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Workshop - X9 Widening & Overlay with Roadway Designer

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Resurfacing Techniques

Module Overview

This module will investigate the techniques for resurfacing roads. It includes optimization of vertical alignments, milling and widening of existing roads.

Module Prerequisites

- Advanced knowledge of geometry commands
- Advanced knowledge of template creation and usage
- Advanced knowledge of Roadway Designer

Modules Objectives

After completing this module, you will be able to:

- Create an optimization template
- Create optimized vertical alignments
- Level and widen roadways

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Resurfacing Techniques

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Introductory Knowledge

Before you being this module, let's define what you already know.

Questions

- 1. Repaying is the same as rehabilitation.
- True
- False
 - 2. Repaying of roads requires leveling.
- True
- False
- Maybe
 - 3. Is superelevation needed for rehabilitating a road?
- True
- False
- Maybe

Answers

1. Repaying is the same as rehabilitation.

False

Rehabilitation usually involves correcting cross slope and or re-engineering superelevation.

2. Repaving of roads requires leveling.

False

Generally, repaving is a simple overlay of asphalt directly on the existing pavement with no corrections.

3. Is superelevation needed for repaving a road?

Maybe

Straight roads will not need superelevation; however, if rehabilitating a roadway and you have curves you will need superelevation applied to your corridor.

Loading Data

We will use an RWK file to load the project data. The RWK is located in the following parent directory:

C:\2008 RBUC_West\Widening and Overlay with Roadway Designer (InRoads_GEOPAK)\Data

The data that will be loaded is:

OG.dtm	(Existing surface file)
Overlay.alg	(Existing regressed geometry file)
Overlay.itl	(Template library file)
Overlay.ird	(Roadway Designer file)
civil.xin	(Preference file)

→ Exercise: Opening the data

- 1. Start InRoads from the InRoads icon (Start>Programs>Bentley>InRoads Group V8i)
- 2. When the MicroStation Manager appears, select the file Overlay.dgn and open it.

Hint: All files for this module are located in the parent directory stated above.

- 3. When MicroStation fully opens and InRoads appears select **File>Open** from the **InRoads** menu.
- 4. Select the file *Ovrelay.rwk* and open it.

Viewing the Data

We will now view the data that exists in the project you just opened.

→ Exercise: Viewing the data

- 1. To view the horizontal alignment select Geometry>View Geometry>Active Horizontal.
- 2. *Fit* the MicroStation view.
- 3. To view the surface data select **Surface>View Surface>Features**. When the dialog opens highlight all the features and select **Apply**.
- 4. Close the View Features dialog.
- 5. Cut a profile along the alignment. Go to **Evaluation>Profile>Create Profile**. Select **Apply** and then identify a location to cut the profile.

Widening Template

The process in this section will allow you to automatically find the controlling points along the road to minimize the leveling.

- → Exercise: Widening
- 1. Go to Modeler>Create Template.
- 2. Expand the tree in the left pane of the **Create Template** dialog until you see the templates called **Widening**.



- 3. Double click on the template *Widening* to activate it.
- 4. Right Click on the point named *L_OEOP*.
- 5. Note that the point is controlled from the centerline point in the horizontal direction and the slope is a vector-offset from the centerline to the inside edge of pavement.
- 6. Close the Create Template dialog.
- 7. Go to Modeler>Roadway Designer.
- 8. Create a new corridor. Go to Corridor>Corridor Management.
- 9. Type in the name *Widening* in the name field of the Manage Corridors dialog.
- 10. Set the following values:

•	Station:	On
•	Start:	48+00
•	Stop:	250+00
•	Туре:	Alignment
•	Horizontal Alignment:	Highway
•	Vertical Alignment:	Highway

- 11. Click **Add** and close the dialog.
- 12. From the Roadway Designer go to Corridor>Template Drops.
- 13. Expand the template list.

- 14. Double click on the folder **Overlay Templates**.
- 15. Highlight *Widening* and select Add.

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Corridor:	Widening	~		Add
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Interval:	50.00		+	Change
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St	Int Template	Enable	Re	Library
Synchro	nize with Library		Edit	Delete

- 16. Close the Template Drops dialog.
- 17. Got to **Corridor>Point Controls**.
- 18. In the **Point Controls** dialog set the following values
 - Point: L_EOP
 - Mode: Both
 - Control Type: Feature
 - Surface: Existing
 - Feature LEP
 - Start Station: 48+00
 - Stop Station: 250+00
 - Vertical Offset 0.25 (for both Start and Stop)

19. In the **Point Controls** dialog set the following values.

- Point: R_EOP
- Mode: Both
- Control Type: Feature
- Surface: Existing
- Feature REP
- Start Station: 48+00
- Stop Station: 250+00
- Vertical Offset 0.25 (for both Start and Stop)

20. In the **Point Controls** dialog set the following values.

- Point: CL
- Mode: Both
- Control Type: Feature
- Surface: Existing
- Feature CL
- Start Station: 48+00
- Stop Station: 250+00
- Vertical Offset 0.25 (for both Start and Stop)
- 21. Close the Point Control dialog.
- 22. Step through the model.
- 23. Close the Roadway Designer (Save the corridor if you would like).

Optimization Template

The process in this section will allow you to automatically find the controlling points along the road to minimize the leveling.

- → Exercise: Reviewing the optimization template
- 1. Go to Modeler>Create Template.
- 2. Expand the tree in the left pane of the **Create Template** dialog until you see the templates called **Visual Optimization**.



- 3. Double click the template *Visual Optimization* to activate it.
- 4. Right click on the green point on the upper most layer of the template and select Move.



- 5. Move the point around and examine how the other layers react.
- 6. Right click to reset.
- 7. **Right click** on the right most green point and move it around.
- 8. **Right click** on the left most green point and move it around.

- Hint: If you accidentally left click and place the layer somewhere else use Edit>Undo or Ctrl+Z to undo the left click.
- CL -0:20 FOP

Double click on the red point at the center of the white layer.

9.

10. Examine the constraints that are attached to the point. The point is constrained horizontally to the green point above it and by slope from the green point to the right.

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Constraints Type: 9 Parent 1: 7 Parent 2: 2 Value: 4 Label: 2 Style Cor	Constra Slope R_EOP_RE R_BOP_RE 2.000%	int 1 OPTie rer Value	× × \$]	+ (Col lorizor CL	nstraint htal	2	× ×	+

- 11. Double click the template *Optimization* to activate it.
- 12. Right click on the upper most green point and select move.
- 13. Move it down in the window and at some point you will see another layer turn on and the layer you were moving turn off.
- 14. Right click to reset.

15. Turn on the toggle **Display All Components**.



- 16. Notice now that you can see the other components (layers) but they are dashed.
- 17. **Move** the point at the left most end of the brown one. Notice if you move it above the upper layer it will turn on.
- 18. Repeat the process with the white one by moving the right most point.
- 19. What is causing this is **Display Rules**.
- 20. **Double click** on any component. In the lower portion of the dialog select the **Edit** button to the right of the **Display Rules** field.

Name:	R_CL_Tie +	Apply
Description:		Close
Style:	P_ROAD_WearingC 🗸 Close Shape	< Previous
Parent Component:	· · · · · · · · · · · · · · · · · · ·	
Diaplau Pulas:		Next>

21. In the lower half of the dialog you will see a list of rules. The upper half of the dialog allows you to use the rules in combination.

Conditional Expression f	or R_CL_Tie Component			ОК
NOT (CL-CL_LEOPTie	OR CL-CL_REOPTie)	~		
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Name Type REVertical CLVertical CLVertical	Expression CL_REOPTie - CL_LEOPTie CL - CL_LEOPTie CL - CL_REOPTie	Test Valu < 0.00 < 0.00 < 0.00	e Result False False False False	
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Name Type RE Vertical -CL Vertical -CL Vertical	Expression CL_REOPTie CL_LEOPTie CL - CL_LEOPTie CL - CL_REOPTie	Test Value 0.00 0.00 0.00 0.00	e Result False False False	
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22. Cancel and Close the Display Rule dialog and Edit Component dialog.

23. Notice there are two more templates in the folder. The *L_Visual Optimization* and *R_Visual Optimization* are subset templates from the *Visual Optimization* template. These will be used to create superelevation. Take a minute to examine the templates.

Optimization Corridor

The process in this section will tie the optimization template into a corridor.

- → Exercise: Creating an Optimization Corridor
- 24. Go to Modeler>Roadway Designer.
- 25. Create a new corridor. Go to Corridor>Corridor Management.
- 26. Type in the name *Visual Optimization* in the name field of the **Manage Corridors** dialog.
- 27. Set the following values:

•	Station:	On
•	Start:	48+00
•	Stop:	250+00
•	Туре:	Alignment
•	Horizontal Alignment:	Highway
•	Vertical Alignment:	Highway

Type: Horizontal Alignment: Vertical Alignment: PI Rounding Tangent: Cognidors: Name Ty	Alignment Highway Highway 0.00	 	+	Staten 48+00.00 Stop: 250+00.00	+	Close Change Copy Copy Fror
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PI Rounding Tangent:	0.00			250+00.00	+	Copy From
Corridors: Name Ty						COPY FIOI
	ipe	Source	Name	Start Station	Stop	Station

28. Click **Add** and close the dialog.

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- 29. From the Roadway Designer go to Corridor>Template Drops.
- 30. Expand the template list.
- 31. Double click on the folder Vertical Optimization.
- 32. Highlight Visual Optimization and select Add.

🛗 Templ	ate Drops			_ 🗆 🔀		
Corridor:	tes	~		Add		
Station:	47+78.74		+	Close		
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				//		

- 33. Close the Template Drops dialog.
- 34. Select the **Superelevation** button on the bottom right of the **Roadway Designer**.
- 35. Right click in the lower right view and select Create Superelevation Wizard>Table.
- 36. Select the 🗔 button on the **Table Wizard** dialog.
- 37. Browse to the workshop folder and select the file *08_50.sup*.

Gen	ieral Supereleva	ition Data						
	IE: C:\2007	UTC\WSO	4\08_50	D.sup				
	% Runoff on Ta	ingent	80%			olate i	able valu	les
	Specify Runout:		0.00		Transitio	n Leng	ths Are:	
1	on-Linear Curv	e Length:	0.00		⊙ Ri	unoff	🔿 Tota	al Transition
2 3 4 5	95+20.34 120+46.78 151+14.81 223+53.89	104+53 145+76 168+29 241+51	.61 .71 .98 .53	0.00% 0.00% 0.00% 0.00%				0.00 0.00 0.00 0.00

- 38. Change the **%Runoff on Tangent** to **80%**.
- 39. Select the Load Value From Table button.
- 40. Select Next.
- 41. When the next step appears select the Add button close to the center of the dialog.
- 42. When the **Add Superelevation Section** dialog appears set the following values in the dialog.

•	Name:	CL_Tie
•	Crown Point:	CL
•	Left Range Point:	L_EOP
•	Right Range Point:	R_EOP
•	Pivot Direction:	From Crown
•	Number of Lanes:	2
•	Station	Off

🐂 Edit Superele	vation Section 🛛 🔀
Name:	CL_Tie OK
Crown Point:	CL + Cancel
Left Range Point:	
Right Range Point:	R_EOP
Pivot Direction:	From Crown Point 💌
Number of lanes:	
Runoff Length Multip	plication Factor: 1.00
Limits Station	
Start:	47+78.74 •
Stop:	578+20.93

- 43. Select OK.
- 44. Select Next and then Finish when the wizard dialog appears.
- 45. Go to Corridor>Template Drops.
- 46. In the **Current Template Drops** list highlight (single click) on the entry in the list.
- 47. In the **Library Templates** list select the *L_Visual Optimization* template.

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- 48. Select Change.
- 49. Select Close.
- 50. Right click in the lower right view and select Create Superelevation Wizard>Table.

- 51. Select Next.
- 52. Select Add.
- 53. When the **Add Superelevation Section** dialog appears set the following values in the dialog.
 - Name: L_Tie
 - Crown Point: CL_LEOPTie
 - Left Range Point: L_EOP_LEOPTie
 - Right Range Point: R_EOP_LEOPTie
 - Pivot Direction: From Left Edge
 - Number of Lanes: 2
 - Station Off
- 54. Select OK.
- 55. Select Next and then Finish when the wizard dialog appears.
- 56. Go to Corridor>Template Drops.
- 57. In the Current Template Drops list highlight (single click) on the entry in the list.
- 58. In the Library Templates list select the *R_Visual Optimization* template.

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Current Te	mplate Drops:		
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59. Select Change.

- 60. Select Close.
- 61. Right click in the lower right view and select Create Superelevation Wizard>Table.
- 62. Select Next.
- 63. Select Add.
- 64. When the **Add Superelevation Section** dialog appears set the following values in the dialog.
 - Name: R_Tie
 - Crown Point: CL_REOPTie
 - Left Range Point: L_EOP_REOPTie
 - Right Range Point: R_EOP_REOPTie
 - Pivot Direction: From Right Edge
 - Number of Lanes:
 - Station Off
- 65. Select OK.
- 66. Select Next and then Finish when the wizard dialog appears.
- 67. Go to Corridor>Template Drops.
- 68. In the Current Template Drops list highlight (single click) on the entry in the list.
- 69. In the Library Templates list select the Visual Optimization template.

2

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Corridor:	tes 💌	Add		
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- 70. Select Change.
- 71. Select Close.
- 72. Select the **Superelevation** button to turn off the superelevation mode.
- 73. Go to Corridor>Point Controls.
- 74. In the **Point Controls** dialog set the following values.
 - Point: CL
 - Mode: Both
 - Control Type: Feature
 - Surface: Existing
 - Feature CL
 - Start Station: 48+00
 - Stop Station: 250+00

^p oint: - Mode						6dd
Mode			I C Station Lin	nits	10.000	
Mode	JCL		Start: 48+	00.00	+	Close
C Horizo	ntal C Vertical	 Both 	Stop: 250	+00.00	+	Change
Control Type	e: Feature	•	Horizontal	Offsets		Help
Surface:	Existing	-	Start: 0.00)	+	
Feature:	CL	- +	- Stop: 0.00)	+	
Use as	Secondary Alignment		→ Vertical Of	fsets		
			Start: 0.00)	+	
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Priority:	1					
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× 1 × 1 × 1 × 1 × 1 × 1 × 1	L_EOP R_EOP CL_LEOPTie R_EOP_LEOP. L_EOP_REOP. CL_EOPTie	47+78.74 47+78.74 47+78.74 47+78.74 47+78.74 47+78.74 47+78.74	578+20.93 578+20.93 578+20.93 578+20.93 578+20.93 578+20.93 578+20.93	Vertical Vertical Vertical Vertical Vertical Vertical	Superelev Superelev Superelev Superelev Superelev Superelev	Control vation CL_Tie CL-L_E vation CL_Tie CL-R_E vation L_Tie L_EOP_L vation L_Tie CL_EOP vation R_Tie CL_EOP vation R_Tie CL_EOP vation R_Tie CL_EOP



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75. Click Add.

76. In the **Point Controls** dialog set the following values.

• Point: L_EOP_LEOP	Tie
---------------------	-----

- Mode: Both
- Control Type: Feature
- Surface: Existing
- Feature LEP
- Start Station: 48+00
- Stop Station: 250+00

77. Click Add.

78. In the **Point Controls** dialog set the following values.

•	Point:	R_EOP_REOPTie
•	Mode:	Both
•	Control Type:	Feature
•	Surface:	Existing
•	Feature	REP
•	Start Station:	48+00

- Stop Station: 250+00
- 79. Click Add and Close the Point Controls dialog.
- 80. Examine the corridor.
- 81. Go to Corridor>Corridor Management.
- 82. Highlight the Visual Optimization corridor.
- 83. Select Copy.
- 84. When the **Copy Corridor** appears enter *Optimization* in the **New Corridor Name** field and select **OK**.

🖌 Copy Corridor	×
Existing Corridor Name:	OK
Visual Optimization	Cancel
New Corridor Name:	
Optimization	

- 85. Close the Manage Corridor dialog.
- 86. In the lower left corner of the **Roadway Design** set the **Corridor** to **Optimization**.
- 87. Go to Corridor>Template Drops.
- 88. Highlight the template drop listed in the Current Template Drops list.

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Corridor:	tes		~		Add
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- 89. In the Library Templates highlight the template Optimization and select Change.
- 90. Close the **Template Drops** dialog.
- 91. Examine the corridor.
- 92. Go to Corridor>Create Surface.

- 93. When the Create Surface dialog appears set the following values.
 - Optimized Name:
 - **Default Preference:** Proposed
 - **Empty Design Surface:** •

•

•

•

On – Style: **P_TOPO_Exterior Add Exterior Boundary:**

On

On

Off

- **Triangulate:** .
 - **Optimization (highlight this one only)**

On – Style: **P_TOPO_Transverse**

- **Create Surface(s) From: Add Transverse Feature:**
- All other toggles:
- 🕌 Create Surface X Name: Optimized Apply Default Preference: Proposed • Close New Surface for Each Corridor Preferences... Empty Design Surface Help Include Null Points Add Exterior Boundary - Style: P TOPO Exterior -Densify Horizontal Curves using Chord Height Tolerance 🔲 Densify Vertical Curves using Chord Height Tolerance ✓ Triangulate Create Surface(s) from: Optimization Visual Optimization All None Clipping Options.. Features 🔽 Add Transverse Features Style: P_TOPO_Transverse Create Alternate Surfaces Frocess Visible Range Only 🔲 Remove Loops 🔲 Display Features in Plan View
- 94. Select Apply. When the processing is finished Close the dialog.
- 95. From the Roadway Designer dialog select File>Save.
- 96. Close the Roadway Designer.

Optimization Vertical Alignment

The process in this section will create an optimized vertical alignment from the corridor we just created.

- → Exercise: Creating an Optimization Vertical Alignment
- 1. To create an optimized vertical go to File>Import>Geometry.
- 2. Select the tab Vertical From Surface.
- 3. Select *Optimized* as the surface name.
- 4. Type in the name *Optimized* for the Vertical Alignment Name.
- 5. Set the station limits from **48+00** to **250+00**.

From Graphics	ICS	Vertical from Surface		
Surface:	Optimi	zed	•	Apply
-Vertical Align	ment			
<u>N</u> ame:	Optimi	zed		
Description:			-	
Style:	Defau	lt .	-	<u>H</u> elp
- Target				
Horizontal Ali	gnment:	Highway	-	
✓ Station Li	mits			
Start		48+00.00	+1	
Store		1959.00.00	<u>-</u>	
		250+00.00	<u>+</u>	
I Horizonta	l <u>O</u> ffset:	0.00		
Points of Ver	tical Inte	rsection		
☐ Int <u>e</u> rval:		0.00		
Tolerance	B:	0.00		

- 6. Select Apply and then Close the Import Geometry dialog.
- 7. Cut a profile and display both the **Highway** vertical alignment and the **Optimized** vertical alignment.
- 8. Examine the differences between the two alignments.

Applying the Optimized Vertical Alignment

Now we will used the optimized vertical alignment to compute leveling.

- → Exercise: Creating an Optimized Corridor
- 1. Go to Modeler>Roadway Designer.
- 2. Set the Active Surface in the lower left of the dialog to *Existing*.
- 3. Go to Corridor>Corridor Management.
- 4. Highlight the *Optimization* corridor and select Copy.
- 5. In the New Corridor Name type in *Overlay*.

🐂 Copy Corridor	×
Existing Corridor Name:	ОК
Uptimization	Cancel
New Corridor Name:	
Overlay	

- 6. Select OK.
- 7. Go to **Corridor>Template Drops** and highlight the template drop in the **Current Template Drops** list.
- 8. In the **Library Templates** list expand the *Overlay Templates* folder and highlight the template *Overlay with Widening*.
- 9. Select Change and Close the Template Drops dialog.
- 10. Go to the **Point Controls** dialog and delete the point controls that have the mode of *"Both"*.
- 11. Add four point controls for the following points.

Point Control 1:

- Point: CL
- Mode: Vertical
- Control Type: Alignment
- Horizontal: Highway
- Vertical: Optimized
- Start Station: 48+00
- Stop Station: 250+00

- Start Vertical Offset: 0.25
- Stop Vertical Offset: 0.25

Point Control 2:

- Point: CL
- Mode: Horizontal
- Control Type: Feature
- Surface: Existing
- Feature: CL
- Start Station: 48+00
- Stop Station: 250+00

Point Control 3:

- Point: L_EOP
- Mode: Horizontal
- Control Type: Feature
- Surface: Existing
- Feature: LEP
- Start Station: 48+00
- Stop Station: 250+00

Point Control 4:

- Point: R_EOP
- Mode: Horizontal
- Control Type: Feature
- Surface: Existing
- Feature: REP
- Start Station: 48+00
- Stop Station: 250+00

- 12. Add three more point controls for the following points.
 - **Point Control 1**:

•	Point:	L_EOP_Tie
•	Mode:	Both
•	Control Type:	Feature

- Surface: Existing
- Feature: LEP
- Start Station: 48+00
- Stop Station: 250+00

Point Control 2:

•	Point:	R_EOP_	Tie

- Mode: Both
- Control Type: Feature
- Surface: Existing
- Feature: REP
- Start Station: 48+00
- Stop Station: 250+00

Point Control 3:

- Point: CL_Tie
- Mode: Both
- Control Type: Feature
- Surface: Existing
- Feature: CL
- Start Station: 48+00
- Stop Station: 250+00

Module Review

Now that you completed this module, let's measure what you learned.

Questions

- 1. Have we optimized the vertical alignment for leveling?
- 2. Have we calculated the leveling?
- 3. Do you see any issues with the model? Why?

Answers

1 Have we optimized the vertical alignment for leveling?

Yes

2 Have we calculated the leveling?

Yes, however, you will need to cut cross sections and run end area volumes

3 Do you see any issues with the model? Why?

If the regressed horizontal alignment is too far away from the original centerline it could cause overlaps in the leveling and the new overlay.

Module Summary

After concluding this module you investigated the techniques for resurfacing roads. It included optimization of vertical alignments, milling and widening of existing roads.

Module Summary