LAB 20 - Constructing A Driveway

Driveway modeling should not be done to the level of detail that mainline corridor modeling is done. However, there may be times when a drive should be modeled accurately. This lab describes a workflow for modeling driveways quickly and easily.

Chapter Objectives: This lab models a driveway from the proposed edge of pavement of the design corridor to the existing ground at the right of way line. The following InRoads tools are used to complete the model:

- Tracking to determine the location of the ramp.
- Generate Longitudinal Feature to construct the centerline and edge features of the ramp.
- Drape Surface to create the end of the drive.
- Import Surface to create features from MicroStation graphics.
- Fillet Feature to construct the drive returns.
- Join Features to create a continuous feature from the driveway edges and returns.
- Apply Template create sideslopes for the driveway.

The following files are used for this lab:

- C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\SH86.dtm
- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\DES12345_Templates.itl

The driveway is 12’ wide extending from the proposed edge of pavement to the right of way, 60’ to the right of the SH 86 centerline. The driveway returns have a 15’ radius. There is a 12:1 slope for 20’ from the edge of pavement.

Lab 20.1 - Locating The Driveway

The new driveway is located on top of the existing driveway between stations 254+00 and 255+00 or the right side of the mainline.

Section Objectives:

- Use Tracking to determine the centerline station of the driveway.
- Use MicroStation key-ins to construct a line for the driveway centerline and end line.

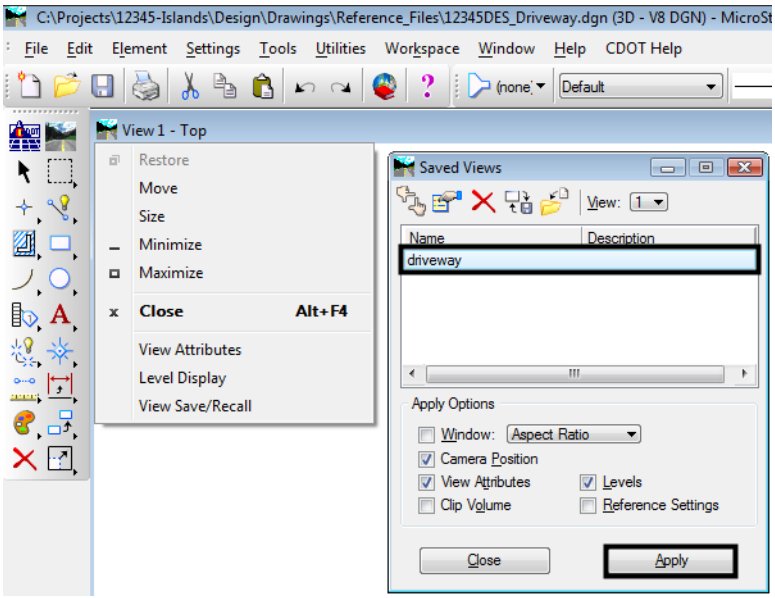
1. Open InRoads using the ***12345DES_Driveway.dgn*** file.

   Note: If the existing drive is not visible, display the driveway saved view. To display a saved view:

   a. **<D>** the icon in the left corner of the view title bar and select **View Save/Recall**.

   b. In the ***Saved Views*** dialog box, highlight **driveway**.

c. **<D> Apply** and then **<D> Close** to dismiss the ***Saved Views*** dialog box.

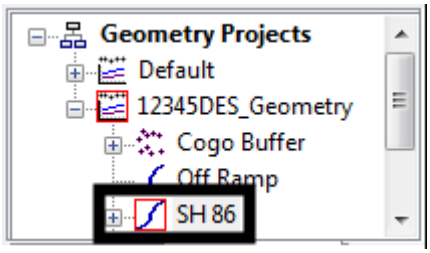


2. Open the following InRoads data files:

   - C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground.dtm
   - C:\Projects\12345\Design\InRoads\SH86.dtm
   - C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
   - C:\Projects\12345\Design\InRoads\DES12345_Templates.itl

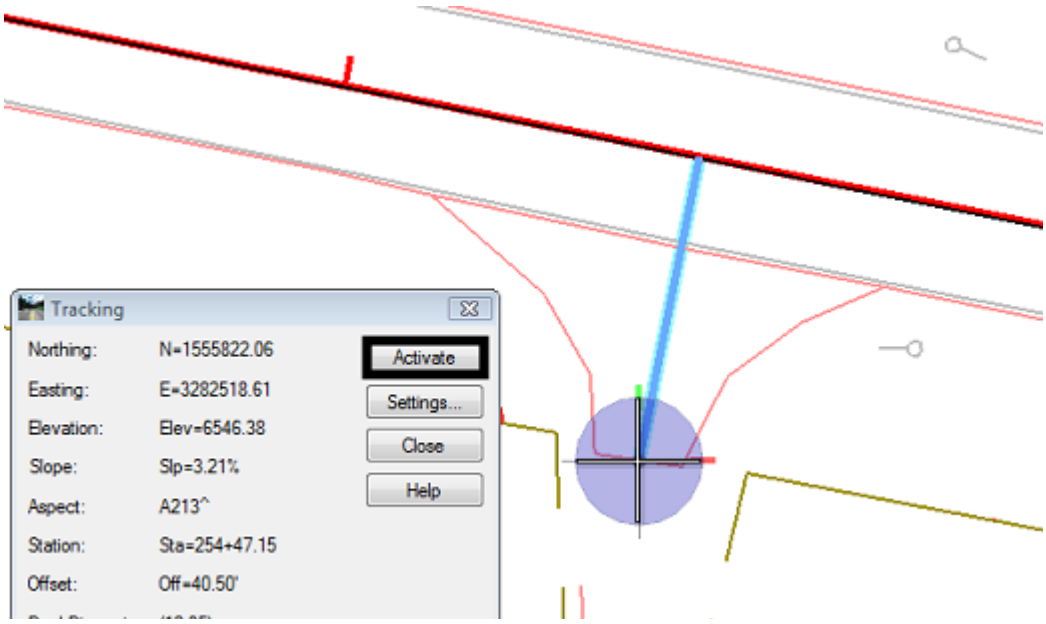
3. Verify that the **C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Preferences\CDOT_Civil.xin** file is loaded.

4. Verify that the **SH 86** alignment is active.

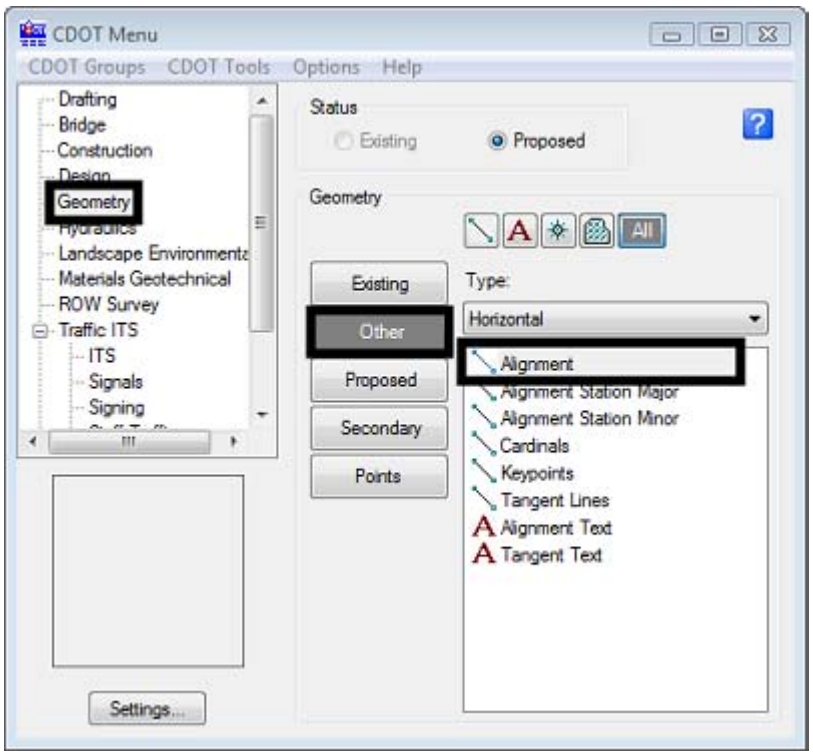


5. Select **Tools > Tracking > Tracking** from the InRoads menu bar.

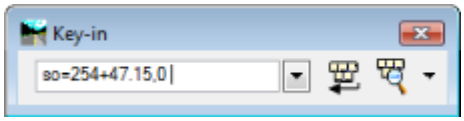
6. **Activate** the tracking and **<T>** to the center of the back of the driveway.



7. Write down the **Station** listed in the ***Tracking*** dialog box.
8. **<D> Close** to dismiss the ***Tracking*** dialog box.
9. From the ***CDOT Menu***, highlight the **Geometry** group.
10. **<D>** the **Other** button and select **Alignment** from the item list.



11. In the MicroStation key-in window, type ***so=254+47.15,0*** and ***Enter***.



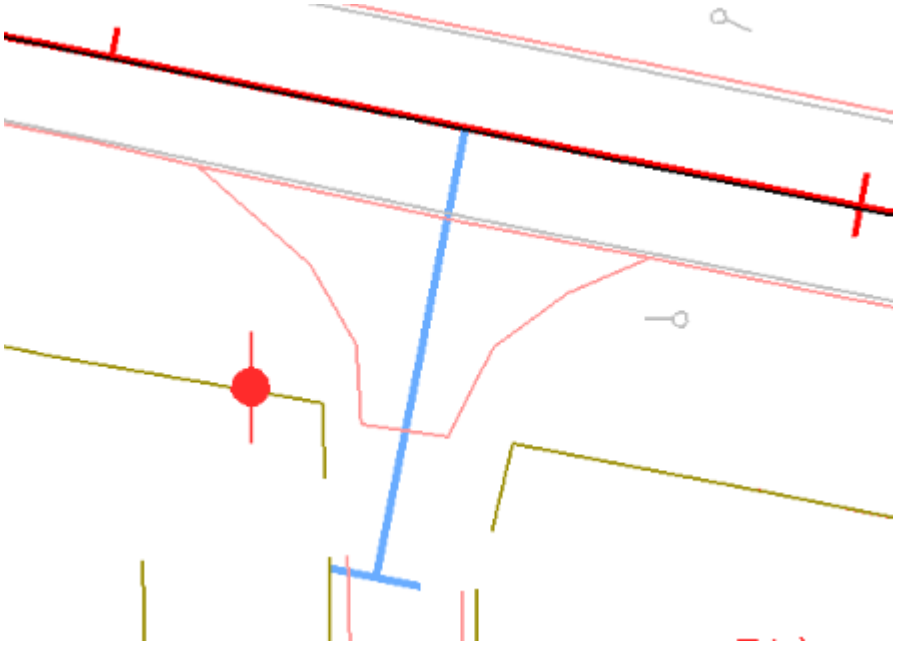
Note: Use the station that you wrote down in step 6.

12. Key in ***so=254+47.15,60*** and ***Enter***. **<R>** to end the line.

This places a line at the centerline of the driveway. This line is used as a reference line when constructing the driveway surface features.

13. Key in ***so=254+41.15,60*** and ***Enter***.

14. Key in ***so=254+53.15,60*** and ***Enter***. **<R>** to end the line.



Note: Use stations 6' before and 6' after the one you wrote down in step 6.

This places a 12' long line at the end of the driveway representing the width of the drive. This line is also used as a reference line when constructing the driveway surface features.

Section Summary:

The location of the driveway was identified and elements needed to create the driveway centerline and end line were placed.

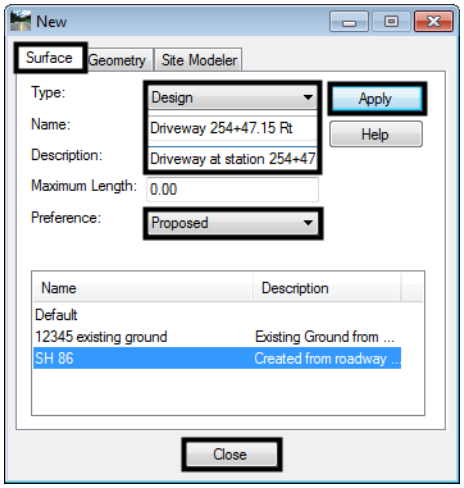
Lab 20.2 - Setting Elevations

In this section, the driveway end line is draped to the existing surface to acquire the elevations for that feature. The line for the driveway centerline is moved to the proper elevation, then is modified to give it the proper slopes.

Section Objectives:

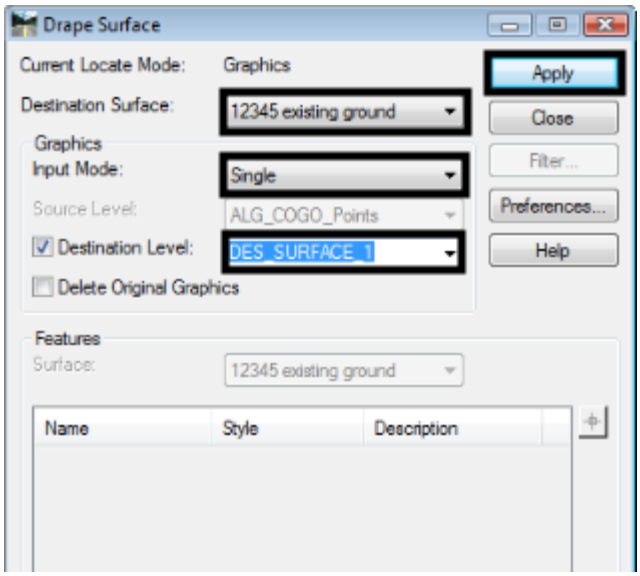
- Create a surface for the driveway.
- Use the Drape Surface command to create the driveway end line feature.
- Display the design surface (SH 86) triangulated features.
- Move the driveway centerline to its proper location (horizontally and vertically.
- Create a centerline feature with the proper slopes using Generate Longitudinal Feature and Edit Feature Point.

1. Select **File > New** from the InRoads menu bar.
2. On the ***Surface*** tab, set the ***Type*** to **Design**.
3. In the ***Name*** field, key in ***Driveway 254+47.15 Rt***.
4. In the ***Description*** field, key in ***Driveway at station 254+47.15 on the right***.
5. Set the ***Preference*** to **Proposed** and **<D> Apply** then **Close**.



6. From the InRoads menu bar, select **Surface > Design Surface > Drape Surface**.
7. Set the ***Destination Surface*** to **12345 existing ground**.
8. Set the ***Input Mode*** to **Single.**
9. Set the ***Destination Level*** to **DES_SURFACE _1**.
10. Toggle on **Delete Original Graphics**.

11. **<D> Apply** then follow the prompts in the MicroStation message window (lower left corner of the screen).



12. **Close** the Drape Surface dialog box.

This creates a MicroStation graphic element that matches the elevations of the existing ground. Next that element is imported into the Driveway 254+47.15 Rt surface.

13. Select **File > Import > Surface** from the InRoads menu bar.

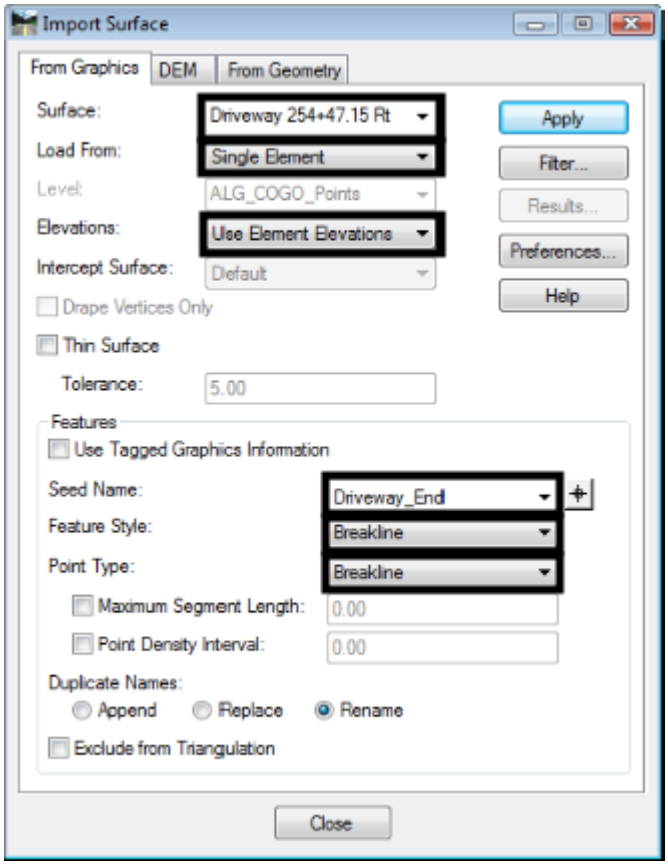
14. In the ***Import Surface*** dialog box, set the ***Surface*** to **Driveway 254+47.15 Rt**.

15. Set ***Load From*** to **Single Element**.

16. Set ***Elevations*** to **Use Element Elevations**.

17. In the ***Seed Name*** field, key in ***Driveway_End***.

18. Set the ***Feature Style*** and ***Point Type*** to **Breakline**.



19. <D> Apply.

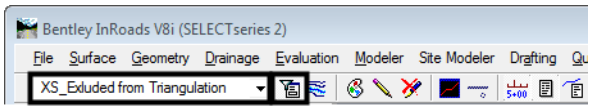
20. **<D>** the element created by the Drape Surface command. **<D>** in a blank area to accept the element.

21. **Close** the ***Import Surface*** dialog box.

The driveway end line is now stored as a surface feature. To place the driveway center line at the correct location, the features of the SH86 surface must be displayed. Use the feature filter to display only the triangulated features of the SH86 surface, then move the driveway centerline to the proper location.

22. On the InRoads Locks toolbar, set the feature filter to **XS_Excluded from Triangulation**.

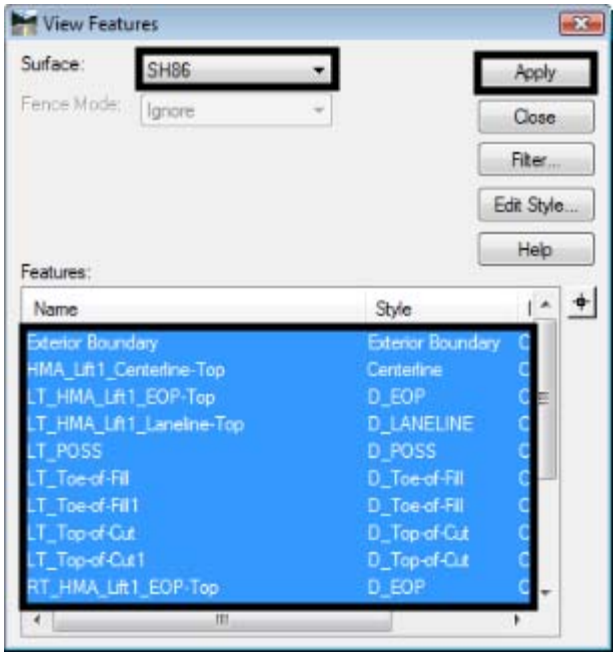
23. Toggle on the **Feature Filter Lock**.



24. Select **Surface > View Surface > Features** from the InRoads menu bar.

25. Select **SH86** for the ***Surface***.

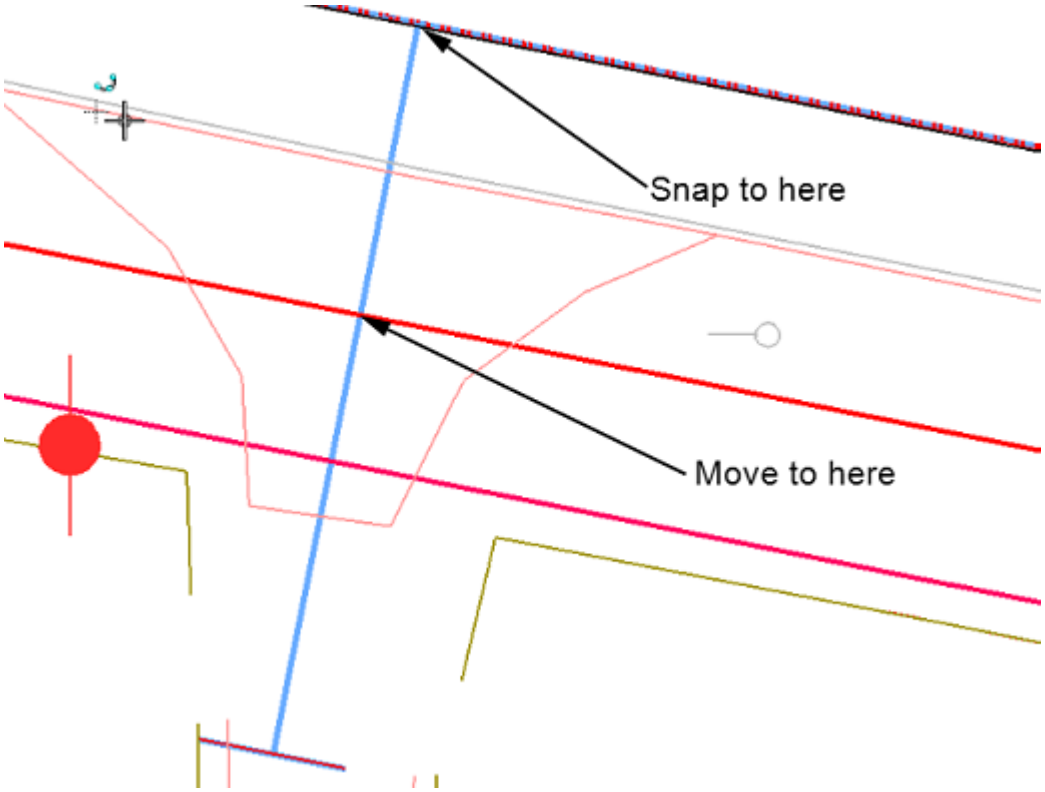
26. Highlight all of the features in the ***Features*** list.
27. **<D> Apply** then **Close** the ***View Features*** dialog box.



The red line running through the existing driveway is the proposed edge of pavement. The driveway centerline needs to be moved to start at this edge line.

28. Use the MicroStation **Move** command and pick up the driveway centerline, snapping to the end on the mainline centerline.

29. Snap to the intersection of the driveway centerline and the edge of pavement feature to place the line in its new location. **<D>** to complete the move then **<R>** to exit the command.



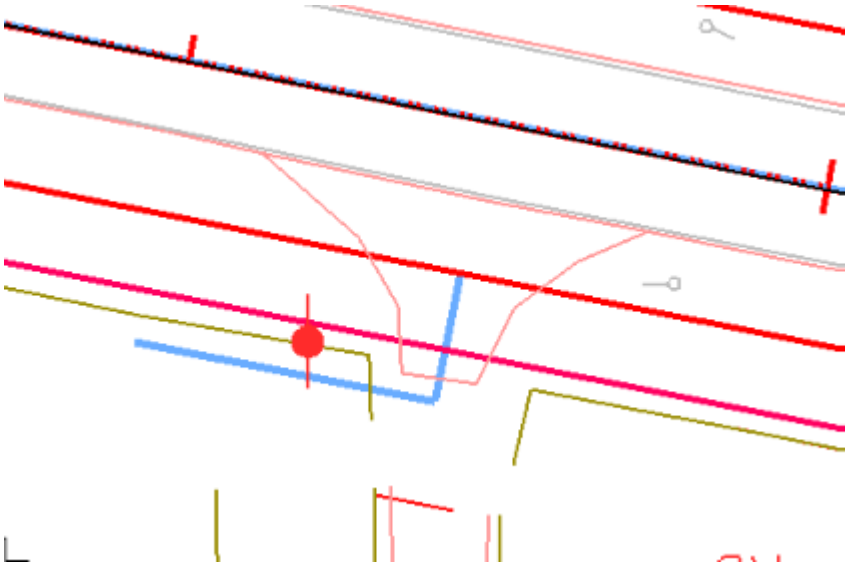
Next, the point of the "breakover" from the 12 to 1 slope must be located. This point is 20' from the proposed edge of pavement, or 44' from the mainline centerline.

30. Select the MicroStation Place Smartline command.

31. In the MicroStation Key-in window, type ***so=254+00,44*** and press Enter. The starting station of this line is not important as it will be deleted once the driveway centerline is modified.

32. Key in ***so=254+47.15,44*** and press **Enter**. **<R>** to end the line.

33. Select **Extend Element to Intersection** from the MicroStation main toolbar and shorten the driveway centerline back to the line just placed. The illustration below shows the result.



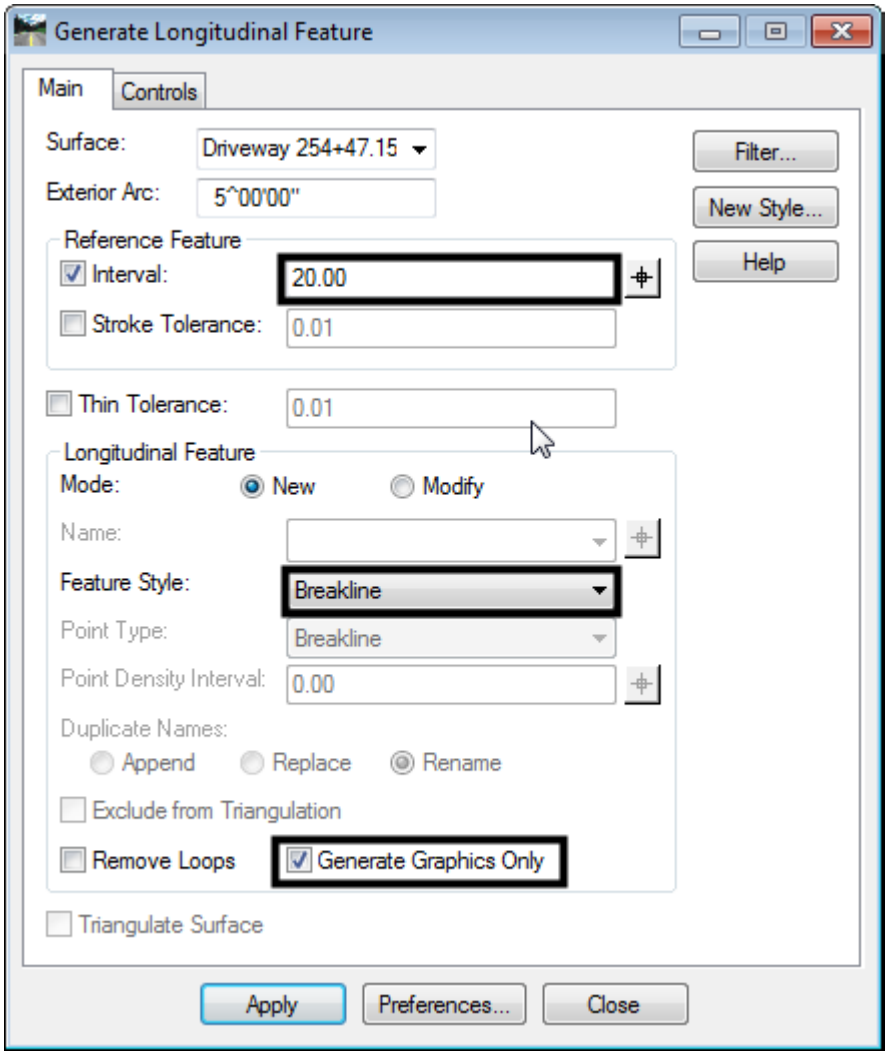
Now the 12 to 1 slope is added to the line. The Generate Longitudinal Feature command is used to create the sloped element. The Generate Graphic Only option is used because additional editing is required.

34. From the InRoads menu bar, select **Surface > Design Surface > Generate Longitudinal Feature**.

35. On the ***Main*** tab of the ***Generate Longitudinal Feature*** dialog box, key in ***20*** for the ***Interval***.

36. set the ***Feature Style*** to **Breakline**.

37. Toggle on **Generate Graphic Only**.



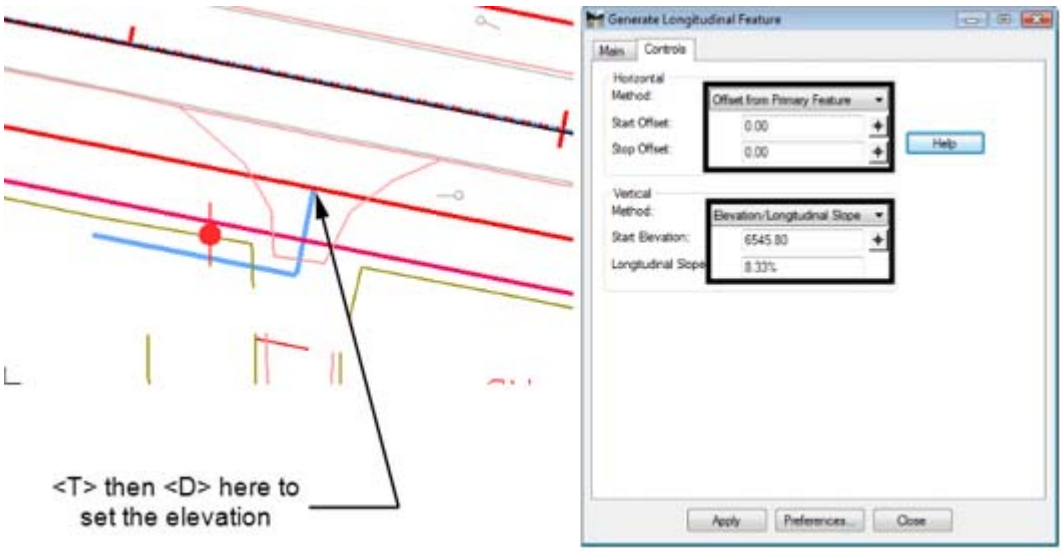
38. Select the **Controls** tab.

39. For the ***Horizontal*** control, use **Offset from Primary Feature** with ***Start*** and ***Stop*** values of ***0.00***.

40. Set the ***Vertical*** control ***Method*** to **Elevation/Longitudinal Slope**.

41. Set the ***Start Elevation*** by selecting the "Target" button then **<T>** to the beginning of the driveway centerline, **<D>** to accept. The elevation should be around 6545.80.

42. Key in ***1/12*** for the ***Longitudinal Slope***. The result is 8.33%.



43. **<D> Apply**, then follow the prompts in the lower left corner of the MicroStation window.

44. Select the driveway centerline as the primary and reference element.

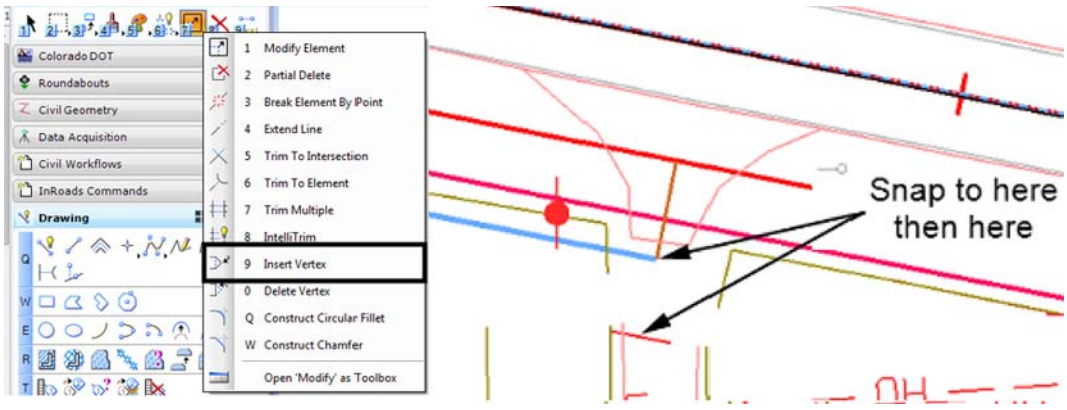
45. **<R>** to use the entire line, then **<D>** to finish the command.

Be careful in the next steps, because the original line is under the line just created. This new line is modified by adding a vertex, extending it to the driveway end line.

46. Select **Insert Vertex** form the MicroStation main toolbar.

47. **<T>** to the end of the new driveway centerline, then **<D>** to accept.

48. **<T>** to the center of the driveway end line and **<D>** to accept. **<R>** to exit the command.



49. Delete the original driveway centerline and the reference line, they are not used to create the driveway surface.

The elevation of the driveway centerline at the edge of pavement was set when the line was moved. The elevation at the end of the initial slope was set using the Generate Longitudinal Feature command. Finally. the elevation at the end of the drive was set by snapping the new vertex to the driveway end line created earlier. The driveway centerline now represents the profile of the driveway.

Section Summary:

In this section, the features of the mainline road were displayed as an aid in designing the driveway. The driveway end line was draped to the existing ground and stored in the driveway surface. A 3D centerline was created with the desired slopes.

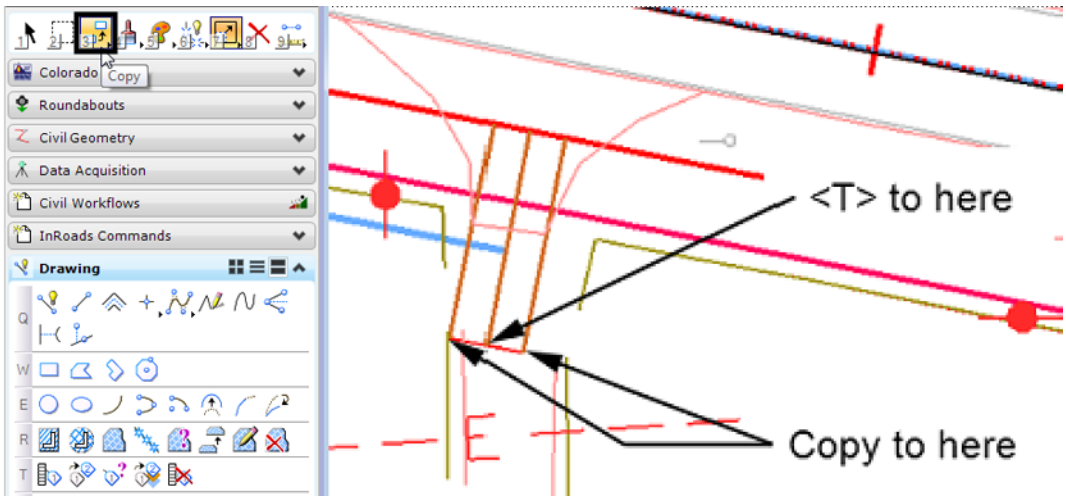
Lab 20.3 - Create Driveway Edges

The Driveway centerline is used to define the driveway edge features, then the Fillet Feature command is used to create the drive returns. The driveway edge lines are then joined to the driveway return to create a single feature.

Section Objectives:

- Copy the Driveway centerline to form the edge lines.
- Use Import Surface to create surface features from the edge line graphic elements.
- Use Fillet Feature to create the driveway returns.
- Use Partial Delete on the edge line features to clear the driveway ramp.
- Use Join Feature to create a single feature from the driveway edge line an the return.

1. Select the Copy command from the MicroStation Main toolbar.
2. **<T>** to the driveway centerline near the driveway end line and **<D>** to accept.
3. **<T>** and accept to each end of the driveway end line. The illustration below shows the results.



4. From the InRoads menu bar, Select **File > Import > Surface**.

5. Set up the ***Import Surface*** dialog box as in the *Setting Elevations* section above, using ***Driveway Edge*** as the ***Seed Name***.

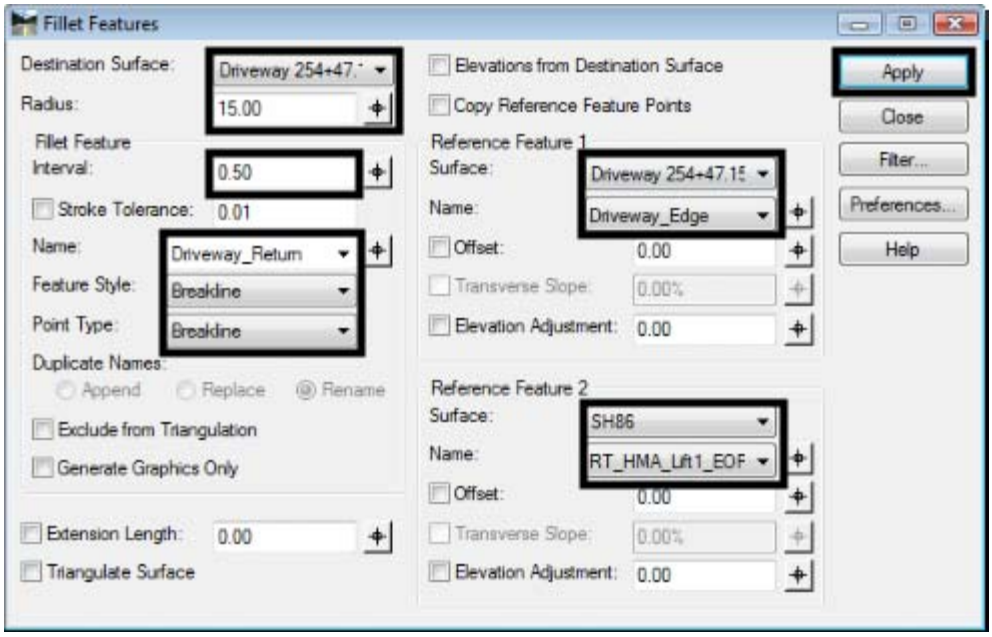
6. **<D> Apply** then **<D>** on one of the edge lines. Repeat the process with the other edge line.

7. **Close** the ***Import Surface*** dialog box.

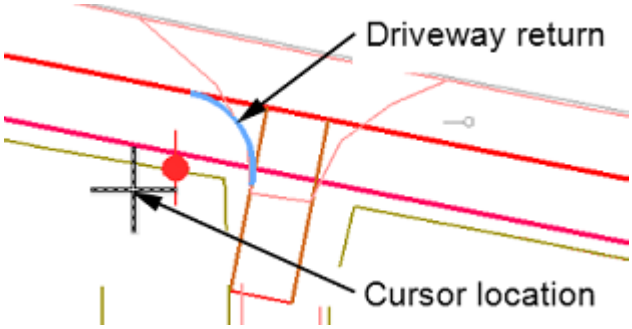
With the driveway edge features added to the surface, the driveway returns can be added.

8. Select **Surface > Design Surface > Fillet Feature** from the InRoads menu bar.

9. Make the settings as shown in the illustration below.

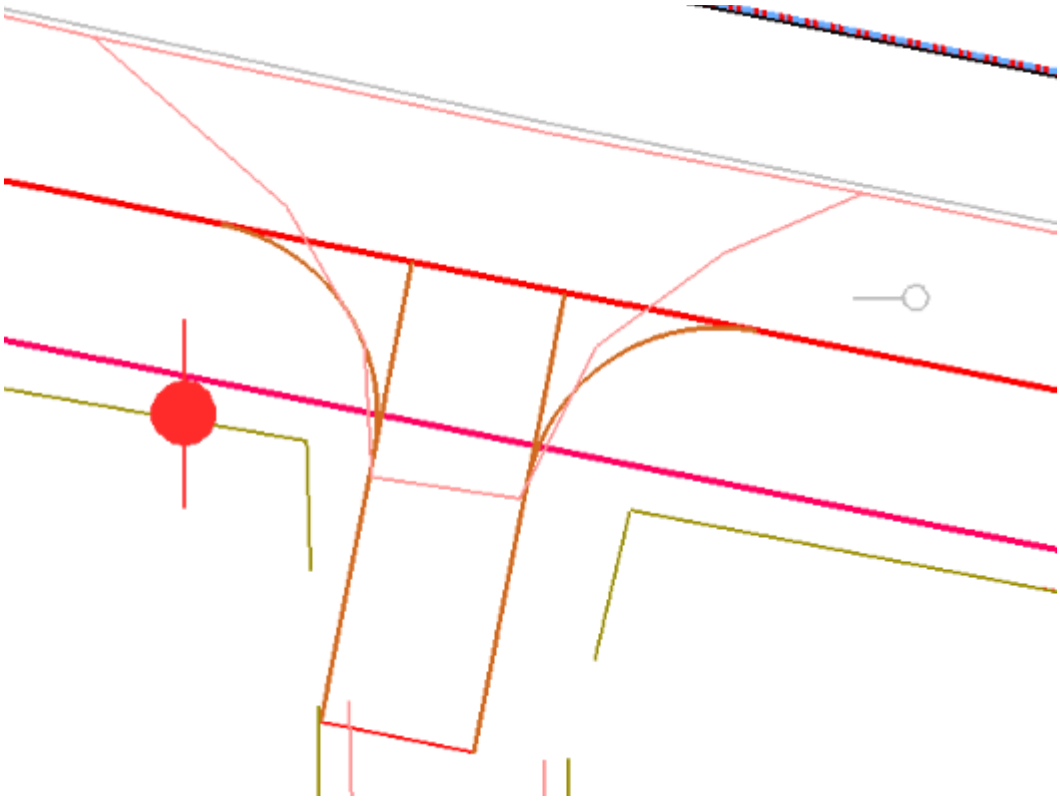


10. **<D> Apply**, then move the cursor into the quadrant for the return and **<D>**. The return is added to the driveway surface.



11. Set the Reference Feature 1 Name to the other driveway edge feature.

12. Repeat step 10 to create the other driveway return feature. The illustration below shows the results.



13. **Close** the ***Fillet Feature*** dialog box.

14. Save the driveway surface.

Next, the driveway edges from the end of the fillet to the edge of the mainline are trimmed to create a smooth cross slope.

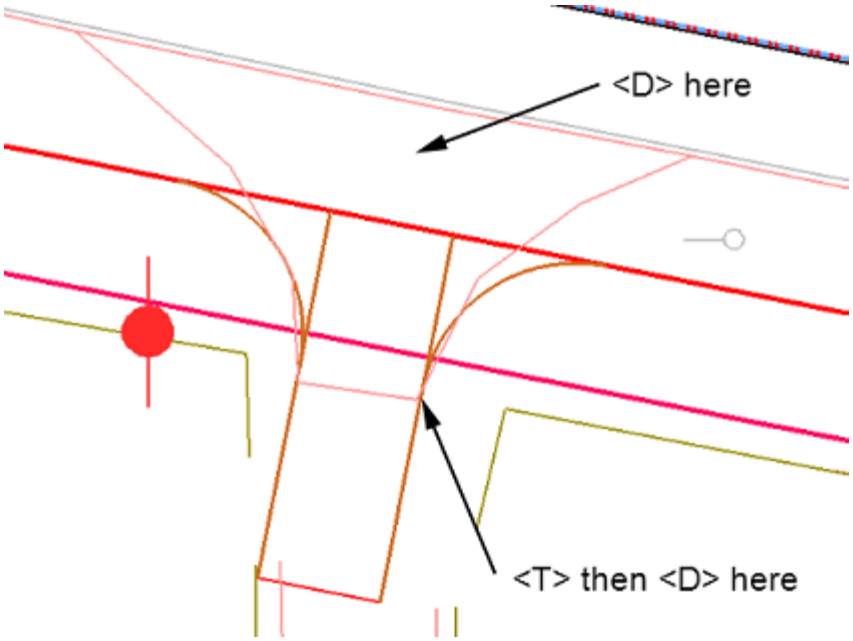
15. Verify that the ***Driveway 254+47.15 Rt*** surface is active.

16. Select **Surface > Edit Surface > Partial Delete** from the InRoads menu bar.

17. **<D>** on a Driveway Edge line and **<D>** to accept it.

18. move the cursor above the mainline edge of pavement line and **<D>**. This sets the partial delete to the end of the driveway edge line.

19. **<T>** to the end of the fillet on the drive way edge line then **<D>** to complete the partial delete.

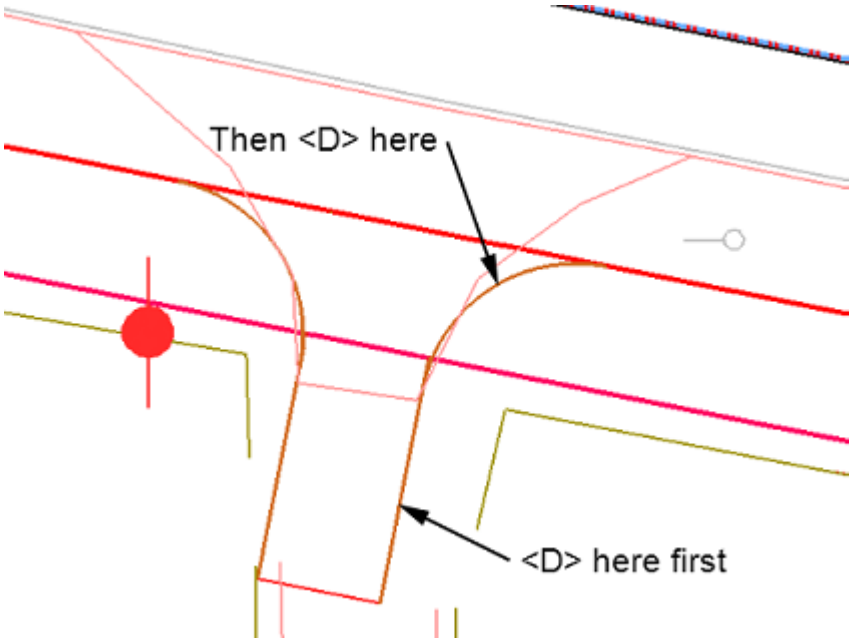


20. Repeat steps 17 through 19 for the other edge line.
21. **Save** the driveway surface.

The final step in creating the driveway edge lines is to join the line and return features to form a single feature. This will make it easier to construct the side slopes for the drive way.

22. Verify that the ***Driveway 254+47.15 Rt*** surface is active.
23. Select **Surface > Edit Surface > Join Features**.
24. **<D>** on a driveway edge line and **<D>** to accept.

25. **<D>** on the corresponding driveway return and **<D>** to accept. **<R>** to exit the ***Join Features*** command. The two features are now combined into a single feature. The name for the combined feature is that of the first feature selected.



26. Repeat steps 23 through 25 for the other driveway edge.

27. **Save** the driveway surface.

This completes the backbone of the driveway.

Section Summary:

The 3D centerline was copied to the ends of the driveway end line, forming the basis of the driveway edge lines. These were imported into the driveway surface. Fillet feature was used to form the driveway returns. Then the edge lines were trimmed back to the ends of the returns. Finally, the edges and returns were joined to make a single feature out of each.

Lab 20.4 - Sideslopes and the Exterior Boundary

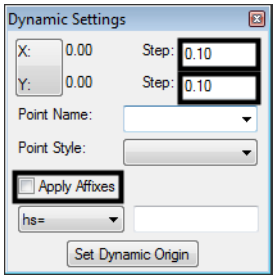
With the backbone of the driveway complete, the sideslopes and exterior boundary can be added to finish the driveway model.

Section Objectives:

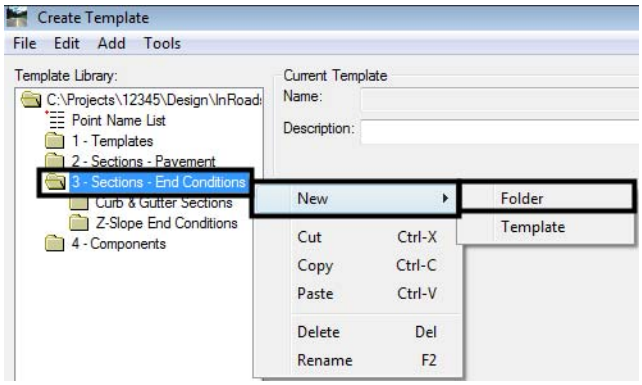
- Modify an end condition section to search for a specific surface.
- Use Apply Template to create driveway sideslopes.
- Create an exterior boundary from graphic elements.

The sideslopes for the driveway must tie to two different surfaces, the proposed (SH86) surface and the existing (12345 existing ground) surface. This is accomplished by modifying the end condition section to seek a specific surface then applying the section to the area where that surface is sought.

1. Turn off the reference file display. This will make it easier to see the data that is used.
2. Select **Modeler > Create Template** from the InRoads menu bar.
3. Display the ***Dynamic Settings*** dialog box.
4. Set the Steps to ***0.10*** and toggle off **Apply Affixes**.



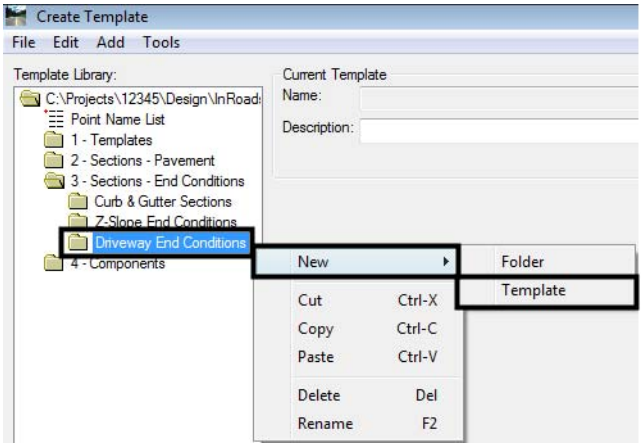
5. Navigate to the **3 - Sections - End Conditions** folder in the template library explorer.
6. **<R>** on the ***3 - Sections - End Conditions*** folder and select **New > Folder**.



7. Key in ***Driveway End Conditions*** for the name.

The next step is to build a new end condition section for the driveway. It uses components that are already in the template library.

8. **<R>** on the ***Driveway End Conditions*** folder and select **New > Template**.



9. Key in ***4_to_1-Existing*** for the name.

Now that the template placeholder is built, data can be added to it. The data for this new section comes from the end condition components folders.

10. Navigate to the **4 - Components > End Conditions > Fill Slope Components** folder.

11. **<D>** on the **Fill_4_to_1** component to display it in the ***Preview*** window.

12. Drag the component from the ***Preview*** window into the ***4_to_1-Existing*** section by its origin and place it on the origin of the new section.

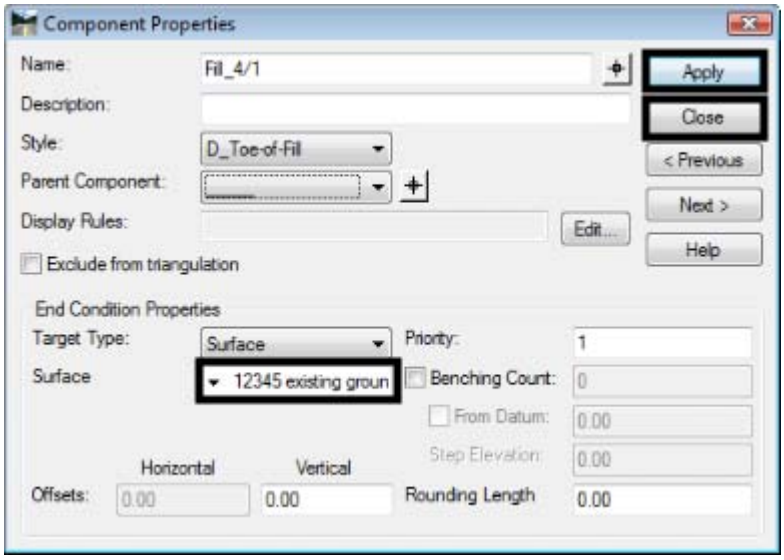
13. Expand the ***Cut Slope Components*** folder and **<D>** on the **Cut_4_to_1** component.

14. Drag and drop this component into the new section on the origin.

15. Edit the fill component.

16. In the ***Component Properties*** dialog box, ***End Condition Properties*** area, set the ***Surface*** to **12345 Existing Ground**.

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

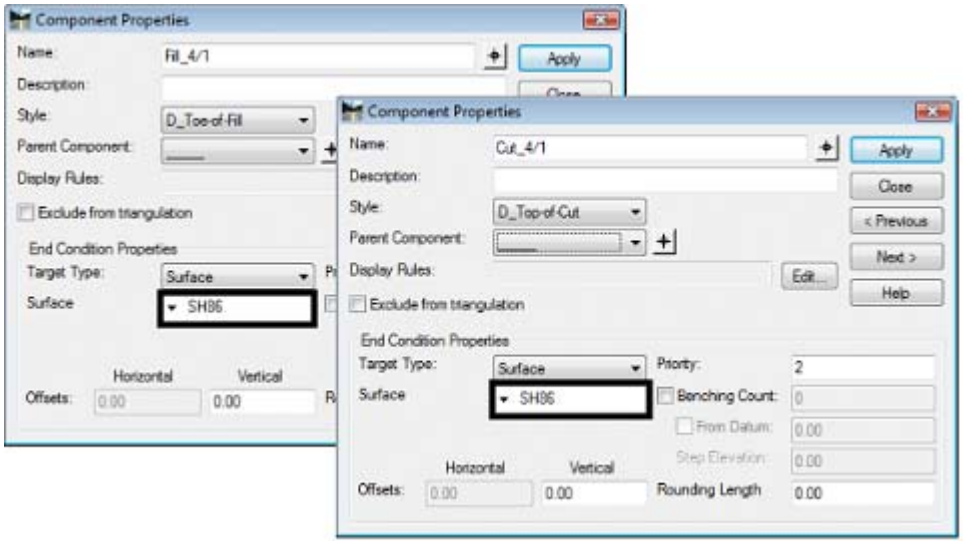


18. Repeat steps 15 and 16 for the cut component.
19. Key in ***2*** for the ***Priority*** of the cut component.
20. **<D> Apply**, then **Close**.
21. Save the template library.

This completes the end condition used to tie to the existing surface. Next, copy this template and modify it to seek the design surface.

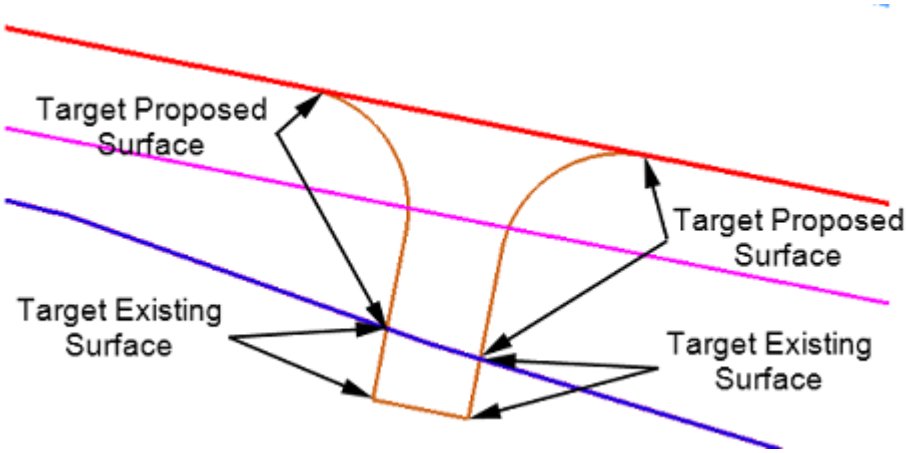
22. **<R>** on the **4_to_1-Existing** section and select **Copy**.
23. **<R>** on the ***Driveway End Conditions*** folder and select **Paste**.
24. Rename the section to ***4_to_1-Proposed***.
25. **<D> <D>** on the ***4_to_1-Proposed*** section to make it active.

26. Edit the component properties as described above, changing the target surface to **SH86**.



27. Save the template library.

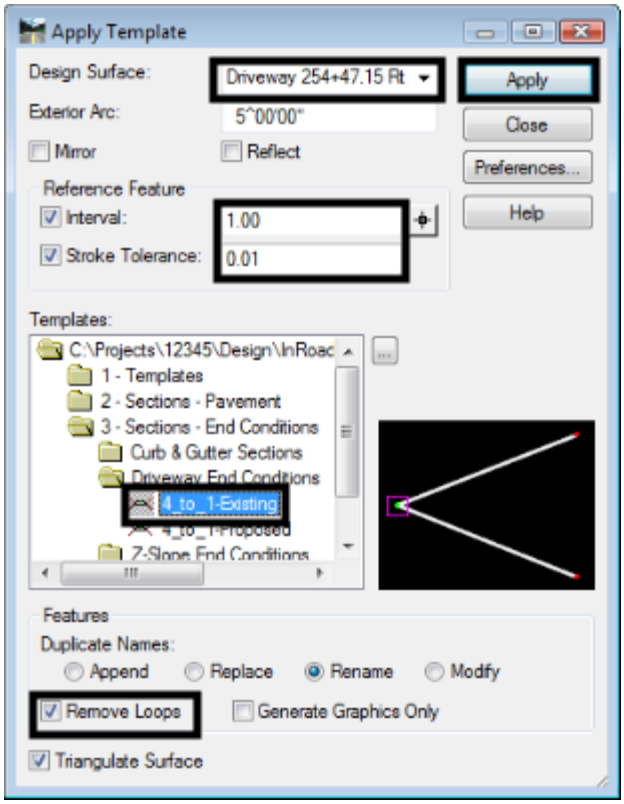
These sections (templates) are used to create the sideslopes on both sides of the driveway. They are applied to specific parts of the driveway to target the desired surface in that area.



28. Select **Surface > Design Surface > Apply Template** from the InRoads menu bar.
29. In the ***Apply Template*** dialog box, set the ***Design Surface*** to **Driveway 254+47.15 Rt.**
30. Toggle on **Interval** and key in ***1.00*** for the value.
31. Toggle on **Stroke Tolerance** and key in ***0.01*** for the value.
32. Navigate to ***3 - Sections - End Conditions > Driveway End Conditions*** in the template library.
33. **<D>** on the **4_to_1-Existing** section.
34. Verify that **Generate Graphics Only** is toggled off.

35. Toggle on **Remove Loops** and **Triangulate Surface**.

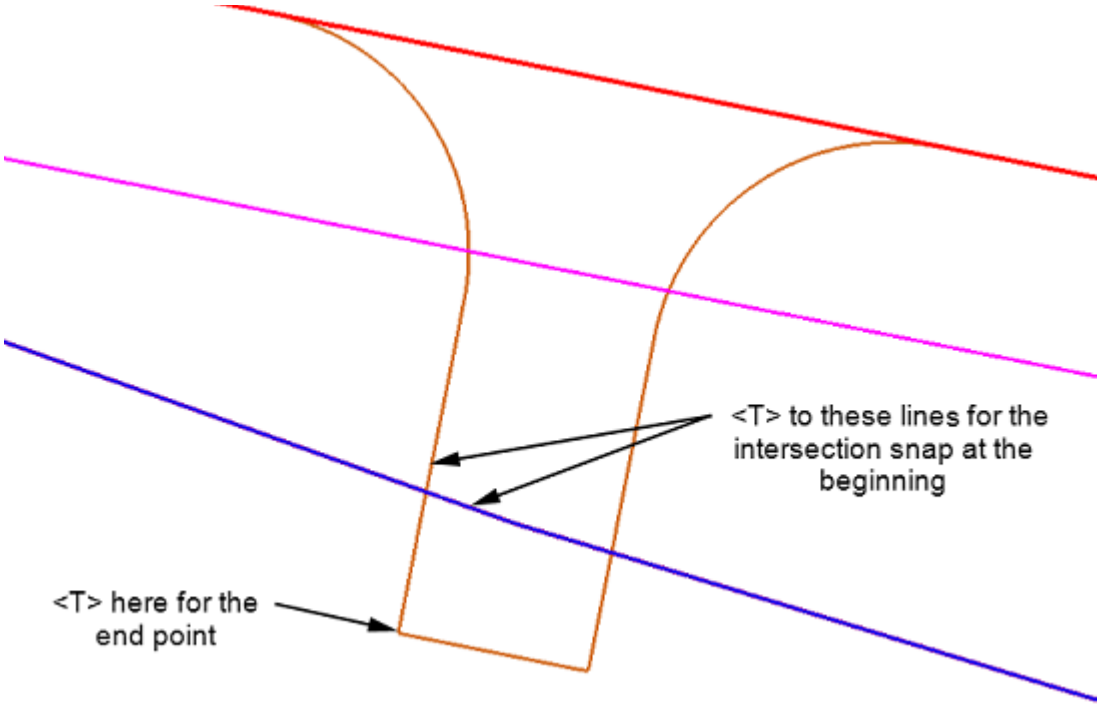
36. **<D> Apply**.



37. Follow the prompts displayed in the lower left corner of the MicroStation window.

38. Select the left driveway edge as the Primary and Reference elements.

39. At the prompt, “Identify Beginning/Reset for Entire”, Set the MicroStation snap mode to Intersection.

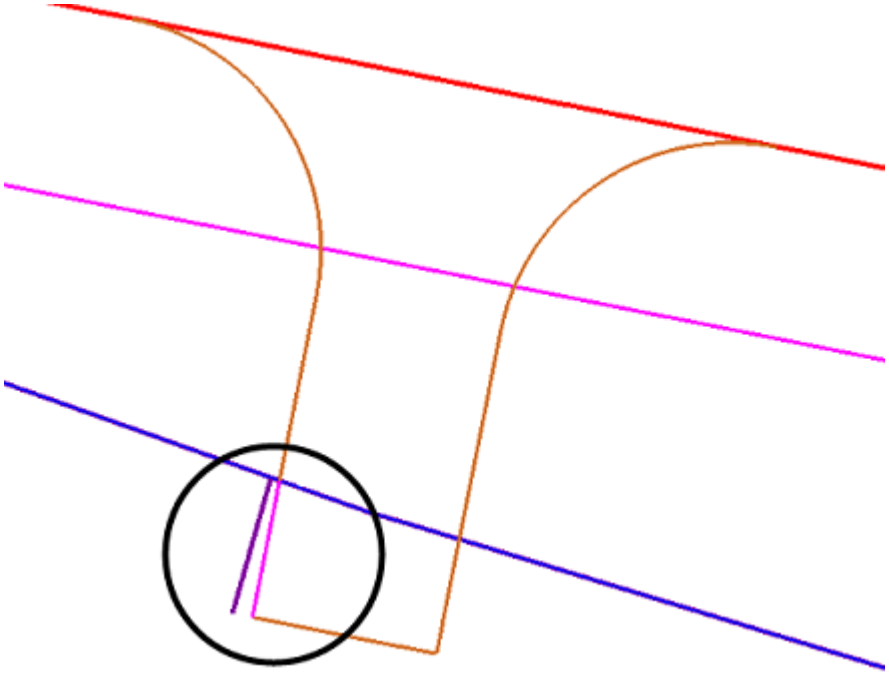


40. **<T>** on the mainline top of cut feature then **<T>** on the driveway edge feature then **<D>** to accept the location.

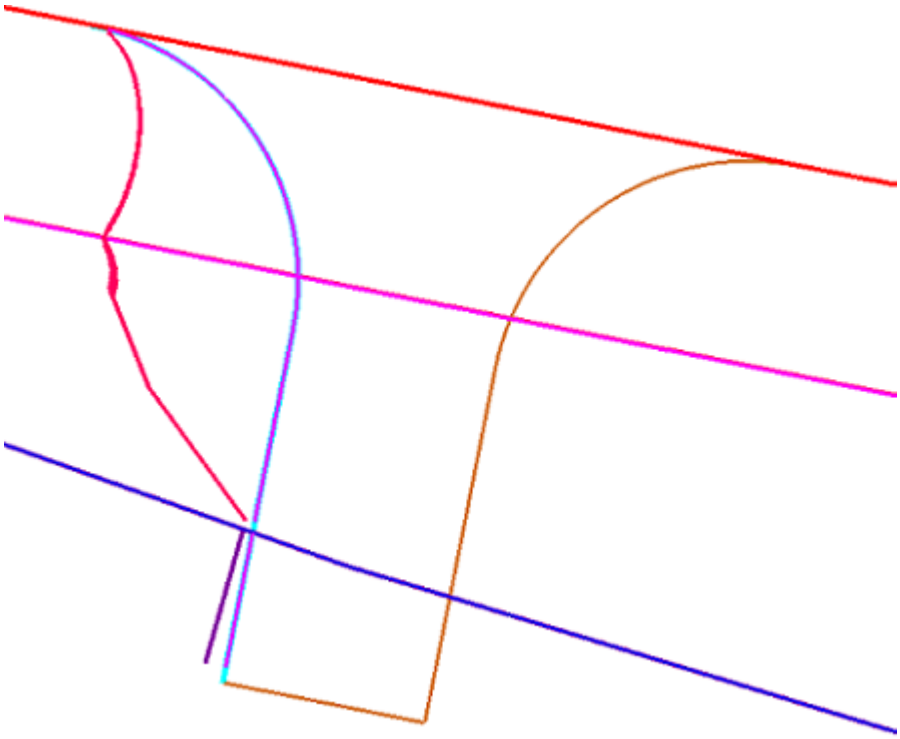
41. Use the keypoint snap to select the end point then **<D>** to accept the location.

Important! After selecting the location to apply the section, the ***Apply Template*** dialog box reappears. However, there is still one more prompt to answer. Do not forget the final **<D>** to accept the solution.

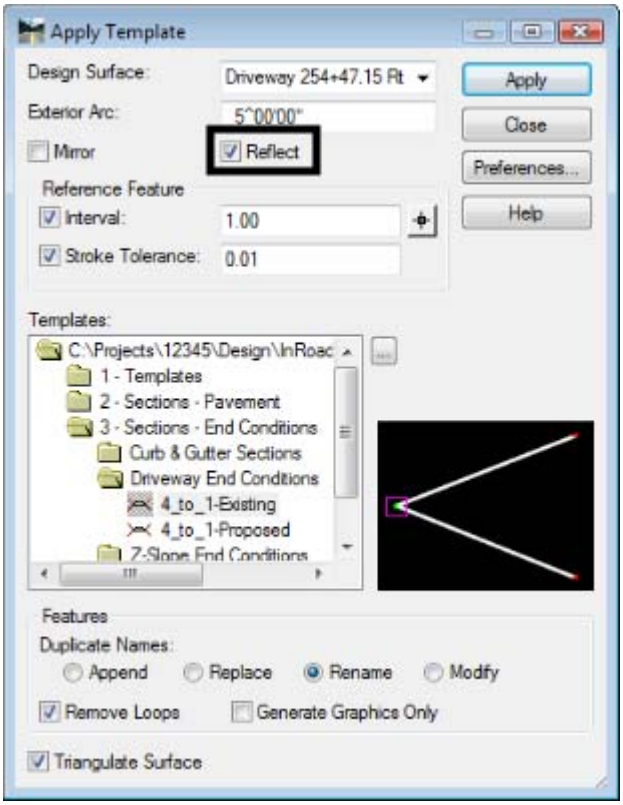
The result of the Apply Template is shown below (shown inside the circle).



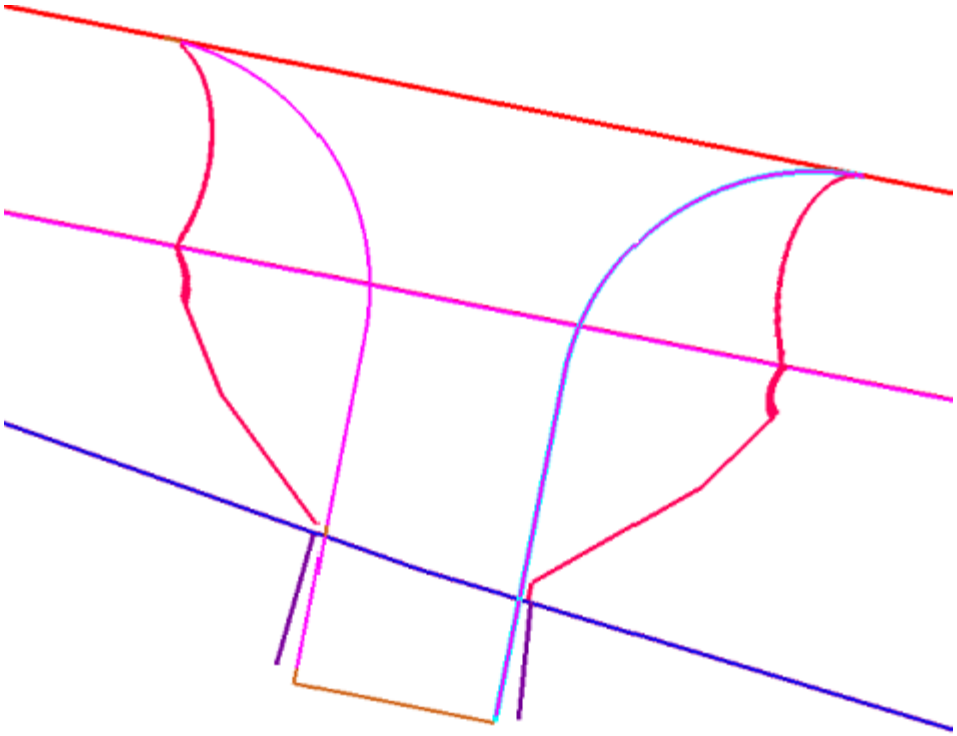
42. Repeat the Apply Template process, using the ***4_to_1-Proposed*** section, to model the sideslope to the (proposed) SH86 surface. The illustration below shows the results after applying both sections to the left side.



43. In the ***Apply Template*** dialog box, toggle on **Reflect**.



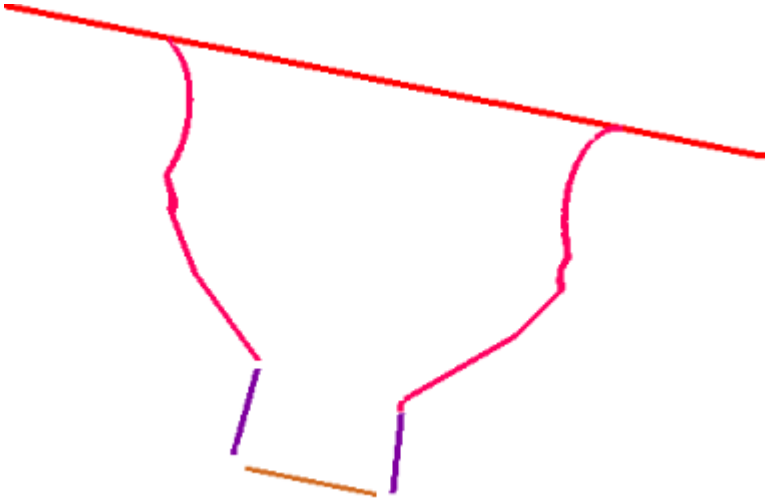
44. Apply both sections to the right side of the driveway as described above. The results of all of the Apply Template commands are shown below.



The final step for the drive is to create an exterior boundary. The boundary is defined using the graphics of the cut and fill features along with the driveway end feature and the proposed edge of pavement from Sh86.

45. Select the MicroStation **Delete** command from the Main toolbar.

46. Delete the graphic elements that will not be used for the exterior boundary. The illustration below shows the elements needed.

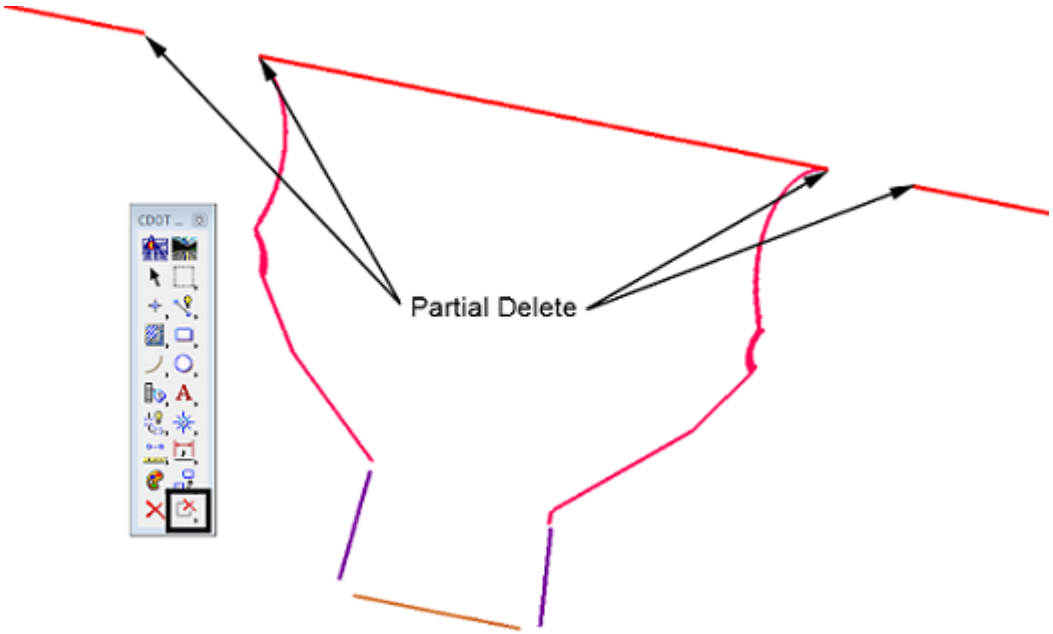


To create the boundary, the edge of pavement line needs to be trimmed and the gaps between elements need to be filled.

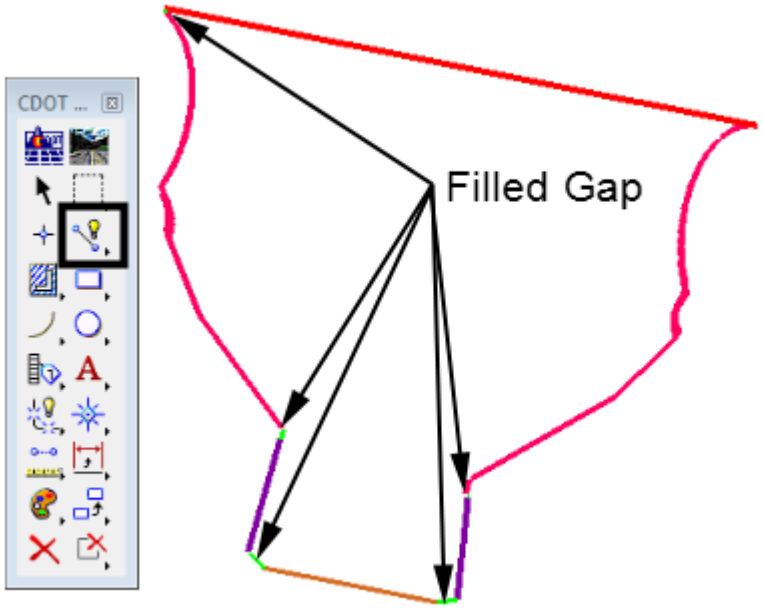
47. In MicroStation, toggle of the **Graphic Group** lock.

48. Select the **Partial Delete** command from the MicroStation Main toolbar.

49. Partial delete the edge of pavement lines from where the driveway toes intersect away from the driveway.

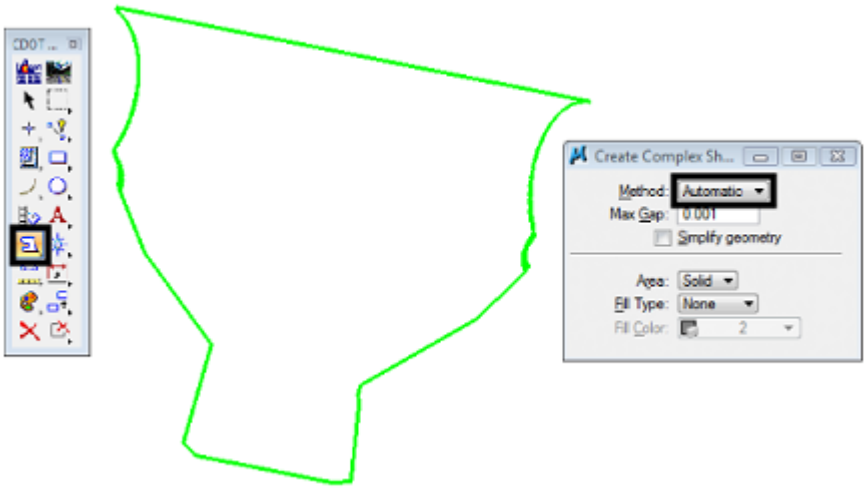


50. Select the MicroStation **Place Smartline** command. Use this command to fill in the gaps between elements. Be sure to **<T>** to the ends of the lines. This will ensure that the elements are connected properly. Not snapping to the lines could result in erroneous elevation data. The gaps filled are illustrated below.



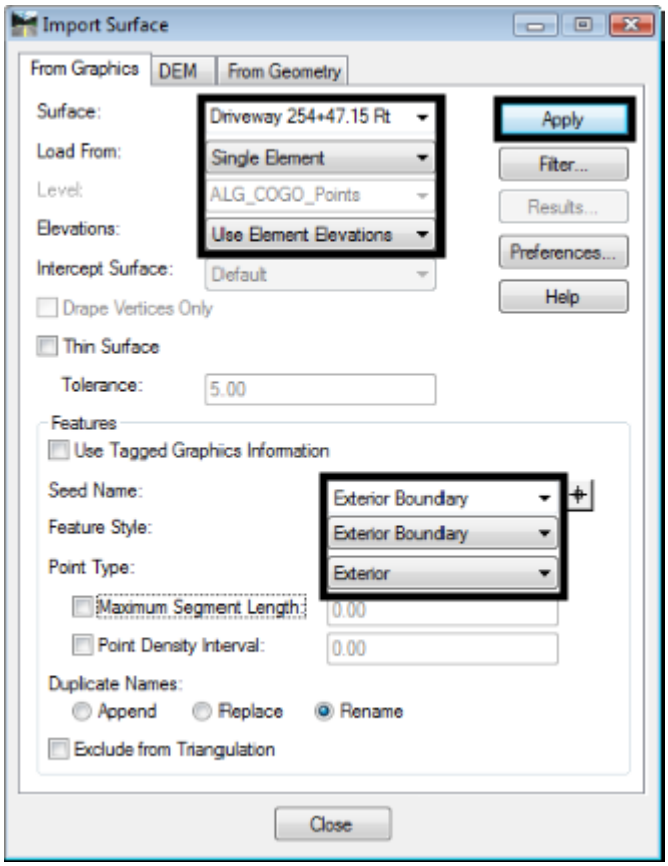
A closed shape element is created from the linework defining the exterior boundary

51. Select the MicroStation **Create Complex Shape** command.
52. In the toolsettings dialog box, set the ***Method*** to **Automatic**.
53. **<D>** on an element of the boundary the **<D>** anywhere. This creates a closed shape from the graphic elements that makeup the exterior boundary.



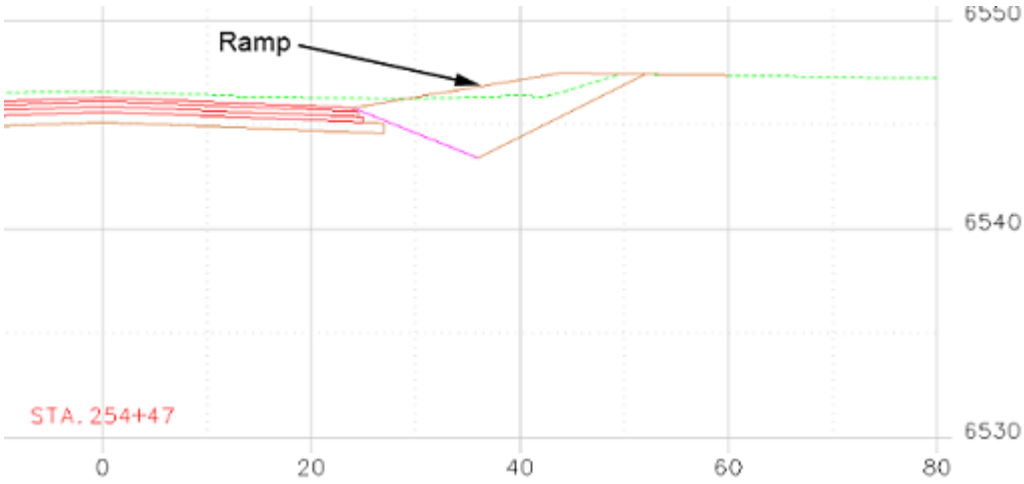
Import complex shape into the driveway surface as an exterior boundary, to complete the model.

54. From the InRoads menu bar, select **File > Import > Surface**.
55. In the I***mport Surface*** dialog box, set the ***Surface*** to **Driveway 254+47.15 Rt**.
56. Set ***Load From*** to **Single Element**.
57. Set ***Elevations*** to **Use Element Elevations**.
58. In the ***Seed Name*** field, key in ***Exterior Boundary***.
59. Set the ***Feature Style*** to **Exterior Boundary**.
60. Set the ***Point Type*** to **Exterior**.
61. **<D> Apply** then **<D>** on the boundary graphic element.

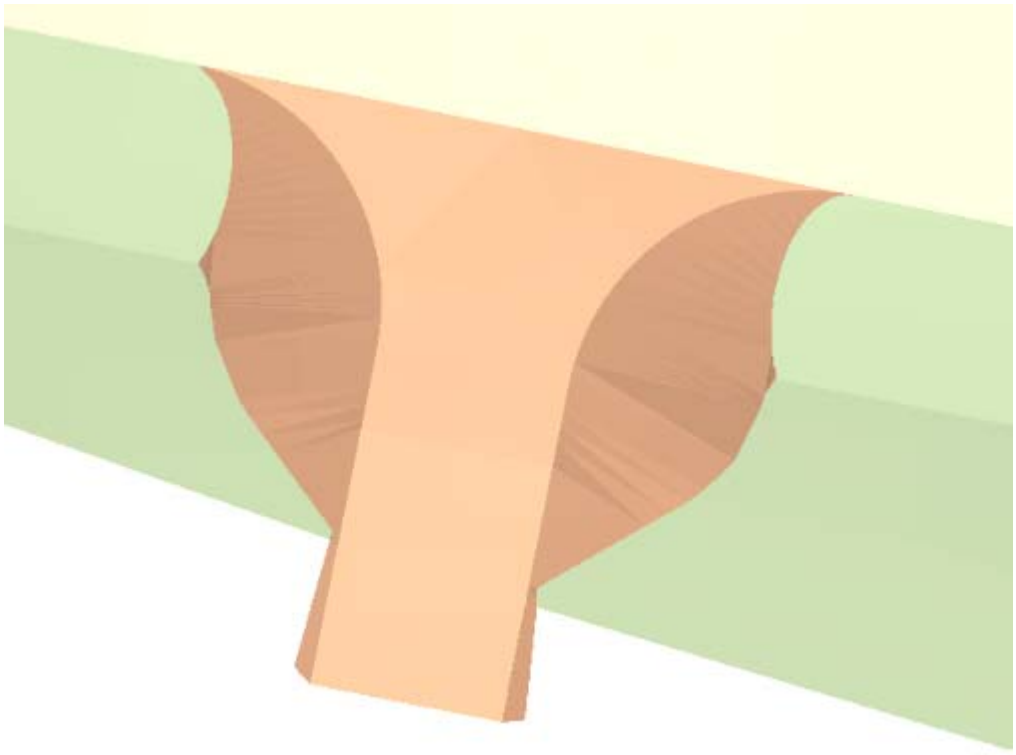


62. **Close** the ***Import Surface*** dialog box.
63. From the InRoads explorer, **<R>** on the **Driveway 254+47.15 Rt** surface and select **Triangulate**.

64. To evaluate the ramp, create a single cross section at station 254+47.15.



Below is a rendered view of the driveway



Section Summary:

In this section, end conditions were developed and applied to the driveway edges to form the side slopes. Features from the driveway surface and the mainline (SH86) surface were displayed and used to build the exterior boundary graphically. This graphic was imported into the driveway surface to finish the model. A cross section was created to review the ramp.

Chapter Summary:

In this lab, a driveway was designed using a variety of InRoads and MicroStation tools. From InRoads, the following tools were used:

- Tracking
- Create Surface
- Drape Surface
- Generate Longitudinal Feature
- Import Surface from Graphics
- View Features
- Fillet Feature
- Partial Delete (Feature)
- Join Features
- Create Template
- Apply Template

From MicroStation, the following tools were used:

- Place Smartline
- Copy
- Partial Delete (Graphic)
- Delete
- Create Complex Shape