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Nordic Civil 2011

14.-16. November 2011, Munkebjerg Hotel, Vejle

Workshop - X15

Intersection Design with Roadway Designer - InRoads

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Accessing the Project

In this lesson the student will learn to access a GEOPAK Corridor Modeler project in preparation for modeling an intersection in Roadway Designer

Lesson Objectives

After completing this module, you will be able to:

- Load the Corridor Modeler Dialog
- Load the Corridor Modeler Preferences
- Load the Roadway Designer IRD project file

Starting the Project in InRoads

1 Go to Start > Programs > Bentley > InRoads Group V8i (SELECTseries 2) > InRoads Suite.

2 The instructor will provide the appropriate path location for this project. When the MicroStation Manager appears, select the file *Design.dgn* and press **OK**.In the InRoads menu, select **File > Open**.

3 Browse to the class data folder.

4 Open the Project file (.rwk) named *My_Project.rwk*.

5 In the *Open* dialog, click **Cancel.**

6 Verify that the following files were opened:

.xin *Default_Styles.xin*

.dtm *Ex_Ground.dtm*

.alg *cmjob001.alg*

.itl *Templates.itl*

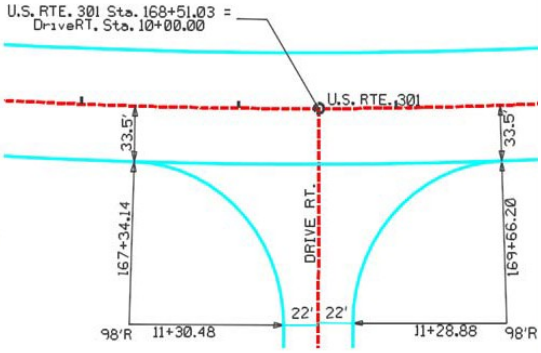
.ird *My_Project.ird*

Open the Roadway Designer by clicking **Modeler > Roadway Designer**.

Reviewing the Design

Preliminary Design

- Two Corridors have been created
  - US 301 (Main Roadway)
  - DriveRT (Side Road)
- US 301 has Superelevation Defined



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Reviewing the Design

In this lesson, the student will review two corridors that have already been created: one for the mainline and one for the side road.

Lesson Objectives

After completing this module, you will be able to:

- Set the Active Corridor
- Review the superelevation
- Review the Point Controls

Analyze the Mainline Corridor

ⓘ There are currently two corridors already established. US 301 is the main line, and DriveRT is the side road corridor, respectively

1 While in Roadway Designer, set the active corridor to **US 301** and review the design.

2 On the bottom right portion of Roadway Designer dialog, set the *Display Mode* to **Superelevation** and review the design.

3 After reviewing the superelevation, select **Corridor > Point Controls** and review the point controls for US 301. When finished, close the *Point Controls* dialog and switch back to the **Normal** view mode.

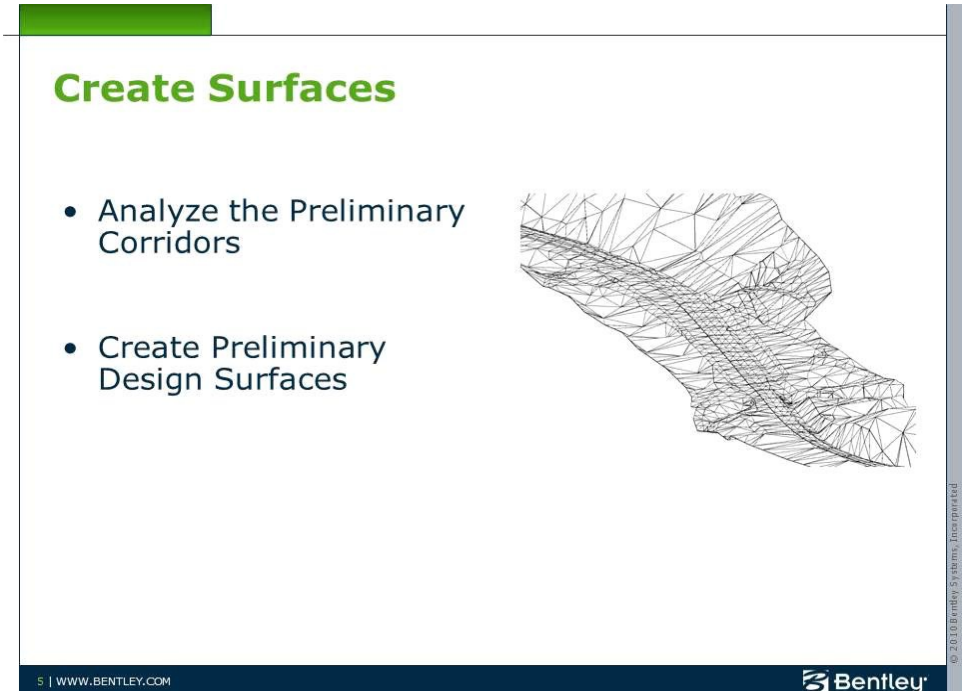
Analyze the Side Road Corridor DriveRT

1 Set the active corridor to **DriveRT** and review the design

2 Select **Corridor > Point Controls** and review the point controls for DriveRT. Notice at this time no Point Controls are assigned. When finished, close the Point Controls dialog.

ⓘ Note: No superelevation is required for the side road Corridor DriveRT.

Create Surfaces



In this lesson the student will create preliminary design surfaces for the two corridors and review the side road profile tie-in.

Lesson Objective

After completing this module, you will be able to:

- Create the US 301 Corridor proposed surface
- Creare the DriveRT Corridor proposed surface
- Plot and review the side road corridor profile

Create the US 301 Surface

1 In Roadway Designer, verify the *Active Surface* is set to **Ex_Ground**.

2 Select **Corridor > Create Surface**.

3 Key in **US 301** for the *Surface Name*, or you can simply select the corridor **US 301** if *New Surface for Each Corridor* is enabled.

4 Select the corridor **US 301**, making sure not to include the DriveRT corridor listing.

5 Make sure **Display Features** and **Display Components in Plan View** are both disabled, and then click **Apply** to generate the first surface

Create the DriveRT Surface

1 Make sure the *Active Surface* is set to **Ex_Ground**.

2 Key in **DriveRT** for the *Surface Name*.

3 Select the *Corridor* **DriveRT**.

4 Click **Apply**.

5 **Close** the **Create Surface** dialog.

6 **Close** Roadway Designer, saving your changes when prompted

Create and Review the Profile of the Side Road (InRoads Users)

1 Set the active alignment to **DriveRT**.

2 Select **Evaluation > Profile > Create Profile**.

3 Enable All the Surfaces (except Default).

Click **Apply**, then place the profile to the far right of the plan graphics.

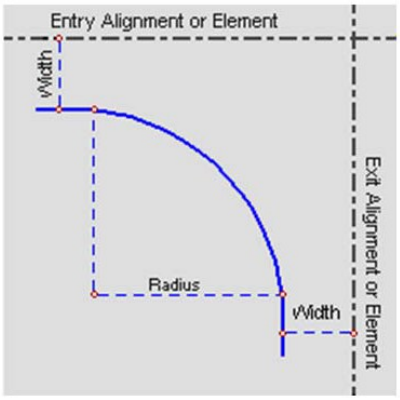
4 Close the Create Profile dialog.

5 Select **Geometry > View Geometry > Vertical Annotation,** then click **Apply**.

Multi-Center Curve Command

Multi-Center Curve Command

- Creates both Horizontal and Vertical Curves based on two alignments
- One, Two or Three Centered Curves can be created
- Vertical Curves are created matching the instantaneous longitudinal grade at the PVC and PVT
- Vertical Geometry Options
  - Vertical Distance
  - Gradient
  - Surface (Useful when the cross slope varies i.e. Superelevation)
- Always Review the Results and make adjustments if necessary



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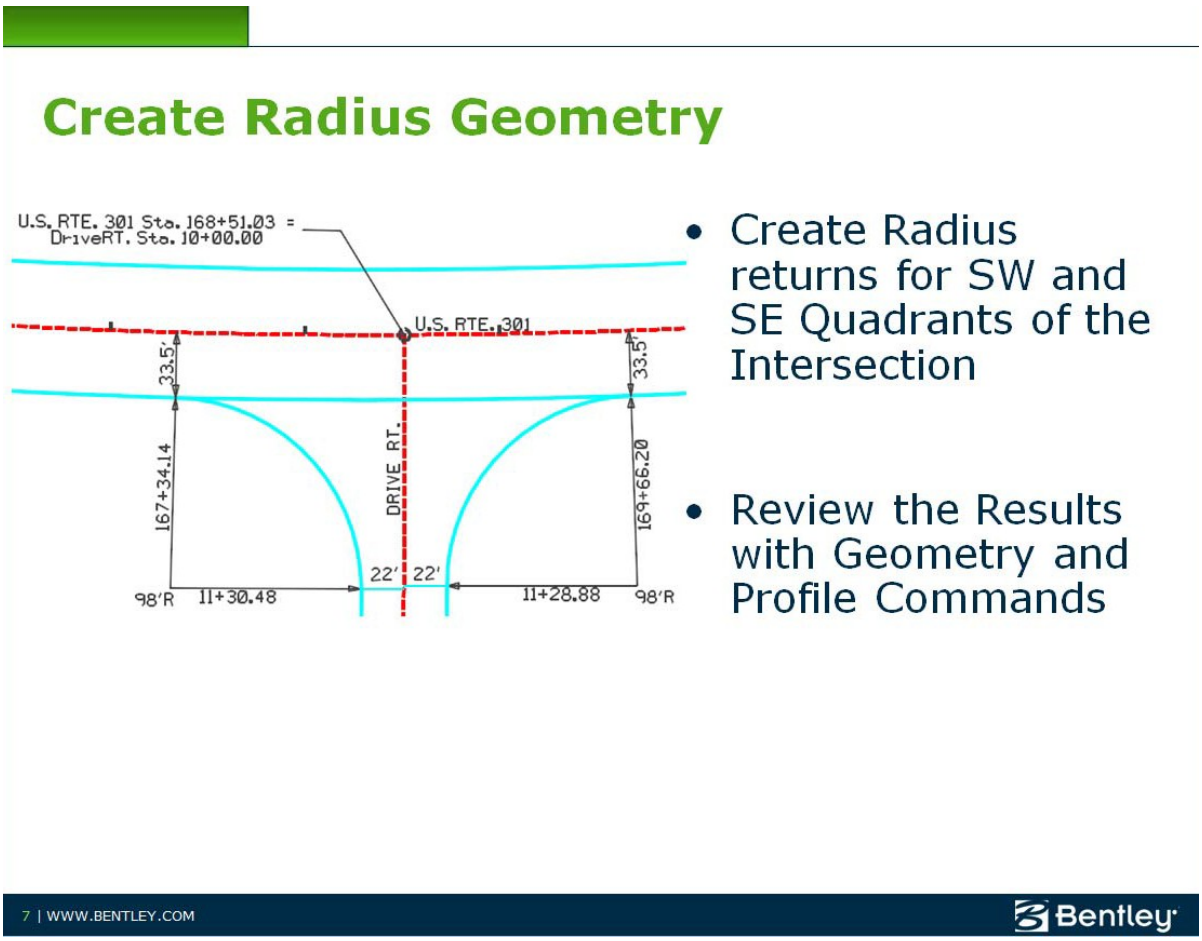
The Multi-Center Curve tool places one-center, two-center, and three-center compound curves at the intersection of two alignments. The command creates a new horizontal alignment in the active geometry project/geometry database, and, if desired, a vertical alignment as well. When creating a vertical alignment, you can choose to define the elevations of the vertical alignment by vertical distance, from transverse gradient (cross slope) or by a surface.

Create the Geometry for the SW and SE Radius Returns



Lesson Objective:

After completing this module, you will be able to:

- Create radius return geometry for the SW quadrant
- Create radius return geometry for the SE quadrant

Create the Radius Return Geometry (InRoads Users)

1 Select **Geometry > Utilities > Multi-Center Curve**.

2 Adjust the settings on the *Main* tab as follows:

Curve Type: One Center

Radius 1: 98

Width 1: 33.5

Width 2: 22

3 Click the **Advanced** tab and adjust the settings as follows:

Name: SW

Style: Lane Line

Create Vertical Alignment: Enabled

First Selected Alignment: Surface: **US 301**

Second Selected Alignment: Surface: **DriveRT**

4 Click **Apply**.

5 Follow the prompts in the MicroStation Status bar. Select **US 301** for the first alignment then select **DriveRT** for the second alignment.

6 Click in the SW quadrant of the intersection to specify the location, and click to accept. Right-click to return to the dialog box. (you may need to right click more than once.)

7 In the *Advanced* tab, adjust the settings as follows:

Name: SE

Style: Lane Line

The settings on the Main tab do not need to be changed.

8 Click **Apply**.

9 Follow the prompts in the MicroStation Status bar. Select **US 301** for the first alignment then select **DriveRT** for the second alignment.

10 Click in the SE quadrant of the intersection to specify the location, and click to accept. Right-click to bring up the dialog box (you may need to right click more than once).

11 When finished, right-click to return to the dialog box.

There should now be two additional alignments in the active geometry project: SW Quadrant and SE Quadrant.

Review the Resulting Profiles (InRoads Users)

1 Change the Active Alignment to **SW Quadrant**.

2 Select **Evaluation > Profile > Create Profile**.

3 Enable all three surface, then click **Apply**.

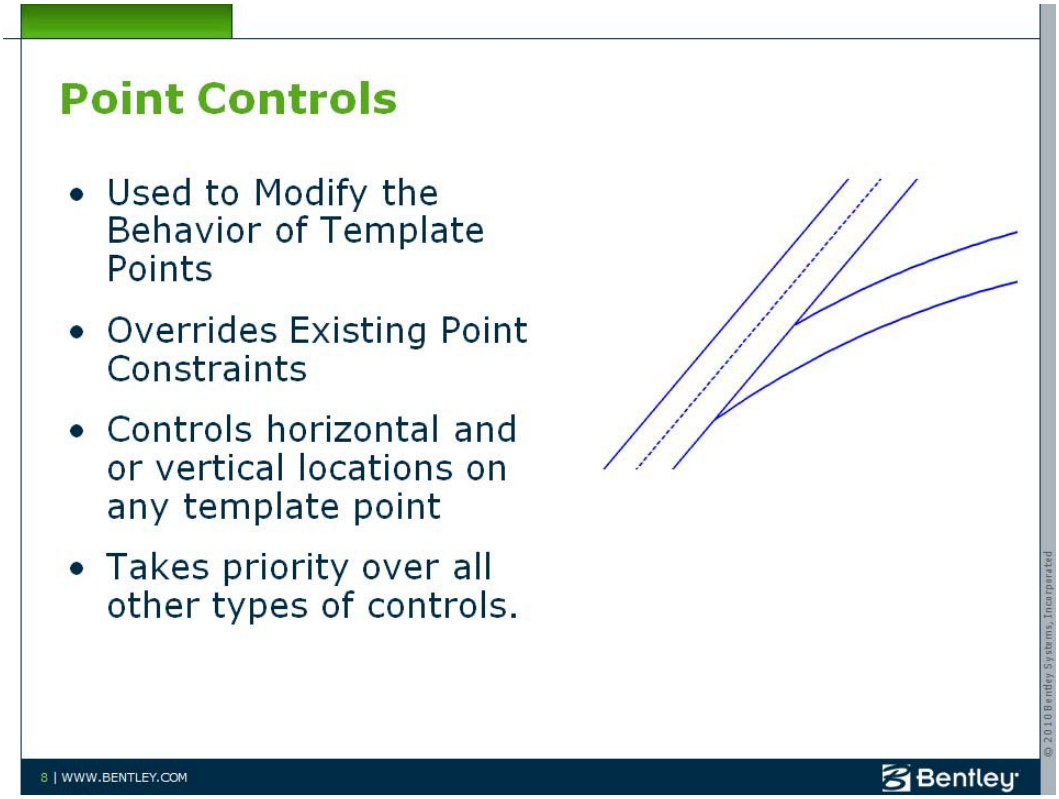
4 Place the profile to the right of the view.

5 Use the **View Vertical Annotation** command to display the vertical alignment and the labeling.

ⓘ The vertical curve set and the Vertical PI commands can be used to modify the vertical alignment of the radius return (for example, adjusting the low point for inlet locations).

Repeat the above steps for the SE Quadrant.

Point Controls



Template point controls are used to override the normal horizontal and/or vertical locations of template points during the modeling process. Design examples include lane widening, ramp and intersection design, superelevation, divided highways with separate grade lines, etc. These overrides are accomplished by assigning template point names to alignments.

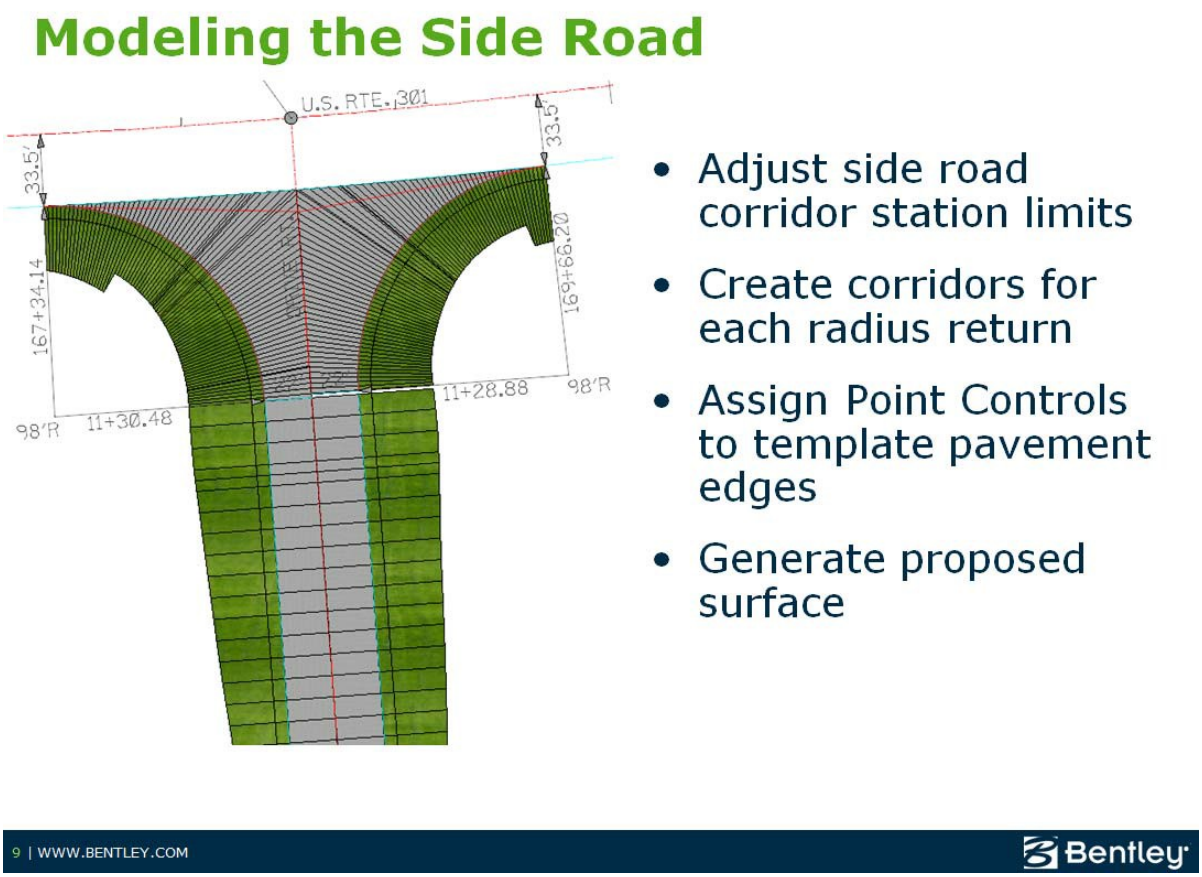
The assigned template points will follow the alignments using horizontal and/ or vertical controls within a specified station range. Surface features can also be used to control template points.

When more than one point control of the same type exists for the same template point within the same station range, then a conflict will occur.

A point control conflict is visible as a tan color in the point controls dialog. Point control conflicts can be resolved by either adjusting the station range of the point controls or changing the priority.

Point Controls can also be used as secondary alignments.

Modeling the Side Road



Lesson Objective

After completing this module, you will be able to:

- Adjust station limits on an existing Corridor
- Create new Corridors
- Assign Point Controls
- Create a design surface

Adjusting The Side Road Corridor (DriveRt) Station Limits

1 Open the Roadway Designer

2 Select the Manage Corridors icon and highlight the Corridor DriveRT.
3 Activate the Station Limits toggle and revise the start station to 11+28.88
4 Select Change to modify the current settings for the side road corridor.
5 Close the Manage Corridors dialog.
6 Save your changes to the IRD project file

Adjusting The Side Road Template Drop (Drivert) Starting Station

1 Select the Template Drops icon and highlight the current template drop.
2 Modify the Station field using the new starting station of 11+30.48.

ⓘ Note: This is NOT the beginning of the Corridor but rather the end of the SW Quadrant

3 Select Change to modify the current settings for the side road corridor.
4 Close the Template Drops dialog.
5 Save your changes to the IRD project file

Create the SW and SE Corridors

1 Select the Manage Corridors icon.
2 In the name field type SW for the southwest corridor.
3 Set the horizontal and vertical alignments to SW.
4 Set the starting station to 0+00.00
5 Select Add to add the SW corridor.
6 Repeat steps 2-5 to create the SE corridor.
7 Close the Manage Corridors dialog.
8 Save your changes to the IRD project file

Applying a Template to the SW Quadrant Corridor

1 Verify the Active Corridor is set to SW and the Active Surface is set to Ex_Ground.
2 Select the Drop Templates icon.
3 Set the following
   - Station: 0+00.00
   - Interval: 2.0

- Template Name - Drive > Drive_RT_PGL

4 Add the template drop

5 Close the Template Drop dialog

6 Save your changes to the IRD project file

Applying a Template to the SE Quadrant Corridor

1 Verify the Active Corridor is set to SE and the active surface is set to Ex_Ground

2 Select the Drop Templates icon

3 Set the following

- Station: 0+00.00
- Interval: 2.0
- Template Name - Drive > Drive_LT_PGL

4 Add the template drop

5 Close the Template Drop dialog

6 Save your changes to the IRD project file

Applying Point Controls to the SW Quadrant Corridor

1 Set the Active Corridor to SW

2 Select the Point Controls icon to access the Point Controls dialog.

3 Use the target button to select point CL (upper left edge of pavement), or select the point from the list

4 Set the Mode to Both

5 Set the Control Type to Corridor Point

6 Set the Corridor to US 301

7 Set the Reference Point to EP_O_EB

8 Set the Start Station to 0+00 (Beginning of the Corridor)

9 Set the Stop Station to 0+85.00 (Intersection of the edge of mainline pavement with side road alignment)

10 Click Add

11 Now change the Control Type to Alignment

12 Set the Horizontal Alignment to DRIVERT

13 Set the Vertical Alignment to DRIVERTFP

14 Set the Start Station to 0+85.01 and the Stop Station to 1+51.61 (End of Corridor)

15 Click Add to add the Point Control

16 Close the Point Controls dialog

17 Save your changes to the IRD project file

Applying Point Controls to the SE Quadrant Corridor

1 Set the Active Corridor to SE.

2 Select the Point Controls icon to access the Point Controls dialog.

3 Use the target button to select point CL (upper right edge of pavement), or select the point from the list.

4 Set the Mode to Both

5 Set the Control Type to Corridor Point

6 Set the Corridor to US 301

7 Set the Reference Point to EP_O_EB

8 Set the Start Station to 0+00 (Beginning of the Corridor)

9 Set the Stop Station to 0+84.49 (Intersection of the edge of mainline pavement with side road alignment)

10 Click Add

11 Now change the Control Type to Alignment

12 Set the Horizontal Alignment to DRIVERT

13 Set the Vertical Alignment to DRIVERTFP

14 Set the Start Station to 0+84.50 and the Stop Station to 1+50.31 (End of Corridor)

15 Click Add to add the Point Control

16 Close the Point Controls dialog

17 Save your changes to the IRD project file

18 Close Roadway Designer

Create the Surface for Side Road Corridor DriveRt

1 In the Design.DGN file switch to the MicroStation model entitled Model3D. It is important to switch to a 3D model or file before proceeding to build a 3D surface.

2 Open Roadway Designer and verify the IRD file My_Project.ird created previously is opened.

3 Verify the Active Surface is set to Ex_Ground and the padlock next to the active surface is locked.

4 Select Corridor > Create Surface

5 Key in DriveRT for the Surface Name

6 Select the corridors DriveRT, SW, and SE corridor listings using CONTROL-MOUSE CLICK option. Do NOT include US 301 corridor.

7 Verify the setting New Surface for Each Corridor is disabled

8 Make sure Display Components in Plan View is enabled, and then click Apply to generate the combined side road surface.

9 Close the Create Surface dialog and minimize Roadway Designer to view the 3D components model of the side road DriveRT.

10 After reviewing the side road model, execute a MicroStation undo to remove the previously plotted 3D components on the side road.

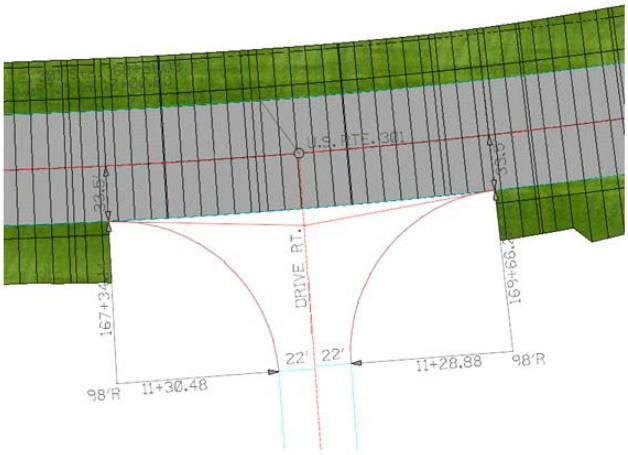
11 Switch back to the DGN default Model

12 Proceed back to Roadway Designer

Modeling the Mainline Corridor

Modeling the Main Line

- Draw a plan graphic to indicate the limits of the radius returns
- Import plan graphic to Roadway Designer
- Target plan graphic as a style constraint using an end condition
- Automatically turns off end conditions and automates the clipping process



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Lesson Objective

After completing this module, you will be able to:

- Import plan graphics locating the station range of the proposed side road radius return tie in locations
- Utilize Style targeting
- Add Key Station locations

ⓘ The template will target this alignment by targeting a style named SideRoad Trigger. When the style associated to this alignment is found, the earth shoulder and end conditions will not be drawn. This is a much simpler approach then dropping additional templates and editing them

Create the Side Road Trigger Line (InRoads Users)

1 Select **File > New**.

2 Click the **Geometry** tab.

3 Change the *Type* to **Horizontal Alignment**.

4 Type in a *Name* of **SideRoad Trigger**.

5 Select a *Style* of **SideRoad Trigger**.

6 Click Apply and close the dialog.

An empty horizontal alignment is created. We will add points in the next steps.

7 Make sure the MicroStation Key-in tool is open (MicroStation > Utilities > Key-in).

8 Select **Geometry > Horizontal Curve Set > Add PI**.

9 At the "Identify first point" prompt, type **SO=167+34.14,40,0,US301** in the MicroStation key-in field (you can cut-and-paste from this document).

The alignment starts at that point, the prompt changes to "Identify Point/ Reject", and the second point of the alignment tanget is attached to the cursor.

10 Type **SO=169+66.2,44,0,US301** in the MicroStation key-in field.

11 The second point of intersection is placed.

12 At the "Identify Point/Reject" prompt, right-click twice to exit the command.

13 Save the Geometry Project (File > Save > Geometry Project).

ⓘ The sideroad trigger line is required to be drawn at or beyond the proposed edge of pavement offset of 33.5 feet. This line would never be plotted but is used merely to change the behavior of the template in Roadway Designer. A powerful alternative to End Condition Exceptions.

ADD KEY STATIONS TO THE MAINLINE CORRIDOR

1 Proceed back to Roadway Designer

2 Verify the Active Corridor is set to US 301

3 Select the Key Stations icon to access the Key Stations dialog

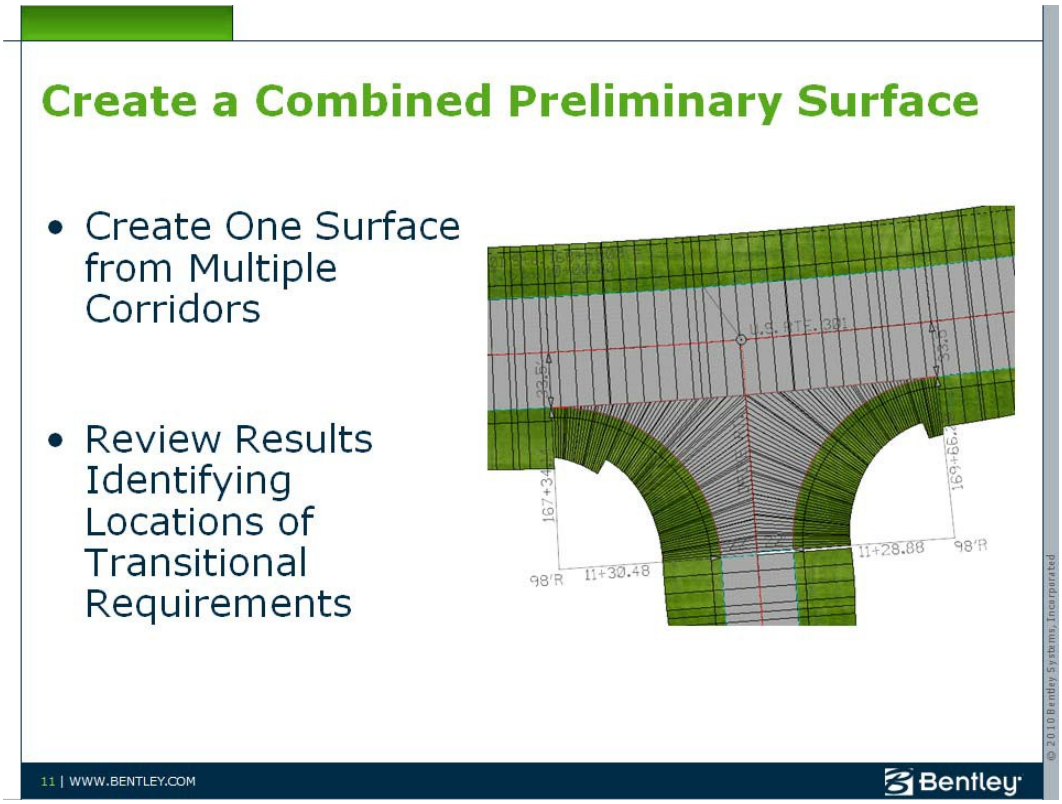
4 Enter the following Key Station Values

- 167+34.13
- 167+34.14
- 169+66.20
- 169+66.21

5 Close the Key Station dialog and save your changes to the IRD Project file

6 Toggle through the cross sections along the US 301 corridor and notice how the earth shoulder and end conditions do not draw within the limits of the side road trigger line imported previously

Creating the Combined Intersection Model



Lesson Objective

After completing this module, you will be able to:

- Create one design surface from multiple corridors
- Identify areas of required transition

CREATING THE COMBINED SURFACE

1. In the Design.dgn file swith to the Default model
2. In Roadway Designer Set the active surface Ex_Ground
3. Select Corridor > Create Surface
4. Enter Finished for the Surface name (New Surface for Each Corridor should be disabled)
5. Select all corridors from the corridor list.
6. Enable Display Components in Plan View, click Apply.

7 Close the Create Surface dialog and minimize Roadway Designer

8 Use the MicroStation rotate view command to review the results

Smoothing Transitions

Lesson Objective

After completing this module, you will be able to:

- Understand Parametric Constraints
- Apply constraints to control transitions

Transitioning Earth Shoulders and Fill Slopes in the Radius Return Corridors

The earth shoulders along the mainline corridor are set to a required design width of 8' and along the side road they are required to be 6' in width. Additionally, the cross slope of the earth shoulder in superelevation on the mainline needs to transition to normal crown slope on the side road. Lastly, the fill slopes of 1:6 on the mainline need to transition to a 1:4 on the side road. This can all be done through the use of Parametric Constraints.

Parametric Constraints, allow the designer to override a template point's original value with a constant or transitional override value. This brings great power to the required flexibility of any true roadway design. A Parametric Constraint can be assigned to any point in a template. The templates in this exercise previously contain the necessary Parametric Constraints for use in this example but can be added at any time throughout the design process

Adding Parametric Constraints

1 Use the MicroStation Undo command to remove the 3D components just drawn into the Design.dgn file.

2 Set the Active Corridor to SW

3 In Roadway Designer select Tools > Parametric Constraints

4 Create the following Parametric Constraints making sure to ADD each constraint as it is completed

RT_ERTH_SHLD_WIDTH

- Start Value 8.00
- Stop Value 6.00
- Start Station 0+00.00

- Stop Station 1+51.61

RT_ERTH_SHLD_SLOPE

- Start Value +4.08%
- Stop Value -8.33%
- Start Station 0+00.00
- Stop Station 1+51.61

RT_Fill_Slope

- Start Value -16.67%
- Stop Value -25.00%
- Start Station 0+00.00
- Stop Station 1+51.61

5 Close the Parametric Constraints dialog

6 Save the changes to the IRD Project file

7 Set the Active Corridor to SE

8 In Roadway Designer select Tools > Parametric Constraints

9 Create the following Parametric Constraints making sure to ADD each constraint as it is completed

LT_ERTH_SHLD_WIDTH

- Start Value -8.00
- Stop Value -6.00
- Start Station 0+00.00
- Stop Station 1+50.31

LT_ERTH_SHLD_SLOPE

- Start Value -4.08%
- Stop Value +8.33%
- Start Station 0+00.00
- Stop Station 1+50.31

ⓘ LT_Fill_Slope - This value is already constant and correctly shown for the mainline and side road therefore it does not need to be set.

10 Save the changes to the IRD Project file

Closing the Gaps

In this lesson, the student will insert a half template drop where the SE quadrant comes short of the template drop for the side road corridor DriveRT. This happens on any intersection that is skewed typically. The radius returns, in general, will not always end at the same station location on the side road with the exception of a true 90 degree symmetrical intersection.

Lesson Objective

After completing this module, you will be able to:

- Add a new template drop copying a previous template
- Edit a template deleting one half of the template

Add and Editing a New Template Drop

ⓘ The SE Corridor stops exactly 1.60' short of the first template drop on the DriveRT corridor. Although this is a rather short distance in this example, on a more severely skewed intersection, this value would increase exponentially. To close this gap, we need to drop in a template along the DriveRT corridor beginning at the same station location the SE Corridor Stops. But to avoid overlaps in components, we need to delete the half of the template that protrudes onto the SW Quadrant.

1 Use the MicroStation undo command to remove the previously plotted 3D components.

2 In Roadway Designer, set the Active Corridor to DriveRT

3 Select the Template Drops icon to access the Template Drops dialog

4 Highlight the current template at station 11+30.48

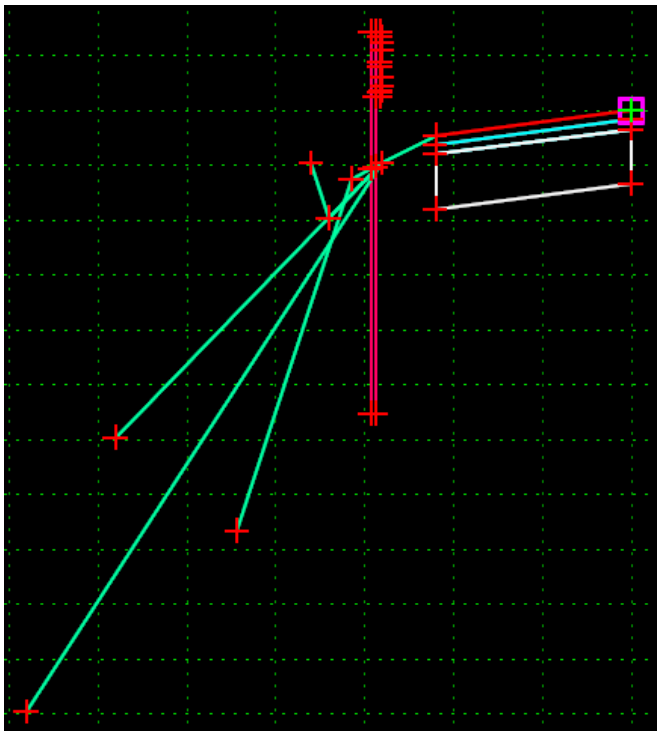
5 In the station field type in the new station 11+28.88 and then select Copy to generate a new template drop.

6 With the template at station 11+28.88 now highlighted, select the Edit button to edit this template drop location.

7 In the Template Editor, right mouse click and select delete components to remove all of the RIGHT SIDE end conditions and guardrail. Note, to delete the components, hold down the left mouse click and drag a line

over them. If you make a mistake, there is an undo icon on the bottom of the template editor window.

8 Right click on each of the four right side pavement points and delete them as well. The edited template should look like this:



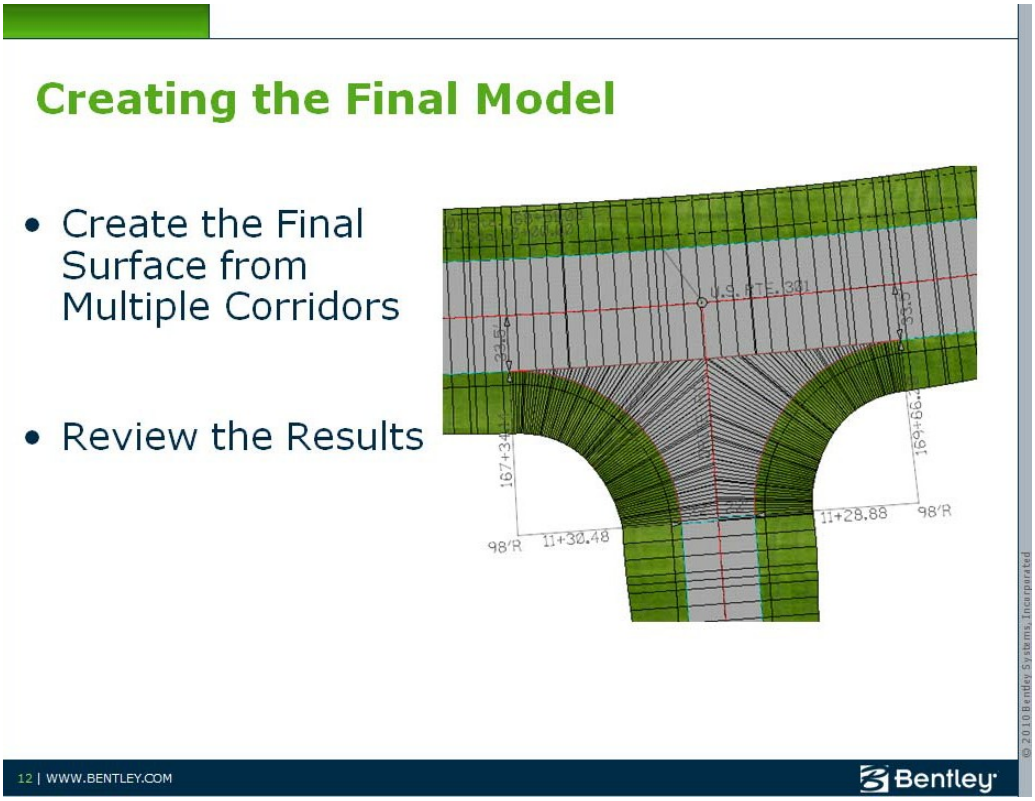
9 Select OK to close the Template Editing dialog.

10 Close the Template Drops dialog.

11 Add a Key Station at 11+30.47 to make a seamless transition.

12 Save the changes to the IRD Project file

Creating the Final Surface Model



Lesson Objective

After completing this module, you will be able to:

- Create a final combined surface Model

Creating the Combined Final Surface

1. In Roadway Designer set the Active Surface to Ex_Ground
2. Select Corridor > Create Surface
3. Enter Finished for the Surface Name (New Surface for Each Corridor should be disabled)
4. Select all corridors from the corridor list.
5. Enable Display Components in Plan View, click Apply.
6. Close the Create Surface dialog and minimize Roadway Designer
7. Use the MicroStation rotate view command to review the results