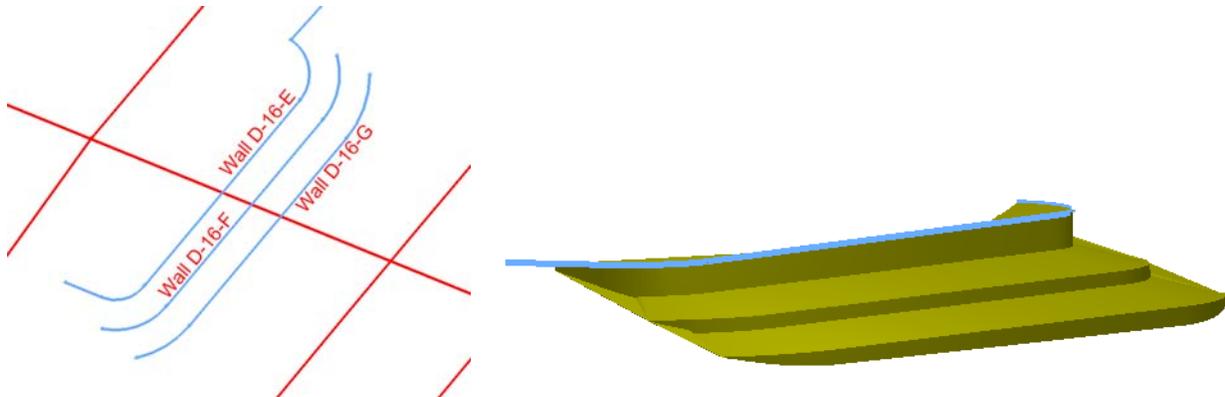


# LAB 23 - Terraced Walls

This lab covers how to use Surface Design and Editing tools to create a terraced wall under a bridge. For more information on the commands shown here, please see the *Surface Editing* chapter of *A Practical Guide for Using InRoads XM*.

In this scenario, three terraced walls are to be used under the SH52 bridge over SH119. Horizontal alignments have already been defined for the three walls along with verticals for the tops of the walls. A template will be created and run along the top wall to seek the other two walls and create the slopes between them.



## Chapter Objectives:

- To learn to use additional Surface Design tools.
- To expand your knowledge of templates by creating a special case terraced wall template.
- To learn how to use templates without setting up a corridor in Roadway Designer.

## Lab 23.1 - Open Data Files

If you have not exited since the last lab, you can skip this section.

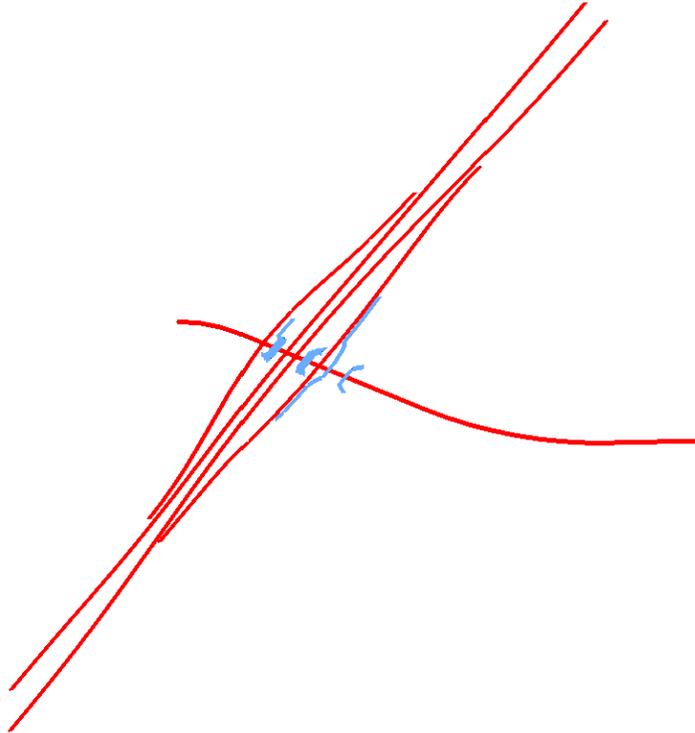
1. Open MicroStation and InRoads using the *C:\Projects\12345\Design\Working\CU12345DES\_Model.dgn* file.
2. Verify the correct *XIN* file is loaded.
3. Select File > Open from the InRoads menu.
4. Open *C:\Projects\12345\Design\InRoads\12345 SH119.dtm*, *12345 SH52.dtm*, *12345DES\_Templates.itl* and *12345 SH119 SH52 interchange.alg*.
5. Open *C:\Projects\12345\ROW\_Survey\InRoads\DTM\12345 existing ground for interchange.dtm*.

## Lab 23.2 - Create Components for the Wall and Slope

The three walls are very similar and therefore one set of components can be created and used multiple times in the final template. To start, components are created that will be run off of Wall D-16-E and will 'find' or 'target' Wall D-16-F. This is used in areas where there is a terrace.

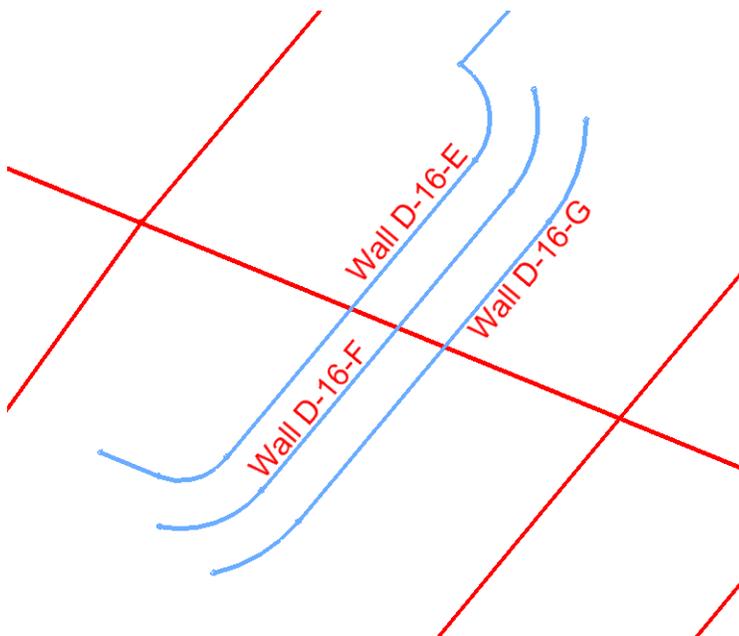
1. **Delete** any MicroStation graphics currently in the design file.

2. Select **Geometry > View Geometry > All Horizontals**.
3. **Fit** the view.



4. Window around the terraced wall area to the left of SH119.

**Note:** The wall names in the illustration below are for information only. The walls are not labeled in your file.

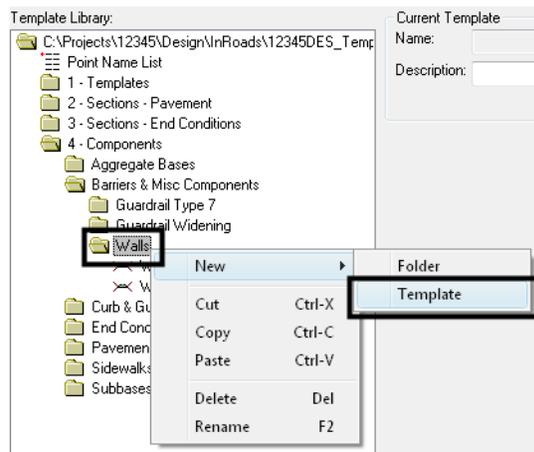


**Note:** Walls *D-16-E*, *D-16-F* and *D-16-G* will be created using a terraced wall template.

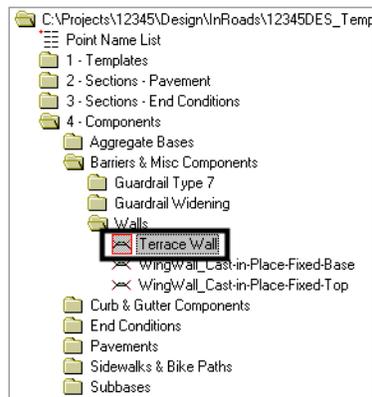
5. Select **Modeler > Create Template**.
6. Verify the template library is *12345DES\_Templates.itl*.

**Note:** Since there are no similar template to the one needed, a new one is created.

7. Expand the library folder structure for *Components > Barriers & Misc Components > Walls*.
8. Right-click on the *Walls* folder and select **New > Template**.

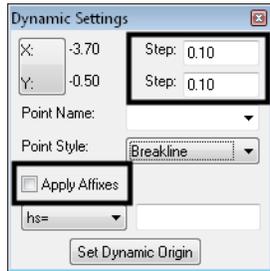


9. While the name is highlighted, type over it with *Terrace\_Wall*.



10. Select **Tools > Dynamic Settings**.
11. Toggle *Apply Affixes* off.

12. For **X** and **Y Step**, key in **0.1**.



13. Right-click in the template view and select **Add New Component > End Condition**.

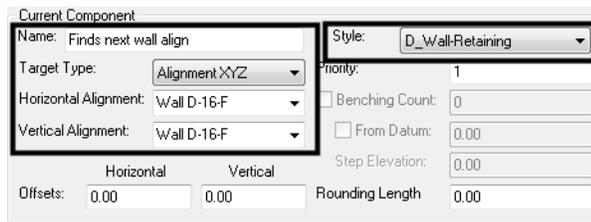
14. Under **Current Component**, key in **Finds next wall align** for the **Name**.

15. Set the **Style** to **D\_Wall-Retaining**.

16. Set the **Target Type** to **Alignment XYZ**.

17. Set the **Horizontal Alignment** to **Wall D-16-F**.

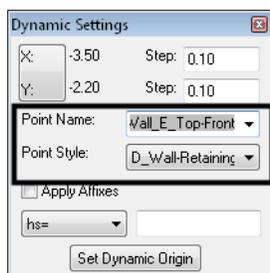
18. Set the **Vertical Alignment** to **Wall D-16-F**.



**Note:** Since the template will start at **Wall D-16-E**, **Wall D-16-F** is the next wall alignment. With a target of **Alignment XYZ**, the component will use a variable slope to ‘find’ the horizontal and vertical alignment.

19. In the **Dynamic Settings** box, key in **Wall\_E\_Top-Front** for the **Name**.

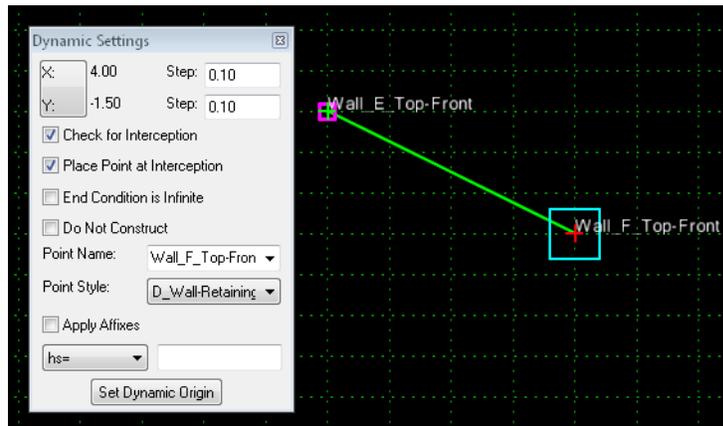
20. Select **D\_Wall-Retaining** for the **Style**.



21. **<D>** on the origin point (0,0).

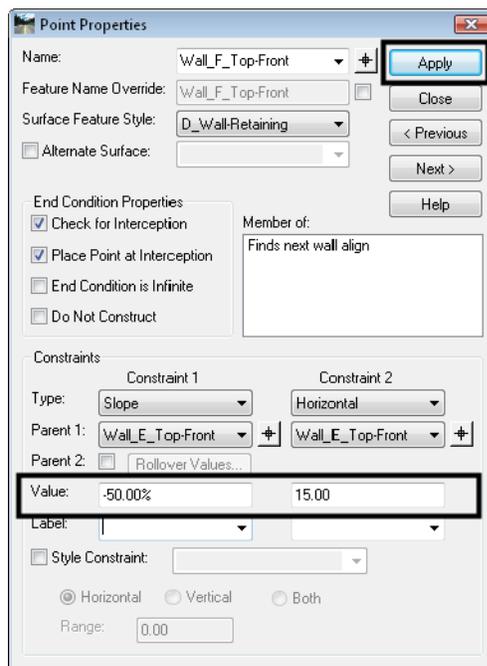
22. Back in the **Dynamic Settings** box, change the name to **Wall\_F\_Top-Front**.

23. <D> on a point down and to the right of the first point as shown.



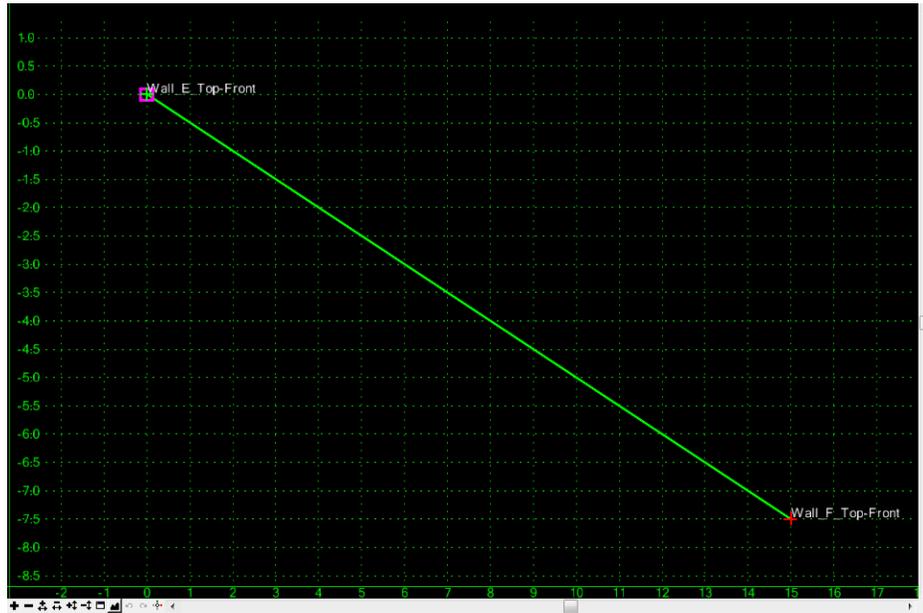
24. <R> and <D> **Finish** to complete the component.
25. **Edit** the second point, *Wall\_F\_Top-Front*. (Either double-click the point or right-click and choose **Edit**.)
26. For the *Slope Constraint*, set the *Value* to **50.00%**.
27. For the *Horizontal Constraint*, set the *Value* to **15.00**.

**Note:** Because the target for this end condition is both a horizontal and a vertical alignment, these values are actually ignored when the template is run. However, it gives a more accurate picture to use realistic values.



28. <D> **Apply**, then **Close**.

29. Fit the template.



In the following series of steps, another component is added to create the face of the wall, a 25% slope to the next wall and a flat top for the next wall.

30. Right-click in the template view and select **Add New Component > Unconstrained**.

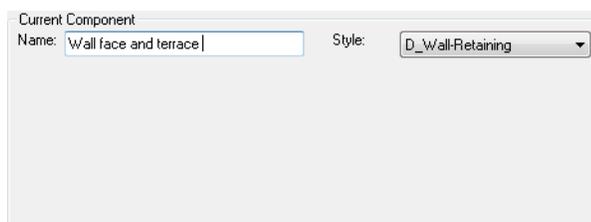
31. Right-click again and make certain all options are toggled off.



32. **<ESC>** to dismiss the menu if everything was already off.

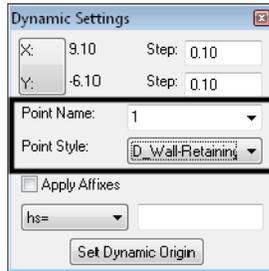
33. Under *Current Component*, key in **Wall face and terrace** for the *Name*.

34. Set the *Style* to **D\_Wall-Retaining**.



35. In the *Dynamic Settings* box, select **D\_Wall-Retaining** for the *Style*.

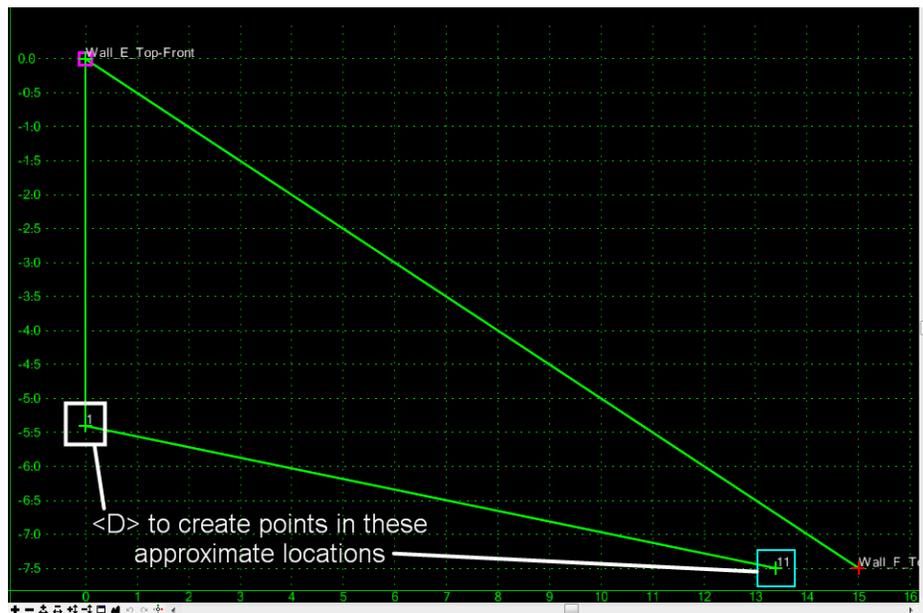
36. Key in **1** for the **Point Name**.



**Note:** This is just a temporary seed name to place points. You will later rename the points.

37. <D> on the **Wall\_E\_Top-Front** point to start the component.

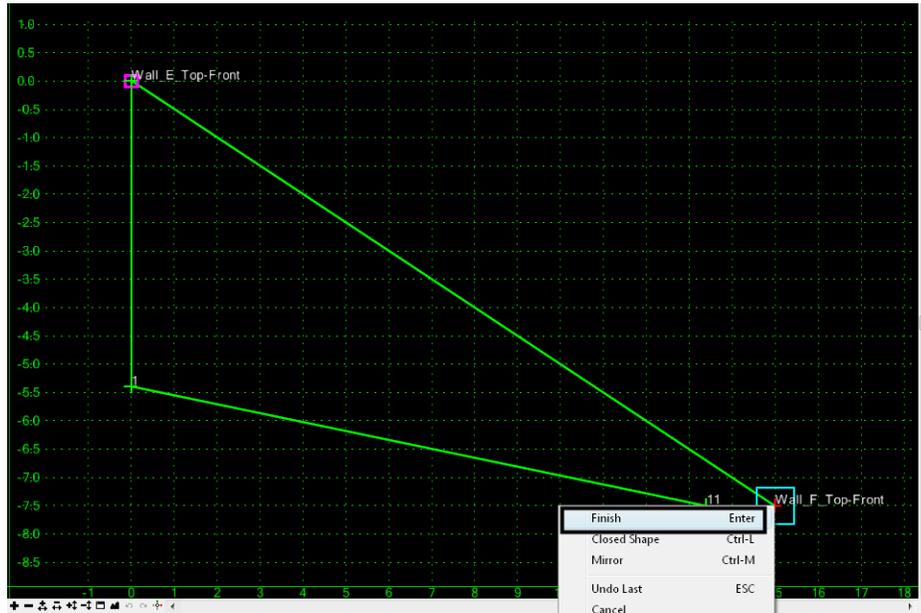
38. <D> to create two additional points similar to what is shown.



**Note:** Do not worry about getting them exact. The slopes and distances will be set with constraints.

39. <D> on the **Wall\_F\_Top-Front** point for the final point in this component.

40. Right click and select **Finish**.

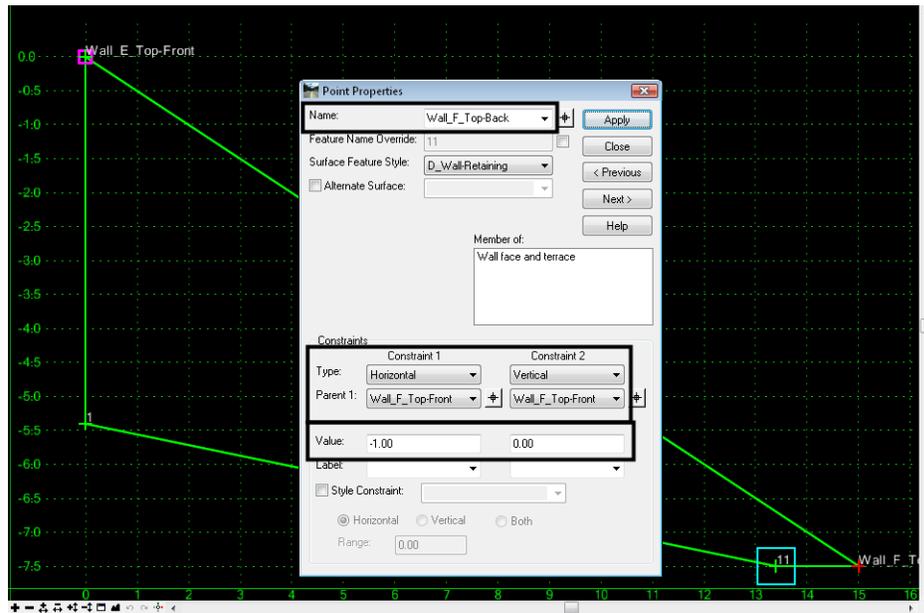


41. Edit the point *II* just inside the *Wall\_F\_Top-Front* point.

**Note:** This point will create the flat top on Wall F.

42. Key in *Wall\_F\_Top-Back* for the *Name*.
43. Set *Constraint 1* to *Horizontal*.
44. Set *Parent 1* to *Wall\_F\_Top-Front*.
45. Key in a *Value* of *1.00*.
46. Set *Constraint 2* to *Vertical*.
47. Set *Parent 1* to *Wall\_F\_Top-Front*.

48. Key in a *Value* of **0.00**.



49. <D> **Apply**, then **Close**.
50. **Edit** the point **1** below *Wall\_E\_Top-Front*.

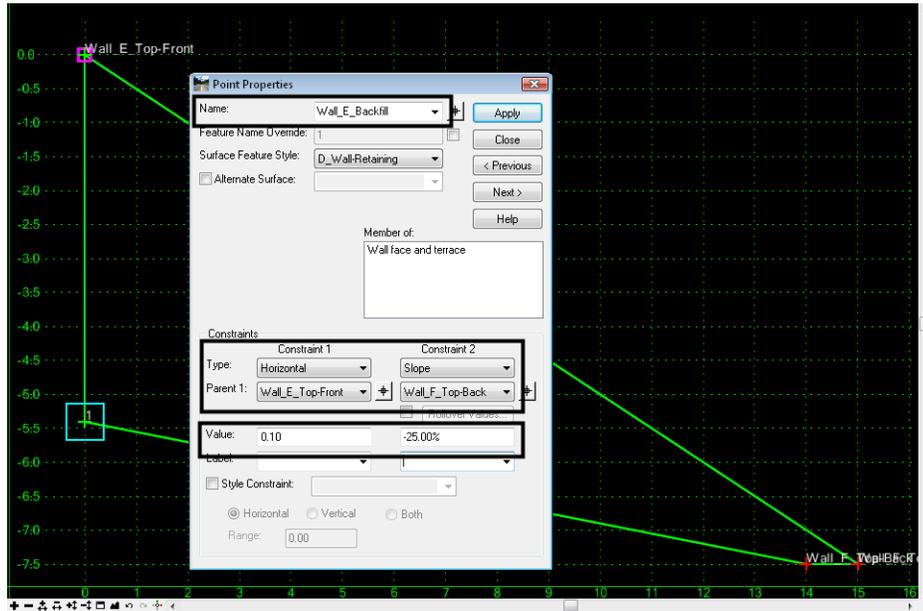
**Note:** This point will become the location where the face of the wall is intercepted by the 25% backfill slope.

51. Key in *Wall\_E\_Backfill* for the *Name*.
52. Set *Constraint 1* to *Horizontal*.
53. Set *Parent 1* to *Wall\_E\_Top-Front*.
54. Key in a *Value* of **0.1**.

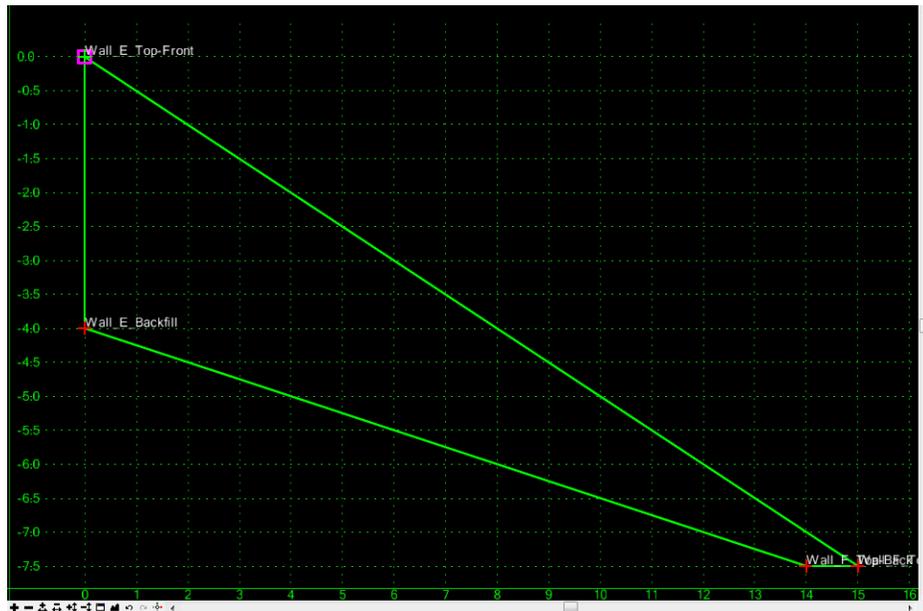
**Note:** This will force a small slope on the front face of the wall to allow triangulation.

55. Set *Constraint 2* to *Slope*.
56. Set *Parent 1* to *Wall\_F\_Top-Back*.

57. Key in a *Value* of **-25.00%**.



58. <D> **Apply**, then **Close**.



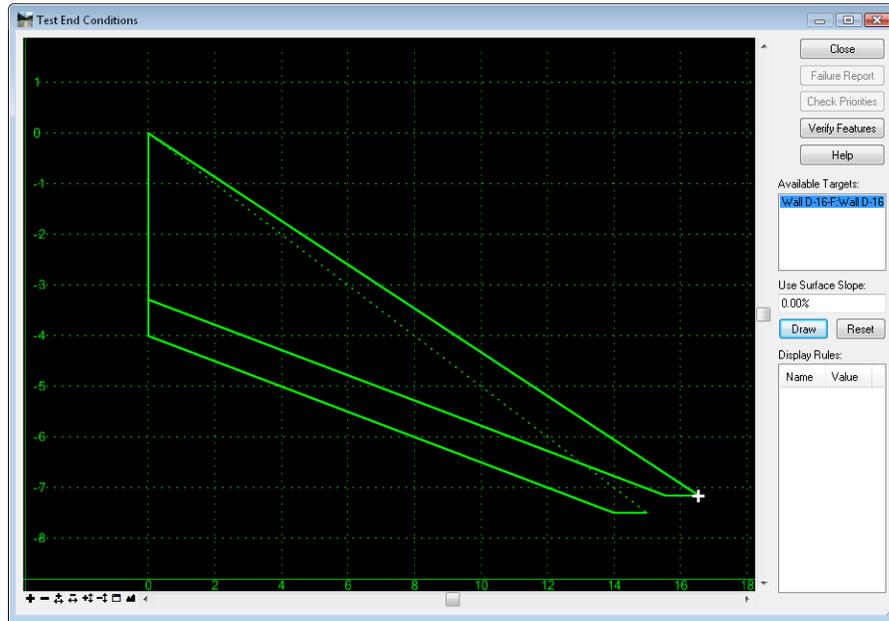
**Note:** Since the horizontal and slope constraints have two different parent points, the location of this point varies when either of the parents moves.

59. <D> **Test**.

60. Under *Available Targets*, <D> on the wall alignment.

61. <D> **Draw**.

62. Move your cursor into the template view to see how the components react.

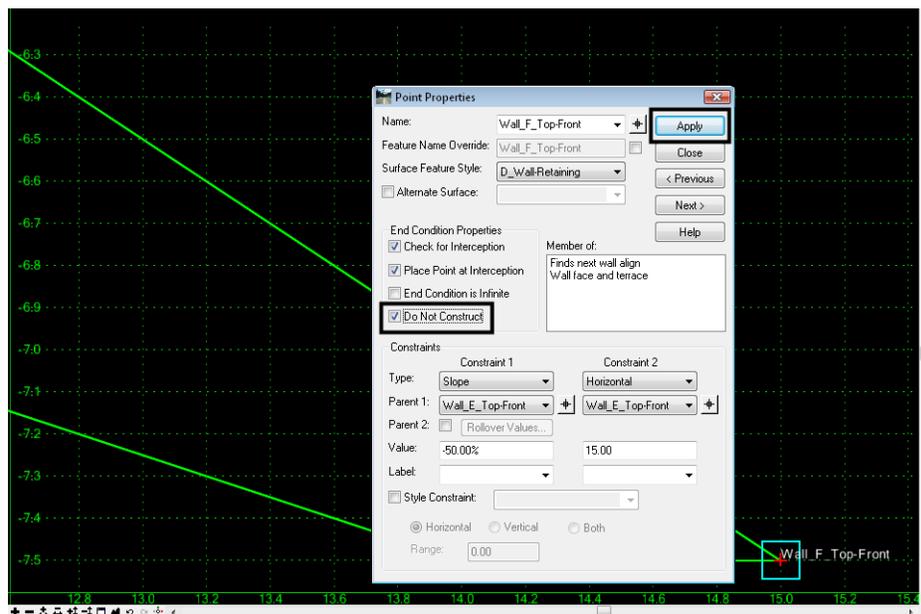


**Note:** The original component has a variable slope, while the *Wall face and terrace* component maintains all slopes. It should also be noted that there is no need to display the original component. Also, if the original component fails the *Wall face and terrace* component should not display either. Both of these situations will be taken care of next.

63. <D> Close on the *Test End Conditions* box.

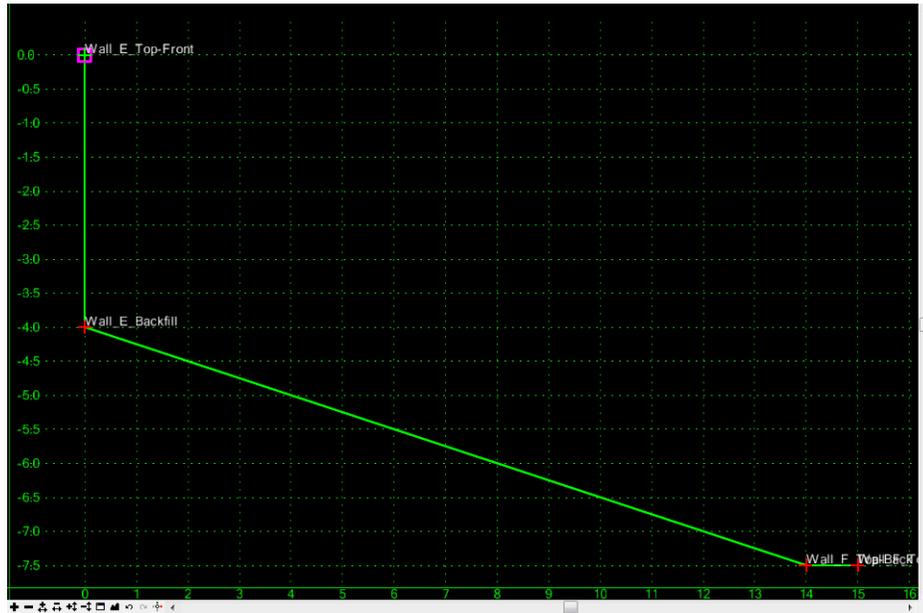
64. Edit the *Wall\_F\_Top-Front* point.

65. Toggle on *Do Not Construct*.



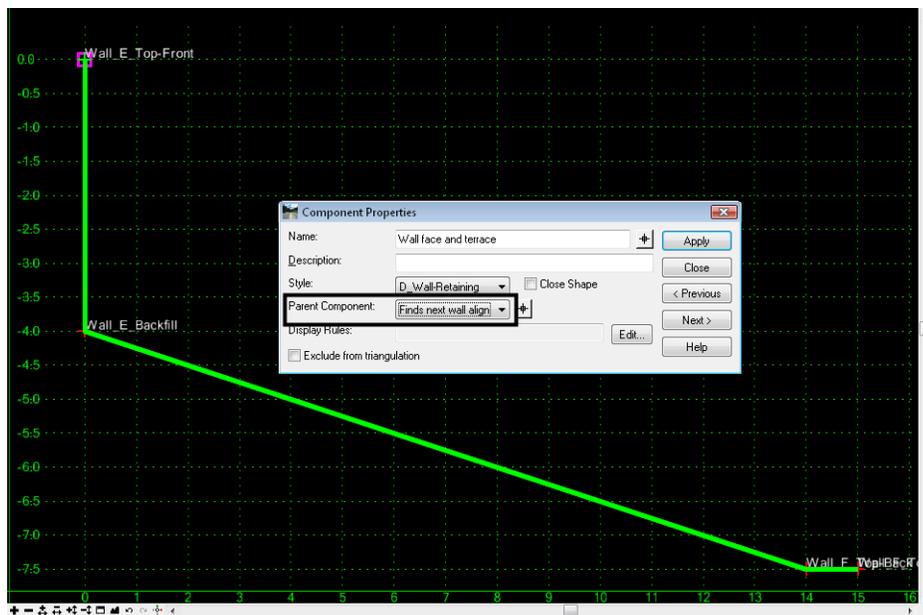
66. <D> Apply, then Close.

**Note:** The *Finds next wall align* component disappears. However, the portion of the *Wall face and terrace* component that contains the *Wall\_F\_Top-Front* point remains. This is because *Do Not Construct* only affects end condition components.



67. Edit the *Wall face and terrace* component. (Double-click the component or right-click on the component and choose **Edit**.)

68. Set the *Parent Component* to *Finds next wall align*.



69. <D> Apply, then Close.

**Note:** Now, if the *Finds next wall align* end condition fails, neither component is used.

70. Test the template again to see the difference.



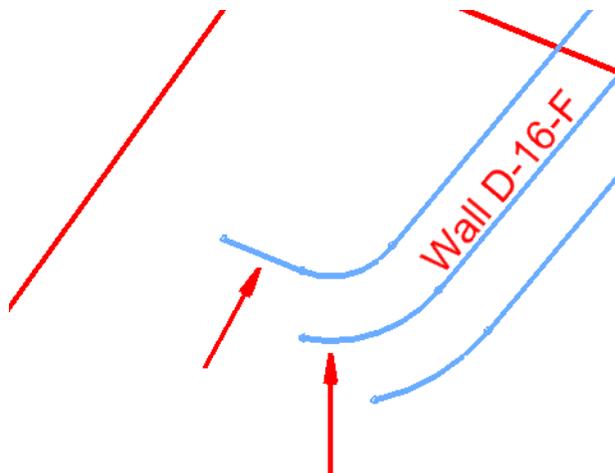
**Note:** Now, only a dashed line is shown initially, indicating when the end condition fails, nothing is displayed. When the end condition succeeds, only the *Wall face and terrace* is displayed.

71. <D> Close on the *Test End Conditions* box.

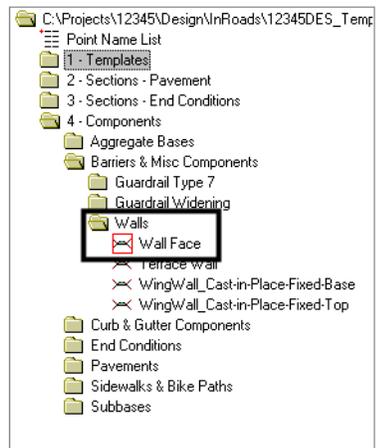
72. Save the template library.

## Lab 23.3 - Create a Component for the Wall Face

In the areas where a perpendicular application of the template from the upper wall alignment would not find the next wall, the template should create a wall face. This situation will be covered in a new template and combined with the other template later.



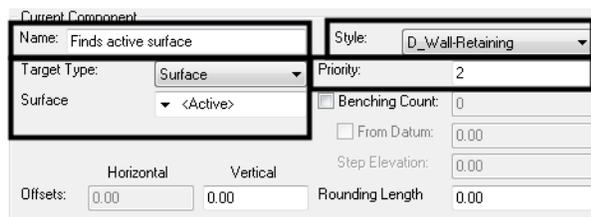
1. Right-click on **Walls** folder again in the library and select **New > Template**.
2. While the name is highlighted, type over it with **Wall\_Face**.



**Note:** Since the face of the wall will eventually be attached to the **Wall\_Top-Front** points which are set to **Do Not Construct**, the face of the wall must be made up of a non-end condition component. However, the face of the wall must also be an end condition so it will stop when it intercepts the target surface. Therefore, the same theory is used for the face as for the terrace: an end condition that doesn't display is used along with a 'regular' component that does display.

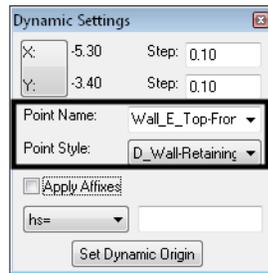
3. Right-click and select **Add New Component > End Condition**.
4. Under **Current Component**, key in **Finds active surface** for the **Name**.
5. Set the **Style** to **D\_Wall-Retaining**.
6. Set the **Target Type** to **Surface**.
7. Set the **Surface** to **<Active>**.
8. Set the **Priority** to **2**.

**Note:** Since this component is to be used only where the terraced wall doesn't work, it will need to be second in priority.

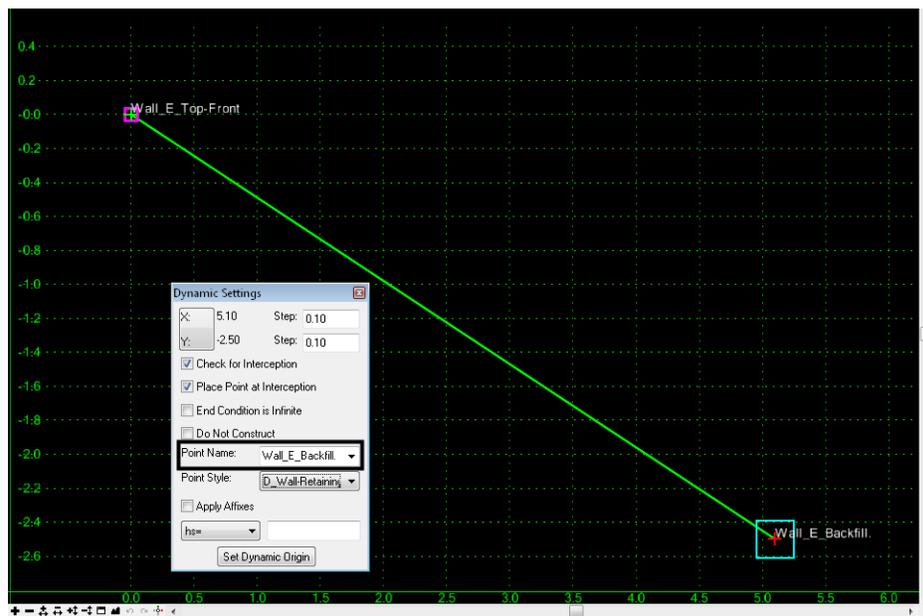


9. In the **Dynamic Settings** box, key in **Wall\_E\_Top-Front** for the **Name**.

10. Select ***D\_Wall-Retaining*** for the ***Style***.

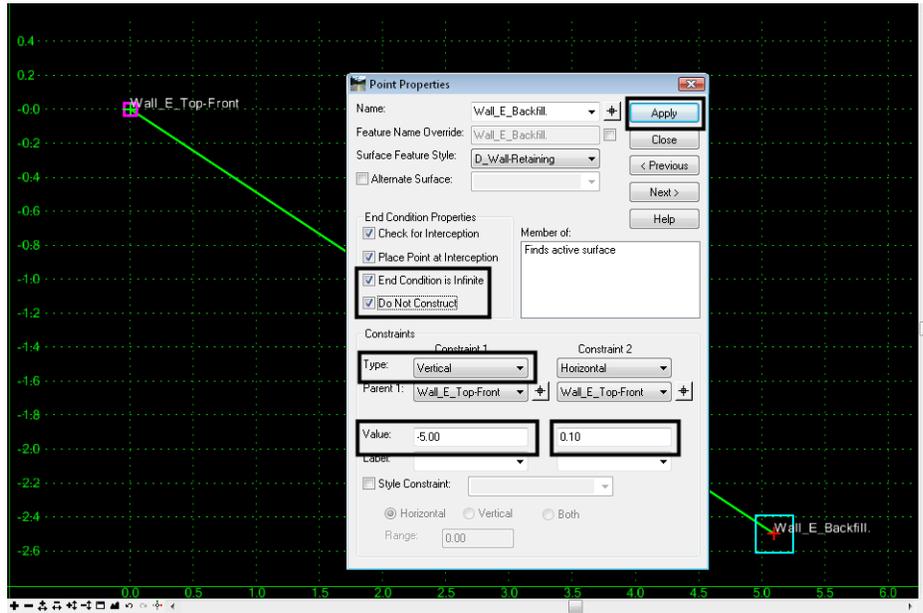


11. <D> on the origin point (0,0).
12. Back in the ***Dynamic Settings*** box, change the name to ***Wall\_E\_Backfill***.
13. <D> on a point down and to the right of the first point as shown.



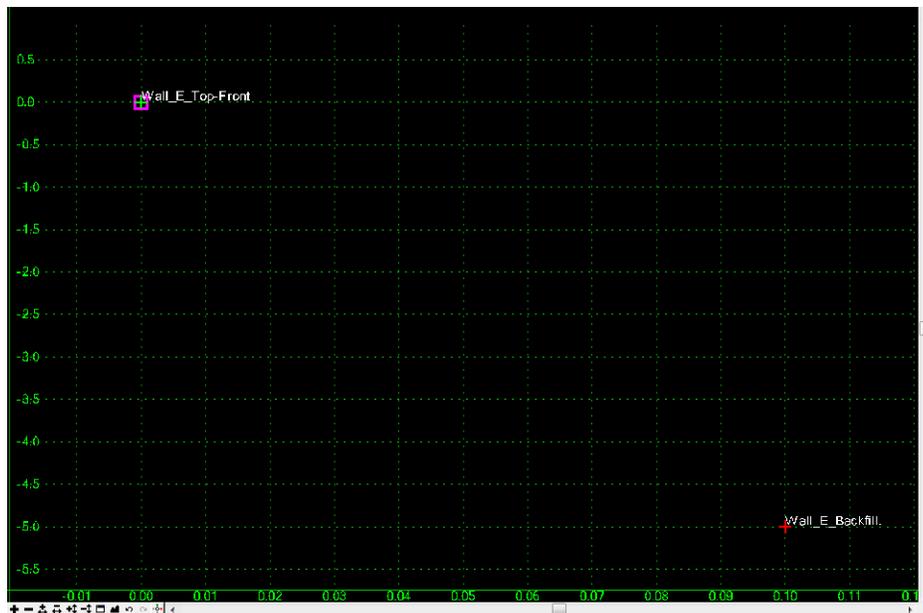
14. Right click and select ***Finish***.
15. ***Edit*** the second point, ***Wall\_E\_Backfill***.
16. Change the ***Slope Constraint*** to ***Vertical*** and set the ***Value*** to ***-5.00***
17. For the ***Horizontal Constraint***, set the ***Value*** to ***0.1***.
18. Toggle on ***End Condition is Infinite***.

19. Toggle on *Do No Construct*.



20. <D> Apply, then Close.

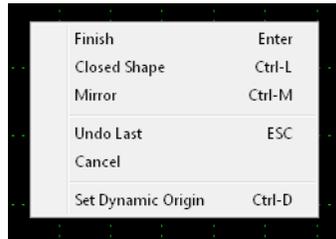
21. Fit the template.



**Note:** The line forming the component disappears, but the points are still there.

22. Right-click in the template view and select **Add New Component > Unconstrained**.

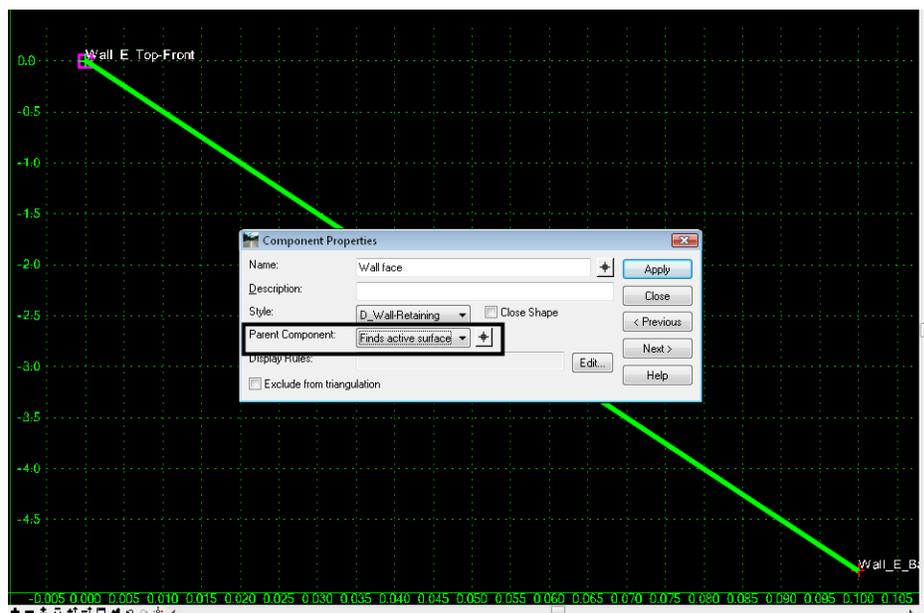
23. Right-click again and make certain all options are toggled off.



24. <ESC> to dismiss the menu if everything was already off.
25. Under *Current Component*, key in **Wall face** for the Name.
26. Set the *Style* to **D\_Wall-Retaining**.



27. <D> on the **Wall\_E\_Top-Front** point to start the component.
28. <D> on the **Wall\_E\_Backfill** point.
29. Right click and select **Finish**.
30. **Edit** the **Wall face** component.
31. Set the *Parent Component* to **Finds active surface**.



**Note:** Now, if the *Finds active surface* end condition fails, neither component is used.

32. Test the template.



**Note:** Only a dashed line is shown initially, indicating when the end condition fails, nothing is displayed. When the end condition succeeds, only the Wall face is displayed. The template is 'fit' to the view, so the slope seen here is not indicative of the final slope.

33. <D> Close on the *Test End Conditions* box.

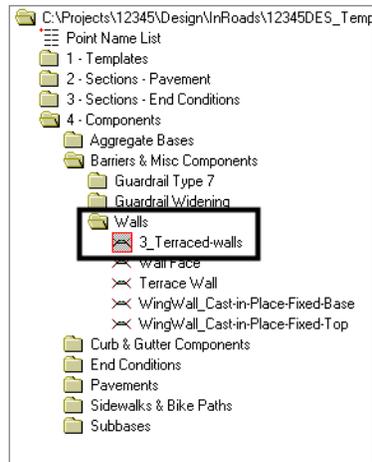
34. Save the template library.

## Lab 23.4 - Create the Final Wall Template

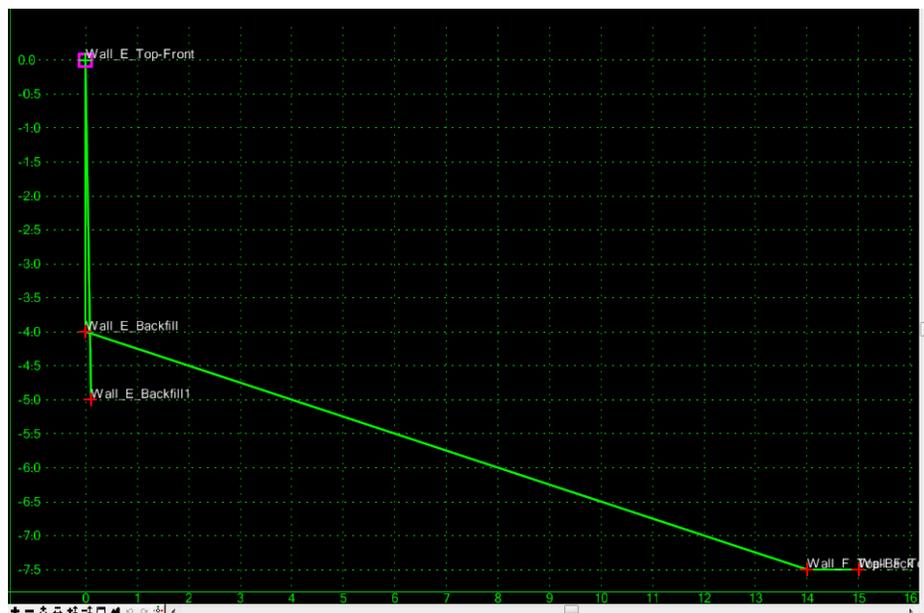
Next, these templates are combined to create the final wall template.

1. Right-click on *Walls* folder again in the library and select **New > Template**.

2. While the name is highlighted, type over with **3\_Terraced-walls**.

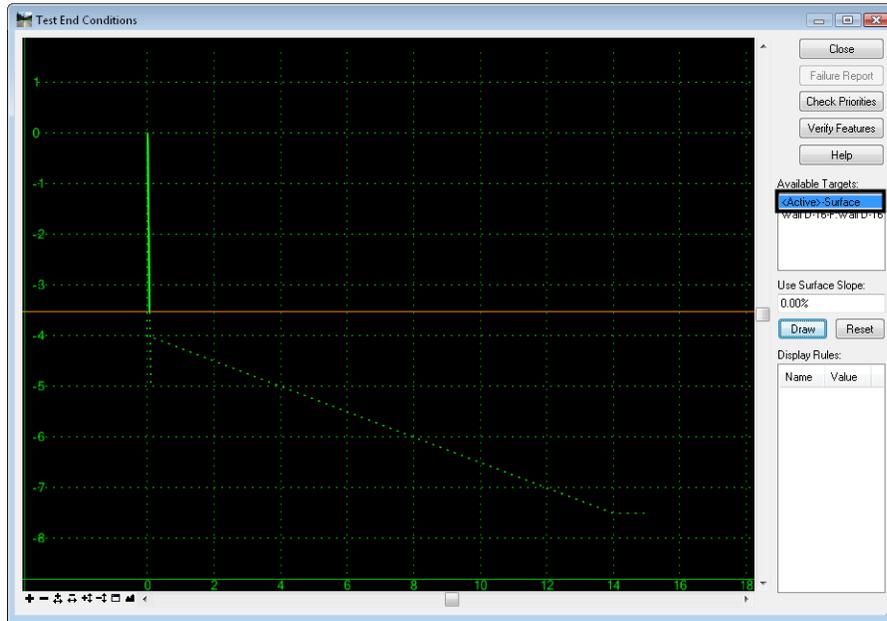


3. Highlight, but do not make active, **Terrace\_Wall**.
4. Drag the **Terrace\_Wall** template from the preview and drop it on the origin of the new template.
5. Highlight, but do not make active, **Wall\_Face**.
6. Drag the **Wall\_Face** template from the preview and drop it on the origin, making certain the **Wall\_E\_Top-Front** point turns white.



7. <D> Test.
8. <D> on the <Active>-Surface under *Available Targets*.
9. <D> on Draw.

10. Move your cursor into the template view.

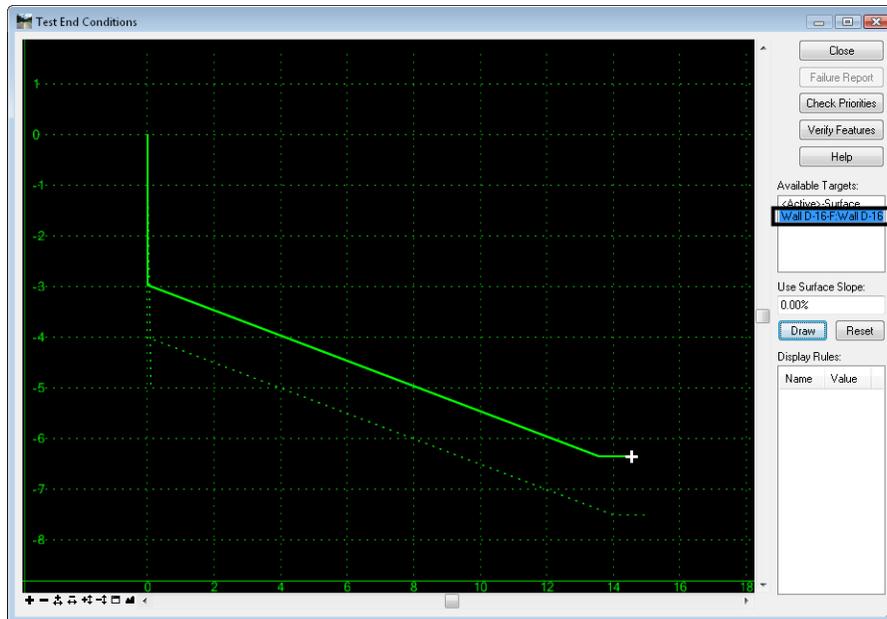


**Note:** The wall face appears, indicating that when the first option, the *Wall face and terrace*, fails, the wall face alone will be created.

11. <D> on the *Wall D-16-F* alignment under *Available Targets*.

12. <D> on *Draw*.

13. Move your cursor into the template view.



**Note:** The wall face and terrace appear.

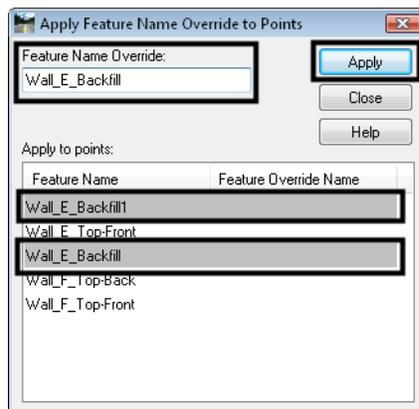
14. <D> **Close** on the *Test End Conditions* dialog.

There are two *Wall\_E\_Backfill* points in the template, so one was renamed with a suffix. In the model, only one of these points will be used at any given location and together, they should form just one breakline. This is accomplished with *Feature Name Overrides*.

15. Select **Tools > Apply Feature Name Override**.

16. Highlight the two *Wall\_E\_Backfill* points

17. Key in *Wall\_E\_Backfill* for the *Feature Name Override*.



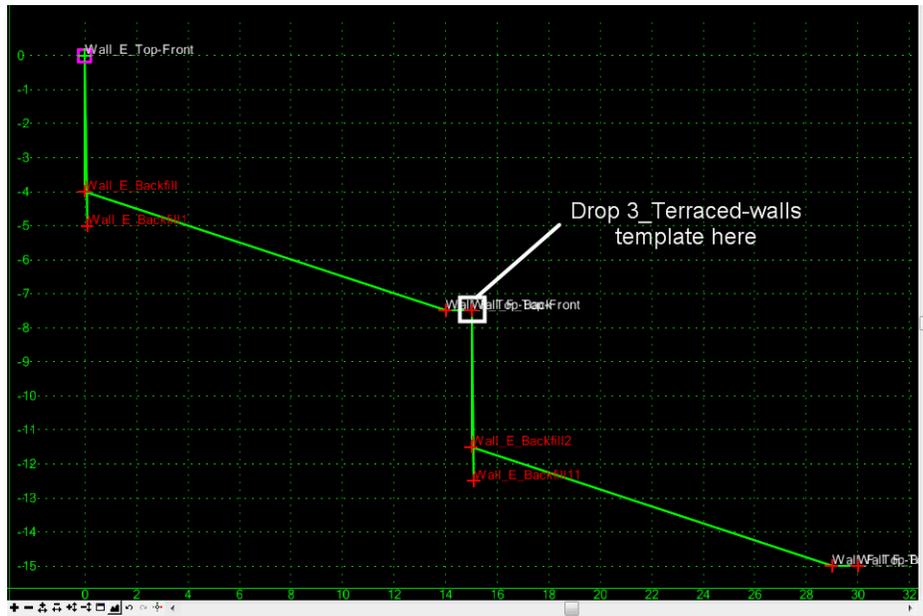
18. <D> **Apply**, then **Close**.



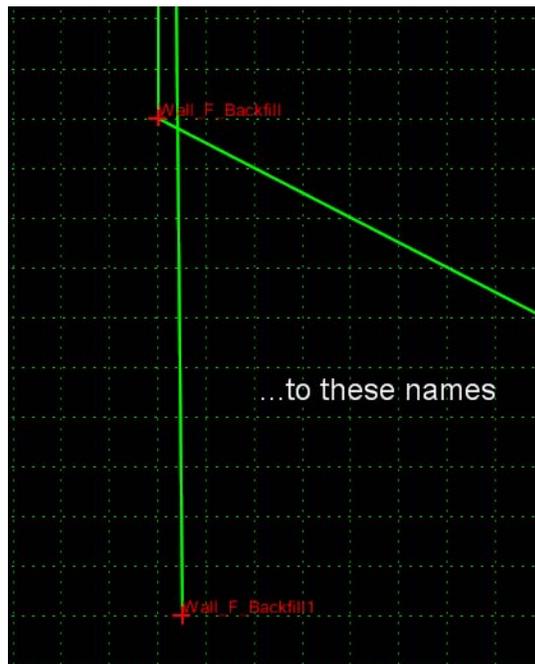
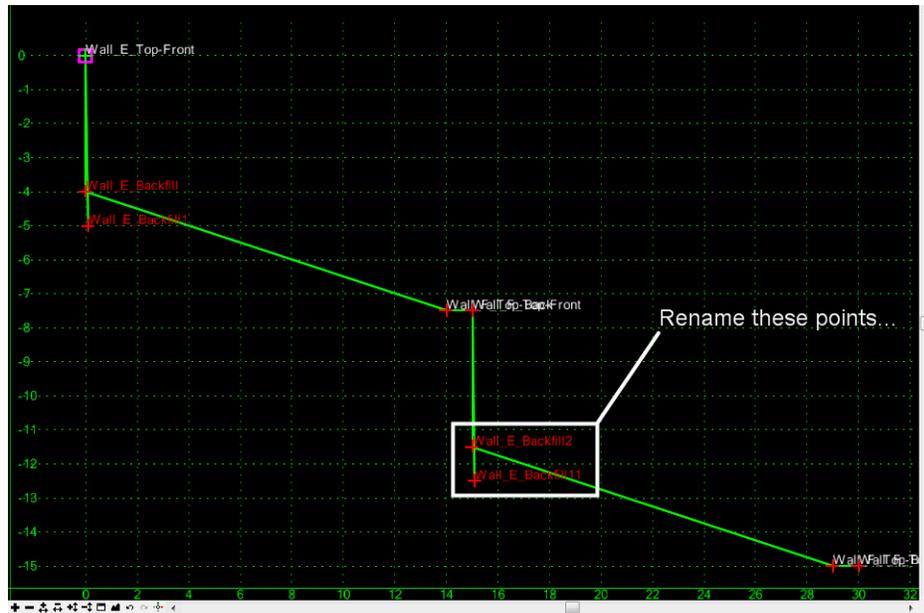
**Note:** The names turn red in the template view, indicating the names have been overridden.

19. **Save** the template library.
20. Highlight the *3\_Terraced-walls* template in the list at left.

- 21. Drag and drop the template from the preview onto the *Wall\_F\_Top-Front* point, making certain the point turns white.

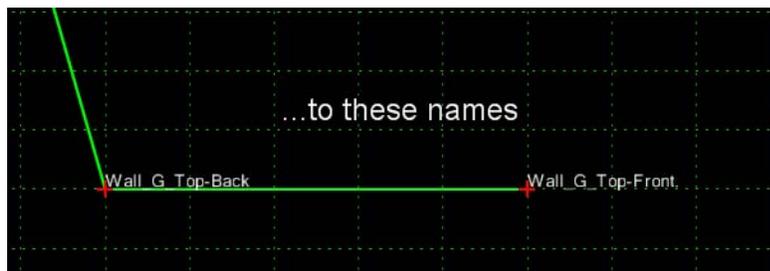
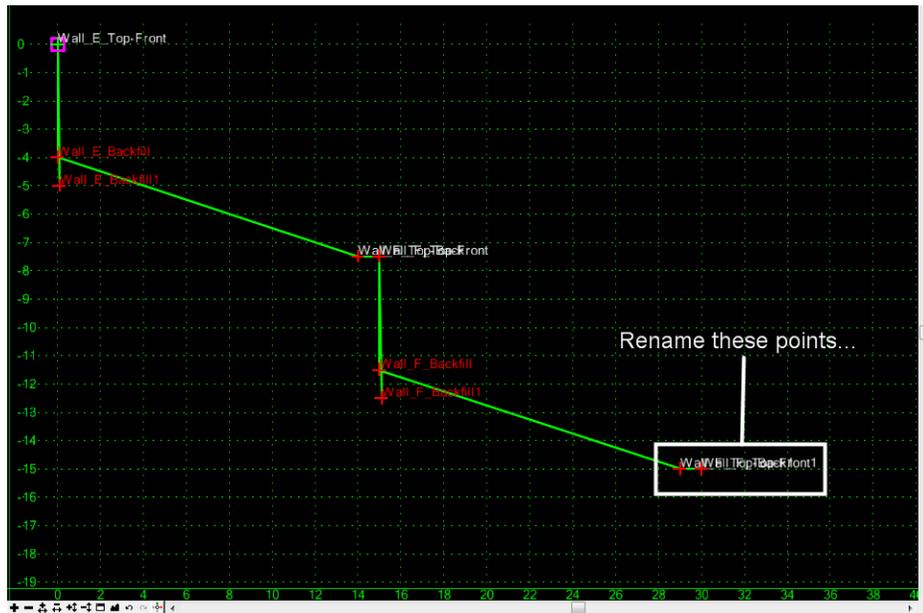


22. Edit the two backfill points for *Wall F* and rename the points to *Wall\_F\_Backfill* and *Wall\_F\_Backfill1*.



23. Rename the *Wall\_F\_Top-Front1* point to *Wall\_G\_Top-Front*.

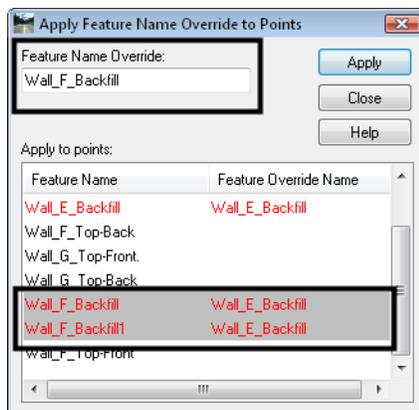
24. Rename the *Wall\_F\_Top-Back1* point to *Wall\_G\_Top-Back*.



25. Select Tools > Apply Feature Name Override.

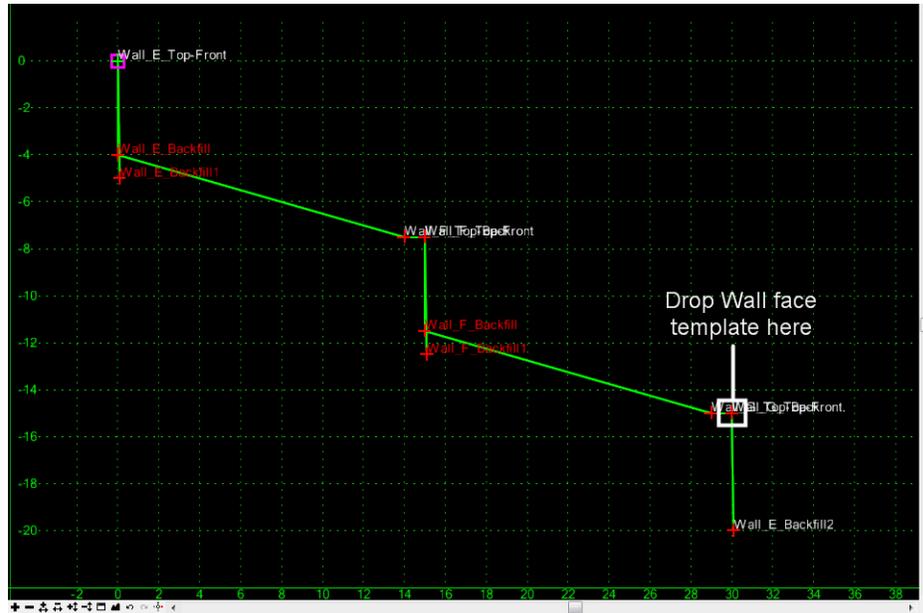
26. Highlight the two *Wall\_F\_Backfill* points

27. Key in *Wall\_F\_Backfill* for the *Feature Name Override*.

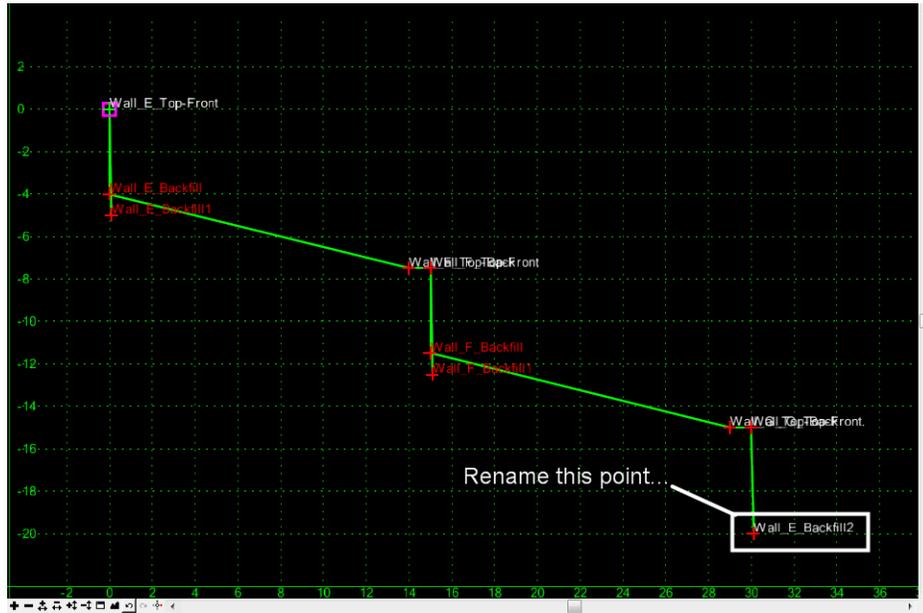


28. <D> Apply, then Close.

29. Highlight, but do not make active, *Wall\_Face*.
30. Drag the *Wall\_Face* template from the preview and drop it on *Wall\_G\_Top-Front*, making certain the *Wall\_G\_Top-Front* point turns white.



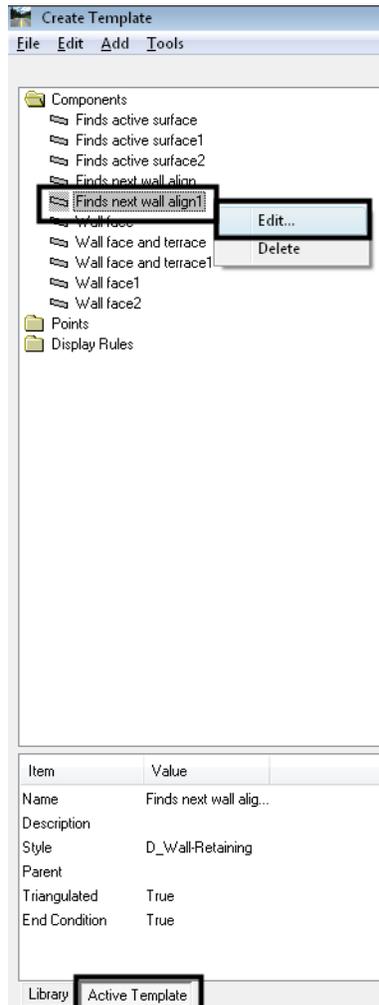
31. Change the new *Wall\_E\_Backfill2* point to *Wall\_G\_Backfill*.



32. At the bottom of the Template Library list at left, select the *Active Template* tab.

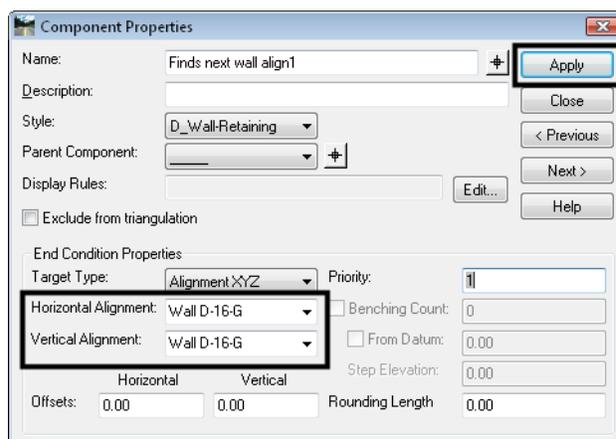
33. Expand the *Components* list.

34. Right-click on *Finds next wall align1* and select **Edit**.



**Note:** Since this component was created from the original one, it is still seeking the *Wall F alignments*. Here, you'll change it to seek *Wall G*.

35. Change the *Horizontal* and *Vertical Alignments* to *Wall-D-16-G*.



36. <D> **Apply**, then **Close**.
37. **Save** the template library.
38. At the bottom of the Template Library list at left, select the **Library** tab.
39. **Test** the **3\_Terrace-walls** template.



40. <D> **Close** on the *Test End Conditions* dialog.
41. <D> **Close** on the *Create Template* dialog.

## Lab 23.5 - Create the Terraced Wall Surface

In this section, the template is used to create a surface representing the terraced walls. The template is run along a graphic element created from the horizontal and vertical alignment for Wall E using the *Apply Template* command. As an alternative, *Roadway Designer* could be used.

1. **Delete** the alignment graphics in the file.

**Important!** If the original graphics remain in the file, you are likely to accidentally identify them when selecting the path for the template, so it is best to delete the original alignment display. The original graphics are at elevation 0. The graphic you are creating is 3D.

2. Select **Geometry > View > 3D Alignment**.

**Note:** This command creates a 3D linestring, taking the X and Y coordinates from the specified horizontal alignment and the Z coordinate from the specified vertical alignment.

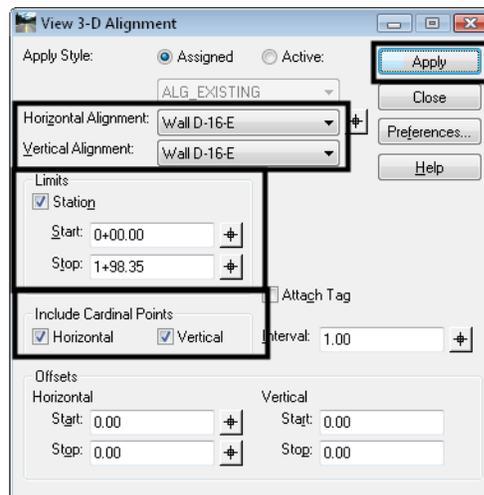
3. Select the **Horizontal** and **Vertical** alignments **Wall-D-16-E**.

4. Toggle on *Station Limits*.
5. Leave the *Start Station* set to *0+00.00*.
6. Key in *1+98.35* for the *Stop Station*.

**Note:** This is the station at the end of the second curve in the wall alignment. From that point on, the wall will be created with the ramp.

7. Under *Include Cardinal Points*, toggle on *Horizontal* and *Vertical*.
8. Key in *1.00* for the *Interval*.

**Note:** This is how often a vertex is created on the resulting linestring.



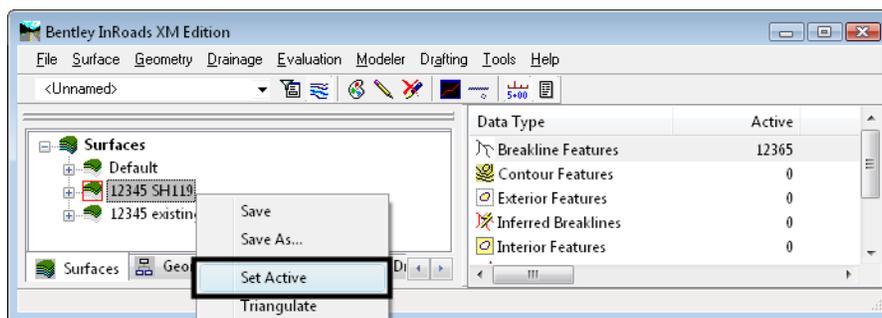
9. <D> **Apply**, then **Close**.

10. Fit the view.



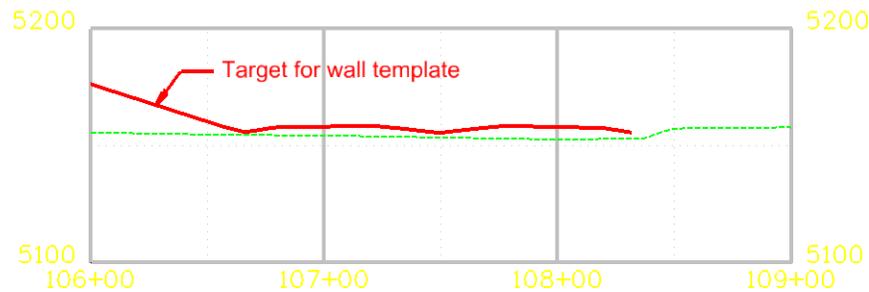
**Note:** The 3D linestring is shown here in plan and in a rotated view. It forms the origin point for the wall template.

11. Make *12345 SH119* the active surface.



**Note:** The SH119 surface has a 3:1 slope from the bottom of the ditch that creates a ‘target’ for the walls.

**Important!** Since the template was created to search for the active surface, *SH119* must be active.

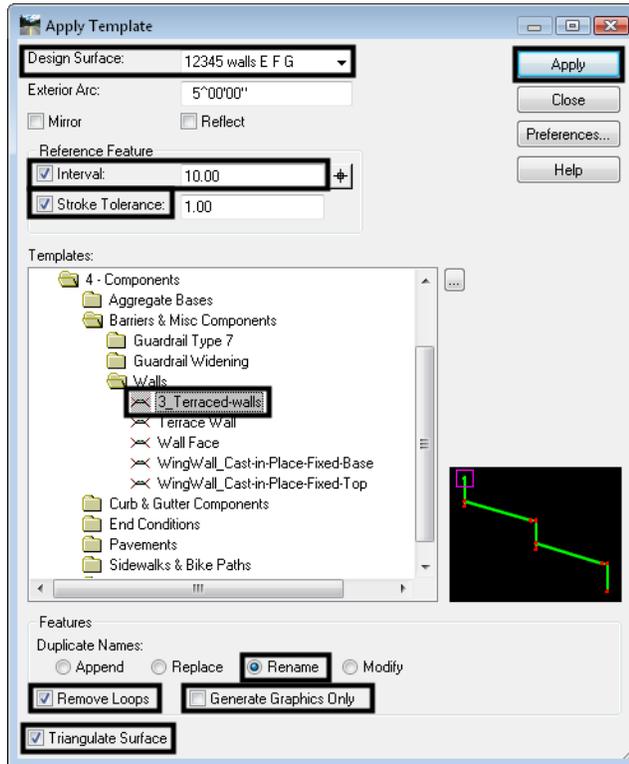


12. Set the *Locate Features / Locate Graphics* toggle to *Locate Graphics*.
13. Select **Surface > Design Surface > Apply Template**.
14. Key in **12345 walls E F G** for the *Design Surface*.
 

**Note:** The design surface does not have to exist. It is created when the command is applied.
15. Set the *Reference Feature Interval* to **10.00**.
16. Toggle on *Stroke Tolerance*.
 

**Note:** The Value does not matter unless the reference graphic has an arc in it. Using *View 3D Alignment* creates a linestring that does not contain arcs.
17. Highlight the **3\_Terraced\_Walls** template in the **4 Components/Barriers & Misc Components/Walls** folder.
18. Set *Duplicate Names* to **Replace**.
19. Toggle on *Remove Loops*.
20. Toggle off *Generate Graphics Only*.

21. Toggle on **Triangulate Surface**.



22. <D> **Apply**.

23. <D> on the 3D alignment graphic to identify the **Primary Element**.

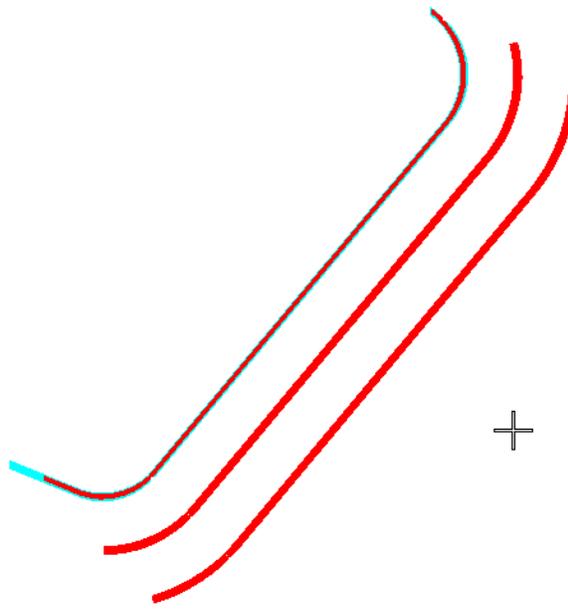
24. <D> anywhere in the view to accept.

25. <D> on the 3D alignment graphic again to identify the **Reference Element**.

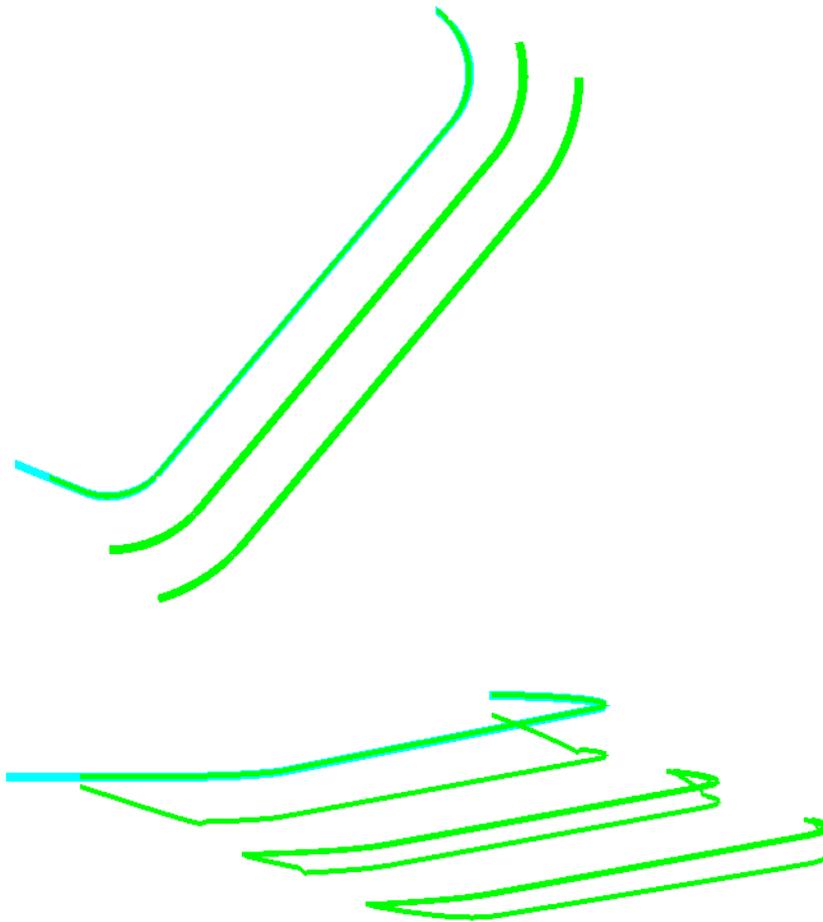
26. <D> anywhere in the view to accept.

27. <R> to apply the template to the entire element.

**Note:** Temporary graphics appear showing the resulting feature locations.

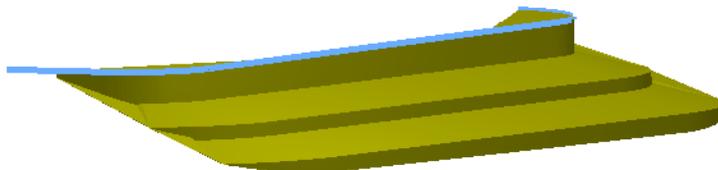


28. <D> anywhere in the view for the location.



**Note:** The *Results* dialog appears showing any end condition failures. Above, you see the plan and rotated views of the graphics. There may be failures at either end of the graphics, since the alignment actually begins slightly underground.

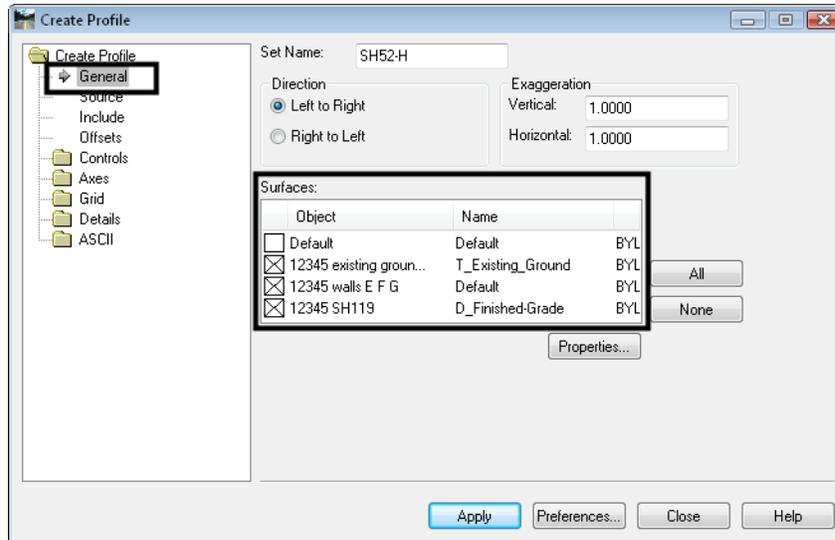
29. **Save** the wall surface to the *c:\Projects\12345\Design\InRoads* folder.
30. Review the surface by displaying triangles and/or contours.



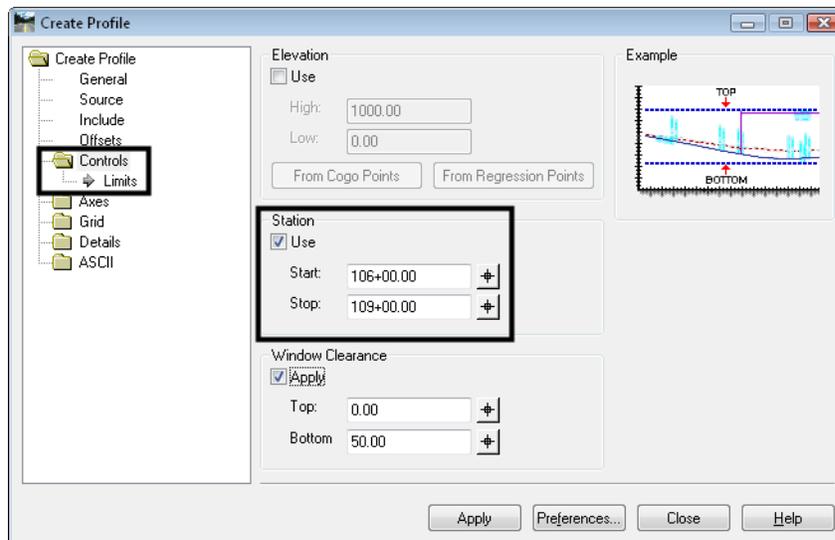
**Note:** If the view is rotated, return to a top view when done.

31. Set the active alignment to *SH52-H*.

32. Select **Evaluation > Profile > Create Profile**.
33. Toggle on *12345 existing ground for interchange, 12345 SH52, 12345 SH119* and *12345 walls E F G*.

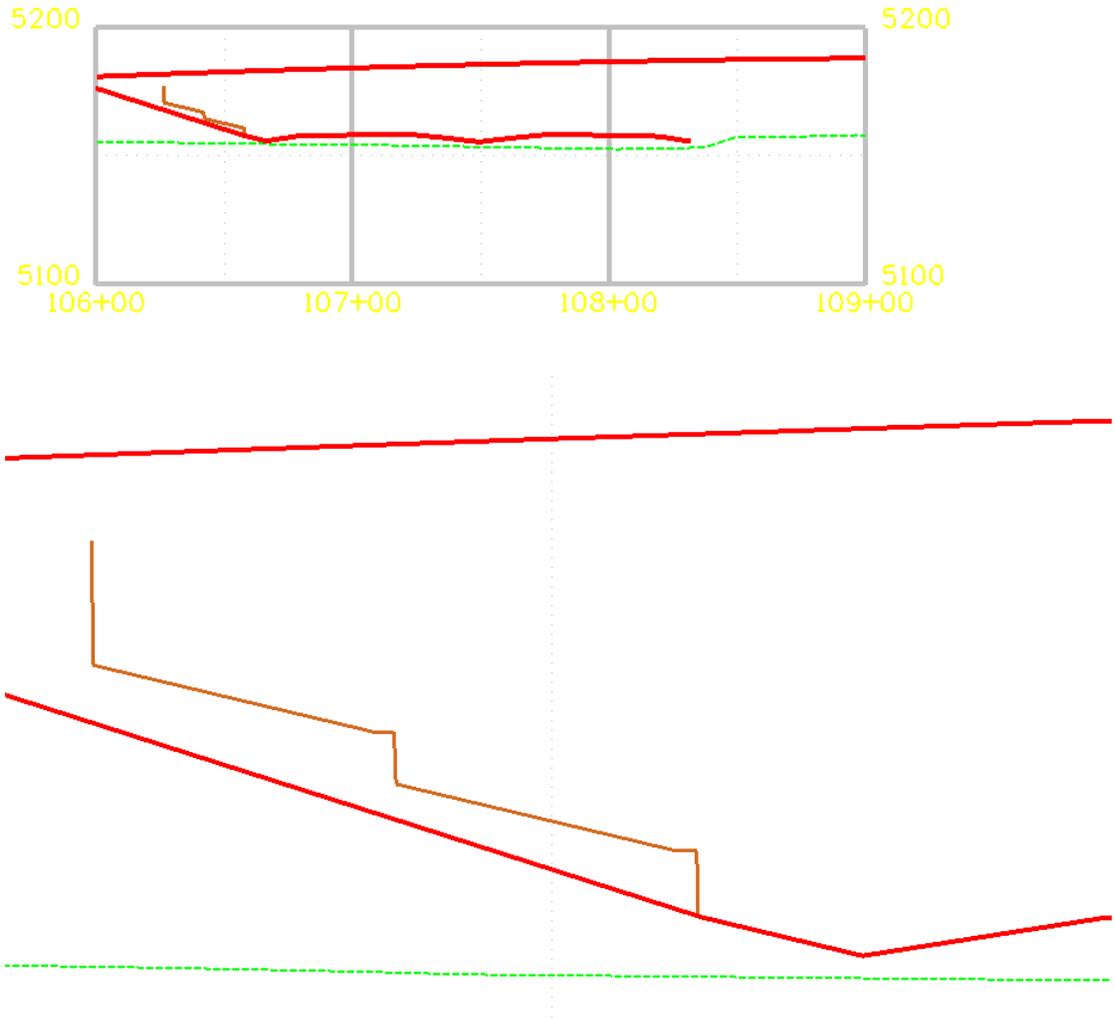


34. Select the **Controls** branch.
35. Set the **Station Limits** to **106+00** to **109+00**.



36. <D> **Apply**.
37. <D> a clear area in the design file for the location of the profile.

38. Window in to see the wall surface.



**Note:** Since templates can also contain non-triangulating and closed shape components, walls, footers, leveling pads, etc. can be created as part of the template if desired.

**Note:** The features developed here can be combined with features from the other models to create an overall interchange model.

**Chapter Summary:**

- Templates can be used to create features for surfaces other than roadways.
- Templates can be used without *Roadway Designer* by ‘running’ them on a 3D elements or features.
- Using targets other than surfaces can greatly expand the capability of templates, allowing them to create features for a variety of design applications.