

# LAB 24 - Widening and Overlay

Widening and overlay projects are an increasingly large part of the CDOT workload. This lab illustrates the MicroStation and InRoads tools used for this type of project.

## Chapter Objectives:

- Create a complex chain for the pavement edges from existing ground features.
- Import the chains as horizontal and vertical alignments.
- Develop a widening and overlay template.
- Define a corridor for the project.

The following files are used in this lab:

- C:\Projects\12345\Design\Drawings\Reference\_Files\12345DES\_Model\_Overlay.dgn
- C:\Projects\12345\Design\InRoads\12345DES\_Geometry\_Overlay.alg
- C:\Workspace\Workspace-CDOT\_XM\Standards-Global\InRoads\Templates\CDOT\_Template-Library.itl
- C:\Projects\12345\Design\ROW\_Survey\InRoads\DTM\12345 existing ground-Overlay.dtm

This project runs the length of the SH 86 alignment from station 205+00 to 259+00. Therefore, the display of features, etc. will be restricted to an area from station 204+00 to 260+00. This will ensure that enough data is available for the full length of the project.

## Lab 24.1 - Chain Pavement Edge Features

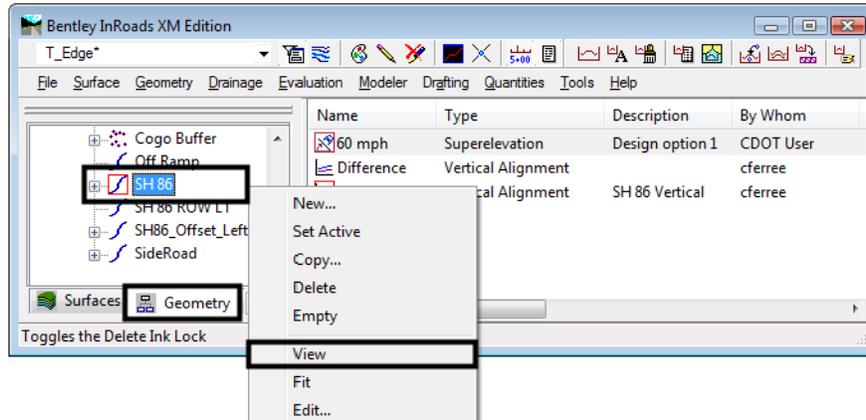
As single continuous lines are easier to use for point controls than a number of unconnected lines. Creating the complex chain also provides the opportunity to close gaps in the pavement edge features.

1. Open MicroStation and InRoads using the **C:\Projects\12345\Design\Drawings\Reference\_Files\12345DES\_Model\_Overlay.dgn** file.
2. Load the following files into InRoads:
  - ◆ **C:\Projects\12345\Design\InRoads\12345DES\_Geometry\_Overlay.alg**
  - ◆ **C:\Projects\12345\ROW\_Survey\InRoads\DTM\12345 existing ground-Overlay.dtm**
  - ◆ **C:\Workspace\Workspace-CDOT\_XM\Standards-Global\InRoads\Templates\CDOT\_Template-Library.itl**
3. Verify that the **C:\Workspace\Workspace-CDOT\_XM\Standards-Global\InRoads\Preferences\CDOT\_Civil.xin** file is loaded.

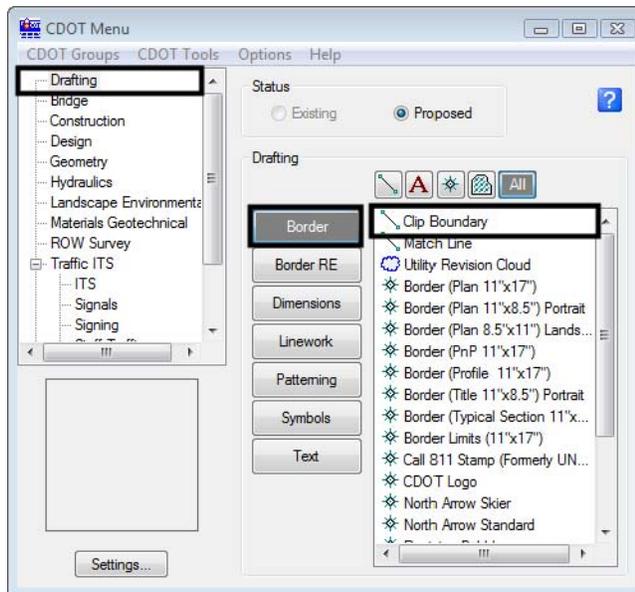
The first step is to mark out the limits of construction. Then a MicroStation fence is used to limit InRoads displays to this area.

4. In the InRoads explorer, <D> the **Geometry** tab.

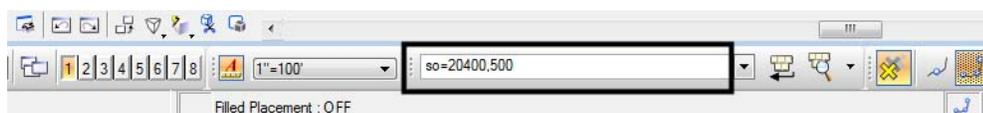
5. **<R>** on the **SH 86** horizontal alignment and select **View** from the right click menu.



6. Select **Fit View** from the MicroStation view controls.
7. From the **CDOT Menu**, select the **Drafting** group.
8. **<D>** the **Border** button.
9. Highlight **Clip Boundary** from the item list. This activates the *Place SmartLine* command.



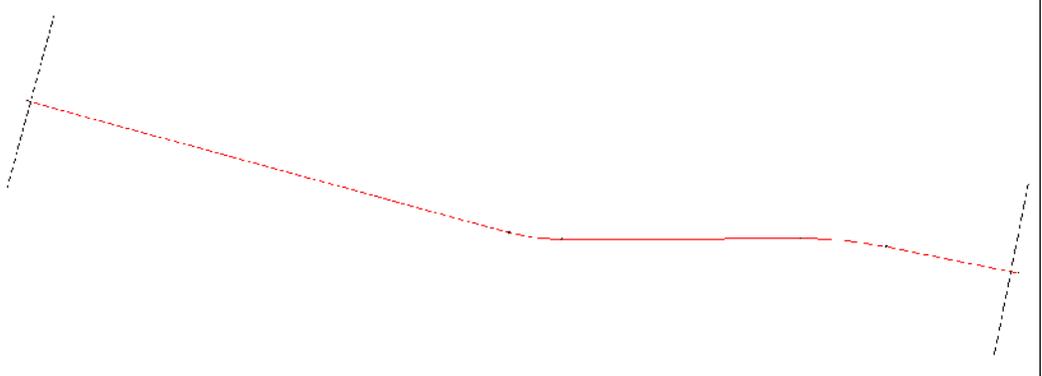
10. In the MicroStation key-in window, key in ***so=204+00,500*** and press **Enter**.



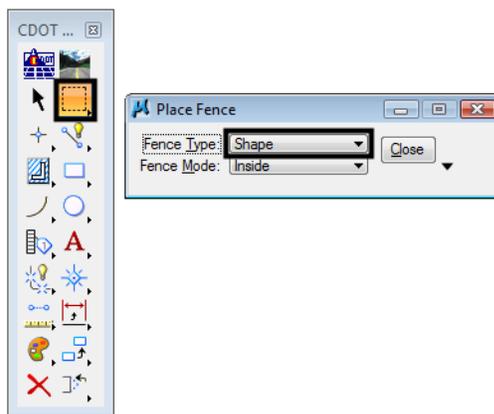
11. Key in ***so=204+00,-500*** and press **Enter. <R>** to finish the line.

This places a line perpendicular to the alignment at the beginning of the project.

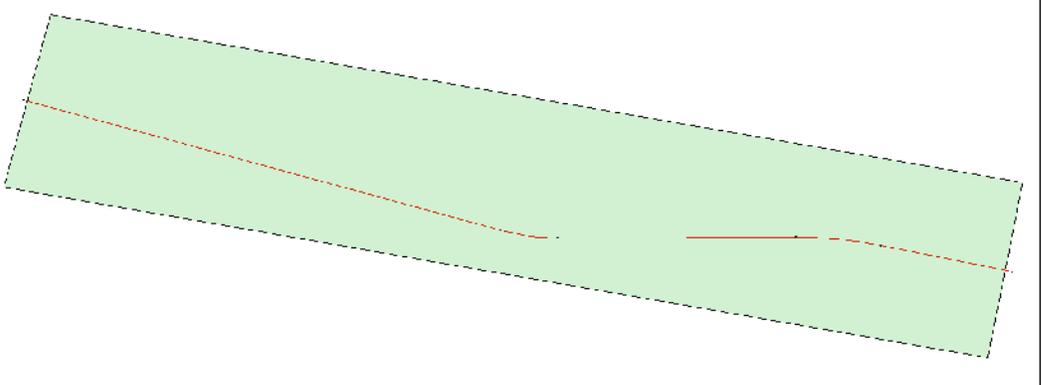
12. The Place SmartLine command is still active. Key in ***so=260+00,500*** and press ***Enter***.
13. Key in ***so=260+00,-500*** and press ***Enter. <R>*** to finish the line.



14. From the MicroStation Main toolbar, **<D> Place Fence**.
15. In the Tool Settings dialog box, set the **Fence Type** to **Shape**.

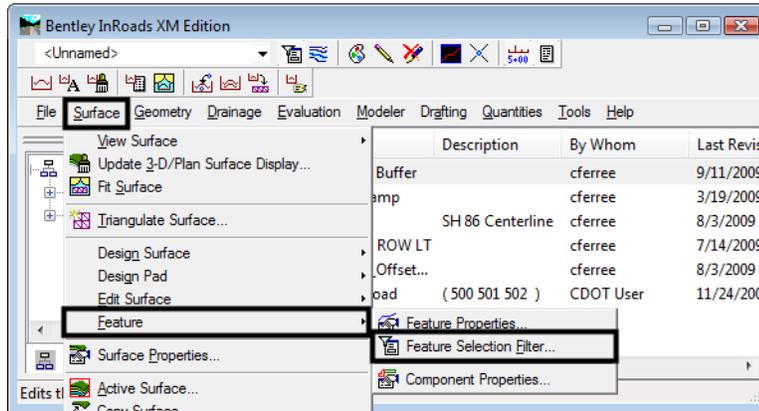


16. **<T>** then **<D>** to the ends of the lines. The fence is shown in the illustration below.

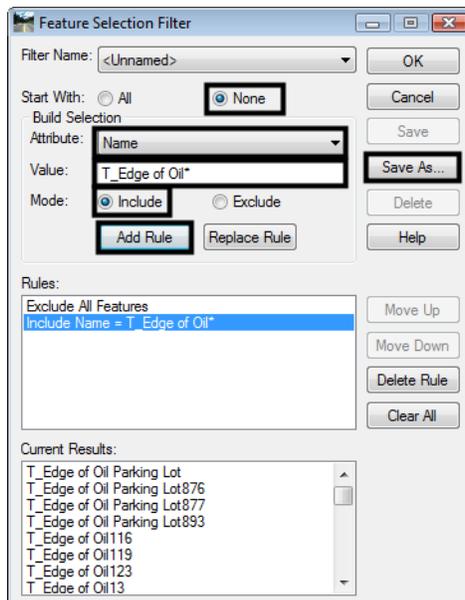


Next, a feature filter is set up that will only display edge of pavement features. In this case these features are named T-Edge of Oil.

17. From the InRoads menu bar, select **Surface > Feature > Feature Selection Filter**.

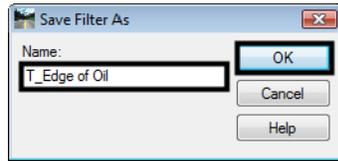


18. From the *Feature Selection Filter* dialog box, toggle on **None** for the *Start With* option.
19. Verify that the *Attribute* is set to **Name**.
20. Key in *T\_Edge of Oil\** for the *Value*.
21. Toggle on **Include** for the *Mode*.
22. <D> the **Add Rule** button.
23. <D> the **Save As** button.

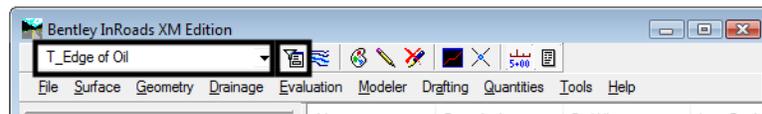


24. In the Save Filter As dialog box, key in *T\_Edge of Oil*.

25. <D> The **OK** button. This creates the filter and dismisses the *Save Filter As* dialog box.

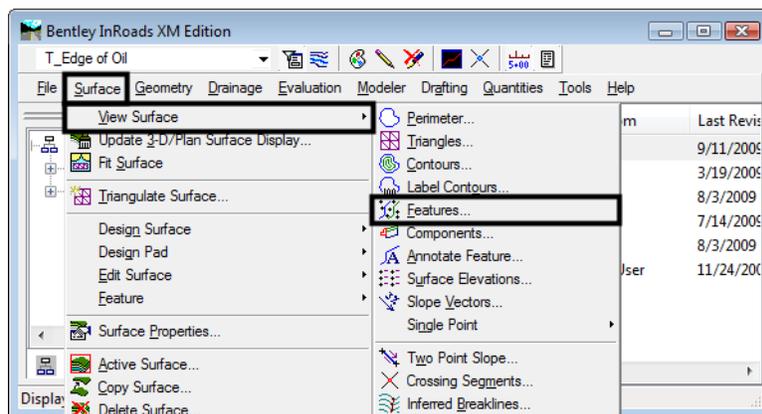


26. <D> the **OK** button to dismiss the *Feature Selection Filter* dialog box.
27. On the InRoads Locks toolbar, verify that the **T\_Edge of Oil** filter is selected and that the **Feature Filter Lock** is turned on.



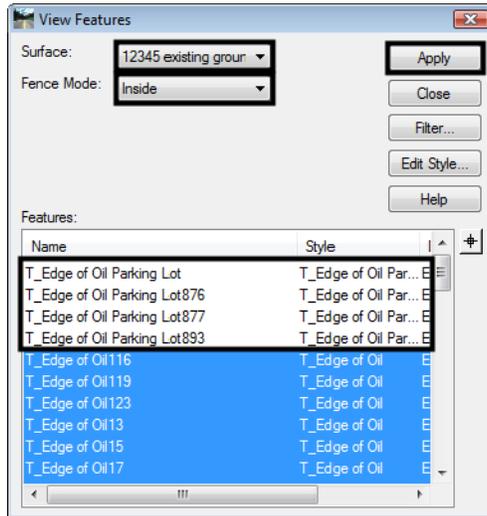
With the Feature Filter defined and set active, The pavement features needed can now be displayed.

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



29. In the *View Features* dialog box, verify that **12345 existing ground-Overlay** is set as the *Surface*.
30. Set the *Fence Mode* to **Inside**.
31. Hold the **Ctrl** key and <D> on each of the *Parking Lot* features to de-select them.

32. <D> the **Apply** button to display the features inside the fenced area.

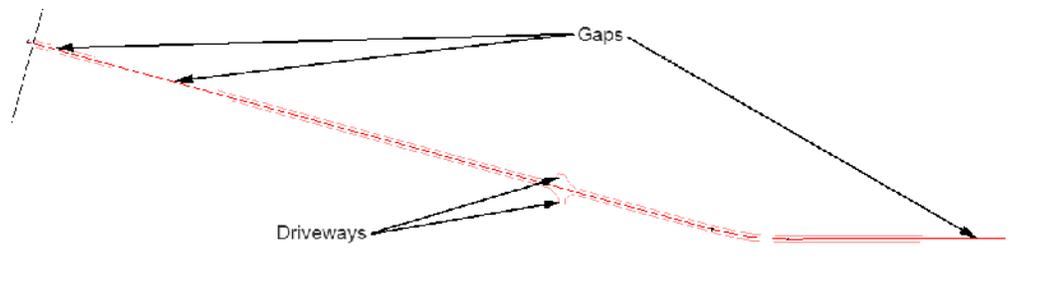


33. <D> **Close** to dismiss the *View Features* dialog box.

**Note:** If the features do not appear in the MicroStation window, <D> the **Fit View** from the view controls button bar.

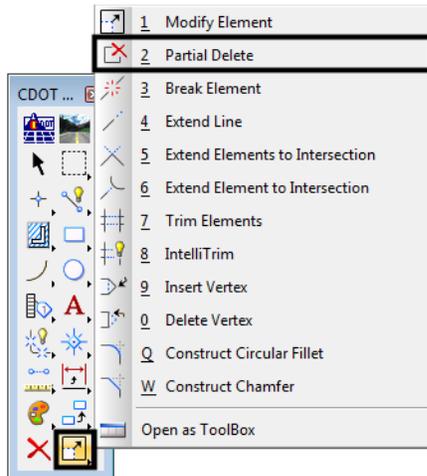
34. From the MicroStation Main toolbar, <D> **Place Fence** to dismiss the fence that was placed earlier.

Notice that each of the edge of oil features displayed has three gaps and a driveway in it. The driveways must be removed and gaps filled in before the pavement edges can be chained together. In order for the corridor to function properly, the lines placed to fill in the gaps must also include elevation information.

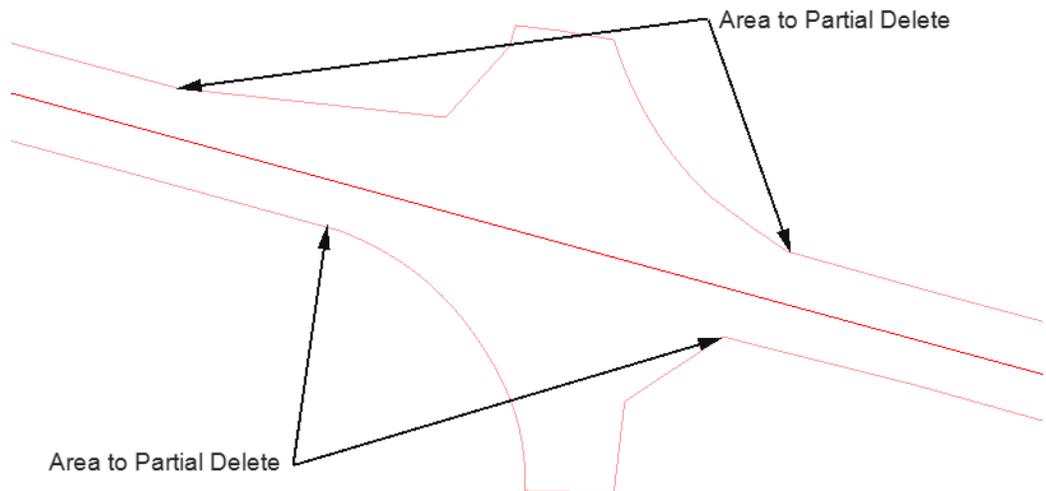


35. Use the MicroStation view controls to zoom in on the area with the driveways.

36. From the InRoads main toolbar, select the **Partial Delete** command.



37. **<D>** on the lines as indicated in the illustration below to remove the driveways.

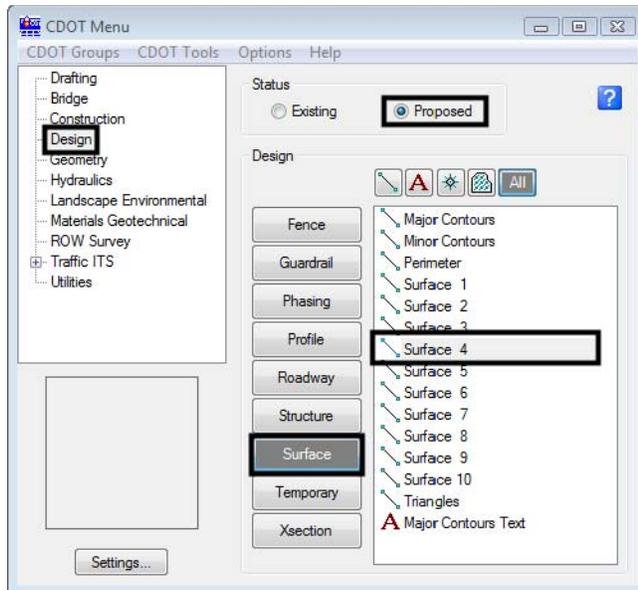


38. On the *CDOT Menu*, select the **Design** group.

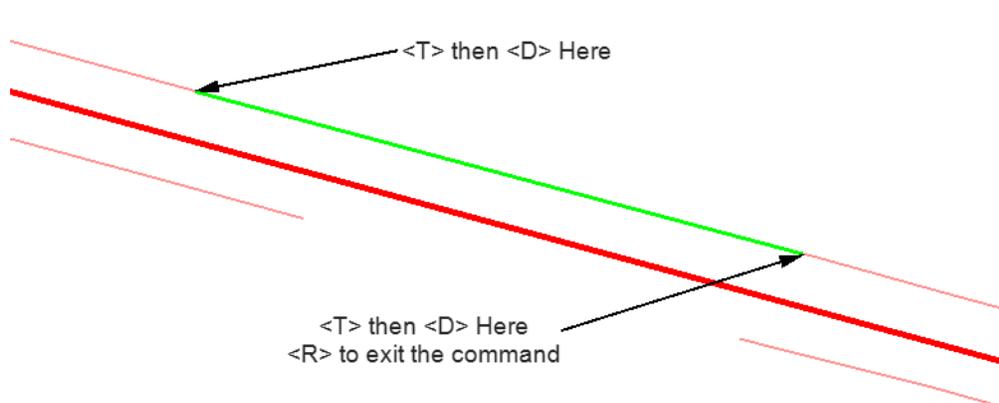
39. Verify that the *Status* is set to **Proposed**.

40. **<D>** the **Surface** button.

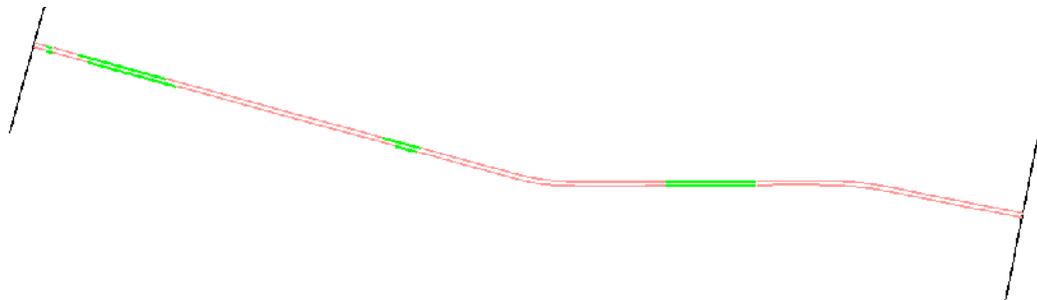
41. Highlight **Surface 4** from the item list. This level was selected because of the contrast to the features displayed.



42. **<T>** then **<D>** at each end of the gap created in the upper pavement edge line and then **<R>** to exit the place line command.

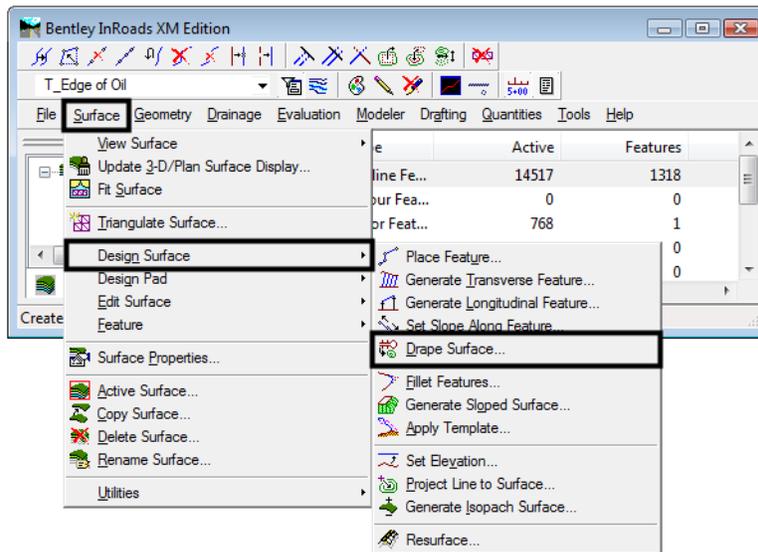


43. Repeat step 41 for each gap in the pavement edge lines. The illustration below shows all of the gaps closed.



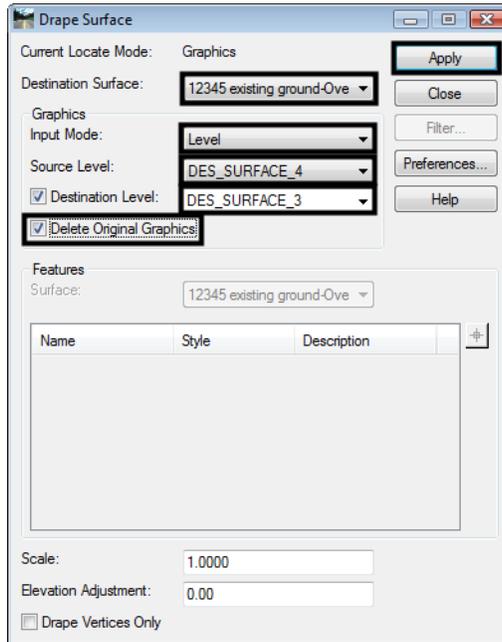
The lines drawn are accurate to the surface only at the points where they were snapped to the features. To ensure that the lines represent the surface over the length of the line, the InRoads Drape Surface command is used.

44. From the InRoads menu bar, select **Surface > Design Surface > Drape Surface**.



45. In the Drape Surface dialog box, verify that the Destination Surface is set to **12345 existing ground-Overlay**.
46. Set the **Input Mode** to **Level**.
47. Set the **Source Level** to **DES\_Surface\_4**.
48. Set the **Destination Level** to **DES\_Surface\_3**. This level was chosen because its display is different from both the lines drawn and the features displayed.

49. Toggle on **Delete Original Graphics**.



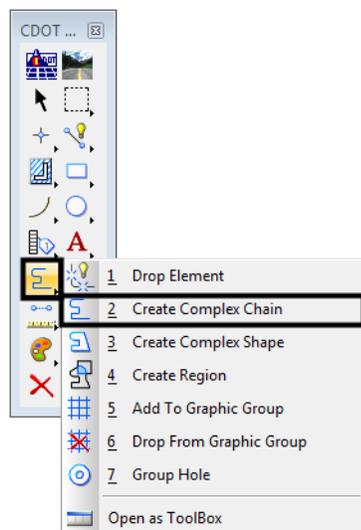
50. **<D> Apply**. The original lines are deleted and replaced with linestrings on the destination level, DES\_SURFACE\_3. The new linestrings contain a vertex at each point where the original line crossed a triangle in the destination surface.

Now the edge of oil lines can be chained into a single element.

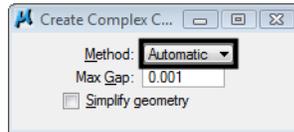
51. Select **Fit View** from the MicroStation *View Controls*.

52. From the MicroStation main toolbar, select the **Delete** command and delete the lines that mark the begin and end of the project. This is to ensure that they are not accidentally included into one of the chains.

53. From the MicroStation main toolbar, select the **Create Complex Chain** command.



54. In the tool settings box, set the *Method* to **Automatic**.



55. <D> on the left most element in the top line then <D> in a blank area. All of the elements that make up the upper pavement edge highlight.
56. <D> in a blank area to accept the selection set and create a single chain from the elements.
57. <D> on the left most element in the bottom line then <D> in a blank area.
58. <D> in a blank area to accept the selection set and create the second chain.

### Section Summary:

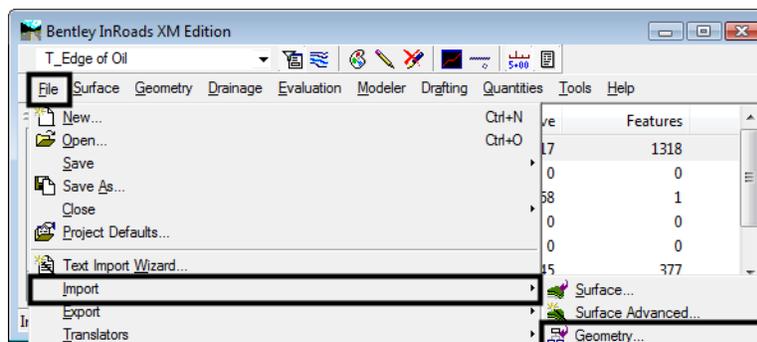
- ◆ Use Feature Selection Filters to limit the number of features to those needed.
- ◆ Use a MicroStation fence to further limit what is displayed to the area of the project.
- ◆ Once displayed, the feature graphics are like any other MicroStation element.
- ◆ Be careful is the Gap setting is increased for the Create Complex Chain command. Increasing the gap could allow the program to grab elements that are not intended to be part of the chain.

## Lab 24.2 - Creating Alignments from Graphic Chains

Now that the pavement edges have been chained together, these linestrings can be imported as horizontal and vertical alignments. These alignments will be used for point controls in a later exercise.

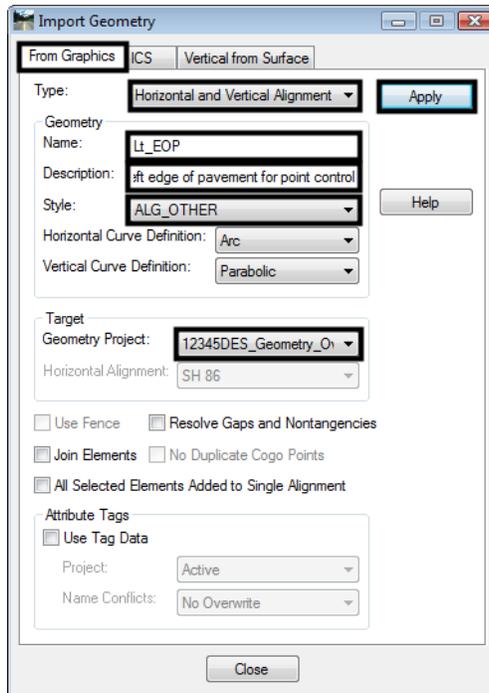
### Section Objectives:

- ◆ Import the graphic elements created in the previous exercise as horizontal and vertical alignments.
1. From the InRoads menu bar, select **File > Import > Geometry**.



2. On the *Import Geometry* dialog box, verify that the **From Graphics** tab is selected.
3. Set the *Type* to **Horizontal and Vertical Alignment**.

4. In the *Name* field, key in ***Lt\_EOP***.
5. In the *Description* field, key in ***Left edge of pavement for point control***.
6. Select **ALG\_OTHER** for the *Style*.
7. Verify that the *Geometry Project* in the *Target* area is set to **12345DES\_Geometry\_Overlay**.
8. **<D> Apply**.



9. **<D>** on the upper chain, then **<D>** again to accept the selection. **<R>** to redisplay the ***Import Geometry*** dialog box.
10. In the ***Import Geometry*** dialog box, key in ***Rt\_EOP*** for the *Name*.
11. In the *Description* field, key in ***Right edge of pavement for point control***.
12. **<D> Apply**.
13. **<D>** on the lower chain, then **<D>** again to accept the selection. **<R>** to redisplay the ***Import Geometry*** dialog box.
14. **<D> Close** to dismiss the ***Import Geometry*** dialog box.
15. In the InRoads explorer, **<D>** the **Geometry** tab and verify that ***Lt\_EOP*** and ***Rt\_EOP*** are in the geometry project.
16. **Save** the **12345DES\_Geometry\_Overlay** geometry project.

### Section Summary:

- ◆ Take care when importing feature graphics as alignments, overlapping and gaps in elements are common and can cause problems in Roadway Designer.
- ◆ One way to tell if the Import Geometry command worked is to look in the Name field after the command was executed. If the last letter in the name has changed, then geometry was created.

## Lab 24.3 - Creating a Widening and Overlay template

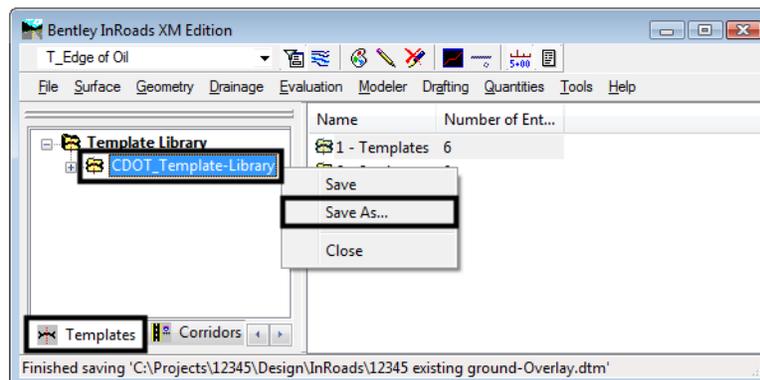
Now that the geometry required for the project is completed, the template and then the corridor can be defined. The template for this project has a 2” overlay of the existing pavement and 8’ paved shoulders added to the existing pavement width.

### Section Objectives:

- ◆ Copy the standard template library into the project folder
- ◆ Create a new template placeholder
- ◆ Add simple components to define the overlay.
- ◆ Change the constraints on the overlay to Project to Surface.
- ◆ Add shoulder and end condition sections.

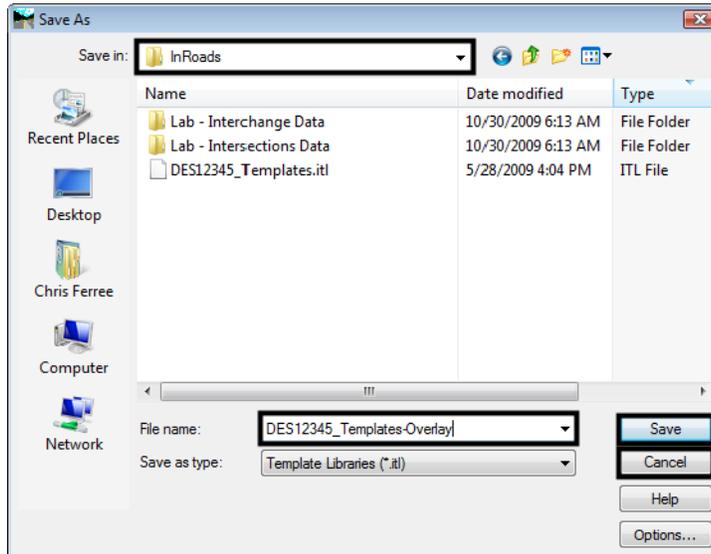
First, the standard template library is copied into the project directory.

1. In the InRoads explorer, <D> the **Template** tab.
2. <R> on the **CDOT\_Template-Library** and select **Save As** from the right click menu.



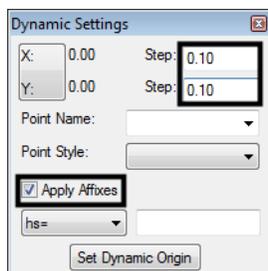
3. In the **Save As** dialog box, verify that the **C:\Projects\12345\Design\InRoads\** directory is selected.
4. In the **File name** field, key in **DES12345\_Templates-Overlay**.

5. **<D> Save** then **<D> Cancel**.

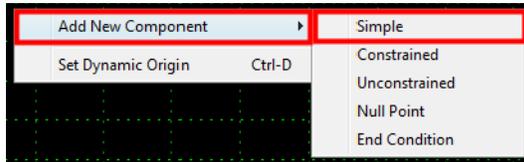


Next, a new template is created in the template library.

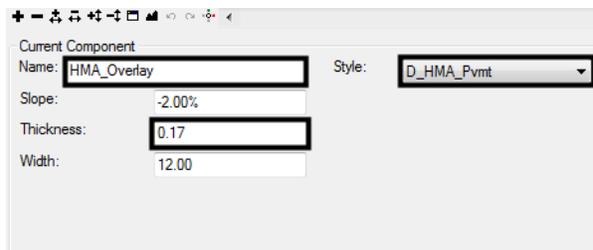
6. On the InRoads menu bar, select **Modeler > Create Template**.
7. In the Create Template dialog box, expand the **C:\Projects\12345\Design\InRoads\DES12345\_Templates-Overlay.itl > 1 - Templates** folder.
8. **<R>** on the **1 - Templates** folder and select **New > Template** from the right click menu.
9. Key in **12345\_Overlay** for the template name.
10. Display the **Dynamic Settings** dialog box.
11. Key in **0.10** for the **X** and **Y Steps**.
12. Toggle on **Apply Affixes**.



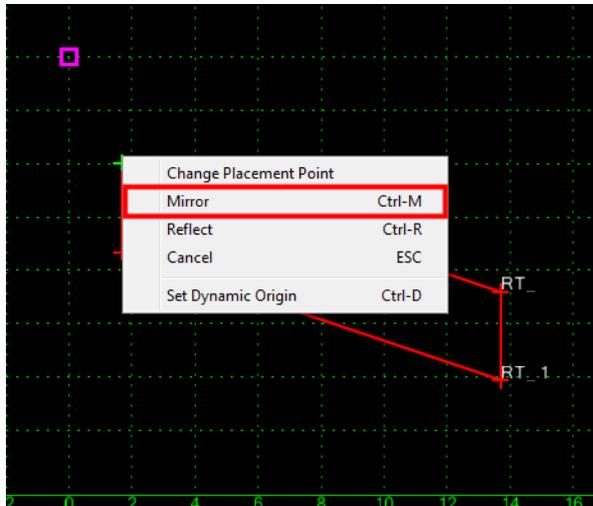
13. <R> in the template view and select **Add New Component > Simple** from the right click menu.



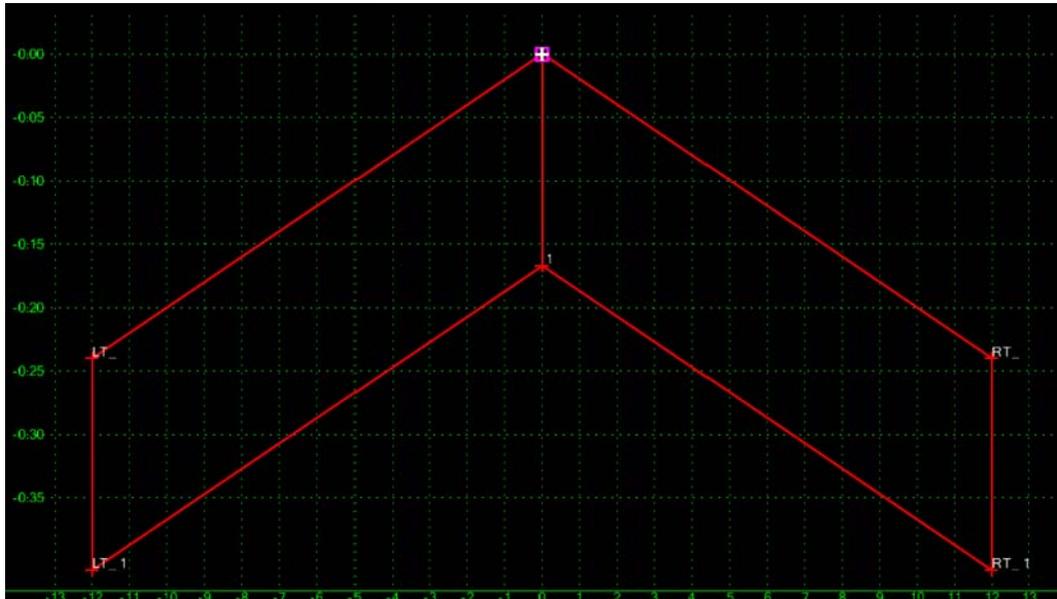
14. In the *Current Component* area, key in **HMA\_Overlay** for the *Name*.
15. Select **D\_HMA\_Pvmt** for the *Style*.
16. Key in **0.1667** for the *Thickness*. Note: this will round to 0.17 in the dialog box.



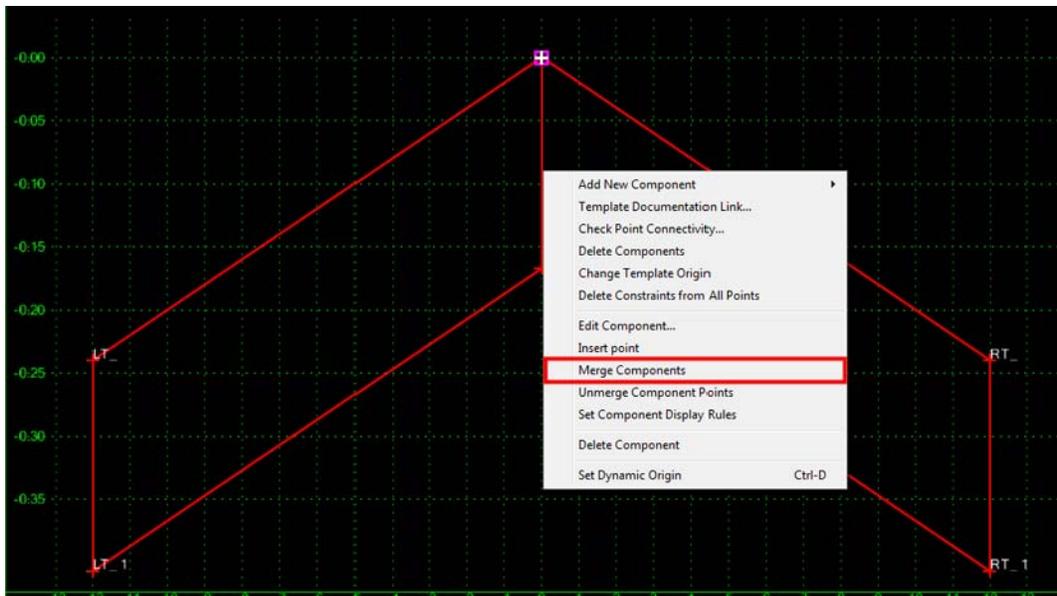
17. <R> in the template view and select **Mirror** from the right click menu.



18. **<D>** on the template origin. This creates the two components shown in the illustration below.

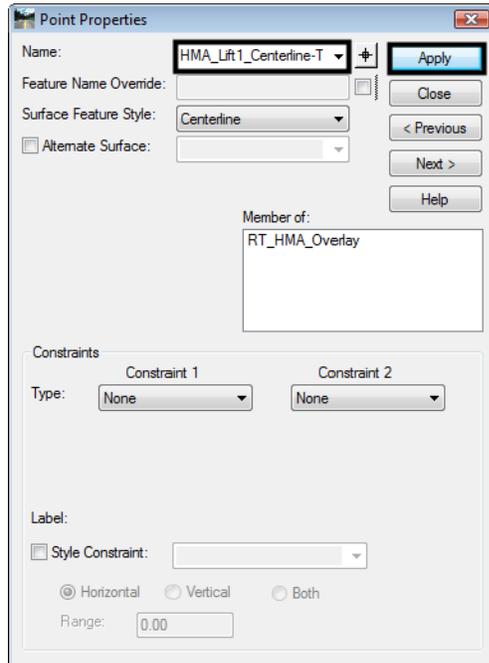


19. **<R>** on the vertical line in the center of the template and select **Merge Components** from the right click menu.



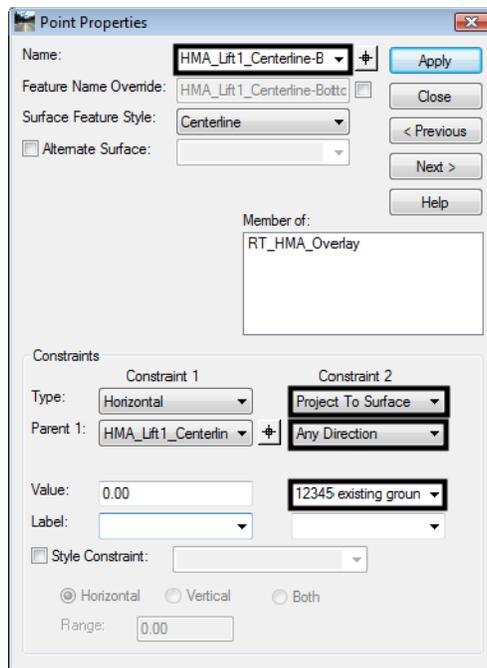
20. **<D>** **<D>** on the centerline point of the template to display the *Point Properties* dialog box.
21. In the *Point Properties* dialog box, select **HMA\_Lifftx\_Centerline-Top** in the *Name* field. This also sets the *Surface Feature Style* to **Centerline**.
22. Change the *x* to a **1** in the *lifftx* part of the name.

23. <D> **Apply** to accept the change.



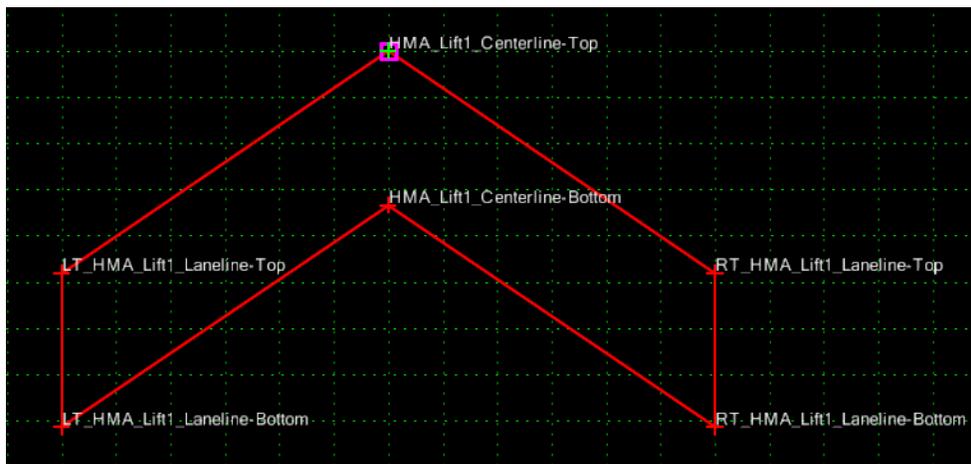
24. <D> the **Next** button to select the center bottom point (*I*).
25. Select **HMA\_Liftx\_Centerline-Top** in the *Name* field.
26. Change the *x* to a **1** in the *liftx* part of the name and change *Top* to **Bottom**.
27. Change the **Vertical** constraint (Constraint 2 in this example) to **Project To Surface**.
28. Set the *Parent 1* of the above constraint to **Any Direction**.

29. Verify that the **Value** for the **Project To Surface** constraint is set to **12345 existing ground-Overlay**.



30. <D> **Apply** to accept the change.
31. <D> the **Next** button to select the right top point (**RT\_**).
32. In the same manner as done in steps 22 and 26, change the name of the point to **RT\_HMA\_Lift1\_Laneline-Top**.
33. <D> **Apply** to accept the change.
34. <D> the **Next** button to select the right bottom point (**RT\_I**).
35. Change the name of the point to **RT\_HMA\_Lift1\_Laneline-Bottom**.
36. Change the **Vertical** constraint (Constraint 2 in this example) to **Project To Surface**.
37. Set the **Parent 1** of the above constraint to **Any Direction**.
38. Verify that the **Value** for the **Project To Surface** constraint is set to **12345 existing ground-Overlay**.
39. <D> **Apply** to accept the change.
40. <D> the **Next** button to select the right top point (**LT\_**).
41. In the same manner as done in steps 22 and 26, change the name of the point to **LT\_HMA\_Lift1\_Laneline-Top**.
42. <D> **Apply** to accept the change.
43. <D> the **Next** button to select the right bottom point (**LT\_I**).

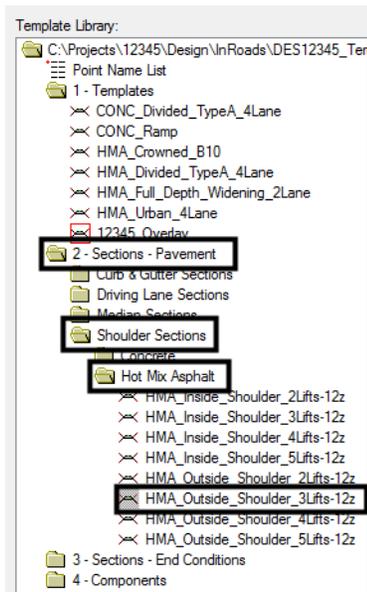
44. Change the name of the point to ***LT\_HMA\_Lift1\_Laneline-Bottom***.
45. Change the **Vertical** constraint (Constraint 2 in this example) to **Project To Surface**.
46. Set the **Parent 1** of the above constraint to **Any Direction**.
47. Verify that the **Value** for the **Project To Surface** constraint is set to **12345 existing ground-Overlay**.
48. **<D> Apply** to accept the change.
49. **<D> Close** to dismiss the **Point Properties** dialog box. The template looks like the illustration below:



Now the shoulders and end conditions are added.

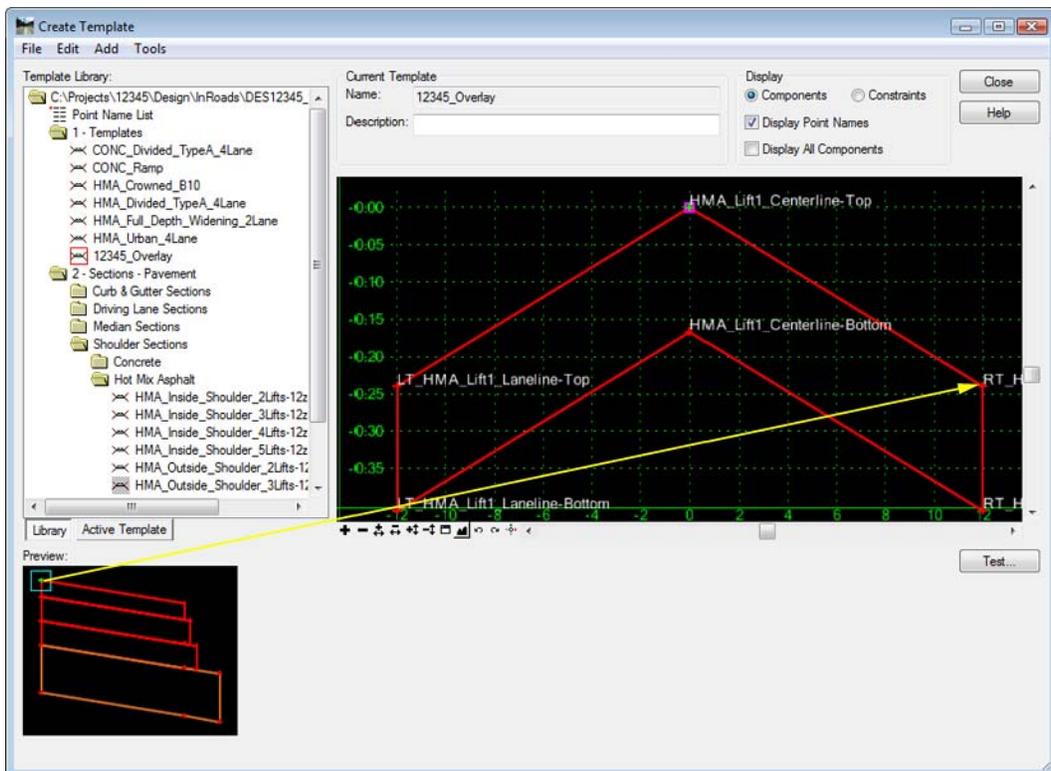
50. Expand the template library to show the contents of the **2 - Sections - Pavement > Shoulder Sections > Hot Mix Asphalt** folder.

51. <D> on the **HMA\_Outside\_Shoulder\_3Lifts-12z** section.



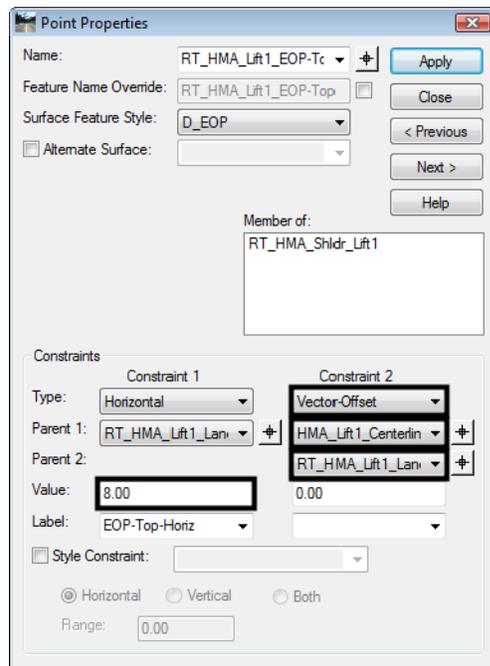
52. In the Preview window, <D> and hold on the shoulder's origin (the upper left point).

53. Drag and drop the section onto the **RT\_HMA\_Lift1\_Laneline-Top** point.



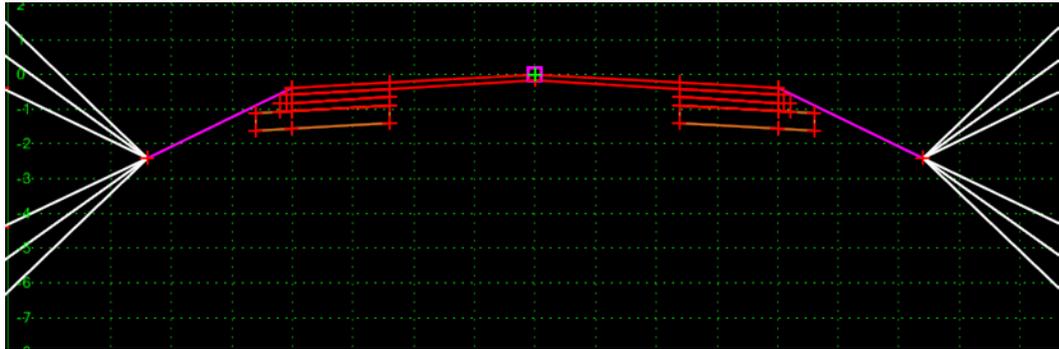
**Note:** Because *Mirror* was turned on when placing the overlay component, both shoulders are now placed in the template.

54. <D> <D> on the **RT\_HMA\_Lift1\_EOP-Top** point to display the *Point Properties* dialog box.
55. Change the *Value* of the *Horizontal* constraint (*Constraint 1* in this example) to **8.00**.
56. Change the *Slope* constraint (*Constraint 2* in this example) to a **Vector-Offset Type**.
57. Set the *Parent 1* to **HMA\_Lift1\_Centerline-Top**.
58. Set the *Parent 2* to **RT\_HMA\_Lift1\_Laneline-Top**.



59. <D> **Apply** and then <D> **Close** to dismiss the *Point Properties* dialog box.
60. Repeat steps 54 through 59 on point **LT\_HMA\_Lift1\_EOP-Top**, using the corresponding points from the left side of the template. Remember to use **-8.00** for the value of the horizontal constraint in step 55.
61. Expand the template library to show the contents of the **3 - Sections - End Conditions > Z-Slope End Conditions > High Speed End Conditions** folder.
62. <D> on the **Z12\_6\_to\_1** section.
63. In the Preview window, <D> and hold on the section's origin (the upper left point).
64. Drag and drop the section onto the **RT\_HMA\_Lift1\_EOP-Top** point.
65. This completes the template. Select **File > Save** from the *Create Template* menu bar.
66. <D> **Close** to dismiss the *Create Template* dialog box.

The illustration below shows the completed template:



### Section Summary:

- ◆ Using the Project to Surface point constraint will cause the bottom of the overlay to match the existing ground exactly.
- ◆ Once the right click options of Mirror and Reflect are turned on, they remain active until they are turned off.

## Lab 24.4 - Creating the Overlay Corridor

Finally, a corridor is constructed using the alignments and template developed earlier.

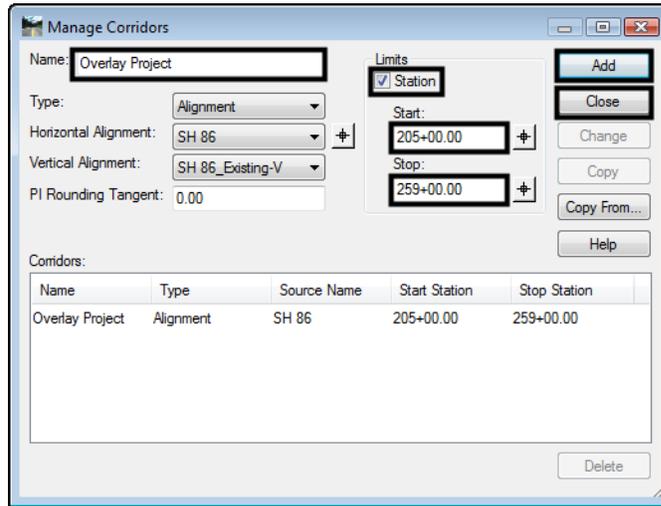
### Section Objectives:

- ◆ Create a corridor for the SH 86 alignment.
- ◆ Add a template drop using the widening and overlay template.
- ◆ Add point controls using the edge of pavement and SH 86 alignments.
- ◆ Review the results in Roadway Designer.

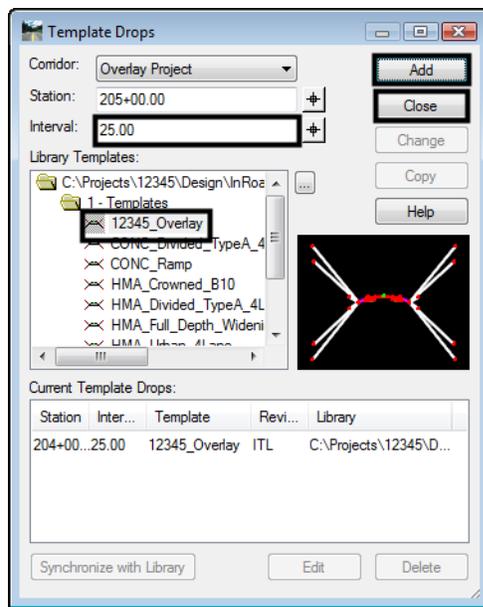
This corridor contains a single template drop and three point controls. These control the two laneline points with a horizontal and vertical control and the centerline with a vertical control. Superelevation is not required for this corridor because the laneline point controls will cause the template to match the existing superelevation.

1. From the InRoads menu bar, select **Modeler > Roadway Designer**.
2. In the *Roadway Designer* dialog box, select **Corridor > Corridor Management** from the menu bar.
3. In the *Manage Corridors* dialog box, key in **Overlay Project** for the *Name*.
4. Toggle on **Station Limits**.
5. Key in **205+00.00** for the *Start* station.
6. Key in **259+00.00** for the *Stop* station.

7. <D>**Add** then <D> **Close** to dismiss the dialog box.

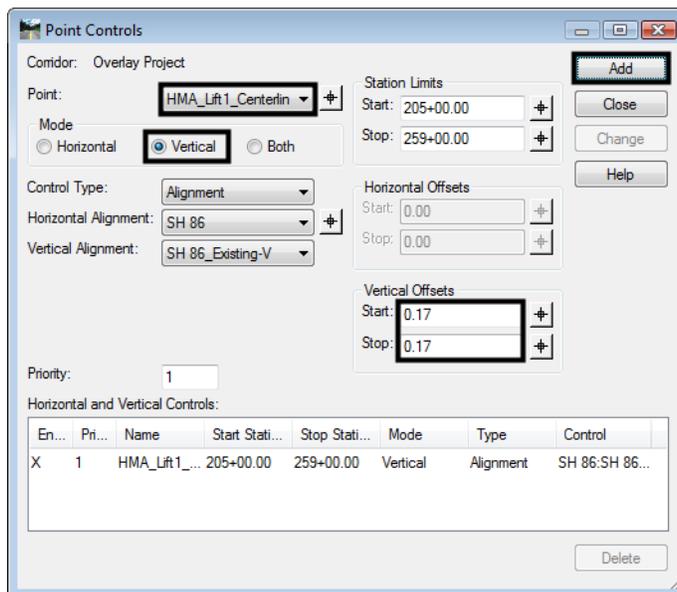


8. In the *Roadway Designer* dialog box, select **Corridor > Template Drops** from the menu bar.
9. In the *Template Drops* dialog box, key in **25.00** for the *Interval*.
10. Expand the **C:\Projects\12345\Design\InRoads\DES12345\_Templates-Overlay** template library to show the contents of the **1 - Templates** folder.
11. Highlight the **12345\_Overlay** template.
12. <D> the **Add** button then <D> the **Close** button to dismiss the *Template Drops* dialog box.



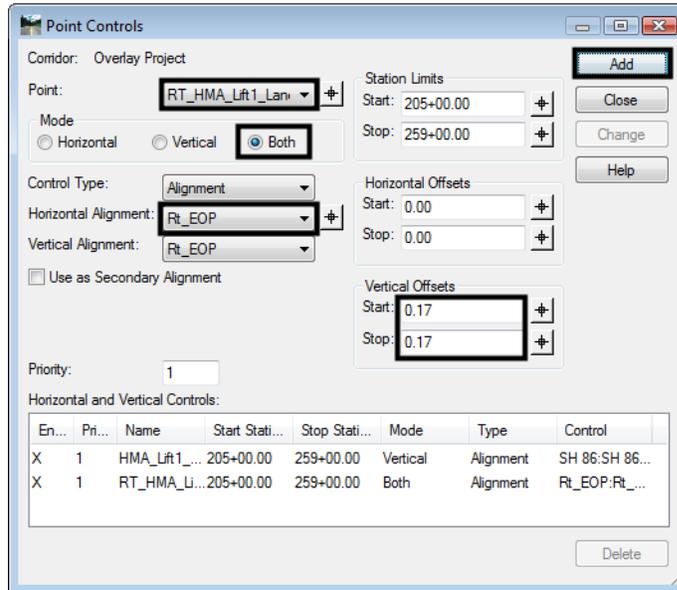
The template is now displayed in the cross section view. Next, point controls are added to raise the template up 2” and match the existing cross slopes of the original surface.

13. In the *Roadway Designer* dialog box, select **Corridor > Point Controls** from the menu bar.
14. In the *Point Controls* dialog box, set the Point to **HMA\_Lift1\_Centerline-Top**.
15. Toggle on **Vertical** for the *Mode*.
16. In the *Vertical Offsets* area, key in **0.1667** for the *Start* and *Stop* offset. Note: these will be rounded to 0.17.
17. <D> the **Add** button.

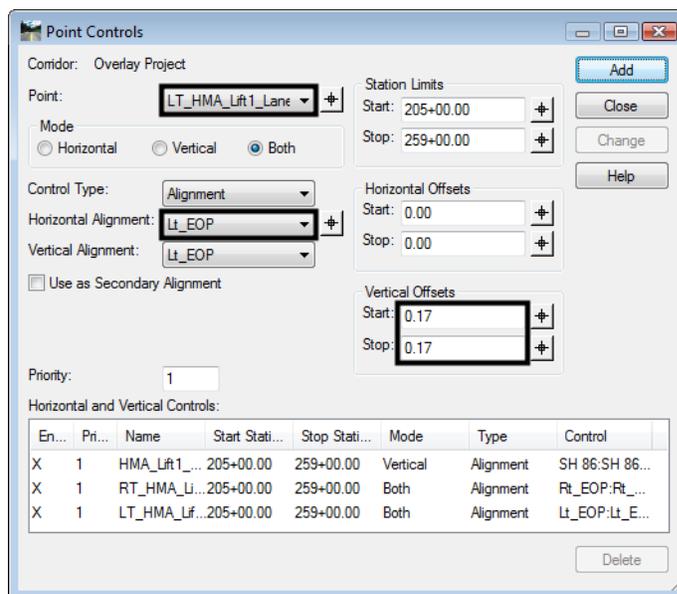


18. In the *Point Controls* dialog box, set the Point to **RT\_HMA\_Lift1\_Laneline-Top**.
19. Toggle on **Both** for the *Mode*.
20. Select **Rt\_EOP** for the *Horizontal Alignment*. This automatically sets the vertical alignment.
21. In the *Vertical Offsets* area, key in **0.1667** for the *Start* and *Stop* offset.

22. <D> the **Add** button.



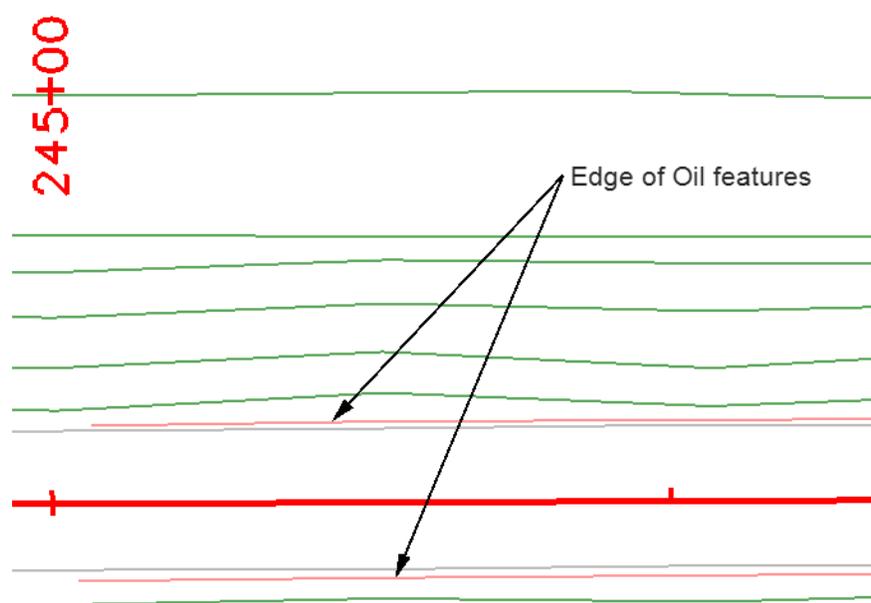
23. In the *Point Controls* dialog box, set the Point to **LT\_HMA\_Lift1\_Laneline-Top**.
24. Select **Lt\_EOP** for the *Horizontal Alignment*. This automatically sets the vertical alignment.
25. In the *Vertical Offsets* area, key in **0.1667** for the *Start* and *Stop* offset.
26. <D> the **Add** button the <D> **Close** to dismiss the Point Controls dialog box.



This completes the corridor definition. Now the corridor can be reviewed in Roadway Designer.

27. Scroll through the template drops using the station controls under the cross section view. Notice that the template top in the backbone of the template maintains a constant slope from the centerline to the edge of pavement.
28. Also notice that some areas did not appear to work properly. This is especially noticeable in the area between station 240+00 and 250+00. There are two causes for these anomalies. The first is the existence of additional features inside the Edge of Oil features used for point control alignments.

The illustration below shows the area where other features are inside the edge of oil features.

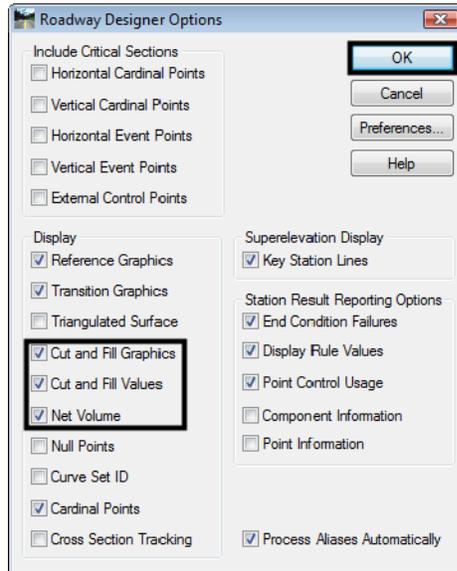


In the example above the grey lines are pavement striping features.

The other situation is similar and occurs where there were gaps in the edge of oil feature. Again features may occur inside where the lines were drawn to fill in these gaps.

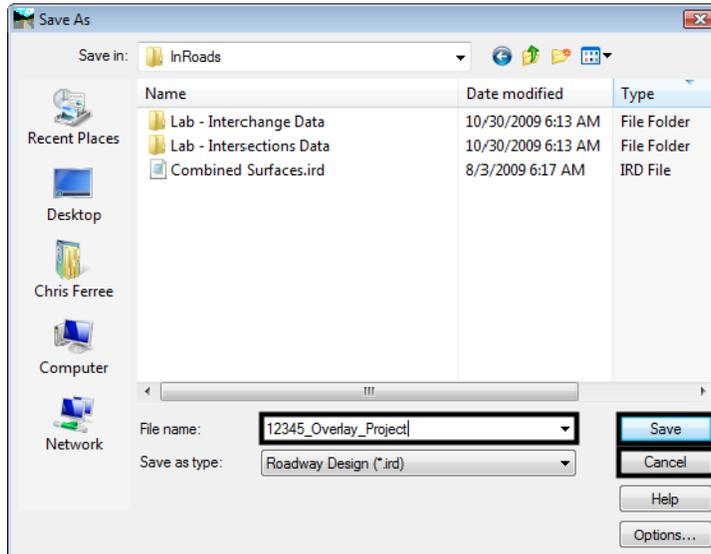
29. From the Roadway Designer menu bar select **Tool > Options**.
30. In the *Roadway Designer Options* dialog box, toggle on **Cut and Fill Graphics**, **Cut and Fill Values**, and **Net Volumes**.

31. <D> **OK** to accept the changes and dismiss the dialog box.



32. Scroll through the template drops again.
33. Notice the heavy blue line in the cross section display. This represents the design surface used to compute volumes. Under the overlay component, this line exactly matches the existing ground line. This is a result of the Project to Surface constraint defining each end of a segment. When a Project to Surface constraint is used on each end of a template segment the line between the points follows the target surface.
34. Also notice that there are no cut or fill areas in the overlay area.
35. From the Roadway Designer menu bar, select **File > Save**.
36. In the *File name* field of the *Save As* dialog box, key in **12345\_Overlay\_Project**.

37. <D> **Save** then <D> **Cancel** to dismiss the dialog box.



38. <D> **Close** to dismiss the Roadway Designer dialog box.

39. Exit InRoads and MicroStation.

### Section Summary:

- ◆ Point controls can be used to match the existing cross slope of the road.
- ◆ Displaying Cut and Fill graphics shows the design surface line used to compute volumes.

### Chapter Summary:

- Surface features can be used to create point control alignments.
- Be aware that other features may reside inside of the edge of pavement which could cause problems when modeling the corridor.
- If the edge of pavement is to be saw cut prior to widening, Copy Parallel the edge of pavement chain the distance of the saw cut before importing the alignment. Also, in this case, the vertical alignment should be created separately, using the Vertical from Surface command.
- The Project to surface command is used to make a template segment match the existing ground.
- Because the point controls force the template to match the existing cross slope, superelevation is not used.
- With minor modification to the template and adjustments in point controls, the exercise can be use to rehabilitate existing cross slopes.