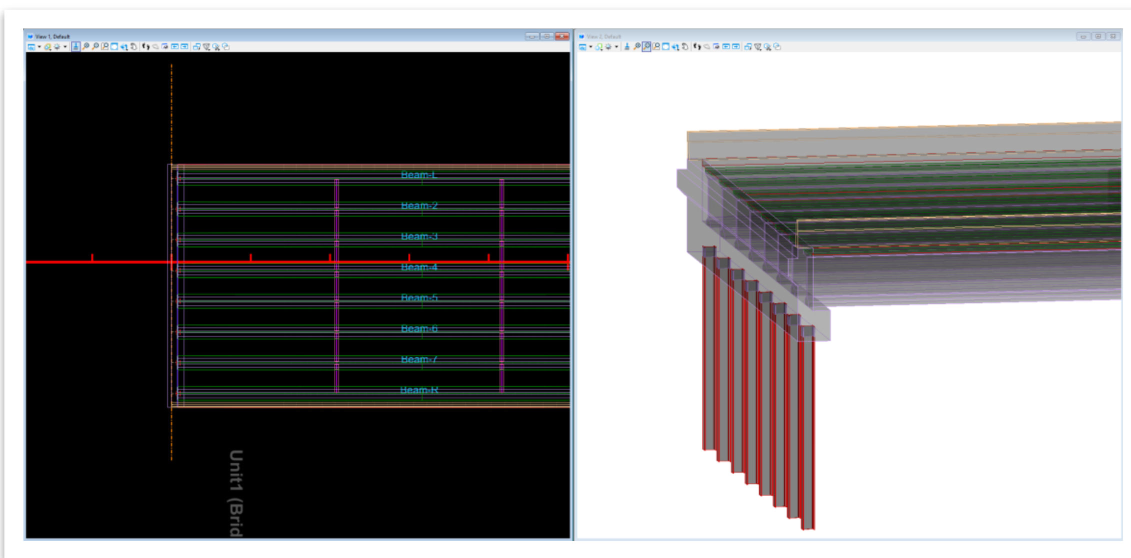
    e. **Cap Material: Concrete >> Substructure Concrete**
    f. **Pile Material: Steel >> 14 x 73 H Section Piles**
    g. **Feature Definition:** Abutment_steel_piles
    h. All settings not explicitly listed can be kept as default (see figure on next page).


Place Abutment
Solid Placement
Template Name
PileCap\TDOT_TR_Abı
Integral
Horizontal Offset
0:0
Longitudinal Offset
0:0
Apply Skew To Solids
Conform BackWall With Deck Top
Edit Elevation Constraints
Orientation
Start
Cap Length Adjustment
Aligned
Material
Cap Material
Substructure Concrete
Column Material
Footing Material
Concrete Pad Material
Pile Material
14 x 73 H Section Piles
Build Order
Pier Cap Build Order
1
Column Build Order
1
Footing Build Order
1
Concrete Pad Build Order
1
Pile Build Order
1
Feature
Feature Definition
Abutment_steel_piles
Name Prefix
Abutment

6. Notice the cursor prompt: **Select SupportLine**. Select the **BegBridge1** Support Line in **View 1** (top view) to place the abutment.



7. **Data Point** (left click) in space to confirm placement. **Reset** (right click) to close the **Place Abutment** dialog box and notice that the begin bridge abutment is now visible in both views.

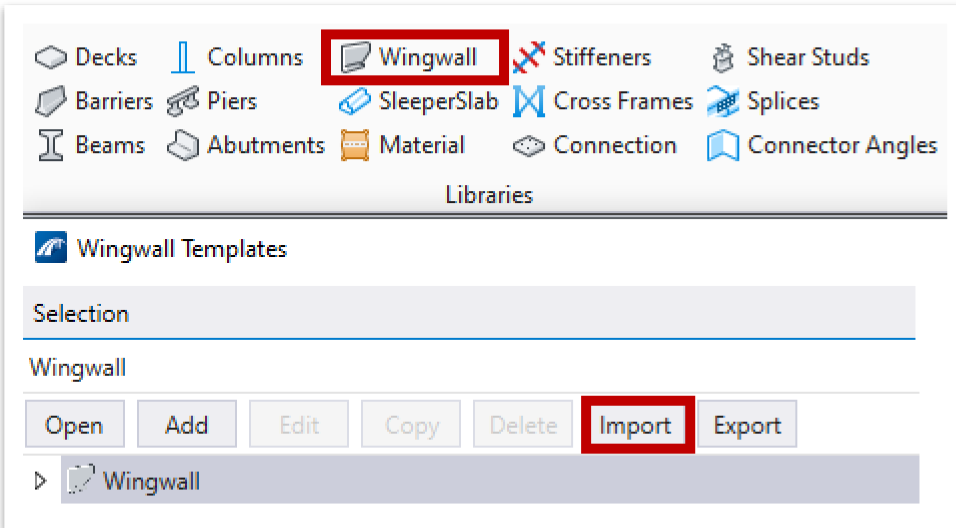


8. Place the end bridge abutment by repeating Steps 4 – 7 but select the **Orientation** as **End** in Step 5.c and select the **EndBridge1** SupportLine in Step 6.

2.5.2 Exercise: Model Wingwalls

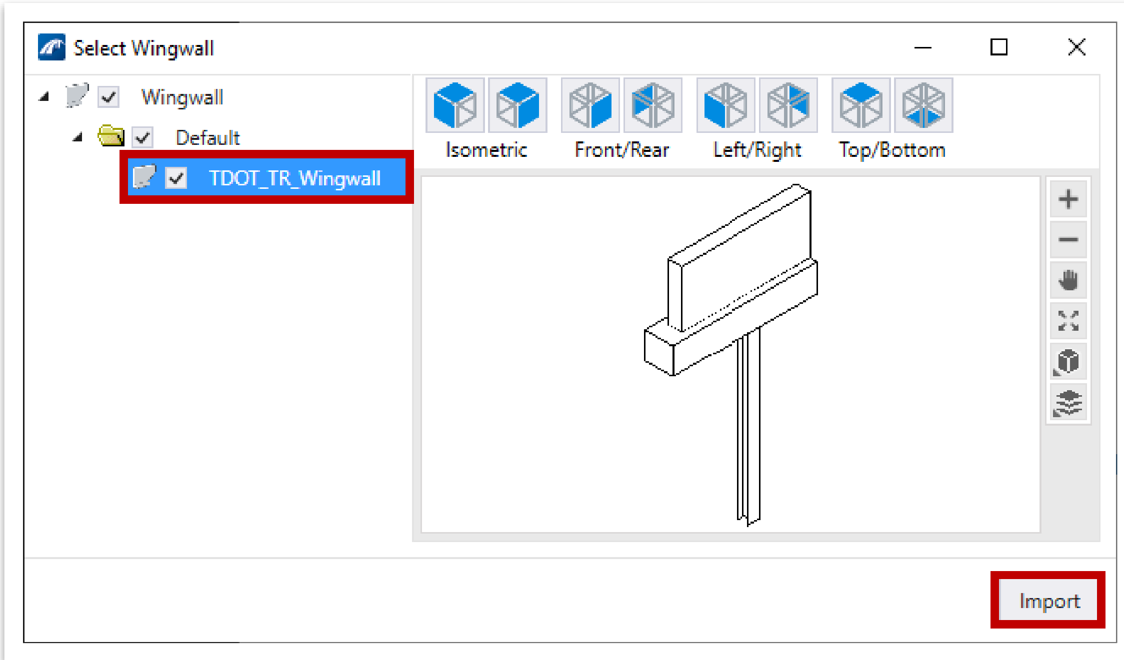
In this exercise, we will use a previously generated wingwall template to place wingwalls on either side of each abutment. We will continue to utilize the same **TDOT_TR_OBM_Model.dgn** file (or **TDOT_TR_OBM_Model_2.5_Begin.dgn**) from the previous portion of the exercise.

1. First, we will import a wingwall template that has been pre-modified for the training model. Open the **Wingwall** tool (**OpenBridge Modeler >> Utilities >> Libraries**). In the **Wingwall Templates** window, click **Import**.

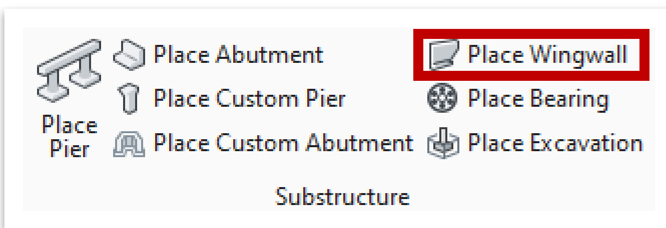


2. The **Import Templates** window should open. Navigate to where the dataset files are located and select the **SubTemplates_TDOT_TR.xml** file and then click **Open** (**C:\ProgramData\Bentley\OpenBridge Designer CE 10.10.20\OpenBridge Modeler\Configuration\WorkSpaces\TDOT_Standards\WorkSets\123456.00_OBM_TR\Standards\Template Library\TR_OBM_Templates**).

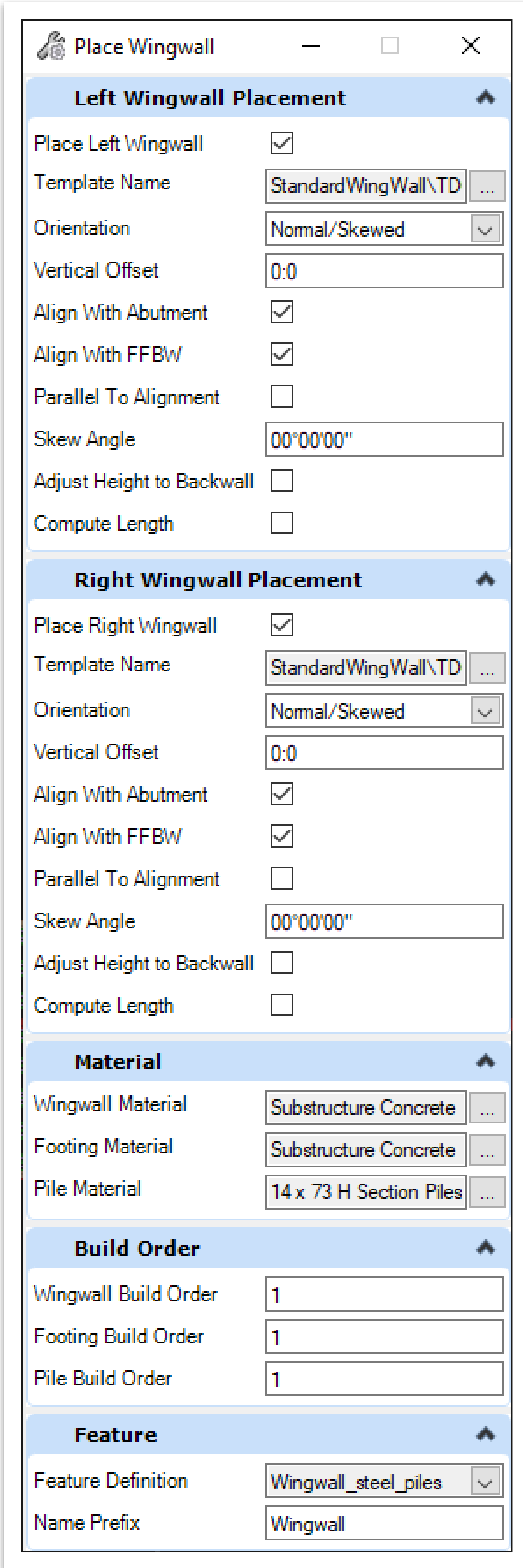
3. The **Select Wingwall** template window should automatically open. Select the **TDOT_TR_Wingwall** checkbox and click **Import**. The template is now available for use. Close the **Wingwall Templates** window.



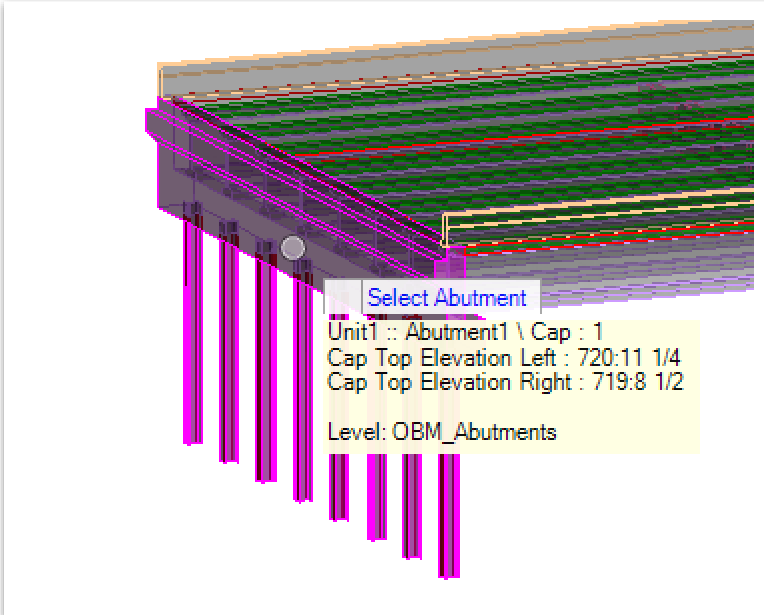
4. To begin wingwall placement, open the **Place Wingwall** tool (**OpenBridge Modeler >> Home >> Substructure**).



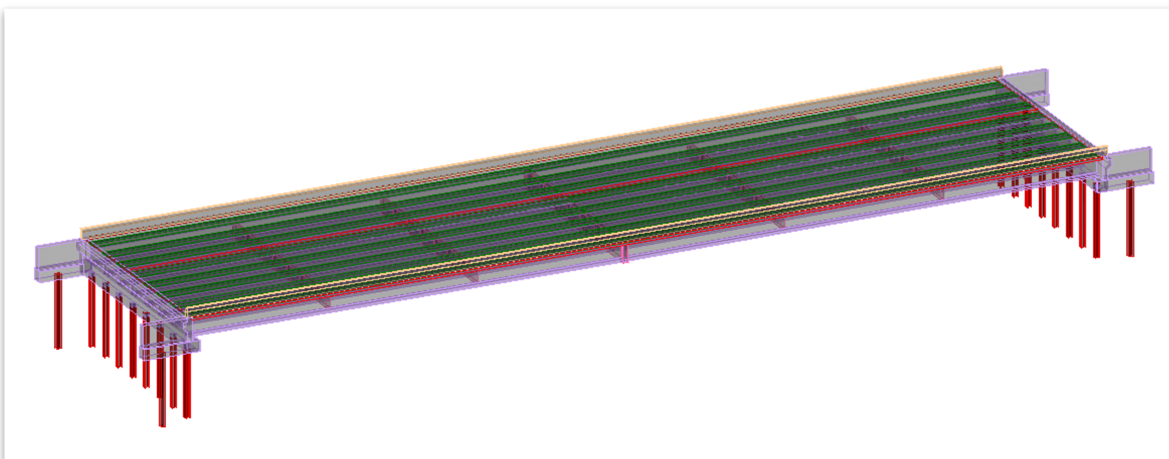
5. In the **Place Wingwall** dialog box (see figure on next page), select the following settings.
    a. **Place Left Wingwall:** Checkmark. **Note:** When this box is checked, additional options in the **Place Wingwall** dialog box are available.
    b. **Template Name:** TDOT_TR_Wingwall (**Wingwall >> Default**). **Note:** This is the imported template.
    c. **Orientation:** Normal/Skewed
    d. **Vertical Offset:** 0:0
    e. **Align With Abutment:** Checkmark. **Note:** When this box is checked, additional options become available.
    f. **Align With FFBW:** Checkmark
    g. **Skew Angle:** 00°00'00"
    h. All other boxes can remain unchecked for the left wingwall.
    i. Repeat Steps 5a – 5g but for the **Right Wingwall Placement** section.
    j. **Wingwall Material: Concrete >> Substructure Concrete**
    k. **Footing Material: Concrete >> Substructure Concrete**
    l. **Pile Material: Steel >> 14 x 73 H Section Piles**
    m. **Feature Definition:** Wingwall_steel_piles
    n. All settings not explicitly listed can be kept as default (see figure on next page).


Place Wingwall
Left Wingwall Placement
Place Left Wingwall
Template Name
StandardWingWall\TD
Orientation
Normal/Skewed
Vertical Offset
0:0
Align With Abutment
Align With FFBW
Parallel To Alignment
Skew Angle
00°00'00"
Adjust Height to Backwall
Compute Length
Right Wingwall Placement
Place Right Wingwall
Template Name
StandardWingWall\TD
Orientation
Normal/Skewed
Vertical Offset
0:0
Align With Abutment
Align With FFBW
Parallel To Alignment
Skew Angle
00°00'00"
Adjust Height to Backwall
Compute Length
Material
Wingwall Material
Substructure Concrete
Footing Material
Substructure Concrete
Pile Material
14 x 73 H Section Piles
Build Order
Wingwall Build Order
1
Footing Build Order
1
Pile Build Order
1
Feature
Feature Definition
Wingwall_steel_piles
Name Prefix
Wingwall

6. Notice the cursor prompt: **Select Abutment**. Select **Abutment1** to place both the left and right wingwalls. You can use either view to select the abutment.



7. **Data Point** (left click) in space to confirm placement.
8. Select **Abutment2** to place both the left and right wingwalls for the end bridge abutment.
9. When you are finished placing the wingwalls, **reset** (right click) to close the **Place Wingwall** dialog box. The wingwalls at all four bridge corners should be visible.



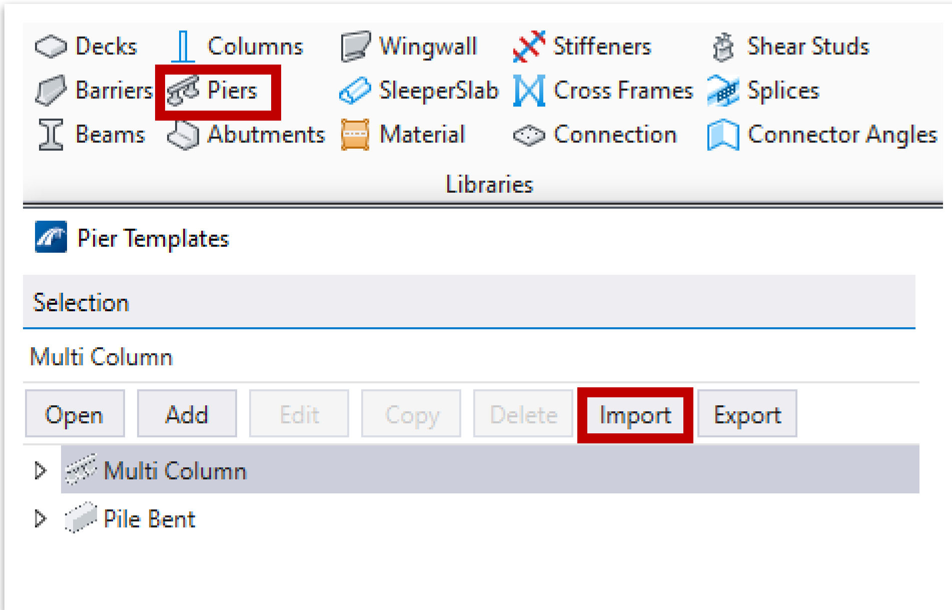
Take Note!

The unique TDOT wingwall and wingbeam geometry is approximated in the training model. You may notice that the connection between wingbeam and abutment beam has slight discontinuities and the top of the wingwall is modeled as level. Enhancements have been made to future releases of OBM to better accommodate that unique geometry.

2.5.3 Exercise: Model a Pier

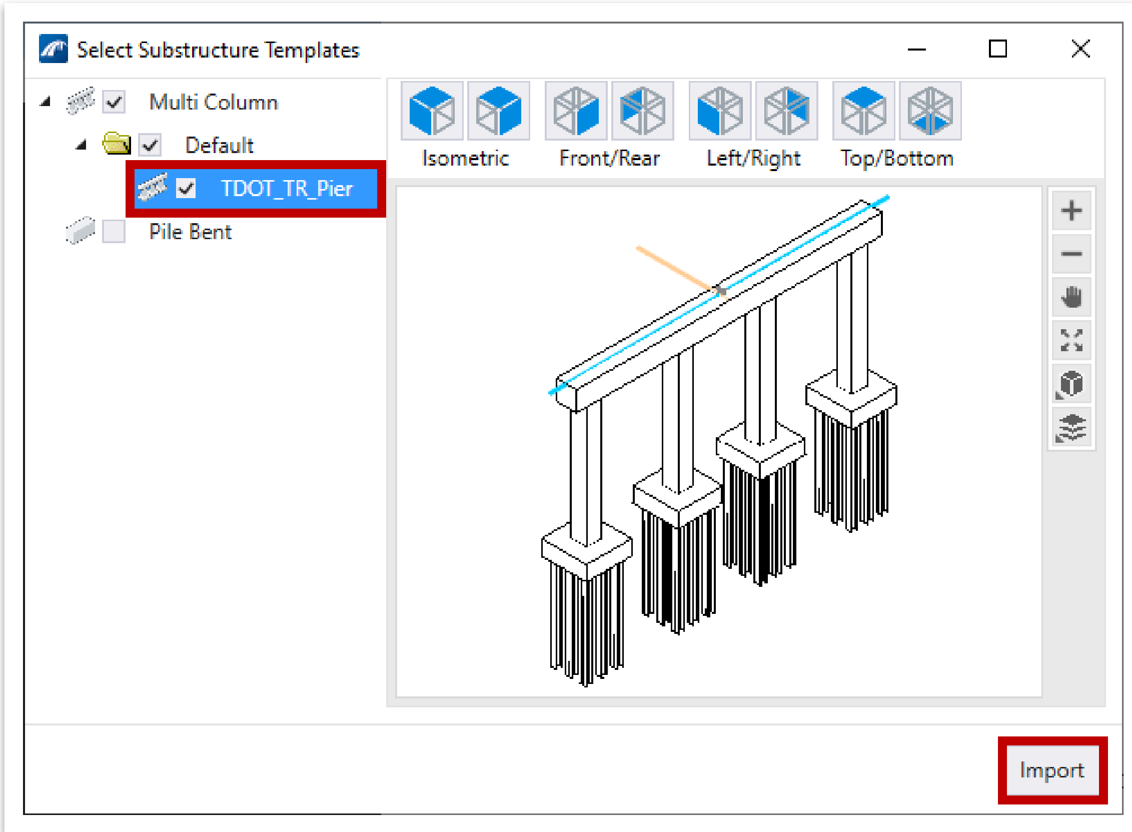
In this exercise, we will use a previously generated pier template to place a pier. We will continue to utilize the same **TDOT_TR_OBM_Model.dgn** file (or **TDOT_TR_OBM_Model_2.5_Begin.dgn**) from the previous portion of the exercise.

1. First, we will import a pier template that has been pre-modified for the training model. Open the **Piers** tool (**OpenBridge Modeler >> Utilities >> Libraries**). In the **Pier Templates** window, click **Import**.

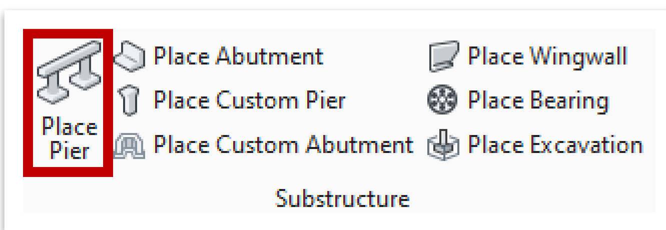


2. The **Import Templates** window should open. Navigate to where the dataset files are located and select the **SubTemplates_TDOT_TR.xml** file, and then click **Open** (**C:\ProgramData\Bentley\OpenBridge Designer CE 10.10.20\Modeler\Configuration\WorkSpaces\TDOT_Standards\WorkSets\123456.00_OBM_TR\Standards\Template Library\TR_OBM_Templates**).

3. The **Select Substructure Templates** window should automatically open. Select the **TDOT_TR_Pier** checkbox and click **Import**. The template is now available for use. Close the **Pier Templates** window.



4. To begin pier placement, open the **Place Pier** tool (**OpenBridge Modeler >> Home >> Substructure**).

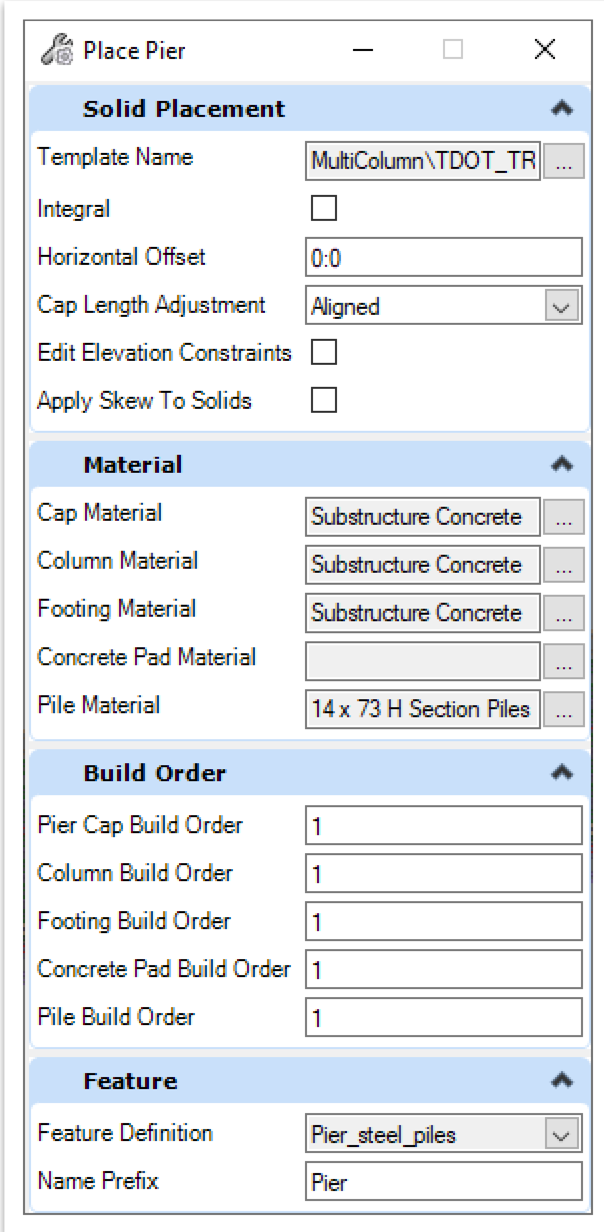


5. In the **Place Pier** dialog box (see figure on next page), select the following settings.
    a. **Template Name:** TDOT_TR_Pier (**Multi Column >> Default**). **Note:** This is the imported template.
    b. **Cap Length Adjustment:** Aligned. This setting will automatically center the pier cap on the deck.

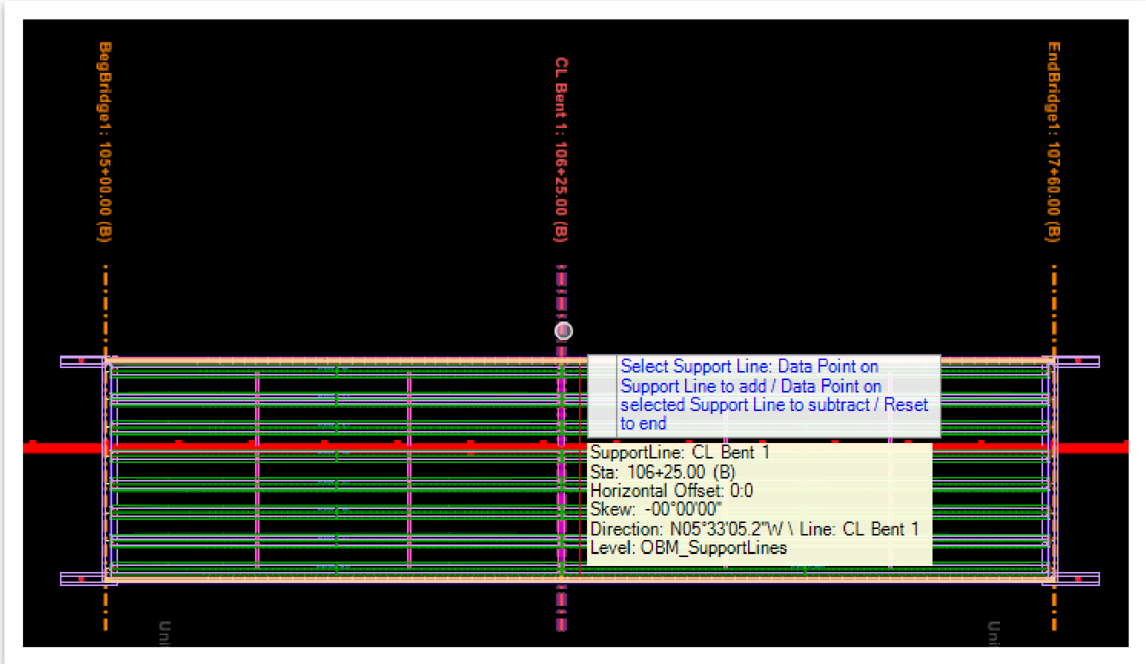
Take Note!

*If the pier cap is not centered on the deck, you can keep the **Cap Length Adjustment** as **None** and instead use the **Horizontal Offset** to manually set the horizontal offset from the alignment to the geometric center of the abutment cap.*

    c. **Cap Material: Concrete >> Substructure Concrete**
    d. **Column Material: Concrete >> Substructure Concrete**
    e. **Footing Material: Concrete >> Substructure Concrete**
    f. **Pile Material: Steel >> 14 x 73 H Section Piles**
    g. **Feature Definition:** Pier_steel_piles
    h. All settings not explicitly listed can be kept as default (see figure on next page).

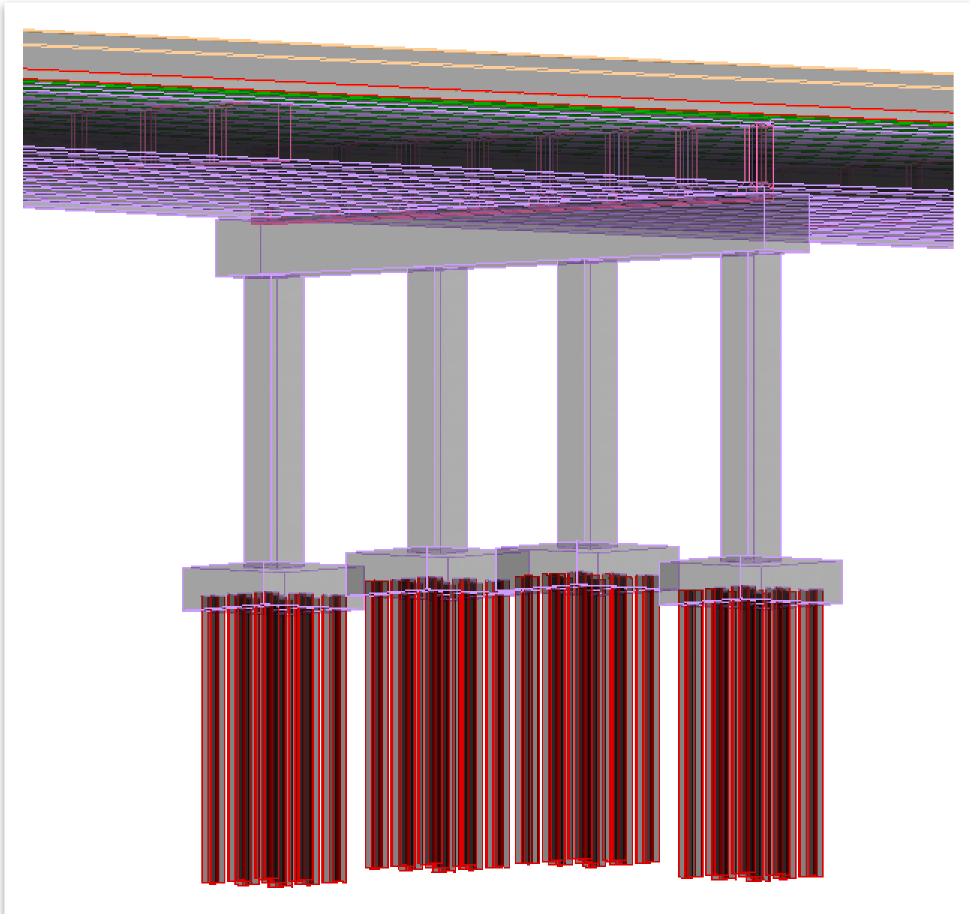

Place Pier
Solid Placement
Template Name
MultiColumn\TDOT_TR
Integral
Horizontal Offset
0:0
Cap Length Adjustment
Aligned
Edit Elevation Constraints
Apply Skew To Solids
Material
Cap Material
Substructure Concrete
Column Material
Substructure Concrete
Footing Material
Substructure Concrete
Concrete Pad Material
Pile Material
14 x 73 H Section Piles
Build Order
Pier Cap Build Order
1
Column Build Order
1
Footing Build Order
1
Concrete Pad Build Order
1
Pile Build Order
1
Feature
Feature Definition
Pier_steel_piles
Name Prefix
Pier

6. Notice the cursor prompt: **Select Support Line**. Select the **CL Bent 1** SupportLine in **View 1** (top view) to place the pier.

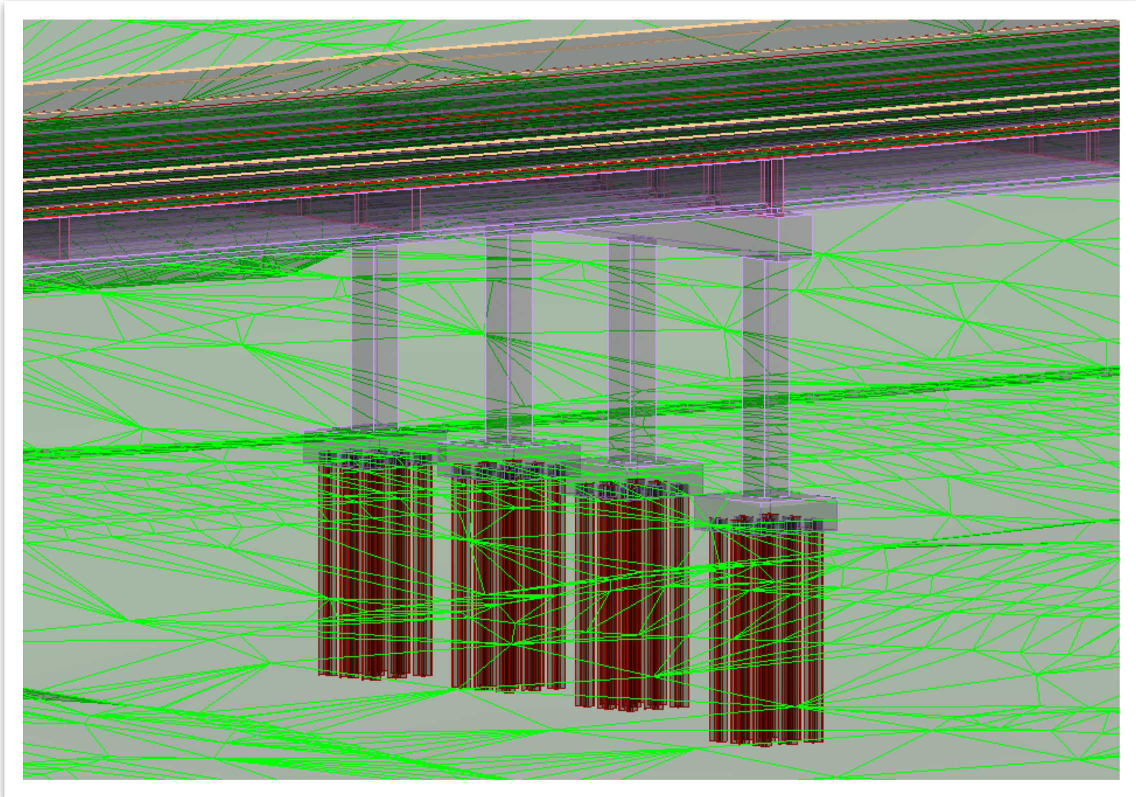


7. **Reset** (right click) in space to end placement. You can place multiple piers at once if needed prior to ending placement. **Data Point** (left click) to continue and confirm entries in the **Place Pier** dialog box.

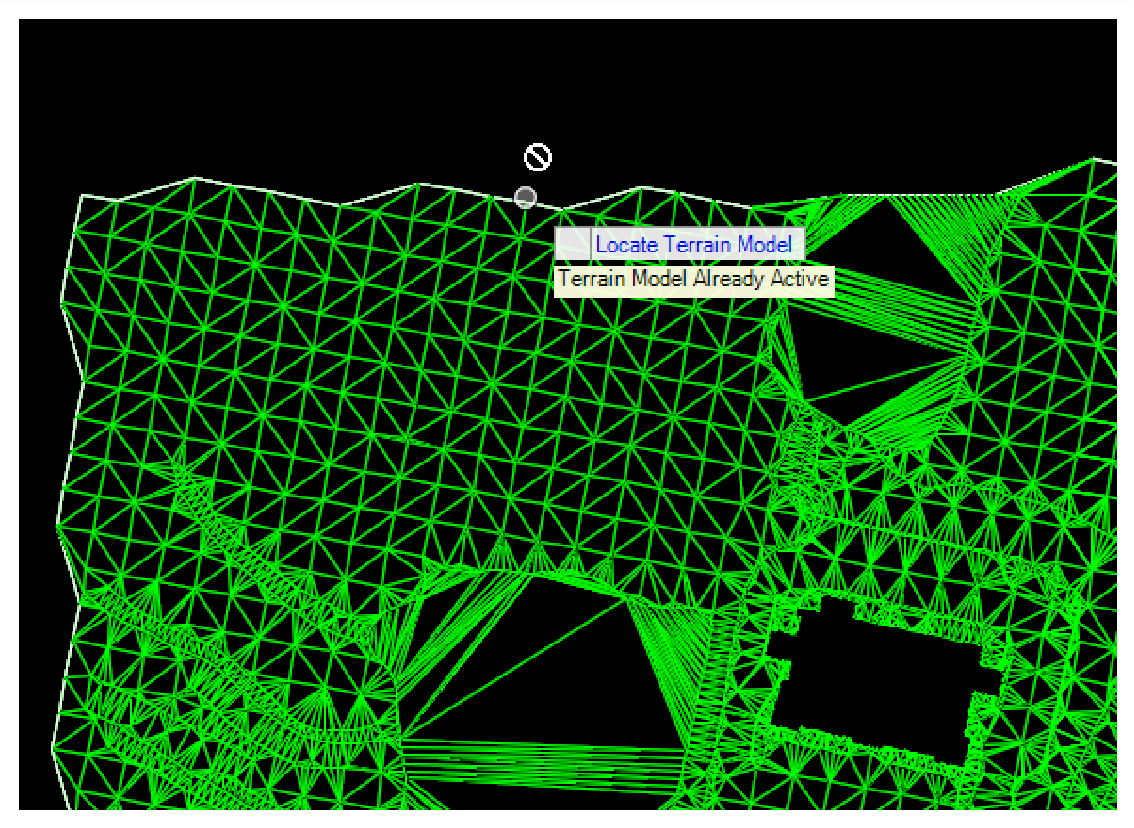
8. When you are finished placing the pier, **reset** (right click) to close the **Place Pier** dialog box. The pier should be visible. **Note:** There are no riser blocks or bearing pads. These will be added in the next exercise and the substructure elements will shift downward after bearings are placed.



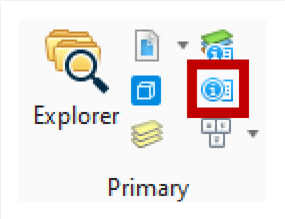
9. Next, let's set the footing elevations to be controlled by the referenced terrain model. Toggle the display on for the **TDOT_TR_Terrain.dgn** reference file and the triangles should appear.



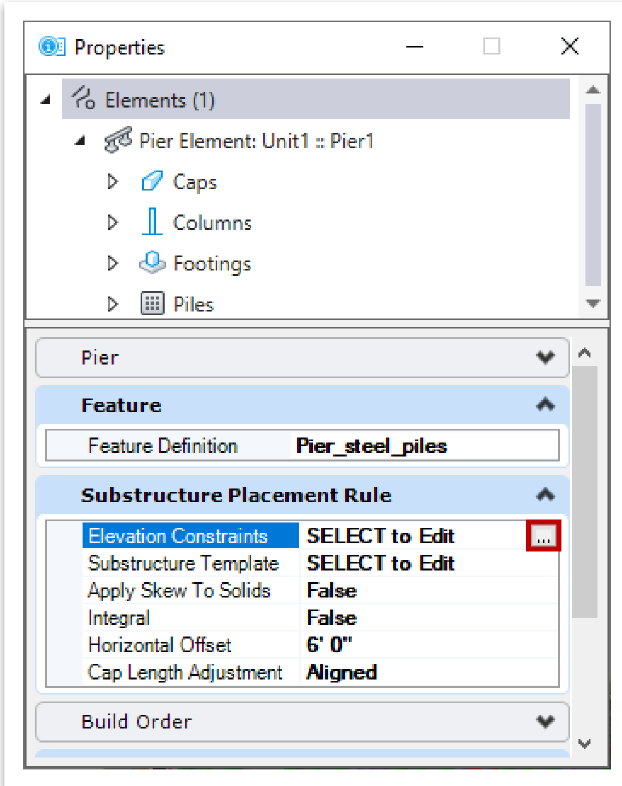
10. The terrain file should be active by default, but if not, open the **Terrain** tool (**OpenBridge Modeler >> Home >> Bridge Setup**) and then select the boundary of the terrain. **Note:** You will need to zoom out to be able to view the boundary. If the terrain model is already active, the cursor prompt will indicate as such.



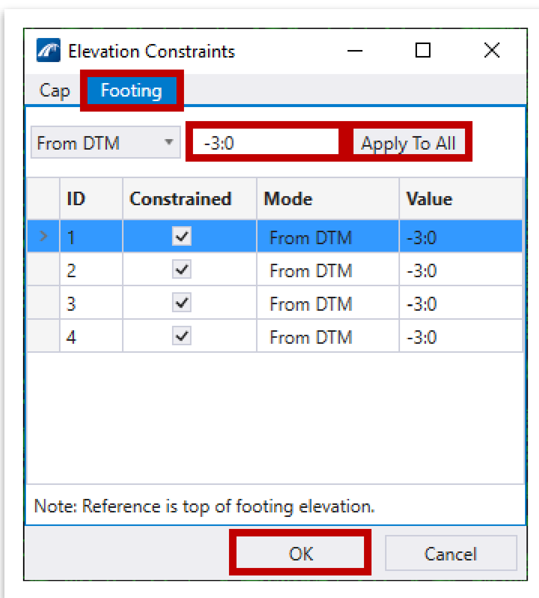
11. Now select the pier and open the **Properties** (**OpenBridge Modeler >> Home >> Primary**).



12. Click the ellipses next to **Elevation Constraints**.



13. Select the **Footing** tab. Change the **From DTM** value to **-3:0** and click **Apply To All** and then click **OK**. This sets the top of the footing elevation three feet below the ground elevations.

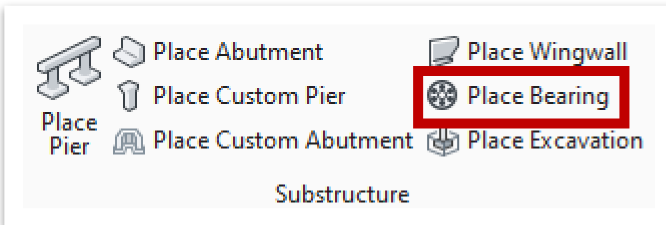


14. Notice the footing elevations were lowered. Go ahead and turn off the **TDOT_TR_Terrain.dgn** reference file.

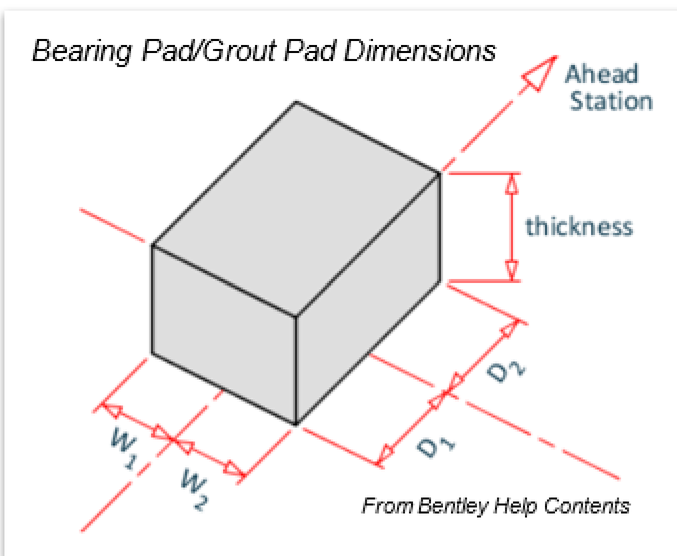
2.5.4 Exercise: Model Bearing Elements

In this exercise, we will place bearing elements at the pier and abutments. We will continue to utilize the same **TDOT_TR_OBM_Model.dgn** file (or **TDOT_TR_OBM_Model_2.5_Begin.dgn**) from the previous portion of the exercise.

1. To begin bearing placement, open the **Place Bearing** tool (**OpenBridge Modeler >> Home >> Substructure**).

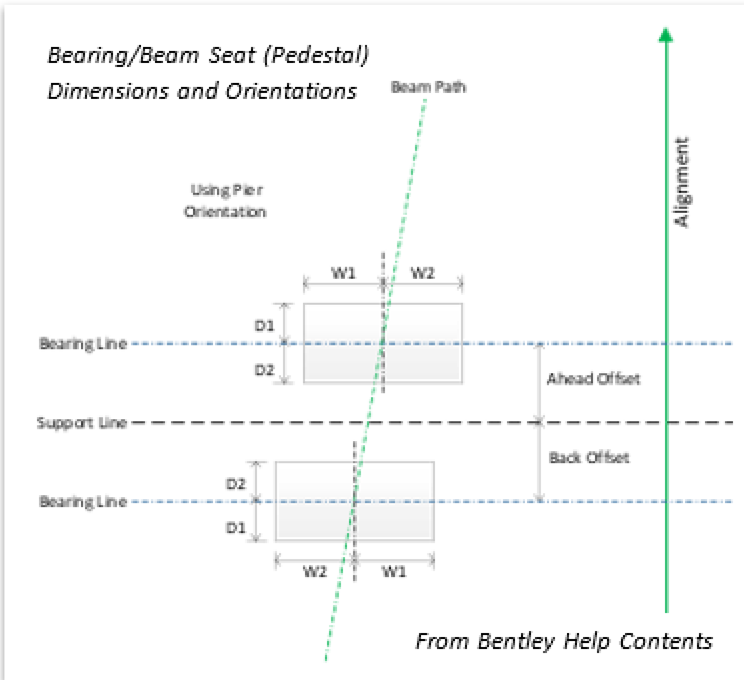


2. In the **Place Bearing** dialog box (figure shown after step 2r), select the following settings.
    a. **Bearing Type:** Cube. **Note:** This corresponds to rectangular bearings.
    b. **Cube Width, W:** 2:2
    c. **Cube Depth, D:** 0:9
    d. **Cube Height:** 0:0.5
    e. **Orientation:** Girder



    f. **Has Bearing Seats:** Checkmark. **Note:** When this box is checked, additional options in the **Place Bearing** dialog box are available.
    g. **Seat Min. Thickness:** 0:3

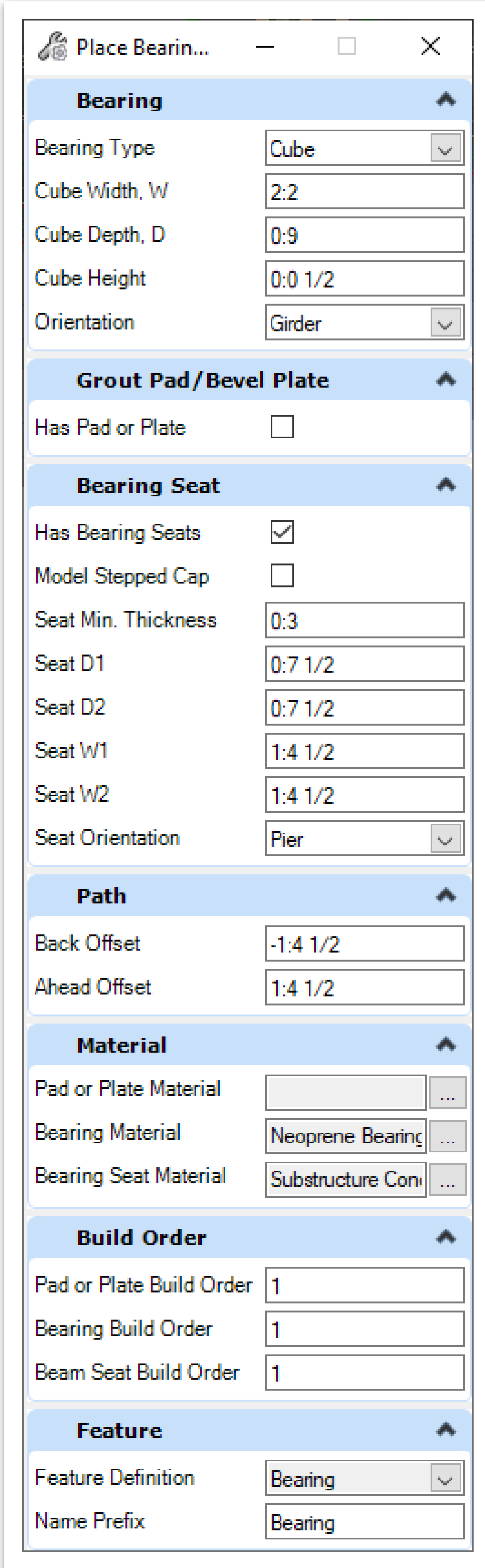
h. **Seat D1:** 0:7.5
i. **Seat D2:** 0:7.5
j. **Seat W1:** 1:4.5
k. **Seat W2:** 1:4.5
l. **Seat Orientation:** Pier
m. **Back Offset:** -1:4.5
n. **Ahead Offset:** 1:4.5



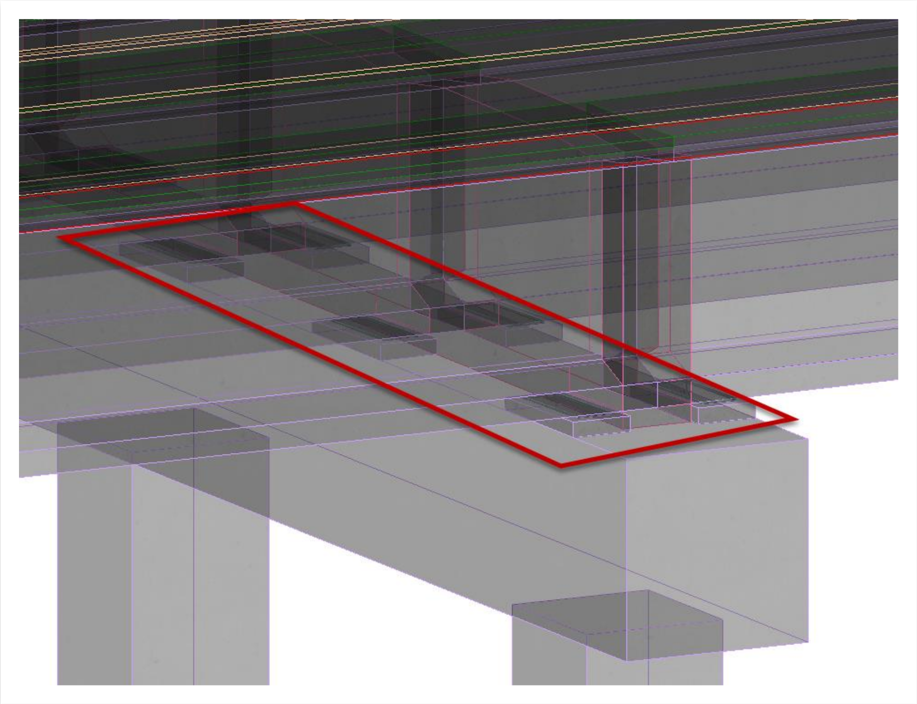
o. **Bearing Material: Miscellaneous >> Neoprene Bearing Pads**
p. **Beam Seat Material: Concrete >> Substructure Concrete**
q. **Feature Definition:** Bearing
r. All settings not explicitly listed can be kept as default (see figure on next page).

Take Note!

Bearing dimensions, like other bridge elements, can be edited after placement. Each bearing line can have different dimensions if needed.

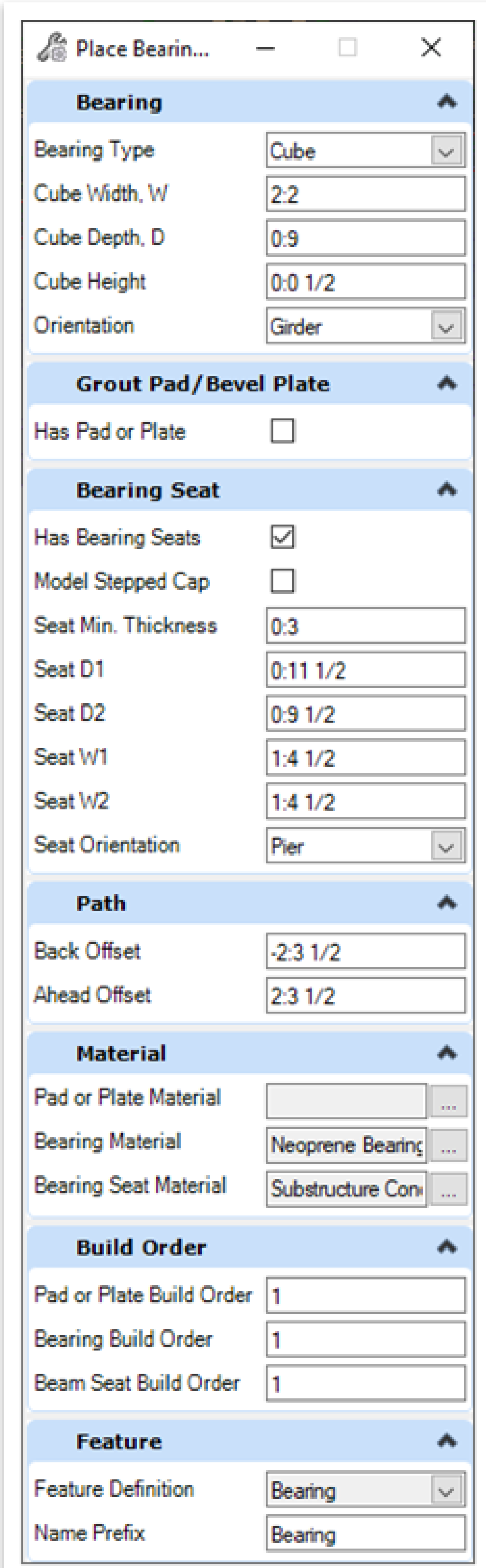

Place Bearin...
Bearing
Bearing Type
Cube
Cube Width, W
2:2
Cube Depth, D
0:9
Cube Height
0:0 1/2
Orientation
Girder
Grout Pad/Bevel Plate
Has Pad or Plate
Bearing Seat
Has Bearing Seats
Model Stepped Cap
Seat Min. Thickness
0:3
Seat D1
0:7 1/2
Seat D2
0:7 1/2
Seat W1
1:4 1/2
Seat W2
1:4 1/2
Seat Orientation
Pier
Path
Back Offset
-1:4 1/2
Ahead Offset
1:4 1/2
Material
Pad or Plate Material
Bearing Material
Neoprene Bearinç
Bearing Seat Material
Substructure Con
Build Order
Pad or Plate Build Order
1
Bearing Build Order
1
Beam Seat Build Order
1
Feature
Feature Definition
Bearing
Name Prefix
Bearing

3. Next, select the **CL Bent 1** SupportLine to place the beam risers and bearing pads.
4. After the pier SupportLine is selected, you will see a temporary graphic indicating where the bearings will be placed. **Reset** (right click) to end SupportLine selection. **Data Point** (left click) to continue and confirm entries in the **Place Bearing** dialog box. The beam risers (beat seats) and bearing pads should now be visible at the pier. **Note:** You can place multiple bearing lines at once if needed prior to ending placement with a reset. In this case, we will only place the bearings at the pier because the bearings at the abutment have different geometry.

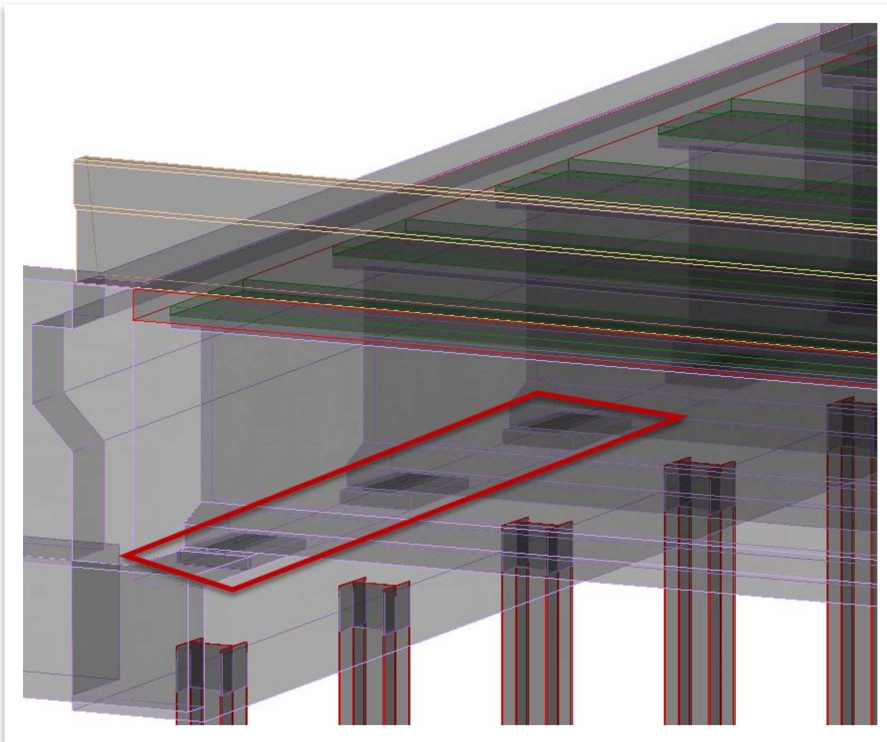


5. Now we will place the bearing lines at the abutments. We will place these bearing lines at the same time since the program knows which end bent is begin and which is end. Open the **Place Bearing** tool once again (**OpenBridge Modeler >> Home >> Substructure**).

6. In the **Place Bearing** dialog box (see figure on next page), select the following settings.
    a. **Bearing Type:** Cube
    b. **Cube Width, W:** 2:2
    c. **Cube Depth, D:** 0:9
    d. **Cube Height:** 0:0.5
    e. **Orientation:** Girder
    f. **Has Bearing Seats:** Checkmark. **Note:** When this box is checked, additional options in the **Place Bearing** dialog box are available.
    g. **Seat Min**. **Thickness:** 0:3
    h. **Seat D1:** 0:11.5
    i. **Seat D2:** 0:9.5
    j. **Seat W1:** 1:4.5
    k. **Seat W2:** 1:4.5
    l. **Seat Orientation:** Pier
    m. **Back Offset:** -2:3.5
    n. **Ahead Offset:** 2:3.5
    o. **Bearing Material: Miscellaneous >> Neoprene Bearing Pads**
    p. **Beam Seat Material: Concrete >> Substructure Concrete**
    q. **Feature Definition:** Bearing


Place Bearin...
Bearing
Bearing Type
Cube
Cube Width, W
2:2
Cube Depth, D
0:9
Cube Height
0:0 1/2
Orientation
Girder
Grout Pad/Bevel Plate
Has Pad or Plate
Bearing Seat
Has Bearing Seats
Model Stepped Cap
Seat Min. Thickness
0:3
Seat D1
0:11 1/2
Seat D2
0:9 1/2
Seat W1
1:4 1/2
Seat W2
1:4 1/2
Seat Orientation
Pier
Path
Back Offset
-2:3 1/2
Ahead Offset
2:3 1/2
Material
Pad or Plate Material
Bearing Material
Neoprene Bearinç
Bearing Seat Material
Substructure Con
Build Order
Pad or Plate Build Order
1
Bearing Build Order
1
Beam Seat Build Order
1
Feature
Feature Definition
Bearing
Name Prefix
Bearing

7. Next, select the **BegBridge1** and **EndBridge1** SupportLines to place the beam risers and bearing pads at both locations.
8. After the abutment SupportLines are selected, you will see temporary graphics indicating where the bearings will be placed. **Reset** (right click) to end SupportLine selection. **Data Point** (left click) to continue and confirm entries in the **Place Bearing** dialog box. Beam risers (beat seats) and bearing pads should now be visible at both abutments.



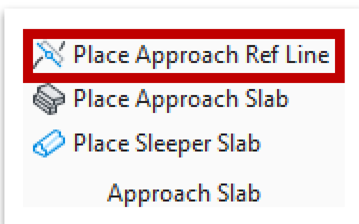
2.6: Model Approach Slabs with Barriers and Sleeper Slabs

In the following exercises, we will place approach slabs (Reinforced Concrete Pavement at Bridge Ends) with barriers at either end of the bridge. We will then add a sleeper slab (footing) at the roadway side of the approach slabs. For this training, we will be using pre-generated approach slab (deck) templates. See 2.3.2 Exercise for information on how to create a deck template. Note that the nomenclature used for Reinforced Concrete Pavement at Bridge Ends will be “approach slab” in this exercise to match the software.

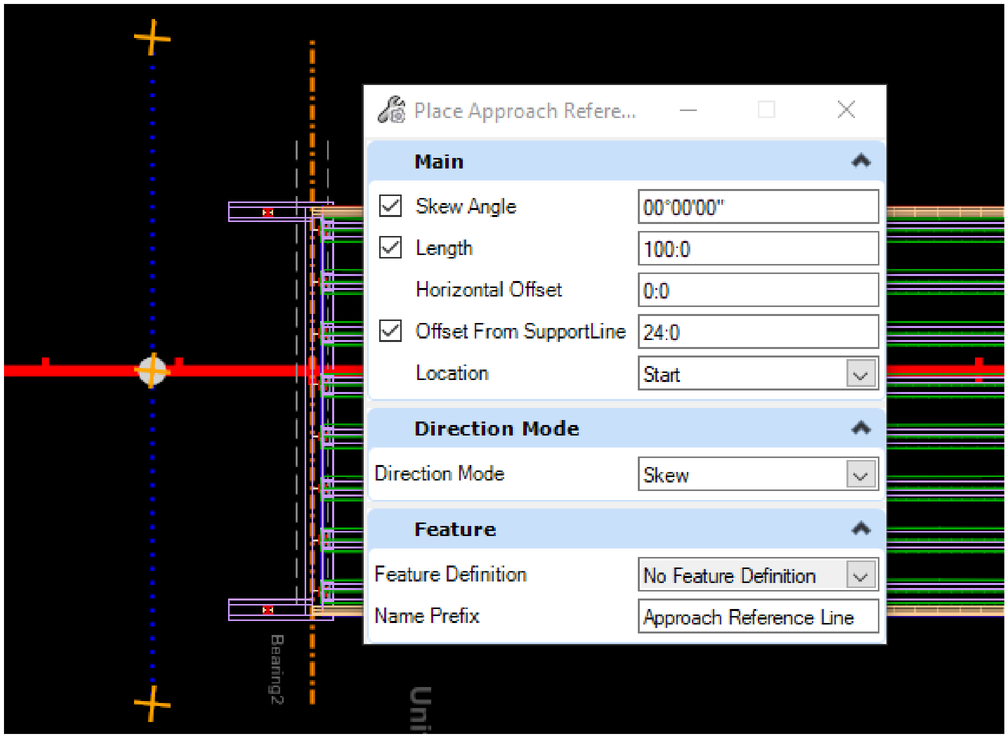
2.6.1 Exercise: Model Approach Slab with Barriers

In this exercise, we will use previously generated approach slab (deck) templates to model approach slabs with barriers at either end of the bridge. We will continue to utilize the same **TDOT_TR_OBM_Model.dgn** file (or **TDOT_TR_OBM_Model_2.6_Begin .dgn**).

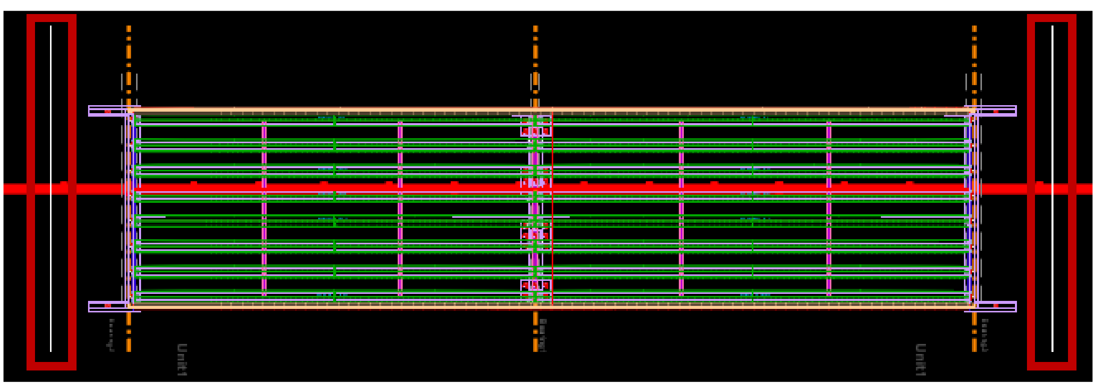
1. The first step in creating an approach slab is to place an approach ref line to indicate where the approach slab begins (at begin bridge) or ends (at end bridge). Open the **Place Approach Ref Line** tool (**OpenBridge Modeler >> Home >> Approach Slab**).



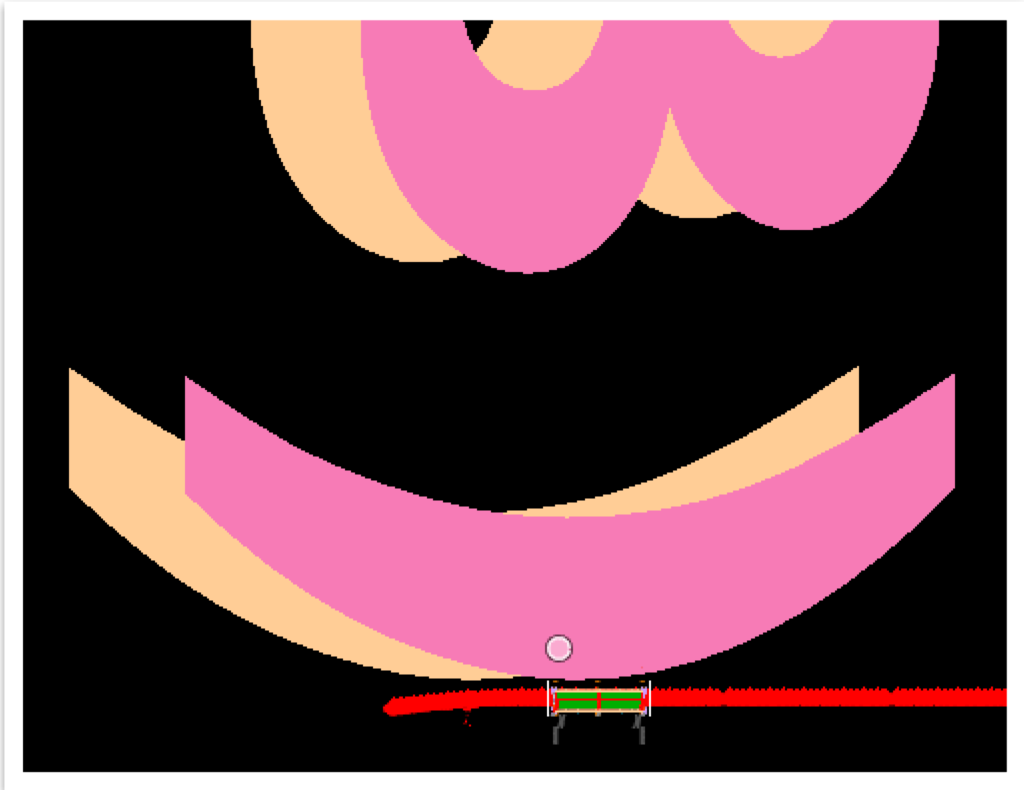
2. In the **Place Approach Reference Line** dialog box (see figure on next page), select the following settings. **Note:** You will notice in plan view that as the data is entered, a temporary graphic where the reference line will be placed will be visible in **View 1** (top view).
    a. **Skew Angle:** Checkmark (**00°00'00"**)
    b. **Length:** Checkmark (**100:0**)
    c. **Offset From SupportLine:** Checkmark (**24:0**)
    d. **Location:** Start
    e. **Direction Mode:** Skew
    f. **Feature Definition:** No Feature Definition. **Note:** A feature definition for approach slab reference lines will be added in future TDOT workspaces.
    g. All settings not explicitly listed can be kept as default (see figure on next page).



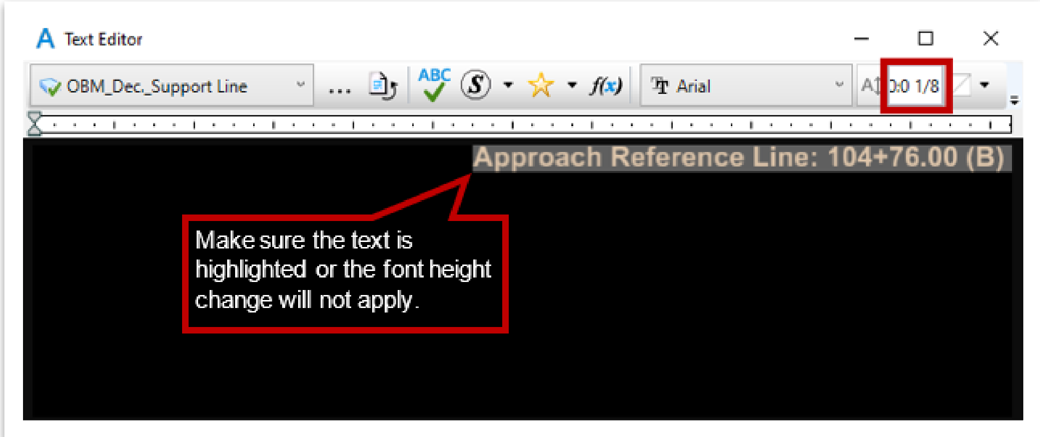
3. Next, **data point** (left click) in space to confirm location. **Data Point** (left click) again to continue and confirm entries in the **Place Approach Reference Line** dialog box.
4. In the **Place Approach Reference Line** dialog box, change the **Location** to **End** and **data point** (left click) to confirm location and then again to confirm entries. There will now be approach slab reference lines at both ends of the bridge. **Reset** (right click) to close the dialog box.



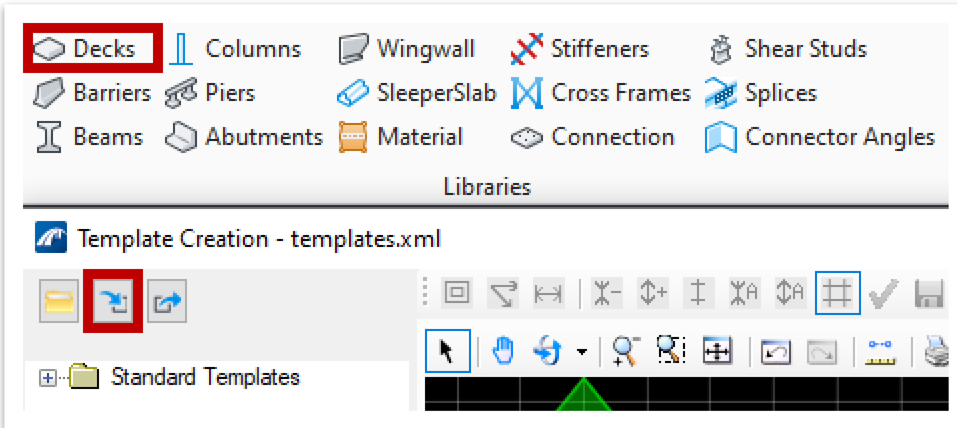
5. Notice that the approach slab reference line color is white (default level) and the text for the approach slab reference line is extremely large. These will be adjusted in future TDOT OBM workspace feature definitions. For this class, we will keep the default level but adjust the text.
    a. In **View 1**, double click one of the two large lines of text. Then click the text again to open the **Text Editor**.



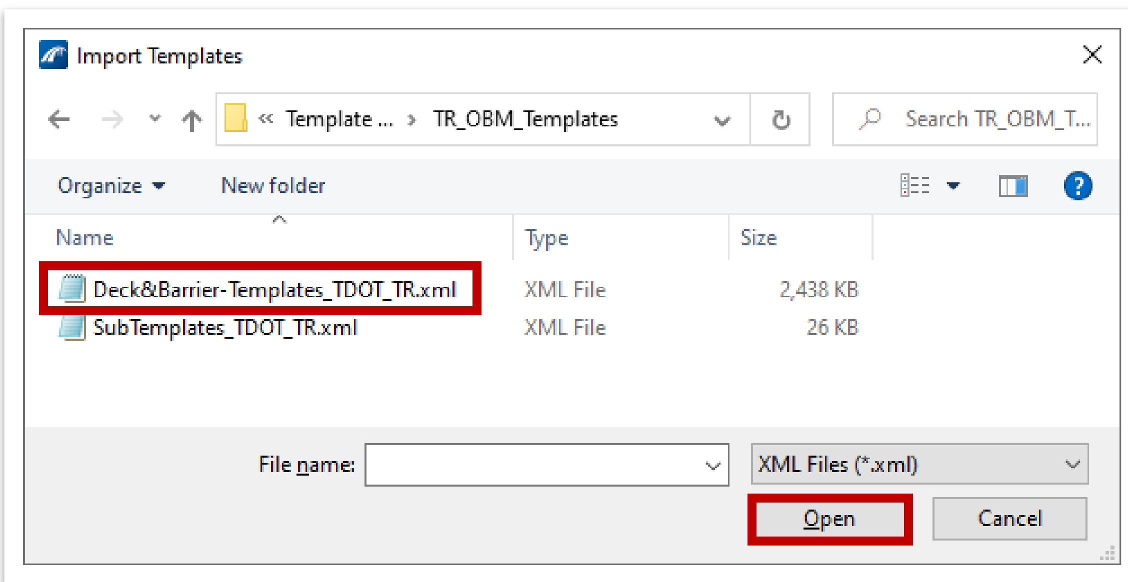
    b. In the **Text Editor**, make sure the text is highlighted and change the **Font Height** to **0:0.125** and click enter or tab.



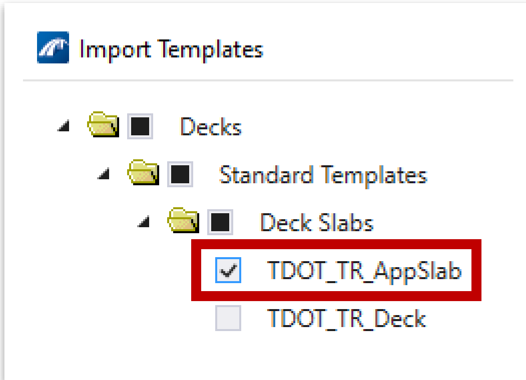
6. Repeat Step 5 for the other approach slab reference line text. Once updated, there should no longer be excessively large text for either.
7. Now we will import an approach slab template that has been pre-modified for the training model. Open the **Decks** tool (**OpenBridge Modeler >> Utilities >> Libraries**). In the **Template Creation - templates.xml** window, click **Import**.



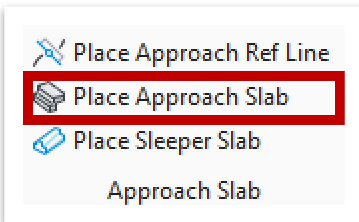
8. The **Import Templates** window should open. Navigate to where the dataset files are located and select the **Deck&Barrier-Templates_TDOT_TR.xml** file, and then click **Open** (**C:\ProgramData\Bentley\OpenBridge Designer CE 10.10.20\OpenBridge Modeler\Configuration\WorkSpaces\TDOT_Standards\WorkSets\123456.00_OBM_TR\Standards\TemplateLibrary\TR_OBM_ Templates**).



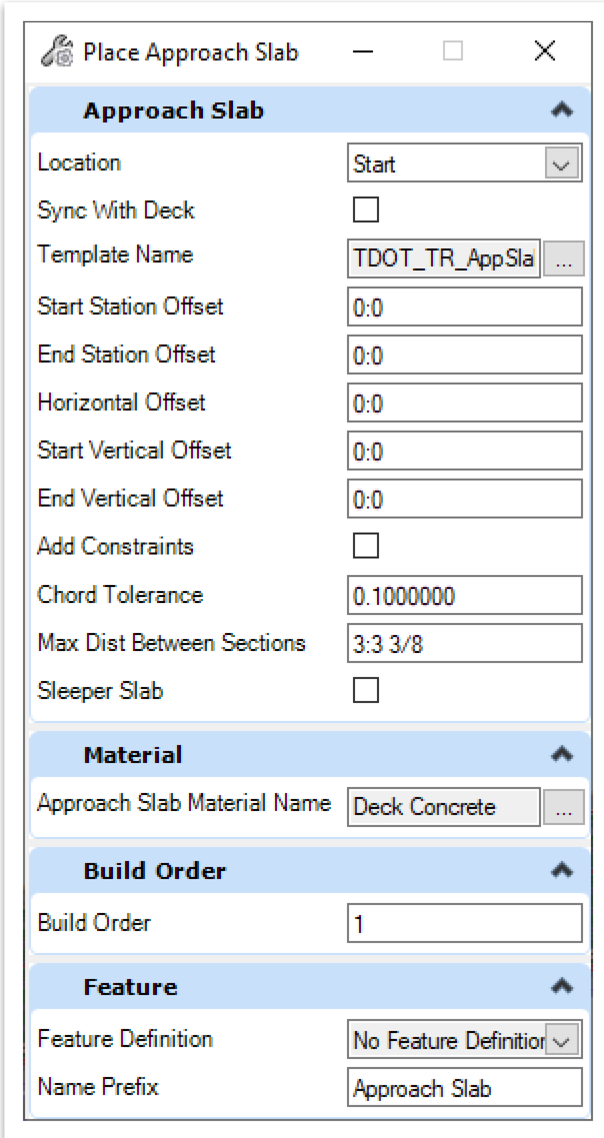
9. The **Import Templates** window should automatically open. Select the **TDOT_TR_AppSlab** checkbox and click **Import**. The template is now available for use. Click **Close** to close the **Template Creation** window.



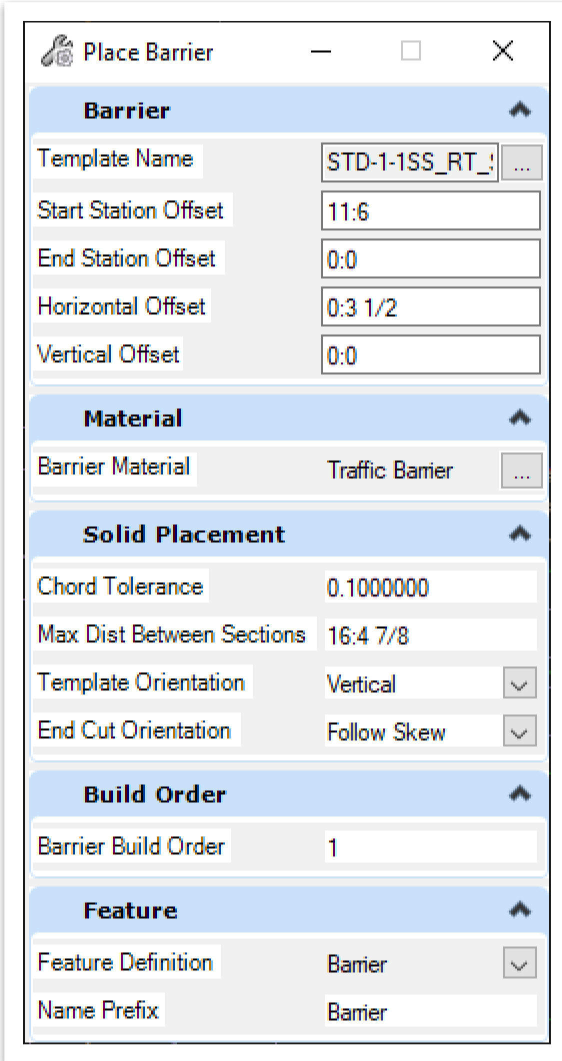
10. To begin approach slab placement, open the **Place Approach Slab** tool (**Open Bridge Modeler >> Home >> Approach Slab**).



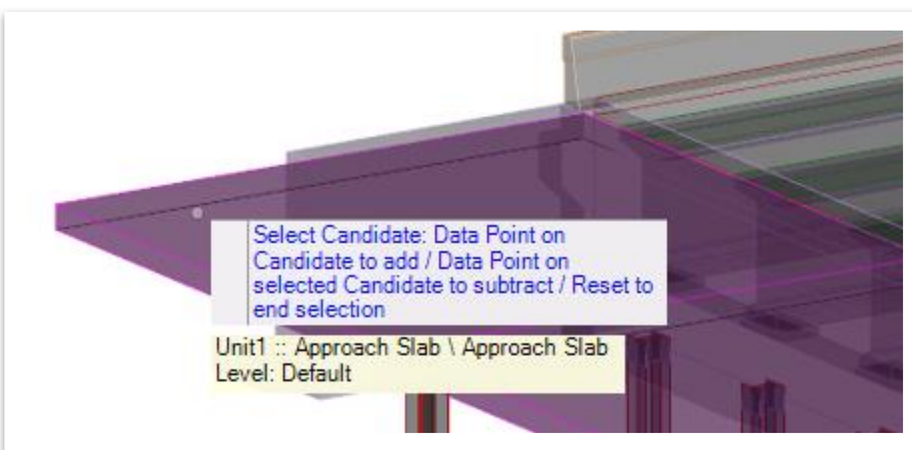
11. In the **Place Approach Slab** dialog box (see figure on next page), select the following settings.
    a. **Location:** Start
    b. **Template Name:** TDOT_TR_AppSlab (**Standards Templates >> Deck Slab**). **Note:** This is the imported template.
    c. **Approach Slab Material Name:** Deck Concrete
    d. **Feature Definition:** No Feature Definition. **Note:** A feature definition for approach slabs will be added in future TDOT workspaces.
    e. All settings not explicitly listed can be kept as default (see figure on next page).


Place Approach Slab
Approach Slab
Location
Start
Sync With Deck
Template Name
TDOT_TR_AppSla
...
Start Station Offset
0:0
End Station Offset
0:0
Horizontal Offset
0:0
Start Vertical Offset
0:0
End Vertical Offset
0:0
Add Constraints
Chord Tolerance
0.1000000
Max Dist Between Sections
3:3 3/8
Sleeper Slab
Material
Approach Slab Material Name
Deck Concrete
...
Build Order
Build Order
1
Feature
Feature Definition
No Feature Definitior
Name Prefix
Approach Slab

12. Now **data point** (left click) in space to confirm entries in the **Place Approach Slab** dialog box.
13. Place the end approach slab by opening the **Place Approach Slab** tool once again (**Open Bridge Modeler >> Home >> Approach Slab**) and changing the **Location** to **End**.
14. Next, we need to add barriers to the approach slab. Open the **Place Barrier** tool (**OpenBridge Modeler >> Home >> Accessory**). In the **Place Barrier** dialog box (see figure on next page), select the following settings to place a barrier on the right side of the begin bridge approach slab. **Note:** By default, the last settings used will be selected initially.
    a. **Template Name:** STD-1-1SS_RT_SingleSlopeParapet
    b. **Start Station Offset:** 11:6. This controls where the barrier starts in relation to the start of the approach slab. Positive is upstation and negative is backstation.
    c. **End Station Offset:** 0:0. This controls where the barrier ends in relation to the end of the approach slab. Positive is upstation and negative is backstation.
    d. **Horizontal Offset:** 0:3.5. This controls where the Working Point (**WP**) of the barrier is in relation to the candidate (approach slab). Since the approach slab ends at the wingwall but the barrier is on the wingwall, a positive value (to the right) is required to have the WP outside of the candidate.
    e. **Barrier Material:** Traffic Barrier
    f. **Feature Definition:** Barrier
    g. All settings not explicitly listed can be kept as default (see figure on next page).



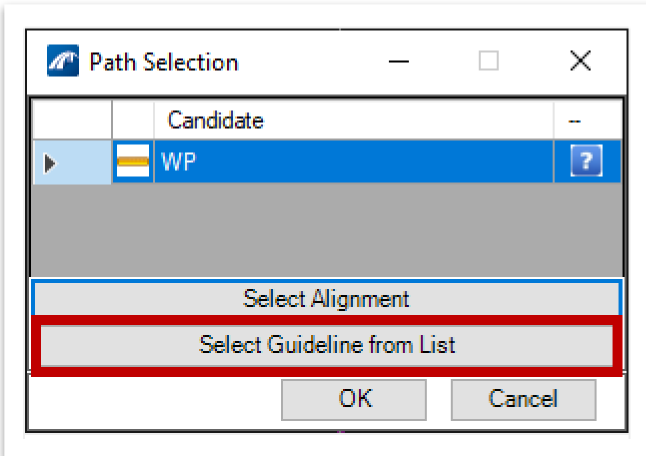
15. Notice the cursor prompt: **Select Candidate**. Select the <u>begin</u> bridge approach slab (in either view) as the candidate. The approach slab should be highlighted. **Reset** (right click) to end selection and **data point** (left click) to continue.



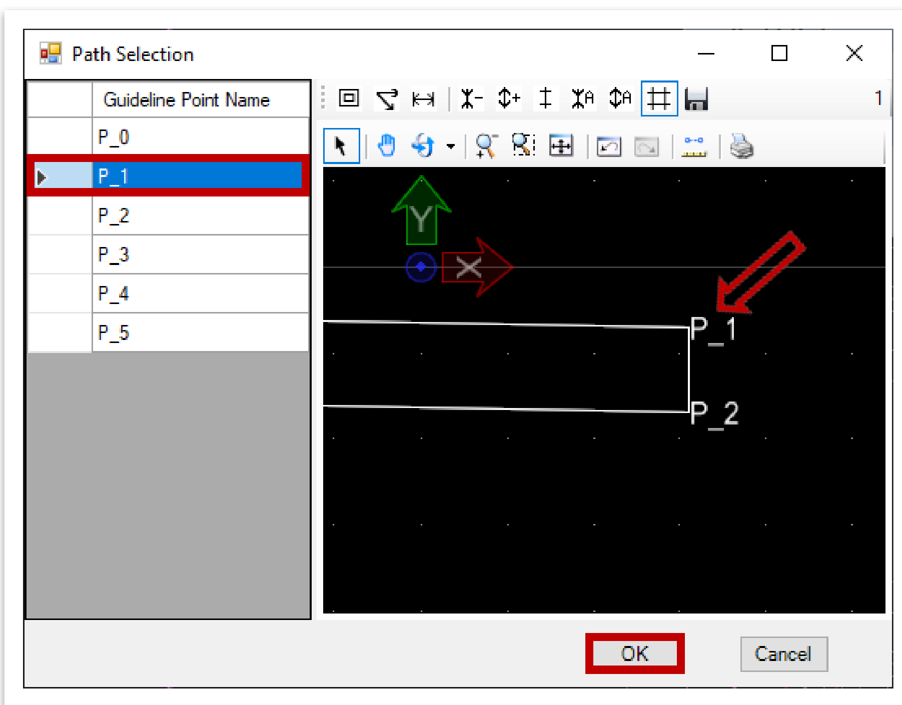
Take Note!

*When the message reads **Reset to end selection**, you can select multiple candidates. You can use this to add barriers to multiple decks/approach slabs at once but would need to adjust the properties after placement.*

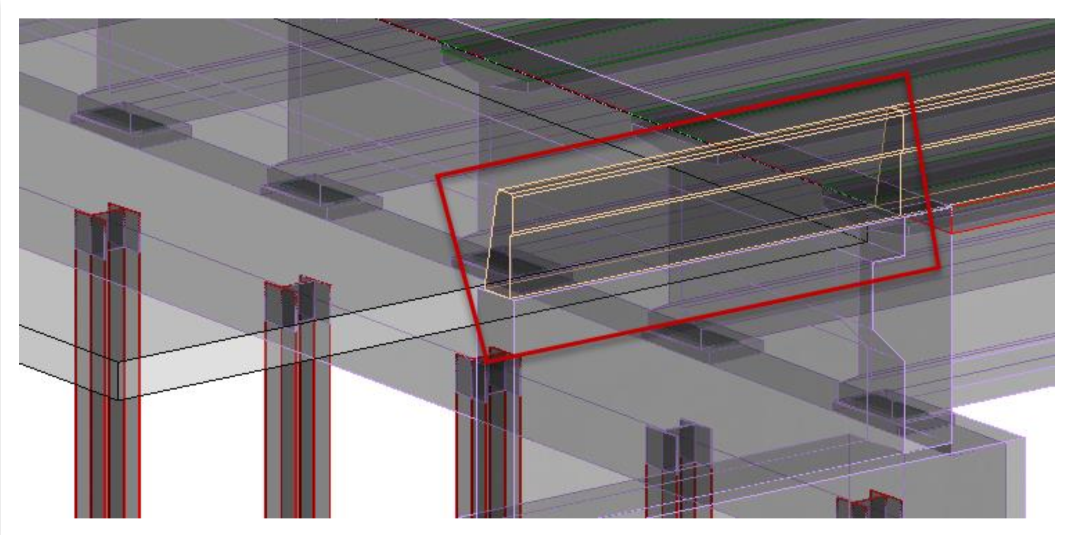
16. The **Path Selection** dialog box should open automatically. Click **Select Guideline from List** to select which point on the approach slab template will be used as the control point for the horizontal (and vertical) offset values entered.



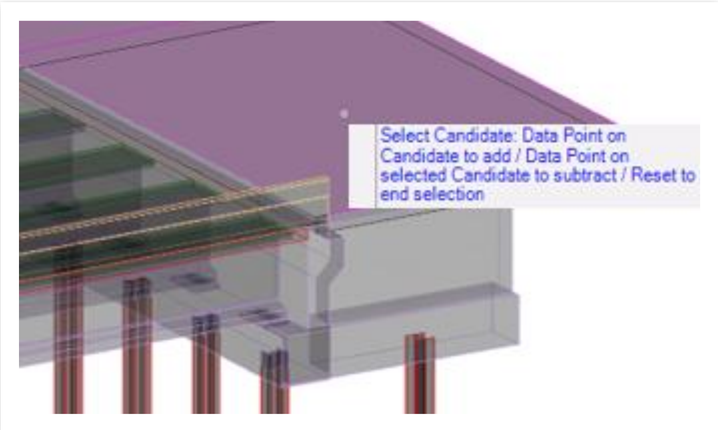
17. Another **Path Selection** dialog box should open. Select **P_1** as the **Guideline Point Name**, which corresponds with the top right edge of the approach slab. You can zoom in and out of the graphical display of the selected template to confirm which point name corresponds to which point on the template. Click **OK**.



18. Click **OK** on the previous **Path Selection** dialog box to finalize the selection. The barrier will now be visible.



19. Open the **Place Barrier** tool once again (**OpenBridge Modeler >> Home >> Accessory**). In the **Place Barrier** dialog box, select the following settings to place a barrier on the right side of the end bridge approach slab.
    a. **Template Name:** 1SS_RT_SingleSlopeParapet
    b. **Start Station Offset:** 0:0
    c. **End Station Offset:** -11:6
    d. **Horizontal Offset:** 0:3.5
    e. **Barrier Material:** Traffic Barrier
    f. **Feature Definition:** Barrier
20. Notice the cursor prompt: **Select Candidate**. Select the end bridge approach slab (in either view) as the candidate. The approach slab should be highlighted. **Reset** (right click) to end selection and **data point** (left click) to continue.



21. The **Path Selection** dialog box should open automatically. Click **Select Guideline from List**.
22. Another **Path Selection** dialog box should open. Select **P_1** as the **Guideline Point Name**, which corresponds with the top right edge of the approach slab. Click **OK**.
23. Click **OK** on the previous **Path Selection** dialog box to finalize the selection. The barrier will now be visible.
24. Open the **Place Barrier** tool once again (**OpenRoads Modeler >> Home >> Accessory**). In the **Place Barrier** dialog box, select the following settings to place a barrier on the left side of the begin bridge approach slab.
    a. **Template Name:** 1SS_LT_SingleSlopeParapet
    b. **Start Station Offset:** 11:6
    c. **End Station Offset:** 0:0
    d. **Horizontal Offset:** -0:3.5. **Note:** A negative offset indicates to the left.
    e. **Barrier Material:** Traffic Barrier
    f. **Feature Definition:** Barrier
25. Select the begin bridge approach slab (in either view) as the candidate. The approach slab should be highlighted. **Reset** (right click) to end selection. **Data point** (left click) to continue.
26. The **Path Selection** dialog box should open automatically. Click **Select Guideline from List**.
27. Another **Path Selection** dialog box should open. Select **P_5** as the **Guideline Point Name**, which corresponds with the top left edge of the approach slab. Click **OK**.
28. Click **OK** on the previous **Path Selection** dialog box to finalize the selection. The barrier will now be visible.
29. Open the **Place Barrier** tool once again (**OpenBridge Modeler >> Home >> Accessory**). In the **Place Barrier** dialog box, select the following settings to place a barrier on the left side of the end bridge approach slab.
    a. **Template Name:** 1SS_LT_SingleSlopeParapet
    b. **Start Station Offset:** 0:0
    c. **End Station Offset:** -11:6
    d. **Horizontal Offset:** -0:3.5. **Note:** A negative offset indicates to the left.
    e. **Barrier Material:** Traffic Barrier
    f. **Feature Definition:** Barrier

30. Select the end bridge approach slab (in either view) as the candidate. The approach slab should be highlighted. **Reset** (right click) to end selection. **Data point** (left click) to continue.
31. The **Path Selection** dialog box should open automatically. Click **Select Guideline from List**.
32. Another **Path Selection** dialog box should open. Select **P_5** as the **Guideline Point Name**, which corresponds with the top left edge of the approach slab. Click **OK**.
33. Click **OK** on the previous **Path Selection** dialog box to finalize the selection. The barrier will now be visible.

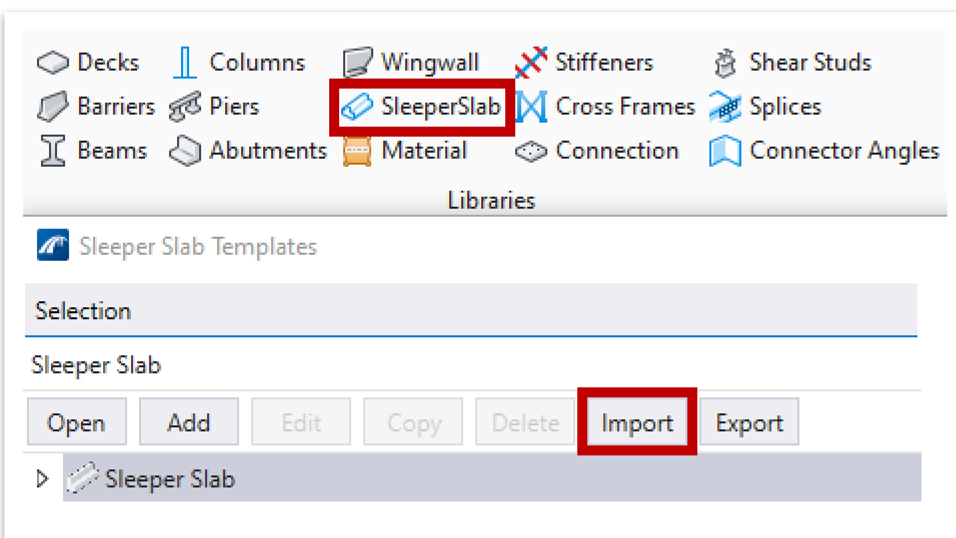
Take Note!

You may notice the barriers are not modeled directly on top of the wingwall. This is due to the wingwalls being modeled as level. As discussed in previous exercises, upcoming enhancements to OBM will allow for a more accurate representation of TDOT bridge geometry.

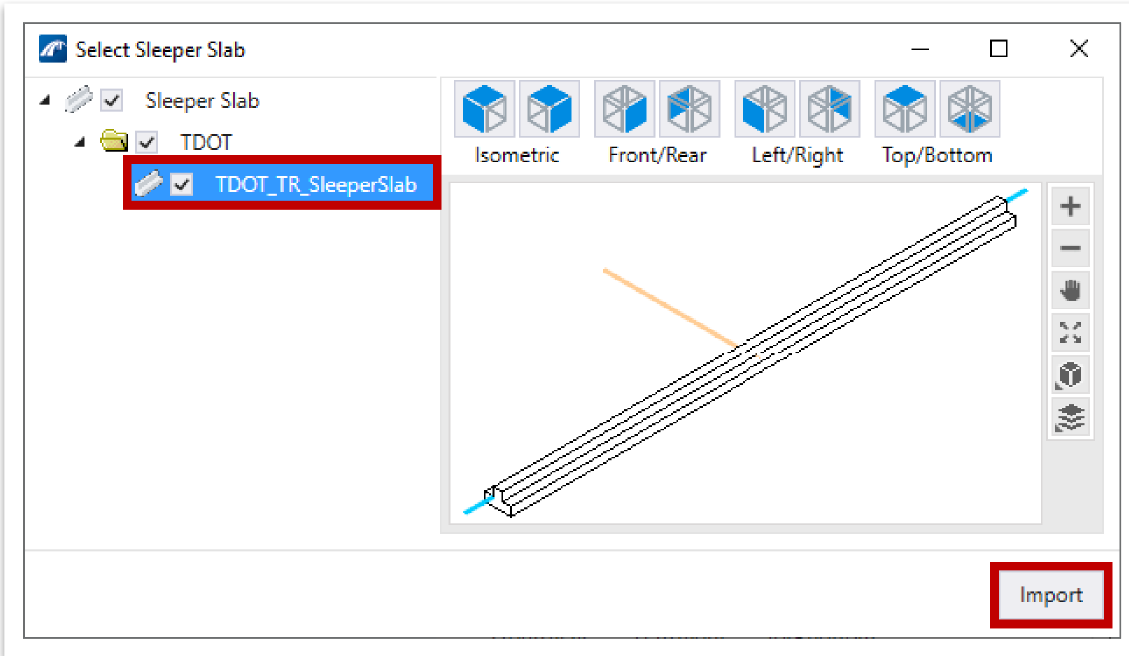
2.6.2 Exercise: Model Sleeper Slabs

In this exercise, we will use previously generated sleeper slab (footing) templates to model sleeper slabs at the roadway end of the approach slabs. We will continue to utilize the same **TDOT_TR_OBM_Model.dgn** file (or **TDOT_TR_OBM_Model_2.6_Begin .dgn**) from the previous portion of the exercise.

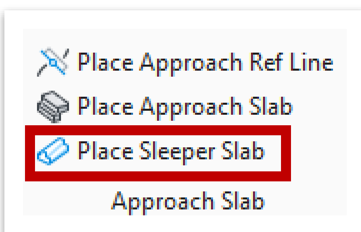
1. First, we will import a sleeper slab template that has been pre-modified for the training model. Open the **SleeperSlab** tool (**OpenBridge Modeler >> Utilities >> Libraries**). In the **Sleeper Slab Templates** window, click **Import**.



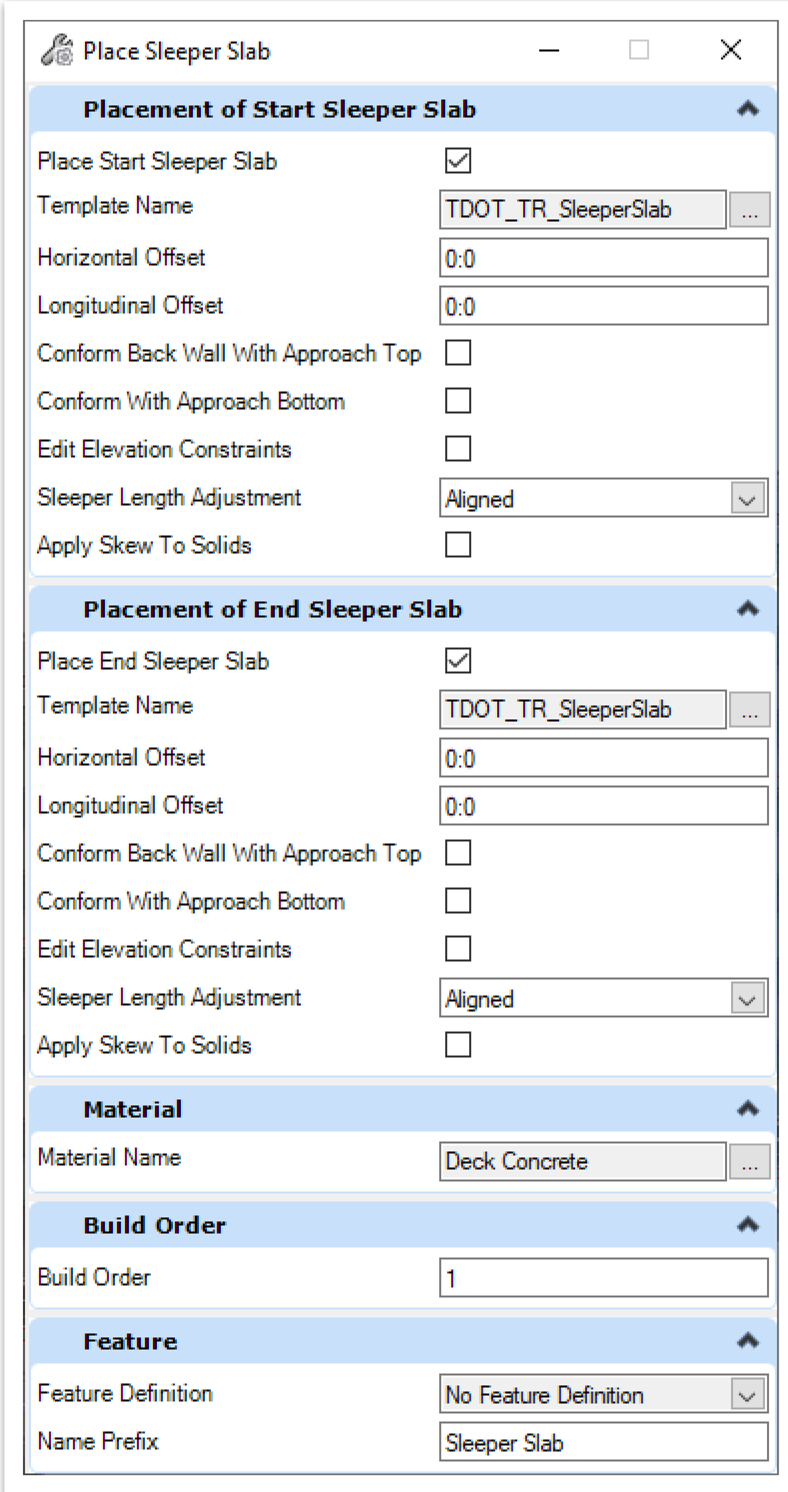
2. The **Import Templates** window should open. Navigate to where the dataset files are located and select the **SubTemplates_TDOT_TR.xml** file, and then click **Open** (**C:\ProgramData\Bentley\OpenBridge Designer CE 10.10.20\Open Bridge Modeler\Configuration\WorkSpaces\TDOT_Standards\WorkSets\123456.00_OBM_TR\Standards\Template Library\TR_OBM_Templates**).
3. The **Select Sleeper Slab** window should automatically open. Select the **TDOT_TR_SleeperSlab** checkbox and click **Import**. The template is now available for use. Close the **Sleeper Slab Templates** window.



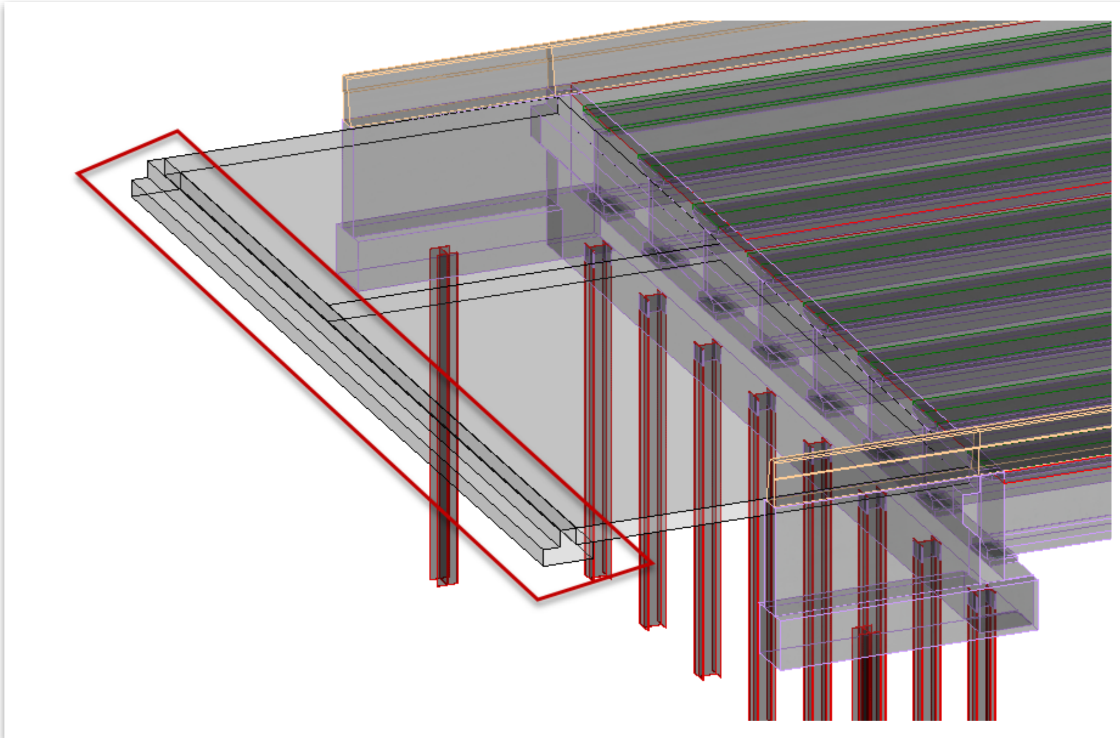
4. To begin sleeper slab placement, open the **Place Sleeper Slab** tool (**OpenBridge Modeler >> Home >> Approach Slab**).



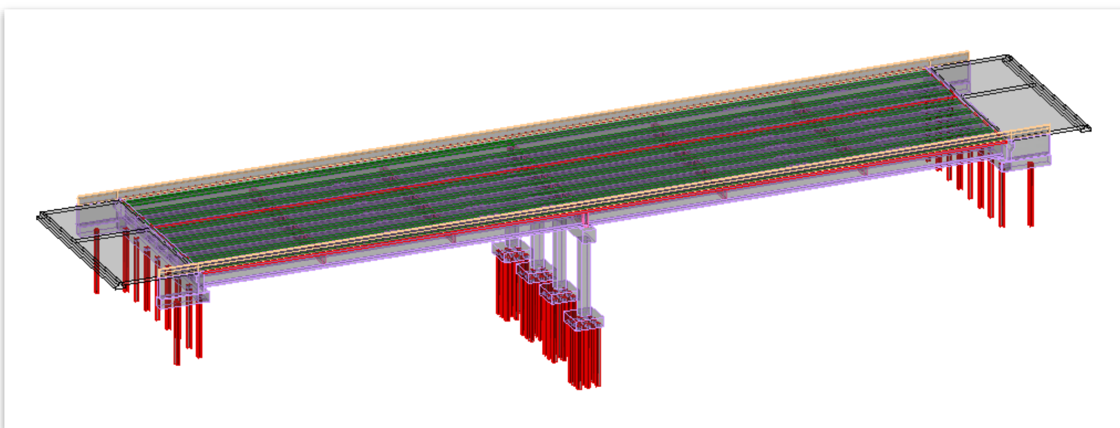
5. In the **Place Sleeper Slab** dialog box, select the following settings (see figure on next page).
    a. **Place Start Sleeper Slab:** Checkmark. **Note:** When this box is checked, additional options in the **Place Sleeper Slab** dialog box are available.
    b. **Template Name:** TDOT_TR_SleeperSlab (**Sleeper Slab >> TDOT**) **Note:** This is the imported template.
    c. **Sleeper Length Adjustment:** Aligned. This setting will automatically center the sleeper slab on the deck.
    d. **Place End Sleeper Slab:** Checkmark. **Note:** When this box is checked, additional options in the **Place Sleeper Slab** dialog box are available.
    e. **Template Name:** TDOT_TR_SleeperSlab
    f. **Sleeper Length Adjustment:** Aligned
    g. **Material Name:** Deck Concrete
    h. **Feature Definition:** No Feature Definition. **Note:** A feature definition for sleeper slabs will be added in future TDOT workspaces.
    i. All settings not explicitly listed can be kept as default (see figure on next page).


Place Sleeper Slab
Placement of Start Sleeper Slab
Place Start Sleeper Slab
Template Name
TDOT_TR_SleeperSlab
Horizontal Offset
0:0
Longitudinal Offset
0:0
Conform Back Wall With Approach Top
Conform With Approach Bottom
Edit Elevation Constraints
Sleeper Length Adjustment
Aligned
Apply Skew To Solids
Placement of End Sleeper Slab
Place End Sleeper Slab
Template Name
TDOT_TR_SleeperSlab
Horizontal Offset
0:0
Longitudinal Offset
0:0
Conform Back Wall With Approach Top
Conform With Approach Bottom
Edit Elevation Constraints
Sleeper Length Adjustment
Aligned
Apply Skew To Solids
Material
Material Name
Deck Concrete
Build Order
Build Order
1
Feature
Feature Definition
No Feature Definition
Name Prefix
Sleeper Slab

6. Now **data point** (left click) in space to confirm start sleeper slab entries. **Data point** (left click) in space again to confirm end sleeper slab entries. Sleeper slabs at both ends of the approach slabs should be visible.



7. The full bridge model is now complete and can be referenced in the overall roadway model to complete the corridor. The model can now be used for a variety of advanced features, including quantity reports, elevation reports, clash detection, dynamic plans production, rebar modeling, digital twin asset management and more!



Be on the lookout for future TDOT OBM manuals for additional exercises and details!