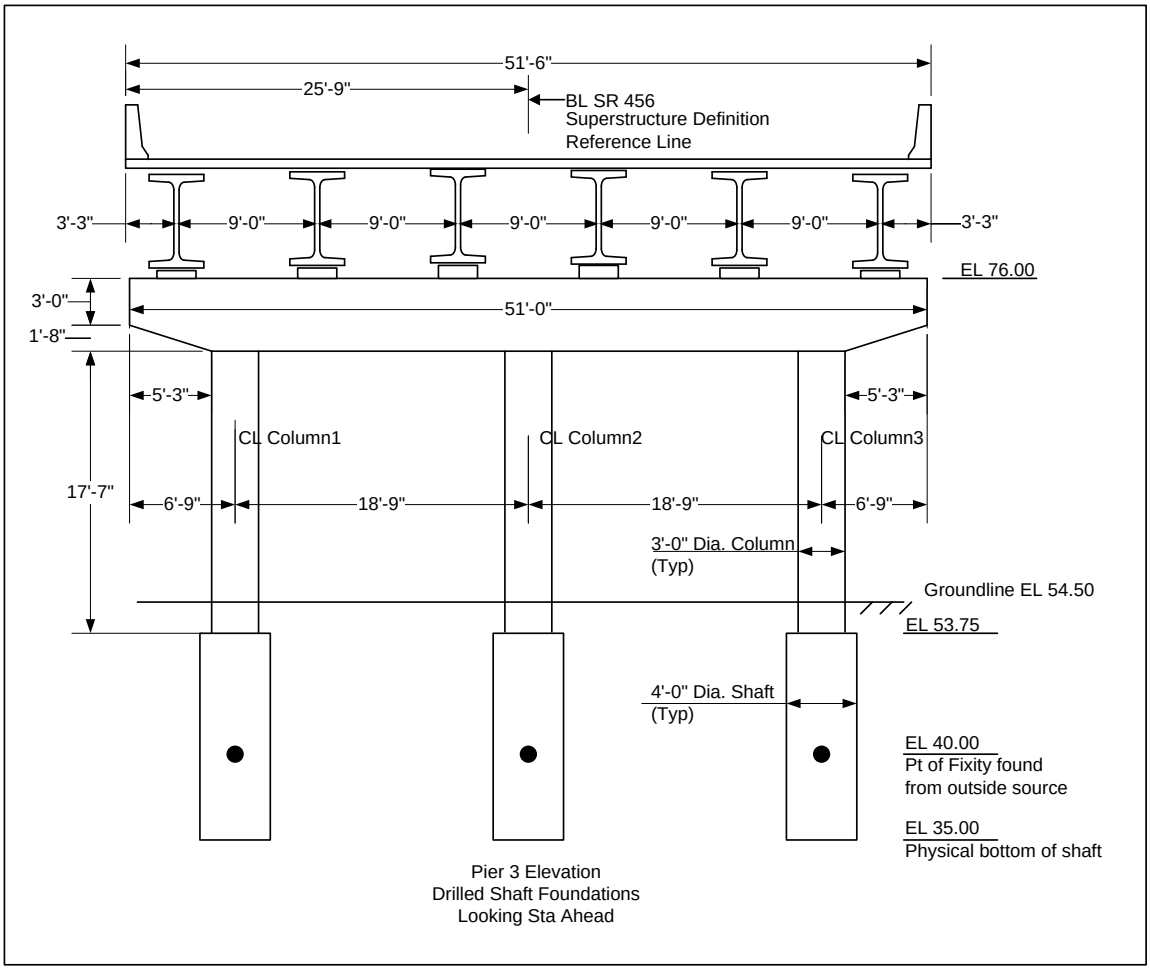
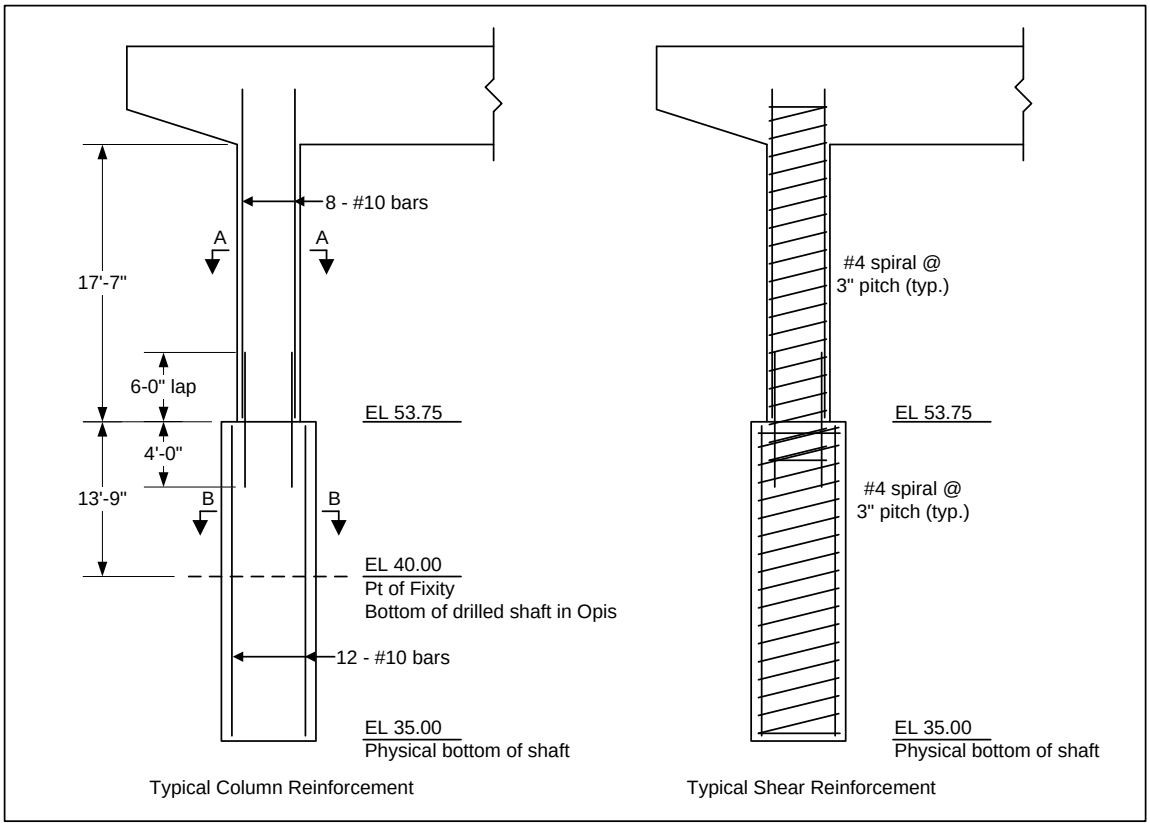
AASHTOWare BrDR 7.5.0

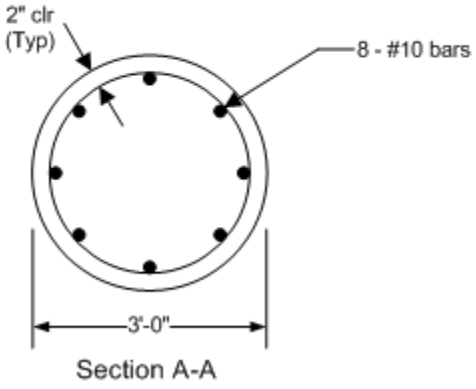
Substructure Tutorial

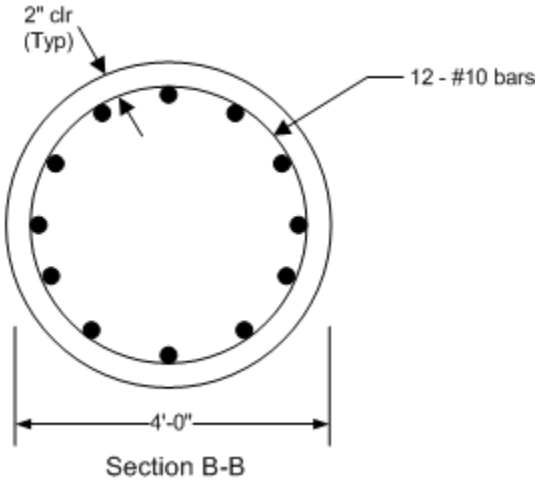
Pier Drilled Shaft Example



Pier 3 Elevation
Drilled Shaft Foundations
Looking Sta Ahead


8 - #10 bars
A
A
17'-7"
6-0" lap
EL 53.75
4'-0"
13'-9"
B
B
EL 40.00
Pt of Fixity
Bottom of drilled shaft in Opis
12 - #10 bars
EL 35.00
Physical bottom of shaft
Typical Column Reinforcement
#4 spiral @
3" pitch (typ.)
EL 53.75
#4 spiral @
3" pitch (typ.)
EL 35.00
Physical bottom of shaft
Typical Shear Reinforcement


2" clr
(Typ)
8 - #10 bars
3'-0"
Section A-A


2" clr
(Typ)
12 - #10 bars
4'-0"
Section B-B

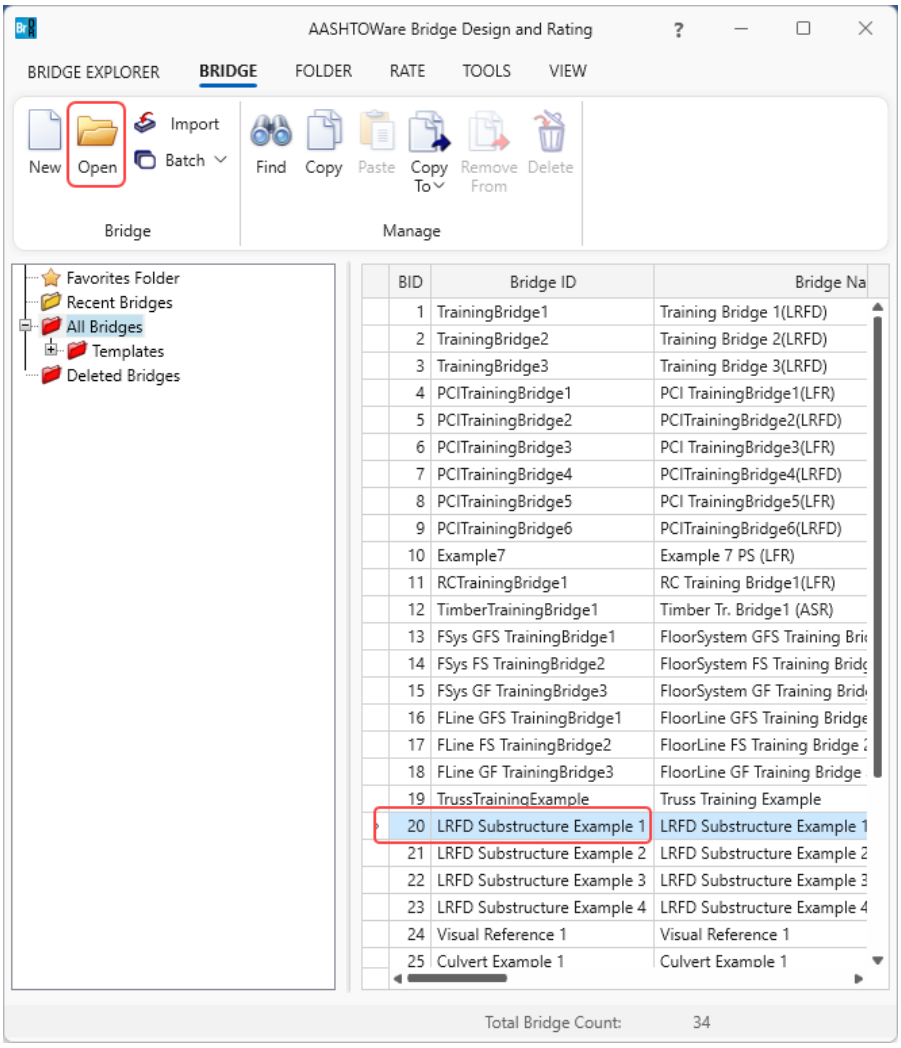
BrDR Substructure Training

Pier Drilled Shaft Example

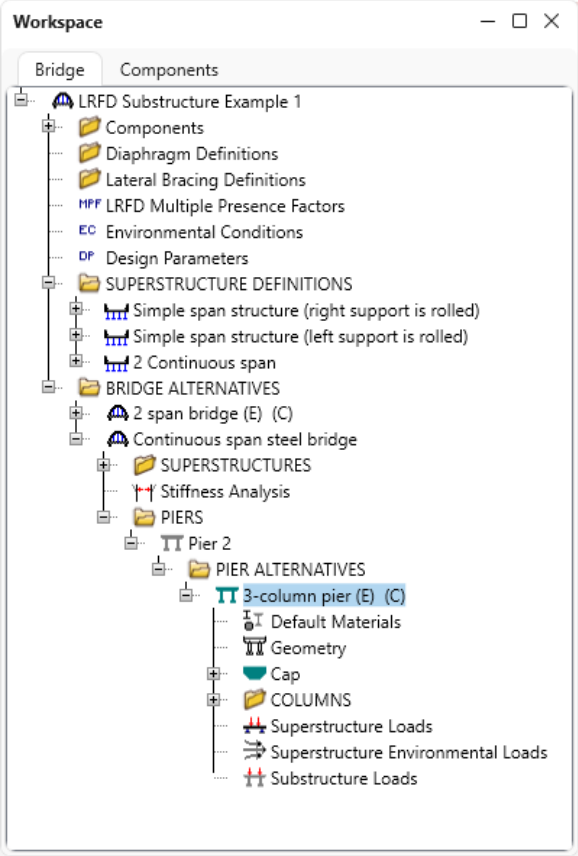
This example modifies one of the spread footings in the **BID20** example to be a drilled shaft foundation. BrDR substructure has the ability to perform a soil-structure interaction analysis. An example describing the analysis can be found in tutorial “3 Drilled Shaft” in 2012 User Group – Training.

If the user does not want to use the BrDR soil-structure interaction analysis, this example describes how to analyze a pier with drilled shafts considering a user-defined point of fixity. The user can enter a point of fixity found from an outside source, such as LPile or COM624, as the base of the drilled shaft in BrDR. BrDR can then perform a finite element analysis and spec check of the pier considering that point of fixity.

Double click on **BID20 LRFD Substructure Example 1** from the **Bridge Explorer** (or click and select **Open**) to open the bridge as shown below.

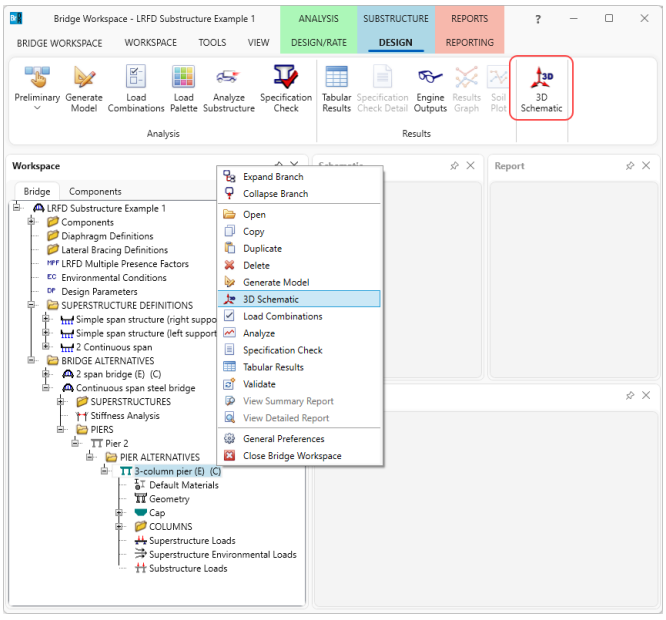


Expand the **Bridge Workspace** tree as shown below.

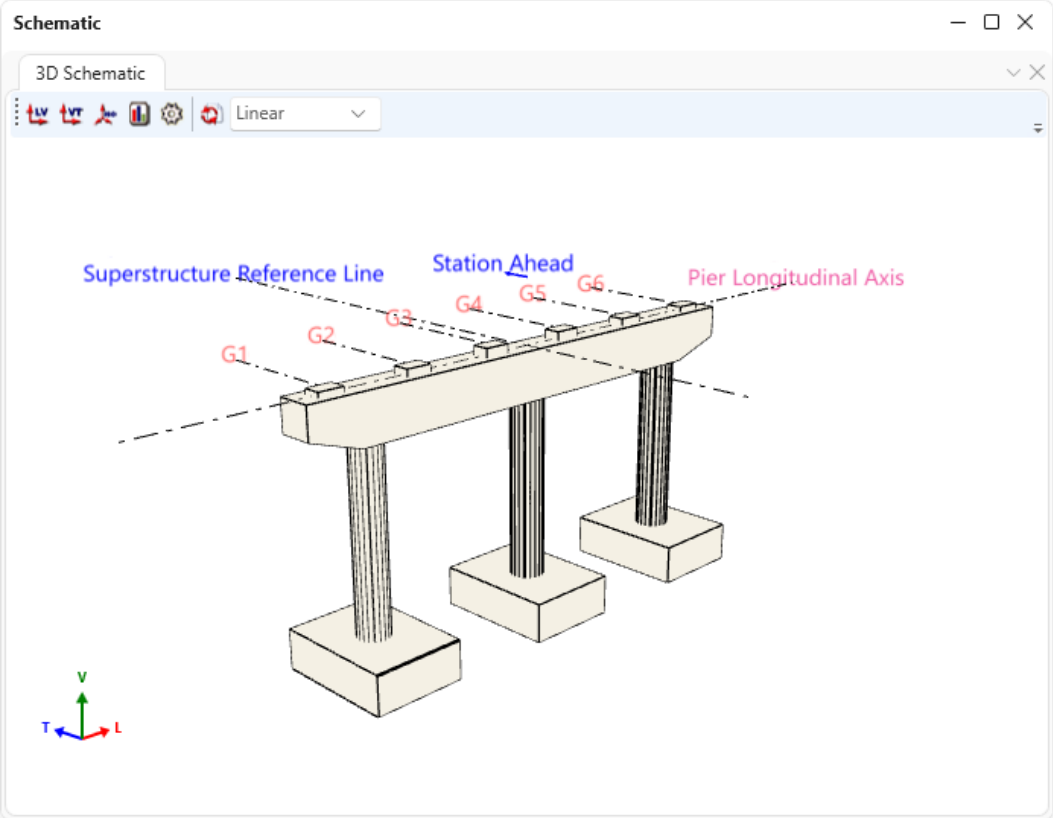


3D Schematic - Pier

Select **3-column pier** and click on the **3D Schematic** button on the **SUBSTRUCTURE DESIGN** ribbon (or right click and select **3D Schematic**) as shown below.



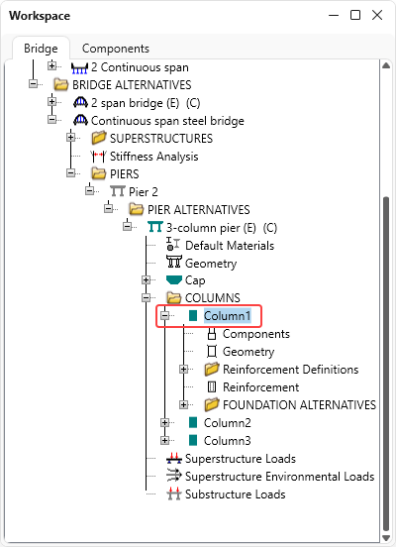
The 3D schematic of the pier is shown below. The 3-column pier example is a multi-frame pier on spread footings.



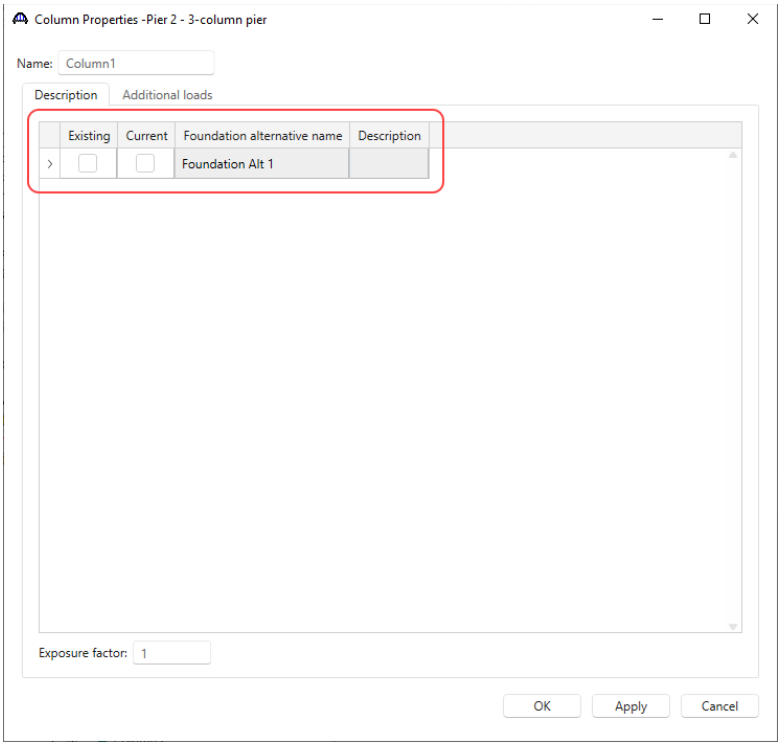
This tutorial discusses modeling the foundation for Column 1 as a drilled shaft instead of a spread footing.

Column Properties

Expand the **COLUMNS** folder under the pier alternative - **3-column pier** and double click on **Column 1** to open the **Column Properties** window as shown below.



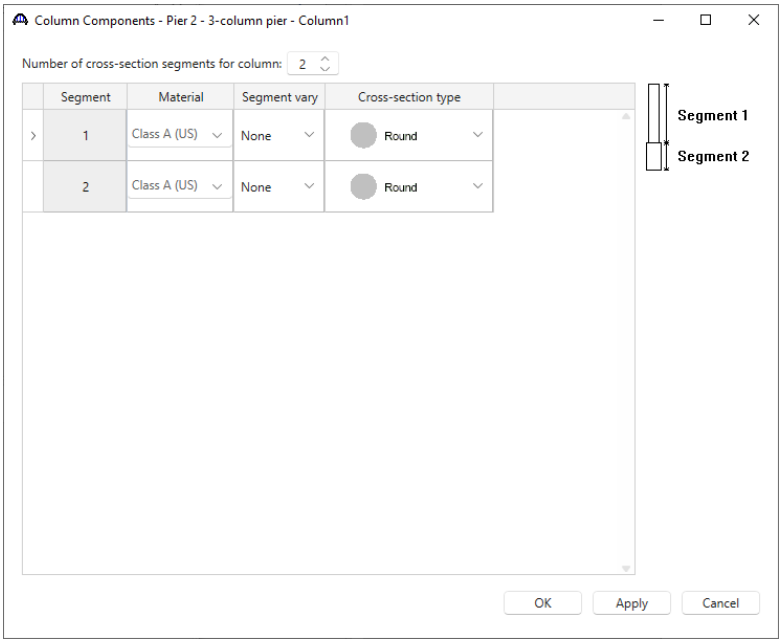
Uncheck the checkboxes for the **Existing** and **Current** foundations as shown below.



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

Column Components

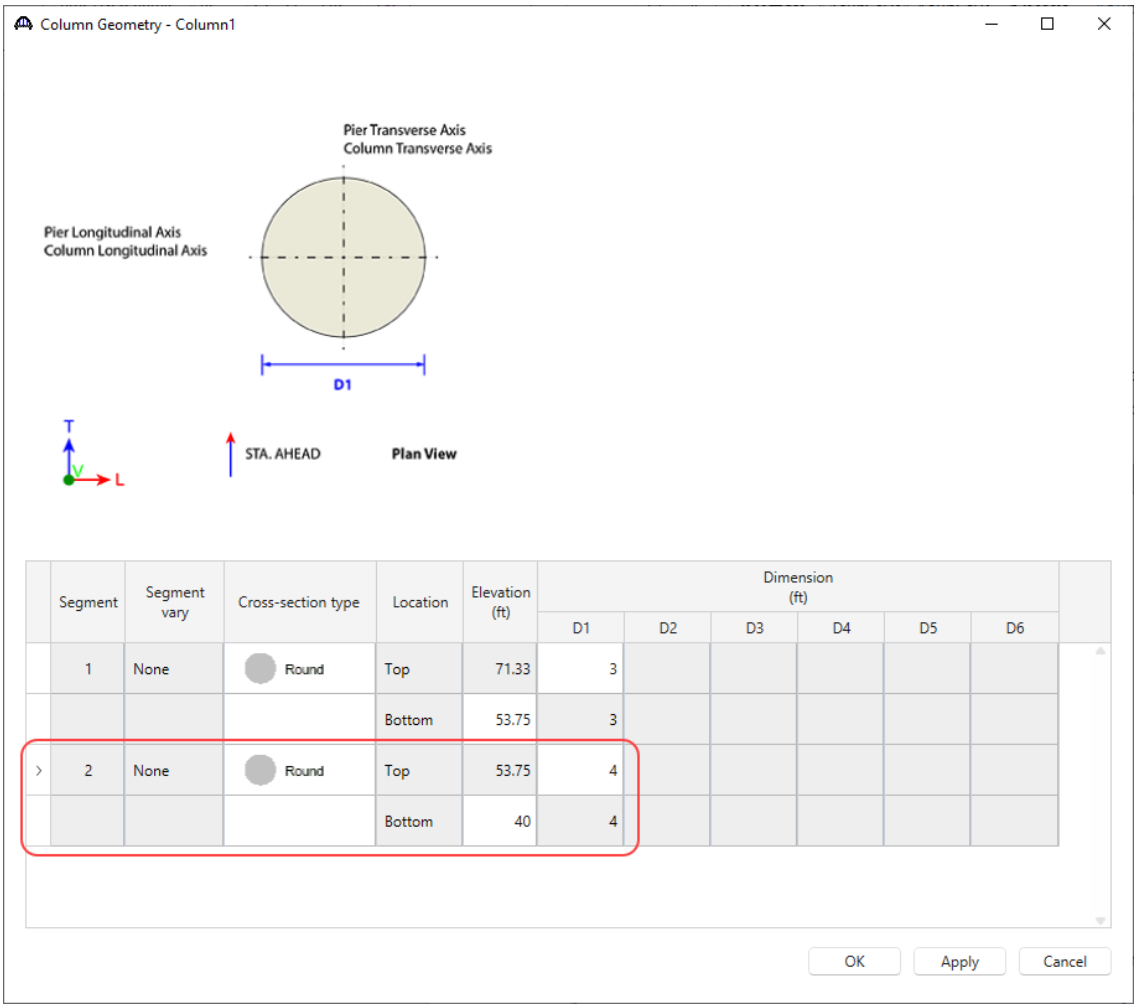
Double click on the **Components** node in the **Bridge Workspace** tree to open the **Column Components** window and increase the number of segments to 2 as shown below.



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

Column Geometry

Double click on the **Geometry** node in the **Bridge Workspace** tree to open the **Column Geometry** window and enter the bottom elevation of Segment 2 as 40.00. For **Segment 2** enter the D1 = 4.0 as shown below.

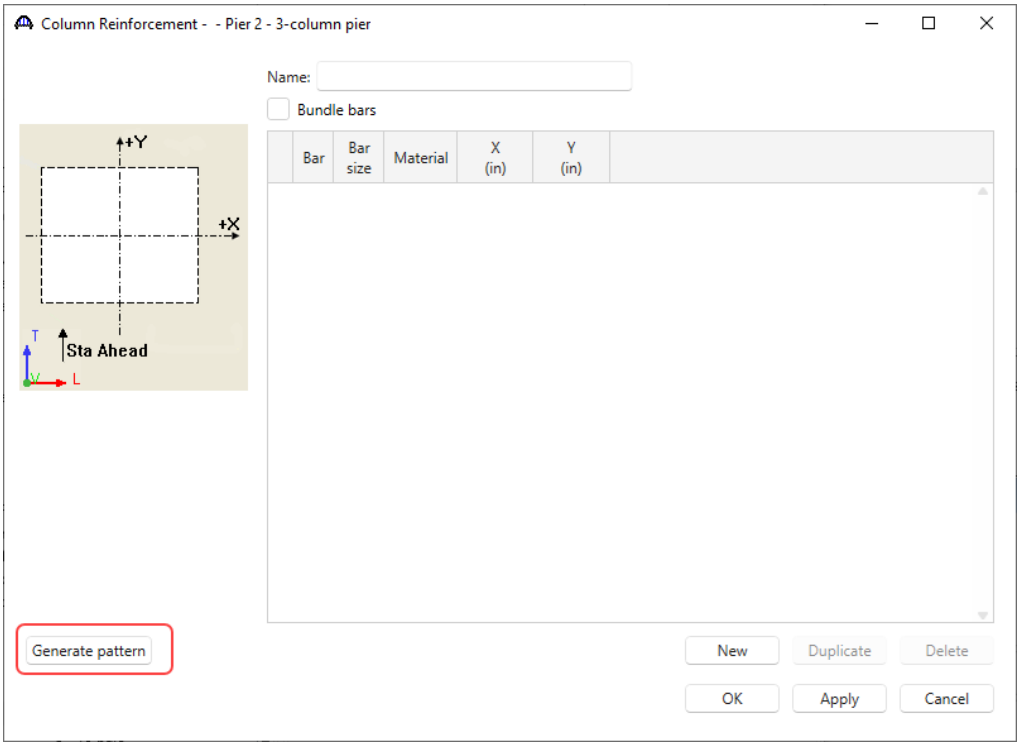


Click **OK** to apply the data and close the window.

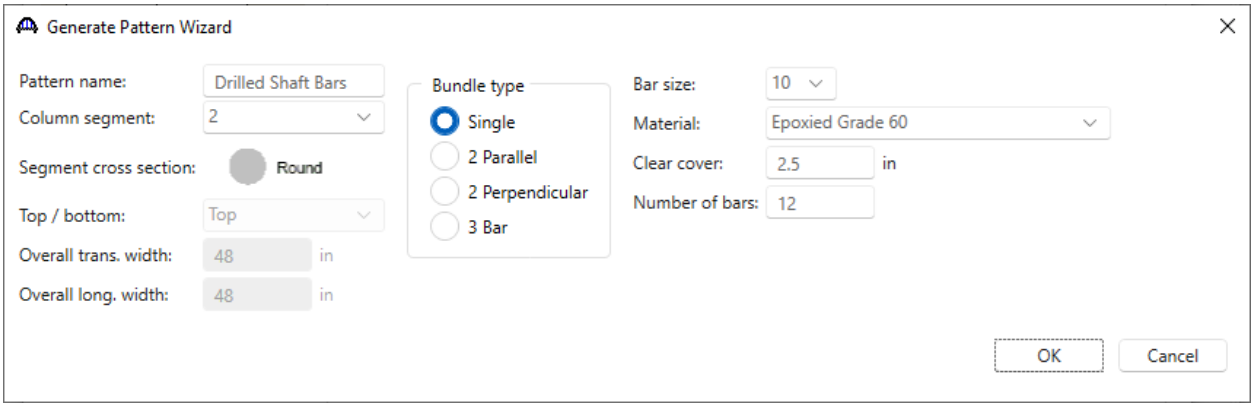
Column Reinforcement - Generate Pattern Wizard

Create a reinforcement definition for the drilled shaft segment using the **Pattern Wizard** as shown below. Be sure to select the column segment 2 as shown so the reinforcement bar coordinates will be generated correctly for the 4' wide drilled shaft segment.

From the **Bridge Workspace** tree, double click on the **Reinforcement Definitions** folder to open the **Column Reinforcement** window and add a new reinforcement. The following window appears.

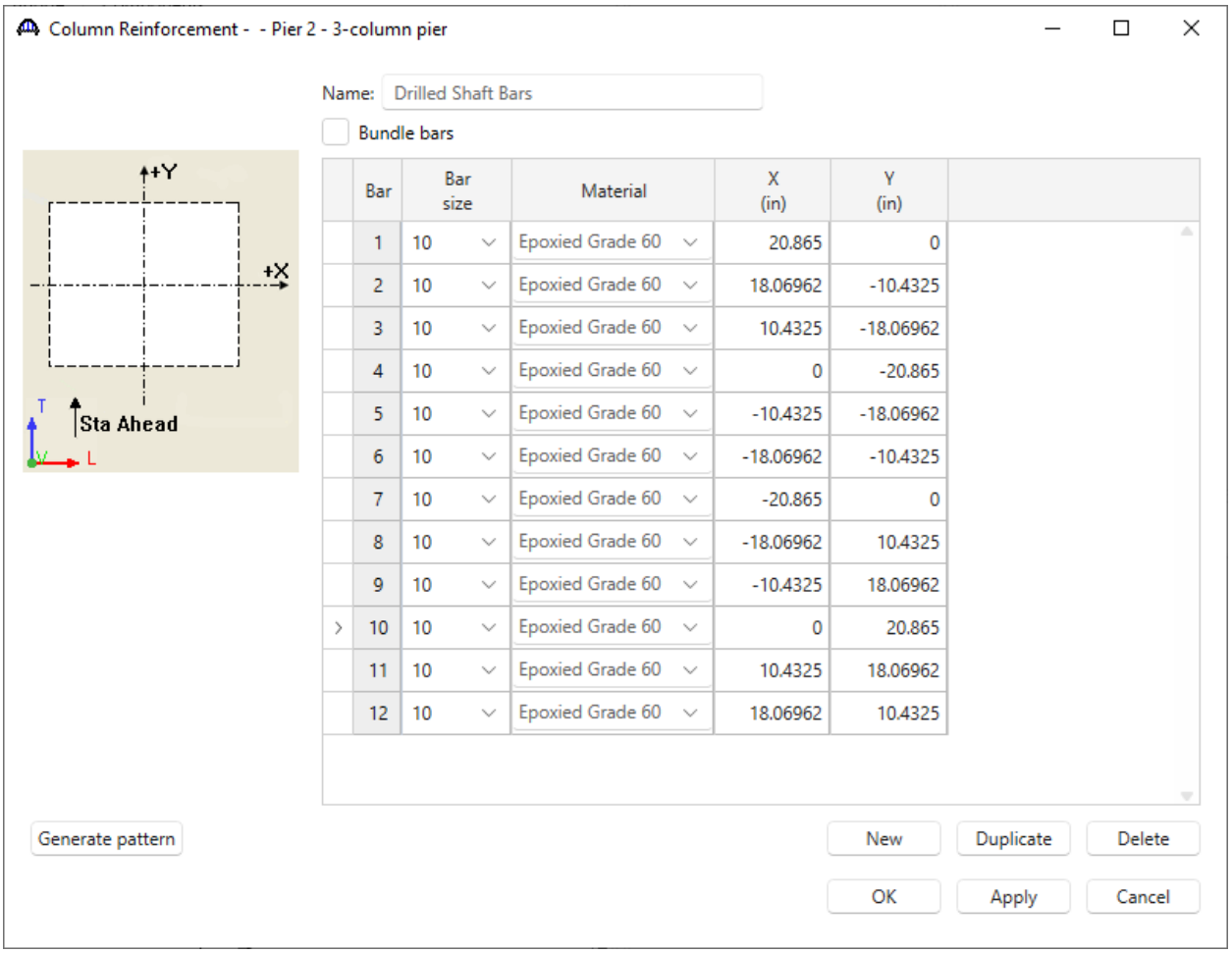


Click on **Generate pattern** to open the **Generate Pattern Wizard**. Enter data as shown below.



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

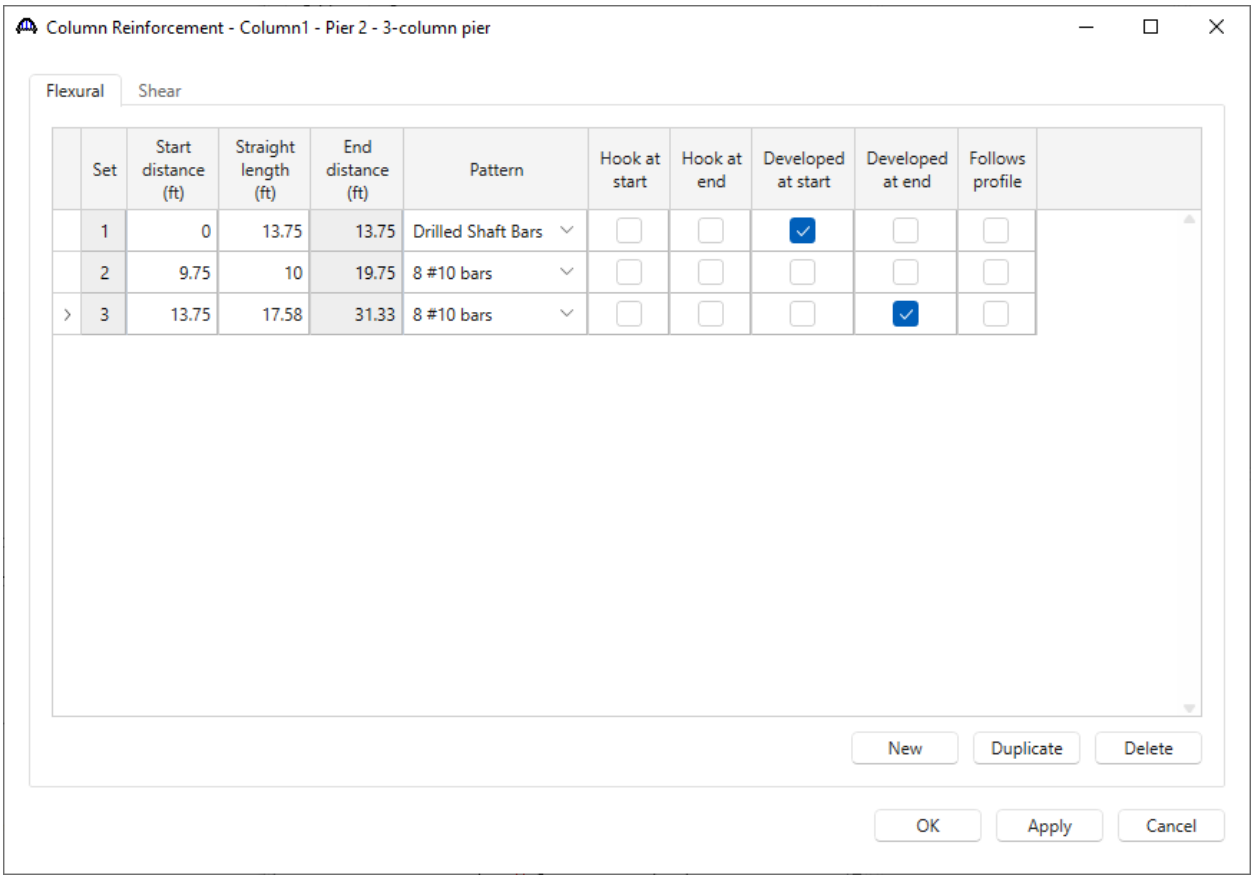
The reinforcement data generated using the result will show up in the **Column Reinforcement** window as shown below. Make sure to uncheck **Bundle bars** checkbox for this example.



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

Column Reinforcement

Double click on the **Reinforcement** node in the **Bridge Workspace** tree to open the **Column Reinforcement** window. Assign the column reinforcement as shown below.

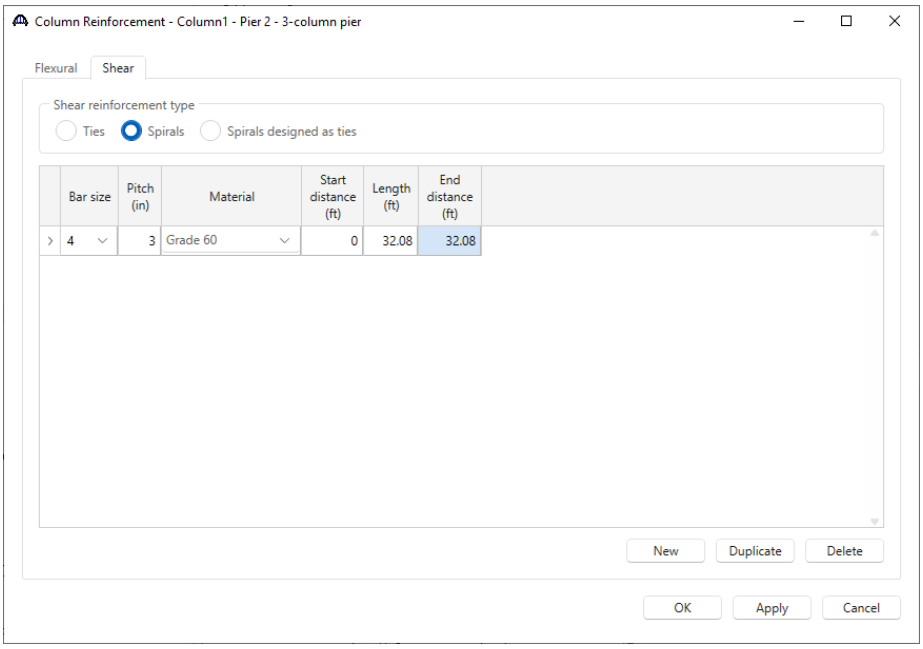


The first row describes the rebar in the drilled shaft segment. Mark these bars as **Developed at start** which assumes that the actual length of the drilled shaft segment below the point of fixity at elevation 40.0 ft provides enough length for these bars to be fully developed.

The second row describes the lap bars extending from the column into the drilled shaft.

The third row describes the column reinforcement. Mark these bars as **Developed at end** since it can be assumed that the bars extend far enough into the cap to be developed.

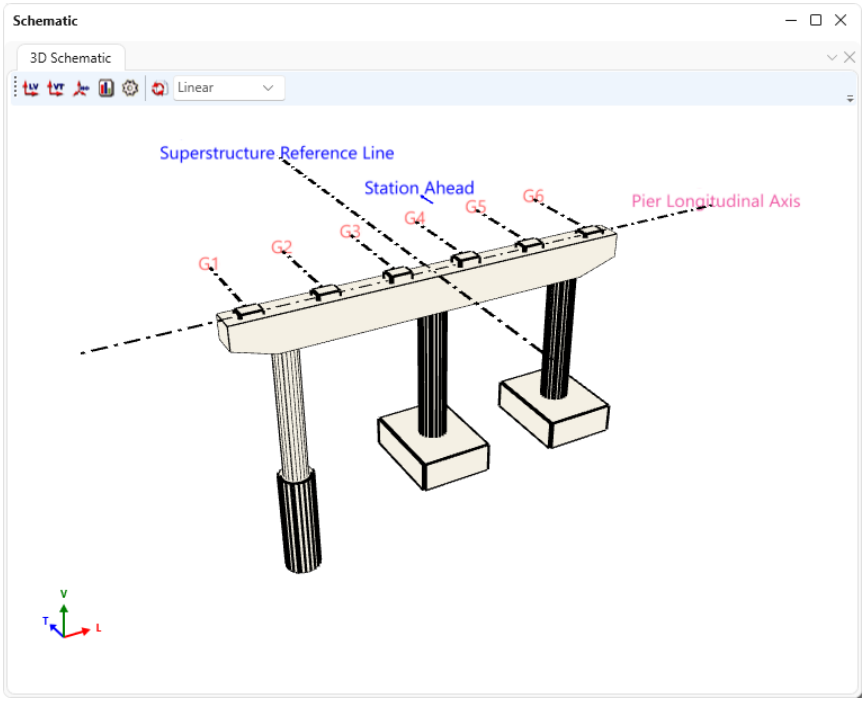
Navigate to the **Shear** tab of this window and enter the shear reinforcement as shown below.The overlap of spirals at the column-drilled shaft connection is a detailing requirement that can be ignored in this example.



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

3D Schematic - Pier

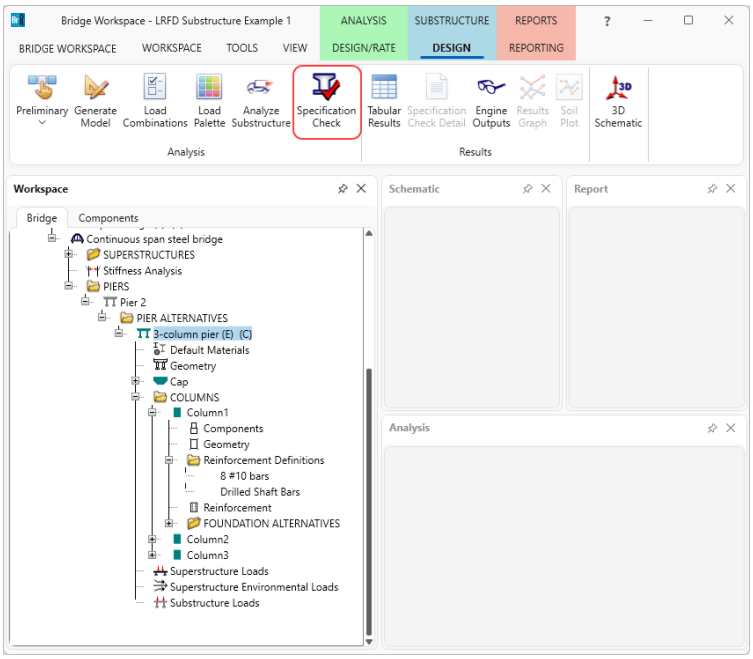
Select **3-column pier** and click on the **3D Schematic** button on the **SUBSTRUCTURE DESIGN** ribbon (or right click and select **3D Schematic**) to open the pier schematic.



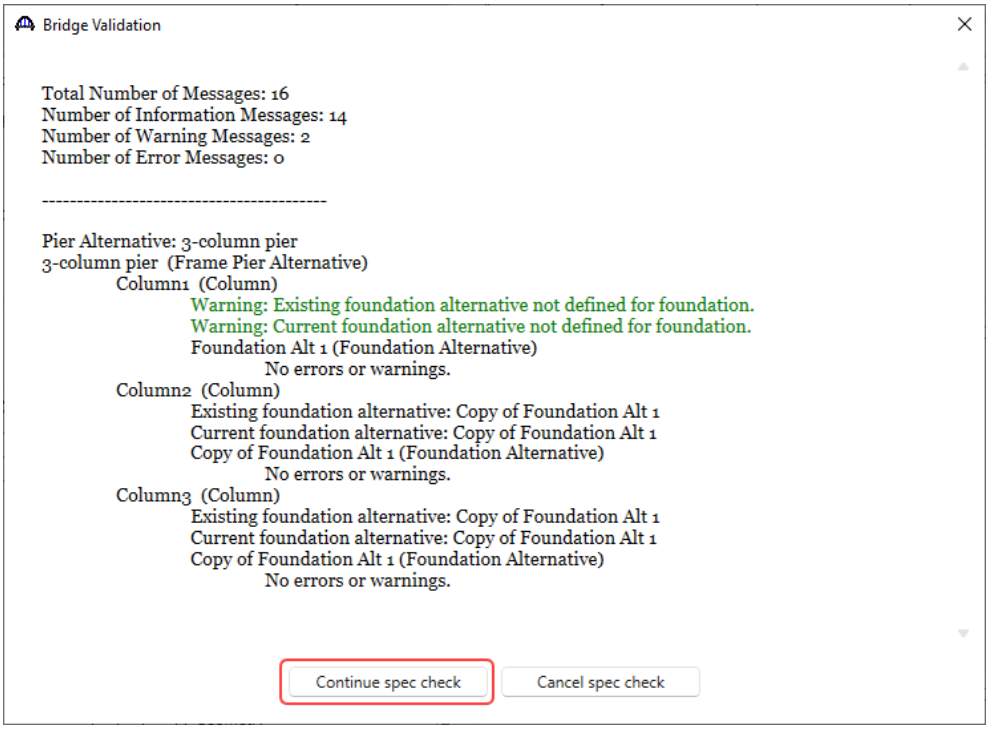
A specification check will now be performed on the pier.

Specification Checks - Pier

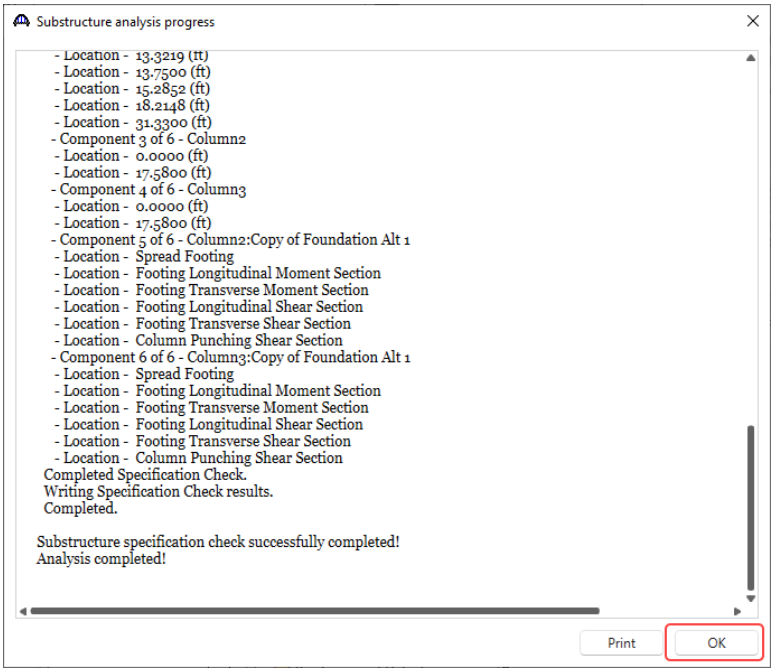
With **3-column pier** selected in the **Bridge Workspace** tree, click on the **Specification Check** button from the **Analysis** group of the **SUBSTRUCTURE DESIGN** ribbon.



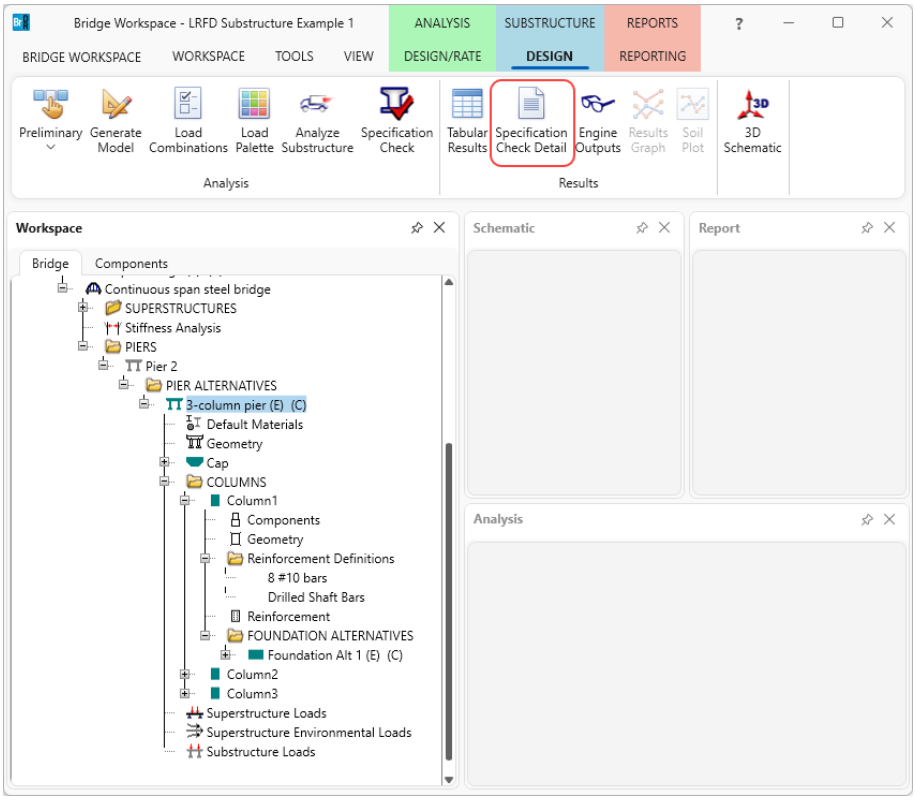
The **Bridge Validation** window appears as shown below. Click on the Continue spec check button to perform the specification checks.



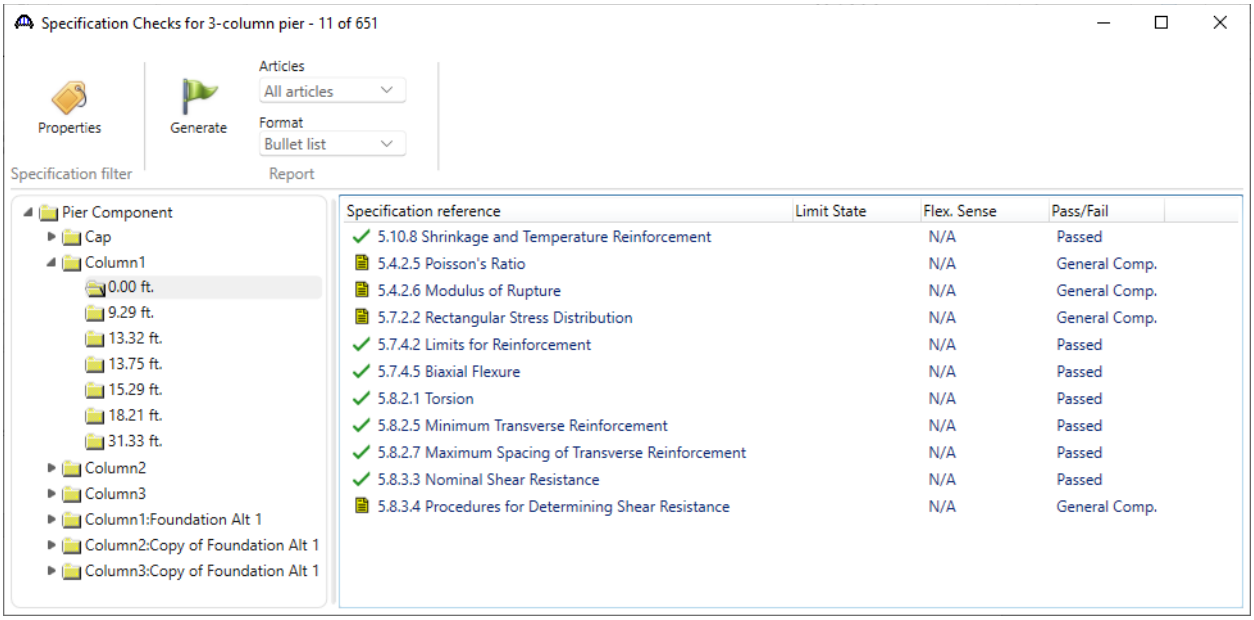
The **Substructure analysis progress** window opens showing the analysis log. Once the analysis the complete, click the **OK** button to close this window.



Specification check results can be reviewed by clicking the **Specification Check Detail** button from the **Results** group of the **SUBSTRUCTURE DESIGN** ribbon. The window shown below will open.



Specification checks are performed at the following locations in **Column 1**.



The focus is primarily on the following points:

1. The 0.00 ft location is the base of the column in BrDR which is the point of fixity for the drilled shaft segment.
2. The 13.75 ft location is the interface of the column and drilled shaft segment.

The remaining points are the locations where the reinforcement achieves full development.

The specification check at the point of fixity is shown below.