



Bentleyuser.dk Årsmøde 2008

Nordic Civil 2008

10.-12. November 2008, Munkebjerg Hotel, Vejle

Workshop - X9

Widening & Overlay with Roadway Designer

Presenter: Joe Waxmonsky, P.E., Bentley Systems USA

Bentley Systems, Incorporated
685 Stockton Drive
Exton, PA 19341
www.bentley.com



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

Introductory Knowledge

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

Questions

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

Answers

1. Repaving 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

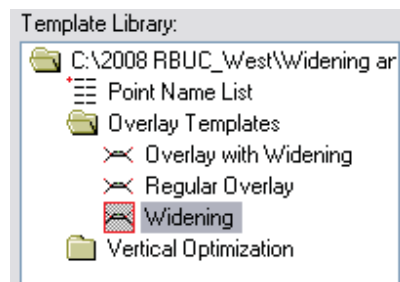
1. To view the horizontal alignment select **Geometry>View Geometry>Active Horizontal**.
2. **Fit** the MicroStation view.
3. To view the surface data select **Surface>View Surface>Features**. When the dialog opens highlight all the features and select **Apply**.
4. **Close** the View Features dialog.
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

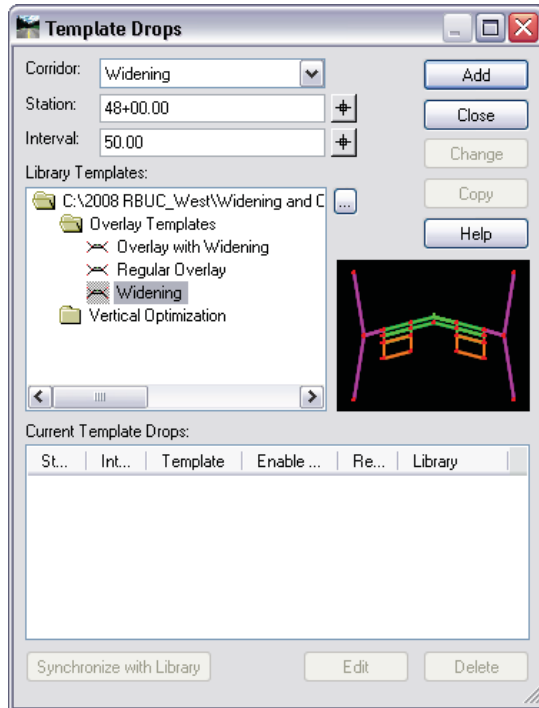
1. Go to **Modeler>Create Template**.
2. Expand the tree in the left pane of the **Create Template** dialog until you see the templates called **Widening**.



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
• Type:	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**.



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.

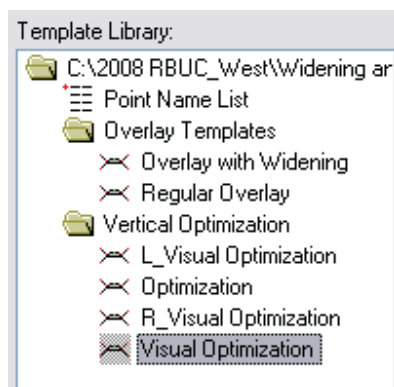
23. **Close** the **Roadway Designer** (Save the corridor if you would like).

Optimization Template

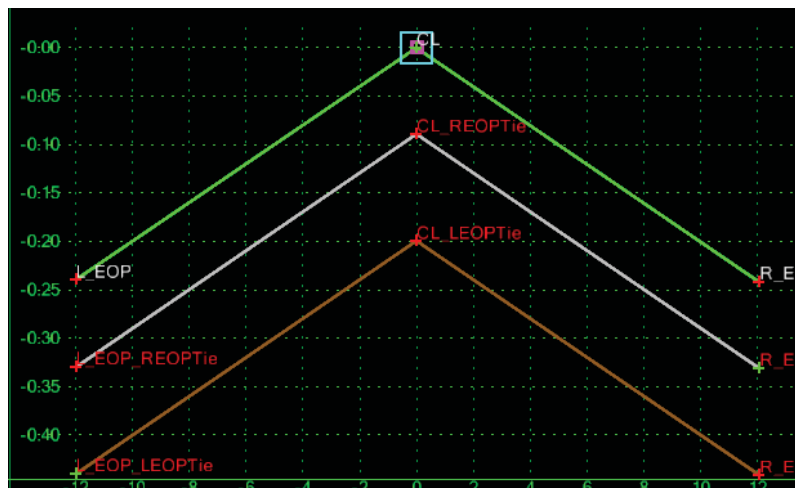
The process in this section will allow you to automatically find the controlling points along the road to minimize the leveling.

➔ 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**.



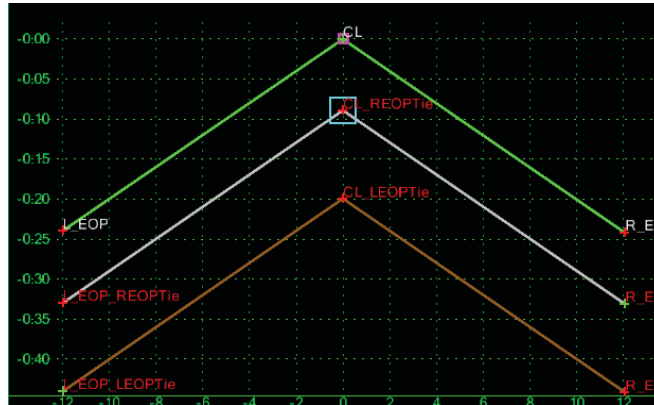
3. Double click the template *Visual Optimization* to activate it.
4. **Right click** on the green point on the upper most layer of the template and select **Move**.



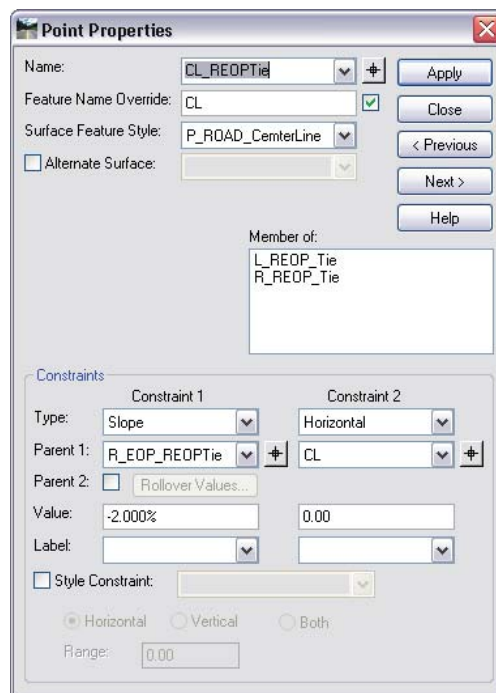
5. Move the point around and examine how the other layers react.
6. **Right click** to reset.
7. **Right click** on the right most green point and move it around.
8. **Right click** on the left most green point and move it around.

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

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

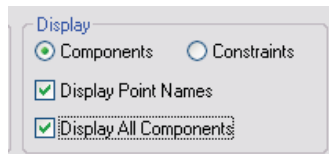


10. Examine the constraints that are attached to the point. The point is constrained horizontally to the green point above it and by slope from the green point to the right.

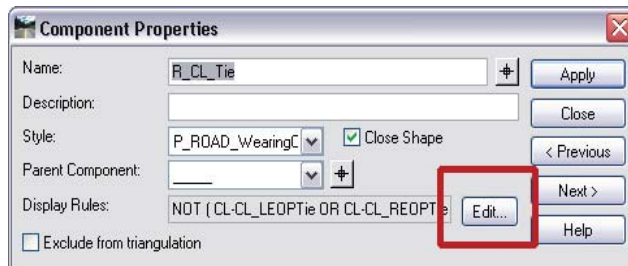


11. **Double click** the template *Optimization* to activate it.
12. **Right click** on the upper most green point and select move.
13. Move it down in the window and at some point you will see another layer turn on and the layer you were moving turn off.
14. **Right click** to reset.

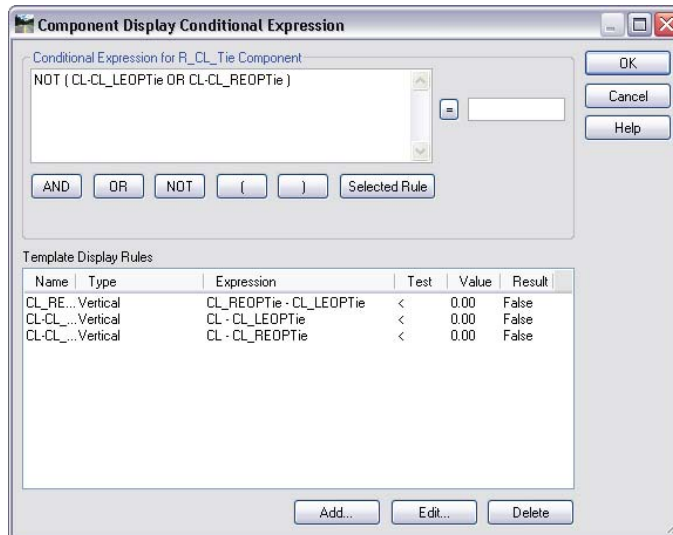
- Turn on the toggle **Display All Components**.



- Notice now that you can see the other components (layers) but they are dashed.
- 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.
- Repeat the process with the white one by moving the right most point.
- What is causing this is **Display Rules**.
- Double click** on any component. In the lower portion of the dialog select the **Edit** button to the right of the **Display Rules** field.



- 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.



- 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.

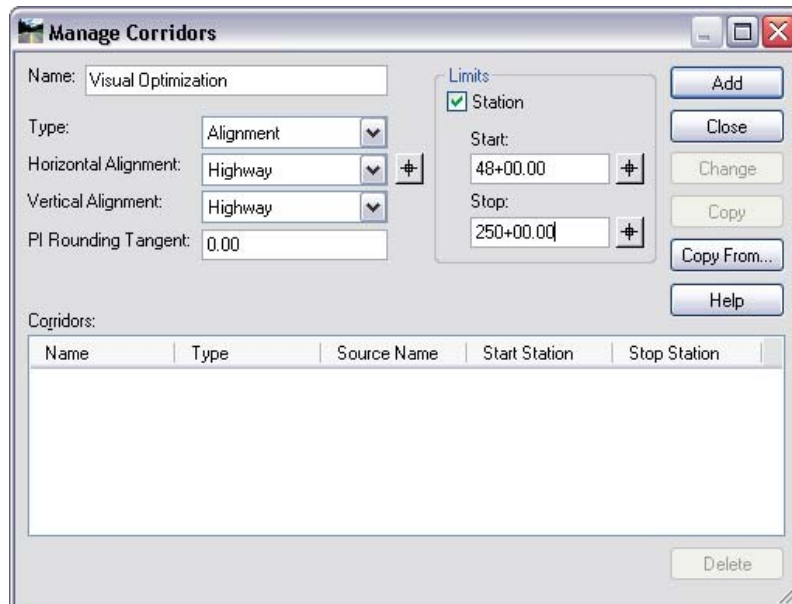
Optimization Corridor

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

➔ Exercise: Creating an Optimization Corridor

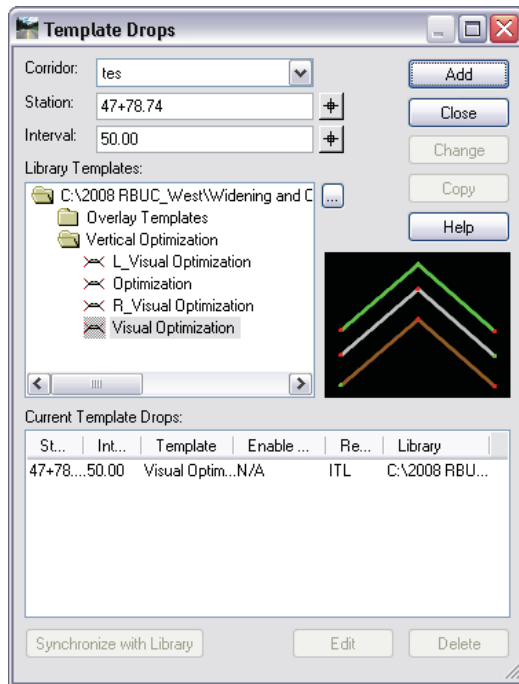
24. Go to **Modeler>Roadway Designer**.
25. Create a new corridor. Go to **Corridor>Corridor Management**.
26. Type in the name *Visual Optimization* in the name field of the **Manage Corridors** dialog.
27. Set the following values:


- **Station:** **On**
- **Start:** **48+00**
- **Stop:** **250+00**
- **Type:** **Alignment**
- **Horizontal Alignment:** **Highway**
- **Vertical Alignment:** **Highway**

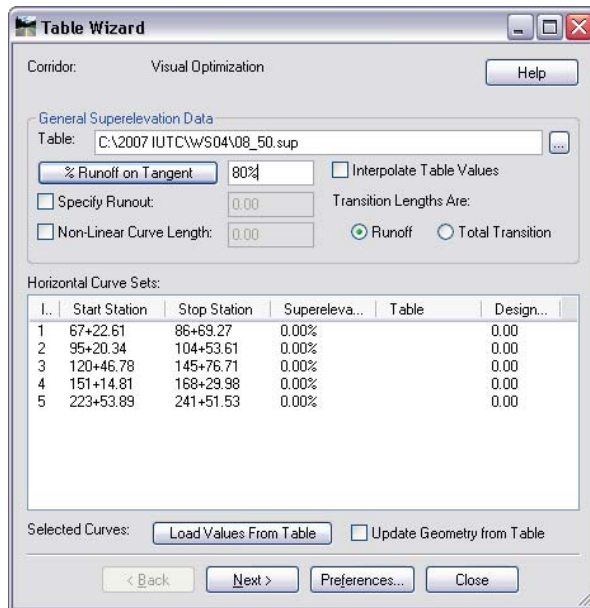


28. Click **Add** and close the dialog.

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**.



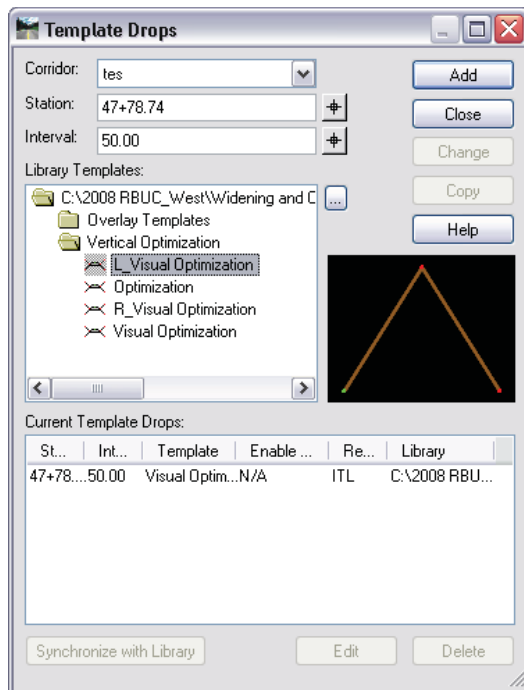
33. **Close** the **Template Drops** dialog.
34. Select the **Superelevation** button on the bottom right of the **Roadway Designer**.
35. **Right click** in the lower right view and select **Create Superelevation Wizard>Table**.
36. Select the  button on the **Table Wizard** dialog.
37. **Browse** to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



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**

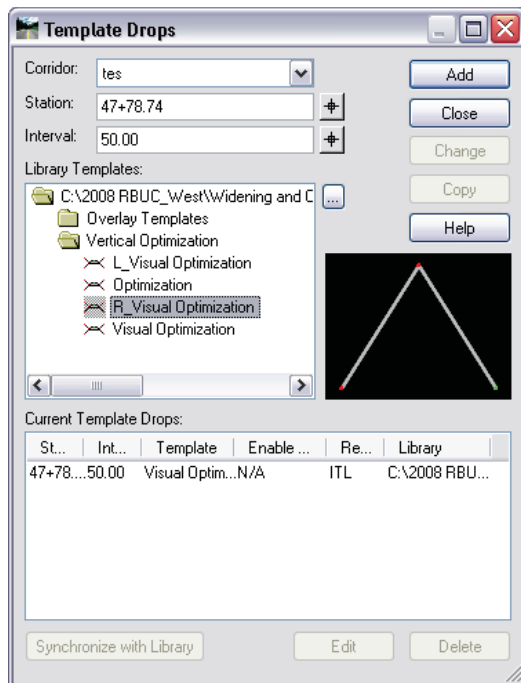


43. Select **OK**.
44. Select **Next** and then **Finish** when the wizard dialog appears.
45. Go to **Corridor>Template Drops**.
46. In the **Current Template Drops** list highlight (single click) on the entry in the list.
47. In the **Library Templates** list select the *L_Visual Optimization* template.



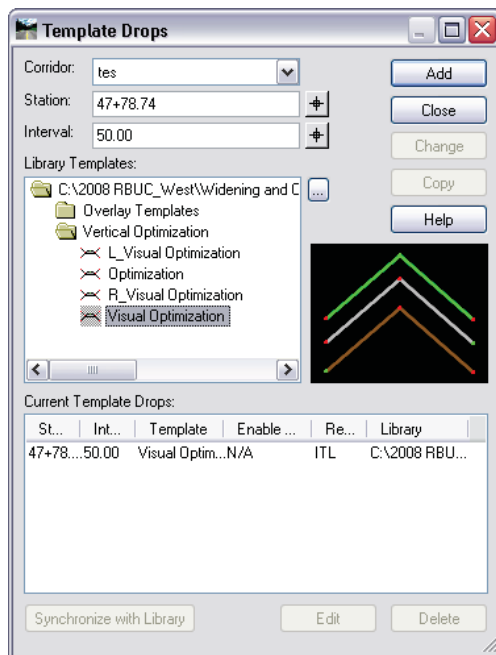
48. Select **Change**.
49. Select **Close**.
50. **Right click** in the lower right view and select **Create Superelevation Wizard>Table**.

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.

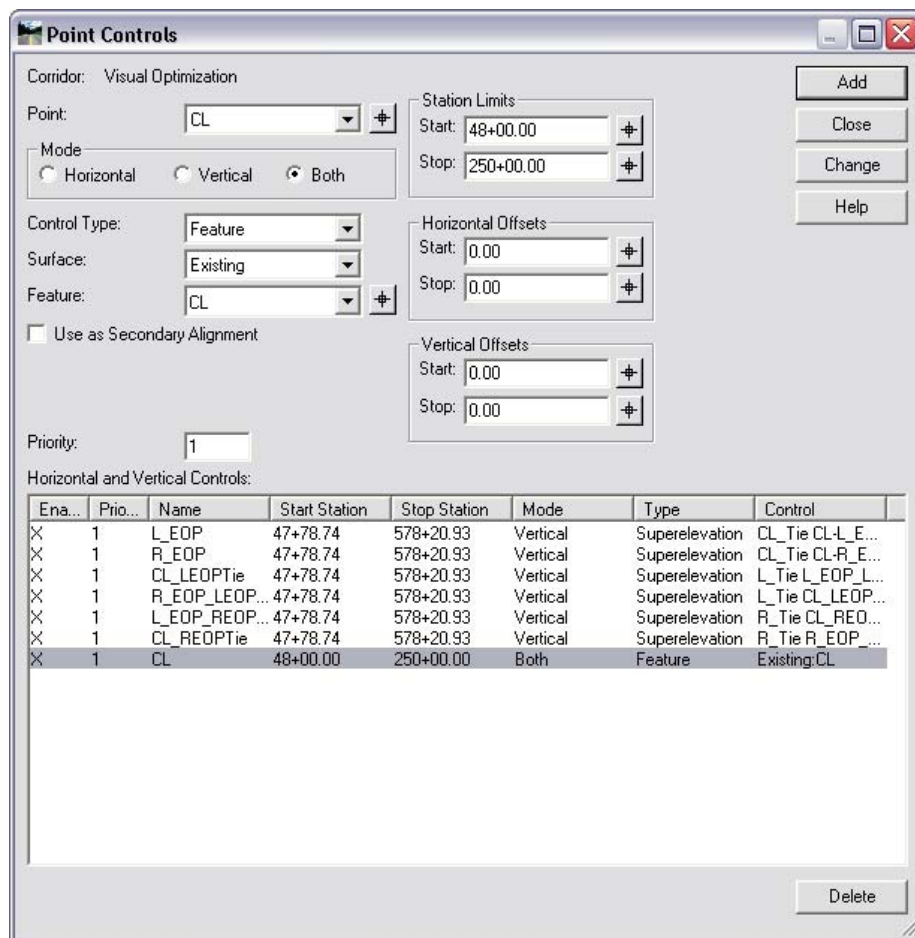


59. Select **Change**.

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:** 2
 - **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.



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



75. Click **Add**.

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

- **Point:** L_EOP_LEOPTie
- **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.

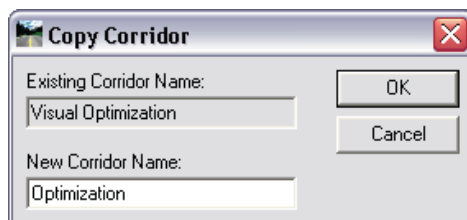
80. Examine the corridor.

81. Go to **Corridor>Corridor Management**.

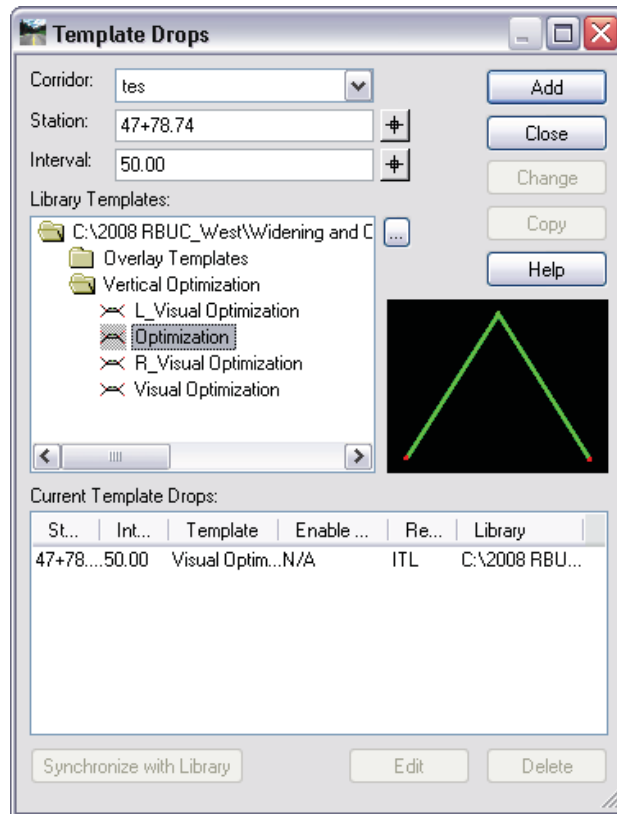
82. Highlight the **Visual Optimization** corridor.

83. Select **Copy**.

84. When the **Copy Corridor** appears enter *Optimization* in the **New Corridor Name** field and select **OK**.



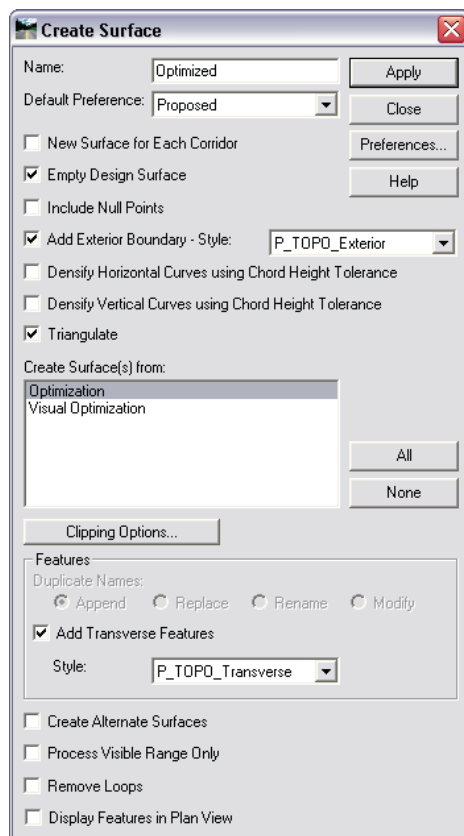
85. Close the **Manage Corridor** dialog.
86. In the lower left corner of the **Roadway Design** set the **Corridor** to **Optimization**.
87. Go to **Corridor>Template Drops**.
88. Highlight the template drop listed in the **Current Template Drops** list.



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.

- **Name:** **Optimized**
- **Default Preference:** **Proposed**
- **Empty Design Surface:** **On**
- **Add Exterior Boundary:** **On – Style: P_TOPO_Exterior**
- **Triangulate:** **On**
- **Create Surface(s) From:** **Optimization (highlight this one only)**
- **Add Transverse Feature:** **On – Style: P_TOPO_Transverse**
- **All other toggles:** **Off**



94. Select **Apply**. When the processing is finished **Close** the dialog.

95. From the **Roadway Designer** dialog select **File>Save**.

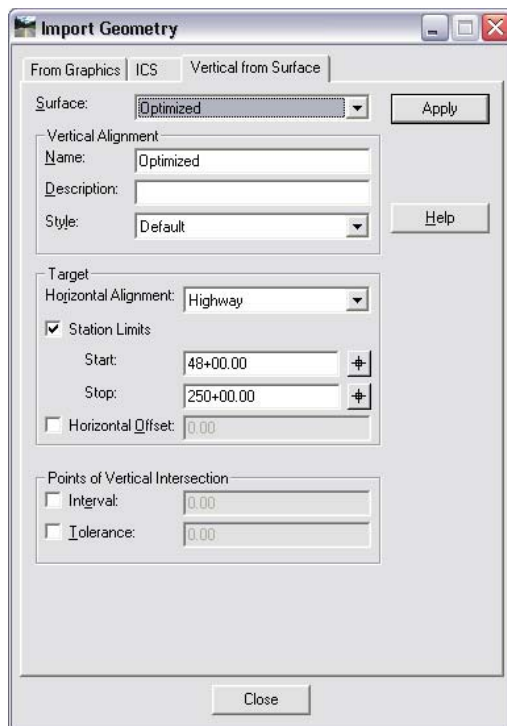
96. **Close** the **Roadway Designer**.

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**.



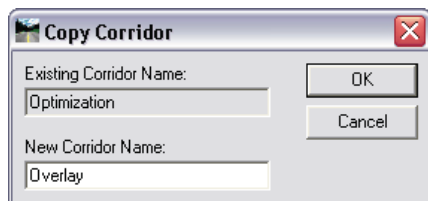
6. Select **Apply** and then **Close** the **Import Geometry** dialog.
7. Cut a profile and display both the **Highway** vertical alignment and the **Optimized** vertical alignment.
8. Examine the differences between the two alignments.

Applying the Optimized Vertical Alignment

Now we will use 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*.



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.

