# 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.

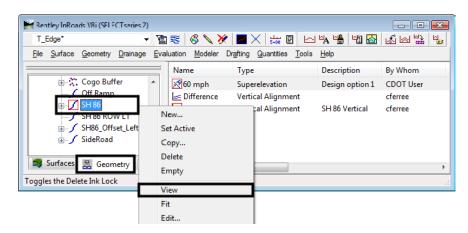
# Lab 24.1 - Chain Pavement Edge Features

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.

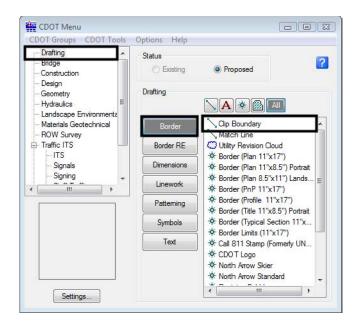
The first step is to mark out the limits of construction. Then a MicroStation fence is used to limit InRoads displays to this area.

- 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 **Draffing** group.
- 8. **<D>** the **Border** button.

9. Highlight **Clip Boundary** from the item list. This activates the *Place SmartLine* command.



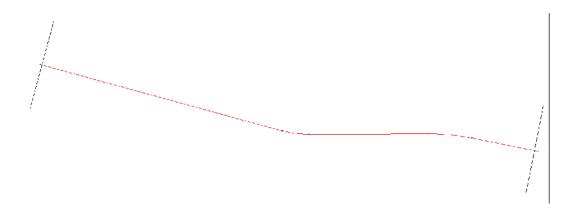
10. In the MicroStation key-in window, key in *so=204+00,500* and press *Enter*.

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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.

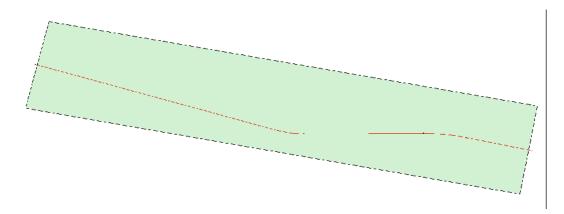


14. From the MicroStation Main toolbar, **<D> Place Fence**.

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**.

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- 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.

Feature Selection Filter	
Filter Name:	ОК
Start With: All  None Build Selection Attribute: Name	Cancel Save
Value: T_Edge of Oil*	Save As
Mode:  Mo	Delete Help
Rules: Exclude All Features	Move Up
	Move Up
	Move Down
	Clear All
Current Results:	
T_Edge of Oil Parking Lot T_Edge of Oil Parking Lot876 T_Edge of Oil Parking Lot877 T_Edge of Oil Parking Lot893 T_Edge of Oil Parking Lot893	
T_Edge of Oil119 T_Edge of Oil123 T_Edge of Oil13	

- 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.

🐂 Save Filter As	×
Name:	ОК
T_Edge of Oil	Cancel
	Help

- 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.

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

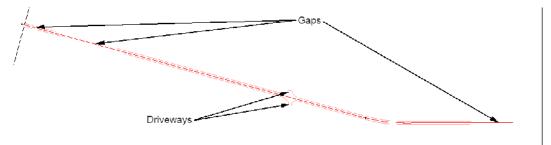
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- 28. Select **Surface > View Surface > Features** from the InRoads menu bar.

- 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.

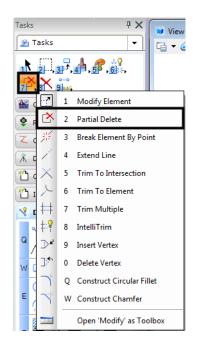
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Fence Mode: Inside -		Close
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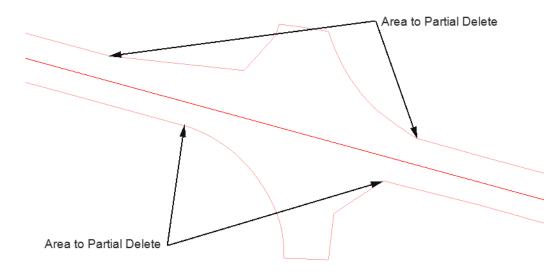
- 33. **<D> Close** to dismiss the *View Features* dialog box.
- 34. From the MicroStation Main toolbar, **<D> Place Fence** to dismiss the fence that was placed earlier.

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.



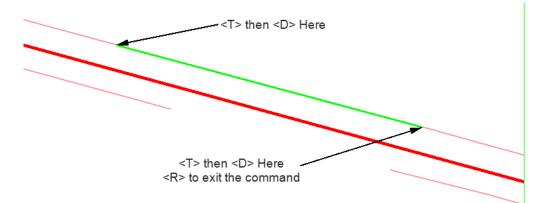


37. **<D>** on the lines as indicated in the illustration below to remove the driveways.

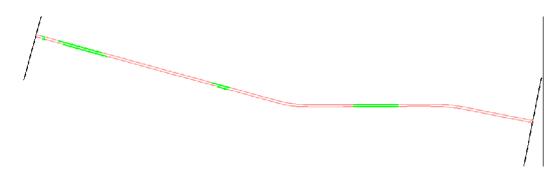
- 38. On the *CDOT Menu*, select the **Design** group.
- 39. Verify that the *Status* is set to **Proposed**.
- 40. **<D>** the **Surface** button.
- 41. Highlight **Surface 4** from the item list. This level was selected because of the contrast to the features displayed.

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	Profile	Surface 3
	Roadway	Surface 4
		Surface 6 Surface 7
		Surface 8
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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**.

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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.

🚼 Drape Surface			- • •
Current Locate Mode:	Graphics		Apply
Destination Surface:	12345 existing gr	ound-Ove 🔻	Close
Graphics Input Mode:	Level	•	Filter
Source Level:	DES_SURFACE	_4 •	Preferences
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Delete Original Graph	nics		
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Copy To Destination	Surface		+
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Scale:	1.0000		
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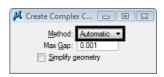
- 50. **<D>** Apply. The original lines are deleted and replaced with linestrings on the destination level, *DES\_SURFACE\_3*. The new linestrings contain a vertex at each point where the original line crossed a triangle in the destination surface.
- 51. **<D> Close** to dismiss the *Drape Surface* dialog 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.

- Tasks Ψ× 🧃 View 1 - Top, CDOT Default 💁 Tasks • 🕞 - 🥥 🔅 - 🔺 🍳 🍳 🕄 🛙 18 1 Drop Element 5 2 Create Complex Chain 💒 Colorado DOT 🛛 🔡 🗮 3 Create Complex Shape ₩₽₽. 쉸 4 Create Region Roundabouts 雔 5 Add To Graphic Group Civil Geometry × 6 Drop From Graphic Group 🕅 Data Acquisition 0 7 Group Hole 省 Civil Workflows InRoads Commands Open 'Groups' as Toolbox
- 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.

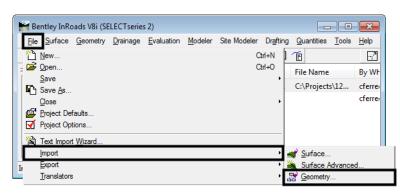
## Lab 24.2 - Creating Alignments from Graphic Chains

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**.

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Geometry Name:			
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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.

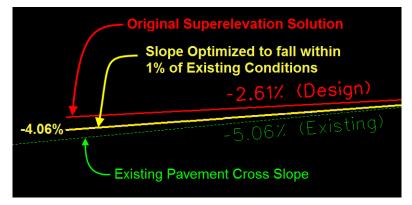
### Section Summary:

- 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.

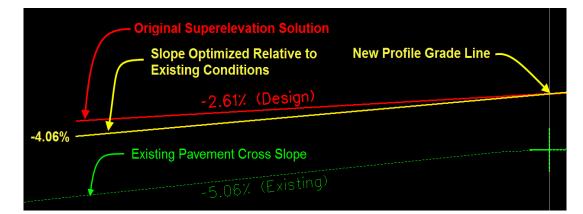
# Lab 24.3 - Cross Slope Optimization - Concept Lab

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.

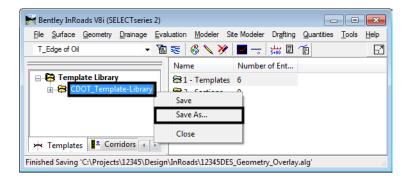


### Section Objectives:

- 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*.

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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**.
- In the Create Template dialog box, expand the C:\Projects\12345\Design\ InRoads\DE\$12345\_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 *O. 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.

Dynamic Settings 🛛 🖾					
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Y: 0.00	Step: 0.10				
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Apply Affixes					
hs=					
Set Dynamic Origin					

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

	Add New Compone	ent I	Simple
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- 16. In the *Current Component* area, key in *DrivingLane-12FT* for the *Name*.
- 17. Select **D\_CONC\_Pvmt** for the *Style*.

Style:	D_CONC_Pvmt
	Style:

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

	Finish	Enter
	Closed Shape	Ctrl-L
>	Mirror	Ctrl-M
	Undo Last Cancel	ESC
	Set Dynamic Origin	Ctrl-D

- 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.

Dynamic S	ettings		X
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Y: 0.	00	Step:	0.10
Point Nam	ie: [	aneline	•
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hs=	•	12,-2.0	%
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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.

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-0:2 ·	LT_	Laneli	ne										RT	_Lane	line	
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- 4		-‡ 🗖 🖬	50	<b>•</b> • ∢												

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

Point Properties			X
Name:	Centerline 👻	+	Apply
Use Feature Name Override:	Centerline	]	Close
Surface Feature Style:	D_LANELINE -	]	< Previous
Alternate Surface:	-		Next >
	Member of		Help

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

-0:2 LT_Laneline RT_Laneline -0:4 -0:6	-0.0					Ce	nterlin	e				
-0.4	-0.2	. 1.т.	lanel	ine						RI	lane	linė
-0:6	-0.4										_cane	
	0.4											
	0.0											

- 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.

Name: Slope	Optimiza	ition			Limits		Add
Surface Symbo Type: Horizontal Align Vertical Alignm PI Rounding T	nment: ent:	D_SURFAC Alignment SH 86 SH 86_Exis 0.00	- - -	+	Station           Start:           205+00.00           Stop:           259+00.00	+ +	Close Change Copy Copy From. Help
Corridors: Name	т	уре	Source	Name	Start Station	Stop	Station
Slope Optimiza	atio Ali	gnment	SH 86		205+00.00	259+(	00.00
\$							Delete

- 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.

- Manual Template Drops - - -Corridor: Slope Optimization Add Station: 205+00.00 ÷ Close Interval: 25.00 ŧ Change Library Templates Templates Copy A 12345\_Slope-Optimization Help CONC\_Divided\_TypeA\_ → CONC\_Ramp HMA\_Crowned\_B10 ⊶ HMA\_Divided\_TypeA\_4La → HMA\_Full\_Depth\_Widenii ≍ HMA\_Urban\_4Lane n 2 Contin - D-Current Template Drops: Stati... Inter... Template Enable Tr... Rev... Library 205+0... 25.00 12345\_Slop...N/A ITL C:\Projects\1. Delete Synchronize with Library Edit
- <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.

	igner - C:\Projects\12345\Design\InRoads\12345_Corr.ir Superelevation Tools Overlay Tools	d
<b>!</b> ₩± <b>-</b> 1	Create Superelevation Wizard	AASHTO
	Create Single Control Line	Fixed Length
	Apply Shoulder Rollover Lock	Table
	Import Superelevation Import Superelevation from Alignment	4 · · · · ·

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

 In the Open Superelevation Table dialog box, navigate to : C:\Workspace\Workspace-CDOT\_V8i\Standards-Global\InRoads\Superelevation Tables\AASHTO 2004\

🚔 Open Superele	vation Table						X
Look jn:	鷆 AASHTO 2	004	•	G 💋	Þ	<b></b>	
Ca.	Name	Date modified	Туре	Size			•
Recent Places	@ 06_25.sup @ 06_30.sup						
	@ 06_35.sup						
Desktop	@ 06_40.sup						
	@ 06_50.sup						E
Todd	06_55.sup						
	08_15.sup						
Computer	08_25.sup						-
2	File name:	06_55.sup			•	<u>O</u> p	en
Network	Files of type:	Superelevation T	able (*.sup)		•	Car	ncel
						<u>H</u> e	lp

- 4. Select *06-55.sup* and **<D>** the **Open** button.
- 5. **<D>** the **Load Values From Table** button.

👬 Table Wizard				
Comidor:	Slope Optimization			Help
General Superelev	ation Data			
	obal\InRoads\Supe	erelevation Tables	AASHTO 2004	06_55.sup
% Runoff on T	angent 60%	Inte	rpolate Table Val	ues
Specify Runout		Transiti	on Lengths Are:	
Non-Linear Cur	ve Length: 0.00	۲	Runoff 💿 Tot	al Transition
Horizontal Curve Set	s:		1	
ID Start Station	Stop Station	Superelevati	Table	Design
1 231+75.30 2 248+08.02	234+72.97 252+90.13	6.00% 4 40%	06_55.sup 06_55.sup	0.00
2 240400.02	202+00.10	4.40%	00_00.sup	0.00
Selected Curves:	Load Values Fro	m Table 📃 🔲	Jpdate Geometry	from Table
< Bi	ack Next	> Preference	ces Clos	se

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**.

ections: Name	Start Stati	Stop Stati	Crown Po	Left Rang	Dista Da	Pivot Direc
vame	Statt Statt	stop stati	Crown Po	Lett hang	hight ha	Pivot Direc
			_			
				Add	E dit	Delete
	n for Selected					
			Exiting R	Width fro	Superelevat	ion Rate
uperelevation Start Stati			Exiting R	Width fro	Superelevat	ion Rate
			Exiting R	Width fro	Superelevat	ion Rate
			Exiting R	Width fro	Supereleval	ion Rate
			Exiting R	Width fro	Supereleval	ion Rate
			Exiting R	Width fro	Supereleval	ion Rate

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

ections:						Help
Name	Start Stati	Stop Stati	Crown Po	Left Rang	Right Ra	Pivot Direc
	e for Selected (	Section		Add	Edit	Delete
perelevation						
uperelevation Start Stati	Stop Stati	Entering	Exiting R	Width fro	Supereleva	tion Rate
-			Exiting R	Width fro	Supereleva	tion Rate
-			Exiting R	Width fro	Supereleva	tion Rate
-			Exiting R	Width fro	Supereleva	tion Rate
-			Exiting R	Width fro	Supereleval	tion Rate

- 8. Use the drop down menu or the target <sup>+</sup> 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.** 

🕌 Add Supereleva	tion Section		Σ
Name:	Section1		ОК
🔲 List all backbone	points		Cancel
Crown Point:	Centerline 🔻	+	Help
Left Range Point:	LT_Laneline 🔹	+	
Right Range Point:	RT_Laneline 🔹	+	
Pivot Direction:	From Crown Point -		
Number of lanes:	🖲 Two 🛛 🔘 Four		
Runoff Length Multip	olication Factor: 1.00		
Limits			
Start:	203+80.28		
Stop:	260+43.16	+	

- 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.

Superelevation	Controls			
Section:	Section1		•	Help
Superelevation Co	ntrols:			
Name	Point	Pivot Point	Initial Slope	Applies To
Section1 Cen Section1 Cen	-	Centerline Centerline	-2.00% -2.00%	
Round Station	n to Nearest: [	+00.00	Edit	Delete
<	Back	Finish Pref	erences	Close

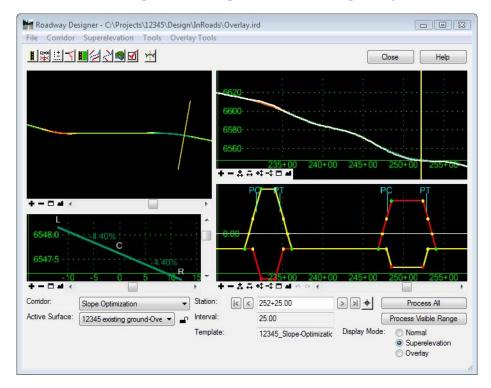
13. **<D> Finish**. This completes the development of superelevation for the corridor.

	eline 203+80.28				Section 1 Centerline-RT_Laneline	
		1.55564/61055		1.0.000		1200000
		Stop St	Mode	Time	Control	Description
and Vertica						
	-		Stop: 0.	00	- <del>ф</del> -	
	, ng nino n		10.00			
Secondary	Alianment		U.	00	<u>+</u>	
	51100	<u> </u>				
Alianment:	-	<u> </u>	10000			
pe:	Alianment	•		1011		
ontal 🤅	Vertical 🔘	Both	Stop: 25	59+00.00	+	Help
		نے ر	Start: 20	05+00.00	+	Change
	Centerline	<b>→</b> +	Station L	imits		Close
escription:						
Slope Optin	nization					Add
	Slope Optir escription: orital () pe: Alignment: Secondary and Vertica Name LT_Lane	Centerline Ontal Vertical  I Alignment: Alignment: SH 86 Secondary Alignment I and Vertical Controls: Name Start St LT_Laneline 203+80.28	Slope Optimization escription: Centerline	Slope Optimization escription: Centerline	scription: Centerline	scription: Centerline

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.

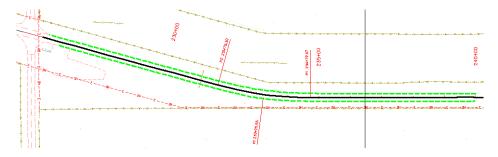
At each template application location the existing ground cross slope is determined by computing the delta elevation divided by the absolute distance between the existing pivot point and either a feature in the existing DTM or an alignment that represents the existing edge of pavement.

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.

<u> &lt;</u> <	236+00.00	> > +	Process All
	25.00	(	Process Visible Range
	12345_Slope-Optimizatio	Display Mode	<ul> <li>Superelevation</li> <li>Overlay</li> </ul>
			/

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

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

🚼 Roadway Designer -	
File Corridor Superelevation Tools	Overlay Tools
	Cross Slope Optimization
	Vertical Adjustment Settings
	Smooth Adjusted Vertical Alignment
	Apply Adjusted Vertical Alignment

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.

Existing Ground Cross Slo	pe Definition	Optimization Parameters		Close
Existing Type:	Feature Name 👻	Slope Tolerance:	1.00%	
Pivot Feature:	T_Traffic Double Yel 👻 🕈		0.00	Preferences
Superelevated Feature:		1		Report
		Maximum Desirable Delta G.	1.00	Help
Design Cross Slope Defini	tion	Limits		
Design Type:	Control Line 🔻	Station		
Control Line:	Section 1 Centerline-	Start:	226+55.00	+
		Stop:	239+95.00	
Calculate Correction	Reset Results			
esults:				
esults: tation Ground	Slope Design Slope	Difference Corrected Slo	pe Delta Elevation	Delta G
	Slope Design Slope	Difference Corrected Slo	pe Delta Elevation	Delta G
	Slope Design Slope	Difference Corrected Slo	pe Delta Elevation	Delta G
	Slope Design Slope	Difference Corrected Slo	pe Delta Elevation	Delta G
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	Slope Design Slope	Difference Corrected Slo	pe Detta Elevation	Delta G
	Slope Design Slope	Difference Corrected Slo	pe Detta Elevation	Delta G
	Slope Design Slope	Difference Corrected Slo	pe Delta Elevation	
tation Ground		Difference Corrected Slo		
tation Ground		Difference Corrected Slo		

- 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.

<ul> <li>Slope Tolerance:</li> <li>Elevation Tolerance:</li> <li>Maximum Desirable Delta</li> </ul>	0.00	Preferences.
	0.00	Fieleiences.
Maximum Desirable Delta	0.00	
	G: 1.00	Report
Limits		Help
V Station		
Start:	226+55.00	+
Stop:	239+95.00	+
rence Corrected S	Slope Delta Elevation	Delta G
% -3.29%	0.13	0.26
% -3.49%	0.13	0.15
% -3.81%	0.13	0.15
% -3.93%	0.13	0.14
% -4.06%	0.13	0.10
% -4.27%	0.13	0.10
% -4.27% % -4.65%	0.13 0.13	0.10
% -4.65%	0.13	0.18
% -4.65% % -5.55%	0.13 0.07	0.18 0.43
	♥ Station           Start:           Stop:   rence           Corrected S           %           3.29%           %           3.81%           %           3.93%	✔ Station           Stat:         226+55.00           Stop:         239+95.00           rence         Corrected Slope         Delta Elevation           %         -3.29%         0.13           %         -3.49%         0.13           %         -3.81%         0.13           %         -3.93%         0.13

- 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.

Bentley Civil Report Browser - C:\Users\cferree\AppData\Local\Te	mp\RPTE3D8.xml
File Tools Help	
C:\Workspace\Workspace-CDOT_V8\\Standards-Global\InRoads\XML Bridge Cant	Cross Slope Optimizatio
CDOT	Report Created: 3. Time: 10:49:
A: CrossSectionOptimizationASCII xsl	Corridor: Slope Optimization
Le Cross SlopeOptimization Stations xsl	File Name: C:\Projects\12345\Design\InRoa
DataCollection	Input Grid Factor: 1.000000
Geometry ICS	Existing Ground Data: Type: Feature Name
images in a second seco	Pivot: T_Traffic Double Yellow467

- 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.

New Control	PCP	T	PC PT	POE
0.00	$\sim$	·^~;		
	A.	/		
<u>220+00</u> + - 古 井 井 ⊟ ▲ ∽ ∝	230+00	/ 240+00	250+00	260+1

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*.

Existing Type: Pivot Feature: Superelevated Fea		e Name 🔻		n Parameters		Close
	T_Traf		Slope T	olerance:	1.00%	
Superelevated Fea	1_1101	fic Double Yel 🔻	1	n Tolerance:		Preferences.
Suberelevaren Lea	atura:		<u>.</u>		0.00	Report
	T_Edg	e of Oil497 🔻	+ Maximum D	esirable Delta G:	1.00	Help
Design Cross Slop	e Definition		Limits			Нер
Design Type:	Contro	Line 🔻	Station	n		
Control Line:	Section	n1 Centerline-	Start		226+55.00	÷
			Stop		239+50.00	
Calculate Correction	on Reset f	Regulte	5100		200+00.00	+
Calculate Contocti		loodito				
esults:		1	1		1	1
itation 26+75.00	Ground Slope	Design Slope	Difference -0.17%	Corrected Slope		Delta G
	-1.83%	-2.00%		-2.00%	-0.02	
27+00.00	-1.72%	-2.00%	-0.28%	-2.00%	-0.04	0.00
27+00.00 27+25.00	-1.72% -1.53%	-2.00% -2.00%	-0.28% -0.47%	-2.00% -2.00%	-0.04 -0.06	0.00
27+00.00 27+25.00 27+50.00	-1.72% -1.53% -1.34%	-2.00% -2.00% -2.00%	-0.28% -0.47% -0.66%	-2.00% -2.00% -2.00%	-0.04 -0.06 -0.09	0.00
27+00.00 27+25.00 27+50.00 27+75.00	-1.72% -1.53% -1.34% -1.08%	-2.00% -2.00% -2.00% -2.00%	-0.28% -0.47% -0.66% -0.92%	-2.00% -2.00% -2.00% -2.00%	-0.04 -0.06 -0.09 -0.12	0.00 0.00 0.00
27+00.00 27+25.00 27+50.00 27+75.00	-1.72% -1.53% -1.34%	-2.00% -2.00% -2.00%	-0.28% -0.47% -0.66%	-2.00% -2.00% -2.00%	-0.04 -0.06 -0.09	0.00
27+00.00 27+25.00 27+50.00	-1.72% -1.53% -1.34% -1.08%	-2.00% -2.00% -2.00% -2.00%	-0.28% -0.47% -0.66% -0.92%	-2.00% -2.00% -2.00% -2.00%	-0.04 -0.06 -0.09 -0.12	0.00 0.00 0.00
27+00.00 27+25.00 27+50.00 27+75.00 28+00.00	-1.72% -1.53% -1.34% -1.08% -0.76%	-2.00% -2.00% -2.00% -2.00% -2.00%	-0.28% -0.47% -0.66% -0.92% -1.24%	-2.00% -2.00% -2.00% -2.00% -1.76%	-0.04 -0.06 -0.09 -0.12 -0.13	0.00 0.00 0.00 0.11
27+00.00 27+25.00 27+50.00 27+75.00 28+00.00 28+25.00	-1.72% -1.53% -1.34% -1.08% -0.76% -0.59%	-2.00% -2.00% -2.00% -2.00% -2.00% -2.00%	-0.28% -0.47% -0.66% -0.92% -1.24% -1.41%	-2.00% -2.00% -2.00% -2.00% -1.76% -1.59%	-0.04 -0.06 -0.09 -0.12 -0.13 -0.13	0.00 0.00 0.00 0.11 0.08

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.

Corridor	r: Slope	e Optimization							Add
Control	Descripti	ion:							Close
oint:		Centerline		+	Statio	on Limits	3		
Mode		Contonin	9		Start:	205+0	00.00	<b>+</b>	Change
	prizontal	Vertical	🔘 Both		Stop:	259+0		 +	Help
Control	Type:	Alignmen	t •	7	Horiz	ontal Of	fsets		
lorizon	ntal Alignn	nent: SH 86		+	Start:	0.00	4	<del>+</del>	
					Stop:	0.00			
								<u> </u>	
Llea	an Saco	ndan Alianment							
Use	e as Seco	ndary Alignment			Vertic	cal Offse	ets		
Use	as Seco	ndary <mark>Ali</mark> gnment				al Offse		<del>•</del>	
Use	e as Seco	ndary Alignment			Start:			ф-	
Use Priority:		ndary Alignment			Start:	0.00		-	
'riority:					Start:	0.00		-	
riority: Iorizori	ital and V	1	Start Sta	Stop S	Start: Stop:	0.00		-	Description
riority: Iorizori	ital and V	1 /ertical Controls:		Stop 5 260+43	Start: Stop: <b>ita</b>	0.00 0.00 Mode	Type	<u>+</u>	1 March 1997
'riority: łorizon En	ntal and V Prio	1 /ertical Controls: Name	Start Sta	260+43	Start: Stop: Sta	0.00 0.00 Mode Vertical	Type Superelevatio	Control	_aneline:Cen
'riority:	ntal and V Prio 1	1 /ertical Controls: Name LT_Laneline	Start Sta 203+80.28 203+80.28	260+43 260+43	Start: Stop: 3ta 16 \ 1.16 \	0.00 0.00 Mode Vertical	Type Superelevatio Superelevatio	Control	Laneline:Cen Laneline:Ce
riority: Iorizon En	ntal and V Prio 1 1	1 /ertical Controls: Name LT_Laneline RT_Laneline	Start Sta 203+80.28 203+80.28	260+43 260+43	Start: Stop: 3ta 16 \ 1.16 \	0.00 0.00 Mode Vertical	Type Superelevatio Superelevatio	Control Section 1 Centerline-LT_L Section 1 Centerline-RT_	Laneline:Cen Laneline:Ce
riority: Iorizon En	ntal and V Prio 1 1	1 /ertical Controls: Name LT_Laneline RT_Laneline	Start Sta 203+80.28 203+80.28	260+43 260+43	Start: Stop: 3ta 16 \ 1.16 \	0.00 0.00 Mode Vertical	Type Superelevatio Superelevatio	Control Section 1 Centerline-LT_L Section 1 Centerline-RT_	Laneline:Cen Laneline:Ce

- **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.

Contraction of the second	nd Cross Slope Definit	ion	Optimizati	on Parameters			Close	
Existing Type: Feature Name		re Name 🔻	Slope	Tolerance:	1.00%			
Pivot Feature: T_Traffic Double Yel ▼ Superelevated Feature: T_Edge of Oil511 ▼		ffic Double Yel 🔻	+ O Elevation Tolerance:		0.00	Preferences.		
		ne of Oil511 👻	+ Maximum	Desimble Dalla Ci			Report	
			Maximum Desirable Delta G:		1.00		Help	
Design Cross	Slope Definition		Limits					
Design Type:	Contro	l Line 🔻	V Statio	n				
Control Line:	Sectio	n 1 Centerline- 🔻	Sta	Start:		+		
	Jech	ITT CERTERINE			226+55.00	+		
			Sto	p:	239+95.00	+		
Calculate Con	Reset	Results						
Results:								
Station	Ground Slope	Design Slope	Difference	Corrected Slop	e 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+00.00	3.37%	6.00%	2.63%	4.37%	0.13	0.06		
	2 25%	c nn%	0 75%	1 0E%	n 10	0.00		
233+25.00							•	
233+25.00 222-50.00		- 102	_		1210			
233+25.00 233+25.00 4	Slopes: <	> Largest	1		Delta G B	Errors:	< >	
233+25.00 222.50 00		> Largest			Delta G E	Errors:		
233+25.00	ine	> Largest			Delta G E	Errors:		

- 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.

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# 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.

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.

Dynamic Settings	;	
X: 0.00	Step: 0.10	
Y: 0.00	Step: 0.10	
Point Name:		
Point Style:		
Apply Affixes		
hs= ▼		
Set Dynamic Origin		

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

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

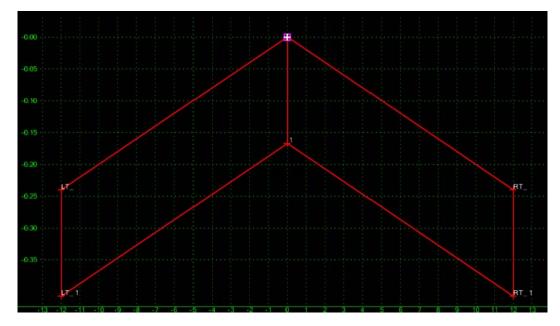
Add New Component	۱.	Simple
Set Dynamic Origin	Ctrl-D	Constrained Unconstrained
	· · · · · .	Null Point
		End Condition
		Overlay/Stripping

- 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.

+ - ☆ ↔ + + - + □ ▲ ⇔ ⇔ ↔ ∢ Current Component Name: HMA_Overlay		Style:	D_HMA_Pvmt 👻
Slope:	-2.00%		
Thickness:	0.17	]	
Width:	12.00		

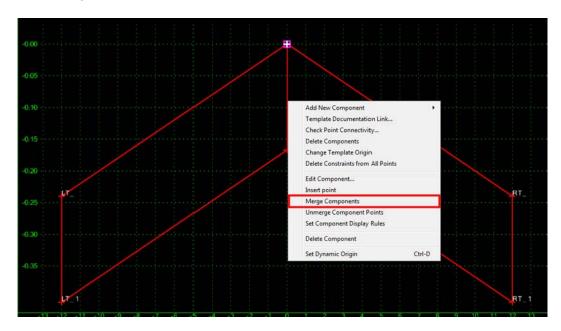
12. **<R>** in the template view and select **Mirror** from the right click menu.

	Change Placement P				1
	Mirror	Ctrl-I			
	Reflect	Ctrl-			
	Cancel	ES	C		
	Set Dynamic Origin	Ctrl-	D	RT_	
				RT1	
2 0 2	4 6	8 10	12	14	16



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.



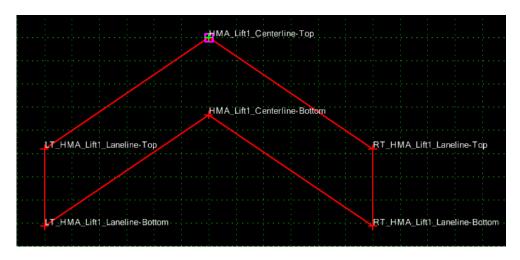
- 15. <D> <D> on the centerline point of the template to display the *Point Properties* dialog box.
- 16. In the *Point Properties* dialog box, select **HMA\_Liftx\_Centerline-Top** in the *Name* field. This also sets the *Surface Feature Style* to **Centerline**.
- 17. Change the *x* to a **1** in the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

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

Point Properties	X
Name: Feature Name Override: Surface Feature Style:	HMA_Lift1_Centerline-T  Apply Conse Centerline  Centerline  Member of:  RT_HMA_Overlay
Constraints Constra Type: None	int 1 Constraint 2
Label: Style Constraint: Horizontal Range: 0.00	Vertical O Both

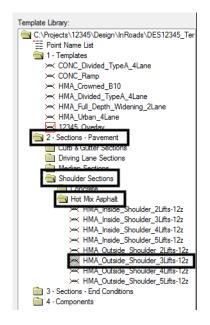
- 19. **<D>** the **Next** button to select the center bottom point (*1*).
- 20. Select HMA\_Liftx\_Centerline-Top in the Name field.
- 21. Change the name and change to read HMA\_Lift1\_Centerline-Bottom.
- 22. **<D> Apply** to accept the change.
- 23. **<D>** the **Next** button to select the right 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:

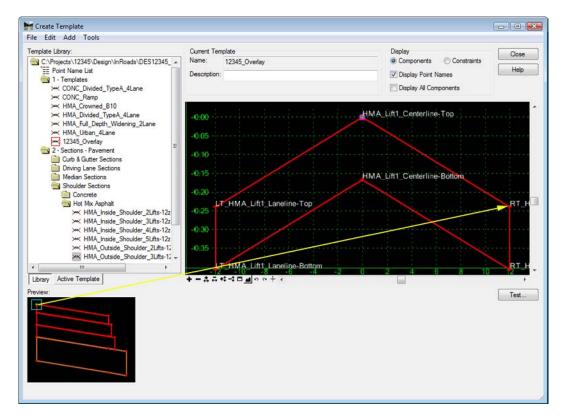


Now the shoulders and end conditions are added.

- 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.

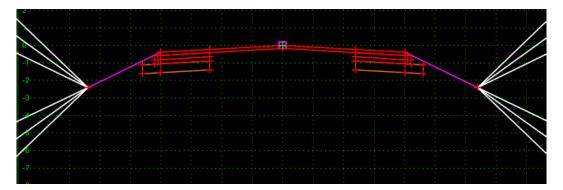
- **Note:** Because *Mirror* was turned on when placing the overlay component, both shoulders are now placed in the template.
- 40. **<D> <D> on the RT\_HMA\_Lift1\_EOP-Top** point to display the *Point Properties* dialog box.
- 41. The shoulders should be 8' wide. Change the *Value* of the *Horizontal* 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.

Point Properties	
Name:	RT_HMA_Lift1_EOP-Tc - + Apply
Feature Name Override:	RT_HMA_Lift1_EOP-Top
Surface Feature Style:	D_EOP
Alternate Surface:	Next >
	Member of:
	RT_HMA_Shldr_Lift1
Constraints	int 1 Constraint 2
	int 1 Constraint 2 Vector-Offset
Type: Horizontal	
Type: Horizontal	▼ Vector-Offset ▼
Constra Type: Horizontal Parent 1: RT_HMA_	▼         Vector-Offset           ⊥ft1_Lan:         ↓           HMA_Lift1_Centerlin         ↓
Constra Type: Horizontal Parent 1: RT_HMA_ Parent 2:	▼     Vector-Offset       uft1_Lanr     ↓       HMA_Lift1_Centerlin     ↓       RT_HMA_Lift1_Lanr     ↓       0.00
Constra Type: Horizontal Parent 1: RT_HMA_ Parent 2: Value: 8.00	▼     Vector-Offset       uft1_Lanr     ↓       HMA_Lift1_Centerlin     ↓       RT_HMA_Lift1_Lanr     ↓       0.00
Constra Type: Horizontal Parent 1: RT_HMA_ Parent 2: Value: 8.00 Label: EOP-Top-H	v vector Offset v HMA_Lft1_Centerlin v + RT_HMA_Lft1_Lanv v + 0.00 oriz v v

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.

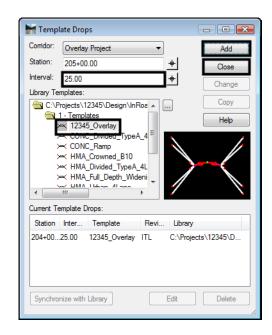
This corridor will contain a single template drop along with point controls. Horizontal controls will define the width of the overlay section. Vertical controls will be generated initially through superelevation and ultimately refined by cross slope optimization. Overlay and stripping criteria will be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

Name: Overlay_F	<sup>p</sup> roject		Limits	Add
Surface Symbolog Type: Horizontal Alignmen /ertical Alignment PI Rounding Tang	Alignment SH 86 SH 86_Exist	- - - +	Station           Start:           205+00.00           Stop:           259+00.00	+ Cose Change Copy Copy From Help
Corridors: Name	Туре	Source Name	Start Station	Stop Station
Overlay_Project	Alignment	SH 86	205+00.00	259+00.00

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.
- <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.

🚔 Display Refer	rences	
Comidor: Overla	y Project	Add
Display Referen	(	Close
Alignment:	Rt_EOP -	+ Change
Sufface:	12345 existing groun 💌	
Feature:	T_Billboard Over 10f 👻	+ Help
Filter:	<unnamed> 💌</unnamed>	
Display as R	ight of Way	
Limits		
Start:	203+80.28	+ I
Stop:	260+43.16	<b>+</b> -
Display Referenc	es:	
Na	me Right of Start S	St Stop Sta
Alignment Lt_E		
Alignment Rt_	EOP False	
		Delete

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

The alignments are displayed in Roadway Designer.

6628:5			
6628:0 • • • • • •	Lt_EOP	Rt_EOP	
6627:5		+	
6627.0			. /
6626:5 • • • • •			
6626:0			
6625:5 · · · · · ·			

- 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.

Point Controls		
Conidor: Overlay_Project		Add
Control Description: Horizontal location for right lane		Close
Point: RT_HMA_Lift1_Lan +	Station Limits Start: 205+00.00 +	Change
Horizontal O Vertical O Both	Stop: 259+00.00	Help
Control Type: Alignment	Horizontal Offsets	
Horizontal Alignment: Rt_EOP - +	Start: 0.00 +	
	Stop: 0.00 +	
Use as Secondary Alignment Priority: 1	Vertical Offsets           Start:         0.00         +           Stop:         0.00         +	
Horizontal and Vertical Controls:		
E P Name Start St Stop St M	ode Type Control	Description
X 1 RT_HMA205+00.00 259+00.00 Hc	rizontal Alignment Rt_EOP H	lorizontal locatic
<		Þ

- 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.

6622:5 · · · ·	· · · · · · · · · · · · · · · · · · ·
6622.0	
	Point
6621:5 · · · ·	Name: LT_HMA_Lift1_Laneline-Top Style: D_LANELINE
	Offset: -12.52
6621:0 · · · ·	Elevation: bb/2.04 Constraints:
	Slope
6620:5 • • • •	Horizontal

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.

	ianer - C:\Projects\12345\Design\InRoads\12345_Corr.i Superelevation Tools Overlay Tools	rd
∎∰:≛ <b>-</b> ≤	Create Superelevation Wizard	AASHTO
	Create Single Control Line	Fixed Length
	Apply Shoulder Rollover Lock	Table
	Import Superelevation Import Superelevation from Alignment	4 · · · · ·

- 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.

🚔 Open Superele	evation Table					X
Look jn:	鷆 AASHTO 2	004	•	G 🏂 📂	<b></b>	
<b>S</b>	Name 06_25.sup	Date modified	Туре	Size		*
Recent Places	06_30.sup					
Desktop	a 06_40.sup a 06_45.sup					
Todd	@ 06_50.sup					Ш
i Nuu	a 06_60.sup a 08_15.sup					
Computer	@ 08_20.sup @ 08_25.sup					-
Network	File <u>n</u> ame:	06_55.sup		÷		
	Files of type:	Superelevation	fable (*.sup)	•	Can <u>H</u> e	_

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

Ger	neral Superelevat	ion Data			
Tab	le: dards-Glob	al\InRoads\Supe	relevation Tables	AASHTO 2004	\06_55.sup
	% Runoff on Tar	ngent 60%	📃 Inte	rpolate Table Va	alues
	Specify Runout:	0.00	Transiti	on Lengths Are:	
	Non-Linear Curve	Length: 0.00	۲	Runoff 💿 Ta	otal Transition
ID 1	Start Station	Stop Station	Superelevati	Table	Design
ID	Start Station	Stop Station	Superelevati	Table	Design
1	231+75.30 248+08.02	234+72.97 252+90.13	6.00% 4.40%	06_55.sup 06_55.sup	0.00
-					
	ted Curves:	Load Values Fro	m Table	Update Geometr	v from Toble

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.

Superelev	ation Section	Definitions				
ections:						Help
Name	Start Stati	Stop Stati	Crown Po	Left Rang	Right Ra	Pivot Direc
iuperelevati	on for Selected	Section:		Add	E dit	Delete
Start Stati	. Stop Stati	Entering	Exiting R	Width fro	Superelevati	ion Rate
						E dit
						Eui
	< Bac	* N	ext > Pr	eferences	Close	

23. Use the drop down menu or the target 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.**

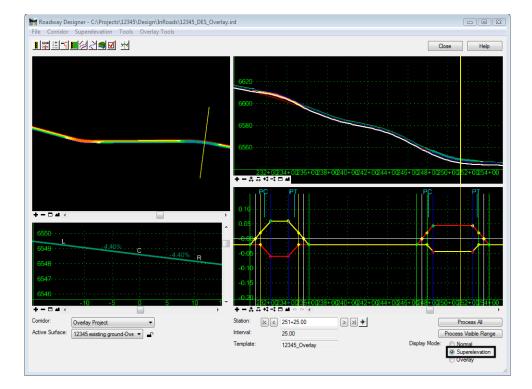
#### 26. <D> OK.

🕍 Add Supereleva	ation Section		×
Name:	Section 1		ОК
🔲 List all backbone	e points	_	Cancel
Crown Point:	HMA_Lift1_Centerlin 🔻	<b>+</b>	Help
Left Range Point:	LT_HMA_Lift1_Lane 🔻	+	
Right Range Point:	RT_HMA_Lift1_Lan	+	
Pivot Direction:	From Crown Point -		
Number of lanes:	Two OFour		
Runoff Length Multi	plication Factor: 1.00		
Limits Station			
Start:	203+80.28	+	
Stop:	260+43.16	+	

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

Superelevation	Controls	-	, • 💌
Section:	Section1	•	Help
Superelevation Co	ntrols:		
Name	Point	Pivot Point	Initial SI
	LT_HMA_Lift1_Laneline-Top RT_HMA_Lift1_Laneline-Top	HMA_Lift1_Centerline-Top HMA_Lift1_Centerline-Top	
•			Þ
Round Statio	n to Nearest: 0+00.00	Edit	Delete
<	Back Finish Pr	eferences Close	

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*.

Existing Grour Existing Type:	nd Cross Slope Definit Alignm		Optimizatio	n Parameters olerance: 0.	00%	Close		
Pivot Alignmer	nt: SH 86	-	+ © Elevatio	Elevation Tolerance:				
Superelevated	Alignment:	P 🔻	1	Maximum Desirable Delta G: 1.00				
Design Cross	Slope Definitio <u>n</u>		Limits			Help		
Design Type:	Contro	l Line 🔻	Statio	n				
Control Line:	Sectio	n 1 HMA Lift 1 👻	Star	t: 20	3+80.28			
			Stor		0+43 16	+		
Results:								
Station	Ground Slope	Design Slope	Difference	Corrected Slope	Delta Elevation	Delta G		
205+00.00	-1.78%	-2.00%	-0.22%	-1.78%	0.00	0.00		
205+25.00	-1.14%	-2.00%	-0.86%	-1.14%	0.00	0.33		
205+50.00 205+75.00	-1.48%	-2.00%	-0.52% -0.12%	-1.48%	0.00	0.17		
205+75.00	-1.88%	-2.00%	0.33%	-1.88%	0.00	0.20		
	-2.33%	-2.00%	0.33%	-2.33%	0.00	0.23		
	-3.20%	-2.00%	1.20%	-3.20%	0.00	0.23		
	-3.53%	-2.00%	1.53%	-3.53%	0.00	0.17		
206+50.00					0.00			
206+50.00 206+75.00		-2.00%			0.00	0.15		
206+50.00	-3.53%		1.24%	-3.24%		0.15		
206+50.00 206+75.00 207+00.00	-3.24%	-2.00%	U 0E4	0 0F%		+		
206+25.00 206+50.00 206+75.00 207+00.00 207-25.00 Adjusted Cross New Control L Section Name	-3.24% 2 0.5% Slopes: <			0 659	Delta G E	inors: <		

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

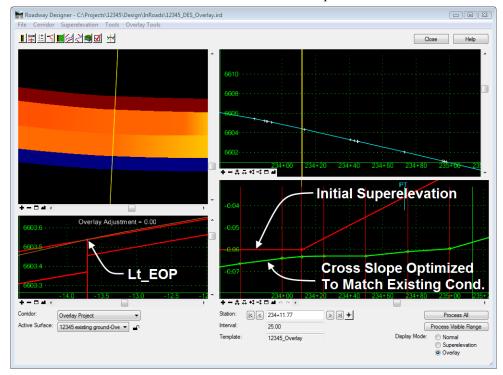
Note the values in columns Ground Slope & Corrected Slope match indicating the design cross slope now matches existing conditions.

- 10. Select Section Name: Section 1
- 11. Key in for Control Line: Slope-Opt\_Lt\_Laneline

Existing Ground Existing Type:	d Cross Slope Definiti	on e Name 🔻	Optimizati	on Parameters			Close	
				Folerance:	1.00%	ſ	Preference	s
Pivot Feature:		fic Double Yel 🔻	🕂 🔘 Eevati	on Tolerance:	0.00		Report	_
Superelevated I	Feature: T_Edg	e of Oil <mark>4</mark> 97 🔻	+ Maximum	Desirable Delta G:	1.00			•
Design Cross S	Inco Defeation		Limits			Į	Help	
Design Cross 5 Design Type:	Contro	lline -	Static	in				
1000 T (100 T (100	Control Line: Section 1 Centerline-		Sta		220.55.00 +1			
control line.	Section I Centerline- V		12.0		226+55.00 +			
			Sto	n <sup>.</sup>	239+95.00	1000		
			0.0		239+95.00	+		
Calculate Corre	ction Reset I	Results	0.0	-	239+90.00	<u>+</u>		
	ction Reset I	Results			239+90.00	<u>+</u>		
lesults:	ction Reset I Ground Slope	Results Design Slope	Difference	Corrected Slope		 Delta G		
Results: Station		-					17 2. 2.	-
Results: Station 230+83.50	Ground Slope	Design Slope	Difference	Corrected Slope	Delta Elevation	Delta G		-
Results: Station 230+83.50 231+00.00	Ground Slope -4.29%	Design Slope -2.00%	Difference 2.29%	Corrected Slope	Delta Elevation 0.13	Delta G		-
Results: Station 230+83.50 231+00.00 231+25.00	Ground Slope -4.29% -4.49%	Design Slope -2.00% -2.00%	Difference 2.29% 2.49%	Corrected Slope -3.29% -3.49%	Delta Elevation 0.13 0.13	Delta G 0.26 0.15		(1 10 10 10 10 10 10 10 10 10 10 10 10 10
Results: Station 230+83.50 231+00.00 231+25.00 231+25.00 231+34.50	Ground Slope -4.29% -4.49% -4.81%	Design Slope -2.00% -2.00% -2.00%	Difference 2.29% 2.49% 2.81%	Corrected Slope -3.29% -3.49% -3.81%	Delta Elevation 0.13 0.13 0.13	Delta G 0.26 0.15 0.15		
Results: Station 230+83.50 231+00.00 231+25.00 231+34.50 231+50.00	Ground Slope -4.29% -4.49% -4.81% -4.93%	Design Slope -2.00% -2.00% -2.00% -2.00%	Difference           2.29%           2.49%           2.81%           2.93%	Corrected Slope -3.29% -3.49% -3.81% -3.93%	Delta Elevation 0.13 0.13 0.13 0.13 0.13	Delta G 0.26 0.15 0.15 0.14		(1 10 10 10 10 10 10 10 10 10 10 10 10 10
lesults: Station 230+83.50 231+00.00 231+25.00 231+34.50 231+50.00 231+75.00	Ground Slope -4.29% -4.49% -4.81% -4.93% -5.06%	Design Slope -2.00% -2.00% -2.00% -2.00% -2.61%	Difference           2.29%           2.49%           2.81%           2.93%           2.45%	Corrected Slope -3.29% -3.49% -3.81% -3.93% -4.06%	Delta Elevation 0.13 0.13 0.13 0.13 0.13 0.13	Delta G 0.26 0.15 0.15 0.14 0.10		11 11 12 14 14 14 14 14 14 14 14 14 14 14 14 14
lesults: Station 230+83.50 231+00.00 231+25.00 231+25.00 231+50.00 231+75.00 232+00.00	Ground Slope -4.29% -4.49% -4.81% -4.33% -5.06% -5.27%	Design Slope -2.00% -2.00% -2.00% -2.00% -2.00% -2.61% -3.59%	Difference           2.29%           2.49%           2.81%           2.93%           2.45%           1.68%	Corrected Slope -3.29% -3.49% -3.81% -3.93% -4.06% -4.27%	Delta Elevation 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	Delta G 0.26 0.15 0.15 0.14 0.10 0.10		(1 10 10 10 10 10 10 10 10 10 10 10 10 10
Calculate Corre Results: Station 230+83.50 231+20.00 231+25.00 231+34.50 231+50.00 232+50.00 232+25.00 232+36.50	Ground Slope 4.29% 4.49% 4.81% 4.93% 5.06% 5.27% -5.65%	Design Slope -2.00% -2.00% -2.00% -2.00% -2.00% -2.61% -3.59% -4.57%	Difference 2.29% 2.49% 2.81% 2.93% 2.45% 1.68% 1.08%	Corrected Slope 3.29% 3.49% 3.81% 4.06% 4.27% 4.65%	Delta Elevation 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	Delta G 0.26 0.15 0.15 0.14 0.10 0.10 0.10		(1 10 10 10 10 10 10 10 10 10 10 10 10 10
lesults: Station 230+83.50 231+00.00 231+25.00 231+34.50 231+50.00 231+75.00 232+00.00 232+25.00	Ground Slope 4.29% 4.49% 4.81% 4.33% 5.05% 5.27% 5.65% 6.11%	Design Slope -2.00% -2.00% -2.00% -2.00% -2.00% -2.61% -3.59% -4.57% -5.55%	Difference 2.29% 2.49% 2.81% 2.93% 2.45% 1.68% 1.68% 1.08% 0.56%	Corrected Slope 3.29% -3.49% -3.81% -3.93% -4.06% -4.27% -4.65% -5.55%	Delta Elevation 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	Delta G 0.26 0.15 0.15 0.14 0.10 0.10 0.18 0.43		11 11 12 14 14 14 14 14 14 14 14 14 14 14 14 14

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

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*.

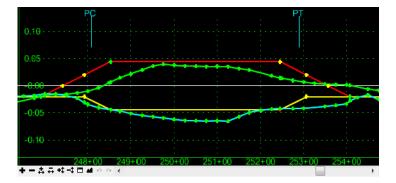
In the Design Cross Slope Definition area, select Control Line for the Design Type.

- 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	Туре	Control
	1	LT_HMA_Lift1_Laneline-Top	203+80.28	260+43.16	Vertical	Superelevation	Section 1 HMA_Lift 1_Centerline-Top-LT_HMA_Lift 1_Laneline-
	1	RT_HMA_Lift1_Laneline-Top	203+80.28	260+43.16	Vertical	Superelevation	Section 1 HMA_Lift 1_Centerline-Top-RT_HMA_Lift 1_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

547:0			
546.5		 	
10.0	1		
46.0			
40.0			
45.5			The second second second
M0:0			
15.0			

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.

Material	Surface Area	Volume	Units	Unit Cost	Total Cost/Material	Close
D_ABC_Class 6		59400.0	CF	0.00	0.00	
D_HMA_Pvmt		83257.2	CF	36.25	3018073.50	Report
D_SHOULDER-Emba	131388.38		SF	0.00	0.00	Help
D_Toe-of-Fill	24653.33		SF	0.00	0.00	Help
D_Top-of-Cut	57365.62		SF	0.00	0.00	
		Total Es	timated	l Cost: 30	18073.50	]

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**<sup>"</sup> 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**

Figure 2 Contract Provided Adjustment Settings	×
Backbone Thickness Minimur Overlay Backbone 0.00 © Use Minimum Overlay: 0.17	
O Use Minimum Milling	
Maximum Milling:       0.00         Template Rance       Left Point:         Left Point:       LT_HMA_Lift1_Lane ▼         Right Point:       RT_HMA_Lift1_Lane ▼	Existing Ground Range Type: Match Template Range
Limits Station Start: 203+80.28 + Stop: 260+43.16 +	Solution Option <ul> <li>Examine all Cross Section Points</li> <li>Examine Template Points Only</li> <li>Maximum Vertical Difference: 0.00</li> </ul>

- Overlay Adjustment = 0.15 6632:2 6631:5 6631:5 -10 -5 0 5 10 15
- Overlay Adjustment = 0.15

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.

	. (	Overlay A	Adjustme	nt = 0.15	1	1
6632:2						
6632:0 · · ·						
6631.8		1	T			
6631.6 · · ·	Levelin Necess	g Course ary				$\overline{}$
7	- 10	-5		5	10	15

- 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.

Edit Add Tools							
nplate Library:	Current Ten	plate			Display		Close
C:\Projects\12345\Design\InRoads	Nome:	12345_Overlay	¥		Component	ts 🗇 Constraints	farmina and a second
Point Name List	Description	2" overlay with	1" milling & paver	nent widening	Display Po	int Names	Help
IZ345 Overlay					Display Al	Components	
× 12345_Slope-Optimization							
CONC_Divided_TypeA_4Lz							
HMA Crowned B10							
HMA_Divided_TypeA_4Lar	0.4						
- HMA_Ful_Depth_Widening	0.2						
HMA_Ful_Depth_Widening							
HMA_Uban_4Lane	+0.0				-		
3 - Sections - End Conditions	.0.2		and the second		Contraction of the local division of the loc	ALCO PROPERTY AND	
4 - Components							
HMA_StropingOnly_Zane	100					100	and the second se
	100						
	0.8						
	-10		1			+	
	-1:2						
			-				
	-116						
· · ·			-10			5 10	15 . 2
brary Active Template	+-4.6.		~+ e	20		1	asouth a
view	Current Com	ponent					Test
	Name: HM	Levelng		Style: D	LEVELING-Aphat		
	Top option:		Follow Compo	cent . tree	te Bottom Surface:	- 33	
	Bottom optic				te Bottom Surface:		
			Follow Highes				
	Component	Depth:	0.50	Label:			
	Surface:		(Active)	- E Sea	oping Component		
	Surface Dec	th:	0.00	Label:			

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.

1.5				 	 	 	 •••••••••
0.5	HN	IA Levelii	na				
0.0	Co	mponent				 	
-0:5							 
-1:0						<u>.</u>	 
-1:5							
-2:0 · · · · ·							

- **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.

6628:4	 Overlay /	Adjustm	ent = 0.17	
6628:2				
6628:0 ····				 
6627:8				
6627:6				
6907.4	 · · · · · · · · · · · · · · · · · · ·		<u></u>	 

- 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 \_\_\_\_\_\_.

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

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.

Backbone Thickness		Minimun Overlay		Maximum Milling	Cancel Preferences. Reset
			Pa	rametric Label	Help
Backbone		0.00		•	
Ose Minimum C	verlay:	0.17		-	
🔘 Use Minimum N	Milling				
🔽 Maximum Milling	g:	0.08	1	•	
	T_HMA_L	ift1_Lan∈ ▼ _ <del> </del> ift1_Lan∈ ▼ _ <del> </del>	Existi Type	ng Ground Range Match Template F	lange 🔹 🔻
Limits				ion Option kamine all Cross Section	on Points
Start: 20	)3+80.28	+	© E	kamine Template Poin	ts Only
Stop: 26	60+43.16	+	м	aximum Vertical Differ	ance: 0.00

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.

e Edit Add Tools				
emplate Library: C\Projects\12345\Design\InRoads E Point Name List		5_Overlay erlay with 1" milling & pavement widening	Display Components Constraints Display Point Names	Close Help
<ul> <li>Interdate</li> <li>Interdate</li></ul>	0.4		Deploy A Components	
Bray Active Template	-1:2	-10864 ■ ■ = = + + +		10 12 1
	Name: D_Miling Top option: Bottom option: Component Depth Surface:	Follow Component • 0.00 Lat	D_MILLING  mate Bottom Surface: ek. Steppong Componente	
	Surface Depth:	<active> + V</active>	stepping Component	

#### 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**

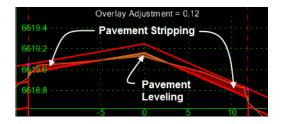
In Roadway Designer synchronize the revised template with the corridor.

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

Material	Surface Area	Volume	Units	Unit Cost	Total Cost/Material		Close
D_ABC_Class 6		59400.0	CF	0.00	0.00		
D_HMA_Pvmt		83257.2	CF	36.25	3018073.50		Report
D_LEVELING-Asphał		536.48	CF	32.00	17167.27		Help
D_MILLING		5288.31	CF	8.80	46537.10		neip
D_SHOULDER-Emba	131388.38		SF	0.00	0.00		
D Too of Fill	20 00210		CE	0.00	0.00	Ŧ	
	20 00210		CE	0.00	0.00	÷	

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.

Co21.30	Smoothed Vertical Alignment
🕌 Smooth Overlay Vertical Alignment 🛛	
Tolerance: 0.04 Apply	
Create Linear Elements Only	
Vertical Alignment Name: 12345_Smoothed Help	Original Vertical ——— Alignment
+	28 225+30 225+32 225+34 225+36

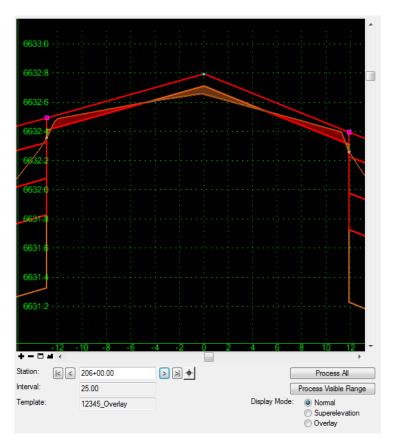
- 5. **<D> Close.**
- 6. Select Overlay Tools > Apply Adjusted Vertical Alignment.
- 7. Toggle on Apply Adjusted Vertical Alignment to Corridor.
- 8. Select **ALG\_OTHER\_Vert** for the *Style*.
- 9. <D> OK.

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.

Material	Surface Area	Volume	Units	Unit Cost	Total Cost/Material	*	Close
D_ABC_Class 6		59400.0	CF	0.00	0.00		
D_HMA_Pvmt		83257.2	CF	36.25	3018073.50		Report
D_LEVELING-Asphał		1342.25	CF	32.00	42951.88		Help
D_MILLING		3043.68	CF	8.80	26784.38		Help
D_SHOULDER-Emba	131388.38		SF	0.00	0.00		
D Top of Fill	21560 42		CE	0.00	0.00	Ψ.	
<							

- 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.