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Workshop - X13
Interchange Design

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Interchange Design

Overview

This workshop takes attendees over the workflows in Roadway Designer to efficiently design limited access ramps alongside their respective mainline corridor. Attendees will also examine such features as Target Aliasing and Point Control to complete this task.

Prerequisites

- Understanding of transportation engineering.
- Familiarization with the Create Template function and the ability to construct well organized typical sections with defined point names and styles.
- Better than basic understanding and use of Roadway Designer and ability to create and manage Corridors.
- Basic understanding of super elevation; how it is applied and how it transitions.
- Ability to visualize in 3-D.
- Proficient in *MicroStation*.

Objectives

After completing this course, you will be able to:

- Know various methods to merge corridor design.
- Modify corridors.
- Form digital terrain models for the interchanges you design.
- Teach others how to design interchanges
- Buy the instructors dinner.

Start InRoads and Data Load

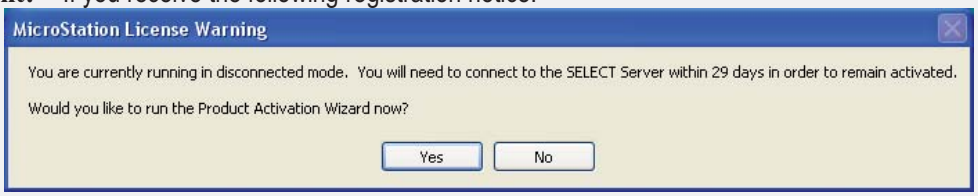
Utilize the existing InRoads Project File (.RWK) to load the data required for this workshop.

Note: Data set may be located in a different location than described here. Please verify the location of your data set prior to beginning this workshop.

➔ **Exercise: Start Inroads**

1. From the start menu select All Programs > Bentley > InRoads Group XM > InRoads Suite (or InRoads).
2. Navigate to C:\2008 RBUC\Interchange Design\working.dgn and select the **Open** button at the bottom of the dialog box.

Hint: If you receive the following registration notice:



Please click the **No** button.

3. From the *Bentley InRoads Suite XM* interface select **File > Project Defaults …** and verify that the **Configuration Name:** is set to **<None>.**
4. From the *Bentley InRoads Suite XM* interface select **File > Open …**
5. Navigate to C:\2008 RBUC\Interchange Design and left click on **Interchange_Design.rwk** then select the **Open** button at the bottom of the dialog box.
6. Select the **Cancel** button to dismiss the **Open** dialog box.

Note: The RWK file loads the existing ground digital terrain model, the geometry file, the typical section library, and the XIN file. The paths in the RWK file are relative.

Know the Data

It's always easier to design a project when you know a little bit about it. Take a few minutes to review the project.

➔ **Exercise: Data review**

1. From the *Bentley InRoads Suite XM* interface select **Surface > View Surface > Features**. Verify that **EXISTING** is selected in the **Surface:** pull down menu. Right click in the **Features:** area and choose **Select All.**
2. Select the **Apply** button to display the existing ground terrain features.
3. Select the **Close** button to dismiss the **View Features** dialog box.

Note: This focus of this project is widening the access controlled hwy from 4 lanes to 6 lanes. In the area we are concerned with the south bound roadway will be relocated nearly parallel with the north bound roadway. We are to design and model the interchange of the southbound roadway with Orange Road.

4. Delete the existing ground digital terrain model graphics just displayed with your favorite *MicroStation* delete method.

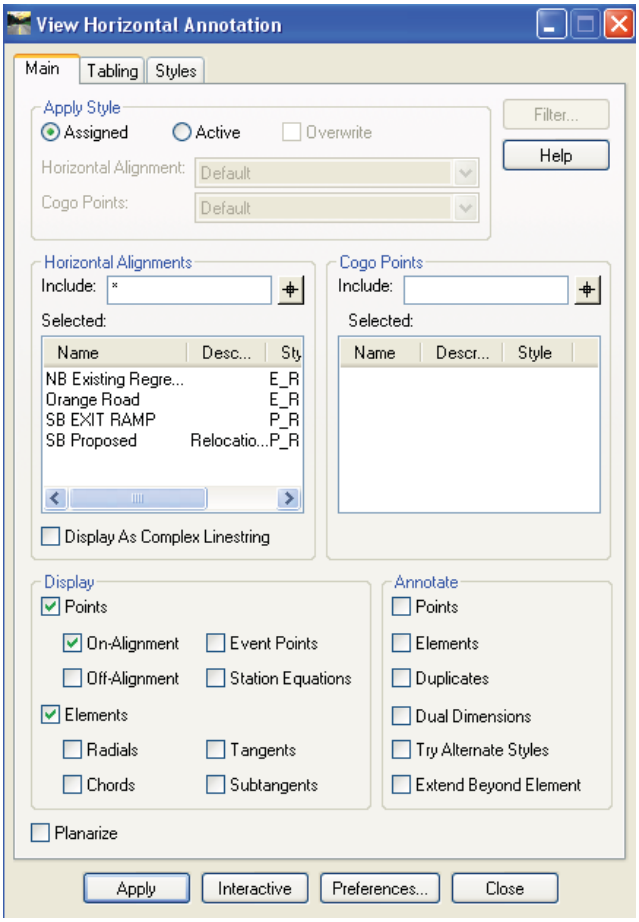
5. From the *Bentley InRoads Suite XM* interface select **Geometry > View Geometry > Horizontal Annotation…**.

6. Type "*****" in the **Include:** field in the **Horizontal Alignments** area then press the "tab" key. Four alignment names should be displayed in the **Selected:** area as shown here.

7. Do not change any other settings. Select the **Apply** button to display the three alignments.

8. Select the **Close** button to dismiss the **View Horizontal Annotation** dialog box.

9. Select the **Geometry** data type on the *InRoads* workspace bar. Set **SB Proposed** as the active alignment by right clicking on the alignment.



10. From the *Bentley InRoads Suite XM* interface select **Tools > Tracking > Tracking…** Select the **Activate** button on the **Tracking** dialog box to familiarize yourself with the stationing and key points of the **SB Proposed** alignment.

11. Select the **Close** button to dismiss the **Tracking** dialog box.

12. Turn on the **Topo.dgn** and **working.dgn** *MicroStation* reference files. Fit the view.

Note: The stationing on both **SB Proposed** and **SB EXIT RAMP** alignments increase from the bottom to the top. Offsets from **SB Proposed** alignment to **SB EXIT RAMP** are to the left; hence the offset values will be negative.

Interchange Design Basics

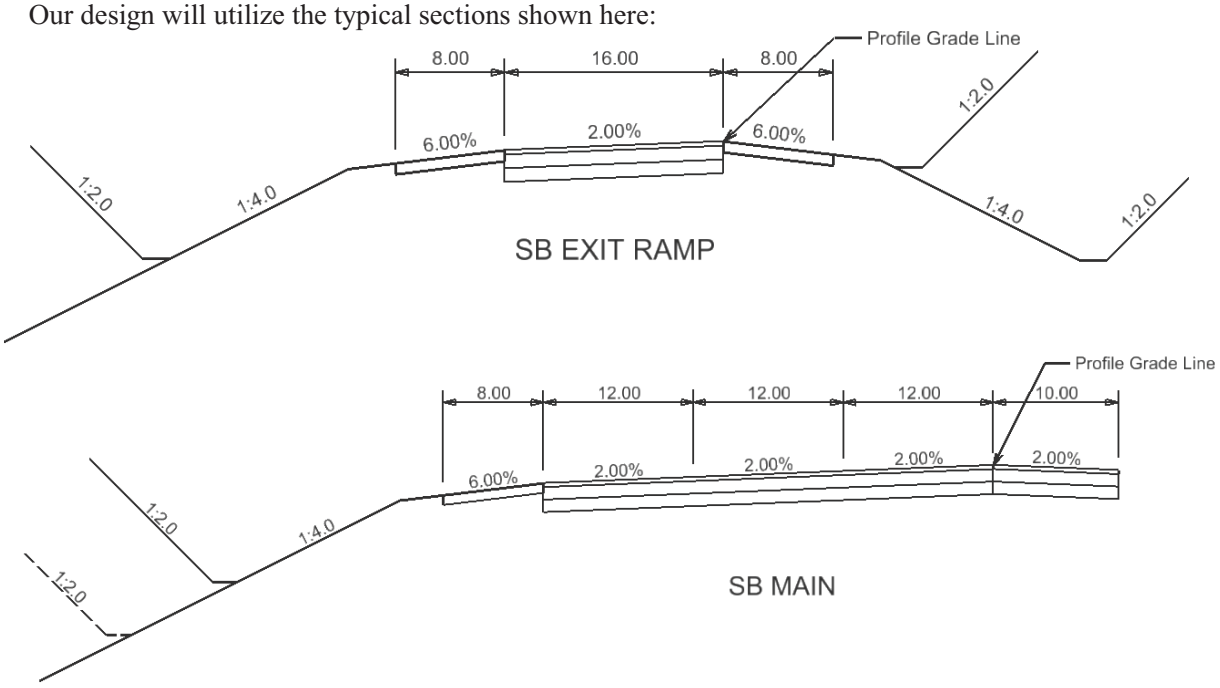
There are several methods to design interchanges with software as powerful as ours. In this project we will hold the Main roadway widths and elevation as designed. The Ramp widths and elevations will warp to meet the Main roadway. The complexity of the design or specific design criteria may dictate use of a different method as this software is implemented in your workplace. Regardless of the design method employed there are some key stations that will be critical to us in our design:

- Begin Ramp Station. This is where the ramp begins to taper from nothing. (Remember that our stationing is increasing from south to north.)
- End Taper / Begin Full Width Station. Station where the full ramp width is achieved.
- Station where the distance between the Ramp and the Main outside edge of pavement is equal to the shoulder width of the Main design.
- Station where the Ramp shoulder and the Main shoulder intersect.

The Begin Ramp Station is a key alignment point in the geometry of our project. The ramp taper length for our design is 180', so computation of the End Taper / Begin Full Width Station is a simple calculation. The geometry for the ramp alignment was designed so the End Taper / Begin Full Width Station is at the point of tangency; another alignment key point. With the geometry tools available to us we can easily compute the other two key stations, but this workshop is built around the Roadway Designer so let's begin to build our corridors and use its byproducts to compute the remaining key stations instead.

Note: The Ramp vertical alignment design computed for you is based off a projected design plane from the Main roadway. The projected design plane incorporates the vertical alignment, cross slope and super elevation where applicable. The ramp vertical alignment matches the projected Main roadway design plane as closely as possible through the Ramp transition area.

Our design will utilize the typical sections shown here:



➔ **Exercise: Create Corridors**

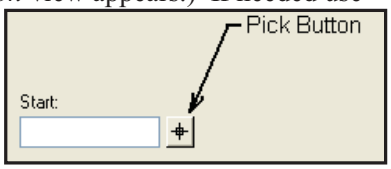
1. From the *Bentley InRoads Suite XM* menu select **Modeler > Roadway Designer…**
2. On the **Roadway Designer** dialog box select **Corridor > Corridor Management…**
3. In the **Name:** area on the **Manage Corridors** dialog key in SB Proposed Exit Ramp Orange 1.
4. Verify the following:

   a. **Type:** Alignment
   b. **Horizontal Alignment:** SB EXIT RAMP
   c. **Vertical Alignment:** SB EXIT RAMP Vertical
   d. **PI Rounding Tangent** 0.000

5. Select the **Add** button.
6. Add another corridor for the Main roadway. In the **Name:** area on the **Manage Corridors** dialog key in SB Proposed Mainline.
7. Verify the following:

   a. **Type:** Alignment
   b. **Horizontal Alignment:** SB Proposed
   c. **Vertical Alignment:** Vertical
   d. **PI Rounding Tangent** 0.000

8. In the **Limits** area enable the **Station** button.
9. While holding the '*Ctrl*' key down select the Pick Button next to the **Start:** key in area. This will allow you to determine the starting station from our *MicroStation* views. (Release the '*Ctrl*' key when the *MicroStation* view appears.) If needed use your *MicroStation* **View Control** commands to locate the intersection of the SB Proposed alignment at Orange Road. Left Click near the intersection to set the **Start** station. The start station should be between 156+00 and 158+00.

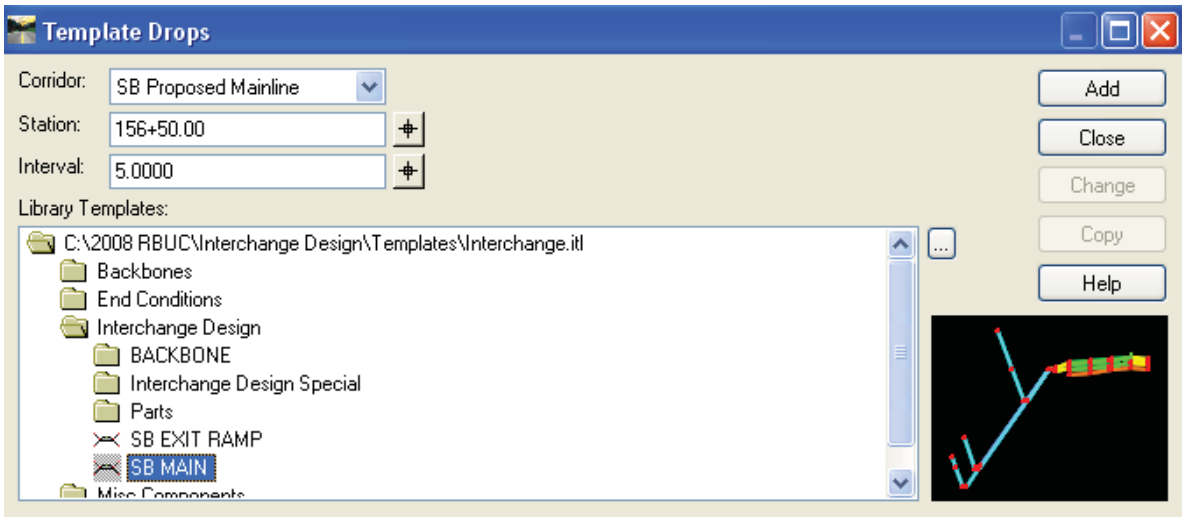


Record the **Start** station for the **SB Proposed Mainline** corridor here: _____+_____

10. Leave the **Stop:** station at the default value; 185+20.19
11. Select the **Add** button then select **Close** to dismiss the **Manage Corridors** dialog.
12. On the **Roadway Designer** dialog box select **File > Save.** Note that the **Save As** dialog box appears. In the **File name:** area key in Interchange Design Step 1 the select the **Save** button.
13. Select the **Cancel** button to dismiss the **Save As** dialog.
14. *Do not close* the **Roadway Designer** dialog box.

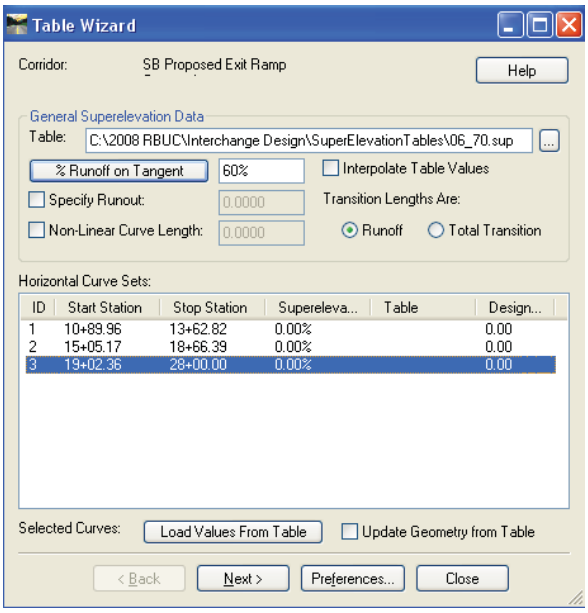
➔ **Exercise: Add Template Drops and Superelevation**

1. On the **Roadway Designer** dialog box select **Corridor > Template Drops…**
2. The **Template Drops** dialog box appears. The last corridor created will be the active corridor. Verify that **SB Proposed Mainline** is the active **Corridor:.**
3. Verify that the value in the **Station:** field matches the station recorder in Step 9 of the Create Corridors Exercise above.
4. Set the **Interval**: value to 5.
5. Expand the folder structure in the **Library Templates:** area, select the **SB MAIN** template then mash the **Add** button.



Hint: Since we are not concerned with the right side of the Main roadway in this exercise we have elected to omit end conditions on the right side for this exercise.

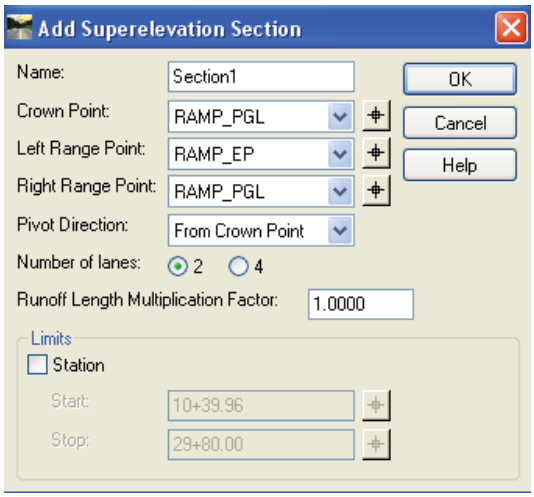
6. Utilize the pull down menu in the **Corridor:** area to make **SB Proposed Exit Ramp Orange 1** the active corridor.
7. Set the Station value to match the beginning station of the Ramp alignment.
8. Verify that the **Interval:** is set to 5.
9. Add typical section **SB EXIT RAMP** to the corridor then select the **Close** button to dismiss the **Template Drops** dialog box.
10. Click on **Display Superelevation** in the lower right corner of the **Roadway Designer** dialog box. We need to apply superelevation and shoulder rollovers to the last curve where the Ramp meets the Main.
11. Use the navigational arrows at the bottom of the **Roadway Designer** dialog box or the yellow grab bar to navigate to Station 24+50; a station on the curve that superelevation will be calculated for.
12. Select **Superelevation > Create Superelevation Wizard > Table…** from the **Roadway Designer** dialog box.



13. Select the ellipses button on the **Table Wizard** dialog box and navigate to the **Interchange Design > SuperElevationTables** folder wherever your data is located. Select the **06_70.sup** superelevation table then click **Open**.

14. Click on **ID 3** (the last curve in the list) then verify that your **Table Wizard** dialog box settings are as shown here. We will only compute superelevation for the last curve in this exercise. Select the **Load Values From Table** button and notice that only the last curve is affected. Select the **Next >** button at the bottom of the dialog box to move to the **Superelevation Section Definitions** dialog box.

15. Select the **Add…** button on the **Superelevation Section Definitions** dialog box. The **Add Superelevation Section** dialog box appears. Select the **Crown Point, Left Range Point** and **Right Range Point** with either the pick button or the pull down menu for each field. The values should be as shown. Select the OK button to accept the choices and dismiss the **Add Superelevation Section** dialog box.



16. Verify the values in the **Superelevation Section Definitions** dialog box then select the **Next >** button.

17. Click the **Finish** button on the **Superelevation Controls** dialog box to complete the superelevation calculation.

18. On the **Roadway Designer** dialog box select **Superelevation > Apply Shoulder Rollover Lock…** The **Apply Shoulder Rollover Lock** dialog box appears.

19. Verify that the **High Side** and **Low Side** slopes are set to **0.00%** then select **Apply** to compute the left shoulder rollover. Select **Apply** again to compute the right shoulder rollover. Select **Close** to dismiss the **Apply Shoulder Rollover Lock** dialog box.

20. Select **Superelevation > Create Superelevation Wizard > Table…** from the **Roadway Designer** dialog box to close the superelevation diagram.

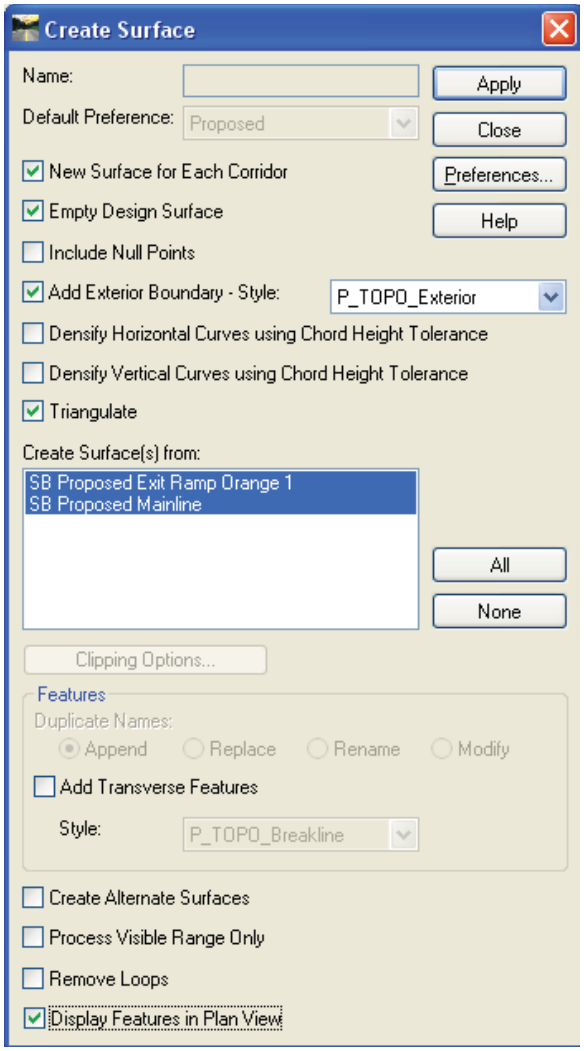
21. On the **Roadway Designer** dialog box select **File > Save As.** In the **File name:** area key in Interchange Design Step 2 the select the **Save** button.

22. Select the **Cancel** button to dismiss the **Save As** dialog.

23. *Do not close* the **Roadway Designer** dialog box.

➔ **Exercise: Create Preliminary Design Surfaces**

1. On the Roadway Designer dialog box select Corridor > Create Surface…
2. The **Create Surface** dialog box appears.
3. Enable the features as shown here. The **New Surface for Each Corridor** and **Display Features in Plan View** are typically not enabled by default.
4. Verify that both corridors are selected as shown here:
5. Create preliminary models of the Ramp and Main roadway by selecting the **Apply** button.
6. Once the corridors process and the surfaces are created select the **Close** button to dismiss the **Create Surface** dialog box.
7. **Close** the **Roadway Designer** dialog box.
8. Explore the **Surfaces** data tab on the *Bentley InRoads Suite XM* menu and note that two additional surfaces are now there; **SB Proposed Exit Ramp Orange 1** and **SB Proposed Mainline**.



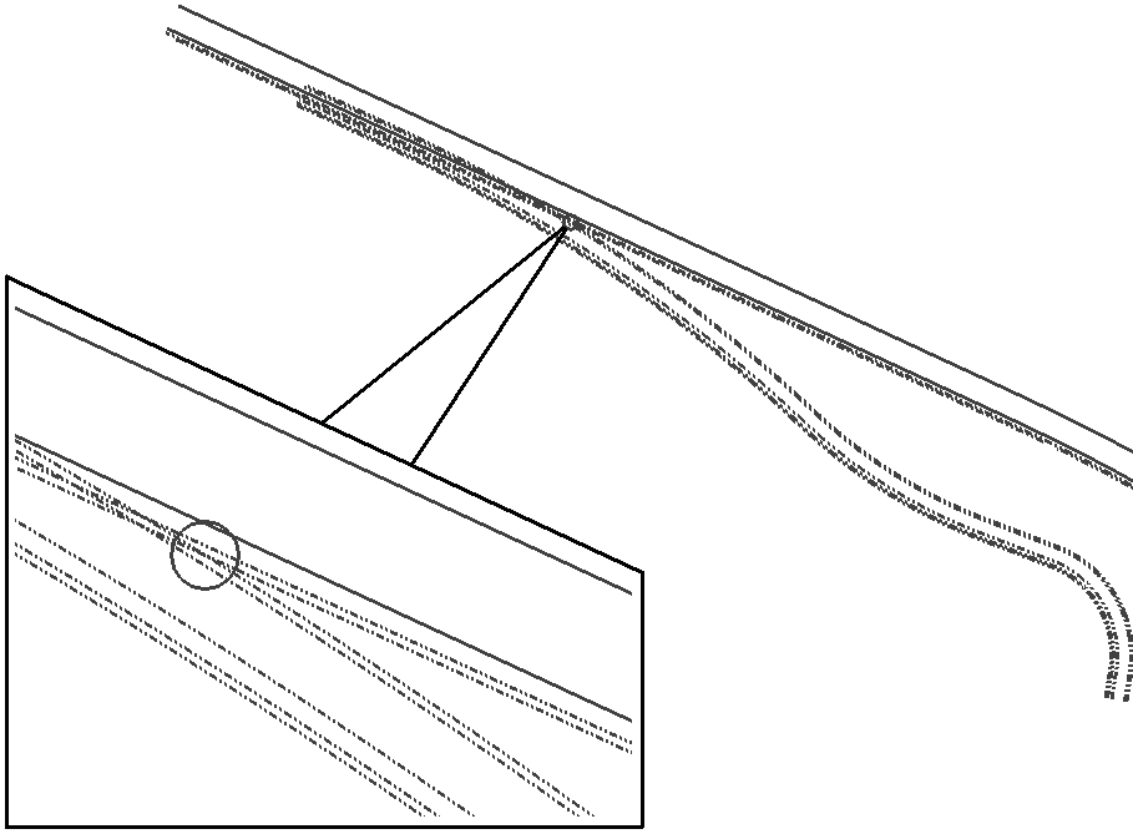
Note: This focus of this project is widening the access controlled hwy from 4 lanes to 6 lanes. In the area we are concerned with the south bound roadway will be relocated nearly parallel with the north bound roadway. We are to redesign and model the interchange of the southbound roadway with Orange Road.

➔ **Exercise: Identify and Locate key Template Transition Stations**

1. Select the **Geometry** data type on the *InRoads* workspace bar. Set **SB EXIT RAMP** as the active alignment by right clicking on the alignment name.

Note: A key point for the departure transition of the ramp is the point where the unpaved shoulder points of the Ramp and Main intersect. The travel-way width on the Main section is held through the design. Ramp widths will transition to accomplish the taper.

2. Window in on the area illustrated below:



3. From the *Bentley InRoads Suite XM* menu select **Tools > Tracking > Tracking…** to open the **Tracking** dialog box. Select the **Activate** button on the **Tracking** dialog box to familiarize yourself with the stationing and key points of the **SB Proposed** alignment

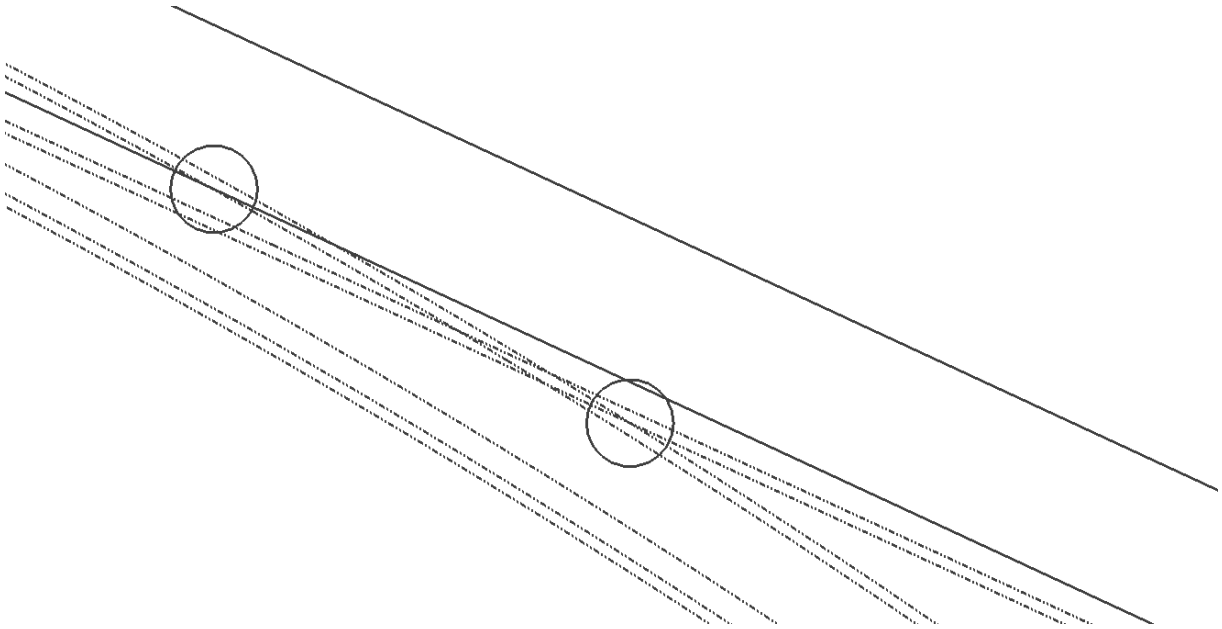
4. Select the **Activate** button on the **Tracking** dialog box and calculate the station where the unpaved shoulder points of the Ramp and Main intersect. We will utilize this station as a point control station as we further define the Ramp corridor with **Point Controls**.

Record station of unpaved shoulder intersect point here:
_____ + _____

Hint: Refer to the Typical Sections at the bottom of page 5. The unpaved shoulder point is 3.5' beyond the 8' shoulder shown on the drawing.

Interchange Ramp Refinement

In a flat and perfect world the point on the upper left shown below would be a critical point (Ramp Shoulder overlaps Main travel-way). In the real world ramp profiles and main profiles are not coincident. Design of the gore area is based on a range of acceptable slopes between the departing travel-ways. Instead of having a Ramp Shoulder and Main Shoulder between the points shown below there will be one common shoulder. The common shoulder may extend further into the gore area based if required by your design criteria.

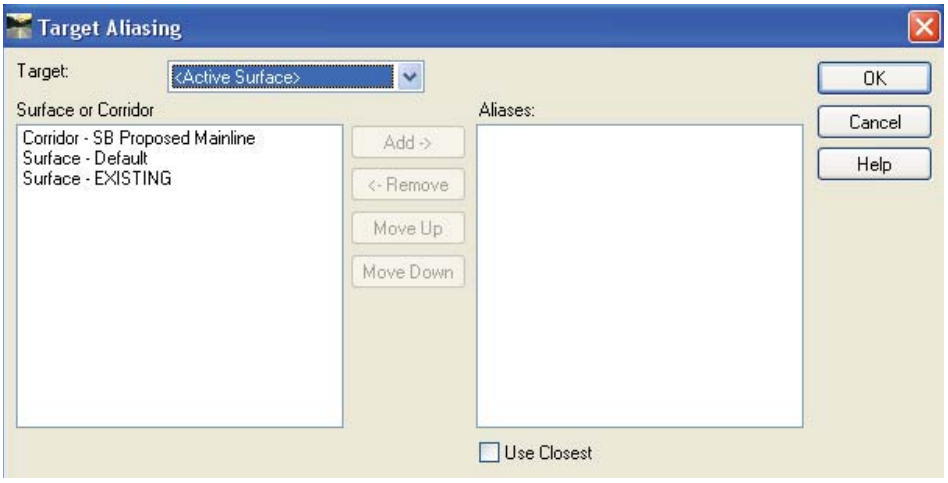


Merging Corridors: There are two methods used to intelligently blend corridors to form a composite digital terrain model. **Target Aliasing** enables us to choose multiple digital terrain models to target with our end conditions and the priority in which to look for them. Target Aliasing also gives us the ability to target the solution of another corridor. In Interchange Design this is especially important to us since interchanges require so many corridors. **Point Controls** are the second method we can utilize to form composite digital terrain models. Point controls are used to modify the behavior of points in a template. These controls take precedence over the original point constraints. The Point Control Mode is either Horizontal, Vertical or Both. The Point Control Mode can be applied to various control Types. Point Control Types can be Alignment, Feature, Style, or Corridor Point. In Interchange Design the Corridor control type gives us the ability to match a specific Ramp point to a specific Main point to seamlessly blend the corridor. Both Target Aliasing and Point Controls are needed to form final interchange models. **Clipping Options** eliminate a large "clean up" effort in the merged final model. Clipping Options automatically remove areas of overlap when working with multiple corridors. The available clipping options are populated from the Target Aliasing settings. By default, the first alias is the clipping corridor.

➔ Exercise: Add Target Aliasing

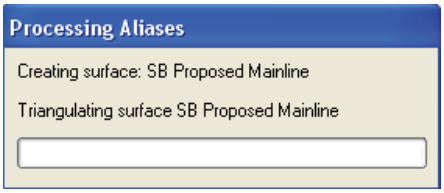
1. From the *Bentley InRoads Suite XM* menu select **Modeler > Roadway Designer…**
2. Verify that **SB Proposed Exit Ramp Orange 1** is the active **Corridor:**
3. On the **Roadway Designer** dialog box select **Tools > Target Aliasing…**

At this point we are going to determine which targets the Ramp corridor should look for and the order of priority. Designers typically target the Active Surface. The Active Surface usually is the existing ground surface, but Target Aliasing allows us to change that for any corridor.



4. Left click on **Corridor – SB Proposed Mainline** then select the **Add** button. This will be the Ramp corridor's first priority.
5. By assigning target aliases we are forgoing the ability to target the Active Surface, but in some locations we will need to target the existing ground surface. Left click on **Surface – EXISTING** then select the **Add** button. The existing ground surface will now be targeted in areas where the SB Proposed Mainline does not exist.

   The Alias order may be changed by selecting a target in the **Aliases** area then utilizing the **Move Up** or **Move Down** buttons.
6. Select the **OK** button to accept the entries and dismiss the **Target Aliasing** dialog box.
7. On the **Roadway Designer** dialog set **SB Proposed Mainline** as the active **Corridor:** then select **Process All**. This will creates a pseudo SB Proposed Mainline surface in memory for use in the Roadway Designer.
8. Make **SB Proposed Exit Ramp Orange 1** the active **Corridor:** again. You may briefly notice a **Processing Aliases** dialog box as the Ramp corridor targets the Main corridor.

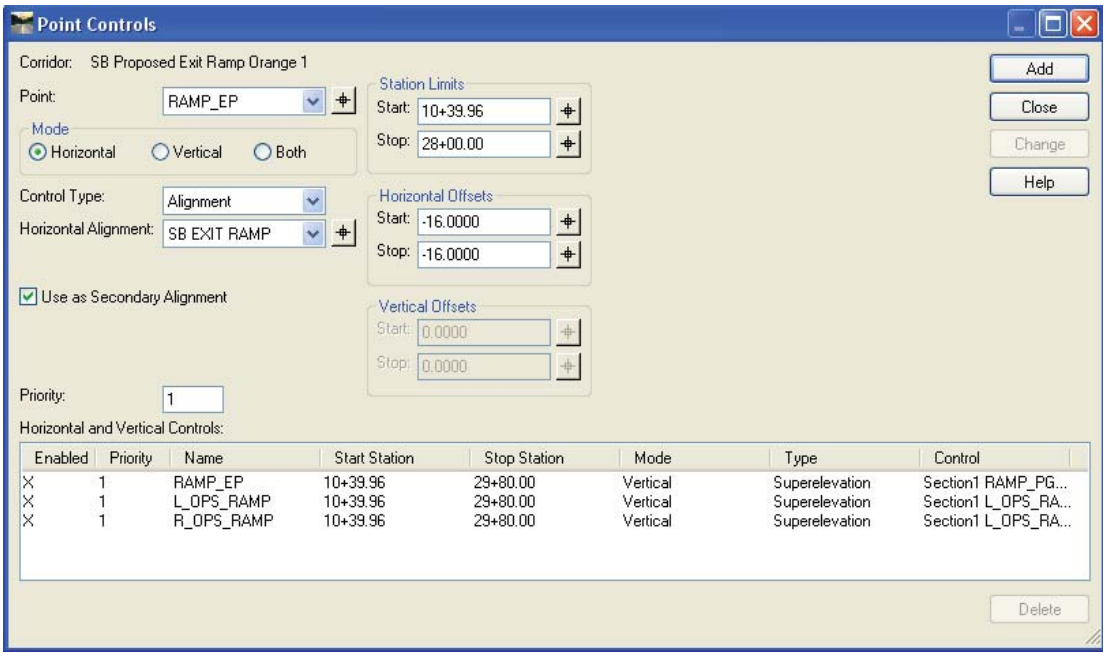


   In the cross section view on the **Roadway Designer** the SB Proposed Mainline surface is represented as a grey line. The Target Aliasing is most obvious between station 16+00 and station 29+80.

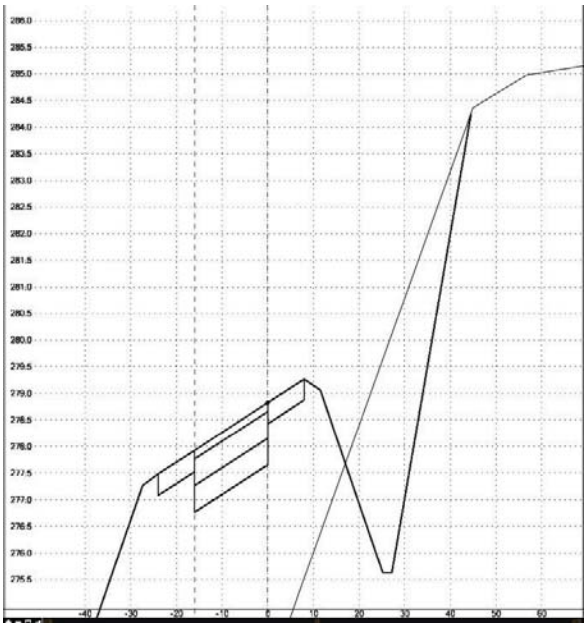
Target Aliasing ties the fill slopes of our Ramp and Main together rather nicely. Let's continue by joining the Ramp to the Main with Point Controls.

➔ Exercise: Add Point Controls

1. From the **Roadway Designer** dialog select **Corridor > Point Controls…** or simply select the icon for this command. There should already be three point controls for superelevation (possibly more point controls if you super elevated all the curves).
2. Begin by firmly establishing the left pavement edge of the Ramp. In the **Point** area on the **Point Controls** dialog box select **RAMP_EP**. The **Mode** should be **Horizontal** and the **Horizontal Alignment:** should be **SB EXIT RAMP**. Enable the **Use as Secondary Alignment** radio button. In the **Station Limits** area the **Start:** should be **10+39.96** and the **Stop:** should be **28+00.00**. In the **Horizontal Offsets** area the **Start:** and **Stop:** values should be **– 16.00** (note the negative number indicating to the left). Select the **Add** button.

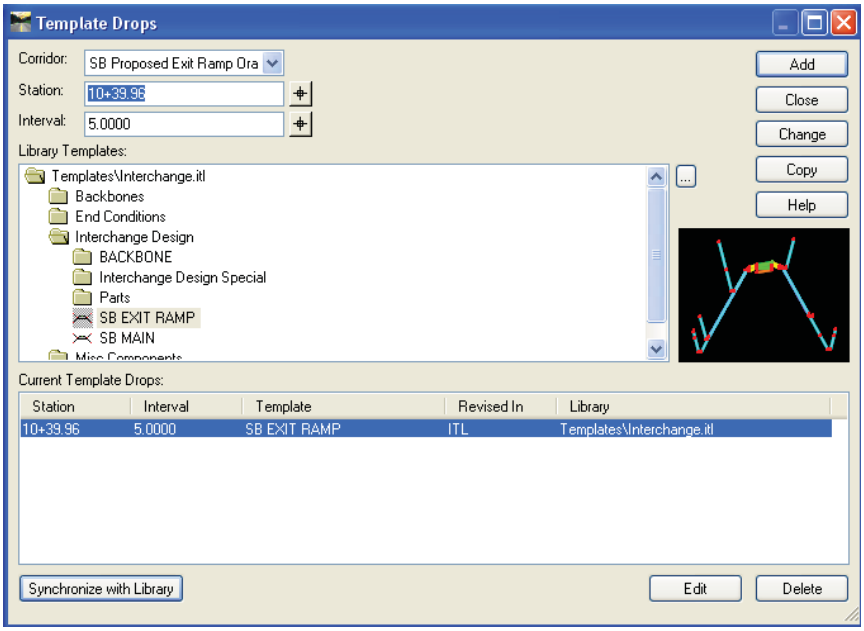


3. Change the **Start:** station to **28+00** and the **Stop:** to **29+80**. Set the **Start:** offset to **-16.00** and the **Stop:** offset to **-0.50**. Select the **Add** button. This will define the Ramp taper. Select the **Close** button on the **Point Controls** dialog box.
4. From the **Roadway Designer** dialog select **Corridor > Display References…** or simply select the icon for this command. We will add cues for visually enforcement that the Ramp transitions are copasetic. Enable the **Alignment:** radio button in the **Display Reference** area of the **Display References** dialog box. Verify that **SB EXIT RAMP** is the alignment. Enable **Display as Right of Way** then select **Add**. Use the pull down menu to change the alignment to SB Proposed and select **Add** again. Select the **Close** button on the **Display References** dialog box.



5. Review the cross sections between 22+00 and 23+00. Notice that the tie point on the Main surface moves up the fill slope and onto the backbone of the Main corridor. When we utilize **Clipping Options** to form the final design surface critical data on the Main will be lost. Window in on the area of intersection between Ramp and Main to determine the last station where the tie point on Main falls on the fill slope similar to the illustration here:
Record the Station: _____+_____ .

6. Edit the template drops that define the Ramp corridor so that the end condition does not overlap the main line. From the **Roadway Designer** dialog box select **Corridor > Template Drops…** Verify that **SB Proposed Exit Ramp Orange 1** is the active corridor. Click on the first (only) template in the **Current Template Drops:** area. Notice that the template instantaneously highlights in the **Library Templates:** area. Click in the **Station:** area and key in the station from step 5 above. Select the **Add** button.



7. The **Current Template Drops:** area should now have a another template entry similar to those shown here:

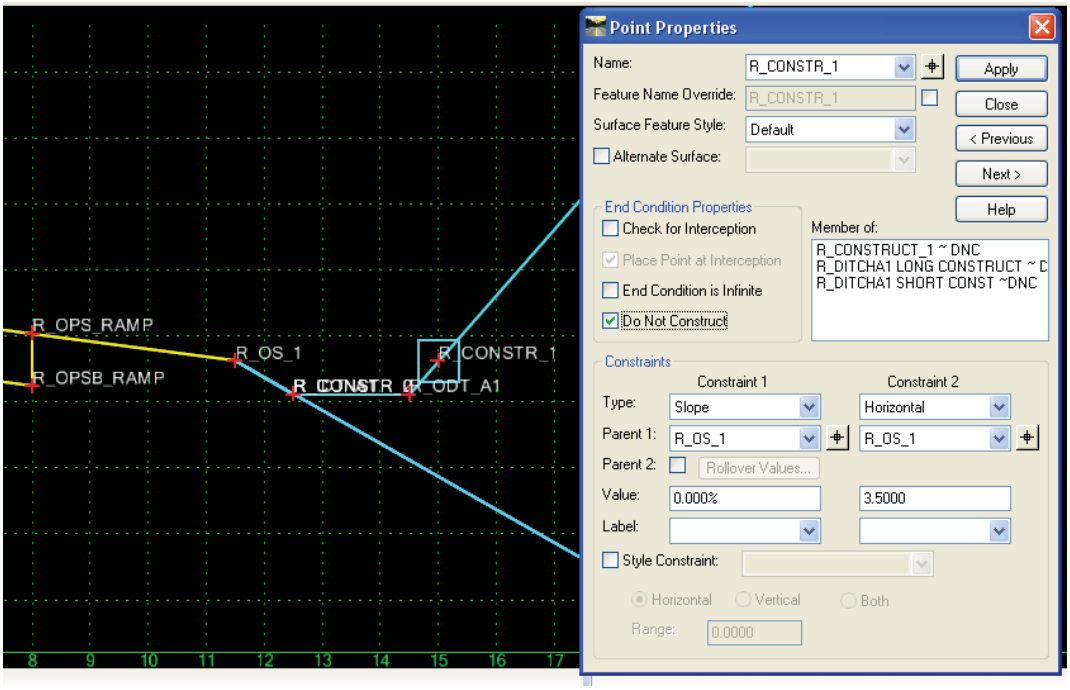
Current Template Drops:

Station	Interval	Template	Revised In	Library
10+39.96	5.0000	SB EXIT RAMP	ITL	Templates\Interchange.itl
22+35.00	5.0000	SB EXIT RAMP	ITL	Templates\Interchange.itl

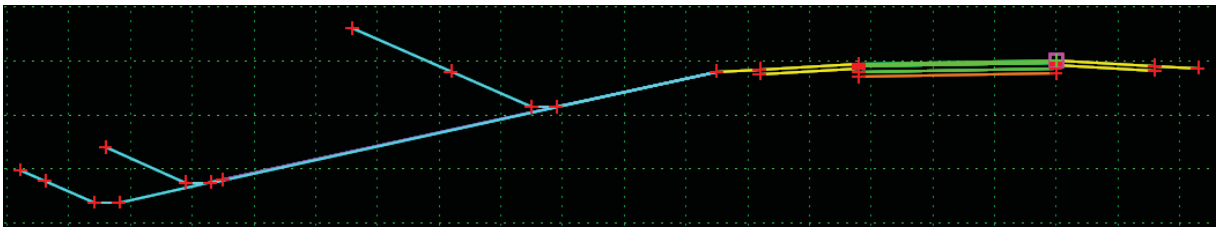
8. Select the template at the station added in the previous step and then select the **Edit** button on the **Template Drops** dialog box. The **Editing Roadway Designer Template Drop** dialog box appears.

Note: In this workshop we will edit the templates in the Roadway Design file (IRD) as opposed to the Template Library file (ITL). The templates in the IRD are copied from the ITL and stored in the IRD. Templates in the IRD may be edited just as they are edited in the ITL. Templates in the IRD are specific to the corridor they fall under. Templates in the ITL can be added to any corridor in any IRD.

9. Window in on the left shoulder of the Ramp typical section and edit the **R_CONSTRUCT_1** point. Un-check the **Do Not Construct** toggle then select **Apply**. **Close** the **Point Properties** dialog box.



10. Delete all the end condition components to the right of the **R_OS_1** point. The template should now look similar to the image below:



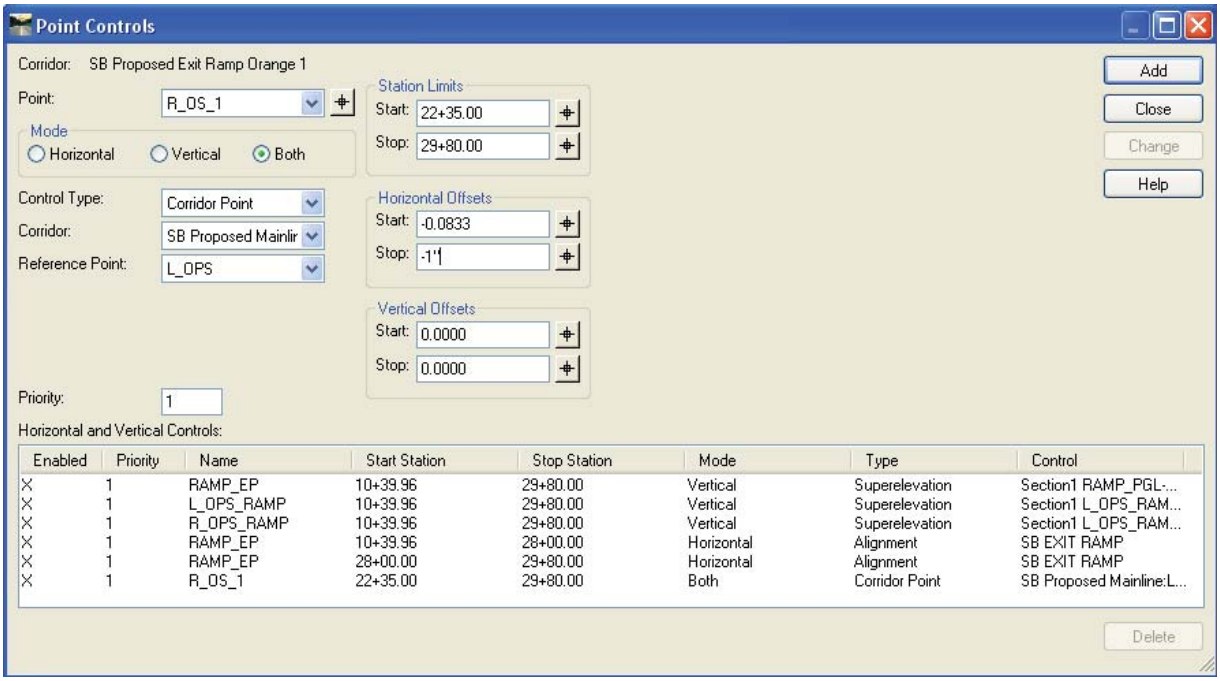
11. Select the **OK** button on the **Editing Roadway Designer Template Drop** dialog box to exit. Notice that the edited template is now Red and that the **Revised In** column indicates **IRD** instead of **ITL** like the initial station.

Current Template Drops:

Station	Interval	Template	Revised In	Library
10+39.96	5.0000	SB EXIT RAMP	ITL	Templates\Interchange.itl
22+35.00	5.0000	SB EXIT RAMP	IRD	Templates\Interchange.itl

12. From the **Roadway Designer** interface verify that all Ramp cross sections beyond the edited template (22+35 as we computed, yours may be different) do not tie to the Main surface.

13. Tie the right unpaved Ramp shoulder point; **R_OS_1**, to the left paved Main shoulder point; **L_OPS**, with a Point Control. From the **Roadway Designer** dialog select **Corridor > Point Controls…** or simply select the icon for this command.



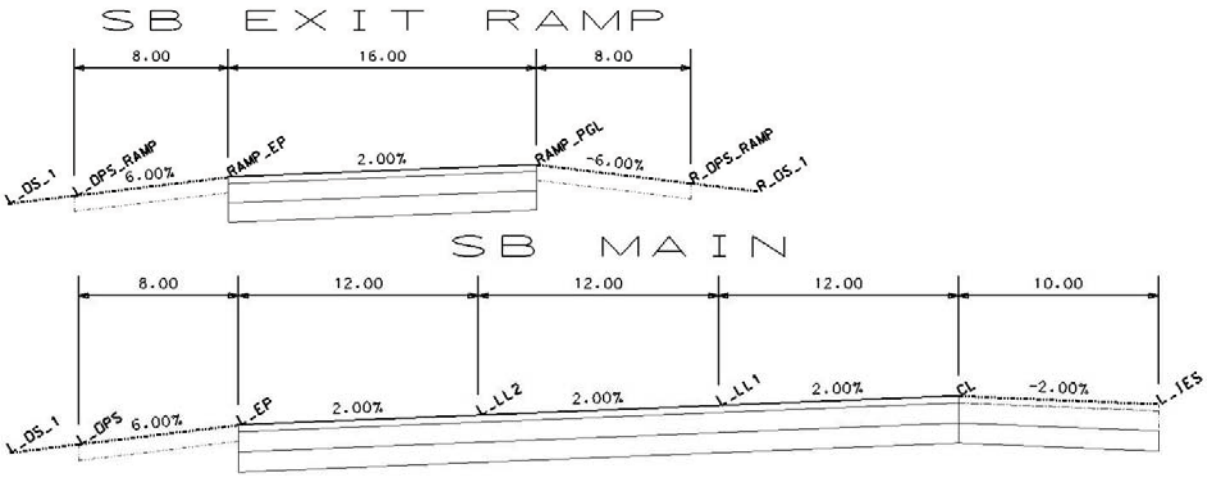
In the **Point:** area select **R_OS_1** as the point to control. Select the **Mode:** radio button for **Both**. The **Control Type:** should be **Corridor Point**; we are targeting the shoulder of the Main corridor. The **Corridor:** for Main is **SB Proposed Mainline**. The **Reference Point:** to target is **L_OPS**.

The **Station Limits** for the point control should **Start:** where the special template with the end condition removed was added; station **22+35** as we computed, your location may be different. We do not know the **Stop:** station yet, so let it run to the alignment end; **29+80**. The **Horizontal Offsets** values should not be 0.000. If they are 0.000 the Main features will be clipped by the **Clipping Options…** when the final composite surface is formed. Hold the point control 1" to the left by keying in either **-1"** or **-0.0833** then press the "**tab**" key. Select the **Add** button to commit the data.

14. From the **Roadway Designer** interface review the behavior of the unpaved shoulder between the Ramp Paved Shoulder and the Main Paved Shoulder. Our design standard state that the minimum width of unpaved shoulder in gore areas is 8'. We know from Step 4 on page 10 where the Unpaved Shoulders intersect, so look for the target station before that point. Record the last station for unpaved gore shoulder here: _____+_____.

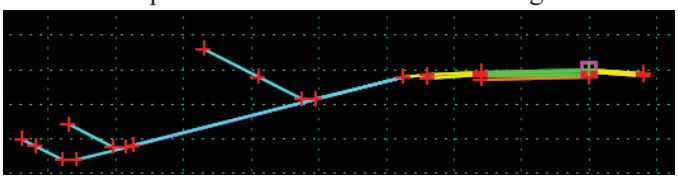
➔ **Exercise: Refine the Roadway Designer Templates**

1. From the **Roadway Designer** dialog box select **Corridor > Template Drops…** Click on the first template in the **Current Template Drops:** area. Notice once again that the template instantaneously highlights in the **Library Templates:** area. Click in the **Station:** area and key in the **visually computed station from step 16** on the previous page. Select the **Add** button. We will need to customize on other typical section for the final Ramp / Main tie in. Click on the first template in the **Current Template Drops:** area then click in the **Station:** area and key **2700**. Select the **Add** button. We have the ability to change the station values at any time.

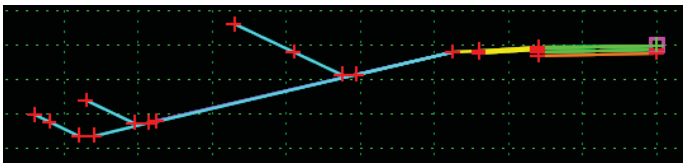


2. Select the first template added in the previous step (should be third from top in the **Current Template Drops:** list), then select the **Edit** button on the **Template Drops** dialog box. The **Editing Roadway Designer Template Drop** dialog box appears.

3. Follow the procedures previously outlined on page 15 for editing (don't forget to edit the **R_CONSTRUCT_1** point) and remove all components to the right of the **R_OPS_RAMP** point. The edited template should be similar to the image below:



4. Edit the template at the bottom of the **Current Template Drops:** list by removing all components to the right of the **RAMP_PGL** point. The edited template should be similar to the image below:



5. Verify that your **Template Drops** dialog box is similar to this the **Close**:

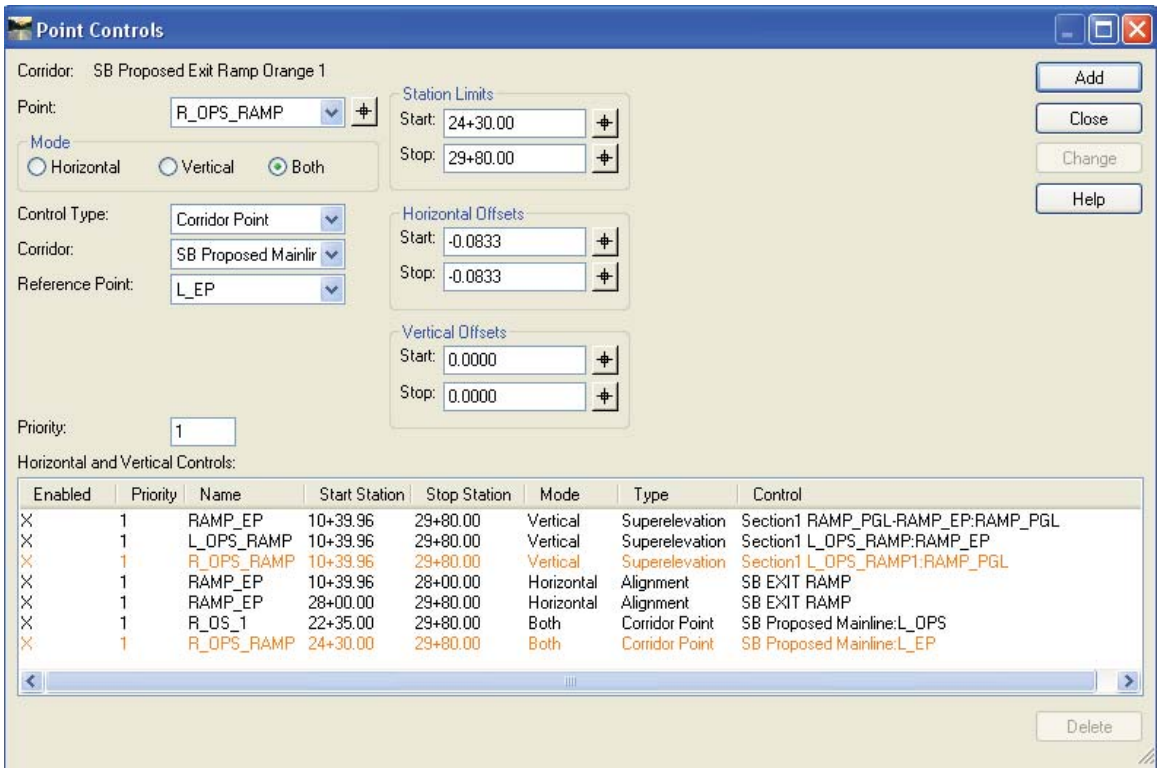
Current Template Drops:

Station	Interval	Template	Revised In	Library
10+39.96	5.0000	SB EXIT RAMP	ITL	Templates\Interchange.itl
22+35.00	5.0000	SB EXIT RAMP	IRD	Templates\Interchange.itl
24+30.00	5.0000	SB EXIT RAMP	IRD	Templates\Interchange.itl
27+00.00	5.0000	SB EXIT RAMP	IRD	Templates\Interchange.itl

➔ Exercise: More Point Controls

1. The edited template inserted at 24+30 has the unpaved shoulder removed. Our design will have a single common shoulder from this point on in the gore area. Add a point control on Ramp point **R_OPS_RAMP** to follow Main point **L_EP**. The **Mode** will be **Both** and the **Control Type:** will of course be **Corridor Point**. Remember to offset the target point by a small amount to the left. Use the alignment end station; **29+80,** as the **Stop:** value.

2. Observe the Horizontal and Vertical Controls: entries in the **Point Controls** dialog box. Two entries are now Orange in color.

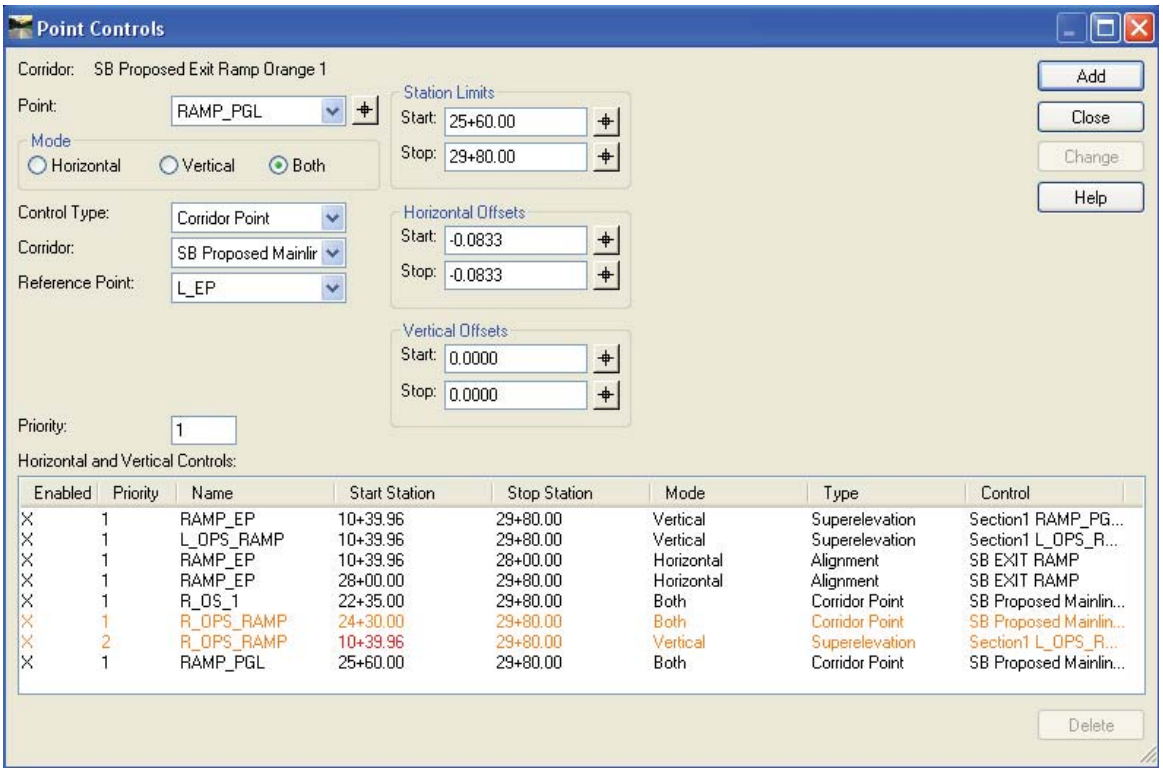


The orange color is a cue that we have a point control conflict. The point control just added specifies that point **R_OPS_RAMP** follows Main point **L_EP**. The superelevation point control is forcing point **R_OPS_RAMP** along another path. If left unresolved we will not know which point control is in effect. There are two options to resolve the conflict; edit the station range or change the **Priority**. Editing the **Priority** is easiest option, so change the **Priority** on the superelevation point control to 2. Highlight the superelevation point control then change the **Priority:** value to **2**. Select the **Change** button to commit the changes.

3. Select the **Close** button on the **Point Controls** dialog box. From the **Roadway Designer** interface review the behavior and effect of the point controls defined to this point.

4. Our design standard state that the minimum width of common paved shoulder in gore areas is 10'. If the width is less than 10' full depth pavement should be placed in lieu of the typical shoulder pavement section. Locate the station where the distance between the Ramp full pavement depth and the Main full pavement depth is about 10'. Record the last station for paved gore shoulder here:_____+_____ .

5. Add a point control on Ramp point **RAMP_PGL** to follow Main point **L_EP** beginning at the station computed in the previous step. The **Mode** will be **Both** and the **Control Type:** will of course be **Corridor Point**. Remember to offset the target point by a small amount to the left. Use the alignment end station; **29+80,** as the **Stop:** value. Your final point controls in the **Horizontal and Vertical Controls:** area should have station values similar to those shown below:



When the custom templates were added to the Template Drops in step 1 on page 17 of the **Refine the Roadway Designer Templates** exercise we did not know the exact station to apply the custom typical section. The template with no shoulders on the right side was added at **27+00**, but now we know the true station values to use from step 5 above.

➔ Exercise: Modify the Roadway Designer Templates

1. From the **Roadway Designer** dialog box select **Corridor > Template Drops…** Select the 27+00 template definition in the **Current Template Drops** at the bottom of the list. Select the **Station:** area at the top of the **Current Template Drops** dialog box and key in the station used for **RAMP_PGL** point control. Select the **Change** button to complete the modification. Select **Close** to dismiss the **Current Template Drops** dialog box.
2. From the **Roadway Designer** interface review the Ramp corridor transition to the Main corridor.

There are numerous acceptable design solutions that for this interchange. Use the template drop locations shown below as a guide:

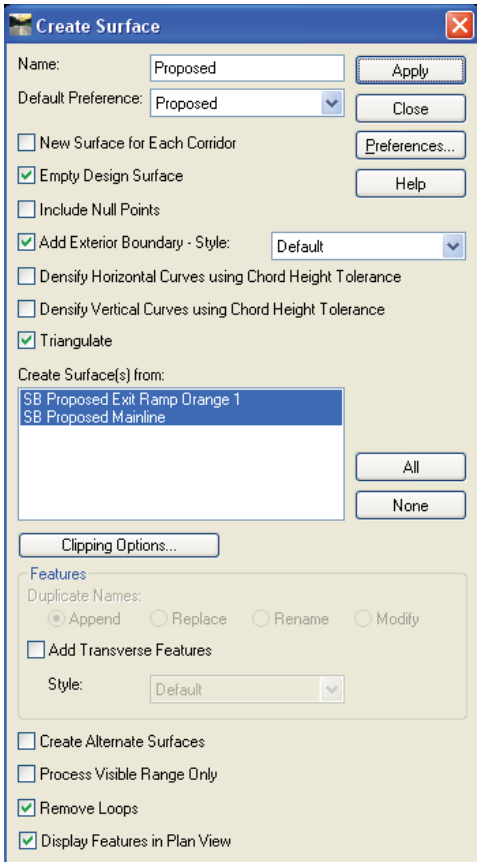
Current Template Drops:

Station	Interval	Template	Revised In	Library
10+39.96	5.0000	SB EXIT RAMP	ITL	Templates\Interchange.itl
22+35.00	5.0000	SB EXIT RAMP	IRD	Templates\Interchange.itl
24+30.00	5.0000	SB EXIT RAMP	IRD	Templates\Interchange.itl
25+60.00	5.0000	SB EXIT RAMP	IRD	Templates\Interchange.itl

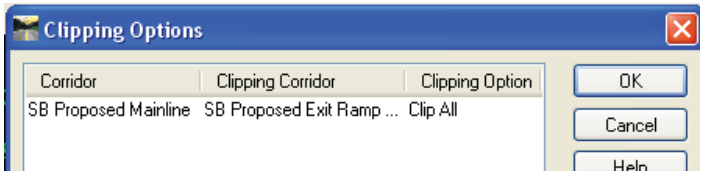
Creating the Design Surfaces

Now that the design of the corridors is complete we can create digital terrain models. We have the option of creating a merged digital terrain model consisting of two or more corridors, or we can create individual models for each corridor. Of course you can produce a merged digital terrain model and individual corridor digital terrain models. In this workshop we will create a merged digital terrain model.

➔ **Exercise: Create a Proposed surface from the corridor definitions.**



1. From the **Roadway Designer** dialog box select **Corridor > Create Surfaces…**
2. Key in **Proposed** in the **Name:** field on the **Create Surface** dialog box.
3. Set the **Default Preference:** to **Proposed**.
4. Enable **Empty Design Surface**
5. Enable **Add Exterior Boundary** and set the ***Style*** to **Default**.
6. Enable **Triangulate**.
7. Verify that both corridors are selected as shown:
8. Select the **Clipping Options…** button and set the **Clipping Options** to **Clip All**.



9. Enable **Remove Loops** and **Display Features in Plan View**.
10. Select the **Apply** button. Once the corridors have processed review then dismiss any corridor reports. Select the **Close** button on the **Create Surface** dialog box.

11. On the **Roadway Designer** dialog box select **File > Save As**. Set the **Save in:** path to the **…\Interchange Design\Corridors** folder. In the **File name:** area key in Interchange Design Step 3 the select the **Save** button. Select the **Cancel** button to dismiss the **Save As** dialog box.
12. Select the **Close** button on the **Roadway Designer** dialog box.

Reviewing the Design Surfaces

The features displayed in plan view by the Create Surfaces process are a good indicator of potential problems in the modeling. Large gaps, crossing features and overlaps indicate that an entry may have been miss-keyed. Utilize all your tools to view and evaluate the Proposed surface just created.

➔ **Exercise: View the Digital Terrain Model Data with various methods.**

1. View the triangles of the Proposed surface. Look for any irregularities in the triangle pattern. Upon completion of your review remove the triangles just displayed with your favorite *MicroStation* delete method.
2. View the contours of the Proposed surface at a one foot interval. Notice the contours in the gore area between Ramp station 22+50 to 24+00. Upon completion of your review remove the contours with your second favorite *MicroStation* delete method.
3. View the Components of the proposed surface. Open *MicroStation* View 8 and observe the design. Close View 8 and remove the displayed Components with your favorite *MicroStation* delete method.
4. Create Cross Sections along the SB Proposed alignment between 173+00 and 182+00. Set the cross section interval at 25’ with offsets –300’ left and 50’ right. Review the sections.
5. Delete this first set of cross sections and generate a second set of cross sections from 174+90 to 176+85 on a 5’ interval. Change the offsets to -150’ left and 50’ right. Look closely at the gore area in these sections. Let’s add a wall through this area to eliminate the questionable slope between the corridors. The Ramp alignment stations for the wall are 22+30 to 24+05.

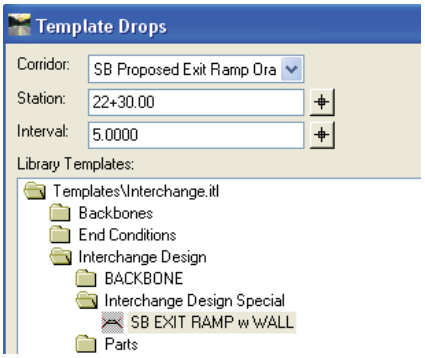
Modifications in the Roadway Designer (for the advanced user)

(this section is optional)

When the design philosophy changes on a corridor as complex as ours it can quite often lead to conflictions in the corridor definition. The importance of a well organized naming scheme is accentuated when modifications are required.

➔ **Exercise: Design changes in the Roadway Designer**

1. From the **Roadway Designer** dialog box select **Corridor > Template Drops…** Key in **2230** in the **Station:** field.
2. In the **Library Templates:** area expand **Templates\Interchange.itl > Interchange Design > Interchange Design Special** and select **SB EXIT RAMP w WALL** as shown here:



3. Select the **Add** button on the **Template Drops** dialog box.
4. Key in **2405** in the **Station:** field and select the **Add** button on the **Template Drops** dialog box again. The **Current Template Drops:** should be similar to those shown beow at this point:

Current Template Drops:

Station	Interval	Template	Revised In	Library
10+39.96	5.0000	SB EXIT RAMP	ITL	Templates\Interchange.itl
22+30.00	5.0000	SB EXIT RAMP w WALL	ITL	Templates\Interchange.itl
22+35.00	5.0000	SB EXIT RAMP	IRD	Templates\Interchange.itl
24+05.00	5.0000	SB EXIT RAMP w WALL	ITL	Templates\Interchange.itl
24+30.00	5.0000	SB EXIT RAMP	IRD	Templates\Interchange.itl
25+60.00	5.0000	SB EXIT RAMP	IRD	Templates\Interchange.itl

5. Before we added the "wall" template the template at 22+35 was in effect from 22+35 to 24+30. Change this template so its first occurrence is **2405.01**.
6. Click on the first template in the **Current Template Drops:** area (10+39.96) then select the **Station:** field. Key in **2229.99** and select the **Add** button on the **Template Drops** dialog box again. This will eliminate any long irregular transitions from the beginning of the Ramp to this point.

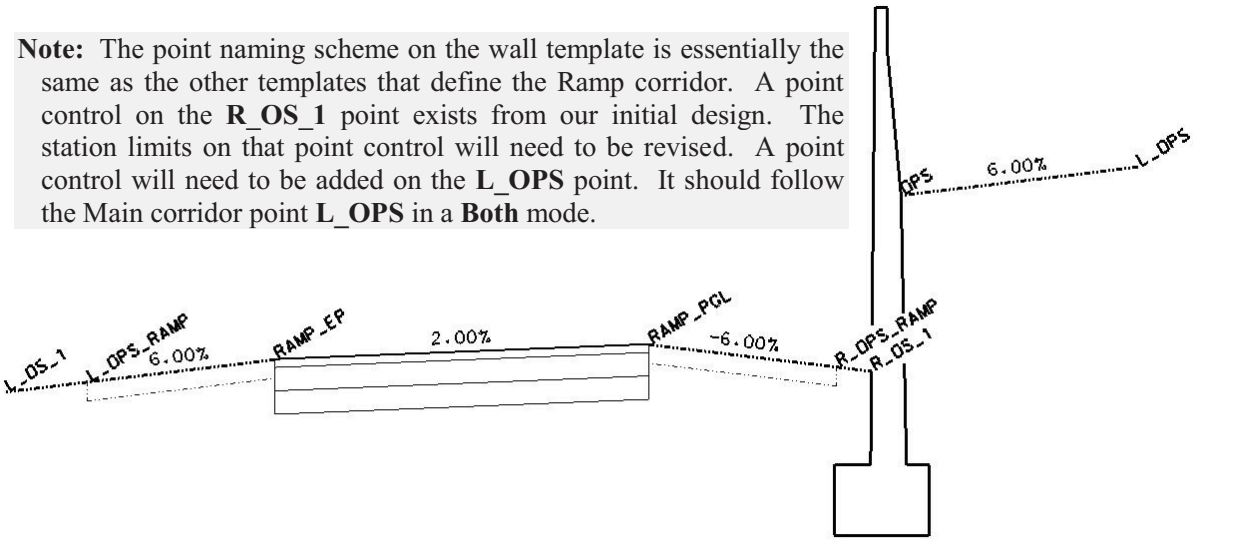
Note: The **Current Template Drops:** display is not always sorted by the Station column. Click on the word "Station" to make it the controlling sort column.

7. The final entries in the **Current Template Drops:** area should be similar to those shown to the right. Select the **Close** button to dismiss the **Template Drops** dialog box.

Current Template Drops:

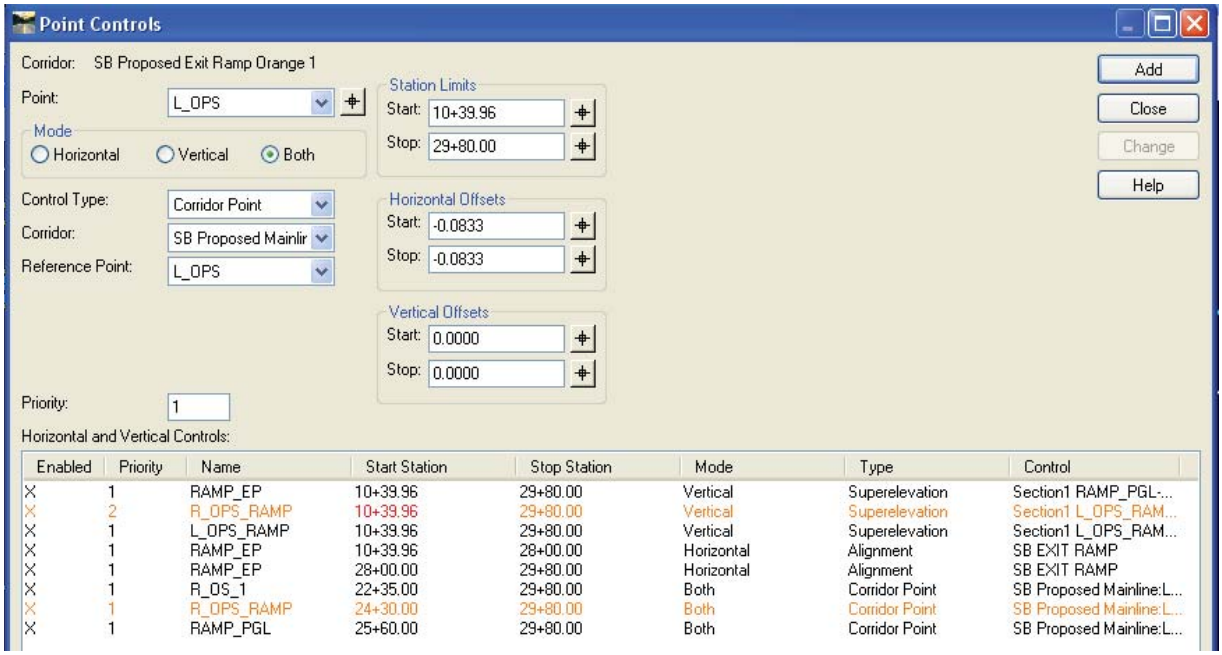
Station	Interval	Template	Revised In
10+39.96	5.0000	SB EXIT RAMP	ITL
22+29.99	5.0000	SB EXIT RAMP	ITL
22+30.00	5.0000	SB EXIT RAMP w WALL	ITL
24+05.00	5.0000	SB EXIT RAMP w WALL	ITL
24+05.01	5.0000	SB EXIT RAMP	IRD
24+30.00	5.0000	SB EXIT RAMP	IRD

Note: The point naming scheme on the wall template is essentially the same as the other templates that define the Ramp corridor. A point control on the **R_OS_1** point exists from our initial design. The station limits on that point control will need to be revised. A point control will need to be added on the **L_OPS** point. It should follow the Main corridor point **L_OPS** in a **Both** mode.



SB EXIT RAMP w WALL

8. From the **Roadway Designer** dialog select **Corridor > Point Controls…** or simply select the icon for this command. Select **L_OPS** as the **Point:** to control. In the **Mode** area select the **Both** radio button. The control type is **Corridor Point** and the **Corridor:** is **SB Proposed Mainline**. The **Reference Point:** is **L_OPS**. The station limits should match the wall station limits 22+30 to 24+05. Add a slight horizontal offset to the left as we have done throughout this workshop. Select the **Add** button to complete the entry.



9. Select the **R_OS_1** point control in the **Horizontal and Vertical Controls:** area of the **Point Controls** dialog box. Originally the point control started at station 22+35, but now it is not needed until the wall ends. Change the **Start Station** of the **R_OS_1** point control to **24+05.01**.

10. Select the Close button to dismiss the **Point Controls** dialog box. Review the design changes in the **Roadway Designer** cross section window.

11. On the **Roadway Designer** dialog box select **File > Save As**. Set the **Save in:** path to the **…\Interchange Design\Corridors** folder. In the **File name:** area key in Interchange Design Step 4 the select the **Save** button. Select the **Cancel** button to dismiss the **Save As** dialog box.

12. Select the **Close** button on the **Roadway Designer** dialog box.

Modifications in the Roadway Designer (for the advanced user)

(this section is optional and without instructions)

There are a few problems with our design. Make the following modifications to the design:

1. Adjust the cross slope on the Ramp so it more closely matches the Main Roadway cross slope.
2. Add a shallow paved ditch with 6:1 slopes between the wall and the Main Roadway. The ditch should transition to the ditch that ends at Ramp Station 22+30

Key Station Computation Answers

➔ **Exercise: Create Corridors (page 9)**

Step 9) Start station for the **SB Proposed Mainline** corridor here: **between 156+00 and 158+00** (somewhere in this range).

➔ **Exercise: Identify and Locate key Template Transition Stations (page 13)**

Step 4) Station of unpaved shoulder intersect point **24+37.469**

➔ **Exercise: Add Point Controls (page 17)**

Step 5) … Window in on the area of intersection between Ramp and Main to determine the last station where the tie point on Main falls on the fill slope similar to the illustration here: **Record the Station: 22+35.00**

➔ **Exercise: Add Point Controls (page 19)**

Step 14) … We know from Step 4 on page 10 where the Unpaved Shoulders intersect, so look for the target station before that point. Record the last station for unpaved gore shoulder here: **24+30**.

➔ **Exercise: More Point Controls (page 21)**

Step 4) Our design standard state that the minimum width of common paved shoulder in gore areas is 10'. Locate the station where the distance between the Ramp full pavement depth and the Main full pavement depth is about 10'. Record the last station for paved gore shoulder here: **25 + 60** .

Module Summary and Review

Summary

You are now able to:

- Know various methods to merge corridor design.
- Modify corridors.
- Form digital terrain models for the interchanges you design.
- Teach others how to design interchanges
- Buy the instructors dinner.