Bentleyuser.dk Årsmøde 2010

Nordic Civil 2010

8.-10. November 2010, Munkebjerg Hotel, Vejle

Workshop - X9
Resurfacing and Overlay Tools InRoads V8i

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

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

Lesson Name: Opening a Project (InRoads User)

LESSON OBJECTIVE:

In this lesson the student will learn to access an InRoads project in preparation for designing a model in Roadway Designer. Note, this lesson is for InRoads users only.

EXERCISE: GETTING STARTED (INROADS USER)

This exercise will guide you through the steps to get started

1. Go to **Start > Programs > Bentley > InRoads Group Athens > InRoads Suite**.
2. When the MicroStation Manager appears select the file:

    C:\2010 RBC Data\CE2WK3 What's New Overlay Tools\DATA\Overlay.dgn and press **Open**.
3. When the InRoads Explorer appears, go to **File > Open** from the InRoads menu.
4. When the Open dialog appears select the InRoads project file:

    C:\2010 RBC Data\CE2WK3 What's New Overlay Tools\DATA\Overlay.rwk and press **OK**.

    Opening the *RWK* project file opens the following files:

    Overlay.alg
    Overlay.itl
    Overlay.ird
    Existing.dtm
    Overlay.xin
5. Press **Cancel** to close the Open dialog.
6. Select **Modeler > Roadway Designer** from the InRoads Explorer menu to access Roadway Designer.
7. Load the following .ird file.

    *C:\2010 RBC Data\CE2WK3 What's New Overlay Tools\DATA\Overlay***.ird**

Lesson Name: Opening a Project (GEOPAK User)

LESSON OBJECTIVE:

In this lesson the student will learn to access a GEOPAK project in preparation for designing a model in Roadway Designer. Note, this lesson is for GEOPAK users only.

EXERCISE: GETTING STARTED (GEOPAK USER)

This exercise will guide you through the steps to get started

1. Open the DGN file

    C:\2010 RBC Data\CE2WK3 CE2WK3 What's New Overlay Tools\DATA\Overlay.dgn.

2. If not already activated, activate GEOPAK.

    Applications > GEOPAK > Activate GEOPAK

3. Access Corridor Modeling.

    Applications > GEOPAK > Road > Corridor Modeling

4. Select **jobOLY.gpk**.

5. Load the Corridor Modeling Preference file.

    File > Load > Overlay.rdp

6. Access Roadway Designer.

7. Load the following .ird file.

    *C:\2010 RBC Data\CE2WK3 What's New Overlay Tools\DATA\Overlay**.ird***

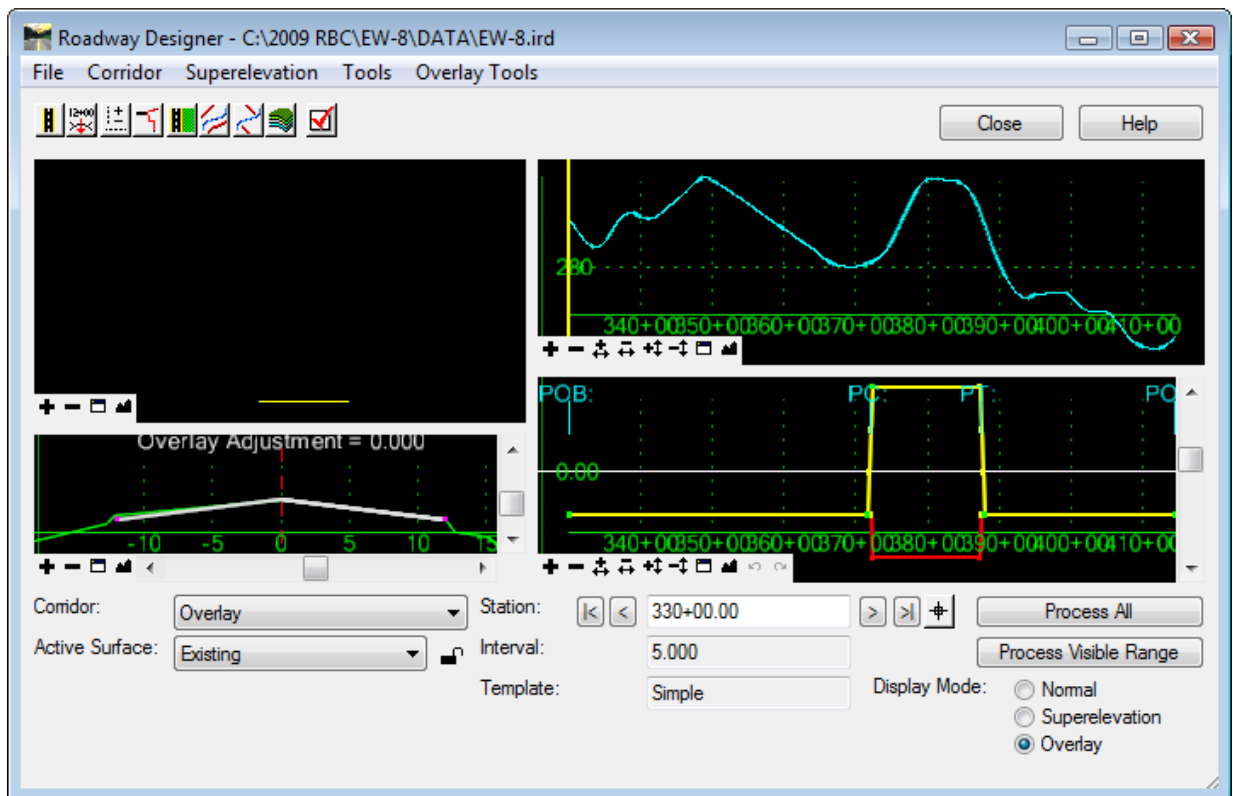**LESSON NAME: CROSS SLOPE OPTIMIZATION**

LESSON OBJECTIVE:

This lesson will take you through how to optimize the design cross slope against the existing ground cross slope.

On-Line Help Topic: Search on "Cross Slope Optimization"

EXERCISE: CROSS SLOPE OPTIMIZATION

This exercise will take you through using the Cross Slope Optimization tool to set you design cross slope.

1. When the Roadway Designer opens, make sure the **Corridor** is set to "**Overlay**" and the **Active Surface** is set to "**Existing**". Set the **Display Mode** in the lower right corner to **Overlay.** You will see four panes in the window. The top left pane is the plan view. The bottom left is the cross section view. The top right pane is the profile view, and the bottom right is the super elevation view.

2. Switching to this mode activates the **Overlay Tools** commands. From the **Roadway Designer** menu, select **Overlay Tools > Cross Slope Optimization.**

   The Cross Slope Optimization dialog is used to adjust the design cross slope to match the existing ground cross slope within a certain slope or elevation tolerance. This dialog is set up to work on one lane of the design at a time. You are going to look at the right side first. Note that for the **Existing Ground Cross Slope Definition** you have the ability to compare against either existing surface features or alignments. When using alignments, there is no need to define a vertical profile for the alignment. The alignment will be draped on the existing ground to determine the elevations for the pivot and superelevated edge. For the **Design Cross Slope Definition** you have the choice of comparing against a super elevation control line, or a constant slope.

   Note: InRoads users have the ability to use both surface features and alignments, while GEOPAK users only have the ability to use alignments. However, for the purposes of his workshop we'll use surface features.

   Fill out the top portion of the dialog as shown below. Once you have done so, press the **Calculate Corrections** button.

3. You should now see the results of the calculation in the **Results** table. Note that the buttons next to **Adjusted Cross Slopes** are still disabled. This means that no adjustments to the control line were needed to maintain the **Slope Tolerance** of 2%. Press the **>** button next to **Delta G Errors**. You should see that the design Delta G in the area of the transition is 1.0. You could fix this by modifying the superelevation control line, but leave it for now. Finally, notice that the ground surface cross slope was actually drawn in superelevation window (gray line).
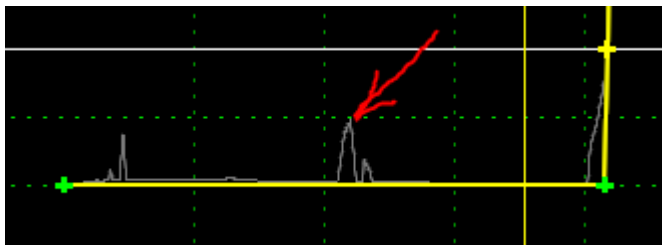
4. Now do the left side. Set the **Superelevated Feature** to be **LEP**, and set the **Control Line** to be **L_EOP**.

Note: InRoads users have the ability to use both surface features and alignments, while GEOPAK users only have the ability to use alignments. However, for the purposes of this workshop we'll use surface features.

5. Press the **Reset Results** button to clear the grid.
6. Press the **Calculate Correction** button.
7. For the Left side, we do have an area where the difference between the existing cross slope and the design cross slope exceeds the specified tolerance. Press the **Largest** button, and note that the station location in Roadway Designer is updated to show the location. The cross section view shows the existing ground line that was used for the calculation as a red dashed line.
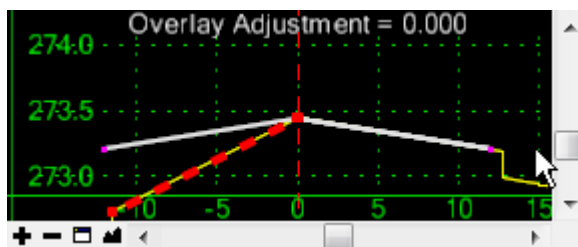
Note: Navigating the results using the arrow keys or by selecting the row will update the station location in Roadway Designer.

8. Now we are going to create a new control line from the corrected slope results. In the **New Control** Line section at the bottom of the dialog, set **Section Name** to **Section1**. For **Control Line Name** enter "**Adjusted L_EOP**".

9. Press the **Create** button. When this is executed, two things will occur. First, a new super elevation control line will be created and displayed in the super elevation view. Second, if the **Design Cross Slope Definition Design Type** was a control line, the program will ATTEMPT to replace the super elevation point control that uses the specified control line with the newly create control line. If it is successful, the program will not remove the previous point control, but will merely disable it. So you should see something like this in the super elevation window:
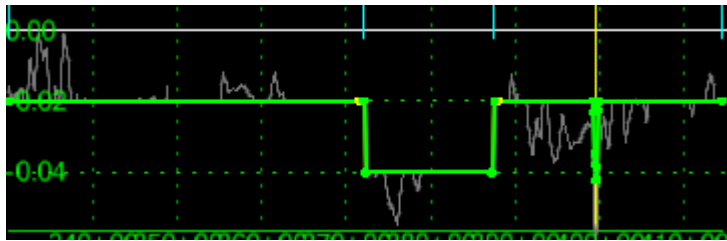
and if you close the **Cross Slope Optimization** dialog and open the **Corridor > Point Controls** dialog, you will see this in the list box:

Horizontal and Vertical Controls:

En...	Priority	Name	Start Station	Stop Station	Mode	Type	Control	Description
	1	L_EOP	330+00.00	414+53.46	Vertical	Superelevati...	L_EOP:CL	
X	1	R_EOP	330+00.00	414+53.46	Vertical	Superelevati...	R_EOP:CL	
X	1	L_EOP	330+00.00	414+53.46	Vertical	Superelevati...	Adjusted L_EOP:CL	Created by Cross Slope Optimization

10. Close the **Point Controls** dialog, and on the **Roadway Designer** menu, select **File > Save** now.

LESSON OBJECTIVE:

This lesson will take you through how to adjust the vertical alignment for an overlay project to maintain a minimum amount of overlay.

On-Line Help Topic: Search on "Vertical Overlay Adjustment"

EXERCISE: VERTICAL OVERLAY ADJUSTMENT

Using a simple template that represents the top of the new design surface, This exercise will take you through the tools to create and apply an adjusted vertical profile to you design.

1. From the Roadway Designer menu, select **Overlay Tools > Vertical Adjustment Settings**. This will bring up the **Vertical Overlay Adjustment Settings** dialog. Fill it out as show below.
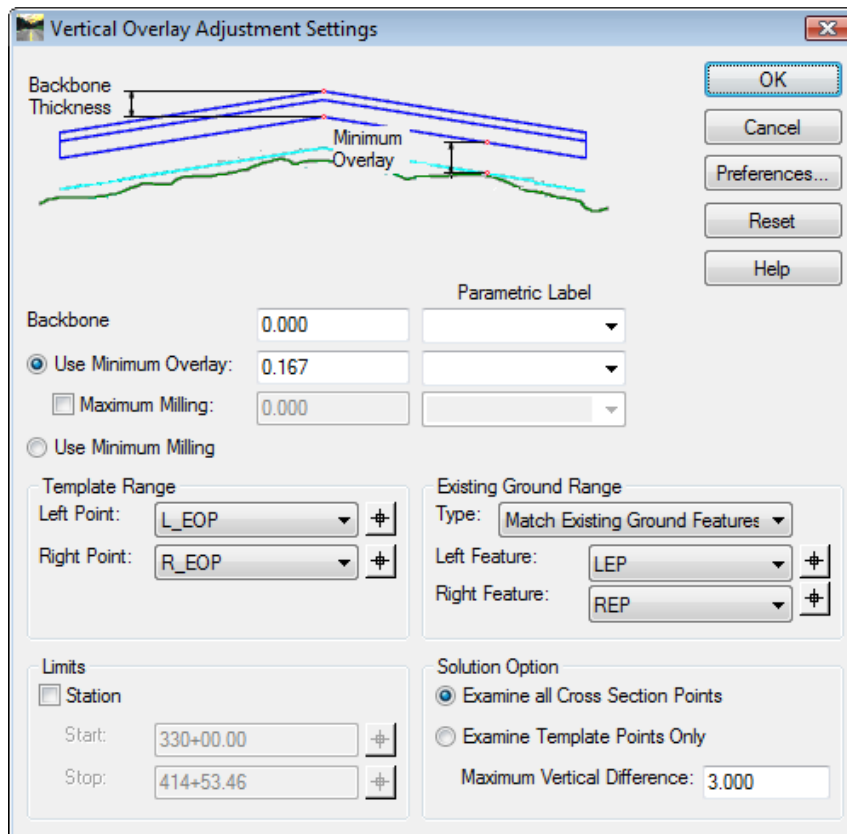
2. Close this dialog box.

3. Navigate to the first station of the corridor. In the cross section view, notice the **Overlay Adjustment** = 0.220. This means that the current vertical profile at this station will need to be adjusted upward by 0.220 feet to maintain a minimum overlay of 2" (0.167). The vertical dashed red lines represent the left and right range over which the adjustment was calculated. These lines indicate the intersection of the Template Range and the Existing Ground Range. All points along the existing ground and all points along the TOP of the template that fall between the range lines are looked at to determine the critical (controlling) point. The red box on the existing surface indicates the critical point. This is the point where the minimum overlay will occur for the given adjustment.

4. Depending on the quality of the existing road, and the accuracy of the survey, the critical point is not necessarily at one of the end points or in the center. Navigate to station 387+80. Note that at this location the critical point is about 4.5 feet to the right of the centerline.

5. Press the **Process All** button. When the processing is finished, the **Ideal** vertical profile will be displayed in the **Profile** view as a red line.

6. Zoom into a portion of this line and right click over it. Notice that you can move or delete points along this line as needed to adjust areas due if needed (due to bad input data or simply to smooth some areas out).

7. Now, from the menu, select **Overlay Tools > Smooth Adjusted Vertical Alignment**. This tool is used to create a best fit (regressed) vertical alignment that can then be added to the corridor's horizontal alignment and used as the design alignment. Set the values as follows and press the **Apply** button:
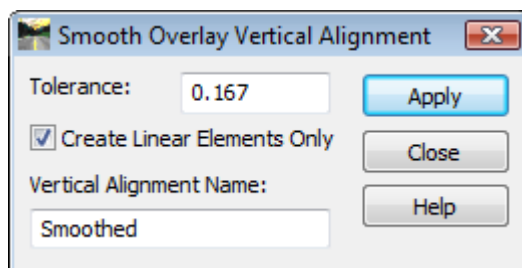
Notice in your profile there are two new lines - A yellow line that represents the top bounding line (0.167 above the ideal line) and a green line that represents the regressed alignment.
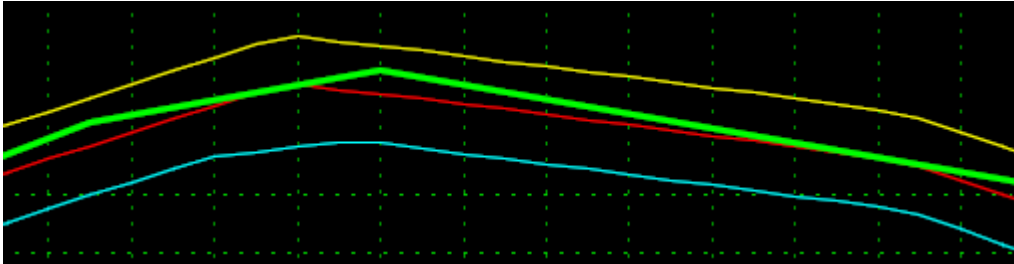
Notice the green line never goes below the red line. Therefore, it will maintain the minimum overlay.

*Hint – if you want to use the **Ideal** line as the new vertical alignment, run this command with the **Tolerance** set to **0.0**.*

8. Close the **Smooth Overlay Vertical Alignment** dialog. At this point, the vertical alignment has been created, but it only resides in memory, and has not been assigned to the corridor's horizontal alignment yet.

9. Select **Overlay Tools > Apply Adjusted Vertical Alignment**. On the dialog box, set the **Style** to **P_ROAD_Centerline**, and press the **OK** button. This will create a new vertical alignment called "Smoothed" to the Corridor's horizontal alignment, and modify the corridor properties to use this as the vertical alignment. If you switch the **Display Mode** back to **Normal** or review the corridor using the **Manage Corridors** dialog, you can see this.

10. Select **File > Save** to save the .ird file, then close **Roadway Designer**.

(InRoads Users) Save the Geometry Project by selecting the **Geometry** tab in the **InRoads** explorer, and right clicking on the "Highway" project.

(GEOPAK Users) The new profile data is saved automatically to the ALG file. If you want to take the profiles back to the GPK, you can use the *Corridor Modeling > Tools > Export Profile to GPK* application.

LESSON OBJECTIVE:

This lesson will take you through how to use the new Overlay/Stripping component.

On-Line Help Topic: Search on "Overlay/Stripping component"

EXERCISE: INTRODUCING OVERLAY/STRIPPING COMPONENTS

This exercise will introduce you to Overlay/Stripping components and their behavior.

1. Open **Create Template**.
2. From the **Template Library** tree view, open (Set Active) the template **Overlay Templates > Simple** by double clicking on it.
3. From the menu, select **Add New Component > Overlay/Stripping.** Notice the properties at the bottom of the Create Template dialog.
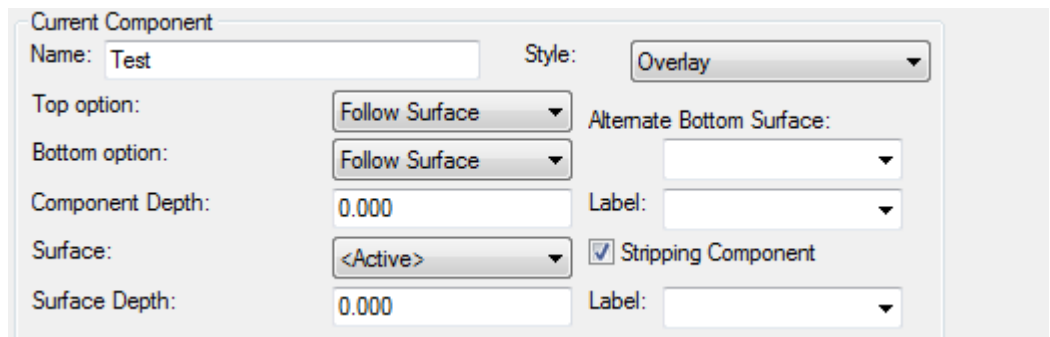
We are going to investigate how these properties affect this new component type, but first a little information about Overlay/Stripping components.

- When placing points to define one of these components, you are only defining the top of the component.

- The **Top** has 3 options:
  - **Follow Surface** – The top of the component will be draped along the top of the target surface. The only points that matter are the leftmost and rightmost points of the component, as they define the extents of the component.
  - **Follow Component** – The top of the component will follow the points that define the component.
  - **Follow Highest** – The top of the component will follow the higher of the surface or the defined component line (points).
- The **Bottom** has 4 options:
  - **Follow Surface** – The bottom of the component will follow the target surface at a distance below the surface as defined by the **Surface Depth**.
  - **Follow Component** – The bottom of the component will follow the points that define the component at distance below them as defined by the **Component Depth**.
  - **Follow Lowest** – The bottom of the component will follow the lower of the surface line or the defined component line at the specified depths.
  - **Follow Highest** – The bottom of the component will follow the lower of the surface line or the defined component line at the specified depths.
- By definition, the bottom of the component will never go above the top of the component. If the Follow rules dictate that the bottom should go across the top, the bottom will simple start to follow the top of component line. In cross sections, these areas of zero thickness are not drawn, but when the component is displayed as a 3D mesh element, the zero thickness areas are created for integrity.

4. Fill in Component Properties as follows and then place the component by snapping to the three points in this template:

5. This might be a standard overlay. Press the **Test** button, and in the **Test End Conditions** dialog draw the **<Active Surface>** target to see the behavior.

6. Close the Test dialog and edit the **Overlay** component. Set the **Component Depth** to 0.1. Set the **Top** to **Follow Surface** and the **Bottom** to **Follow Component.**

7. Test this configuration. Try changing the slope of the surface line. This configuration might be used for a milling component to mill out the high spot and allow our new overlay/leveling to have a minimum thickness of 0.1.

8. Spend a few minutes trying different configurations of the **Top** and **Bottom** options with different thicknesses.

9. When you are done experimenting, close the **Create Template** dialog without saving.

LESSON NAME: USING OVERLAY/STRIPPING COMPONENTS WITH ADJUSTMENTS

LESSON OBJECTIVE:

This lesson will take you show you how to use a combination of the Overlay Vertical Adjustment Settings tool with Overlay/Stripping components and a new tool, Approximate Component Quantities, to determine the optimum solution for a particular situation.

On-Line Help Topic: Search on "Overlay Tools", "Overlay/Stripping", and "Approximate Component Quantities"

EXERCISE:

This exercise will take you through an iterative process to determine the best solution for a widening project.

1. Open **Roadway Designer.** Set the **Corridor** to **"Widening",** and set the **Active Surface** to **"Original".**

2. Set or the **Display Mode** to Overlay

3. Select **Overlay Tools > Vertical Adjustment Settings.** When the dialog box opens, set the values as follows to insure that there is a minimum of 1" leveling.
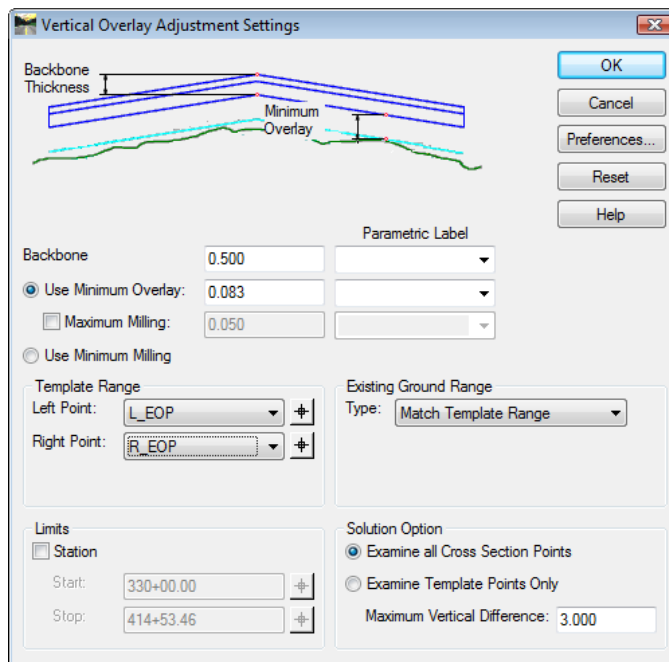
4. Select **OK** on the dialog box to close it and open the **Corridor >Template Drops** dialog.
5. Edit the template drop, and add an Overlay Template to points - **L_Lvl, CL_Lvl,** and **R_Lvl.** The properties of the component should be as follows:

Note that you are setting the depth to 3" because 1" of leveling(the known minimum) is already part of the component. The template should look like this:
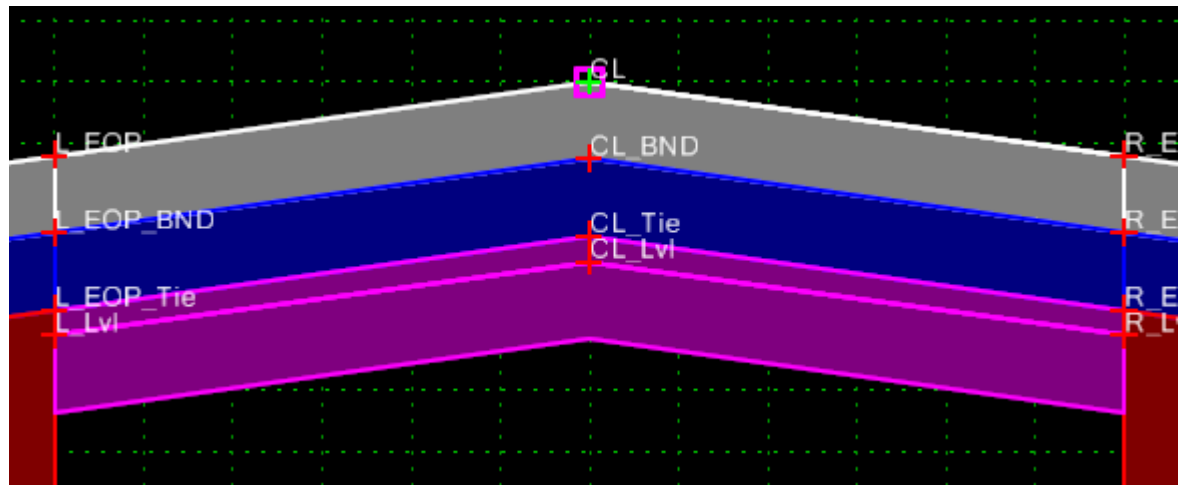
6. Press **OK** to close the **Edit Template** dialog and close the **Template Drops** dialog.
7. Walk down the surface, and you will see that in most places, 4" of leveling is adequate, but there are some locations where it is not.

    Hint – go to station 391+50 and move down station.
8. This gap is to be filled in using a different material, so edit the template drop again.

9. Add an Overlay Stripping Component with the following settings:

The three new points for this component should be directly below the **Lvl** pts and constrained to be directly below them at a distance of 3" (Horizontal Constraint of 0, and Vertical Constraint = 0.25). Your template should look something like this:

10. Press **OK** to close the **Edit Template** dialog and close the **Template Drops** dialog.
11. Press **Process All** and navigate to the end of the corridor.

12. From the menu, select **Tools > Approximate Component Quantities.** This dialog box lists the approximate component material quantities from the start of the corridor to the current station. Closed shapes report volumes, open shapes report area. The user can enter Unit Cost values to get a cost estimate for those components they are interested in. For the **Leveling4** unit cost enter $32.5, and for the **LevelingBinder** enter $24.0. Right now, the total cost for these two materials is about $1,391,000.

13. We are now going to make some adjustments to the design by adding some milling. Close the **Approximate Component Quantities** dialog and open the **Vertical Adjustment Settings** dialog. Enable Maximum Milling and set the value to 2". This will knock off any high points and, hopefully, give us significant savings.

Process All again and open the **Approximate Component Quantities.** Note that the new value for leveling materials is now about $733,000. A savings of $658,000, but we still need to add the milling costs.

14. Close **Approximate Component Quantities**, and edit the template drop again. Add another Overlay/Stripping component along the bottom of the 1" thick leveling component (Pts **L_Lvl, CL_Lvl,** and **R_Lvl**). This location is also the bottom of our maximum milling. Use the following settings:

15. Navigate up and down the corridor and notice that for the Milling, most of sections show triangular type wedges with the maximum height of 2". We need this because milling is typically paid by sq ft, but our milling material is reported to us in cf. In order to plug in a milling cost, we will use a cost of $0.28/sf($2.50/sq yard) divided by an estimated average thickness of 1" (0.83') to arrive at a cost of $3.36/cf.

16. Navigate to the end of the corridor, and open the **Approximate Component Quantities** dialog, find the Milling material and enter $3.36 for the cost. Note the final value is still significantly less than the value without milling.

17. If you wish to find the precise milling area, from the Roadway Designer menu, select **Tools > Milling Report** that opens a report that summarizes the milling at each station and at the bottom, gives the total milling area. This material report operates on all milling components in the model and does not distinguish between material types. If you use the number at the bottom of this report multiplied by 0.28 you get approximately $39000, which is actually less than the $44000 approximate cost in the approximate component quantities dialog, so the estimate of 1" average thickness was a little on the conservative side.

18. Finish the design by creating a smoothed alignment profile using 0.0 tolerance, call it "WideningProfile", and Apply it to the Design.

19. Save the resulting IRD.

(InRoads Users) Save the Geometry Project by selecting the **Geometry** tab in the **InRoads** explorer, and right clicking on the "Highway" project.

(GEOPAK Users) The new profile data is saved automatically to the ALG file. If you want to take the profiles back to the GPK, you can use the *Corridor Modeling > Tools > Export Profile to GPK* application.