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 projects that require pavement widening, overlay, and pavement milling (stripping in InRoads terminology).

In conjunction with overlay and stripping components a slope optimization function is available to constrain transverse design slopes relative to existing conditions. This utility can be utilized for design development whether the design template contains standard components or the new overlay and stripping components introduced with the SELECTseries release of InRoads.

Chapter Objectives:

- Create a complex chains for the pavement edges from existing ground features.
- Import the chains as horizontal and vertical alignments.
- Develop a slope optimization solution.
- Develop a widening and overlay template.
- Define corridors for the project.
- Model the corridor and apply slope optimization.
- Model the corridor with overlay and stripping components.

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_V8i\Standards-Global\InRoads\Templates\CDOT_Template-Library.itl
- C:\Projects\12345\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.

Note: The first two labs in this chapter illustrate a workflow to develop horizontal and vertical alignments which represent the left and right edges of existing pavement. These alignments can be used as point controls on widening projects if the proposed design must vary width, elevation, or both, relative to the existing roadway.
A slope optimization utility is also available which offers additional flexibility for vertical design development. If the design calls for it, point controls can be used to constrain the design template to the existing pavement width. Also the template can be constrained vertically based on user defined delta tolerances between the design template cross slope and the existing cross slope. Allowing the designer flexibility to match existing conditions (0% tolerance) or to define slope deviation as a user input for maximum delta tolerance.

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:

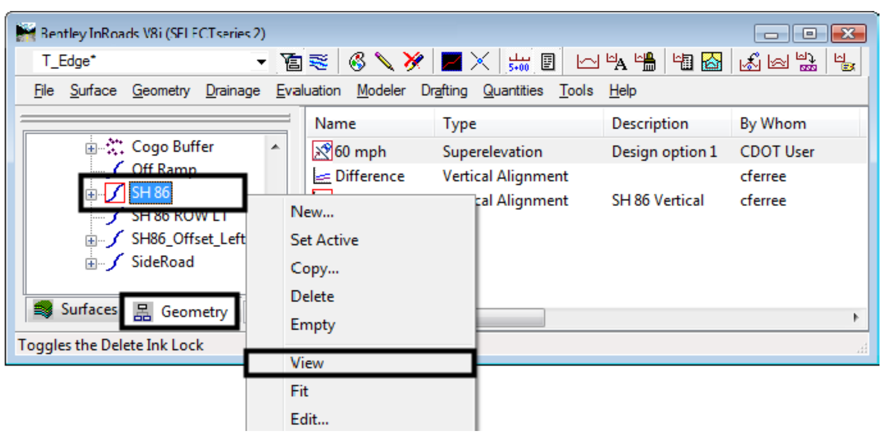
   - **C:\Projects\12345\Design\InRoads\12345DES_Geometry_Overlay.alg**
   - **C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground-Overlay.dtm**
   - **C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Templates\CDOT_Template-Library.itl**

3. Verify that the **C:\Workspace\Workspace-CDOT_V8i\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.

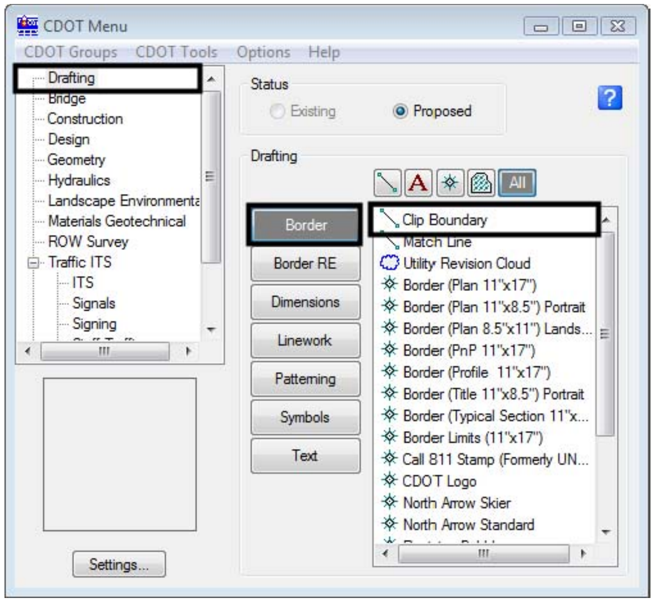


6. Select **Fit View** from the MicroStation view controls.

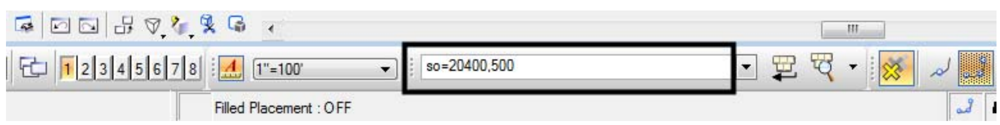
7. From the ***CDOT Menu***, select the **Drafting** group.

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***.

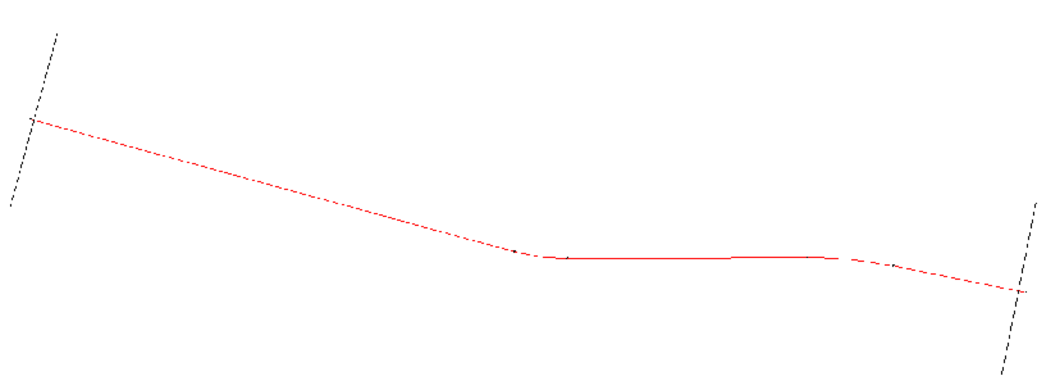


11. Key in ***so=204+00,-500*** and press ***Enter***. **<R>** to finish the line.

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

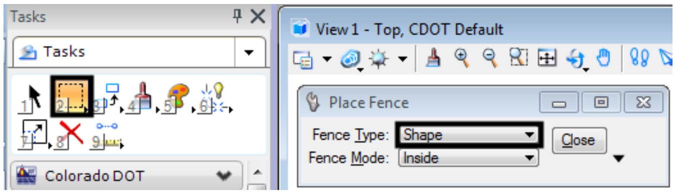
12. The Place SmartLine command is still active. Key in ***so=260+00,500*** and press ***Enter***.

13. Key in ***so=260+00,-500*** and press ***Enter***. **<R>** to finish the line.

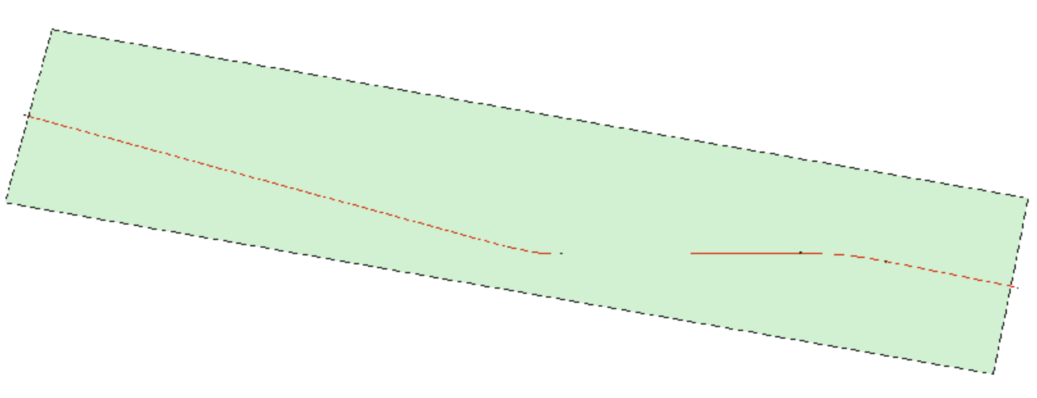


14. From the MicroStation Main toolbar, **<D> Place Fence**.

15. In the Tool Settings dialog box, set the ***Fence Type*** to **Shape**.

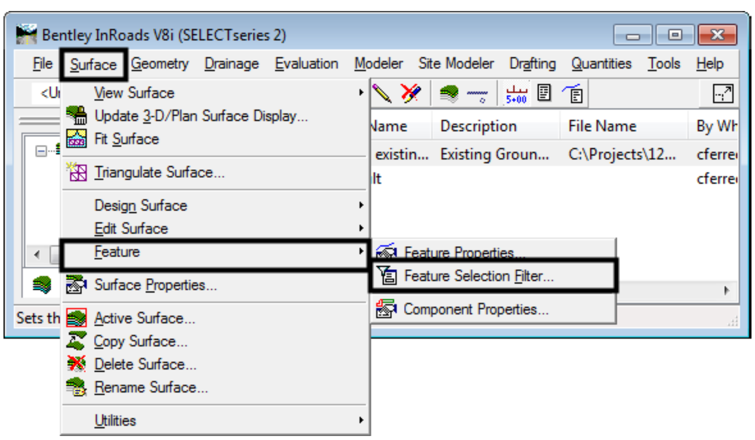


16. **<T>** then **<D>** to the ends of the lines. The fence is shown in the illustration below.



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.

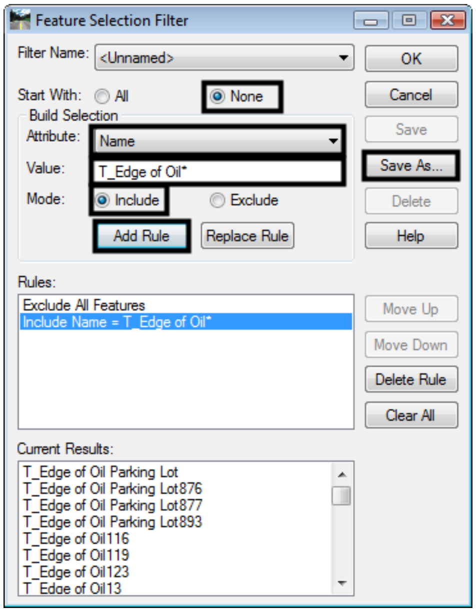
19. Verify that the ***Attribute*** is set to **Name**.

20. Key in ***T_Edge of Oil**** for the ***Value***.

21. Toggle on **Include** for the ***Mode***.

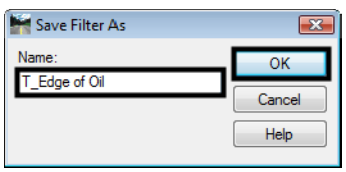
22. **<D>** the **Add Rule** button.

23. **<D>** the **Save As** button.



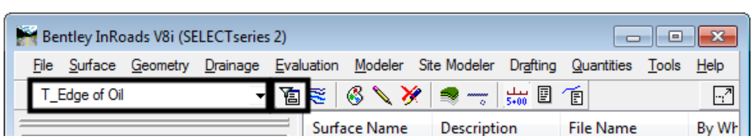
24. In the ***Save Filter As*** dialog box, key in ***T_Edge of Oil.***

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



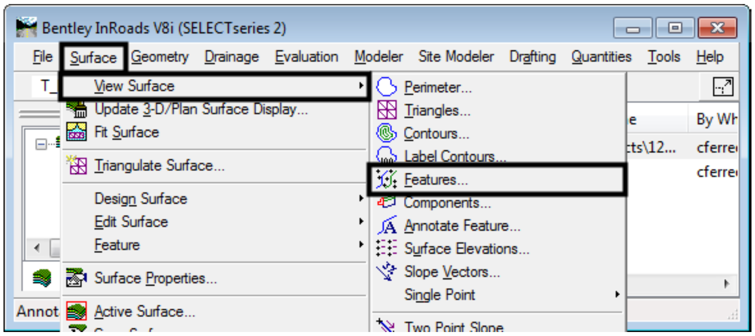
26. **<D>** the **OK** button to dismiss the ***Feature Selection Filter*** dialog box.

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.



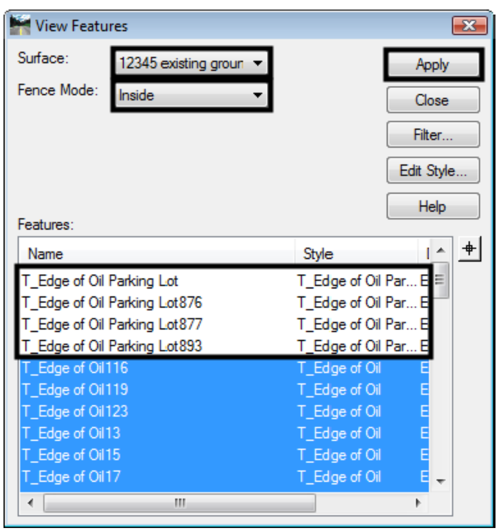
29. In the ***View Features*** dialog box, verify that **12345 existing ground-Overlay** is set as the ***Surface***.

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.

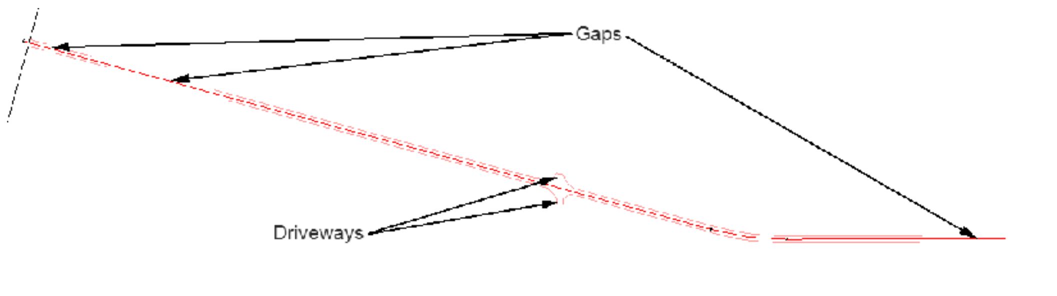
Note: If the features do not appear in the MicroStation window, **<D>** the **Fit View** from the view controls button bar.



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

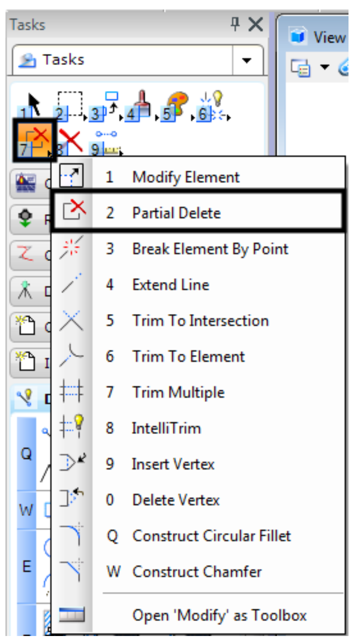
34. From the MicroStation Main toolbar, **<D> Place Fence** to dismiss the fence that was placed earlier.

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.

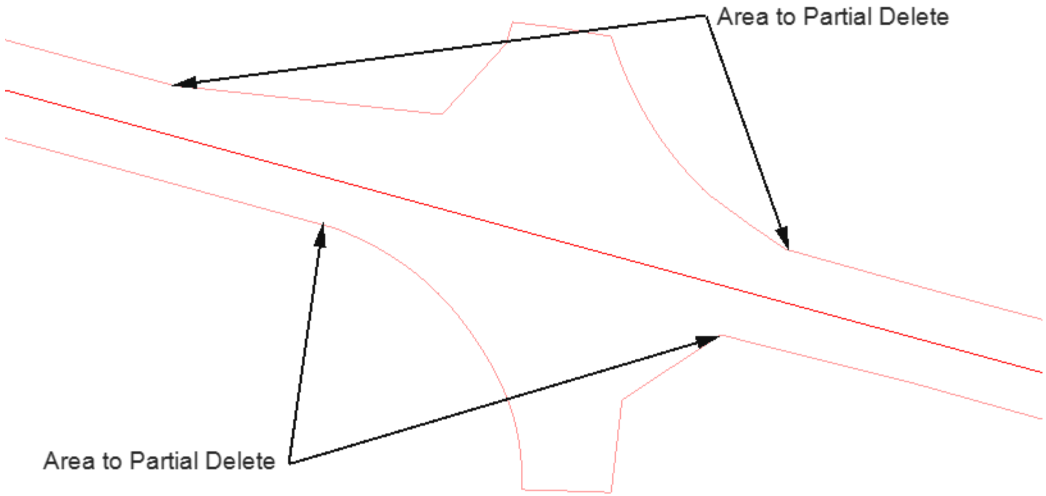


35. Use the MicroStation view controls to zoom in on the area with the driveways.

36. From the MicroStation Main taskbar, select the **Partial Delete** command.



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

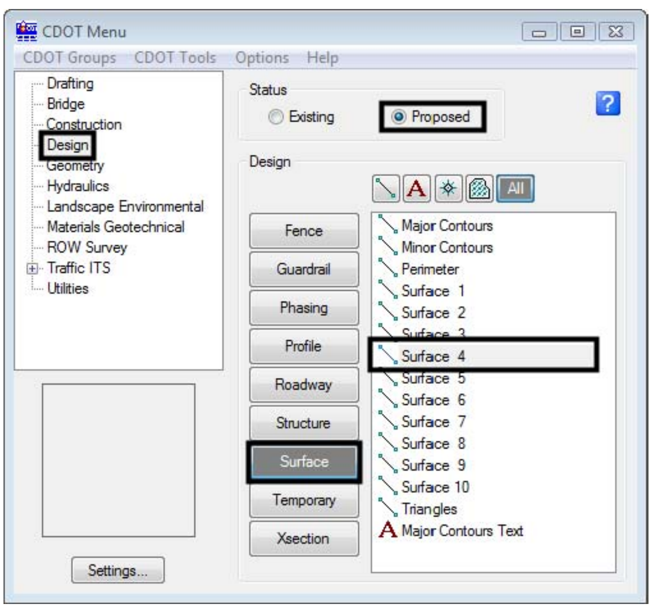


38. On the ***CDOT Menu***, select the **Design** group.

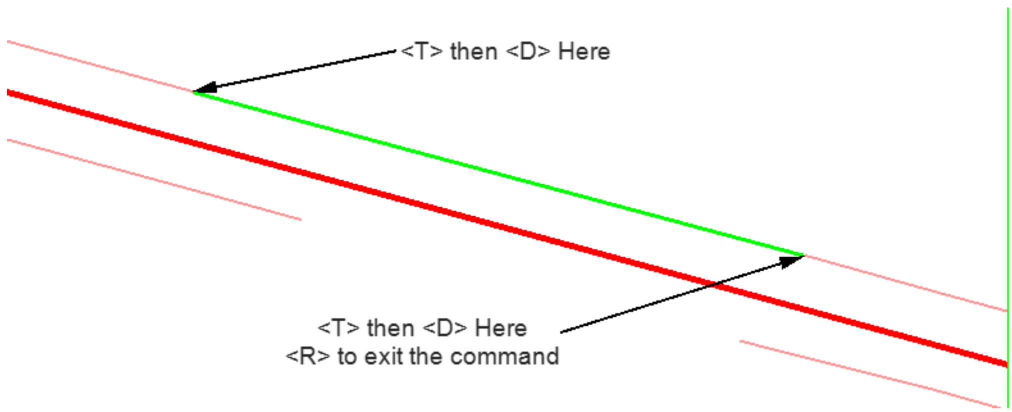
39. Verify that the ***Status*** is set to **Proposed**.

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

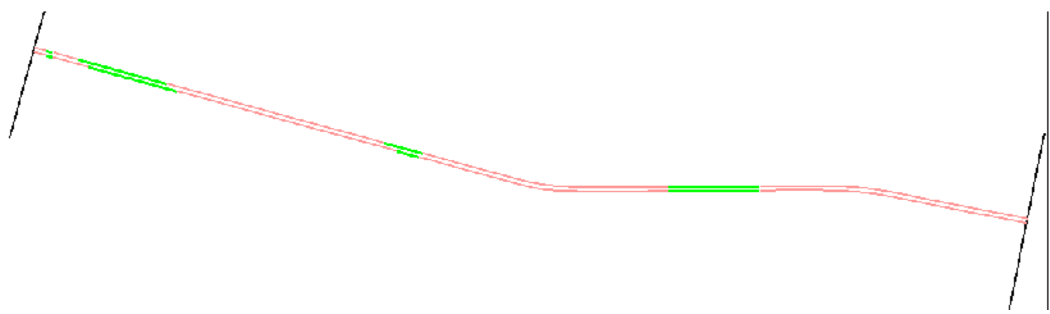
41. Highlight **Surface 4** from the item list. This level was selected because of the contrast to the features displayed.



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.

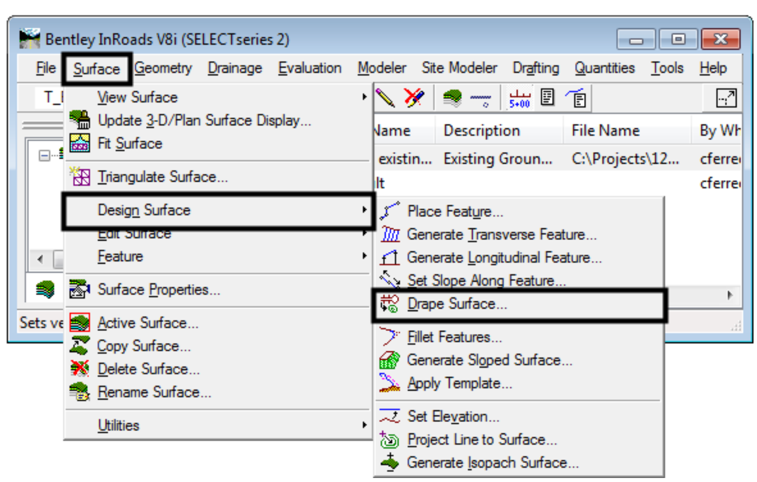


43. Repeat step 42 for each gap in the pavement edge lines. The illustration below shows all of the gaps closed.



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**.



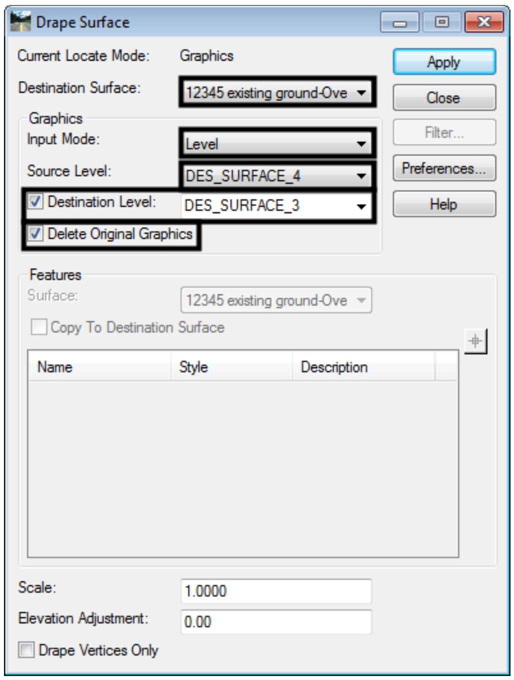
45. In the ***Drape Surface*** dialog box, verify that the Destination Surface is set to **12345 existing ground-Overlay**.

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.

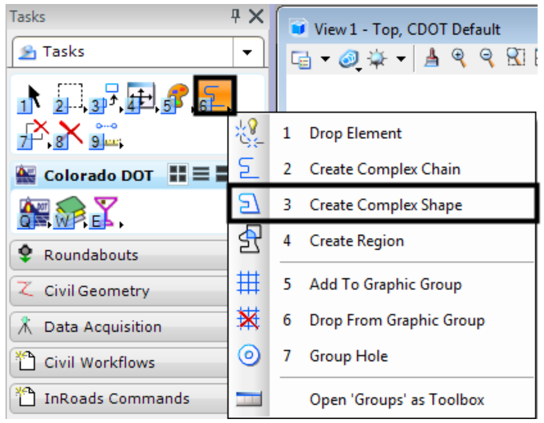
51. **<D> Close** to dismiss the ***Drape Surface*** dialog box.

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

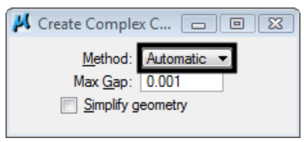
52. Select **Fit View** from the MicroStation ***View Controls***.

53. From the MicroStation main taskbar, 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.

54. From the MicroStation main taskbar, select the **Create Complex Chain** command.



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



56. **<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.

57. **<D>** in a blank area to accept the selection set and create a single chain from the elements.

58. **<D>** on the left most element in the bottom line then **<D>** in a blank area.

59. **<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 if 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.

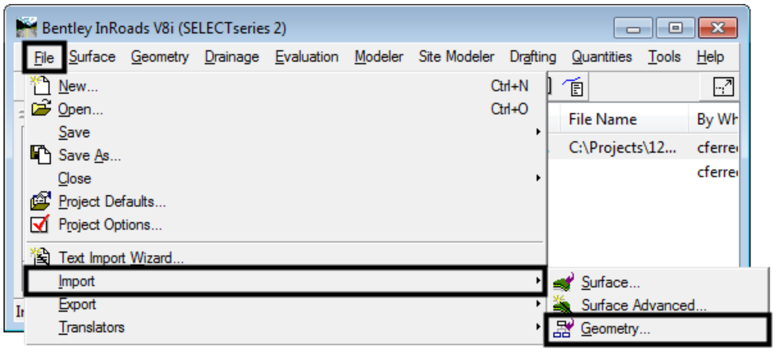
Lab 24.2 - Creating Alignments from Graphic Chains

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**.

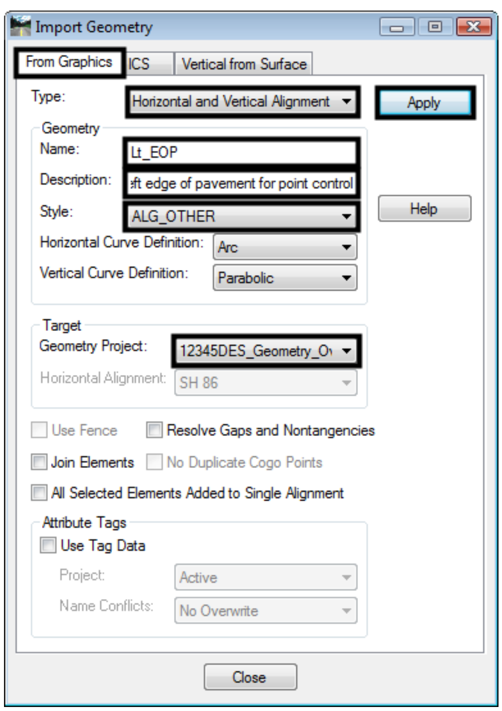
4. In the ***Name*** field, key in ***Lt_EOP***.

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.

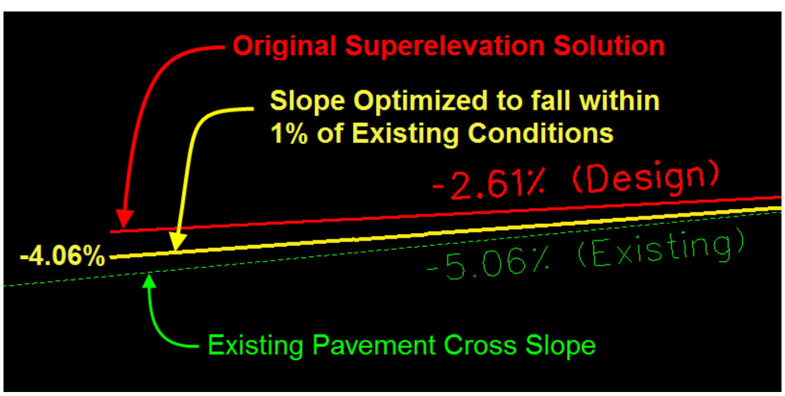
Section Summary:

- ♦ 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.

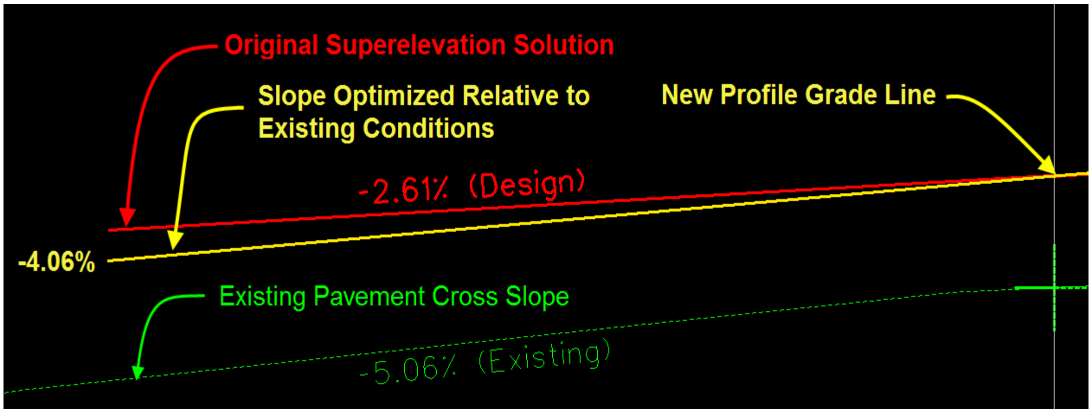
Lab 24.3 - Cross Slope Optimization - Concept Lab

Specialized tools for overlay and stripping projects have been added to the SELECTseries release of InRoads. Included is a slope optimization utility which redefines the cross slope of a template relative to existing conditions. Also new components are available that address overlay, pavement leveling, and milling requirements.

The slope optimization utility compares design cross slopes (based on template design and superelevation) to the existing ground at template application locations. Based on the Slope Tolerance provided by the user, a corrected slope value is calculated for each template drop. This information is used to modify the superelevation control line and adjust the template cross slope.



Slope optimization can be utilized if the design profile is coincident to or offset from existing ground.

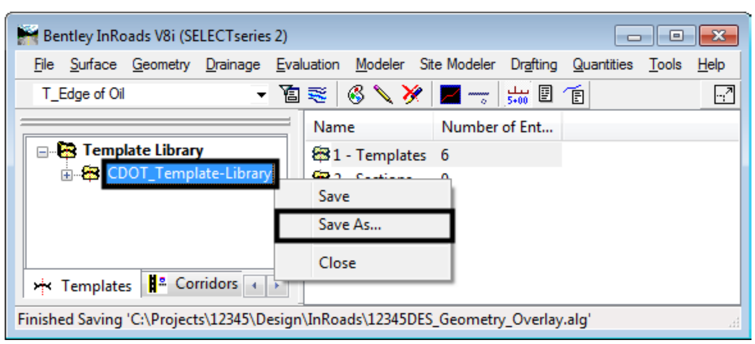


Section Objectives:

- Copy the standard template library into the project folder.
- Create a new template placeholder.
- Add simple components to define the template.
- Illustrate the function of the slope optimization tool.
- A subsequent lab will utilize slope optimization to model an overlay and widening project.

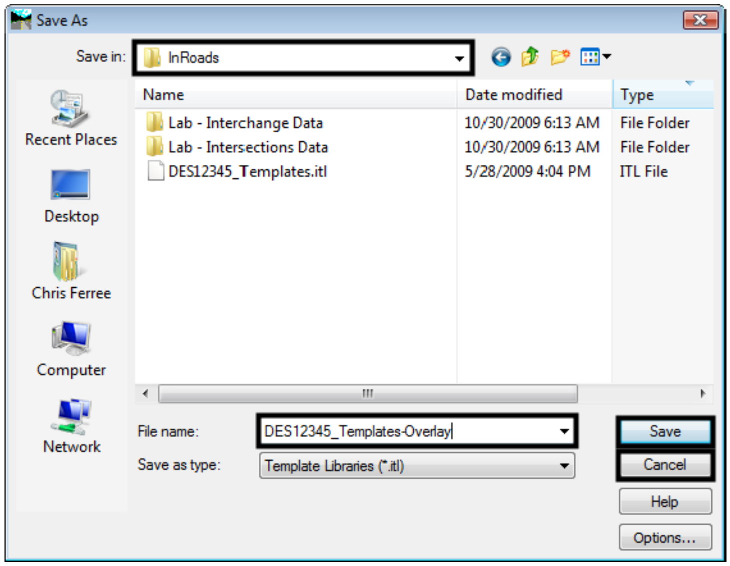
First, the standard template library is copied into the project directory.

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***.

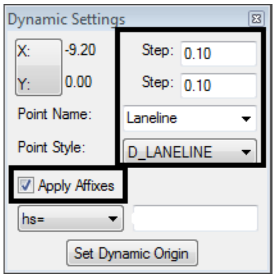
5. **<D> Save** then **<D> Cancel**.



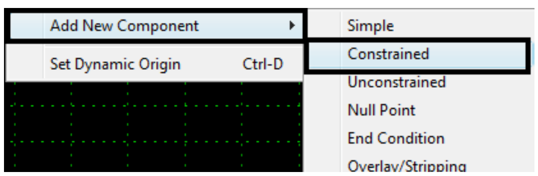
Next, a new template is created in the template library. The template will be very basic to illustrate the slope optimization utility however the concept can be applied to any template created.

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_Slope-Optimization*** for the template name.
10. In the ***Current Template*** area, key in **12 FT lane with 2% Cross Slope** for the ***Description.***
11. Select **Tools>Dynamic Settings** to display the ***Dynamic Settings*** dialog box.
12. In the ***Dynamic Settings*** dialog box, key in ***0.10*** for the ***X*** and ***Y Steps***.
13. Toggle on **Apply Affixes**.

14. In the ***Point Name*** field, select **Laneline.** The ***Point Style*** is automatically set to **D_LANELINE.**



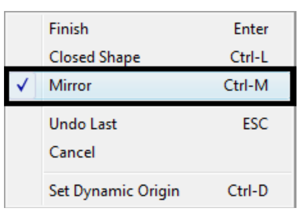
15. **<R>** in the template view and select **Add New Component > Constrained** from the right click menu.



16. In the ***Current Component*** area, key in ***DrivingLane-12FT*** for the ***Name***.

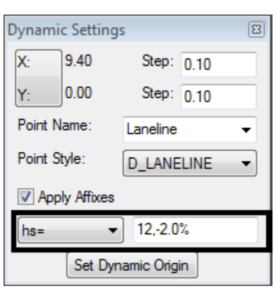
17. Select **D_CONC_Pvmt** for the ***Style***.

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



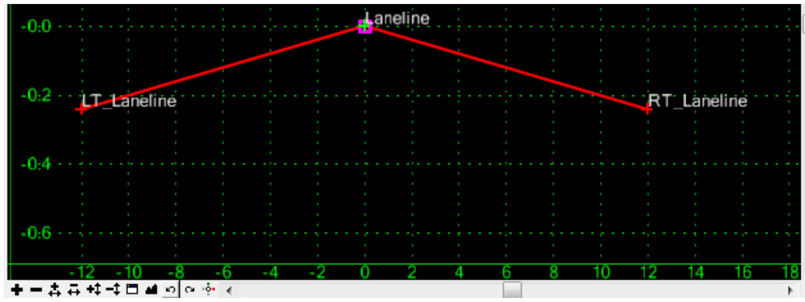
19. **<D>** on the template origin.

20. In the ***Dynamic Settings*** dialog box, key in ***12,-2.0%*** in the **hs=** field and **<enter>** to build the components.

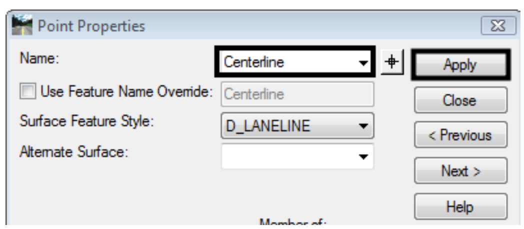


21. **<enter>** a second time to finish the component or **<R>** and select **Finish** from the right click menu.

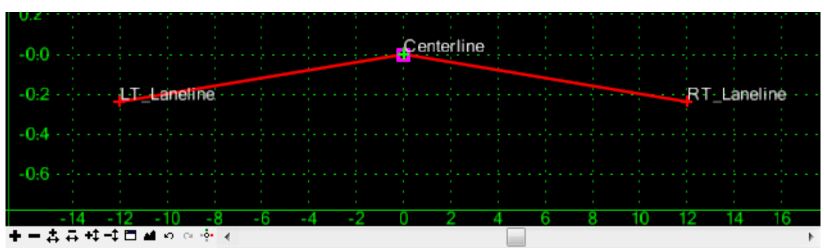
This creates two components representing left and right lanes, however, the the template origin needs to be renamed.



22. **<D><D>** on the **Laneline** point. This displays the ***Point Properties*** dialog box.
23. In the Name field of the ***Point Properties*** dialog box, key in ***Centerline*** and then **<D> Apply.**



24. <D> to dismiss the ***Point Properties*** dialog box.



25. ***Save*** the template library by selecting **File>Save**
26. In the ***Create Template*** dialog box, **<D> Close.**

Lab 24.4 - Creating the Slope Optimized Corridor

A corridor is constructed using the template developed and slope optimization will be applied.

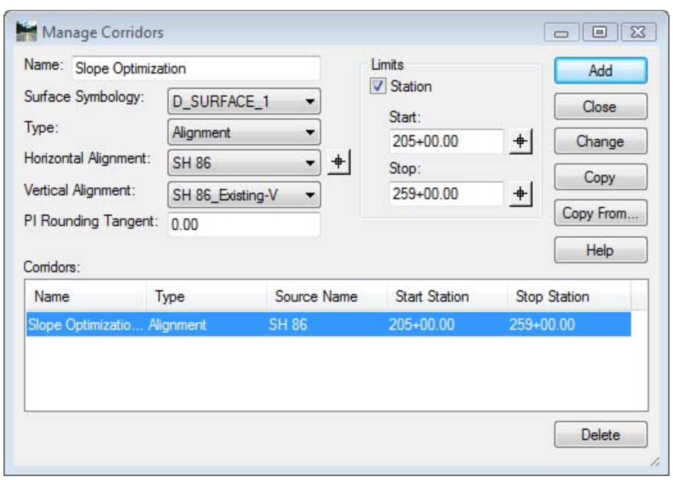
Section Objectives:

- Create a corridor for the SH 86 alignment.
- Add a template drop using the developed template.
- Develop a Superelevation solution for the corridor.

- Review the superelevation solution in Roadway Designer.
- Apply slope optimization to modify the superelevation control lines
- Review the revised corridor

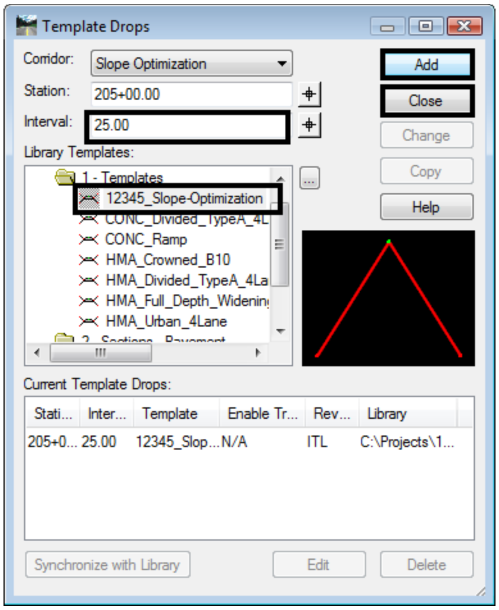
This corridor will contain a single template application. Superelevation is required for this corridor because of design speed criteria. However once the superelevation solution is calculated it will be modified to minimize the cross slope variation relative to existing conditions.

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 ***Slope Optimization*** for the ***Name***.
4. ***Surface Symbology:*** **D_Surface_1**
5. ***Horizontal Alignment:*** **SH 86**
6. ***Vertical Alignment:*** **SH 86_Existing-V**
7. Toggle on **Station Limits**.
8. Key in ***205+00.00*** for the ***Start*** station.
9. Key in ***259+00.00*** for the ***Stop*** station.
10. **<D> Add** then **<D> Close** to dismiss the dialog box.



11. In the ***Roadway Designer*** dialog box, select **Corridor > Template Drops** from the menu bar.
12. In the ***Template Drops*** dialog box, key in ***25.00*** for the ***Interval***.
13. Expand the **C:\Projects\12345\Design\InRoads\DES12345_Templates-Overlay** template library to show the contents of the **1 - Templates** folder.
14. Highlight the **12345_Slope-Optimization** template.

15. **<D>** the **Add** button then **<D>** the **Close** button to dismiss the ***Template Drops*** dialog box.



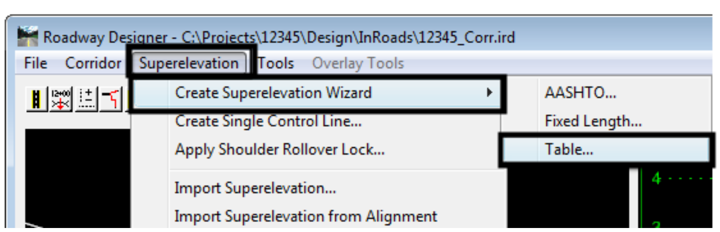
The template is now displayed in the cross section view. Next, superelevation controls are added to the corridor.

Calculating the Initial Superelevation

Superelevation is computed to develop a control line along each edge of pavement. In a subsequent command, Cross Slope Optimization, the computed design cross slopes are evaluated relative to existing conditions. When developing an optimized cross slope the superelevation control lines are copied and modified to develop a revised solution.

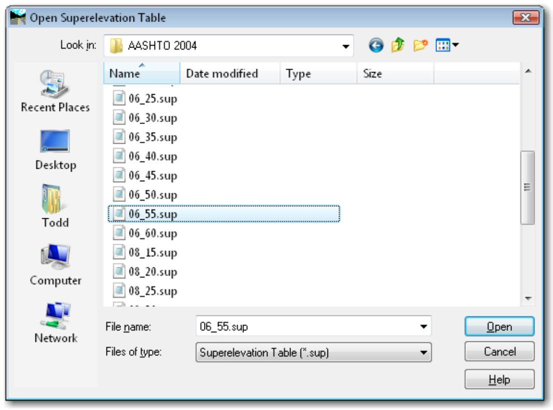
Use the Superelevation Wizard:

1. Select **Superelevation > Create Superelevation Wizard > Table** from the Roadway Designer menu bar.



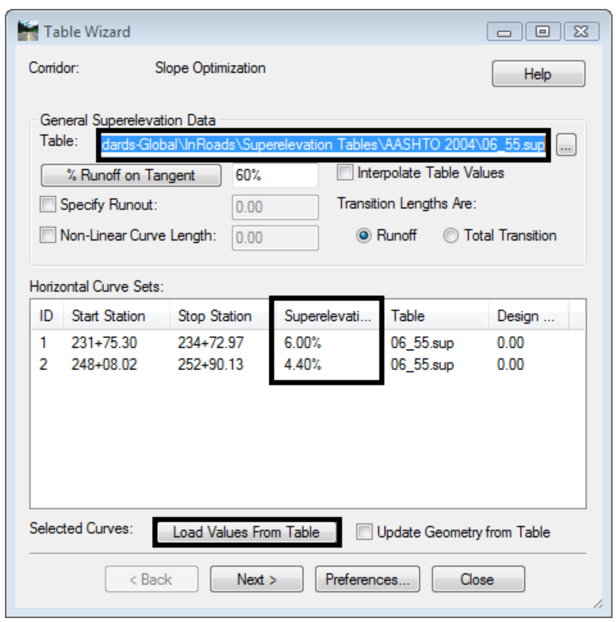
2. In the ***Table Wizard*** dialog box, **<D>** the  button to display the ***Open Superelevation Table*** dialog box.

3. In the ***Open Superelevation Table*** dialog box, navigate to : ***C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Superelevation Tables\AASHTO 2004***



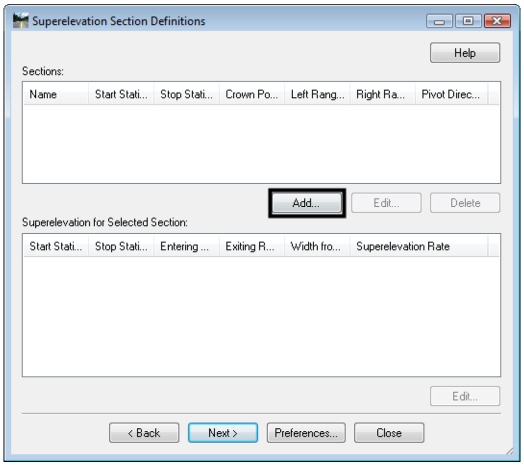
4. Select ***06-55.sup*** and **<D>** the **Open** button.

5. **<D>** the **Load Values From Table** button.

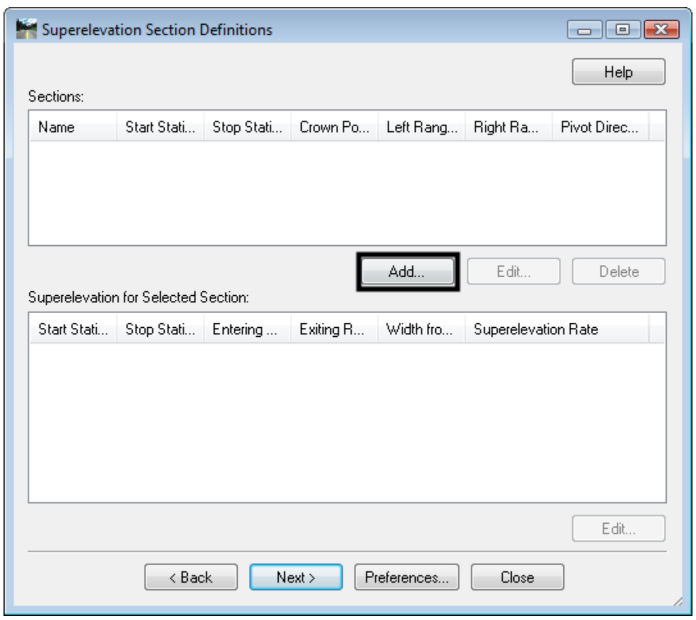


The rate values are read from the table and updated for each horizontal curve set listed in the dialog box or highlighted.

6. **<D> Next**.

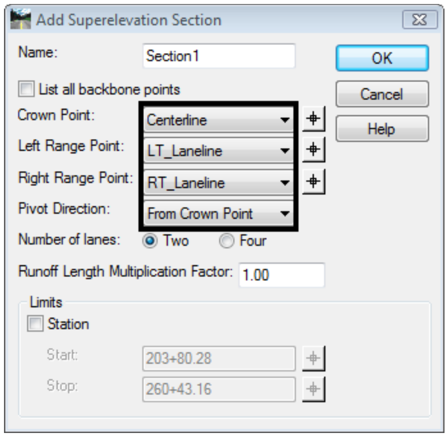


7. **<D>** the **ADD** button on the ***Superelevation Section Definitions*** pane. This displays the ***Add Superelevation Section*** dialog box.



8. Use the drop down menu or the target button to select the ***Crown Point:*** **Centerline**.
9. Use the drop down menu or the target button to select the ***Left Range Point:*** **LT_Laneline.**

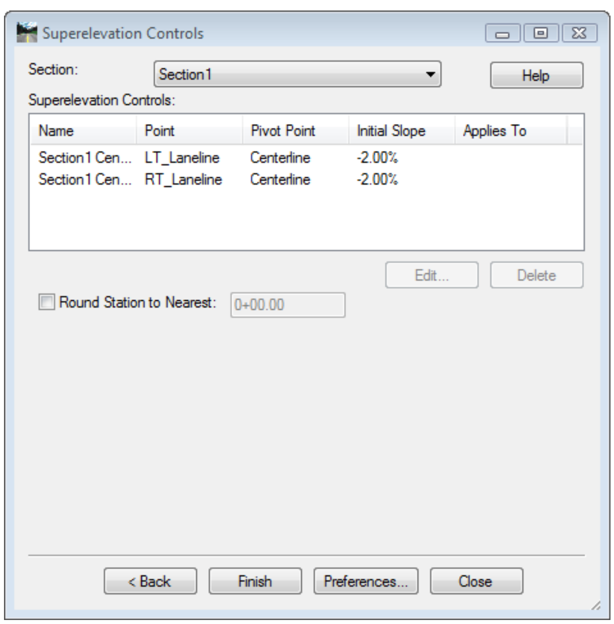
10. Use the drop down menu or the target button to select the ***Right Range Point:*** **RT_Laneline.**



11. **<D> OK.**

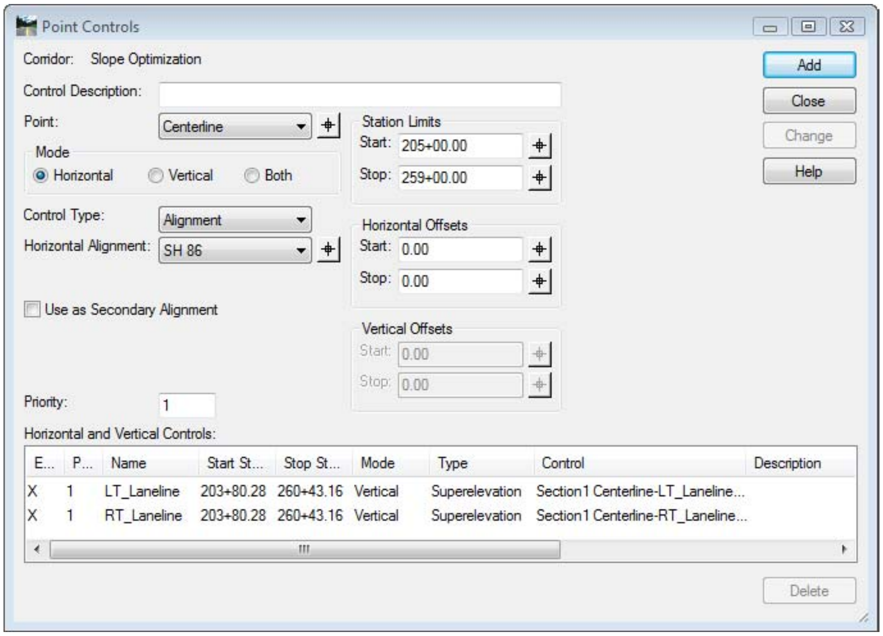
12. **<D> Next** on the ***Superelevation Section Definitions*** pane. This displays the ***Superelevation Controls*** pane.

    Note: This box lists point controls that are created automatically when you step through the Superelevation Wizard. The point controls determine the vertical location (by defining a cross slope) of template points (those at and inside the range points) while rotating in superelevation.



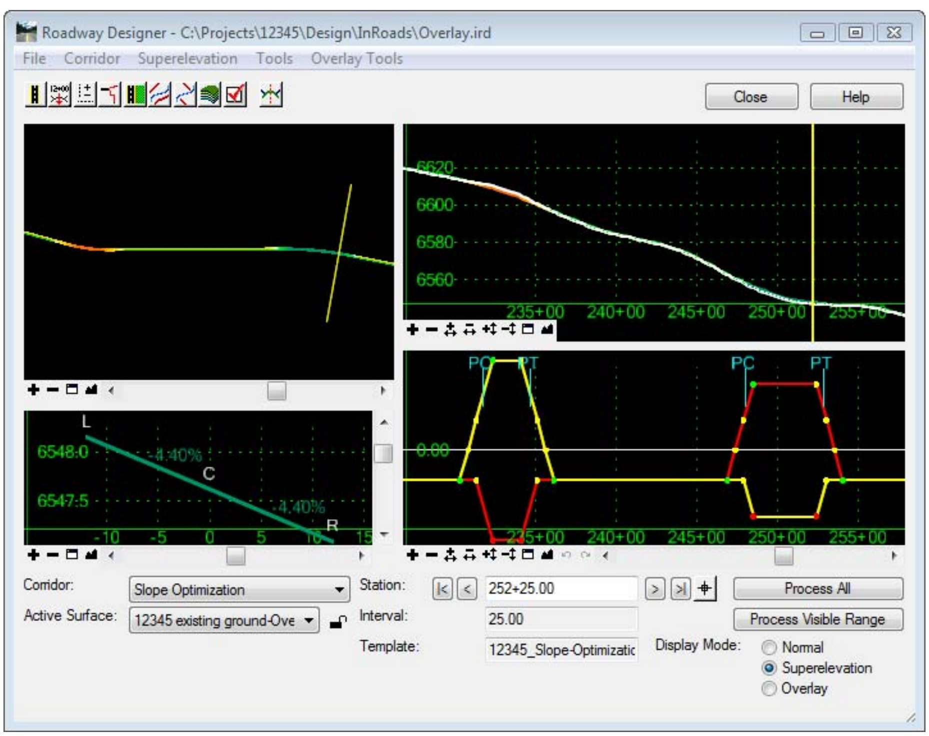
13. **<D> Finish**. This completes the development of superelevation for the corridor.

The Wizard creates superelevation control lines and uses point controls to assign them to template points located within the superelevation range.



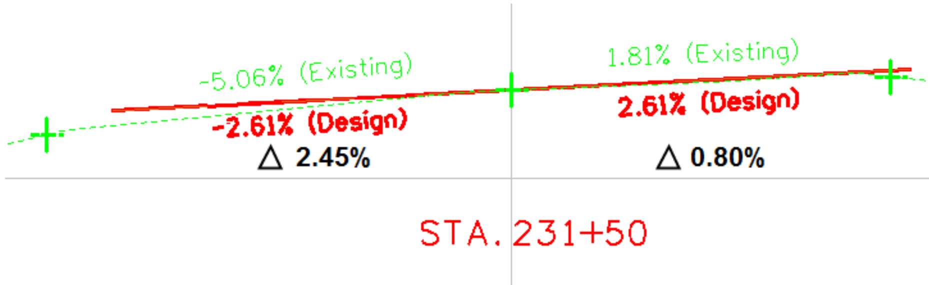
You will need to process your design to see the superelevation results. Each point control corresponds to a control line on the superelevation diagram.

The superelevation control lines are displayed on the superelevation diagram view in Roadway Designer. The control lines represent the percent cross slope (vertical axis) at each station (horizontal axis) for each point that is superelevated in the super range.



14. Toggle between ***Superelevation*** and ***Normal*** display mode to evaluate the design cross slopes vs. the existing conditions along the corridor.

15. In particular review station **231+50**



InRoads has developed the design cross slope based on a theoretical superelevation solution. Due to the nature of this project it is necessary to minimize the amount of cross slope deviation between the design and existing conditions. The slope optimization tool lets a designer add overrides to the computed Superelevation solution.

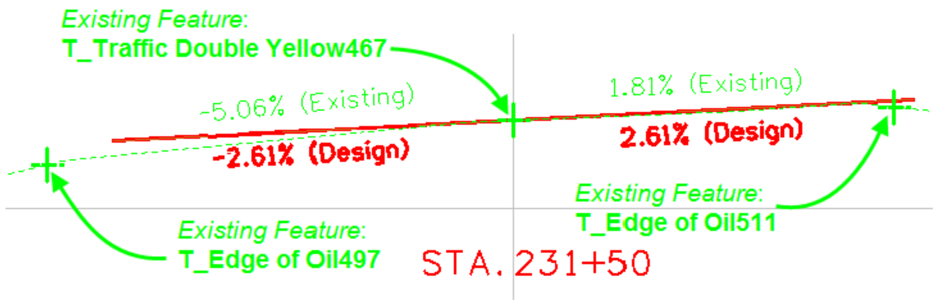
Developing a Slope Optimized Solution

For the following exercise, assume that the desired maximum delta cross slope has been determined to be 1.0%.

- Slope optimization develops additional control lines based on modifications to the superelevation solution developed for the design. The new control lines take precedence over the original superelevation solution by automatically disabling the original solution.
- Slope optimization has to be developed independently for each lane or side of the roadway.
- Station ranges can be used to isolate curves or set based on the location of controlling features contained in the existing DTM.
- Slope optimization may be used whether the design templates contain overlay/ stripping components or not.

At each template application location the existing ground cross slope is determined by computing the delta elevation divided by the absolute distance between the existing pivot point and either a feature in the existing DTM or an alignment that represents the existing edge of pavement.

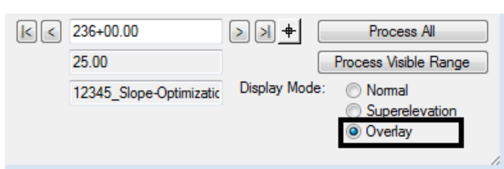
In the ***Cross Slope Optimization*** dialog box, the alignments developed in labs 15.1 and 15.2 can be used as the ***Existing Ground Cross Slope Definition***. However for this exercise, features that reside in the existing DTM will be used to illustrate an optional workflow.



By reviewing the physical location of features contained in the existing DTM it has been determined that a solution can be developed between station range 226+55 and 239+75 which encompasses a superelevated area of the design.

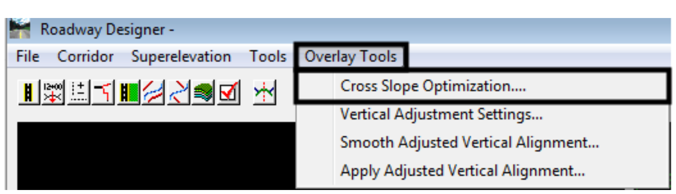
The left side of the roadway will be processed first followed by the right side.

1. In ***Roadway Designer*** toggle on ***Display Mode:*** **Overlay.**



Note: The display mode ***must*** be set to **Overlay** to access the overlay toolset.

2. In ***Roadway Designer*** Select **Overlay Tools>Cross Slope Optimization.**



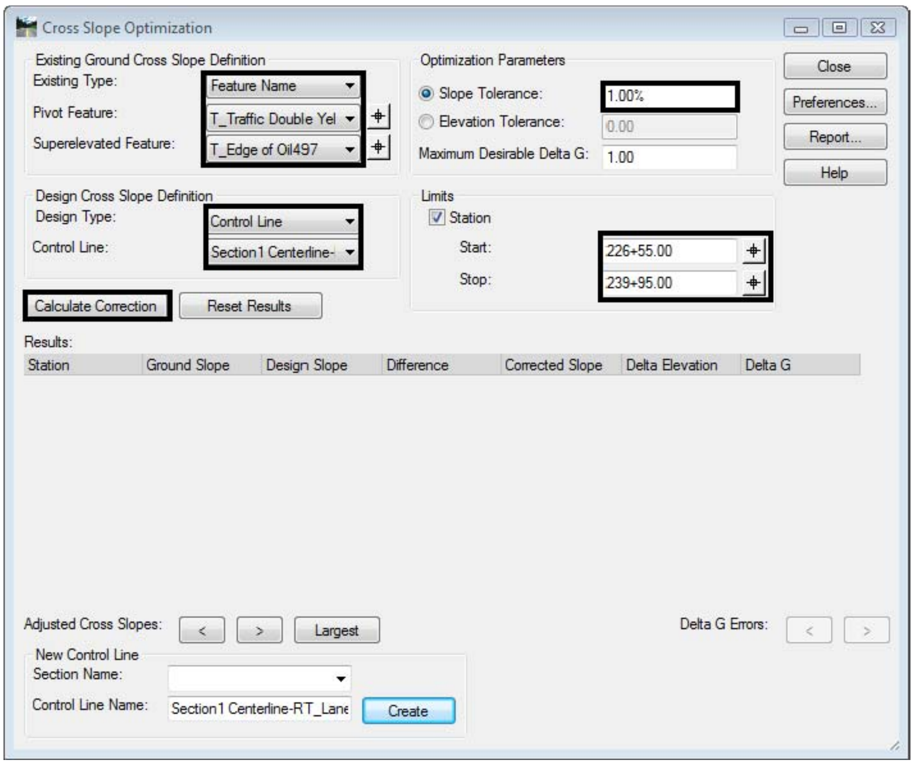
Enter the following criteria to define the ***Existing Ground Cross Slope Definition.***

3. ***Existing Type:*** **Feature Name**
4. ***Pivot Feature:*** **T_Traffic Double Yellow 467**

5. ***Superelevated Feature:*** **T_Edge of Oil497**

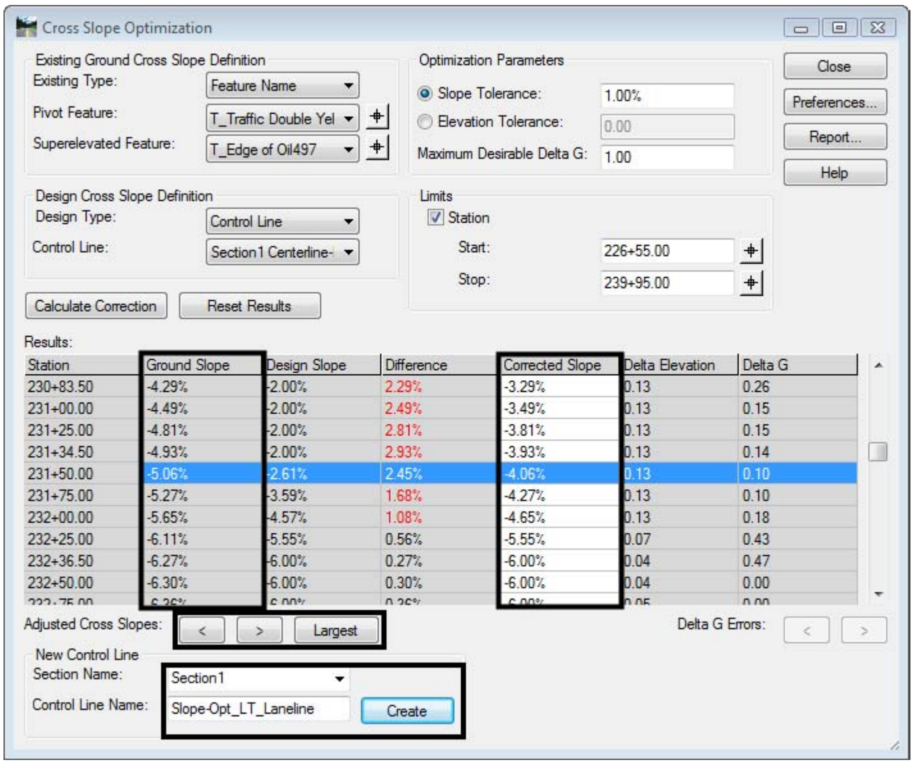
For the ***Design Cross Slope Definition*** select the superelevation control line developed previously for the ***left*** edge of pavement.

6. ***Design Type:*** **Control Line**
7. ***Control Line:*** **Section 1 Centerline-LT_Laneline.**
8. Key in ***1.00%*** for the ***Optimization Parameters - Slope Tolerance***
9. Toggle on ***Station Limits*** and define limits ***Start 226+55 Stop 239+50.***
10. **<D>** the ***Calculate Correction*** button. This computes the cross slope optimization data.

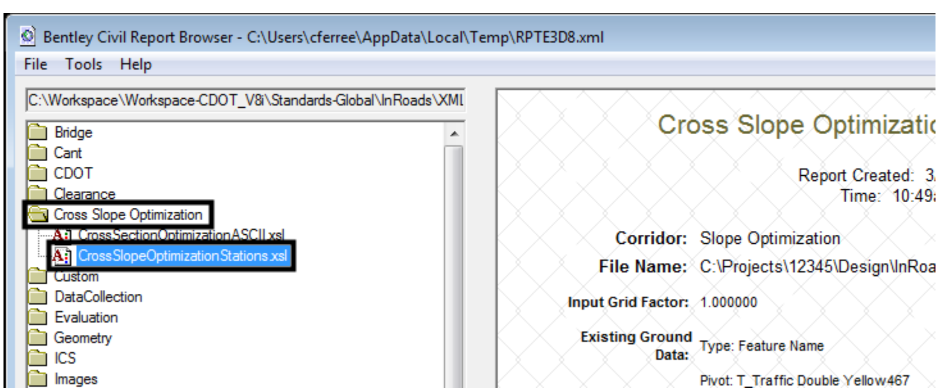


11. Use the navigation arrows to move between the ***Adjusted Cross Slopes*** or to the largest adjustment. Notice that the Corrected Slopes are not more than 1.0% different from the Ground Slope.

    Note: Navigation arrows also exist to review any ***Delta G*** values that exceed the desirable maximum between stations. This value is not used for computing Corrected Slopes and is used for reporting only.



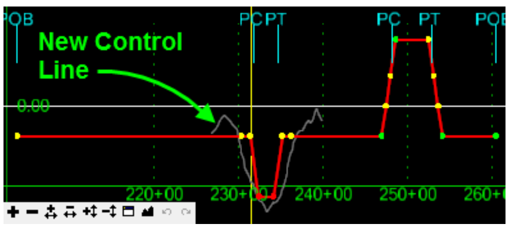
12. Review station **231+50**. The ***Corrected Slope*** (-4.06%) is equal to the existing ***Ground Slope*** (-5.06%) less the specified ***Slope Tolerance*** (1.0%).
13. Select **Report** to generate an XML report for the solution.
14. Select the **Cross Slope Optimization > CrossSlopeOptimizationStations.xsl** style sheet.



15. Dismiss the report after reviewing.

Note: If it's determined the solution is not valid, selecting ***Reset Results*** will clear the results grid.

The new cross slopes have been computed based on the existing cross slope and the allowable ***Slope Tolerance.*** Edits to the corrected values can be made at this time if necessary. Once the new control line is saved edits can also be made to the new control line as with any other superelevation control line. Also note that the solutions are applied at template locations as defined in the corridor. As you navigate between station entries, the ***Roadway Designer*** views synchronize and both the original and the new control line are displayed in the superelevation diagram window.

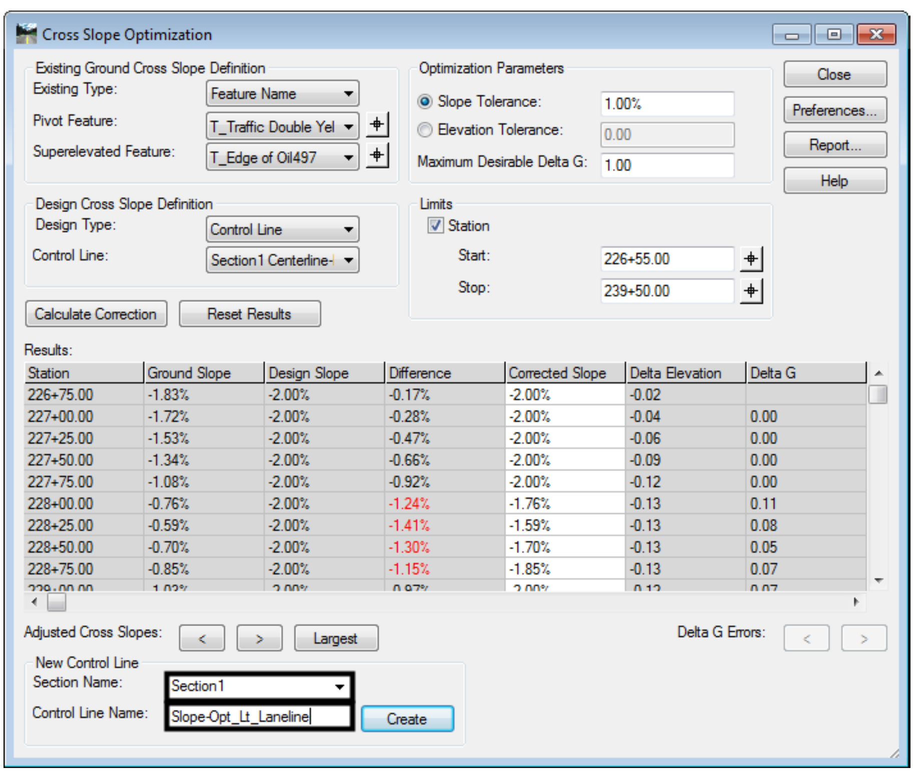


To create the control line:

16. Under ***New Control Line***, select ***Section Name:*** **Section 1.**

17. For ***Control Line Name***: Key in ***Slope-Opt_Lt_Laneline.***

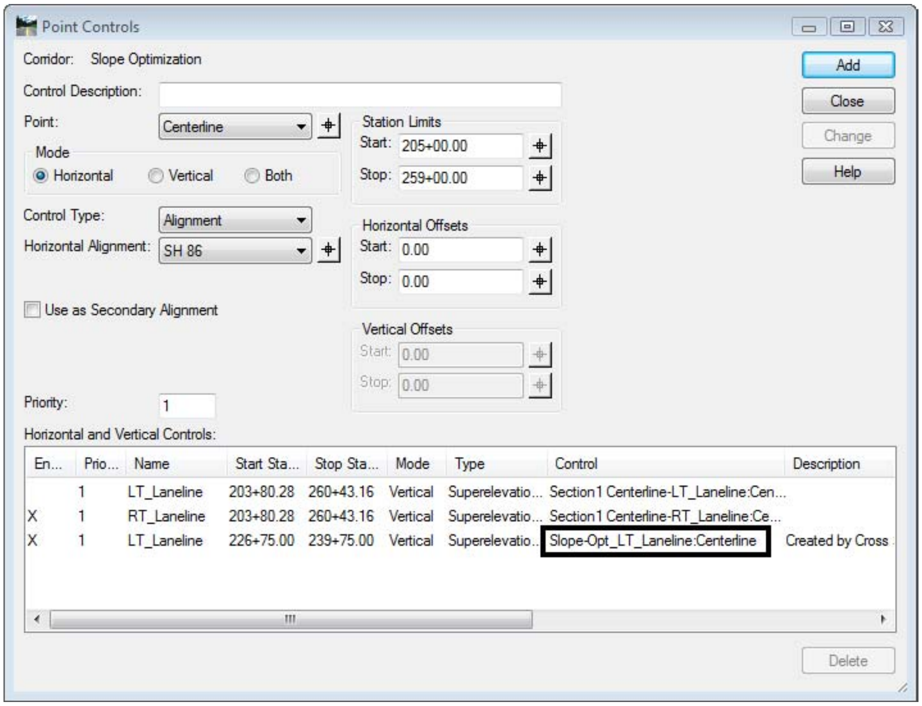
18. **<D>** ***Create***.



19. **<D> Close** to dismiss the ***Cross Slope Optimization*** dialog box.

Review the new control line in the superelevation view and as point controls.

20. Select **Corridor>Point Controls** to view the added control line. Note that it is automatically enabled and the original superelevation control line is disabled.

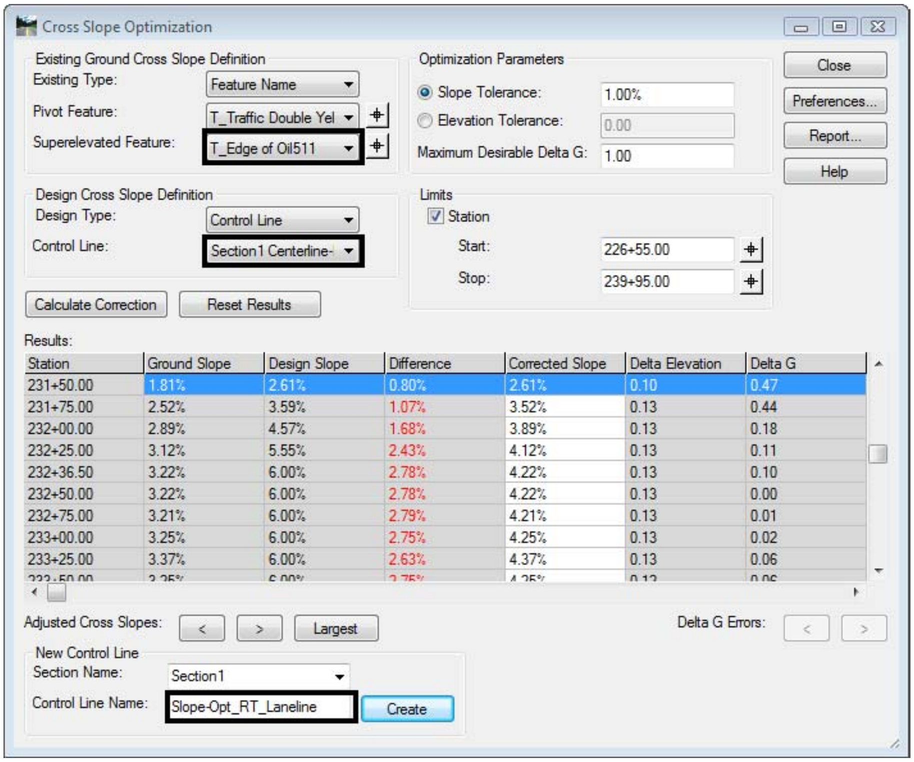


Note: The **Superelevation>Superelevation Report** command can also be used to review the results. When creating reports include ***Control Line Definitions*** to verify which control line is being reviewed.

21. ***Repeat*** steps 2 thru 18 to develop the solution for the right side of the roadway using the following input changes:

- ♦ In the ***Existing Ground Cross Slope Definition*** area, for the ***Superelevated Feature*** field use **T_Edge of Oil511.**
- ♦ In the ***Design Cross Slope Definition*** area, for the ***Control Line*** field use **Section1 Centerline-RT_Laneline.**

♦ In the New Control Line area, for the Control Line Name use **Slope-Opt_RT_Laneline.**



Station	Ground Slope	Design Slope	Difference	Corrected Slope	Delta Elevation	Delta G
231+50.00	1.81%	2.61%	0.80%	2.61%	0.10	0.47
231+75.00	2.52%	3.59%	1.07%	3.52%	0.13	0.44
232+00.00	2.89%	4.57%	1.68%	3.89%	0.13	0.18
232+25.00	3.12%	5.55%	2.43%	4.12%	0.13	0.11
232+36.50	3.22%	6.00%	2.78%	4.22%	0.13	0.10
232+50.00	3.22%	6.00%	2.78%	4.22%	0.13	0.00
232+75.00	3.21%	6.00%	2.79%	4.21%	0.13	0.01
233+00.00	3.25%	6.00%	2.75%	4.25%	0.13	0.02
233+25.00	3.37%	6.00%	2.63%	4.37%	0.13	0.06

22. Once the results have been reviewed and confirmed save the roadway definition.

23. From the Roadway Designer menu bar, select **File > Save**.

24. In the ***File name*** field of the ***Save As*** dialog box, key in ***12345_DES_Overlay.IRD***

Section Summary:

♦ The width of the template can be controlled by adding additional point controls or through the use of parametric constraints.

♦ Slope Optimization can be used to create a design surface that is vertically offset but constrained (parallel or within a delta tolerance) to existing conditions.

♦ A superelevation control line is not a requirement. If matching existing grade, a Design Cross Slope of any value can be input. With Slope Tolerance set to 0% the Corrected Slope will match existing conditions.

♦ An Elevation Tolerance can be used in place of a slope tolerance.

♦ Review the point controls created in Roadway Designer. Those created by the Cross Slope Optimization tool should be active and the control lines created by the superelevation control wizard should not be enabled.

♦ Look for and resolve any conflicting point controls (shown in orange).

♦ Cross Slope Optimization can be used on any template.

Lab 24.5 - Creating a Overlay Template with Widening

The goal of this lab is to overlay the existing roadway and add paved shoulders outside the existing pavement. In Labs 15.1 & 15.2 alignments were created that represent the existing pavement edges. These alignments will be used as horizontal point controls to maintain the existing pavement width.

Note: Stripping and milling are interchangeable terms. They both refer to the uniform removal of some amount of pavement material from an existing roadway. InRoads menus and reference material use the term stripping.

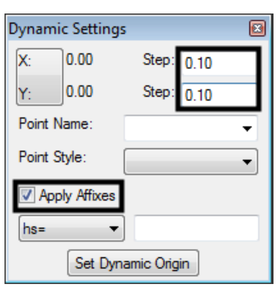
Section Objectives:

- ♦ A 2” pavement overlay is required over the existing surface.
- ♦ 8’ paved shoulders will be added to the outside of the existing pavement.
- ♦ Existing pavement cross slopes will be maintained.

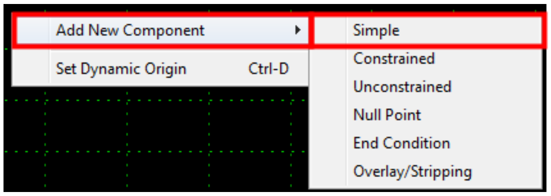
  Note: This template will be modified in a later lab to add stripping and leveling components.

A template will be constructed using new components for the overlay portion and existing components for the shoulders and sideslopes.

1. Open the **Create Template** dialog box.
2. Create a new template in the **1 - Templates** folder.
3. Key in ***12345_Overlay*** for the template name.
4. Key in ***2” overlay with 1” milling & pavement widening*** for the description.
5. Display the **Dynamic Settings** dialog box.
6. Key in ***0.10*** for the ***X*** and ***Y Steps***.
7. Toggle on **Apply Affixes**.

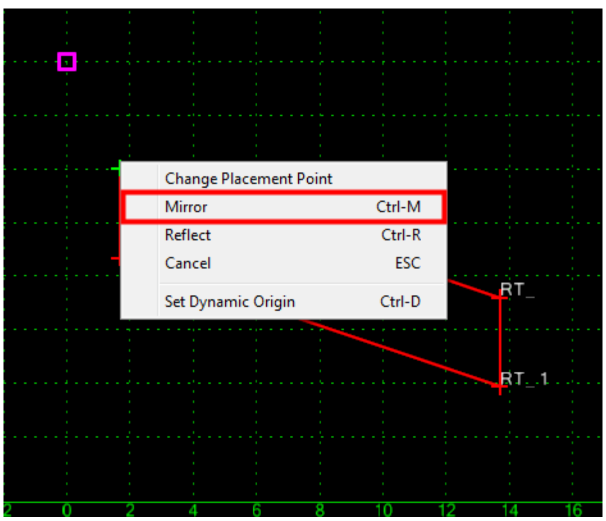


8. **<R>** in the template view and select **Add New Component > Simple** from the right click menu.

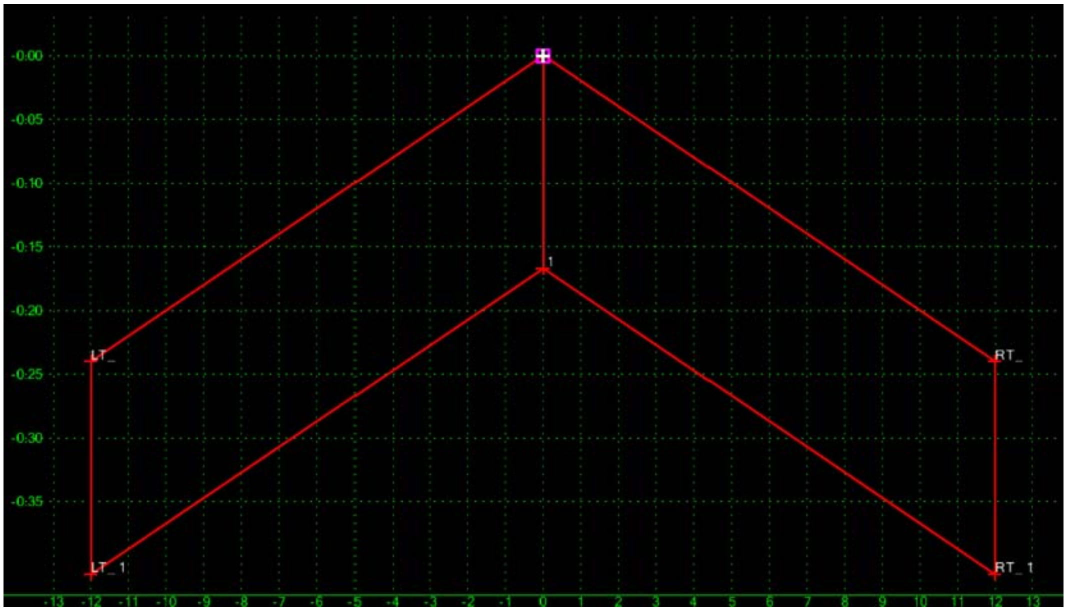


9. In the ***Current Component*** area, key in ***HMA_Overlay*** for the ***Name***.
10. Select **D_HMA_Pvmt** for the ***Style***.
11. Key in ***0.1667*** for the ***Thickness***. Note: this will round to 0.17 in the dialog box.

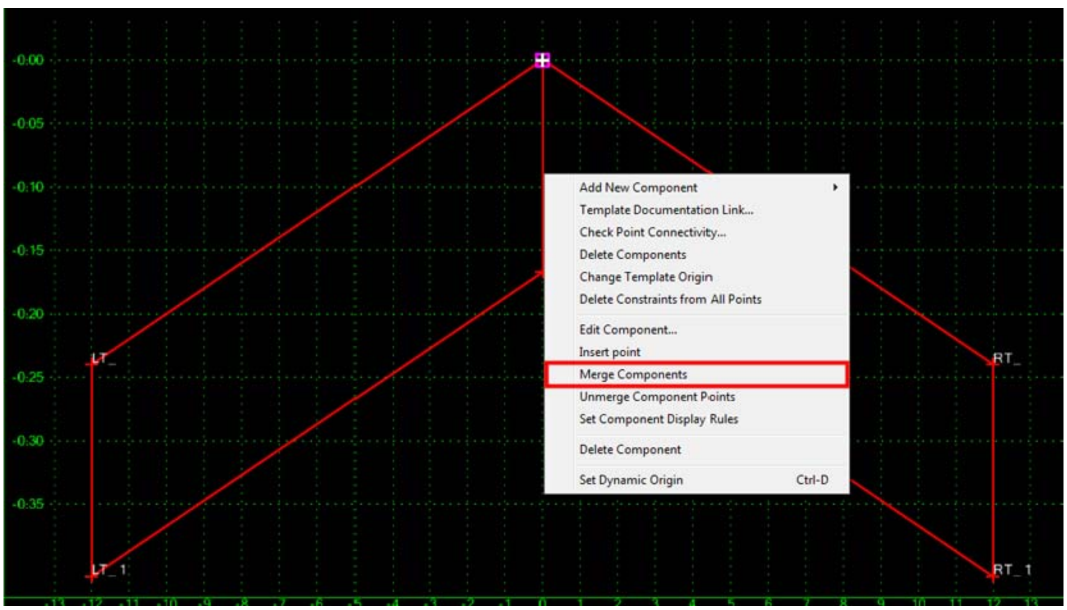
12. **<R>** in the template view and select **Mirror** from the right click menu.



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



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

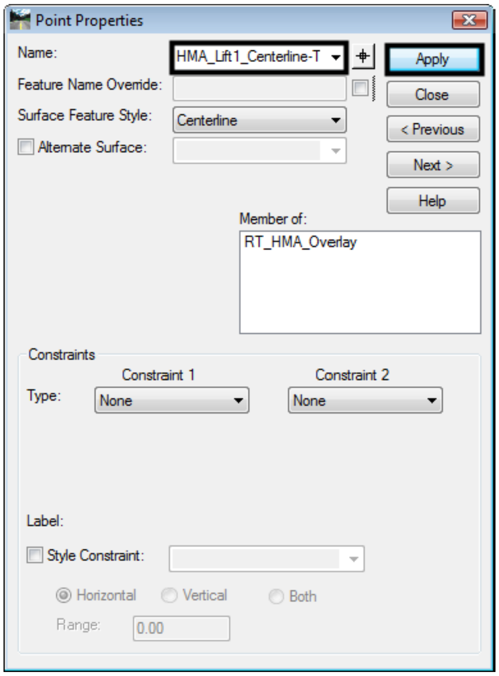


15. **<D> <D>** on the centerline point of the template to display the ***Point Properties*** dialog box.

16. In the ***Point Properties*** dialog box, select **HMA_Liftx_Centerline-Top** in the ***Name*** field. This also sets the ***Surface Feature Style*** to **Centerline**.

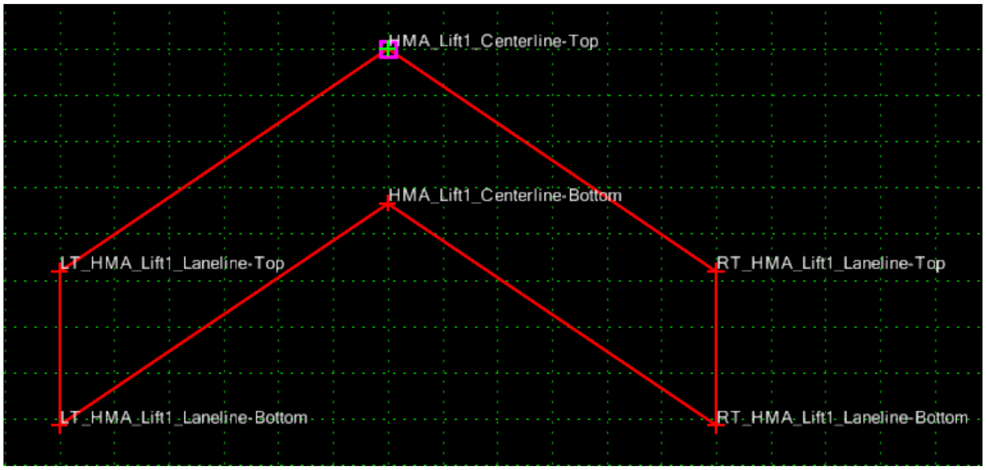
17. Change the ***x*** to a ***1*** in the ***liftx*** part of the name.

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



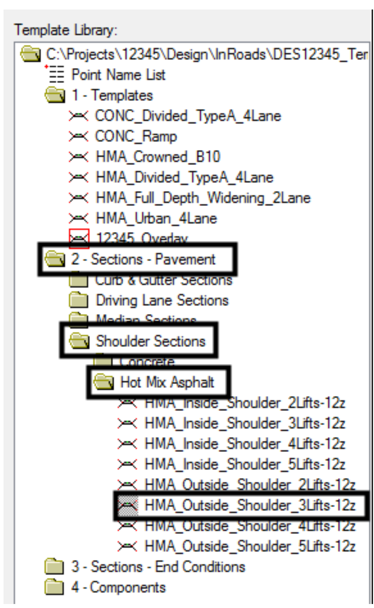
19. **<D>** the **Next** button to select the center bottom point (***1***).
20. Select **HMA_Liftx_Centerline-Top** in the ***Name*** field.
21. Change the name and change to read ***HMA_Lift1_Centerline-Bottom***.
22. **<D> Apply** to accept the change.
23. **<D>** the **Next** button to select the right top point (***RT_***).
24. In the same manner as above, change the name of the point to ***RT_HMA_Lift1_Laneline-Top***.
25. **<D> Apply** to accept the change.
26. **<D>** the **Next** button to select the right bottom point (***RT_1***).
27. Change the name of the point to ***RT_HMA_Lift1_Laneline-Bottom***.
28. **<D> Apply** to accept the change.
29. **<D>** the **Next** button to select the right top point (***LT_***).
30. In the same manner as done as above, change the name of the point to ***LT_HMA_Lift1_Laneline-Top***.
31. **<D> Apply** to accept the change.
32. **<D>** the **Next** button to select the right bottom point (***LT_1***).
33. Change the name of the point to ***LT_HMA_Lift1_Laneline-Bottom***.

34. **<D> Apply** to accept the change.
35. **<D> Close** to dismiss the ***Point Properties*** dialog box. The template looks like the illustration below:



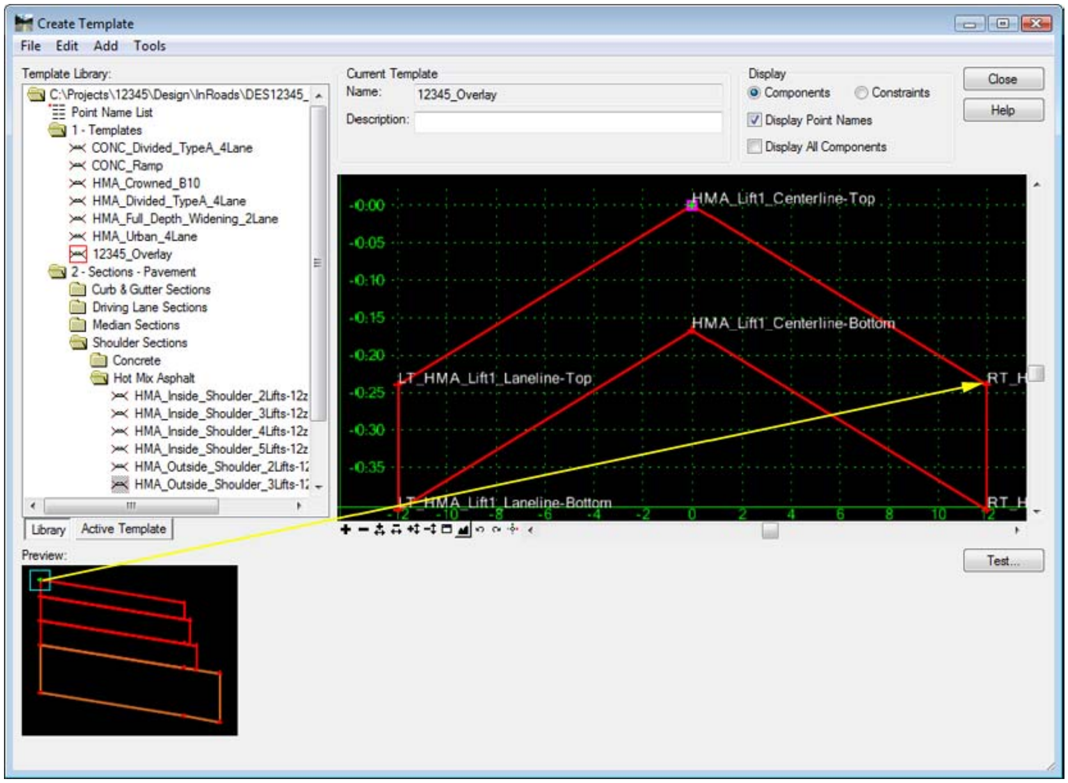
Now the shoulders and end conditions are added.

36. Expand the template library to show the contents of the **2 - Sections - Pavement > Shoulder Sections > Hot Mix Asphalt** folder.
37. **<D>** on the **HMA_Outside_Shoulder_3Lifts-12z** section.



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

39. 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.

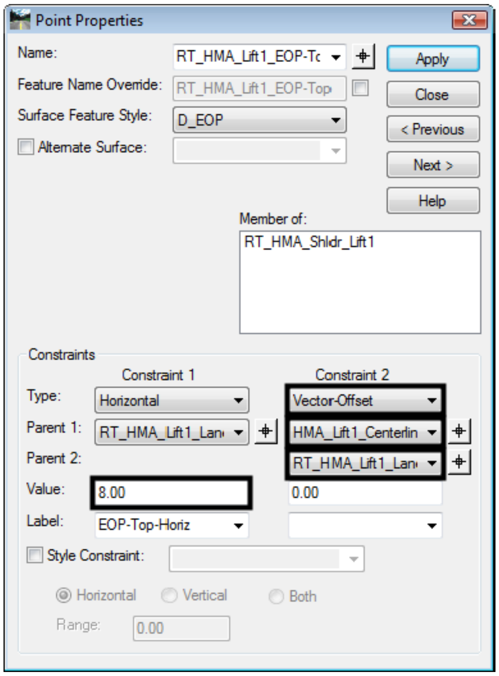
40. **<D> <D>** on the **RT_HMA_Lift1_EOP-Top** point to display the ***Point Properties*** dialog box.

41. The shoulders should be 8' wide. Change the ***Value*** of the ***Horizontal*** constraint (***Constraint 1*** in this example) to ***8.00***.

42. Change the ***Slope*** constraint (***Constraint 2*** in this example) to a **Vector-Offset** ***Type***.

43. Set the ***Parent 1*** to **HMA_Lift1_Centerline-Top**.

44. Set the ***Parent 2*** to **RT_HMA_Lift1_Laneline-Top**.



45. Repeat for 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.

46. **<D> Apply** and then **<D> Close** to dismiss the ***Point Properties*** dialog box.

47. Expand the template library to show the contents of the **3 - Sections - End Conditions > Z-Slope End Conditions > High Speed End Conditions** folder.

48. **<D>** on the **Z12_6_to_1** section.

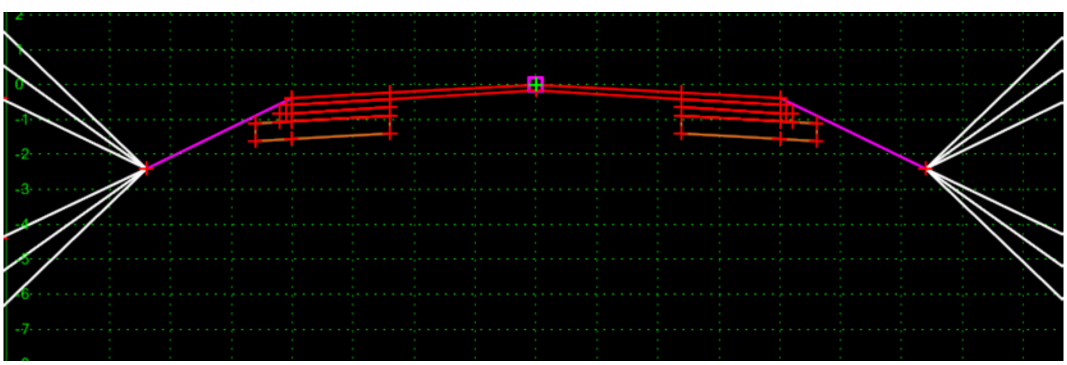
49. In the Preview window, **<D>** and hold on the section's origin (the upper left point).

50. Drag and drop the section onto the **RT_HMA_Lift1_EOP-Top** point.

51. This completes the template. Select **File > Save** from the ***Create Template*** menu bar.

52. **<D> Close** to dismiss the ***Create Template*** dialog box.

The illustration below shows the completed template:



Section Summary:

- By using the vector offset constraint the shoulders will maintain the same slope as the overlay section.
- Once the right click options of Mirror and Reflect are turned on, they remain active until they are turned off.

Lab 24.6 - Creating the Overlay Corridor

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

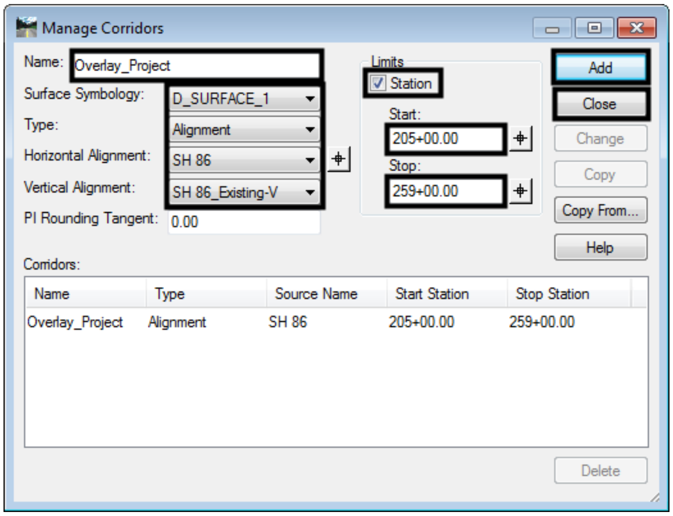
Section Objectives:

- 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.
- Add a superelevation solution to the corridor.
- Refine the corridor using Cross Slope Optimization.
- Add a Leveling course to the template.
- Add a stripping course to the template.
- Add vertical alignment adjustments.
- Regress the refined vertical alignment.
- Apply the regressed vertical alignment to the corridor.

This corridor will contain a single template drop along with point controls. Horizontal controls will define the width of the overlay section. Vertical controls will be generated initially through superelevation and ultimately refined by cross slope optimization. Overlay and stripping criteria will be defined to adjust and smooth the vertical alignment.

1. From the InRoads menu bar, select **Modeler > Roadway Designer**.
2. If not already set, toggle ***Display Mode:*** to **Normal.**
3. In the ***Roadway Designer*** dialog box, select **Corridor > Corridor Management** from the menu bar.
4. In the ***Manage Corridors*** dialog box, key in ***Overlay Project*** for the ***Name***.
5. ***Set Surface Symbology:*** **D_ROADWAY-Asphalt**
6. Set ***Horizontal Alignment:*** **SH 86**
7. Set ***Vertical Alignment:*** **SH 86_Existing-V**
8. Toggle on **Station Limits**.
9. Key in ***205+00.00*** for the ***Start*** station.
10. Key in ***259+00.00*** for the ***Stop*** station.

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



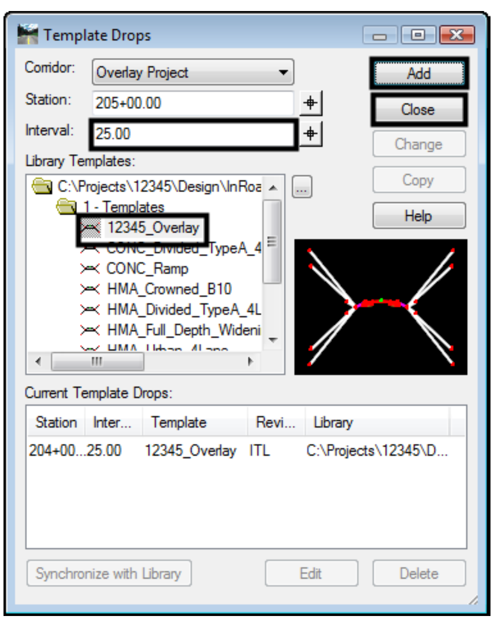
12. In the ***Roadway Designer*** dialog box, select **Corridor > Template Drops** from the menu bar.

13. In the ***Template Drops*** dialog box, key in ***25.00*** for the ***Interval***.

14. Expand the **C:\Projects\12345\Design\InRoads\DES12345_Templates-Overlay** template library to show the contents of the **1 - Templates** folder.

15. Highlight the **12345_Overlay** template.

16. **<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 make the design template match the width of the existing roadway.

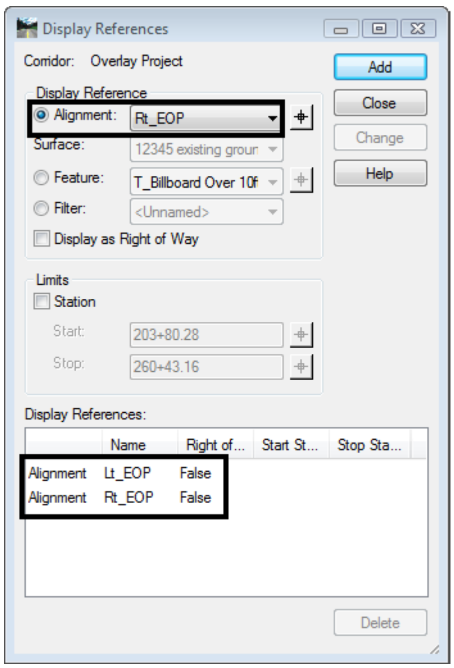
Lab 24.7 - Horizontal Point Controls

Before assigning horizontal controls to the template points, for visual reference, display the controlling elements in the roadway designer views.

1. In the ***Roadway Designer*** dialog box, select **Corridor > Display References**

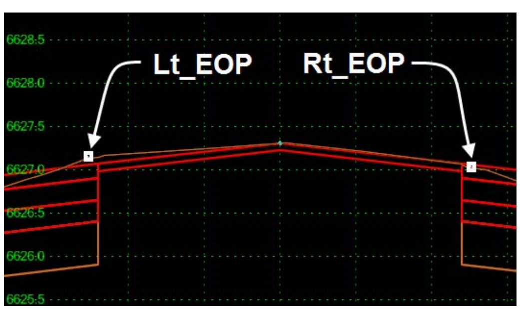
Add the alignments Lt_EOP and Rt_EOP created earlier in this chapter that represent the left and right edges of existing pavement.

2. **Add** alignments ***Lt_EOP*** and ***Rt_EOP*** as displayed references.



3. **<D>** the **Add** button then **<D>** the **Close** button to dismiss the ***Display References*** dialog box.

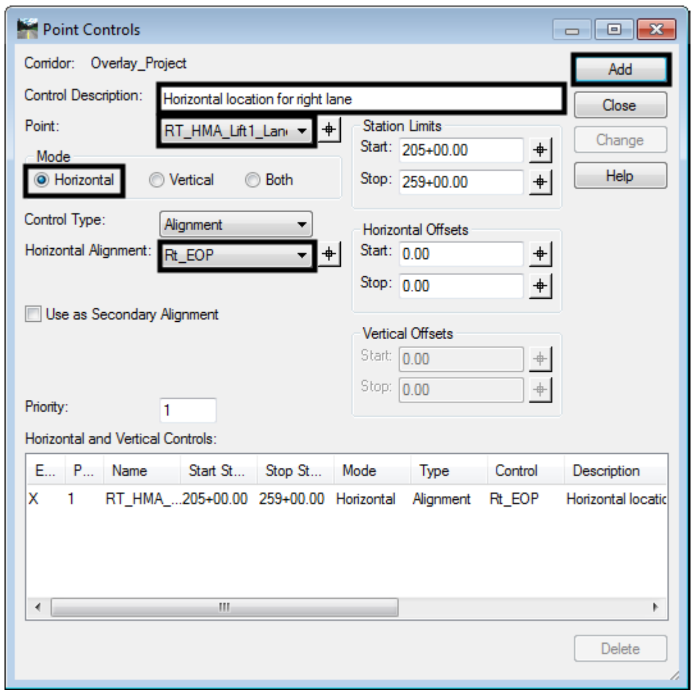
The alignments are displayed in Roadway Designer.



4. From the Roadway Designer menu bar, select **Corridor > Point Controls**.

5. In the ***Point Controls*** dialog box, key in ***Horizontal location for right lane*** for the ***Control Description.***

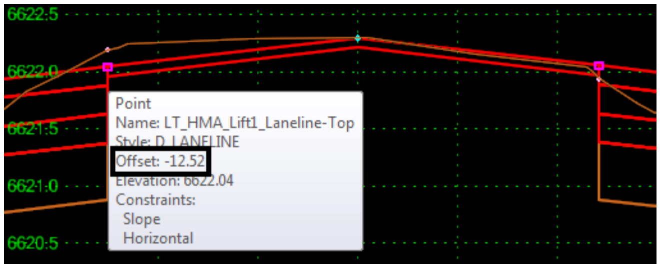
6. Set the Point to **RT_HMA_Lift1_Laneline-Top**.
7. Toggle on **Horizontal** for the ***Mode***.
8. Select **Rt_EOP** for the ***Horizontal Alignment***.
9. **<D>** the **Add** button.



10. In the ***Point Controls*** dialog box, key in ***Horizontal location for Left lane*** for the ***Control Description.***
11. Set the Point to **LT_HMA_Lift1_Laneline-Top**.
12. Select **Lt_EOP** for the ***Horizontal Alignment***.
13. Add ***Control Description: Horizontal location for left lane***
14. **<D>** the **Add** button the **<D> Close** to dismiss the Point Controls dialog box.

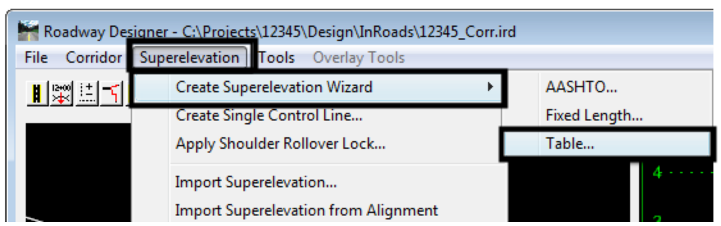
This completes the corridor definition. Now the corridor can be reviewed in Roadway Designer.

15. Scroll through the template drops using the station controls under the cross section view. Notice that the template width matches the horizontal location of the existing pavement.



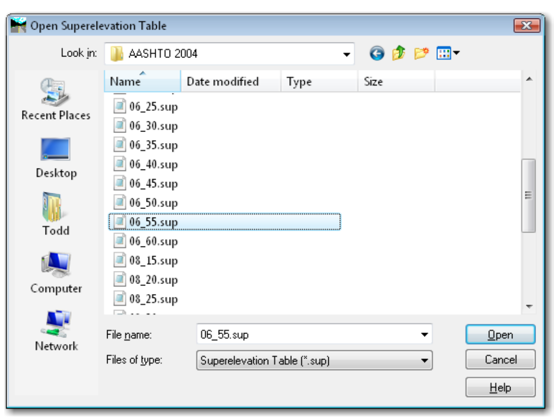
The template has been constrained to match the width of the existing pavement. Next Cross Slope Optimization will be used to match the existing pavement cross slope. First superelevation control lines will be created. These superelevation control lines will be overwritten by new control lines developed using cross slope optimization.

16. Select **Superelevation > Create Superelevation Wizard > Table** from ***the Roadway Designer*** menu bar.



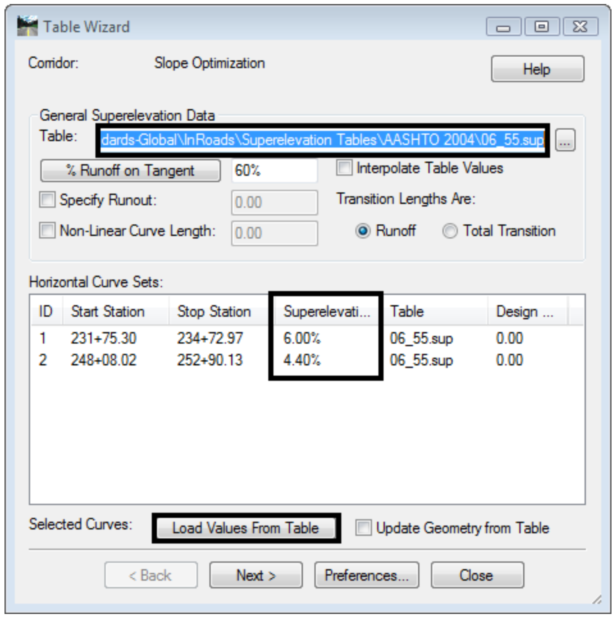
17. In the ***Table Wizard*** dialog box, **<D>** the ... button to display the ***Open Superelevation Table*** dialog box.

18. Navigate to the ***C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Superelevation Tables\AASHTO 2004*** folder.



19. Select ***06-55.sup*** and **<D>** the **Open** button.

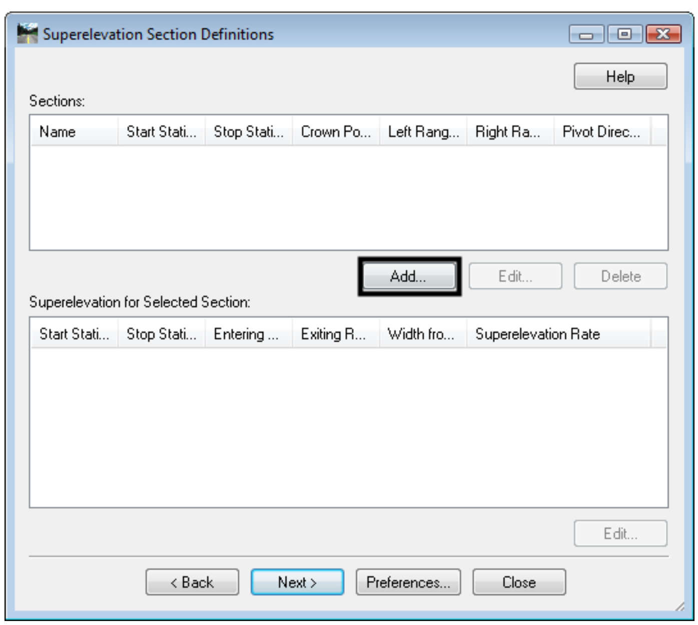
20. **<D>** the **Load Values From Table** button.



The rate values are read from the table and updated for each horizontal curve set listed in the dialog box or highlighted.

21. **<D> Next**.

22. **<D>** the **ADD** button on the ***Superelevation Section Definitions*** pane. This displays the ***Add Superelevation Section*** dialog box.

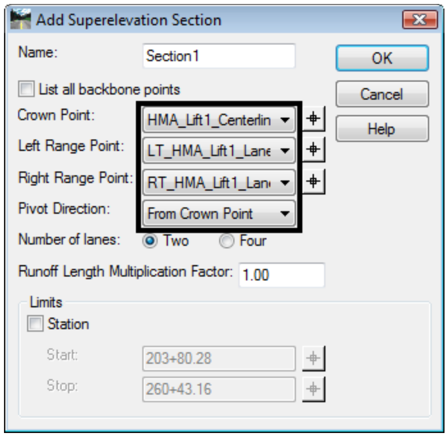


23. Use the drop down menu or the target button to select the ***Crown Point:*** **HMA_Lift1_Centerline**.

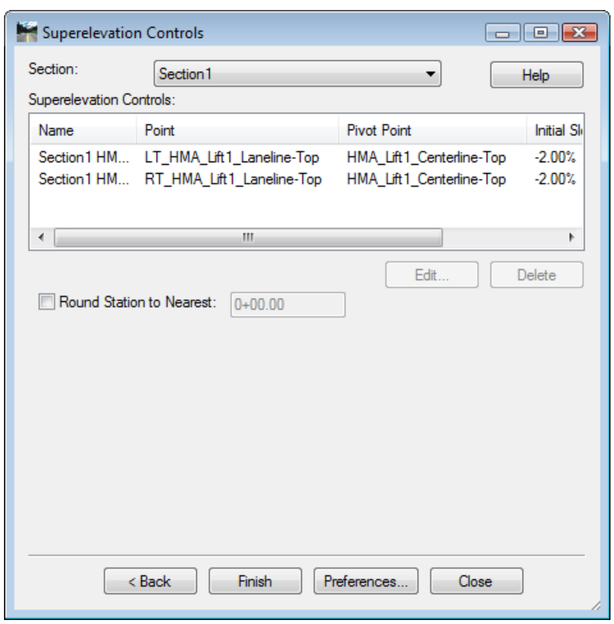
24. Use the drop down menu or the target button to select the ***Left Range Point:*** **LT_ HMA_Lift1_Laneline.**

25. Use the drop down menu or the target button to select the ***Right Range Point:*** **RT_HMA_Lift1_Laneline.**

26. **<D> OK.**

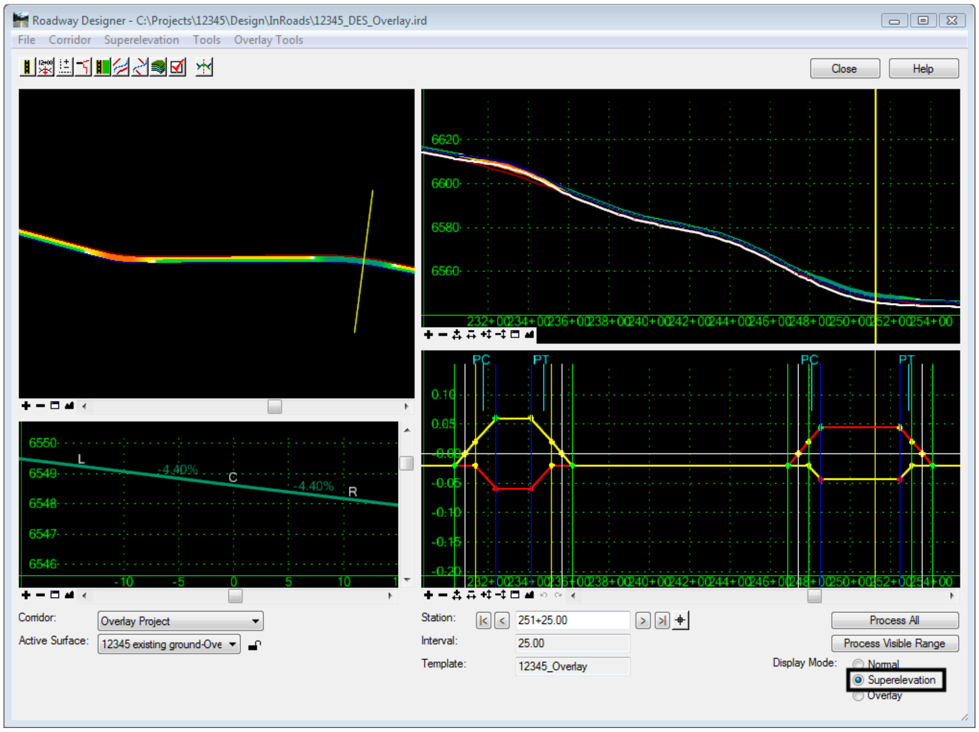


27. **<D> Next** on the ***Superelevation Section Definitions*** pane. This displays the ***Superelevation Controls*** pane.



28. **<D> Finish**. This completes the development of the initial superelevation control lines.

29. Review the computed superelevation in the Roadway Designer views and by setting the ***Display Mode*** to **Superelevation**.



Lab 24.8 - Optimize the Overlay Corridor

Now Cross Slope Optimization will be used to relate the template cross slopes to the existing pavement cross slopes.

1. In ***Roadway Designer*** toggle on ***Display Mode:*** **Overlay.**

   Note: The display mode ***must*** be set to overlay to access the overlay tools.

2. Select **Overlay Tools>Cross Slope Optimization.**

3. In the ***Existing Ground Cross Slope Definition*** area, set the ***Existing Type*** to **Alignment.**

4. Set the ***Pivot Alignment*** to **SH_86.**

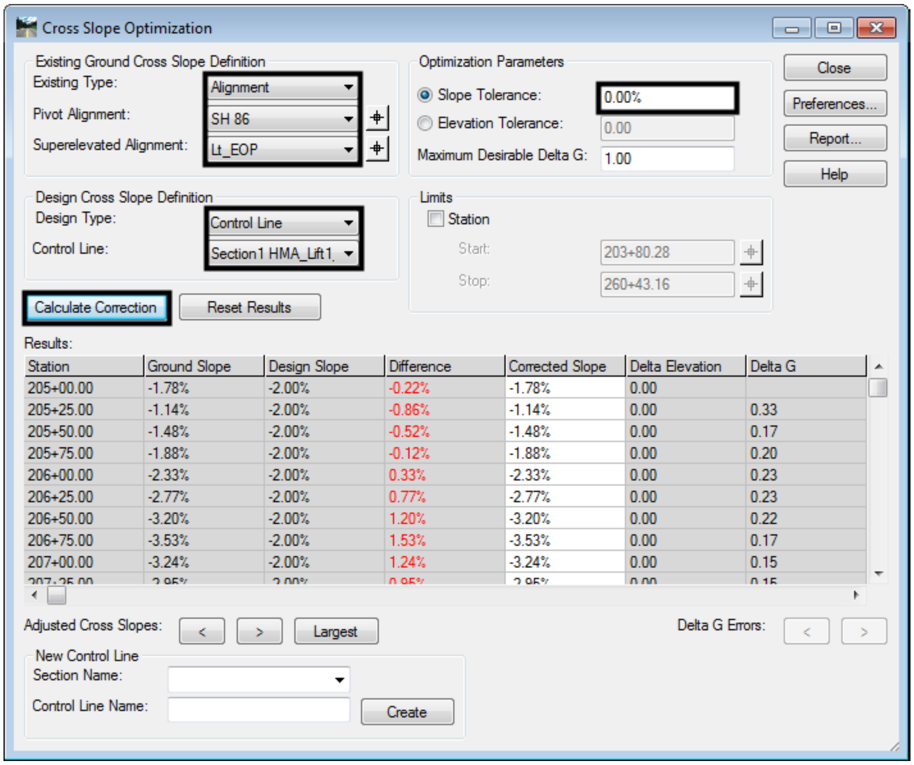
5. Set the ***Superelevated Alignment*** to **Lt_EOP**.

6. In the ***Design Cross Slope Definition*** area,select **Control Line** for the ***Design Type***.

7. ***Select*** **Section1 HMA_Lift1_Centerline-Top-LT_HMA_Lift1_Laneline-Top** for the ***Control Line.***

8. In the ***Optimization Parameters*** area, key in ***0.00%*** for the ***Slope Tolerance.***

9. **<D>** ***Calculate Correction*** a solution is presented.

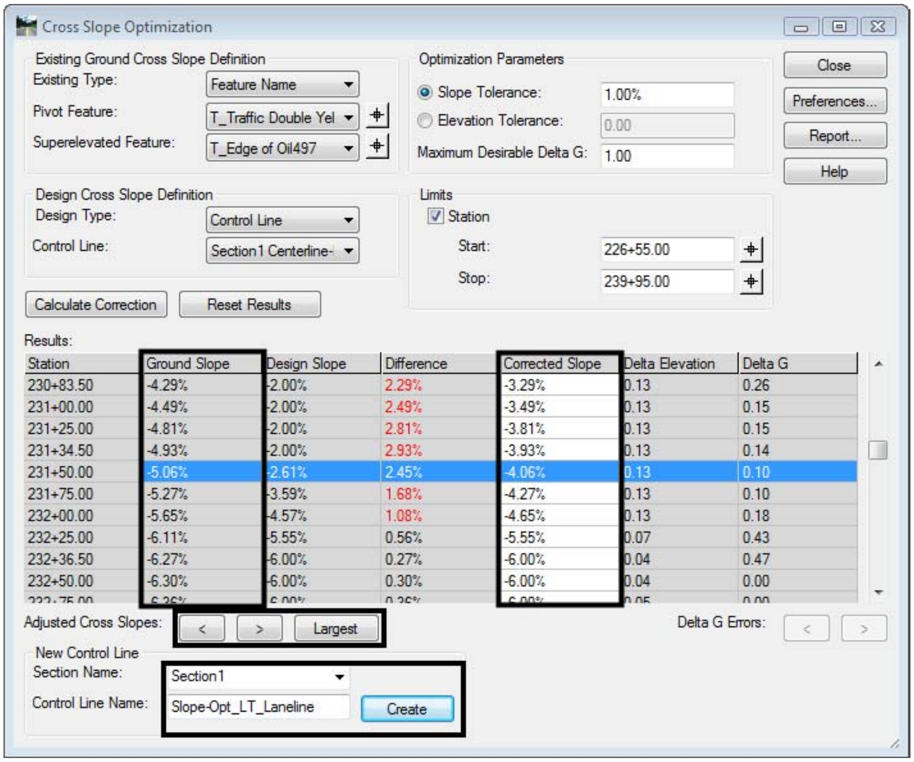


Note the values in columns Ground Slope & Corrected Slope match indicating the design cross slope now matches existing conditions.

10. Select ***Section Name***: **Section 1**

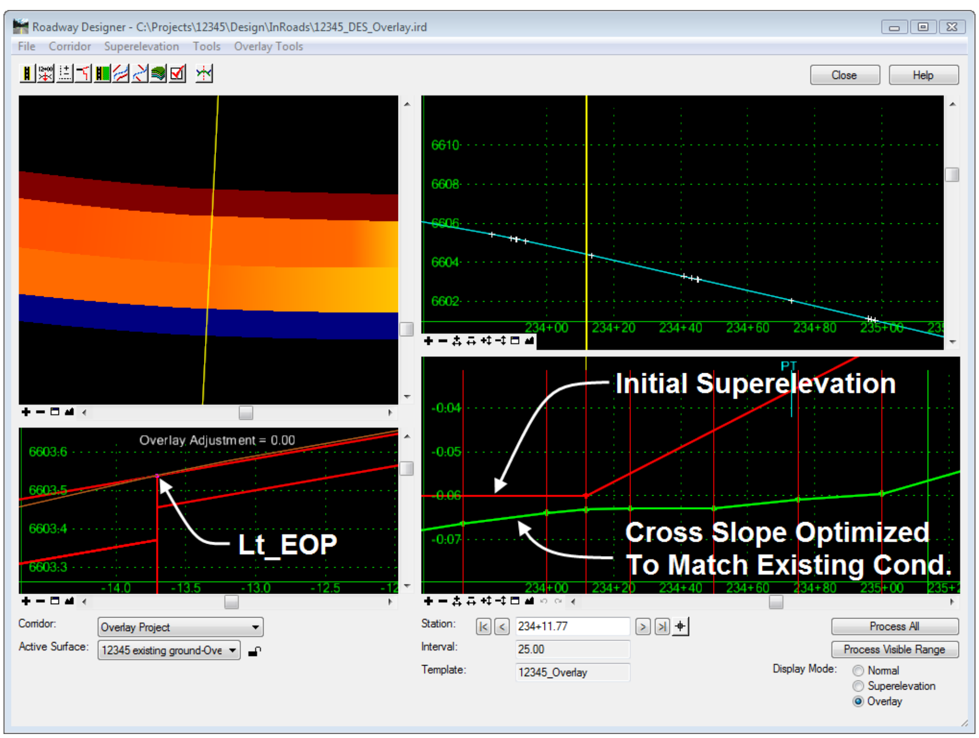
11. Key in for ***Control Line***: ***Slope-Opt_Lt_Laneline***

12. **<D> *Create.*** New point controls are created for the left lane.



Station	Ground Slope	Design Slope	Difference	Corrected Slope	Delta Elevation	Delta G
230+83.50	-4.29%	-2.00%	2.29%	-3.29%	0.13	0.26
231+00.00	-4.49%	-2.00%	2.49%	-3.49%	0.13	0.15
231+25.00	-4.81%	-2.00%	2.81%	-3.81%	0.13	0.15
231+34.50	-4.93%	-2.00%	2.93%	-3.93%	0.13	0.14
231+50.00	-5.06%	-2.61%	2.45%	-4.06%	0.13	0.10
231+75.00	-5.27%	-3.59%	1.68%	-4.27%	0.13	0.10
232+00.00	-5.65%	-4.57%	1.08%	-4.65%	0.13	0.18
232+25.00	-6.11%	-5.55%	0.56%	-5.55%	0.07	0.43
232+36.50	-6.27%	-6.00%	0.27%	-6.00%	0.04	0.47
232+50.00	-6.30%	-6.00%	0.30%	-6.00%	0.04	0.00

13. **<D> Close** and review the new control line in the superelevation view.



14. Repeat **Overlay Tools > Cross Slope Optimization** to develop the solution for the right side of the roadway using the following input changes:

Enter the following criteria to define the **.**

15. In the ***Existing Ground Cross Slope Definition*** area, select **Alignment** for the ***Existing Type***.

16. Select **SH 86** for the ***Pivot Alignment***.

17. Select **Rt_EOP** for the ***Superelevated Alignment***.

In the ***Design Cross Slope Definition*** area, select **Control Line** for the ***Design Type***.

18. Select **Section1 HMA_Lift1_Centerline-Top-RT_HMA_Lift1_Laneline-Top** for the ***Control Line***.

19. **<D>** the **Calculate Correction** button.

20. In the New Control Line area, select **Section 1** for the ***Section Name*.**

21. Key in for ***Slope-Opt_Rt_Laneline*** for the ***Control Line Name***.

22. **<D> Create.** New point controls are created for the right lane.

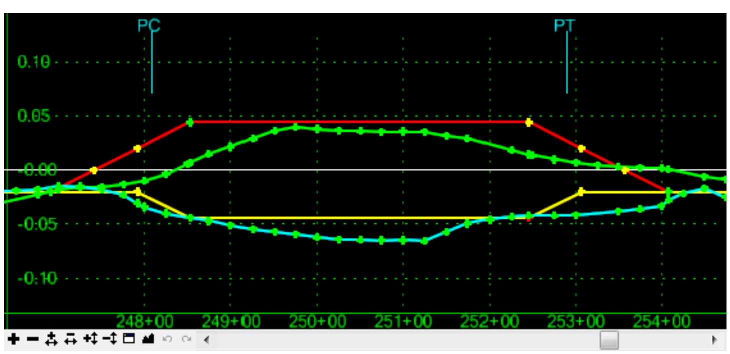
23. **<D> Close** to dismiss the Cross Slope Optimization dialog**.**

24. Select **Corridor > Point Controls**

Enabled	Priority	Name	Start Station	Stop Station	Mode	Type	Control
	1	LT_HMA_Lift1_Laneline-Top	203+80.28	260+43.16	Vertical	Superelevation	Section1 HMA_Lift1_Centerline-Top-LT_HMA_Lift1_Laneline-.
	1	RT_HMA_Lift1_Laneline-Top	203+80.28	260+43.16	Vertical	Superelevation	Section1 HMA_Lift1_Centerline-Top-RT_HMA_Lift1_Laneline.
X	1	LT_HMA_Lift1_Laneline-Top	205+00.00	259+00.00	Horizontal	Alignment	Lt_EOP
X	1	RT_HMA_Lift1_Laneline-Top	205+00.00	259+00.00	Horizontal	Alignment	Rt_EOP
X	1	LT_HMA_Lift1_Laneline-Top	205+00.00	259+00.00	Vertical	Superelevation	Slope-Opt_Lt_Laneline:HMA_Lift1_Centerline-Top
X	1	RT_HMA_Lift1_Laneline-Top	205+00.00	259+00.00	Vertical	Superelevation	Slope-Opt_Rt_Laneline:HMA_Lift1_Centerline-Top

The original two superelevation control lines should be automatically disabled. The remaining four controls effect with and slope of the template.

25. Review the new control lines in the superelevation view.

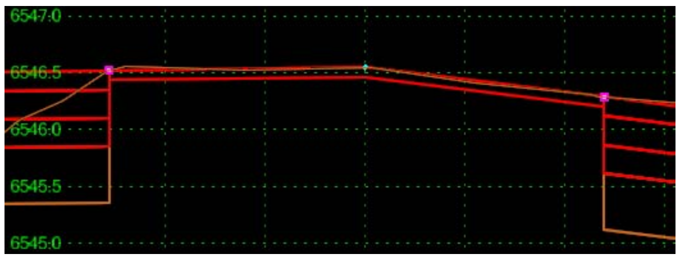


26. From the Roadway Designer menu bar, select **File > Save**.

Lab 24.9 - Corridor Review and Vertical Adjustment

Currently the corridor has horizontal and slope controls relative to existing conditions. In subsequent labs the corridor will be modified to adjust for the overlay thickness, pavement leveling and pavement stripping requirements. Prior to making those adjustments, review the current state of the corridor and related quantities.

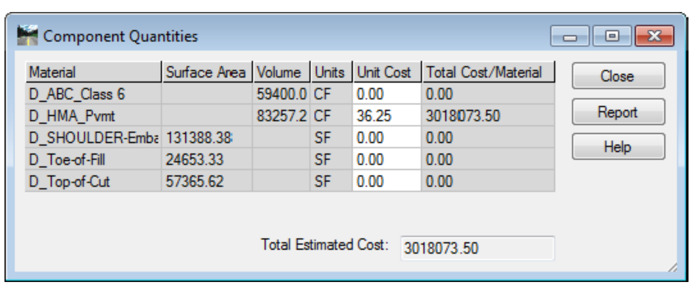
1. In ***Roadway Designer*** toggle on ***Display Mode:*** **Normal.**
2. Scroll through the template drops and note the location of the template relative to existing conditions



It can be seen that the overlay falls almost entirely below the existing conditions. This will be addressed with overlay tools.

3. **<D> Process All** in Roadway Designer
4. Using the scroll buttons navigate to the ***last*** station.
5. From the Roadway Designer menu bar select **Tools > Component Quantities** to take a quick look at quantities and cost.

6. In the ***D_HMA_Pvmt*** row, key in ***36.25*** in the ***Unit Cost*** column. The cost of the overlay is all we will address for this lab.



Component Quantities

Material	Surface Area	Volume	Units	Unit Cost	Total Cost/Material
D_ABC_Class 6		59400.0	CF	0.00	0.00
D_HMA_Pvmt		83257.2	CF	36.25	3018073.50
D_SHOULDER-Emba	131388.38		SF	0.00	0.00
D_Toe-of-Fill	24653.33		SF	0.00	0.00
D_Top-of-Cut	57365.62		SF	0.00	0.00

Close
Report
Help

Total Estimated Cost: 3018073.50

7. Note the **Total Cost/Material** ______________________________.

A combination of changes to the design will be made by adjusting the vertical grade, adding pavement stripping and pavement leveling components to the template to determine the optimum solution.

8. **<D> Close** to dismiss the ***Component Quantities*** dialog box.

9. Select **Tools > Options** in the ***Roadway Designer*** dialog box, toggle on **Cut and Fill Graphics**.

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

Review the limits of cut, note that the overlay is almost entirely in cut because the design profile is coincident with the existing grade. Overlay tools will be used to make adjustments to the design profile alignment.

11. Select **Tools > Options** in the ***Roadway Designer*** dialog box, toggle off **Cut and Fill Graphics**.

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

13. In ***Roadway Designer*** toggle on ***Display Mode:*** **Overlay.**

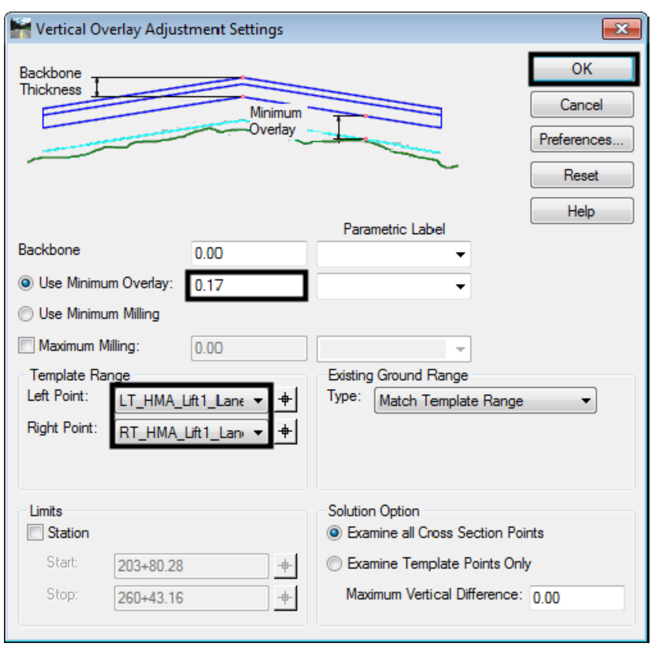
14. Select **Overlay Tools > Vertical Adjustment Settings**.

15. Toggle on **Use Minimum Overlay** and key in ***2"*** which will raise the profile alignment by an amount equal to the overlay pavement thickness.

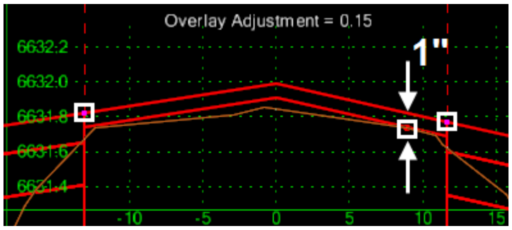
16. Under ***Template Range*** set the ***Left Range*** to **LT_HMA_Lift1_Laneline-Top.**

17. **Set** the ***Right Range*** to **RT_HMA_Lift1_Laneline-Top.**

18. **<D> OK**



19. **<D> Cancel** to close the ***Vertical Overlay Adjustments Settings*** dialog box.



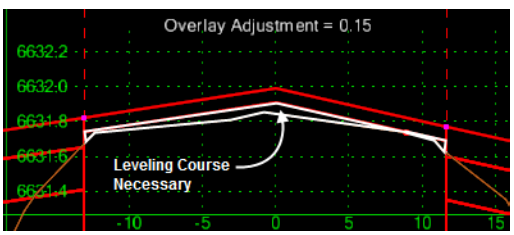
20. <D> Process All.

Between the template range points an evaluation is performed comparing the existing ground to the design template. At template application stations the template is raised to maintain the minimum overlay thickness. The value of the vertical adjustment at the centerline is displayed.

> ***Note:*** It's okay to toggle between Normal and Overlay display modes. However the overlay adjustments are only reflected while the Overlay display mode is active.

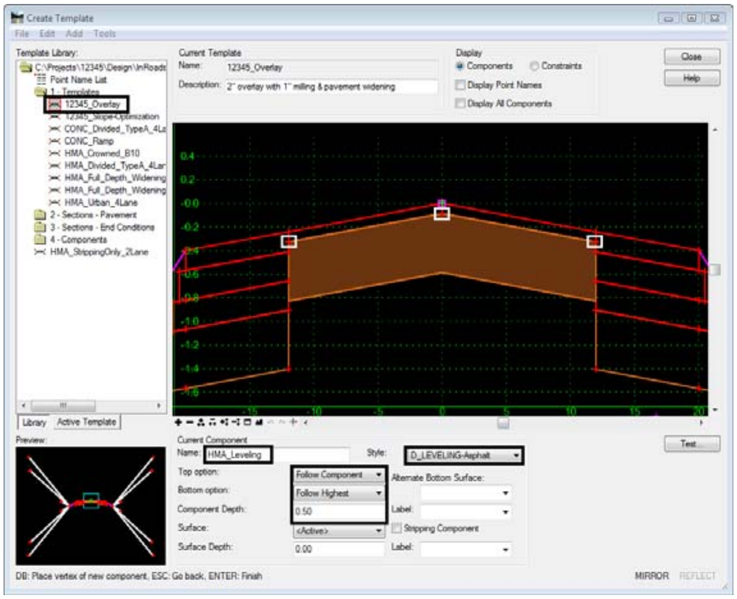
Lab 24.10 - Creating a Pavement Leveling Component

A review of the overlay adjustments shows a gap area between the bottom of the asphalt overlay component and the existing ground. This area will be addressed by adding a leveling component to the template.

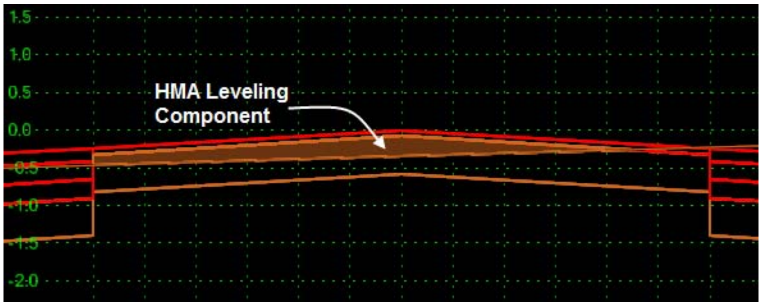


1. **Save** and **Close** the ***Roadway Designer*** dialog box.
2. **Open** the ***Create Template*** dialog box and **<D><D>** on the template ***12345-Overlay*** to open it for editing.

3. **<D> Add > Overlay/Stripping** (component)



4. In the Current Component area, key in ***HMA_Leveling*** for the ***Name***.
5. Select **Follow Component** for the ***Top option***.
6. Select **Follow Highest** for the ***Bottom option***.
7. Key in ***6"*** for the ***Component Depth***.
8. Set the ***Style*** to **D_LEVELING-Asphalt.**
9. Working from left to right, create the component by selecting the three points representing the ***bottom*** of the 2" overlay compliment.
10. **<R> Finish**
11. **<D> Test** to evaluate the added component.



Note: The option selected for ***Top*** option instructs the added component to follow or tie to the bottom of the 1" overlay asphalt component. The bottom option could have been set to follow surface (existing conditions) but by selecting follow highest a second leveling course could be added if a second leveling material is desired. Having done so the first leveling course will tie to the higher of the existing conditions or the second leveling course. In this exercise 6" should suffice for all leveling needs.

12. **File > Save** to save the template library.

13. <D> Close.

In Roadway Designer synchronize the revised template with the corridor.

14. Open **Roadway Designer.**

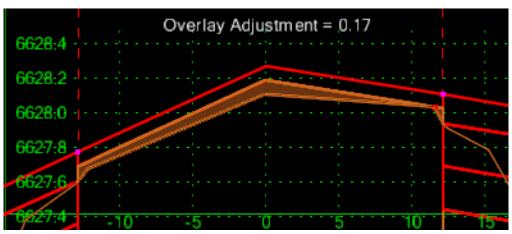
15. **<D> Corridor >Template Drops**.

16. Highlight the template drop.

17. <D> Synchronize with Library.

18. <D> Close.

19. Review the overlay adjustments and the additional leveling course.



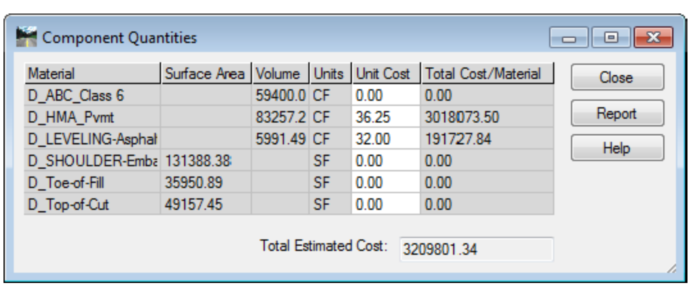
20. **<D> Process All**, in Roadway Designer.

21. Using the scroll buttons navigate to the ***last*** station.

22. From the Roadway Designer menu bar select **Tools > Component Quantities** to review quantities and cost.

23. On the ***D_LEVELING_Asphalt*** row, key in ***32.00*** for the ***Unit Cost/Material*** column.

24. Note the cost of the leveling course ______________________________.


Component Quantities

Material	Surface Area	Volume	Units	Unit Cost	Total Cost/Material
D_ABC_Class 6		59400.0	CF	0.00	0.00
D_HMA_Pvmt		83257.2	CF	36.25	3018073.50
D_LEVELING-Asphal		5991.49	CF	32.00	191727.84
D_SHOULDER-Embε	131388.38		SF	0.00	0.00
D_Toe-of-Fill	35950.89		SF	0.00	0.00
D_Top-of-Cut	49157.45		SF	0.00	0.00

Close
Report
Help

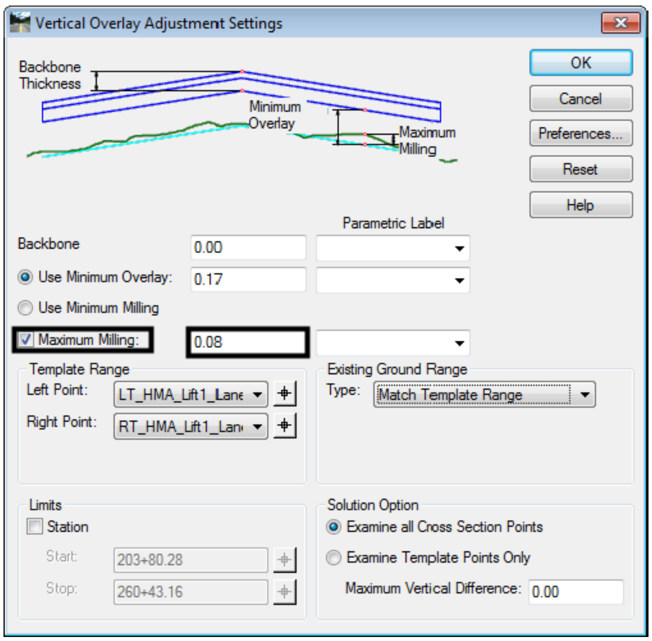
Total Estimated Cost: 3209801.34

25. **<D> Close** to dismiss the ***Component Quantities*** dialog box.

Lab 24.11 - Creating a Pavement Stripping Component

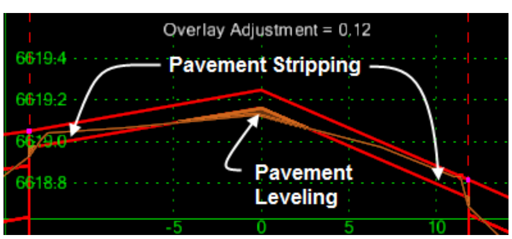
Adding a pavement stripping component to the template can reduce the amount of leveling material required. Two items need to be addressed. First a vertical adjustment will be made to allow for a milling depth. Secondly a component will be added to the template to quantify the amount of material milled.

1. From the Roadway Designer menu bar select **Overlay Tools > Vertical Overlay Adjustment Settings**.
2. Toggle on ***Maximum Milling*** and key-in ***1"***.



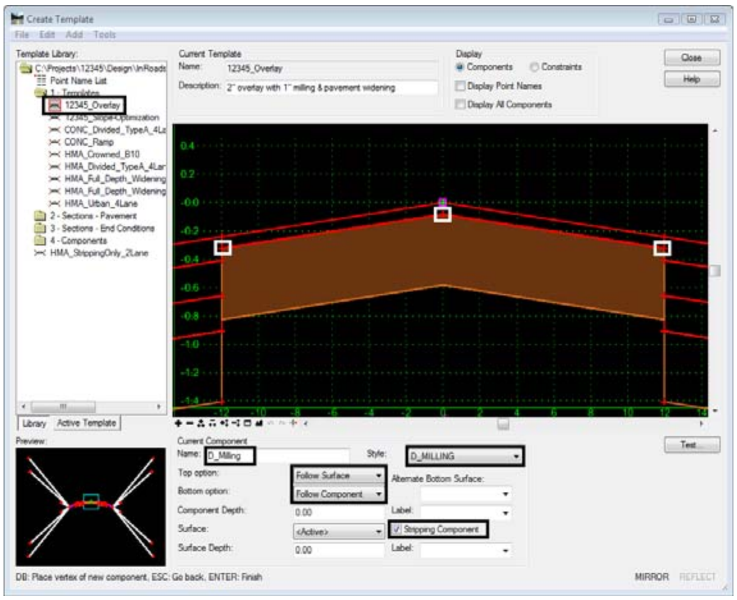
3. **<D> OK** to close the ***Vertical Overlay Adjustment Settings*** dialog box.
4. **<D> Process All**, in Roadway Designer

Review the overlay/leveling results



5. **Save** and **Close** the Roadway Designer dialog box.
6. Open the ***Create Template*** dialog box and **<D><D>** on template ***12345-Overlay*** to open it for editing.
7. **<D> Add > Overlay/Stripping** (component)
8. In the Current Component area, key-in ***D_Milling*** for the ***Name***.

9. Select **Follow Surface** for the ***Top option.***
10. Select **Follow Component** for the ***Bottom option.***
11. Select **D_Milling** for the ***Style***.
12. Toggle on ***Stripping Component***.
13. Create the component by selecting the three points representing the ***bottom*** of the 1” overlay component, from left to right.



14. **<R> Finish.**

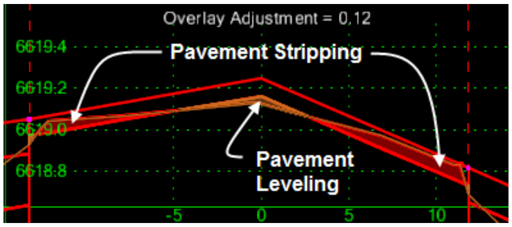
Note: The component created has no depth however it’s application is controlled by a combination of settings in roadway designer overlay tools and the existing surface. Testing the component may display results that appear suspect but will function correctly.

15. Select **File > Save** to save the template library.
16. **<D> Close**

In Roadway Designer synchronize the revised template with the corridor.

17. Open the ***Roadway Designer*** dialog box.
18. **<D> Corridor > Template Drops**.
19. Highlight the template drop
20. **<D>** the ***Synchronize with Library*** button.
21. **<D> Close.**

22. Review the overlay adjustments which should depict both leveling and stripping components.



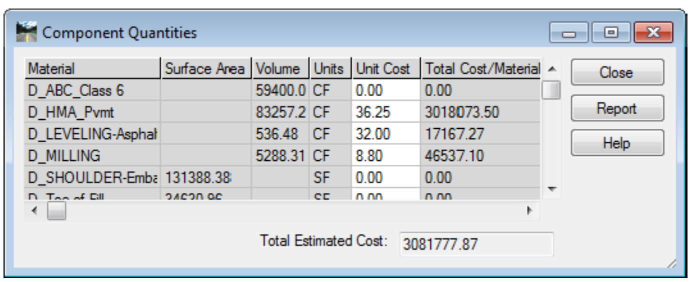
Make a final check on quantities and associated costs.

23. **<D>** the **Process All** button, in Roadway Designer.

24. Using the scroll buttons navigate to the last station.

25. From the Roadway Designer menu bar select **Tools > Component Quantities** to review quantities and cost.

26. For the ***D_Milling*** unit cost key in $***8.80***



Next, compute the cost savings achieved by adding using the milling component to reduce the levelling material.

27. Add the ***Total Cost/Material*** for ***D_LEVELING-Asphalt*** and ***D_Milling***.

    D_LEVELING-Asphalt ______________ + ***D_Milling***______________ = _______________

28. Compare the ***Total Cost/Material*** for the leveling course here with that noted on page 85.

    Cost from pg. 85______________ - Cost above ______________ = Savings_______________

29. **<D> Close** the ***Component Quantities*** dialog box.

30. To find the precise planner area of pavement milling select **Tools > Milling Report**

31. For the XML report Select folder ***Milling*** and the style sheet: ***RoadwayDesignMillingReport.xsl***

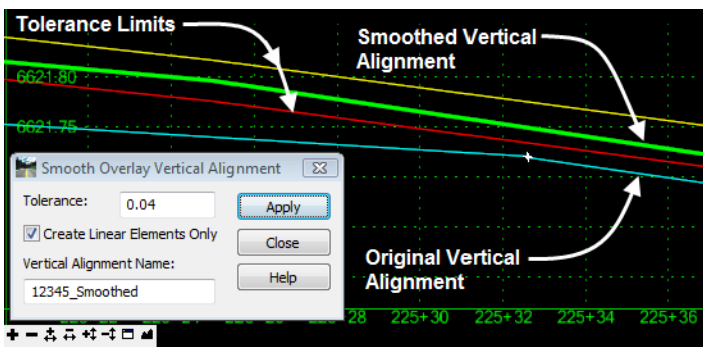
32. **Close** the ***Bentley Civil Report Browser*** and **Close** the ***Component Quantities*** dialog box.

Lab 24.12 - Creating the Regressed Vertical Alignment

The adjustments made to the vertical alignment through the use of overlay tools are temporarily stored in memory until applied to the corridor.

In Roadway Designer (in overlay display mode) the upper-right quadrant of the dialog displays two lines. These lines represent the original vertical alignment used to define the corridor. A second line, shown in red, displays the ideal vertical alignment as defined by the Vertical Adjustment Settings. This optimized alignment can be applied to the corridor as is or it can be smoothed, or regressed, within user defined tolerances to develop a 'best fit' alignment.

1. From the Roadway Designer menu bar, select **Overlay Tools > Smooth Adjusted Vertical Alignment**
2. Key in ***0.5"*** as the ***Tolerance***.
3. Key in ***12345_Smoothed*** for the ***Vertical Alignment Name***.
4. **<D> Apply.**

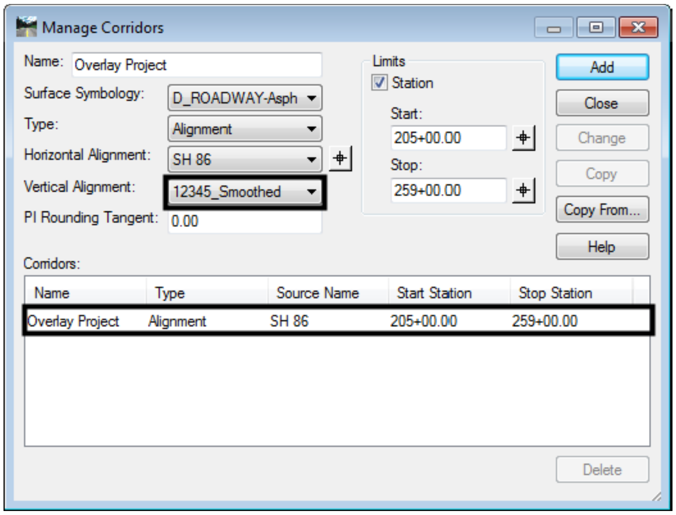


5. **<D> Close.**
6. Select **Overlay Tools > Apply Adjusted Vertical Alignment**.
7. Toggle on **Apply Adjusted Vertical Alignment to Corridor.**
8. Select **ALG_OTHER_Vert** for the ***Style***.
9. **<D> OK.**

To verify the results:

10. Select **Corridor > Manage Corridors**

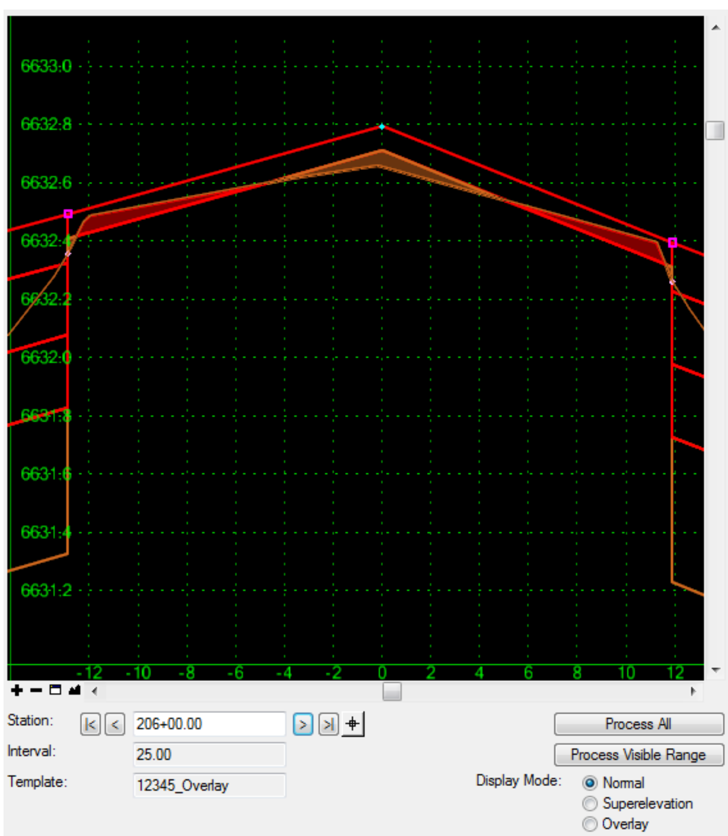
11. **<D>** on corridor ***Overlay Project***, note the vertical alignment associated with the alignment.



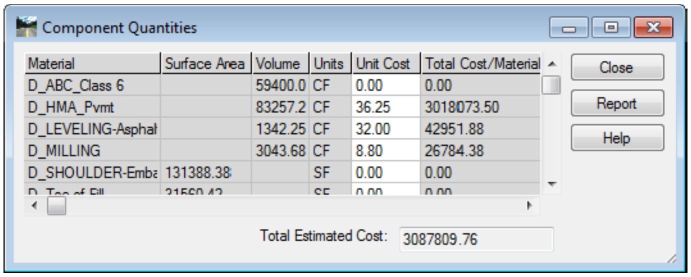
12. **<D> Close** to dismiss the **Manage Corridors** dialog box.

13. In ***Roadway Designer*** toggle on ***Display Mode:*** **Normal.**

14. Using the scroll buttons navigate through the template application locations to review the design.



15. Select **Tools > Component Quantities** to see the results using the smoothed vertical alignment.



16. **<D> Close** to dismiss the ***Component Quantities*** dialog box.
17. Select **File > Save** to write the roadway definitions to ***12345_DES_Overlay.ird***
18. **<D> Close** to dismiss the ***Roadway Designer*** dialog box.
19. Exit InRoads and MicroStation.

Chapter Summary:

- Point controls can be used to match the existing cross slope of the road.
- 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, a horizontal offset can be defined when point controls are created.
- Slope optimization can also be used to develop a design relative to existing conditions.
- Superelevation is used to develop a control line that can be overridden by cross slope optimization.
- Using cross slope optimization can be used to rehabilitate existing pavement cross slopes.
- Vertical alignments can be adjusted for overlay and/or milling requirements.
- There are new template components for overlay and milling (stripping).
- Component quantities can be calculated as a design progresses.